C144-E019-03EN

M2488 CARTRIDGE TAPE DRIVE

PRODUCT GUIDE

FUJITSU

Please complete the comment from at the back of this manual and send it by mail or facsimile to the indicated address.

The contents of this manual may be revised without prior notice.

C144-E019-03EN

PREFACE

The M2488 User's Guide provides the information necessary for the user to operate the M2488 Cartridge Tape Drive.

Chapter 1 Introduction

This chapter provides an overview of the M2488 Cartridge Tape Drive and its optional equipment.

Chapter 2 Installation Instructions

This chapter provides procedures for the preparation and assembly of the M2488 Cartridge Tape Drive.

Chapter 3 Controls and Indicators

This chapter describes the controls, indicators and connectors for the M2488 Cartridge Tape Drive and its optional equipment.

Chapter 4 Configuration

This chapter describes the configuration menus of the M2488 Cartridge Tape Drive.

Chapter 5 Operating Instructions

This chapter provides procedures for operating the M2488 Cartridge Tape Drive and its optional equipment.

Chapter 6 Maintenance and Servicing

This chapter describes the user maintenance and servicing of the M2488 Cartridge Tape Drive.

Chapter 7 Parts List

This chapter describes the M2488 models and optional equipment available.

The ANSI X3.131-199x SCSI specification may be purchased from:

American National Standard Institute, Inc.
1430 Broadway, New York, N.Y. 10018
Tel. (212) 642-4900

SCSI-2 unreleased documentation X3B5/87-099 may be obtained from:

Global Engineering Documents
2805 McGaw
Irvine, CA 92714

CONVENTION

Hexadecimal numbers are denoted by an "h" following the number (e.g. 23h) or 0xNN.
Binary numbers are denoted by a "b" following the number (e.g. 001b).

TABLE OF CONTENTS

CHAPTER TITLE PAGE

REVISION RECORD . . . . **i**
DIRECTORY . . . . **ii**
AGENCY STATEMENTS . . . . **iii**
PREFACE . . . . **iv**
INFORMATION LOCATOR . . . . **vi**
TABLE OF CONTENTS . . . . **ix**
LIST OF FIGURES . . . . **xxi**
LIST OF TABLES . . . . **xxiii**

1
INSTALLATION INSTRUCTIONS **1-1**
1-1 INTRODUCTION 1-1
1-2 PREPARING THE M2488 AND ITS OPTIONAL EQUIPMENT 1-1
1-3 CONFIGURATIONS. 1-1
1-3.1 Rack-mount 1-2
1-3.2 Desktop 1-3
1-4 UNPACKING INSTRUCTIONS 1-4
1-4.1 Unpack the M2488 Tape Drive 1-4
1-4.2 Unpack the Automatic Cartridge Loader 1-5
1-4.3 Unpack the Flush-mounted Automatic Cartridge Loader 1-6
1-5 EQUIPMENT INSPECTION 1-7
1-5.1 Inspect the M2488 Tape Drive 1-7
1-5.2 Inspect the ACL 1-7
1-5.3 Inspect the FACL 1-7
1-6 ASSEMBLY INSTRUCTIONS. 1-8
1-6.1 General Installation and Assembly Instructions 1-9
1-6.1.1 Air Flow and Service Clearances 1-9
1-6.2 Interface Personality Module Installation 1-9
1-6.3 Cable and Power Connections 1-10
1-6.4 Desktop Installation Instructions 1-11
1-6.4.1 Tools Required 1-11
1-6.4.2 Tape Drive Only 1-11
1-6.4.3 Drive with ACL Attached (5-Cartridge Magazine) 1-11
1-6.4.4 Drive with ACL Attached (10-Cartridge Magazine) 1-12
1-6.4.5 Drive with FACL Attached 1-15
1-6.5 Rack-Mount Installation. 1-19
1-6.5.1 Tools Required 1-19
1-6.5.2 Adjust the Guide Plate 1-19
1-6.5.2.1 Inner Cover Mounted to Mounting Tray 1-19
1-6.5.2.2 Inner Cover NOT Mounted to Mounting Tray 1-19
1-6.5.3 Screw Plate Mounting 1-20

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

1-6.5.4 Attach Mounting Tray 1-20
1-6.5.5 Adjust the Brackets 1-22
1-6.5.6 Install the M2488 or M2488 with Medium Changer on the Mounting Tray 1-23
1-6.6 Installation of the Automatic Cartridge Loader. 1-26
1-6.6.1 Prepare the M2488 Tape Drive 1-27
1-6.6.2 Prepare the ACL 1-28
1-6.6.3 Connect the M2488 and the ACL 1-29
1-6.7 Installation of the Flush-mount Automatic Cartridge Loader 1-32
1-6.7.1 Prepare the M2488 Tape Drive 1-33
1-6.7.2 Prepare the FACL 1-34
1-6.7.3 Connect the M2488 and the FACL 1-35
1-7 PREPARATION FOR USE 1-37

2
DESIGN ARCHITECTURE 2-1
2-1 INTRODUCTION. 2-1
2-2 OPERATION OF THE M2488. 2-1
2-3 OPERATION OF THE MAGNETIC TAPE CONTROLLER (MTC). 2-2
2-3.1 Data Path 2-2
2-3.2 Data Buffer 2-2
2-3.3 ERDC Compression Feature 2-2
2-3.4 Microprocessor Control. 2-3
2-3.5 Firmware 2-4
2-4 OPERATION OF THE MAGNETIC TAPE UNIT (MTU) 2-4
2-4.1 Airless Tape Path. 2-4
2-4.2 Read and Write Electronics 2-5

3
SCSI MESSAGES. 3-1
3-1 INTRODUCTION. 3-1
3-2 M2488 TAPE AND MEDIUM CHANGER SCSI MESSAGES 3-1
3-2.1 ABORT code 06h 3-2
3-2.2 BUS DEVICE RESET code 0Ch 3-2
3-2.3 COMMAND COMPLETE code 00h 3-2
3-2.4 DISCONNECT code 04h 3-2
3-2.5 EXTENDED MESSAGE FORMAT code 01h 3-3
3-2.5.1 Synchronous Data Transfer Request (SDTR) 3-3
3-2.5.2 Wide Data Transfer Request (WDTR) 3-5
3-2.6 IDENTIFY code 80h-FFh 3-7
3-2.7 IGNORE WIDE RESIDUE code 23h 3-7
3-2.8 INITIATOR DETECTED ERROR code 05h 3-8
3-2.9 LINKED COMMAND COMPLETE code 0Ah 3-8

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

3-2.10 LINKED COMMAND COMPLETE (WITH FLAG) code 0Bh 3-8
3-2.11 MESSAGE PARITY ERROR code 09h 3-8
3-2.12 MESSAGE REJECT code 07h. 3-8
3-2.13 NO OPERATION code 08h 3-9
3-2.14 RESTORE POINTERS code 03h. 3-9
3-2.15 SAVE DATA POINTER code 02h 3-9
3-3 SCSI BUS STATUS 3-10
3-3.1 Good Status 3-10
3-3.2 Check Condition. 3-10
3-3.3 Busy Status 3-10
3-3.4 Intermediate Status 3-10
3-3.5 Reservation Conflict Status 3-11

4

TAPE UNIT SCSI COMMANDS 4-1

4-1 INTRODUCTION 4-1
4-2 LOGICAL UNITS AND SCSI IDS. 4-1
4-2.1 Target ID 4-1
4-2.2 Initiator ID 4-1
4-2.3 Tape LUN 0 4-1
4-2.4 Media Changer LUN 4 4-1
4-2.5 LUN 4-1
4-3 M2488 TAPE SCSI COMMANDS 4-2
4-3.1 Command Description Block Format. 4-4
4-3.2 CHANGE DEFINITION command 40h 4-5
4-3.2.1 CHANGE DEFINITION CDB Description 4-5
4-3.2.2 CHANGE DEFINITION Changes 4-6
4-3.2.3 CHANGE DEFINITION CHECK CONDITION Status 4-7
4-3.2.4 CHANGE DEFINITION Sense Keys 4-7
4-3.3 DISPLAY command CFh (11h). 4-8
4-3.3.1 DISPLAY CDB Description (11h). 4-8
4-3.3.2 Display Data (11h) 4-9
4-3.3.3 DISPLAY Sense Keys (11h) 4-11
4-3.4 DISPLAY command CFh (10h). 4-12
4-3.4.1 DISPLAY CDB Description (10h). 4-12
4-3.4.2 Display Data (10h) 4-13
4-3.4.3 DISPLAY Sense Keys (10h) 4-14
4-3.5 ERASE command 19h 4-15
4-3.5.1 ERASE CDB Description. 4-15
4-3.5.2 ERASE Sense Keys 4-16
4-3.6 INQUIRY command 12h 4-18
4-3.6.1 INQUIRY CDB Description 4-18
4-3.6.2 INQUIRY CHECK CONDITION Status. 4-19

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

4-3.6.3 Inquiry Data 4-19
4-3.6.4 INQUIRY Sense Keys 4-24
4-3.7 LOAD UNLOAD command 1Bh 4-25
4-3.7.1 LOAD UNLOAD CDB Description 4-25
4-3.7.2 LOAD UNLOAD CHECK CONDITION Status 4-26
4-3.7.3 LOAD UNLOAD Sense Keys 4-27
4-3.8 LOCATE command 2Bh 4-28
4-3.8.1 LOCATE CDB Description 4-28
4-3.8.2 LOCATE CHECK CONDITION Status 4-31
4-3.8.3 LOCATE Sense Keys 4-31
4-3.9 LOG SELECT command 4Ch 4-32
4-3.9.1 LOG SELECT CDB Description 4-32
4-3.9.2 LOG SELECT CHECK CONDITION Status 4-32
4-3.10 LOG SENSE command 4Dh 4-33
4-3.10.1 LOG SENSE CDB Description 4-33
4-3.10.2 LOG SENSE Operation 4-34
4-3.10.3 LOG SENSE Parameters 4-35
4-3.10.3.1 Log Sense Pages 4-37
4-3.10.4 LOG SENSE Sense Keys 4-48
4-3.11 LOOP WRITE TO READ command C1h 4-49
4-3.11.1 LOOP WRITE TO READ CDB Description 4-49
4-3.11.2 LOOP WRITE TO READ CHECK CONDITION Status 4-50
4-3.11.3 LOOP WRITE TO READ Sense Keys 4-50
4-3.12 MODE SELECT command 15h 4-51
4-3.12.1 MODE SELECT CDB Description 4-51
4-3.12.2 Mode Select Data 4-52
4-3.12.3 MODE SELECT Sense Keys 4-55
4-3.13 MODE SENSE command 1Ah 4-56
4-3.13.1 MODE SENSE CDB Description 4-56
4-3.13.2 Mode Sense Data 4-57
4-3.13.3 Mode Settings 4-60
4-3.13.4 Initiator Setup 4-60
4-3.13.5 MODE SENSE Sense Keys 4-62
4-3.14 READ command 08h 4-63
4-3.14.1 READ CDB Description 4-63
4-3.14.2 READ CHECK CONDITION Status 4-64
4-3.14.3 READ Sense Keys 4-66
4-3.15 READ BLOCK LIMITS command 05h 4-68
4-3.15.1 READ BLOCK LIMITS CDB Description 4-68
4-3.15.2 READ BLOCK LIMITS Sense Keys 4-69
4-3.16 READ BUFFER command 3Ch 4-70
4-3.16.1 READ BUFFER CDB Description 4-70

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

4-3.16.2 READ BUFFER Sense Keys 4-74
4-3.17 READ POSITION command 34h 4-75
4-3.17.1 READ POSITION CDB Description 4-75
4-3.17.2 READ POSITION Return Data 4-76
4-3.17.3 Description of Block ID Format 4-78
4-3.17.4 READ POSITION Sense Keys 4-79
4-3.18 READ REVERSE command 0Fh 4-80
4-3.18.1 READ REVERSE CDB Description 4-80
4-3.18.2 READ REVERSE CHECK CONDITION Status 4-81
4-3.18.3 READ REVERSE Sense Keys 4-82
4-3.19 RECEIVE DIAGNOSTIC RESULTS command 1Ch 4-83
4-3.19.1 RECEIVE DIAGNOSTIC RESULTS CDB Description. 4-83
4-3.19.2 Diagnostic Page Codes (PF=1 in SEND DIAGNOSTIC command CDB) 4-85
4-3.19.3 Diagnostic Parameter List (PF=0 in SEND DIAGNOSTIC command CDB) 4-87
4-3.19.4 RECEIVE DIAGNOSTIC RESULTS CHECK CONDITION Status. 4-87
4-3.19.5 RECEIVE DIAGNOSTIC RESULTS Sense Keys 4-88
4-3.20 RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) command 1Ch 4-89
4-3.20.1 RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) CDB Description. 4-89
4-3.20.2 Diagnostic Page Codes (PF=1 in SEND DIAGNOSTIC command CDB) 4-91
4-3.20.3 Diagnostic Parameter List (PF=0 in SEND DIAGNOSTIC command CDB) 4-96
4-3.20.4 RECEIVE DIAGNOSTIC RESULTS CHECK CONDITION Status. 4-96
4-3.20.5 RECEIVE DIAGNOSTIC RESULTS Sense Keys 4-97
4-3.21 RECOVER BUFFERED DATA command 14h 4-98
4-3.21.1 RECOVER BUFFERED DATA CDB Description 4-98
4-3.21.2 RECOVER BUFFERED DATA Operation 4-99
4-3.21.3 RECOVER BUFFERED DATA CHECK CONDITION Status . . 4-99
4-3.21.4 RECOVER BUFFERED DATA Sense Keys 4-100
4-3.22 RELEASE UNIT command 17h 4-101
4-3.22.1 RELEASE UNIT CDB Description 4-101
4-3.22.2 RELEASE UNIT Operation 4-102
4-3.22.3 RELEASE UNIT Sense Keys 4-102
4-3.23 REQUEST SENSE command 03h 4-103
4-3.23.1 REQUEST SENSE CDB Description 4-103
4-3.23.2 REQUEST SENSE CHECK CONDITION Status 4-103
4-3.23.3 REQUEST SENSE Sense Keys 4-104
4-3.24 Report Density Support command 44h 4-105

TABLE OF CONTENTS - CONTINUED

CHAPTER	TITLE	PAGE
	4-3.24.1 REPORT DENSITY SUPPORT CDB Description	4-105
	4-3.24.2 REPORT DENSITY SUPPORT Data	4-106
	4-3.24.3 REPORT DENSITY SUPPORT Sense Keys	4-111
4-3.25	RESERVE UNIT command 16h	4-112
	4-3.25.1 RESERVE UNIT CDB Description	4-112
	4-3.25.2 RESERVE UNIT Operation	4-113
	4-3.25.3 RESERVE UNIT Sense Keys	4-114
4-3.26	REWIND command 01h	4-115
	4-3.26.1 REWIND CDB Description	4-115
	4-3.26.2 REWIND CHECK CONDITION Status	4-115
	4-3.26.3 REWIND Sense Keys	4-116
4-3.27	SEND DIAGNOSTIC command 1Dh	4-117
	4-3.27.1 SEND DIAGNOSTIC CDB Description	4-117
	4-3.27.2 SEND DIAGNOSTIC CHECK CONDITION Status	4-119
	4-3.27.3 Diagnostic Pages (PF=1)	4-119
	4-3.27.4 Diagnostic Parameter List (PF=0)	4-122
	4-3.27.5 SEND DIAGNOSTIC Sense Keys	4-123
4-3.28	SEND DIAGNOSTIC (FACTORY MODE) command 1Dh	4-124
	4-3.28.1 SEND DIAGNOSTIC CDB Description	4-124
	4-3.28.2 SEND DIAGNOSTIC (FACTORY MODE) CHECK CONDITION Status	4-126
	4-3.28.3 Diagnostic Pages (PF=1)	4-126
	4-3.28.4 Diagnostic Parameter List (PF=0)	4-132
	4-3.28.5 SEND DIAGNOSTIC Sense Keys	4-134
4-3.29	SPACE command 11h	4-135
	4-3.29.1 SPACE CDB Description	4-135
	4-3.29.2 SPACE CHECK CONDITION Status	4-136
	4-3.29.3 SPACE Sense Keys	4-137
4-3.30	TEST UNIT READY command 00h	4-138
	4-3.30.1 TEST UNIT READY CDB Description	4-138
	4-3.30.2 TEST UNIT READY CHECK CONDITION Status	4-138
	4-3.30.3 TEST UNIT READY Sense Keys	4-139
4-3.31	WRITE command 0Ah	4-140
	4-3.31.1 WRITE CDB Description	4-140
	4-3.31.2 WRITE CHECK CONDITION Status	4-140
	4-3.31.3 WRITE Sense Keys	4-143
4-3.32	WRITE BUFFER command 3Bh	4-144
	4-3.32.1 WRITE BUFFER CDB Description	4-144
	4-3.32.2 WRITE BUFFER CHECK CONDITION Status	4-148
	4-3.32.3 WRITE BUFFER Sense Keys	4-149
4-3.33	WRITE FILEMARKS command 10h	4-150
	4-3.33.1 WRITE FILEMARKS CDB Description	4-150

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

4-3.33.2 WRITE FILEMARKS CHECK CONDITION Status 4-151
4-3.33.3 WRITE FILEMARKS Sense Keys 4-152
4-4 COMMAND DISCONNECTION. 4-153
4-5 SCSI RESET 4-153

5
TAPE UNIT PARAMETERS. 5-1
5-1 INTRODUCTION 5-1
5-2 ADDITIONAL COMMAND INFORMATION ON MTU MODE SELECT AND MODE SENSE COMMANDS. 5-1
5-2.1 The Parameters Savable Bit (All pages). 5-1
5-2.2 Vendor Unique Parameter 5-2
5-2.3 Error Recovery and Reporting Parameters. 5-4
5-2.4 Disconnect/Reconnect Control Parameters 5-7
5-2.5 Common Device-Type Control Parameters 5-9
5-2.6 Device Configuration Parameters. 5-11
5-2.7 Density Code 28h 5-14
5-2.7.1 M2488 Operation When Density Code 28h Is Not Configured. . . . 5-15
5-2.7.2 M2488 Operation When Density Code 28h Is Configured 5-15
5-3 MTU INQUIRY/CHANGE DEFINITION VITAL PRODUCT DATA PAGES 5-17
5-3.1 General VPD Page Format. 5-17
5-3.2 Supported VPD Pages - Page 00h 5-19
5-3.3 Unit Serial Number Page - Page 80h 5-19
5-3.4 Implemented Operating Definition Page - Page 81h 5-20
5-3.5 ASCII Implemented Operating Definition Page - Page 82h 5-21
5-3.6 Unit Usage Page - Page C0h 5-22
5-3.7 Configuration Page - Page C1h 5-23
5-3.8 Product Identification Page - Page C2h 5-24

6
MEDIA CHANGER SCSI COMMANDS. 6-1
6-1 INTRODUCTION 6-1
6-2 MEDIA CHANGER COMMANDS 6-1
6-2.1 EXCHANGE MEDIUM MC command A6h. 6-2
6-2.1.1 EXCHANGE MEDIUM CDB Description 6-2
6-2.1.2 Exchange Medium Examples. 6-3
6-2.1.3 EXCHANGE MEDIUM Sense Keys. 6-4
6-2.2 MODE SELECT MC command 15h 6-6
6-2.2.1 MODE SELECT CDB Description 6-6
6-2.2.2 MODE SELECT CHECK CONDITION Status 6-8
6-2.2.3 MODE SELECT Data 6-8
6-2.2.4 MODE SELECT MC Sense Keys 6-10
6-2.3 MODE SENSE MC command 1Ah 6-11

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

6-2.3.1 MODE SENSE CDB Description 6-11
6-2.3.2 MODE SENSE Data 6-13
6-2.3.3 MODE SENSE MC Sense Keys 6-14
6-2.4 MOVE MEDIUM MC command A5h 6-16
6-2.4.1 MOVE MEDIUM CDB Description 6-16
6-2.4.2 ACL/FACL Tables of Allowed Moves 6-17
6-2.4.3 MOVE MEDIUM Sense Keys 6-18
6-2.5 READ ELEMENT STATUS MC command B8h 6-19
6-2.5.1 READ ELEMENT STATUS CDB Description 6-19
6-2.5.2 READ ELEMENT STATUS Data 6-21
6-2.5.2.1 Element Status Data 6-22
6-2.5.2.2 Element Status Page 6-23
6-2.5.2.3 Element Descriptors 6-24
6-2.5.3 Source and Destination Elements 6-29
6-2.5.4 READ ELEMENT STATUS Sense Keys 6-29
6-2.6 TEST UNIT READY MC command 00h 6-30
6-2.6.1 TEST UNIT READY CDB Description 6-30
6-2.6.2 TEST UNIT READY CHECK CONDITION Status 6-30
6-2.6.3 TEST UNIT READY Sense Keys 6-31
6-3 ADDITIONAL COMMAND INFORMATION ON MEDIUM CHANGER MODE SELECT AND MODE SENSE COMMANDS 6-32
6-3.1 Page Code 00h, Device Unique Parameters 6-32
6-3.2 Page Code 1Dh, Element Address Assignments 6-35
6-3.3 Page Code 1Eh, Transport Geometry Parameters 6-37
6-3.4 Page Code 1Fh, Device Capabilities 6-38
6-4 MC (MEDIUM CHANGER) INQUIRY/CHANGE DEFINITION VITAL PRODUCT DATA PAGES 6-41
6-4.1 General VPD Page Format 6-41
6-4.2 Supported VPD Pages - Page 00h 6-42
6-4.3 Implemented Operating Definition Page 81h 6-43
6-4.4 ASCII Implemented Operating Definition Page 82h. 6-44
6-4.5 Product Identification Page C2h 6-45

7

TAPE PROCESSING 7-1

7-1 INTRODUCTION. 7-1
7-2 CHANGING MODE PARAMETERS 7-1
7-2.1 Initiator Setup 7-1
7-3 PERMANENT ERROR HANDLING 7-3
7-3.1 PERMANENT WRITE ERROR. 7-3
7-3.2 PERMANENT READ ERROR. 7-3

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

8

MAINTENANCE AND SERVICING . . . 8-1

8-1 INTRODUCTION . . . 8-1
8-2 OPERATOR PANEL DISPLAYED ERROR MESSAGES . . . 8-1
8-2.1 OZONE:xxxxyyyy <text> . . . 8-1
8-2.2 NVRAM Initialization Required . . . 8-2
8-2.3 CHK XX . . . 8-2
8-2.4 Diagnostic Error Codes . . . 8-2
8-2.4.1 Operator Panel Error Code Display . . . 8-2
8-2.4.2 Maintenance Terminal Error Code Display . . . 8-3
8-3 SENSE DATA . . . 8-4
8-3.1 Error Code Sense Format . . . 8-4
8-3.2 Sense Information Bytes 20-43 . . . 8-9
8-3.2.1 Format 0 Sense Information Description for SIC. . . . 8-9
8-3.2.2 Format 01h Sense Information for FMT . . . 8-9
8-3.2.3 Description of Format 01h Sense Information for Drive . . . 8-11
8-3.2.4 Format 2 and 3 Sense Information, Hardware Registers . . . 8-13
8-3.2.5 Format 4 Sense Information for Diagnostic Errors . . . 8-15
8-4 DIAGNOSTICS . . . 8-16
8-4.1 Go/No-Go Diagnostics . . . 8-16
8-4.2 Off-Line Diagnostics . . . 8-16
8-4.3 MTU Diagnostics . . . 8-16
8-4.3.1 Off-Line Diagnostic Menu on the Operator Panel . . . 8-19
8-4.3.2 Off-Line Diagnostic Menu through the Remote Maintenance (RS-232) Interface . . . 8-20
8-4.4 Types of Diagnostic Procedures . . . 8-24
8-4.4.1 Tasked Go/No-Go Diagnostics. . . . 8-24
8-4.4.2 Off-Line Diagnostics . . . 8-25
8-4.4.3 In-line Diagnostics . . . 8-25
8-4.5 Diagnostic Test Registry . . . 8-27
8-4.6 Diagnostic Microcode Specifications . . . 8-27
8-5 FACTORY SETTINGS . . . 8-28
8-6 ERROR RECOVERY PROCEDURES . . . 8-30
8-6.1 EDRC Error Recovery . . . 8-30
8-6.2 Retry Methods . . . 8-30
8-7 MAINTENANCE TERMINAL . . . 8-33
8-7.1 Maintenance Interface . . . 8-33
8-7.2 Remote Debug for JDB . . . 8-34
8-7.2.1 M2488 Side (Remote) . . . 8-34
8-7.2.1.1 Equipment Required . . . 8-34
8-7.2.1.2 Procedure . . . 8-34
8-8 PREVENTIVE MAINTENANCE . . . 8-35

TABLE OF CONTENTS - CONTINUED

CHAPTER	TITLE	PAGE
8-9	TAPE PATH CLEANING PROCEDURE	8-35
8-10	MANUAL TAPE REMOVAL PROCEDURE	8-36
8-10.1	Cartridge Tape Stopped During Loading	8-36
8-10.2	Tape Stopped During Threading	8-37
8-10.3	Tape Wound on Take-up Reel	8-37
8-11	REMOVE AND REPLACE PROCEDURES	8-38
8-11.1	Air Filter Remove and Replace Procedures	8-43
8-11.1.1	Air Filter Removal	8-43
8-11.1.2	Air Filter Replacement	8-43
8-11.2	Fan Assembly Remove and Replace Procedures	8-44
8-11.2.1	Fan Assembly Removal	8-44
8-11.2.2	Fan Assembly Replacement	8-44
8-11.3	IPM Remove and Replace Procedures	8-45
8-11.3.1	IPM Removal	8-45
8-11.3.2	IPM Replacement	8-45
8-11.4	Top Cover Remove and Replace Procedures	8-46
8-11.4.1	Top Cover Removal	8-46
8-11.4.2	Top Cover Replacement	8-46
8-11.5	Bottom Cover Remove and Replace Procedures	8-47
8-11.5.1	Bottom Cover Removal	8-47
8-11.5.2	Bottom Cover Replacement	8-47
8-11.6	DTC PCBA Remove and Replace Procedures	8-48
8-11.6.1	DTC PCBA Removal	8-48
8-11.6.2	DTC PCBA Replacement	8-48
8-11.7	Threader Assembly Remove and Replace Procedures	8-50
8-11.7.1	Threader Assembly Removal	8-50
8-11.7.2	Threader Assembly Replacement	8-50
8-11.8	Loader Assembly Remove and Replace Procedures	8-51
8-11.8.1	Loader Assembly Removal	8-51
8-11.8.2	Loader Assembly Replacement	8-51
8-11.9	OP PCA Remove and Replace Procedures	8-52
8-11.9.1	OP PCA Removal	8-52
8-11.9.2	OP PCA Replacement	8-52
8-11.10	Power Supply (PSU) Remove and Replace Procedures	8-53
8-11.10.1	Power Supply Removal	8-53
8-11.10.2	Power Supply Replacement	8-53
8-11.11	SVL PCBA Remove and Replace Procedures	8-54
8-11.11.1	SVL PCBA Removal	8-54
8-11.11.2	SVL PCBA Replacement	8-54
8-11.12	RDL PCBA Remove and Replace Procedures	8-54
8-11.12.1	RDL PCBA Removal	8-54
8-11.12.2	RDL PCBA Replacement	8-54

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

8-11.13 WTL PCBA Remove and Replace Procedures 8-55
8-11.13.1 WTL PCBA Removal. 8-55
8-11.13.2 WTL PCBA Replacement 8-55

9
PARTS REPLACEMENT CATALOG. 9-1
9-1 INTRODUCTION 9-1
9-2 FIELD REPLACEABLE UNITS 9-1

A
SENSE KEYS. A-1

B
ASC/ASCQ B-1

C
ERPA CODES C-1

D
FAULT SYMPTOM CODES. D-1

E
CHK XX ERROR CODES E-1
E-1 CHK XX ERROR CODE DESCRIPTIONS. E-1
E-2 CHK XX ERROR CODE REPLACEMENT ACTIONS E-7

F
DIAGNOSTIC TESTS AND ERROR CODES F-1

G
SUPPORTED SCSI TRANSFER RATES G-1

H
MTU DIAGNOSTIC SPECIFICATIONS H-1
H-1 OUTLINE H-1
H-2 HOW TO EXECUTE THE DIAG H-1
H-2.1 SCSI interface H-1
H-2.2 RS-232C interface H-1
H-2.3 How to execute the DIAG for the MTU H-1
H-3 M2488 DIAG STRUCTURE H-1
H-4 MTU DIAG PARAMETER H-3
H-4.1 DIAG activation parameter H-3
H-4.2 Explanation H-3
H-4.3 DIAG H-4
H-4.3.1 READ/WRITE: Ten diagnostic tests to check read and write H-4

TABLE OF CONTENTS - CONTINUED

CHAPTER TITLE PAGE

H-4.3.2 LOAD/UNLOAD: Two diagnostic tests to check loading and unloading H-5
H-4.3.3 ACL TEST: Two diagnostic tests to check the autoloader H-6
H-4.3.4 TESTMODE: Diagnostic test to measure operations H-6
H-4.3.4.1 M1:LOAD: Cartridge loading time measurement H-7
H-4.3.4.2 M2:TPPFM: Measure the tape acceleration/ deceleration time. H-7
H-4.3.4.3 M3:AC/PS: Measure the tape access/positioning time. H-7
H-4.3.4.4 M4:MODCH: Mode change time measurement. H-7
H-4.3.4.5 M5:LOCAT: Tape locating time measurement H-8
H-4.3.4.6 M6:REWND: Tape rewinding time measurement H-8
H-4.3.4.7 M7:D.S.E: DSE time measurement H-8
H-4.3.4.8 M8:UNLD: Cartridge unloading time measurement . . H-8
H-4.3.4.9 M9:CLEAN: Cleaning time measurement H-8
H-4.4 COMBINATION : Running test by combining up to ten commands H-9
H-4.5 Error reset command ------- CMD CD : 0x70 or 0xF0 . . . . H-9
H-5 PARAMETER LIST H-10
H-6 DIAG RESULT DATA H-21

I

FLOWCHARTS I-1

INDEX Index-1

LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1-1.	IPM Installation	1-9
Figure 1-2.	Cable and Power Connections	1-10
Figure 1-3.	Drive with ACL (5-cartridge) Desktop Configuration	1-11
Figure 1-4.	Attaching Bases	1-12
Figure 1-5.	Stability Brackets	1-13
Figure 1-6.	Drive Placement	1-13
Figure 1-7.	Drive Positioning	1-14
Figure 1-8.	Rear Bracket Attachment	1-14
Figure 1-9.	M2488 with FACL in Desktop Model	1-15
Figure 1-10.	Attach to Bottom Base	1-16
Figure 1-11.	Desktop Model Top Covers	1-17
Figure 1-12.	Desktop Model Rear Cover	1-18
Figure 1-13.	Guide Plate Installation	1-20
Figure 1-14.	19-inch Rack-mount Kit Installation	1-21
Figure 1-15.	Bracket Adjustment	1-22
Figure 1-16.	M2488 Tray Mounting	1-23
Figure 1-17.	M2488 with ACL Tray Mounting	1-24
Figure 1-18.	Mount FACL to Inner Cover	1-24
Figure 1-19.	FACL Face Plate	1-25
Figure 1-20.	Prepare the M2488 Tape Drive	1-27
Figure 1-21.	Prepare the ACL	1-28
Figure 1-22.	Connect the M2488 and the ACL Base	1-29
Figure 1-23.	Attach Operator Panel Cable to ACL Base	1-30
Figure 1-24.	Attach the ACL Mechanism	1-30
Figure 1-25.	Replace Covers	1-31
Figure 1-26.	Prepare the M2488 Tape Drive	1-33
Figure 1-27.	Prepare the FACL	1-34
Figure 1-28.	FACL Rear	1-35
Figure 1-29.	Connect the M2488 and the FACL	1-36
Figure 1-30.	Cable Connection	1-36
Figure 1-31.	Replace Top Covers	1-37
Figure 2-1.	M2488 Block Diagram	2-1
Figure 2-2.	DTC PCA Block Diagram	2-3
Figure 2-3.	DVL PCA Block Diagram	2-5
Figure 8-1.	Help Information Display	8-23
Figure 8-2.	EDRC Retry	8-32
Figure 8-3.	Maintenance Connector (M2488)	8-33
Figure 8-1.	Tape Path Cleaning	8-35
Figure 8-2.	Interconnect Diagram	8-41
Figure 8-3.	Air Filter Removal	8-43
Figure 8-4.	Fan Assembly	8-44
Figure 8-5.	IPM	8-45

LIST OF FIGURES - CONTINUED

FIGURE	TITLE	PAGE
Figure 8-6.	Top Cover	8-46
Figure 8-7.	Bottom Cover	8-47
Figure 8-8.	DTC PCBA	8-49
Figure 8-9.	Threader Assembly	8-50
Figure 8-10.	Loader Assembly	8-51
Figure 8-11.	OP PCBA	8-52
Figure 8-12.	PSU	8-53
Figure 8-13.	WTL PCBA	8-55
Figure 9-1.	M2488 Tape Drive FRUs (Top Side)	9-2
Figure 9-2.	M2488 Tape Drive FRUs (Bottom Side)	9-3
Figure 9-3.	DTC PCBA	9-4
Figure 9-4.	IPM PCBA	9-4
Figure 9-5.	RDL PCBA	9-5
Figure 9-6.	SVL PCBA	9-5
Figure 9-7.	WTL PCBA	9-6
Figure 9-8.	DVL PCBA (Reference Only)	9-6
Figure I-1.	Operator Panel Flowchart	I-2
Figure I-2.	RUN COMB Flowchart	I-3
Figure I-3.	RUN ACL Flowchart	I-3
Figure I-4.	LIST ERROR Flowchart	I-4
Figure I-5.	RS-232 Flowchart	I-4
Figure I-6.	SETTING Flowchart	I-5
Figure I-7.	LOAD CODE Flowchart	I-6
Figure I-8.	INQUIRY Flowchart	I-6
Figure I-9.	MODE PAGES Flowchart	I-7
Figure I-10.	FACTORY Flowchart	I-8
Figure I-11.	81:FSGRP Flowchart	I-8

LIST OF TABLES

TABLE	TITLE	PAGE
Table 1-1.	Rack-mount Configurations	1-2
Table 1-2.	Desktop Configurations	1-3
Table 1-3.	Equipment and Tools Required for ACL Installation	1-26
Table 1-4.	Equipment and Tools Required for FACL Installation	1-32
Table 3-1.	M2488 SCSI Messages	3-1
Table 3-2.	Ignore Field Description	3-8
Table 3-3.	Status Byte	3-10
Table 3-4.	Status Byte Code Bit Values	3-10
Table 4-1.	M2488 SCSI Commands	4-2
Table 4-2.	CDB Field Description	4-4
Table 4-3.	CHANGE DEFINITION Field Description	4-5
Table 4-4.	Definition Parameter Description	4-6
Table 4-5.	DISPLAY Field Description (11h)	4-8
Table 4-6.	DISPLAY Parameter (11h)	4-9
Table 4-7.	Display Parameter Field Description (11h)	4-9
Table 4-8.	Display Data	4-10
Table 4-9.	Display Mode Selection Bits (11h)	4-11
Table 4-10.	DISPLAY Field Description (10h)	4-12
Table 4-11.	Display Format Control Byte Description (10h)	4-13
Table 4-12.	DISPLAY Parameter (10h)	4-13
Table 4-13.	Display Mode Selection Bits (10h)	4-14
Table 4-14.	ERASE Field Description	4-15
Table 4-15.	INQUIRY Field Description	4-18
Table 4-16.	EVPD Bit	4-19
Table 4-17.	Supported VPD Page Codes	4-19
Table 4-18.	INQUIRY Data Format	4-20
Table 4-19.	INQUIRY Data Format Field Description	4-21
Table 4-20.	Peripheral Qualifiers	4-23
Table 4-21.	Peripheral Device Type	4-23
Table 4-22.	Possible Peripheral Qualifier and Device Types Generated	4-23
Table 4-23.	Default Vendor and Product Identification Fields	4-24
Table 4-24.	LOAD UNLOAD Field Description	4-25
Table 4-25.	LOCATE Field Description	4-28
Table 4-26.	Block ID Format	4-29
Table 4-27.	Block ID Format Field Description	4-30
Table 4-28.	Format Mode Values	4-30
Table 4-29.	LOG SELECT Field Description	4-32
Table 4-30.	LOG SENSE Field Description	4-33
Table 4-31.	Page Codes	4-34
Table 4-32.	Log Page Format	4-35
Table 4-33.	Log Parameter Format	4-36
Table 4-34.	LOG Parameter Field Description	4-36

LIST OF TABLES -CONTINUED

TABLE	TITLE	PAGE
Table 4-35.	Log Sense Page 00h, Supported Log Pages (default)	4-37
Table 4-36.	Log Sense Page 00h, Supported Log Pages *	4-37
Table 4-37.	Log Sense Page 02h, Error Counter Page - Write	4-38
Table 4-38.	Log Sense Page 03h, Error Counter Page - Read	4-40
Table 4-39.	Log Sense Page 0Ch, Sequential-Access Device Page	4-43
Table 4-40.	Log Sense Page 31h, Track Error Statistics	4-44
Table 4-41.	LOOP WRITE TO READ Field Description	4-49
Table 4-42.	MODE SELECT Field Description	4-51
Table 4-43.	MODE SELECT Parameter List Format	4-52
Table 4-44.	MODE SELECT Parameter Header	4-52
Table 4-45.	MODE SELECT Parameter Header Field Description	4-52
Table 4-46.	Buffered Mode Values	4-53
Table 4-47.	Block Descriptor	4-53
Table 4-48.	Block Descriptor Field Description	4-53
Table 4-49.	Page Descriptors	4-54
Table 4-50.	Page Descriptor Field Description	4-54
Table 4-51.	MODE SENSE Field Description	4-56
Table 4-52.	PC Field	4-57
Table 4-53.	MODE SENSE Data Header	4-57
Table 4-54.	MODE SENSE Data Header Field Description	4-58
Table 4-55.	Buffered Mode Description	4-58
Table 4-56.	Block Descriptor	4-59
Table 4-57.	MODE SELECT Parameter Header Field Description	4-59
Table 4-58.	Page Descriptors	4-59
Table 4-59.	Page Descriptor Field Description	4-60
Table 4-60.	READ Field Description	4-63
Table 4-61.	READ BLOCK LIMITS Field Description	4-68
Table 4-62.	READ BLOCK LIMITS Data	4-68
Table 4-63.	READ BUFFER Field Description	4-70
Table 4-64.	READ BUFFER Command Mode	4-71
Table 4-65.	Supported Buffer ID Values for Read Data Mode	4-71
Table 4-66.	Read/Write Data Buffer Descriptor (buffer ID 0)	4-72
Table 4-67.	Read/Write NVRAM Descriptor (buffer ID 1)	4-72
Table 4-68.	Descriptor Mode Field Description	4-72
Table 4-69.	Offset	4-73
Table 4-70.	READ POSITION Field Description	4-75
Table 4-71.	READ POSITION Return Data Description	4-77
Table 4-72.	Block ID Field Description	4-78
Table 4-73.	Format Codes	4-78
Table 4-74.	READ REVERSE Field Description	4-80
Table 4-75.	RECEIVE DIAGNOSTIC RESULTS Field Description	4-83
Table 4-76.	RECEIVE DIAGNOSTIC Parameter List Length Field	4-84

LIST OF TABLES -CONTINUED

TABLE	TITLE	PAGE
Table 4-77.	Diagnostic Page Codes	4-85
Table 4-78.	Receive Diagnostic Results Page, General Form	4-85
Table 4-79.	Page 00h - Supported Diagnostic Pages	4-85
Table 4-80.	Page 80h - Online Diagnostic Test Page	4-86
Table 4-81.	Page 80h Field Description	4-86
Table 4-82.	Online Diagnostic Results data Parameter List	4-87
Table 4-83.	Parameter List Field Description	4-87
Table 4-84.	RECEIVE DIAGNOSTIC RESULTS Field Description	4-89
Table 4-85.	RECEIVE DIAGNOSTIC (FACTORY MODE) Parameter List Length Field	4-90
Table 4-86.	Diagnostic Page Codes	4-91
Table 4-87.	Receive Diagnostic Results Page, General Form	4-91
Table 4-88.	Page 00h - Supported Diagnostic Pages (FACTORY MODE)	4-91
Table 4-89.	Page 80h - Online Diagnostic Test Page	4-92
Table 4-90.	Page 80h Field Description	4-93
Table 4-91.	Page 81h - Online Manufacturing Diagnostic Test Page	4-93
Table 4-92.	Page 81h Field Description	4-94
Table 4-93.	Page 90-9Fh - Online Diagnostic Test Page	4-94
Table 4-94.	Page Code 90-9Fh Field Description.	4-95
Table 4-95.	Online Diagnostic Results data Parameter List	4-96
Table 4-96.	Parameter List Field Description	4-96
Table 4-97.	RECOVER BUFFERED DATA Field Description	4-98
Table 4-98.	RELEASE UNIT Field Description	4-101
Table 4-99.	REQUEST SENSE Field Description	4-103
Table 4-100.	REPORT DENSITY SUPPORT Field Description	4-106
Table 4-101.	REPORT DENSITY SUPPORT Header	4-107
Table 4-102.	DENSITY SUPPORT Data Block for density 09h (18-track, standard length tape)	4-107
Table 4-103.	DENSITY SUPPORT Data Block for density 28h (36-track, standard or extended length tape)	4-108
Table 4-104.	REPORT DENSITY SUPPORT Data Block Field Description	4-109
Table 4-105.	RESERVE UNIT Field Description	4-112
Table 4-106.	REWIND Field Description	4-115
Table 4-107.	SEND DIAGNOSTIC Field Description	4-117
Table 4-108.	SEND DIAGNOSTIC CDB Field Description Overview	4-118
Table 4-109.	Send Diagnostic Page, General Form	4-120
Table 4-110.	Diagnostic Page Codes	4-120
Table 4-111.	Page 00h - Supported Diagnostic Pages	4-120
Table 4-112.	Page 80h - Online Diagnostic Test Page	4-121
Table 4-113.	Diagnostic Parameter List	4-122
Table 4-114.	SEND DIAGNOSTIC (FACTORY MODE) Field Description	4-124
Table 4-115.	SEND DIAGNOSTIC (FACTORY MODE) CDB Field Description Overview	4-125
Table 4-116.	Send Diagnostic Page, General Form	4-127
Table 4-117.	Diagnostic Page Codes	4-127

LIST OF TABLES -CONTINUED

TABLE TITLE PAGE

Table 4-118. Page 00h - Supported Diagnostic Pages 4-127
Table 4-119. Page 80h - Online Diagnostic Test Page 4-128
Table 4-120. Page 81h - Manufacturing Online Diagnostic Test Page 4-129
Table 4-121. Page Code 81h Field Description 4-129
Table 4-122. Page 90-9Fh - MTU Online Diagnostic Test Page 4-131
Table 4-123. Page Code 90-9Fh Field Description 4-131
Table 4-124. Diagnostic Parameter List 4-133
Table 4-125. SPACE Field Description 4-135
Table 4-126. Code Field Bits 4-135
Table 4-127. TEST UNIT READY Field Description 4-138
Table 4-128. WRITE Field Description 4-140
Table 4-129. WRITE BUFFER Field Description 4-145
Table 4-130. WRITE BUFFER Modes 4-145
Table 4-131. Supported Buffer ID Values for Vendor Unique and Write Data Modes 4-146
Table 4-132. WRITE FILEMARKS Field Description 4-150
Table 4-133. WRITE FILEMARK Command Operations 4-151
Table 5-1. Page Codes 5-1
Table 5-2. Page 00 - Vendor Unique Parameter 5-2
Table 5-3. Page 00 -Vendor Unique Parameter Field Description 5-2
Table 5-4. Page 01 - Error Recovery and Reporting Parameters 5-4
Table 5-5. Error Recovery and Reporting Parameters Field Description 5-4
Table 5-6. Valid Combinations of Error Recovery Parameters 5-6
Table 5-7. Page 02 - Disconnect/Reconnect Parameters 5-7
Table 5-8. Page 02 - Disconnect/Reconnect Parameters Field Description 5-7
Table 5-9. Data Transfer Disconnect Control 5-8
Table 5-10. Page 0Ah - Common Device-type Control Parameters 5-9
Table 5-11. Page 0Ah - Common Device-type Control Parameters Field Description 5-9
Table 5-12. Page 10h - Device Configuration Parameters 5-11
Table 5-13. Page 10h - Device Configuration Parameters Field Description 5-12
Table 5-14. Density Code Settings Accepted by Mode Select Command in Default Operation . . 5-15
Table 5-15. Density Code Settings Accepted by Mode Select Command with Density Code 28h Configured 5-15
Table 5-16. Density Codes Reported by Mode Sense Command with DENSITY_CODE_28H Configured 5-15
Table 5-17. Supported MTU VPD Page Codes 5-17
Table 5-18. VPD Page Format 5-17
Table 5-19. VPD Page Format Field Description 5-18
Table 5-20. INQUIRY Data Format VPD Page 00h - Supported VPD Pages 5-19
Table 5-21. INQUIRY Data Format VPD Page 80h - Unit Serial Number Page 5-19
Table 5-22. INQUIRY Data Format VPD Page 81h - Implemented Operating Definition Page . 5-20
Table 5-23. INQUIRY Data Format VPD Page 81h Field Description 5-20
Table 5-24. INQUIRY Data Format VPD Page 82h - ASCII Implemented Operating Definition Page 5-21

LIST OF TABLES -CONTINUED

TABLE	TITLE	PAGE
Table 5-25.	INQUIRY Data Format VPD Page 82h Field Description	5-21
Table 5-26.	INQUIRY Data Format VPD Page C0h - Unit Usage Page	5-22
Table 5-27.	INQUIRY Data Format VPD Page C0h Field Description	5-22
Table 5-28.	INQUIRY Data Format VPD Page C1h - Configuration Page	5-23
Table 5-29.	INQUIRY data format VPD Page C2h - Product Identification Page	5-24
Table 5-30.	INQUIRY Data Format VPD Page C0h Field Description	5-24
Table 6-1.	Commands for Medium Changer Devices	6-1
Table 6-2.	M2488A11 (ACL) Exchange Medium Examples	6-3
Table 6-3.	M2488A12 (FACL) Exchange Medium Examples	6-3
Table 6-4.	MODE SELECT Field Description	6-6
Table 6-5.	Mode Select Parameter List Format	6-8
Table 6-6.	MODE SELECT Mode Parameter Header	6-9
Table 6-7.	Page Descriptors	6-9
Table 6-8.	Page Descriptor Field Description	6-9
Table 6-9.	MODE SENSE Field Description	6-11
Table 6-10.	PC Field	6-12
Table 6-11.	MODE SENSE Data Header	6-13
Table 6-12.	MODE SENSE Data Header Field Description	6-13
Table 6-13.	Page Descriptors	6-13
Table 6-14.	MODE SENSE Page Descriptors Field Description	6-14
Table 6-15.	MOVE MEDIUM Field Description	6-16
Table 6-16.	XCL Allowed Moves	6-17
Table 6-17.	READ ELEMENT STATUS Field Description	6-20
Table 6-18.	Element Type Codes	6-20
Table 6-19.	Element Addresses	6-21
Table 6-20.	Block Structure of READ ELEMENT STATUS Data	6-21
Table 6-21.	Element Status Data Header	6-22
Table 6-22.	Element Status Data Header Field Description	6-22
Table 6-23.	Element Status Page Header	6-23
Table 6-24.	Element Status Page Header Field Description	6-23
Table 6-25.	Medium Transport Element Descriptor (Type Code = 1h)	6-24
Table 6-26.	Medium Transport Element Descriptor Field Description	6-24
Table 6-27.	Storage Element Descriptor (Type Code=2h)	6-25
Table 6-28.	Storage Element Descriptor Field Description	6-25
Table 6-29.	Import Export Element Descriptor (Type Code=3h)	6-26
Table 6-30.	Import Export Element Descriptor Field Description	6-26
Table 6-31.	Data Transfer Element Descriptor (Type Code=4h)	6-27
Table 6-32.	Data Transfer Element Descriptor Field Description	6-28
Table 6-33.	Allowed Source and Destination Elements	6-29
Table 6-34.	TEST UNIT READY Field Description	6-30
Table 6-35.	Page Codes	6-32
Table 6-36.	Page Code 00 - Device Unique Parameters	6-32

LIST OF TABLES -CONTINUED

TABLE	TITLE	PAGE
Table 6-37.	Page Code 00 - Device Unique Parameters Field Description	6-33
Table 6-38.	Mode Codes	6-34
Table 6-39.	Eject Codes	6-34
Table 6-40.	Operation of Cartridge Unload	6-34
Table 6-41.	Cartridge Map	6-35
Table 6-42.	ACL Page Code 1Dh, Element Address Assignments	6-35
Table 6-43.	ACL Page Code 1Dh, Element Address Assignments Field Description	6-36
Table 6-44.	FACL Page Code 1Dh, Element Address Assignments	6-36
Table 6-45.	FACL Page Code 1Dh, Element Address Assignments Field Description	6-37
Table 6-46.	Page code 1Eh, Transport Geometry Parameters	6-37
Table 6-47.	Page code 1Eh, Transport Geometry Parameters Field Description	6-37
Table 6-48.	ACL Page Code 1Fh, Device Capabilities	6-38
Table 6-49.	FACL Page Code 1Fh, Device Capabilities Page	6-39
Table 6-50.	Supported MC VPD Page Codes	6-41
Table 6-51.	VPD Page Format	6-41
Table 6-52.	VPD Page Format Field Description	6-42
Table 6-53.	INQUIRY Data Format VPD Page 00h - Supported VPD Pages	6-42
Table 6-54.	INQUIRY data format VPD Page 81h - Implemented Operating Definition Page	6-43
Table 6-55.	INQUIRY Data Format VPD Page 82h - ASCII Implemented Operating Definition Page	6-44
Table 6-56.	INQUIRY Data Format VPD Page C2h - Product Identification Page	6-45
Table 8-1.	Error Code 70 - Sense Format (on current command)	8-4
Table 8-2.	Error Code 70 Sense Format Field Description	8-5
Table 8-3.	Error Code 71 - Sense Format (deferred error reporting)	8-6
Table 8-4.	Error Code 71 Sense Format Field Description	8-7
Table 8-5.	Additional Sense Formats	8-8
Table 8-6.	Format 01h Sense Information, FMT	8-9
Table 8-7.	Format 01h Sense Information, FMT Field Description	8-9
Table 8-8.	Additional Format Error Information Type	8-10
Table 8-9.	Format 01h Sense Information, Drive	8-11
Table 8-10.	Format 01h Sense Information, Drive Field Description	8-11
Table 8-11.	MTC to MTU Commands	8-12
Table 8-12.	Format 02h Sense Information, SCSI Hardware Registers	8-13
Table 8-13.	Format 03h Sense Information, EDRC Hardware Registers	8-14
Table 8-14.	Format 04h Sense Information, Diagnostic Errors	8-15
Table 8-15.	Format 04h Sense Information, Diagnostic Errors Field Description	8-15
Table 8-16.	Operator Panel Top Level Menus - Diagnostics Mode	8-17
Table 8-17.	Operator Panel Off-Line Diagnostics	8-19
Table 8-18.	Options Byte Field Descriptions	8-24
Table 8-19.	Selftest Description	8-25
Table 8-20.	Page Code 80h Test Description	8-26
Table 8-21.	Diagnostic Microcode Specifications	8-27

LIST OF TABLES -CONTINUED

TABLE	TITLE	PAGE
Table 8-22.	Operator Panel Top Level Menus - Factory Option	8-28
Table 8-23.	Factory Menu Options and Settings Description	8-29
Table 8-24.	Maintenance Interface Connector Pin Assignments	8-33
Table 8-25.	Maintenance Interface Communications Settings	8-34
Table 8-1.	M2488 Interconnects	8-38
Table 8-2.	FRUs Remove and Replace Procedures	8-42
Table 9-1.	Field Replaceable Units	9-1
Table A-1.	Sense Key Descriptions	A-1
Table B-1.	ASC and ASCQ Description (by Sense Key)	B-1
Table B-2.	Action Advised Codes	B-2
Table B-3.	ASC and ASCQ Description (by ASC/ASCQ)	B-3
Table C-1.	ERPA Codes	C-1
Table D-1.	Error Recovery	D-1
Table D-2.	Formatter Error Recovery	D-2
Table E-1.	CHK xx Error Code Descriptions	E-1
Table E-2.	CHK xx Error Code Replacement Actions	E-7
Table E-3.	Replacement Action Codes	E-13
Table F-1.	Diagnostic Test Registry for all Diagnostic Modes	F-1
Table F-2.	Error Codes Common to all Routines/Tests	F-6
Table F-3.	Routine 1 - Control Store Diagnostic Error Codes	F-7
Table F-4.	Routine 2 - Interrupt Request Controller Diagnostic Error Codes	F-8
Table F-5.	Routine 3 - CP Bus Parity Diagnostic Error Codes	F-9
Table F-6.	Routine 4 - Read Signal Verification Processor Diagnostic Error Codes	F-14
Table F-7.	Routine 5 - SDDP External Register Diagnostic Error Codes	F-18
Table F-8.	Routine 6 - Data Buffer Diagnostic Error Codes	F-18
Table F-9.	Routine 7 - SCSI Protocol Controller Diagnostic Error Codes	F-19
Table F-10.	Routine 8 - Formatter Counters Diagnostic Error Codes	F-22
Table F-11.	Routine 9 - PCC Timers Diagnostic Error Codes	F-24
Table F-12.	Routine 10 - EDRC Control Signals Diagnostic Error Codes	F-25
Table F-13.	Routine 11 - EDRC Data Buffers Diagnostic Error Codes	F-32
Table F-14.	Routine 12 - EDRC Address Bus Diagnostic Error Codes	F-38
Table F-15.	Routine 13 - EDRC Error Detection Diagnostic Error Codes	F-44
Table F-16.	Routine 20 - Loop Write to Read Diagnostic Error Codes	F-50
Table F-17.	Routine 50 - 4M Tones Test Error Codes	F-66
Table F-18.	Routine 51 - Incrementing Block Length Test Error Codes	F-67
Table F-19.	Routine 80 - Servo Diagnostic Error Codes	F-69
Table F-20.	Routine 80 Test 06 - Servo ACL Error Codes in Sense Byte 19	F-72
Table F-21.	Routine 80 Test 06 - Servo FACL Error Codes in Sense Byte 19	F-73
Table F-22.	Routine 81 - Manufacturing Test Diagnostic Error Codes	F-74
Table F-23.	Routine 82 - Magnetic Tape Unit Diagnostic Error Codes	F-76
Table F-24.	Routine 83 - Operator Control Panel Diagnostic Error Codes	F-76
Table F-25.	Routine 90 - Tape Drive Diagnostic Error Codes	F-78

LIST OF TABLES -CONTINUED

TABLE	TITLE	PAGE
Table G-1.	SCSI Transfer Rates for 20 MHz	G-1

CHAPTER 1

INSTALLATION INSTRUCTIONS

NOTICE
SERVICE PERSONNEL ONLY

1-1 INTRODUCTION

This chapter contains information on installing the M2488 tape drive and optional equipment. This chapter is divided into the following major paragraphs:

1-2 PREPARING THE M2488 AND ITS OPTIONAL EQUIPMENT
1-3 CONFIGURATIONS
1-4 UNPACKING INSTRUCTIONS
1-5 EQUIPMENT INSPECTION
1-6 ASSEMBLY INSTRUCTIONS
1-7 PREPARATION FOR USE

1-2 PREPARING THE M2488 AND ITS OPTIONAL EQUIPMENT

Upon receipt of your equipment, follow the procedures in the order listed below:

STEP	PROCEDURE	WHERE?
1	Unpack the M2488. Unpack the medium changer (if applicable).	Product Guide, Chapter 1, paragraph 1-4 or User's Guide, Chapter 2
2	Inspect the M2488. Inspect the medium changer (if applicable).	Product Guide, Chapter 1, paragraph 1-5 or User's Guide, Chapter 2
3	Assemble the M2488 and medium changer (if applicable).	Product Guide, Chapter 1, paragraph 1-6 or User's Guide, Chapter 2
4	Configure the M2488.	User's Guide, Chapter 4
5	Operating the M2488.	User's Guide, Chapter 5

1-3 CONFIGURATIONS

The M2488 tape drive may have a medium changer and be rack-mounted or placed on a desktop. Determine which configuration is to be used from the following tables, then refer to the indicated assembly instructions after unpacking and inspecting the equipment.

1-3.1 Rack-mount

There are three configurations for the rack-mount M2488 drive. Refer to Table 1-1 for the assembly instructions to use with your configuration.

Table 1-1. Rack-mount Configurations

CONFIGURATION	EQUIPMENT REQUIRED	TOOLS	ASSEMBLY PARAGRAPH
M2488	M2488 (one or two per tray) IPM (one per M2488) Terminator (may be required) AC Power Cable (110 or 220 VAC, one per M2488) Rack-mount tray Front panel for one M2488 or front panel for two M2488s	Phillips screw-driver	1-6.1 1-6.2 1-6.3 1-6.5
M2488 with ACL	M2488 (one or two per tray) IPM (one per M2488) Terminator (may be required) AC Power Cable (110 or 220 VAC, one per M2488) ACL Rack-mount tray for M2488 with ACL Front panel for one M2488 with ACL or front panel for two M2488s with ACLs 5 or 10-Cartridge Magazine	Phillips screw-driver Allen wrench	1-6.1 1-6.2 1-6.3 1-6.5 1-6.6
M2488 with FACL	M2488 (one or two per tray) IPM (one per M2488) Terminator (may be required) FACL AC Power Cable (110 or 220 VAC, one per M2488) Rack-mount tray for M2488 with FACL Front panel for one M2488 with FACL or front panel for two M2488s with FACLs. 7-Cartridge Magazine (one per FACL)	Phillips screw-driver Allen wrench	1-6.1 1-6.2 1-6.3 1-6.5 1-6.7

1-3.2 Desktop

There are three desktop configurations for the M2488 drive. Refer to Table 1-2 for the assembly instructions to use with your configuration.

Table 1-2. Desktop Configurations

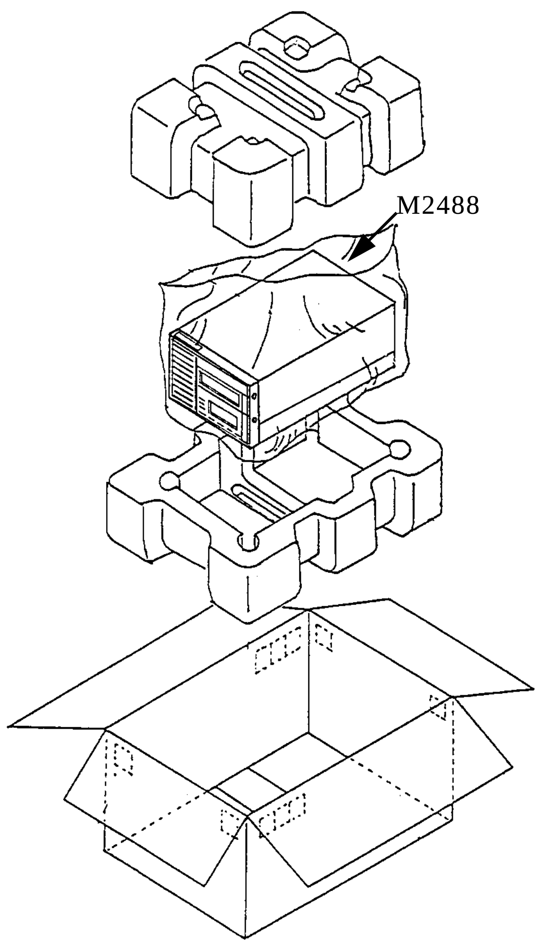
CONFIGURATION	EQUIPMENT REQUIRED	TOOLS	ASSEMBLY PARAGRAPH
M2488	M2488 IPM Terminator (may be required) AC Power Cable (110 or 220 VAC)	Phillips #2 screwdriver	1-6.1 1-6.2 1-6.3 1-6.4
M2488 with ACL	M2488 IPM Terminator (may be required) ACL AC Power Cable (110 or 220 VAC) Optional Support base for M2488 with ACL (5 or 10-cartridge size) 5 or 10-Cartridge Magazine	Phillips #2 screwdriver 5mm, 8 in. long Allen wrench	1-6.1 1-6.2 1-6.3 1-6.5 1-6.6
M2488 with FACL	M2488 IPM Terminator (may be required) FACL AC Power Cable (110 or 220 VAC) 7-Cartridge Magazine Optional Support base for M2488 with FACL	Phillips #2 screwdriver 5mm, 8 in. long Allen wrench	1-6.1 1-6.2 1-6.3 1-6.5 1-6.7

1-4 UNPACKING INSTRUCTIONS

Use the following procedures to unpack the M2488 tape drive and its optional equipment. When the equipment is unpacked, proceed to the inspection procedures in paragraph 1-5.

1-4.1 Unpack the M2488 Tape Drive

Unpack the M2488 tape drive as described below.



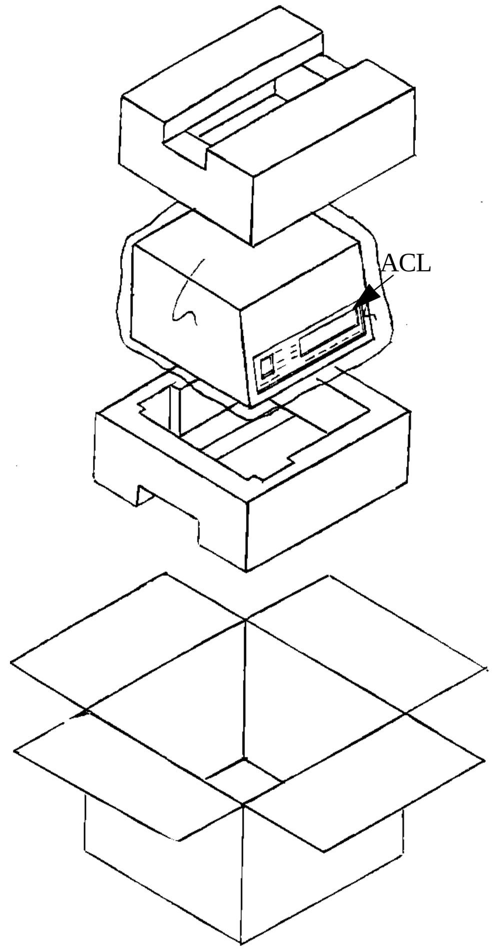
**** NOTE ****

The model shown is a M2488 without an ACL or FACL attached.

1. Carefully remove the M2488 from the packing material as shown in the figure above.
2. Place the tape drive on a flat work surface.
3. Verify contents of package to the packing list.
4. Retain packing material for future use.
5. Continue with unpacking the medium changer (if applicable) or inspect the equipment.

1-4.2 Unpack the Automatic Cartridge Loader

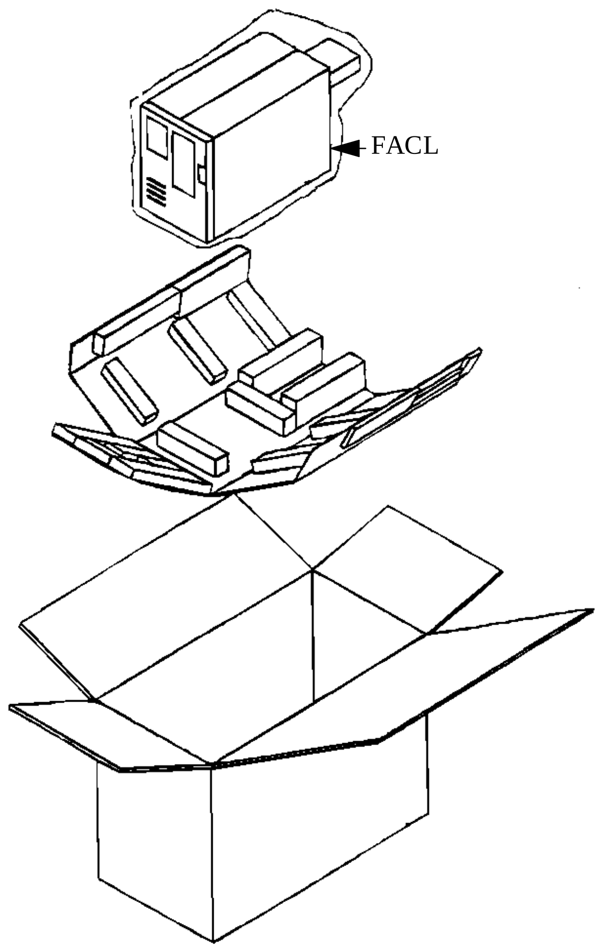
Unpack the ACL as described below.



1. Carefully remove the ACL from the packing material and place on flat work surface.
2. Verify contents of package and accessory kit to the packing list.
3. Retain packing material for future use.
4. Continue with the equipment inspection instructions.

1-4.3 Unpack the Flush-mounted Automatic Cartridge Loader

Unpack the FACL as described below.



1. Carefully remove the FACL from the packing material and place on flat work surface.
2. Verify contents of package and the accessory kit to the packing list.
3. Remove packing material from the inside of the FACL. Press PUSH on the front panel to open door. Press PUSH on the magazine tray and remove packing. Press PUSH again to close the magazine tray, then press PUSH on the front panel to close door.
4. Retain packing material for future use.
5. Continue with the equipment inspection instructions.

1-5 EQUIPMENT INSPECTION

After unpacking, inspect the equipment. If any damage is found, note the type of damage and location. Also note any damage to the packing container. Contact your carrier for further instructions for handling the damaged equipment.

1-5.1 Inspect the M2488 Tape Drive

- Visually examine the chassis for dents and cracks.

Upon completion, inspect the medium changer, if applicable, or continue with the assembly instructions.

1-5.2 Inspect the ACL

- Visually examine the chassis for dents and cracks.

Upon completion, continue with the assembly instructions.

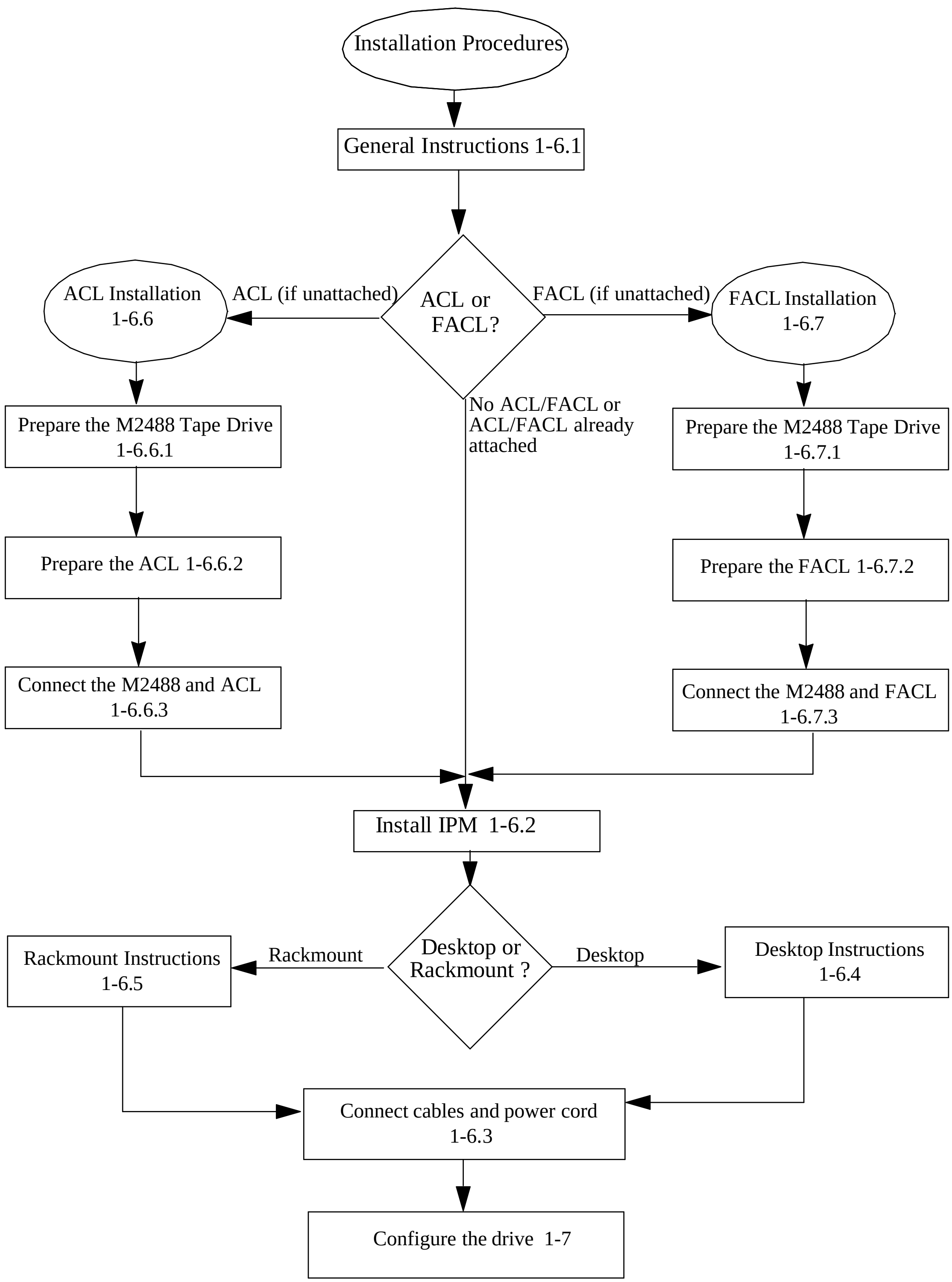
1-5.3 Inspect the FACL

- Visually examine the chassis for dents and cracks.
- Check the door lock by pressing on the lock lever and opening the door.
- Check the carrier movement by rotating the carrier knob. Refer to the Controls and Indicators section in Chapter 3 of the User's Guide for the location of the knob.

Upon completion, continue with the assembly instructions.

1-6 ASSEMBLY INSTRUCTIONS

These paragraphs describe the assembly and installation of the M2488 tape drive and of the optional equipment. Use the following flowchart to determine which procedures are applicable to your equipment configuration. The paragraph number for the procedure is listed in the flowchart with the procedure title.



1-6.1 General Installation and Assembly Instructions

1-6.1.1 Air Flow and Service Clearances

Allow a gap of 50 mm (2 inches) at the rear of the drive for heat dissipation.

Allow a 620 mm (24 inches) servicing area to the rear, with drive extended, for rack-mounted drives.

1-6.2 Interface Personality Module Installation

**** NOTE ****

Prior to assembly, ensure all SCSI cables and power cords have been disconnected. The M2488 should be placed as near as possible to the main AC outlet.

Installation of the IPM is described below.

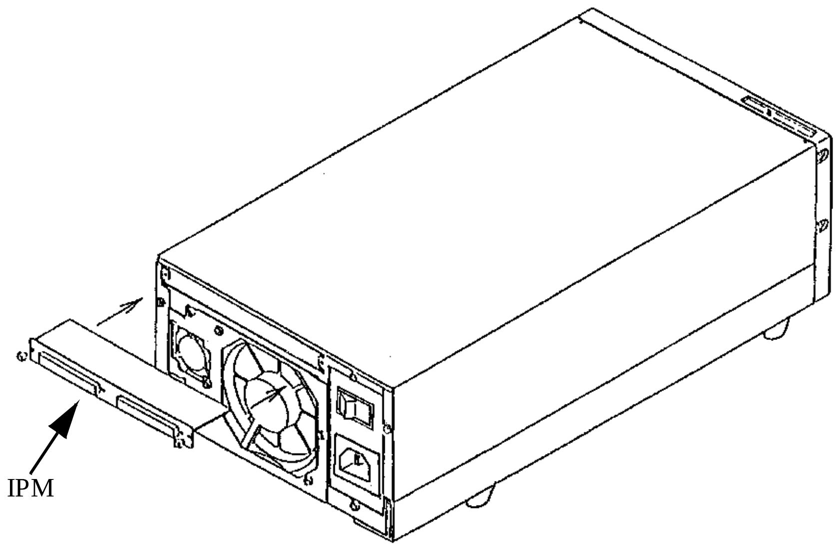


Figure 1-1. IPM Installation

STEP	ACTION
1	Insert the IPM, component side down, into the circuit board at the rear of the M2488. See Figure 1-1.
2	Insert and tighten two screws on the IPM.

1-6.3 Cable and Power Connections

Installation of the SCSI cables and power cord are described in the following paragraphs. The SCSI connectors are described in the User's Guide, Chapter 1.

**** NOTE ****

1. Cable and power connections should only be made upon completion of the M2488 hardware setup to include attachment of optional equipment. Use the appropriate assembly procedures for the desired option.

2. Both SCSI connectors on the IPM must be connected. The connection may be either two SCSI cables or one SCSI cable and one Terminator.

See Figure 1-2.

STEP	ACTION
1	Attach SCSI cable to one of the SCSI connectors on the IPM (which of the two connectors is not important).
2	Attach the Terminator or the second SCSI cable to the other SCSI connector on the IPM.
3	Connect power cord.

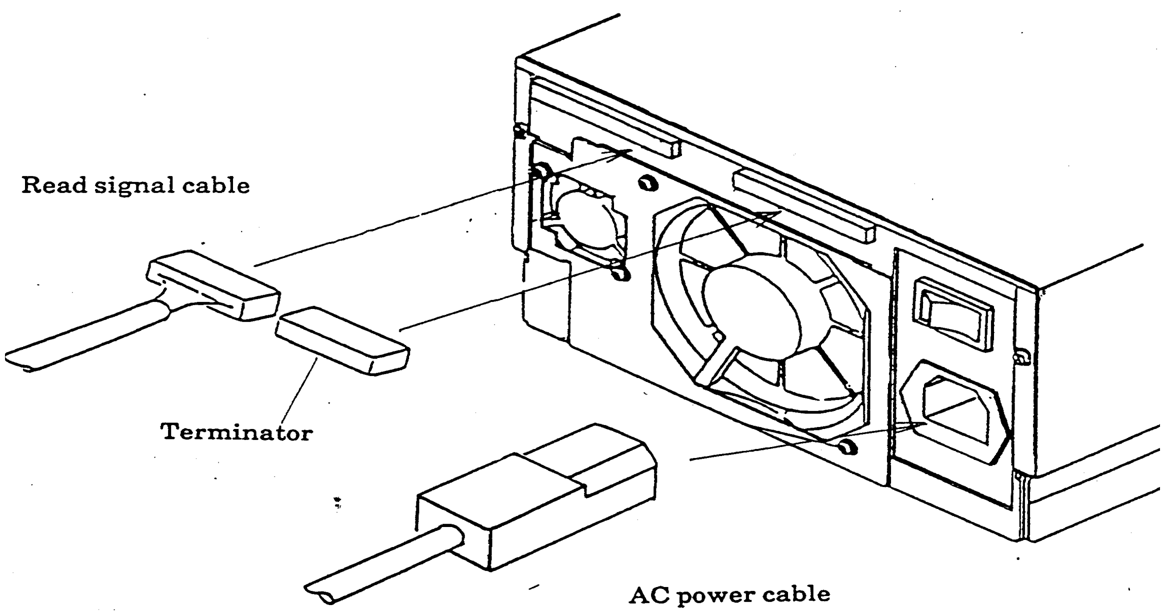


Figure 1-2. Cable and Power Connections

1-6.4 Desktop Installation Instructions

Use the procedure below for your configuration. When completed, continue with paragraph 1-6.3.

1-6.4.1 Tools Required

The following tools are required to install the M2488 in a desktop configuration:

Phillips screwdriver

Flat-head screwdriver

1-6.4.2 Tape Drive Only

If the two foot rails were removed, reattach and place drive in prepared location.

1-6.4.3 Drive with ACL Attached (5-Cartridge Magazine)

Use this procedure if the M2488 with attached ACL is to be used with a support base for a 5-cartridge magazine. Figure 1-3 shows the M2488 with an attached ACL in a desktop model.

STEP	ACTION
1	Attach both foot rails to the M2488 with the four screws.
2	Place the M2488 with attached ACL into the support base.
3	Insert the projections of the rear bracket into the gap on each foot rail. Attach rear bracket with two screws through the rear of the support base.

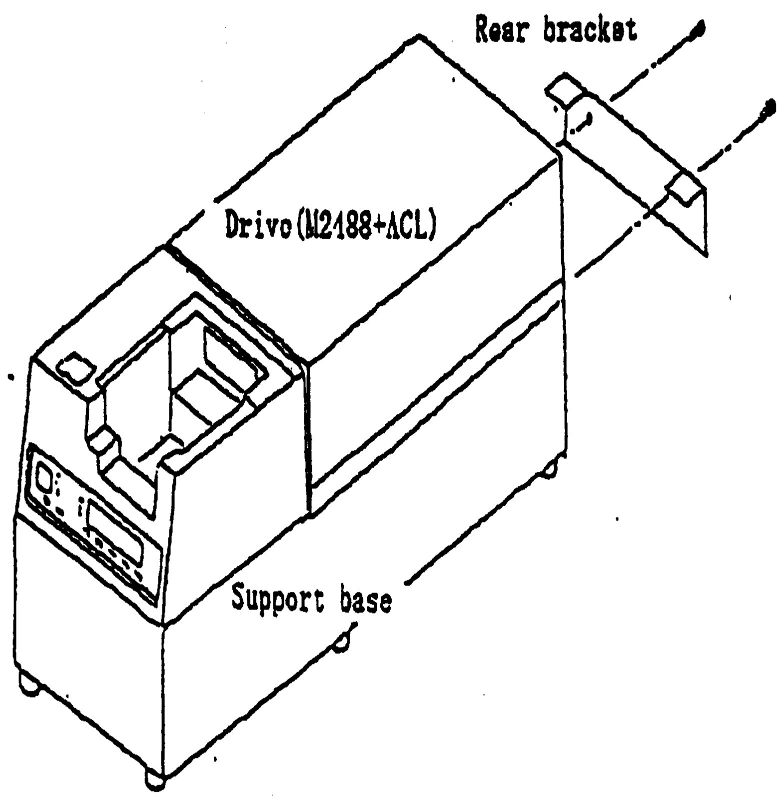


Figure 1-3. Drive with ACL (5-cartridge) Desktop Configuration

1-6.4.4 Drive with ACL Attached (10-Cartridge Magazine)

Use this procedure if the M2488 with attached ACL is to be used with a base for a 10-cartridge magazine.

STEP	ACTION
1	Place the support base onto the M2488A41 (10-cartridge base) and attach with the four screws. See Figure 1-4.
2	For additional stability, attach the rubber feet and two metal brackets on the bottom of the M2488A41 as shown in Figure 1-5 on page 1-13.
3	Place the drive with ACL on the support base. Move the drive forward and attach to the projections on the support base. See Figure 1-6 on page 1-13 and Figure 1-7 on page 1-14.
4	Insert the projections of the rear bracket into the gap on each foot rail. Attach rear bracket with two screws through the rear of the support base. See Figure 1-8 on page 1-14.

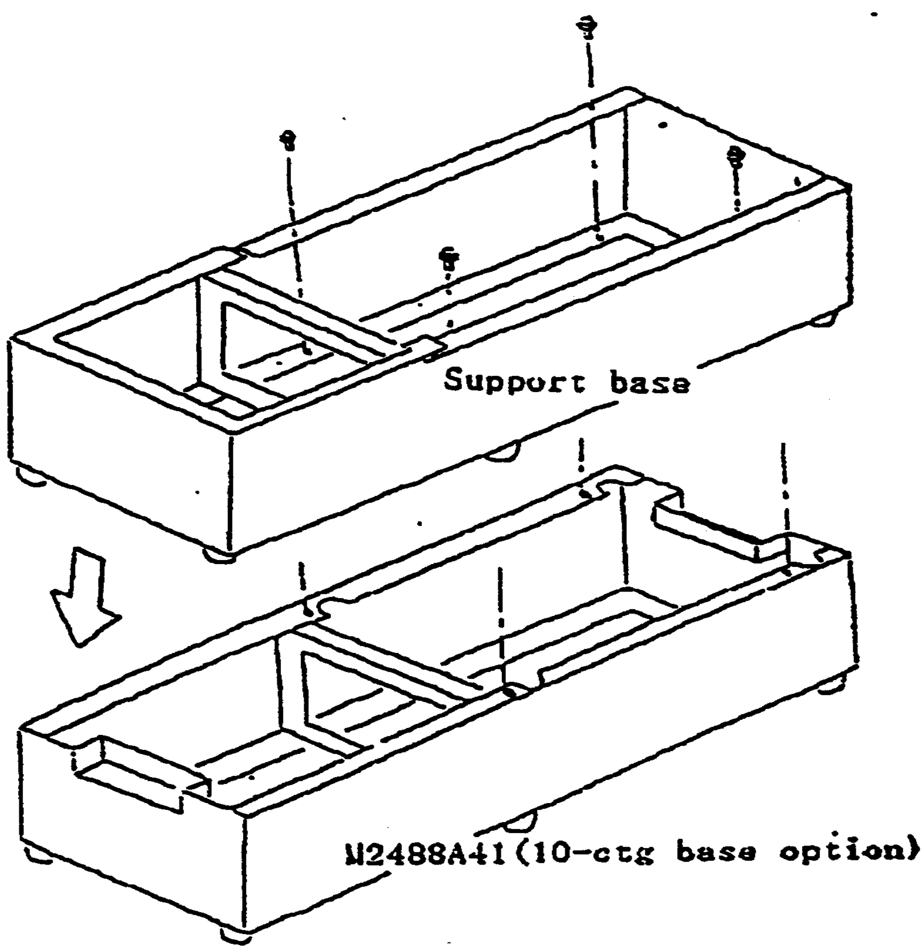


Figure 1-4. Attaching Bases

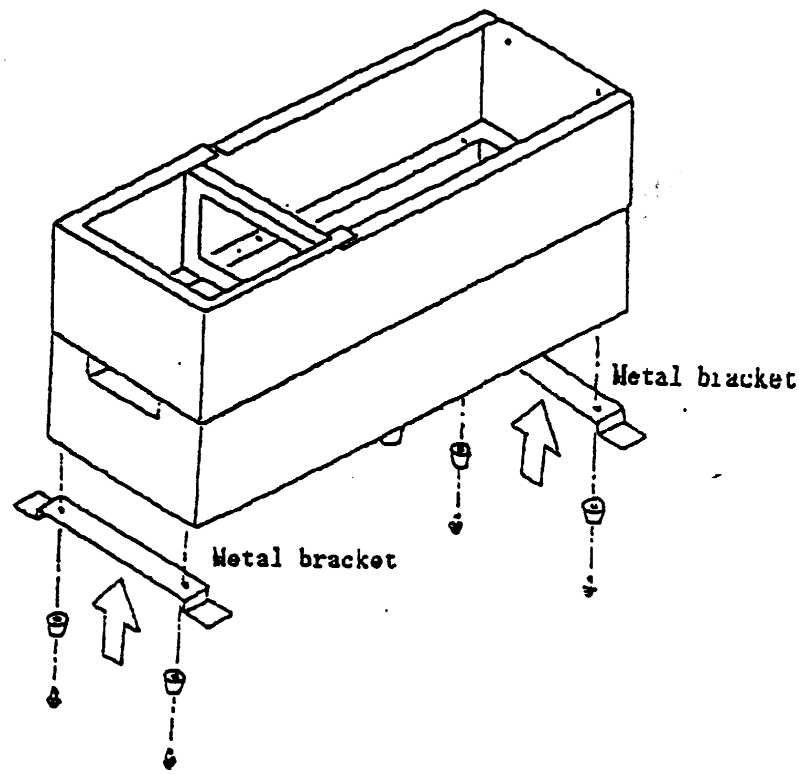


Figure 1-5. Stability Brackets

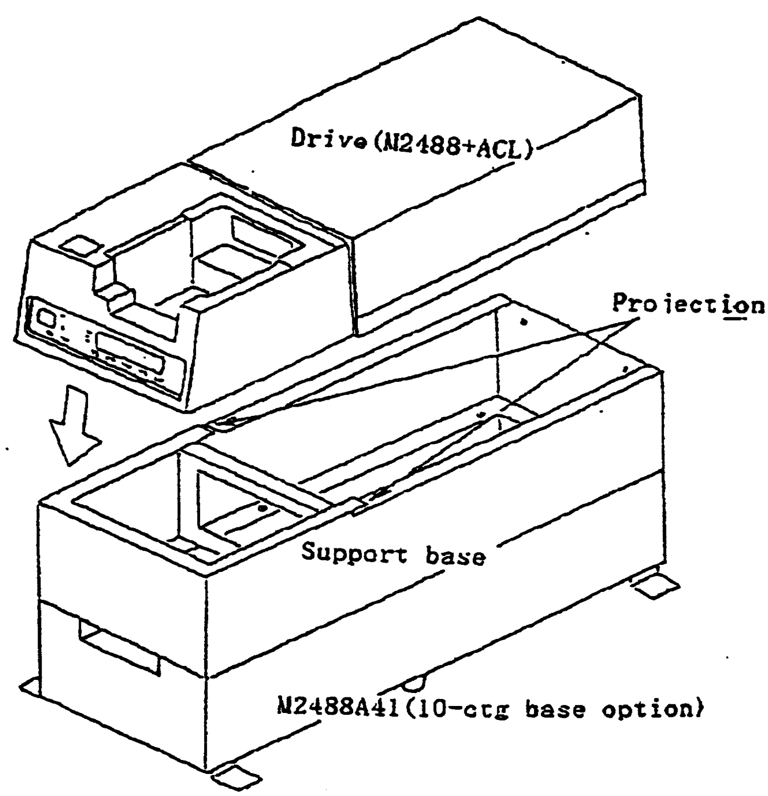


Figure 1-6. Drive Placement

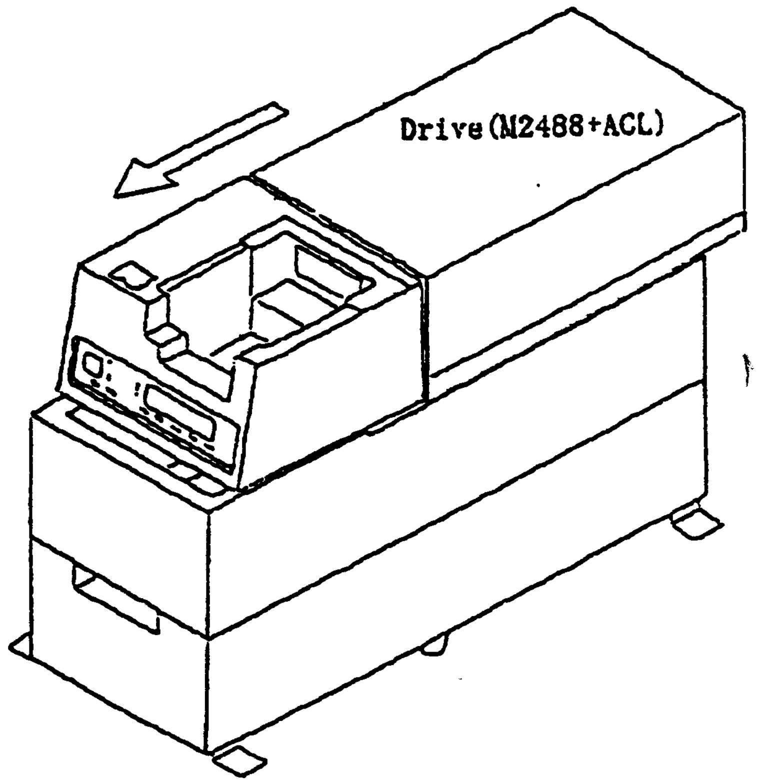


Figure 1-7. Drive Positioning

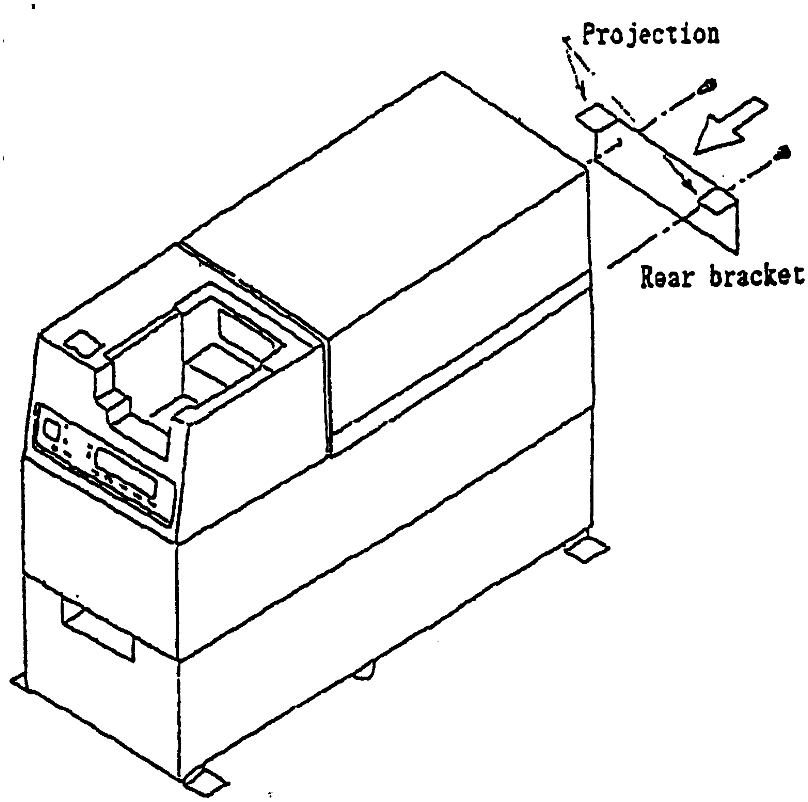


Figure 1-8. Rear Bracket Attachment

1-6.4.5 Drive with FACL Attached

Figure 1-9 shows the M2488 with an attached FACL in a desktop model.

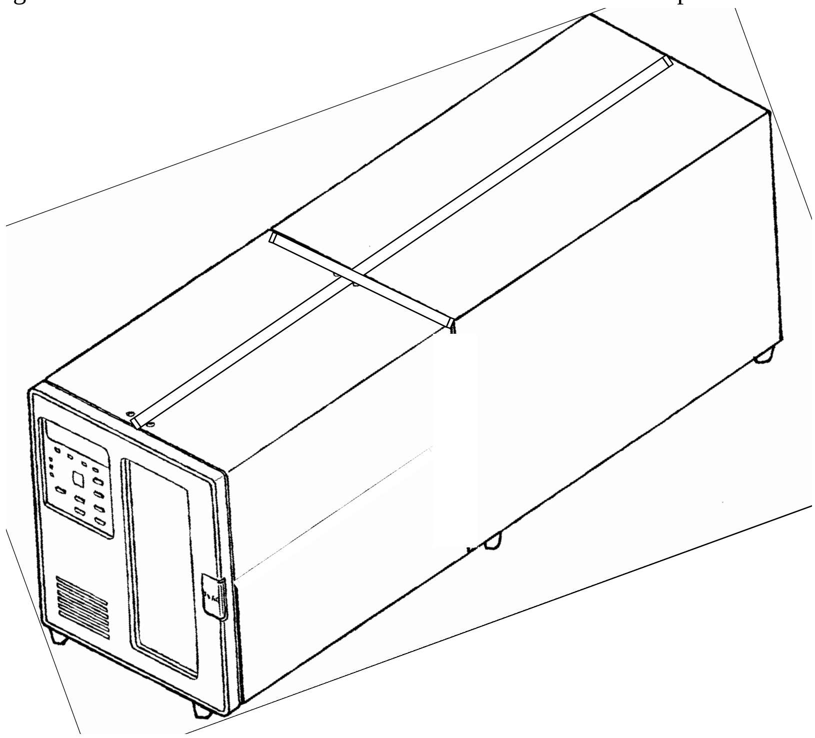


Figure 1-9. M2488 with FACL in Desktop Model

Use the following procedure to insert the M2488 with attached FACL into the desktop model. Refer to Figure 1-10 through Figure 1-12 during performance of this procedure.

STEP	ACTION
1	Insert the M2488 with FACL into the bottom base. Attach through bottom of base into bottom of M2488 and FACL with eight screws. See Figure 1-10.
2	Place the desktop cover over the M2488 and FACL. See Figure 1-11.
3	Tighten the eight screws into the sides of the bottom base.
4	Place rear cover over back opening and tighten with four screws. See Figure 1-12.

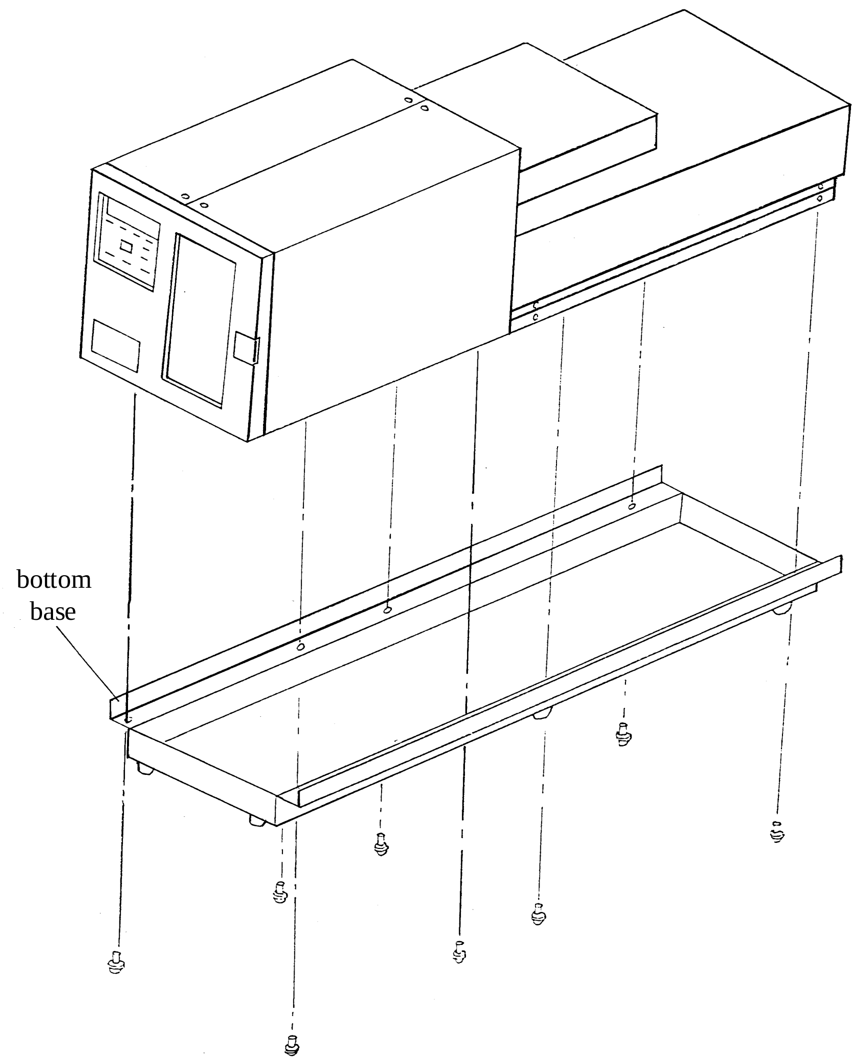


Figure 1-10. Attach to Bottom Base

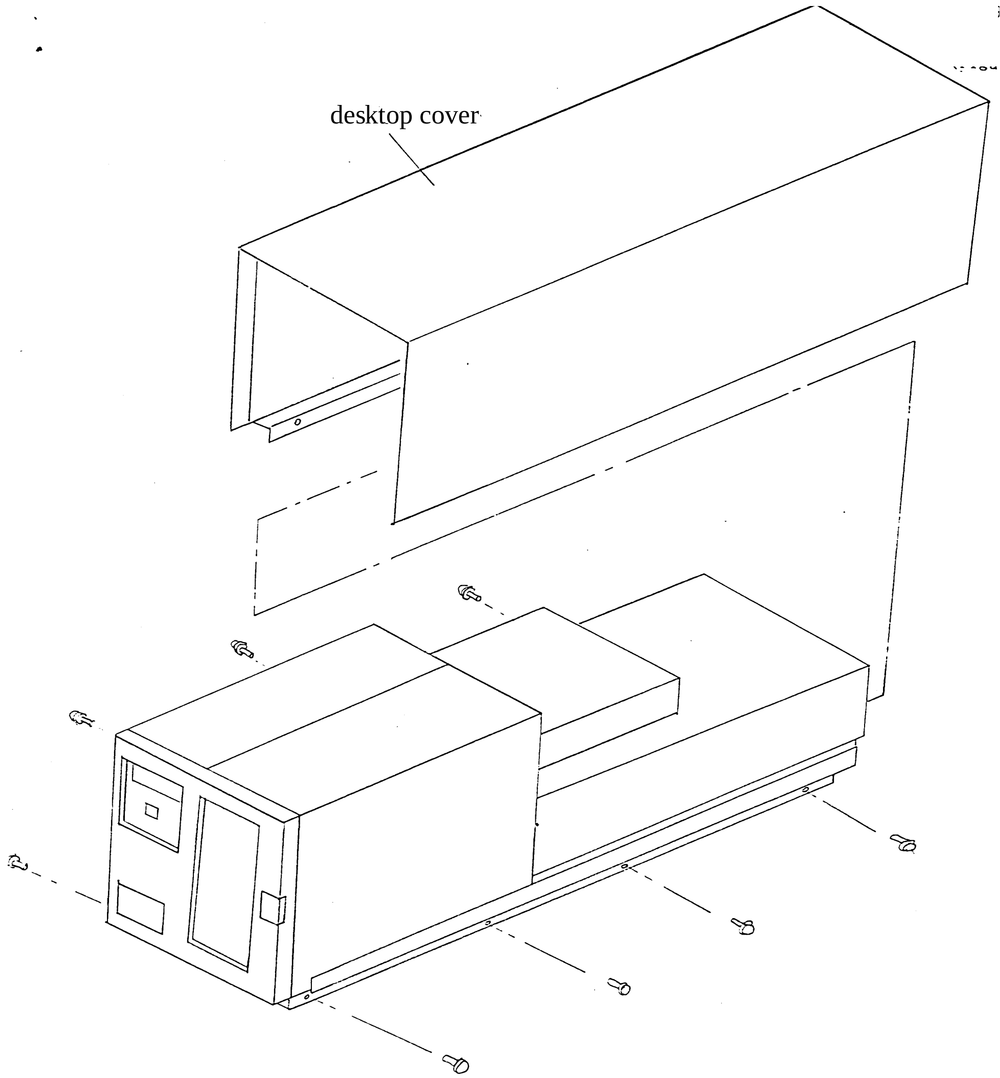


Figure 1-11. Desktop Model Top Covers

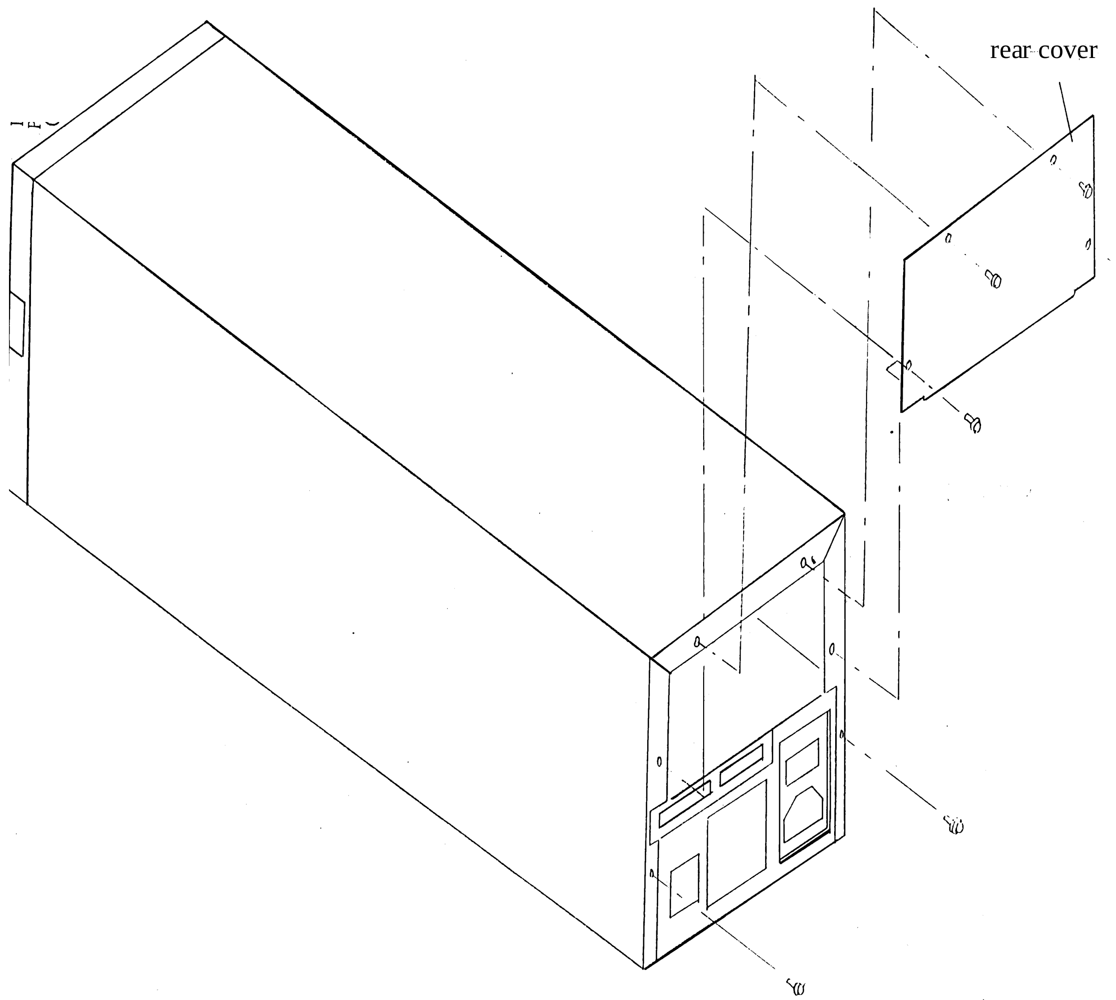


Figure 1-12. Desktop Model Rear Cover

1-6.5 Rack-Mount Installation

This procedure is for mounting the M2488 tape drive, with or without a medium changer, in the rack-mount tray.

****
* CAUTION *
****

The weight of the equipment may exceed 10kg, use caution when mounting the tape drive and medium changer. Installation may require two or more service personnel.

**** NOTE ****

Use M4 x 6mm length screws to mount the M2488 on the rack-mounting tray.

1-6.5.1 Tools Required

The following tools are required to install the M2488 in a rack-mount configuration:

Phillips screwdriver

Hex wrench (M4)

Flat-head screwdriver

1-6.5.2 Adjust the Guide Plate

Refer to Figure 1-13 and Figure 1-14 for this procedure.

For a single drive configuration, the guide plate must be mounted as the guide for the inner cover on the drive mounting side. The drive must be mounted on the right side and use the optional front panel.

For a two drive configuration, the guide plate is not used.

1-6.5.2.1 Inner Cover Mounted to Mounting Tray

See Figure 1-13 (A).

STEP	ACTION
1	Insert the inner cover from the front of the mounting tray and push it into the tray until the stopper is locked.
2	Align the round bump at the center of the guide plate with the hole of the inner cover. Use two bolts to attach guide plate.

1-6.5.2.2 Inner Cover NOT Mounted to Mounting Tray

See Figure 1-13 (B).

STEP	ACTION
1	Remove the inner cover from the mounting tray.
2	Align the round bump at the center of the guide plate with the hole of the mounting tray. Use two bolts to attach guide plate.

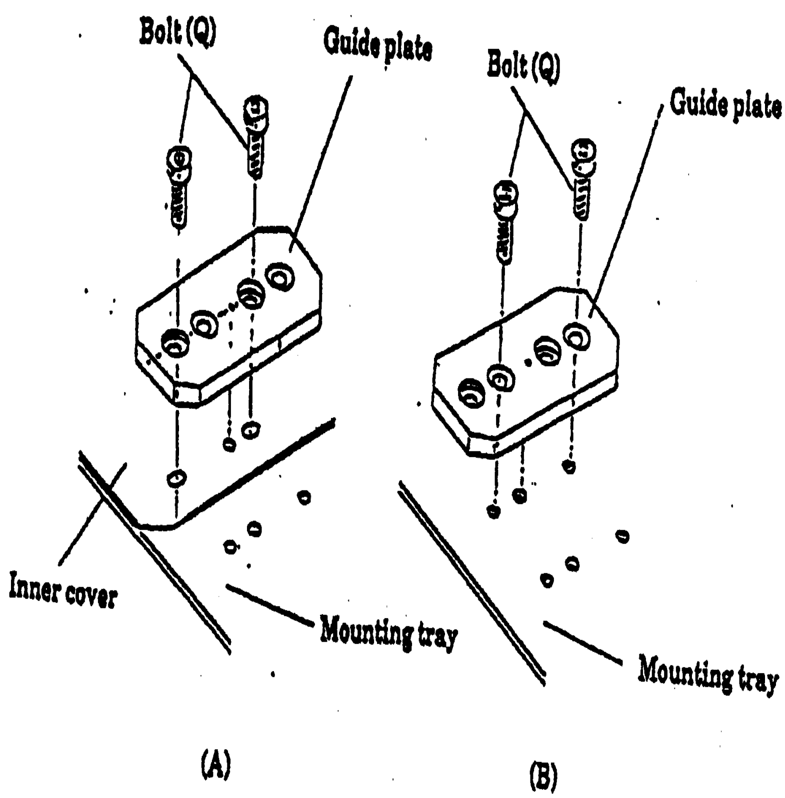


Figure 1-13. Guide Plate Installation

1-6.5.3 Screw Plate Mounting

See Figure 1-14.

STEP	ACTION
1	Each screw plate has nine holes. Mount the screw plate so that the big hole is up.
2	Attach 4 screw plates (g) to the rear of each pole of the rack with two screws (i -SBD-5x2S-M-NI1A) in the top and bottom holes.

1-6.5.4 Attach Mounting Tray

See Figure 1-14.

NOTE: When the mounting hole of the rack is a screw hole, remove the positioning pins at both the left and right sides of the tray (d) with a screwdriver.

STEP	ACTION
1	Insert mounting tray (d) into the 19-inch rack and attach the front with six screws (j - SW2NA-5x12S-M-NI1A).
2	Attach 2 brackets (f) to both the left and right sides of the tray (d) with six screws (k).
3	Attach brackets (f) to the left and right rear poles of the rack with eight screws (j) and tighten.

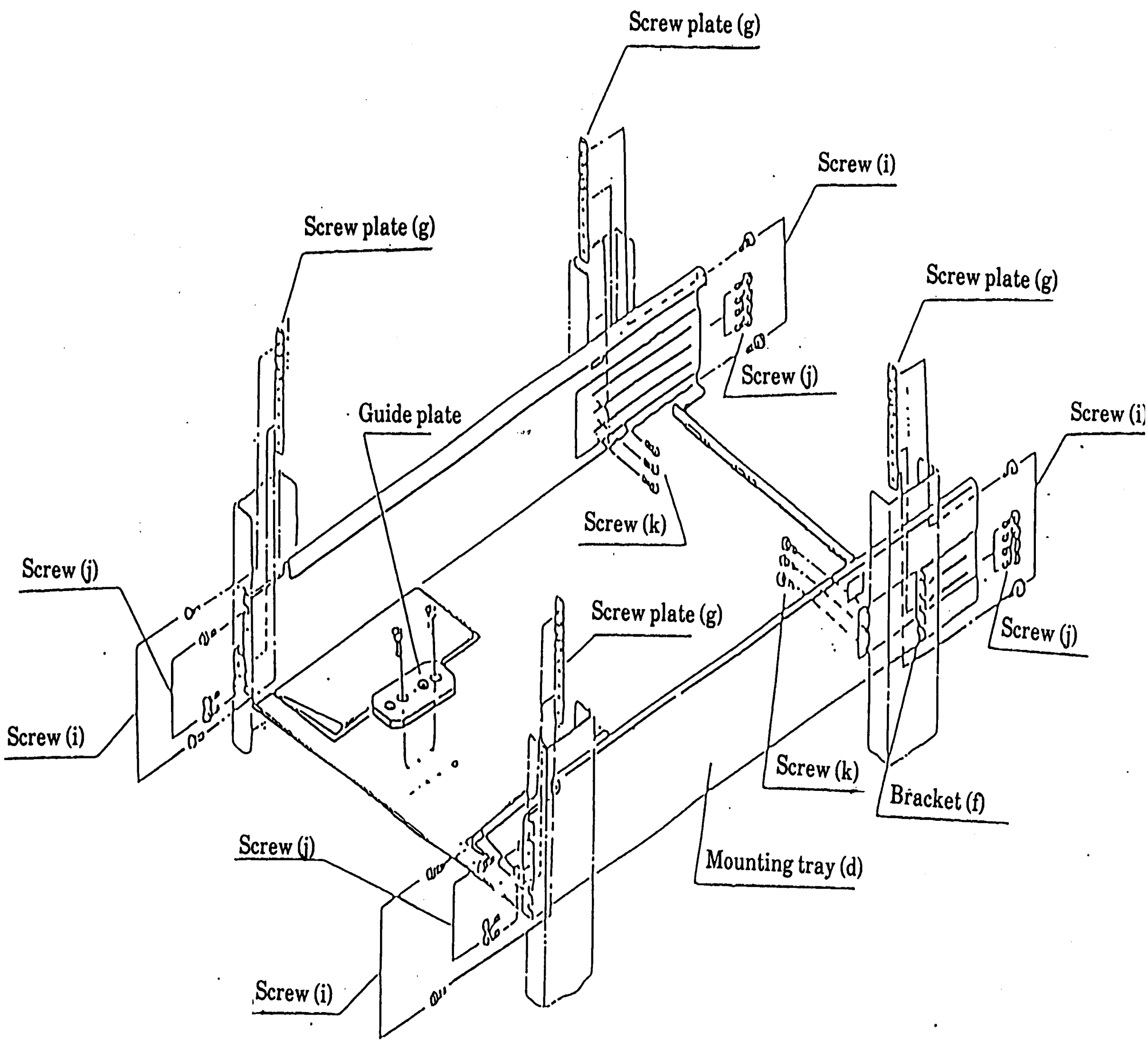


Figure 1-14. 19-inch Rack-mount Kit Installation

1-6.5.5 Adjust the Brackets

The length of the bracket is adjusted according to length 'L' between the front and rear poles of the 19-inch rack. To adjust the length of the bracket, exchange the left and right brackets (as shown in Figure 1-15) or replace the brackets with longer brackets.

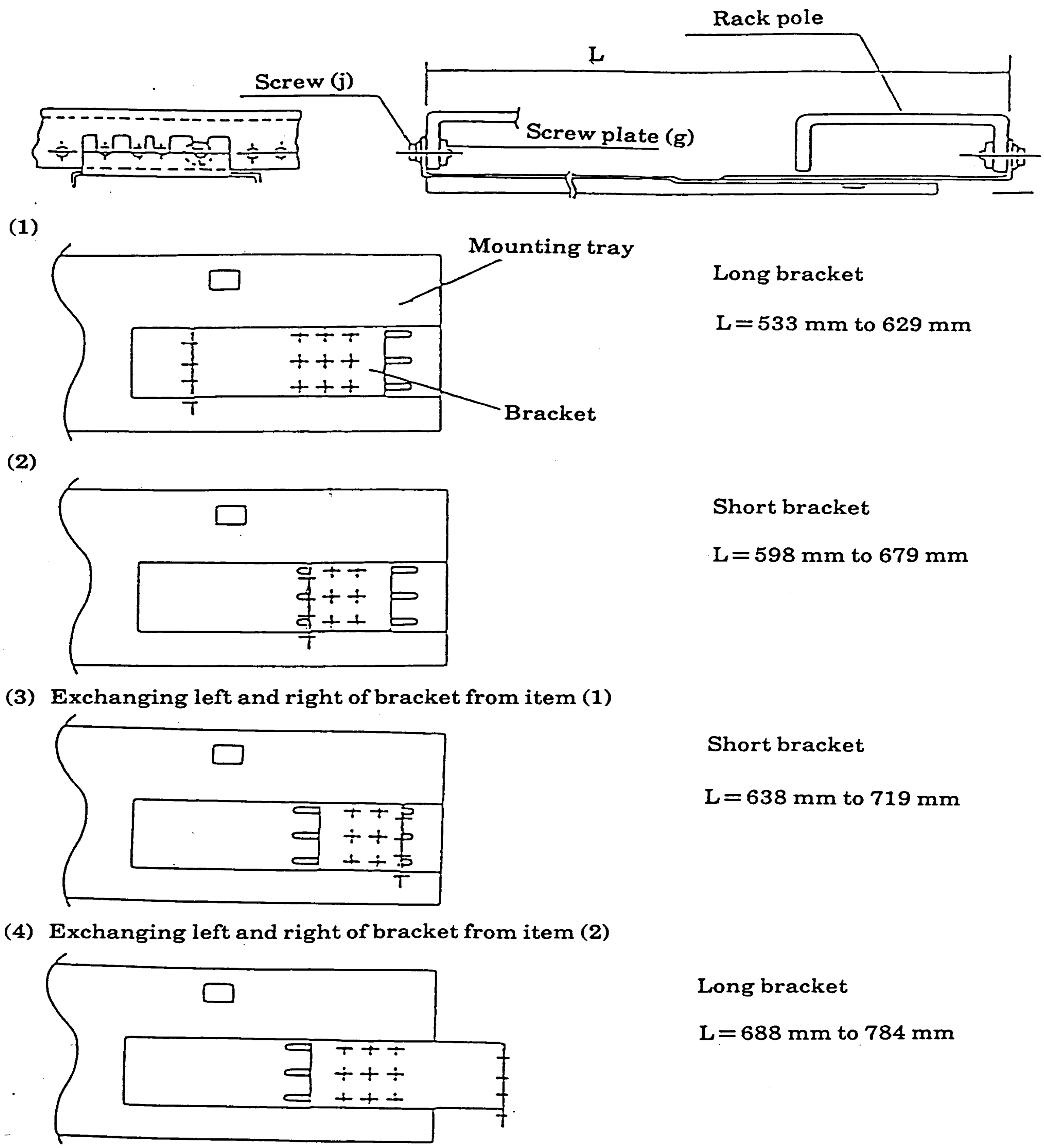


Figure 1-15. Bracket Adjustment

1-6.5.6 Install the M2488 or M2488 with Medium Changer on the Mounting Tray

Refer to Figure 1-14, Figure 1-16 through Figure 1-19 for this procedure.

NOTE: Before inserting, confirm that the inner cover is on the U-type slit of the mounting tray.

STEP	ACTION
1	If a single drive is used, it must be mounted on the right side.
2	Remove the two foot rails from the drive (if installed).
3	Attach drive to the inner cover with four screws (p -CG001901-002). If attached, the FACL should be flush with the front of the inner cover.
4	Attach the rear of the drive with one screw (r - SW3NA-3x12S-M-NI1A) through the L-type bracket.
5	Use the correct faceplate (optional) for either a single or dual drives and attach to drives.

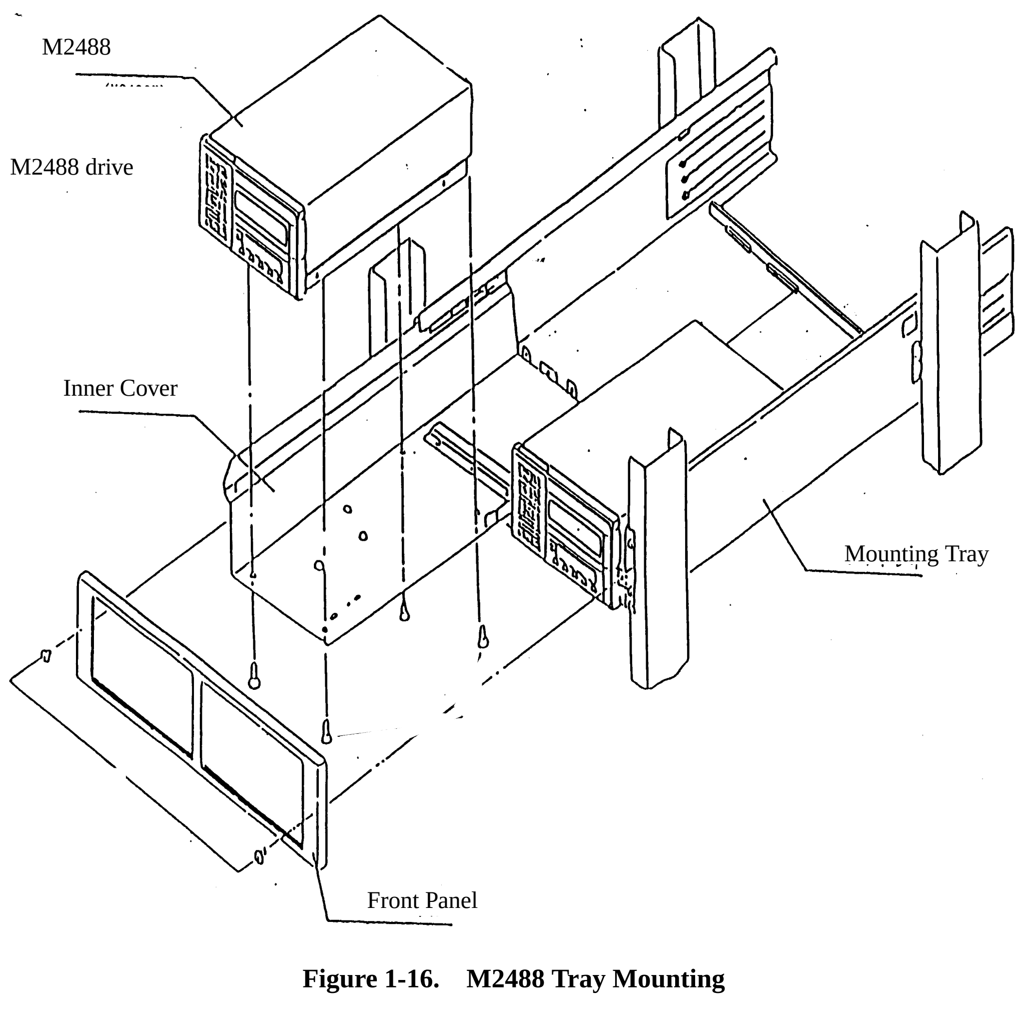


Figure 1-16. M2488 Tray Mounting

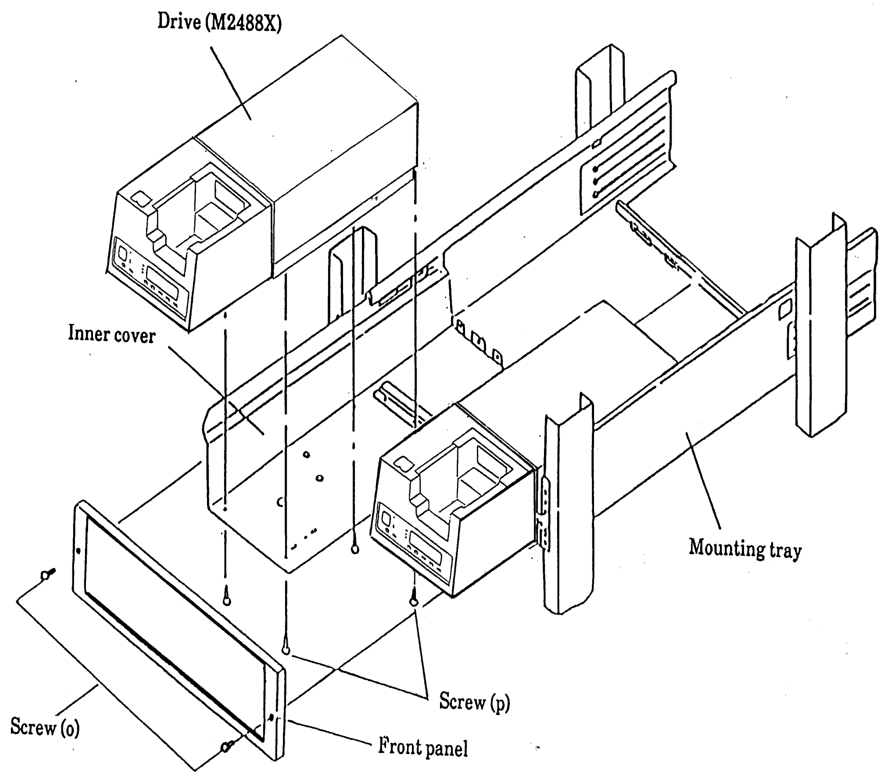


Figure 1-17. M2488 with ACL Tray Mounting

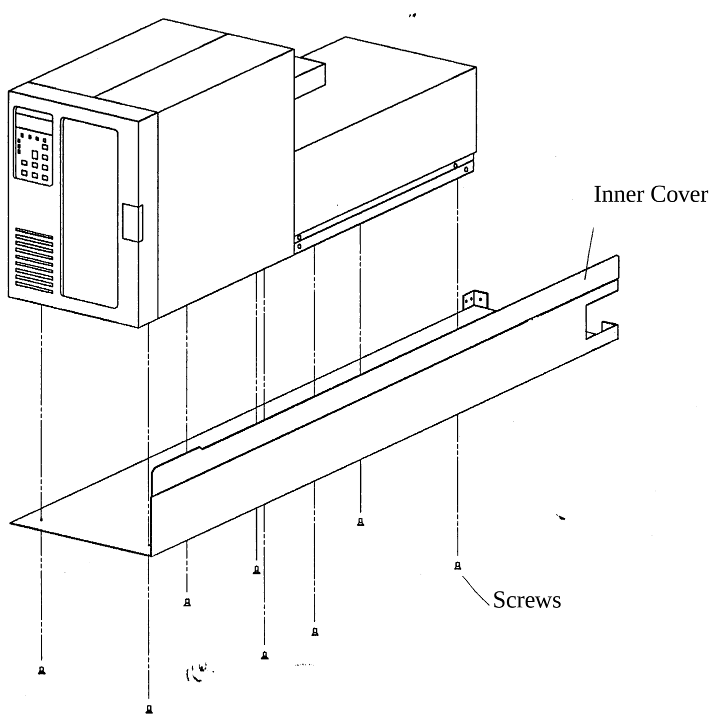


Figure 1-18. Mount FACL to Inner Cover

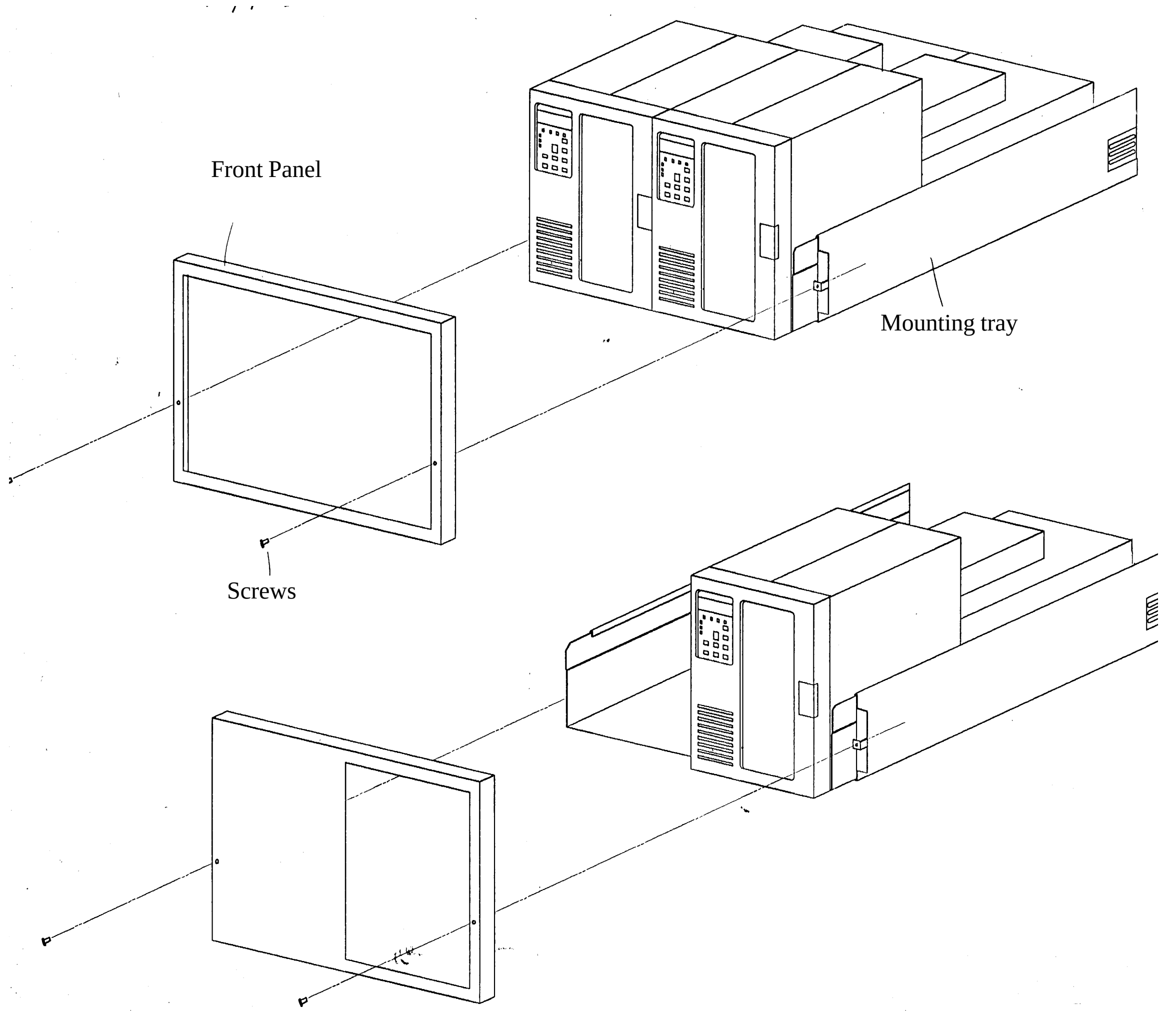


Figure 1-19. FACL Face Plate

1-6.6 Installation of the Automatic Cartridge Loader

Perform the installation procedure for the ACL in the order presented in the following flowchart. The paragraph for each procedure is included in the flowchart. Equipment and tools required for installation are listed in Table 1-3.

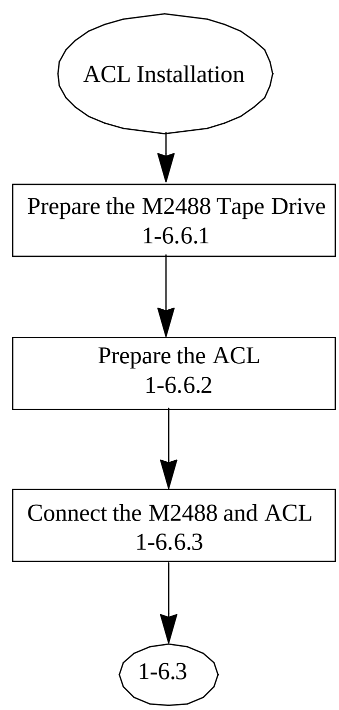
Table 1-3. Equipment and Tools Required for ACL Installation

EQUIPMENT	PART NUMBER	QUANTITY	DESCRIPTION
ACL	B03B-5400-H011A	1	Automatic Cartridge Loader
Allen bolts	Part of ACL accessory kit	3	Used for attachment to drive
Grounding plate	Part of ACL accessory kit.	1	Attaches between ACL and drive
Phillips #2 screwdriver		1	
Allen wrench (5mm)		1	8 inches long

**** NOTE ****

1. ACL versions A0 through B6 are incompatible with the M2488 and should not be attached to this drive.

2. The M2488 should be powered off and all cables and cords disconnected prior to performing this installation procedure. Follow standard procedures and cautions used when handling electronic equipment.



1-6.6.1 Prepare the M2488 Tape Drive

Refer to Figure 1-20, Figure 8-6 and Figure 8-7 during performance of this procedure.

STEP	ACTION
1	Remove two screws from each of the foot rails on the bottom of the drive, then remove the foot rails. See Figure 8-7.
2	Remove the top cover by removing the two screws from the left and right side, and the two screws on the rear. Pull the cover up from the rear and slide backwards. See Figure 8-6.

****
* CAUTION *
****

Remove the top cover by lifting the front of the top cover BEFORE sliding it backwards. Ensure that the cover does not catch on the components on the PCBA under the top cover.

STEP	ACTION
3	Remove the four screws from the sides of the front panel, then gently pull the front panel forward.
4	Disconnect the operator panel cable from the front panel.
5	Remove the two screws holding the panel bracket, then pull off the panel bracket.

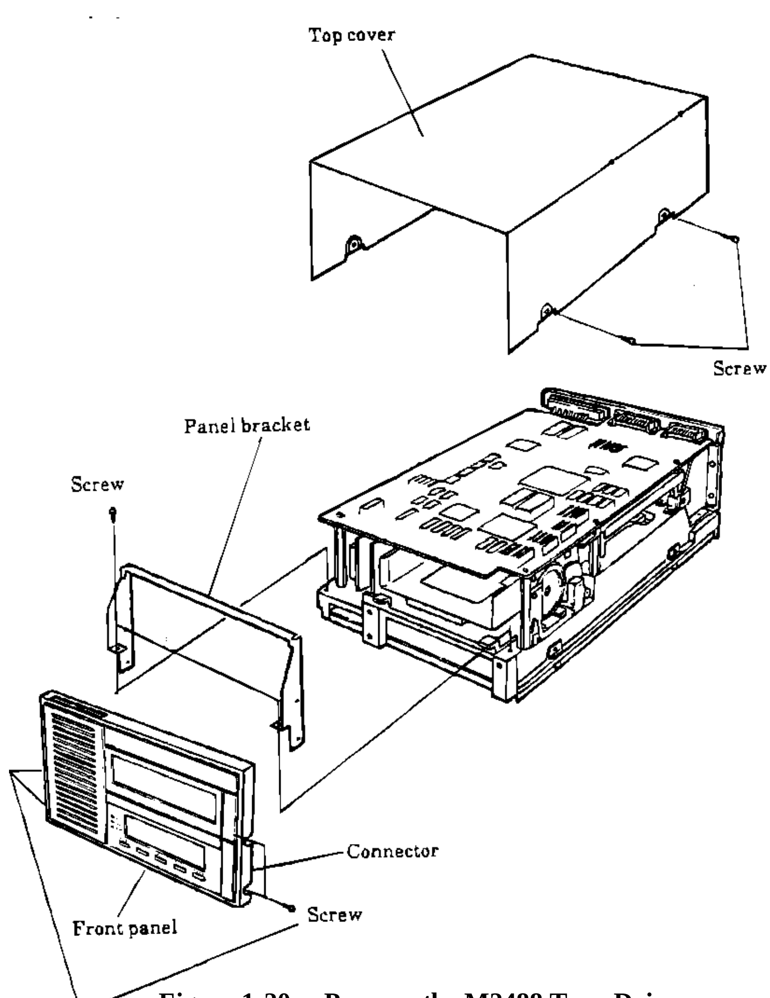


Figure 1-20. Prepare the M2488 Tape Drive

1-6.6.2 Prepare the ACL

Refer to Figure 1-21 during performance of this procedure.

STEP	ACTION
1	Remove two screws (on the bottom front corners) from the ACL top cover.
2	Push down and hold the cover release bar while pulling up and slightly moving the top cover forward. When the cover has cleared the hook on the top rear of the cover (behind the cover release), continue to pull forward then up.
3	Remove the four screws from the bottom of the ACL and gently lift the ACL mechanism from the base.

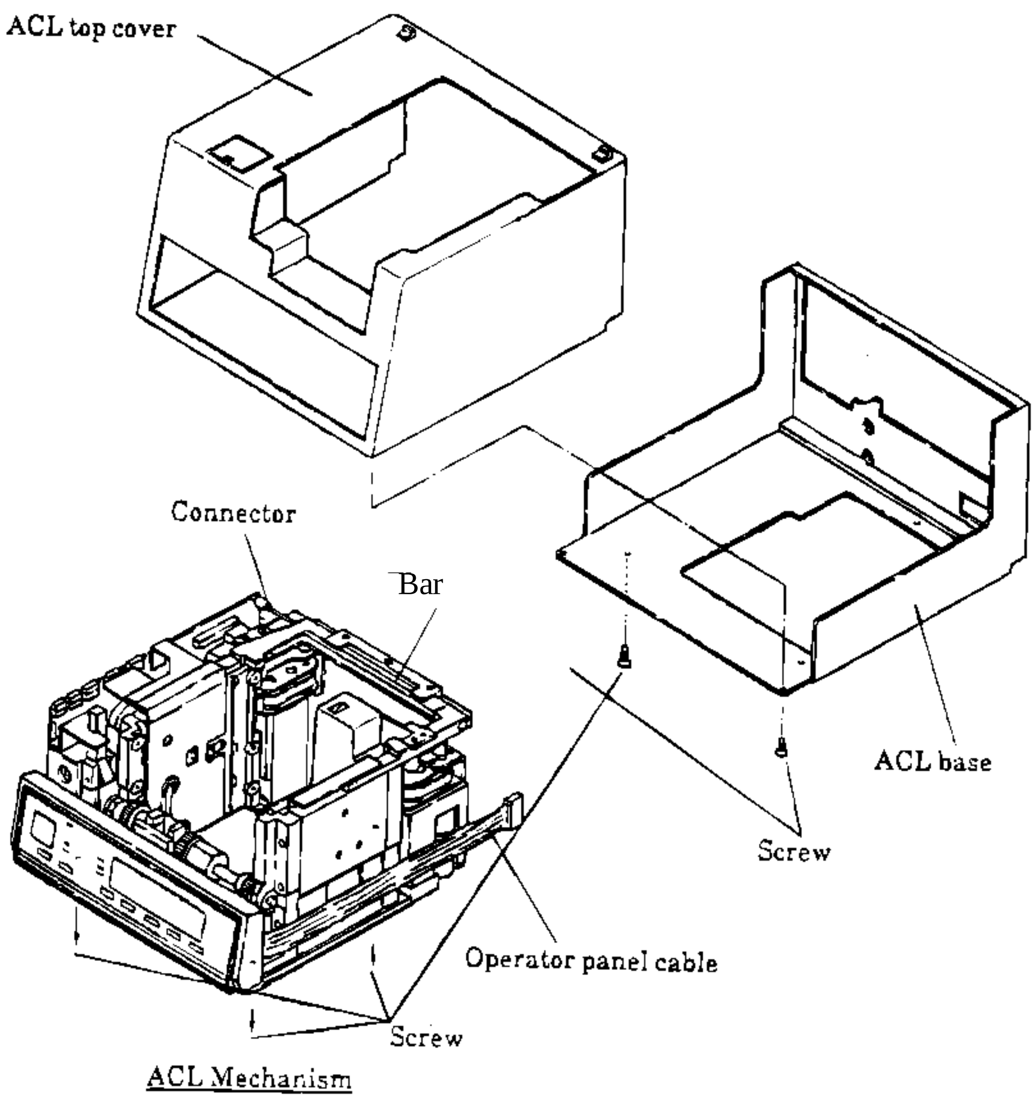


Figure 1-21. Prepare the ACL

1-6.6.3 Connect the M2488 and the ACL

Refer to Figure 1-22 through Figure 1-25 during performance of this procedure.

STEP	ACTION
1	Place the grounding plate on the front of the M2488 (replaces the front panel). See Figure 1-22.
2	Attach the ACL base to the front of the M2488 using the three Allen screws.
3	Pull operator panel cable through small hole on base.
4	Slide the ACL mechanism into the base. Leave slightly forward for cable connection.
5	Refer to Figure 1-23 and Figure 1-24. Connect the cable to the ACL operator panel cable. Tuck connector into hole in base. Remove protective sheet from adhesive tape inside the ACL base and press the operator panel cable to the tape.
6	Attach the interface cable between the connector on the rear of the ACL and the connector on the front of the M2488.
7	Push the mechanism all the way to the rear of the base. Insert the four screws through the ACL base into the ACL mechanism and tighten.
8	Replace the ACL cover and tighten the two bottom corner screws (see Figure 1-25).
9	Replace the M2488 top cover and tighten the six screws.

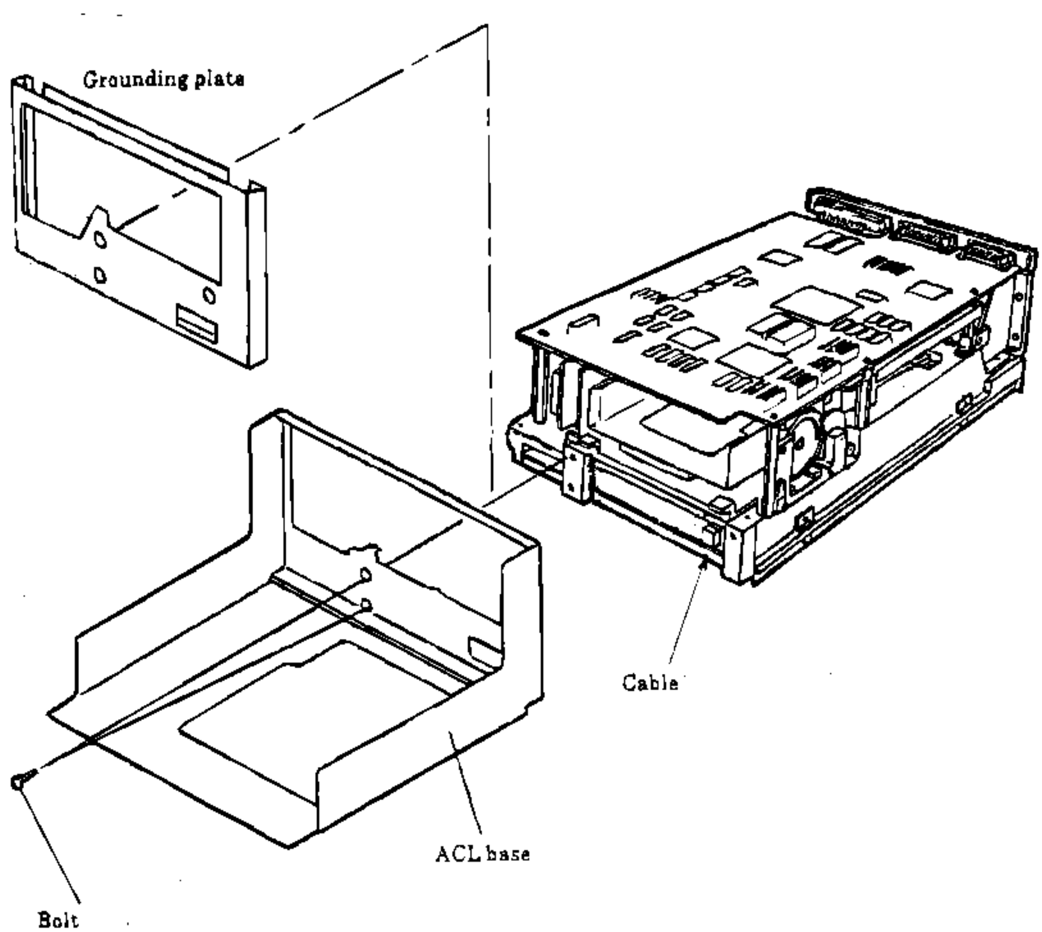


Figure 1-22. Connect the M2488 and the ACL Base

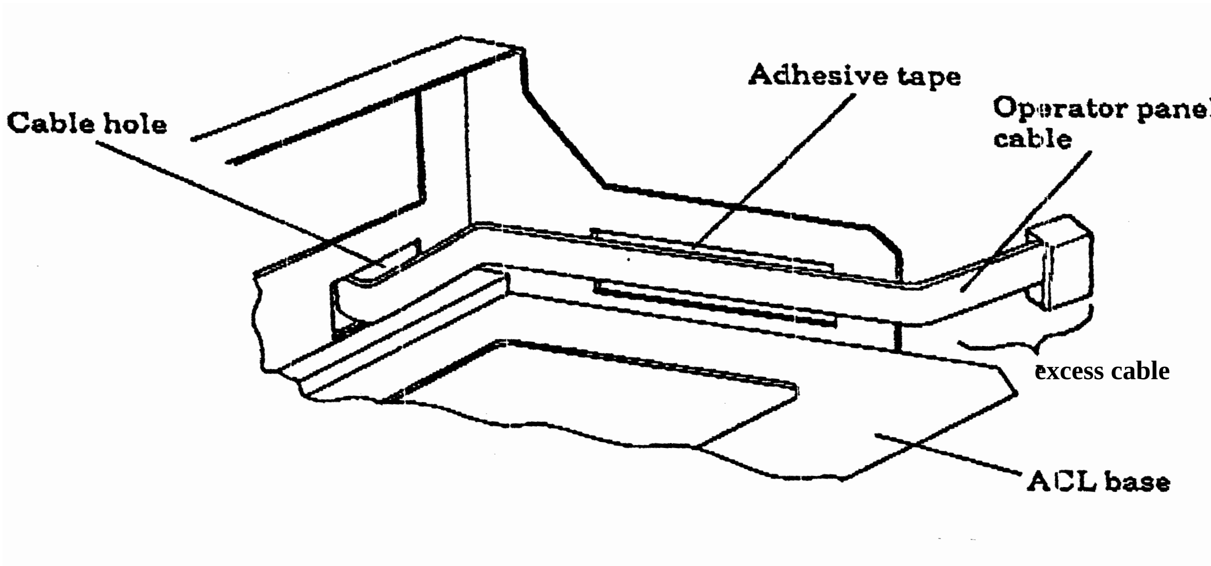


Figure 1-23. Attach Operator Panel Cable to ACL Base

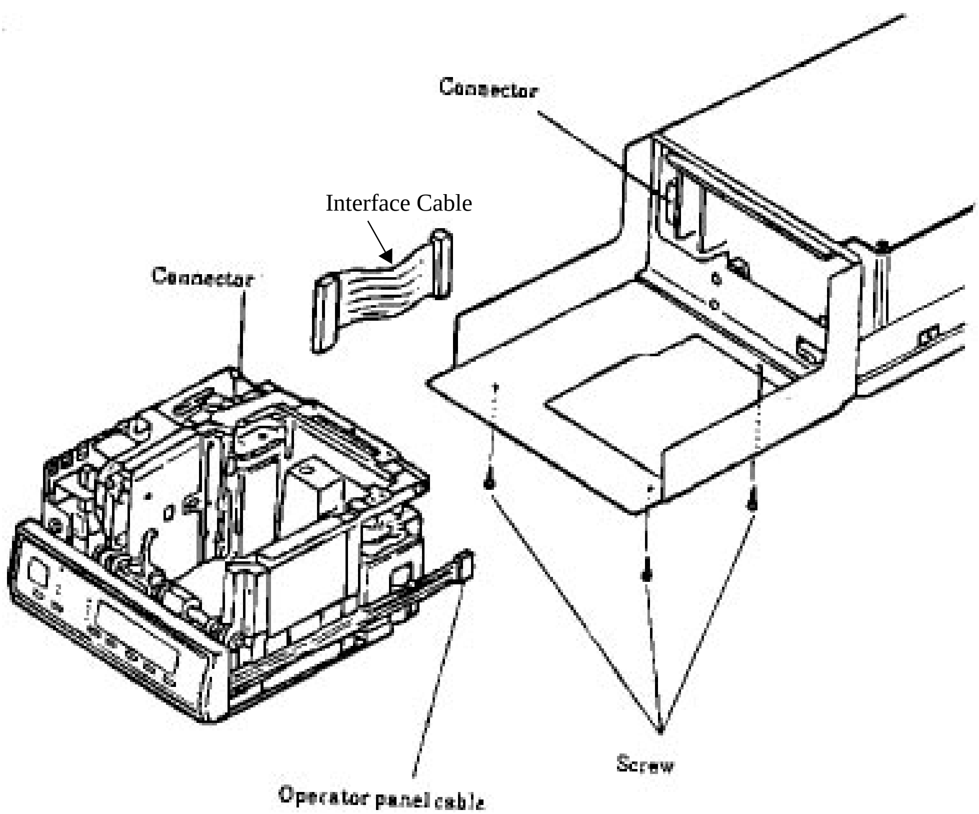


Figure 1-24. Attach the ACL Mechanism

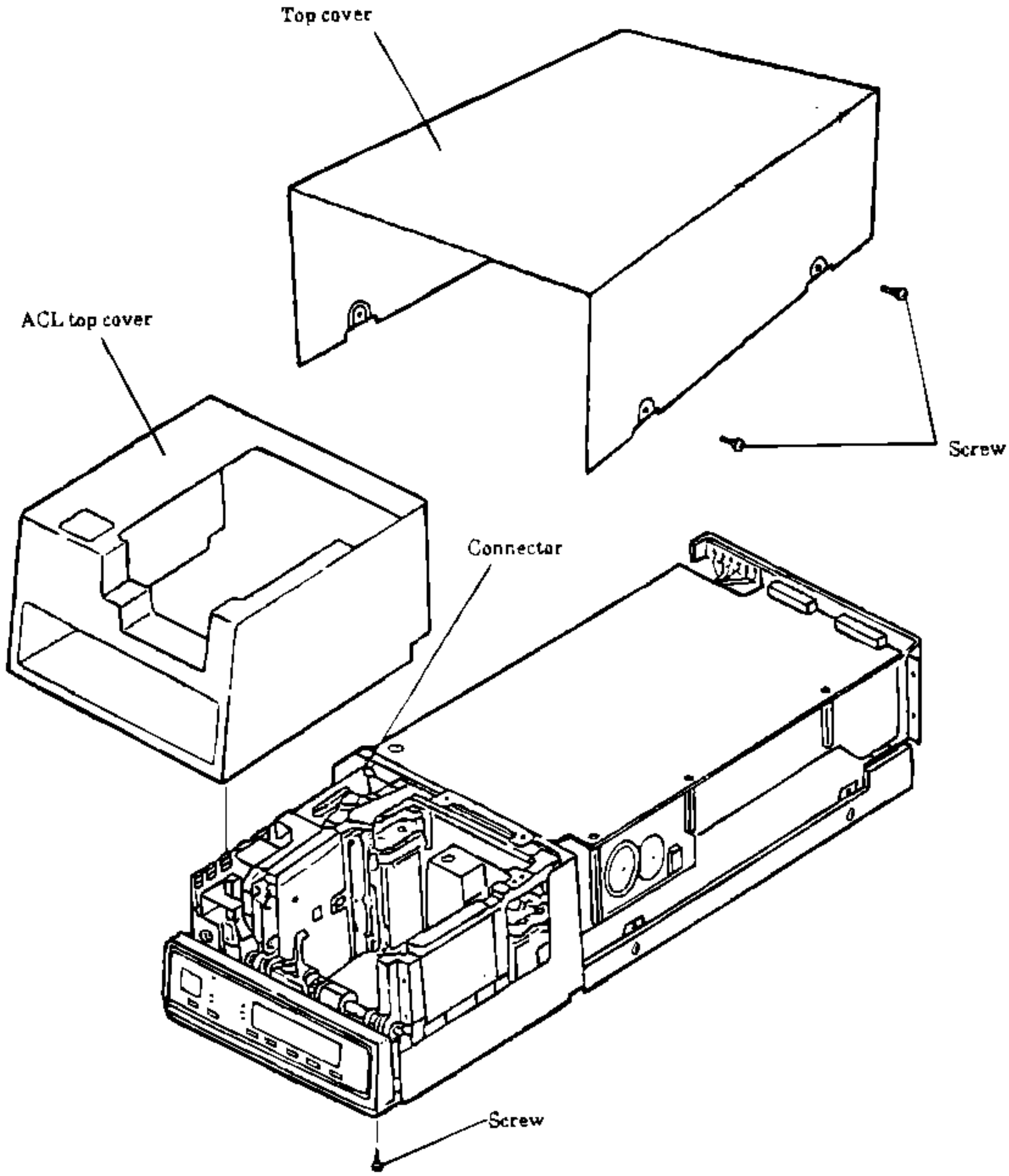


Figure 1-25. Replace Covers

1-6.7 Installation of the Flush-mount Automatic Cartridge Loader

**** NOTE ****

Use caution when handling the FACL. The cleaning cell protrudes from the rear of the FACL and could be damaged by mishandling. **DO NOT** use for lifting.

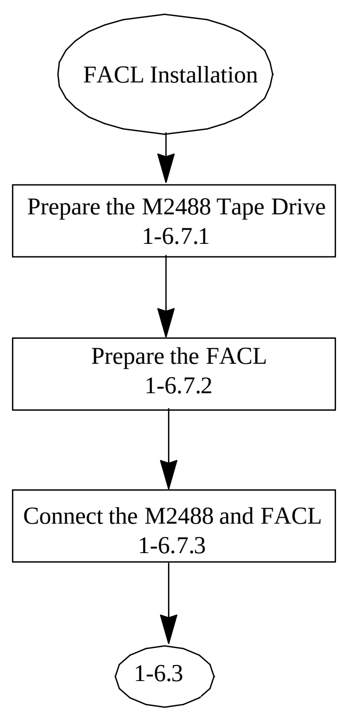
Refer to Table 1-4 for a list of equipment required to install the FACL on the M2488 tape drive. The following flowchart illustrations the sequence of installation.

Table 1-4. Equipment and Tools Required for FACL Installation

EQUIPMENT	PART NUMBER	QUANTITY	DESCRIPTION
FACL	CA01032-B001	1	Flush-mounted medium changer
Allen bolts	Part of FACL accessory kit	3	Used for attachment to drive
Grounding plate	Part of FACL accessory kit.	1	Attaches between FACL and drive
Phillips #2 screwdriver		1	
Allen wrench (5mm)		1	8 inches long

**** NOTE ****

The M2488 should be powered off and all cables and cords disconnected prior to performing this installation procedure. Follow standard procedures and cautions used when handling electronic equipment.



1-6.7.1 Prepare the M2488 Tape Drive

Refer to Figure 1-26 during performance of this procedure.

STEP ACTION

1 Remove the bottom, and the left and right side covers. See Figure 8-7.

2 Remove the top cover by removing the two screws from the left and right side, and the two screws on the rear. Pull the front of the cover up and slide backwards. See Figure 8-6.

****
CAUTION
****

Remove the top cover by lifting the front of the top cover BEFORE sliding it backwards. Ensure that the cover does not catch on the components on the PCBA under the top cover.

3 Remove the four screws from the sides of the front panel, then gently pull the front panel forward.

4 Disconnect the operator panel cable from the front panel.

5 Remove the two screws holding the panel bracket, then pull off the panel bracket.

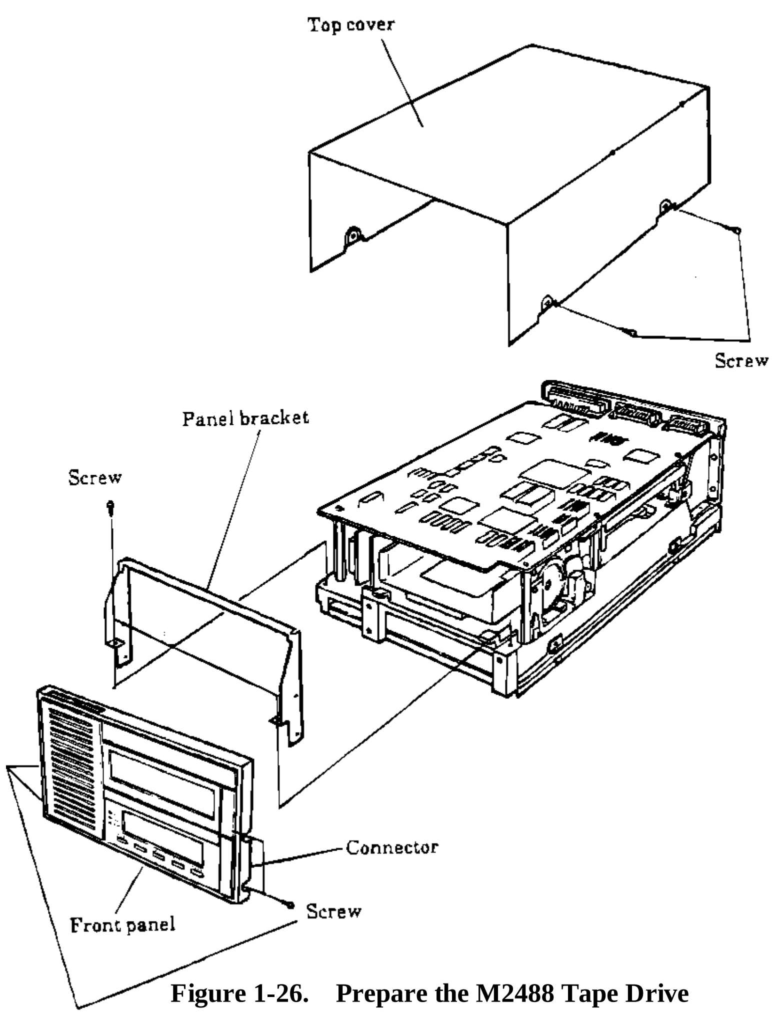


Figure 1-26. Prepare the M2488 Tape Drive

1-6.7.2 Prepare the FACL

Refer to Figure 1-27 and Figure 1-28 during performance of this procedure.

STEP	ACTION
1	Remove the two screws from each of the covers.
2	Pull up on the two top cover halves and remove.
3	Pull the two cables, CNJ24 and CNJ28, through the square hole on the lower right rear of the FACL. See Figure 1-28 for location.

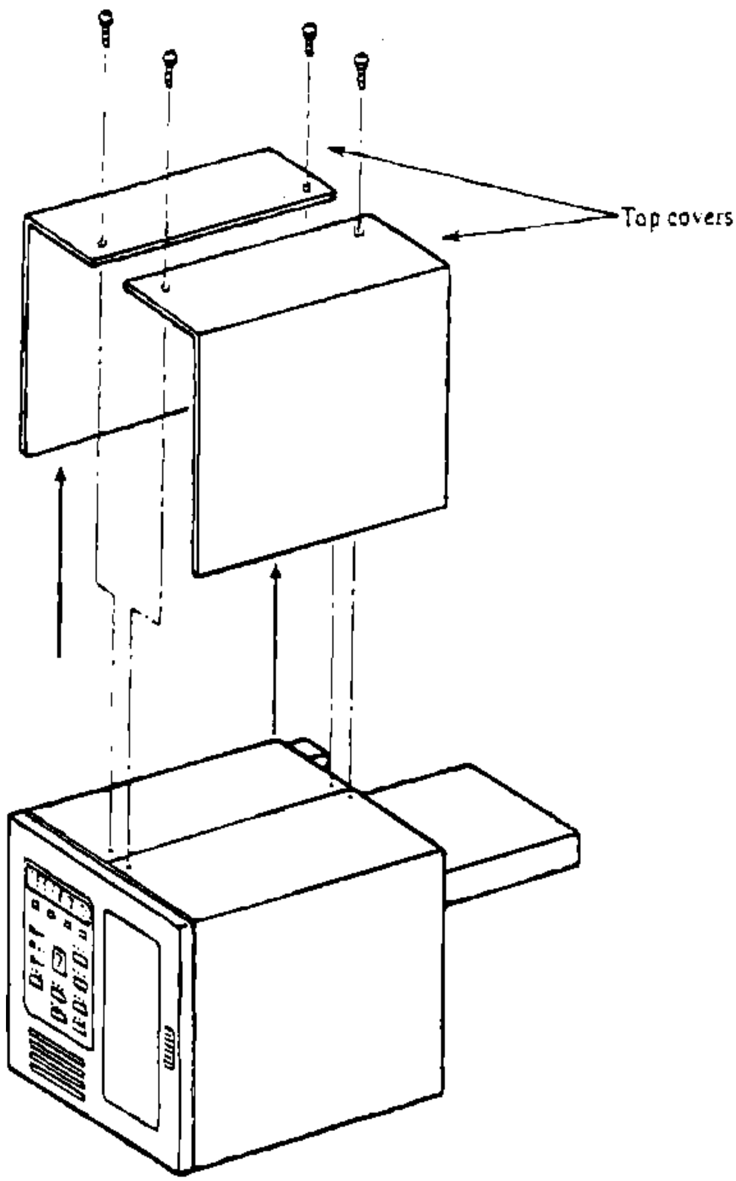


Figure 1-27. Prepare the FACL

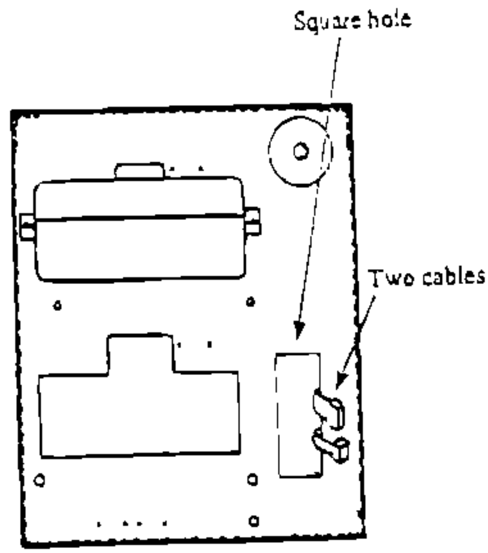


Figure 1-28. FACL Rear

1-6.7.3 Connect the M2488 and the FACL

Refer to Figure 1-29 and Figure 1-30 during performance of this procedure.

STEP	ACTION
1	Insert the grounding plate at the front of the M2488 drive as shown in Figure 1-29.
2	Connect the cable CNJ24 and CNJ28 to the M2488 connectors CNP24 and CNP28. Route the CNJ24 cable through the inside of the corner post on the M2488. See Figure 1-30.
3	Align the positioning projections on the M2488 to the holes on the rear of the FACL. Attach the three Allen bolts through the inside of the FACL into the grounding plate and tighten.
4	Replace the top covers on the FACL. Tighten four screws to hold the covers in place.
5	Replace the top cover on the M2488. Tighten the four screws to hold the cover in place. See Figure 1-31.

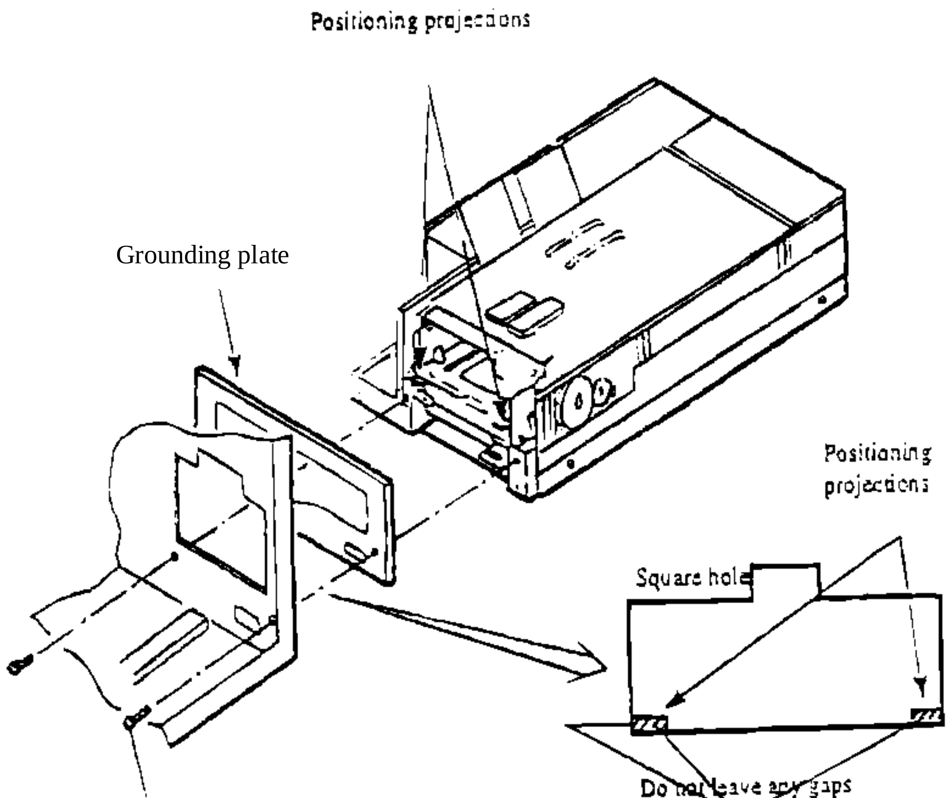


Figure 1-29. Connect the M2488 and the FACL

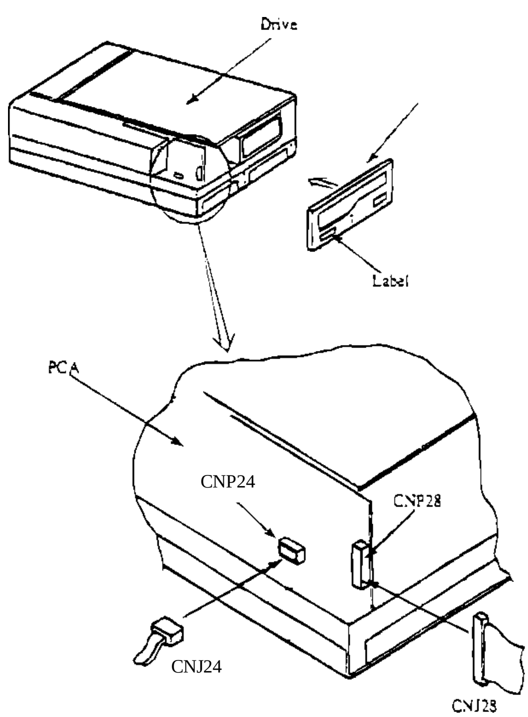


Figure 1-30. Cable Connection

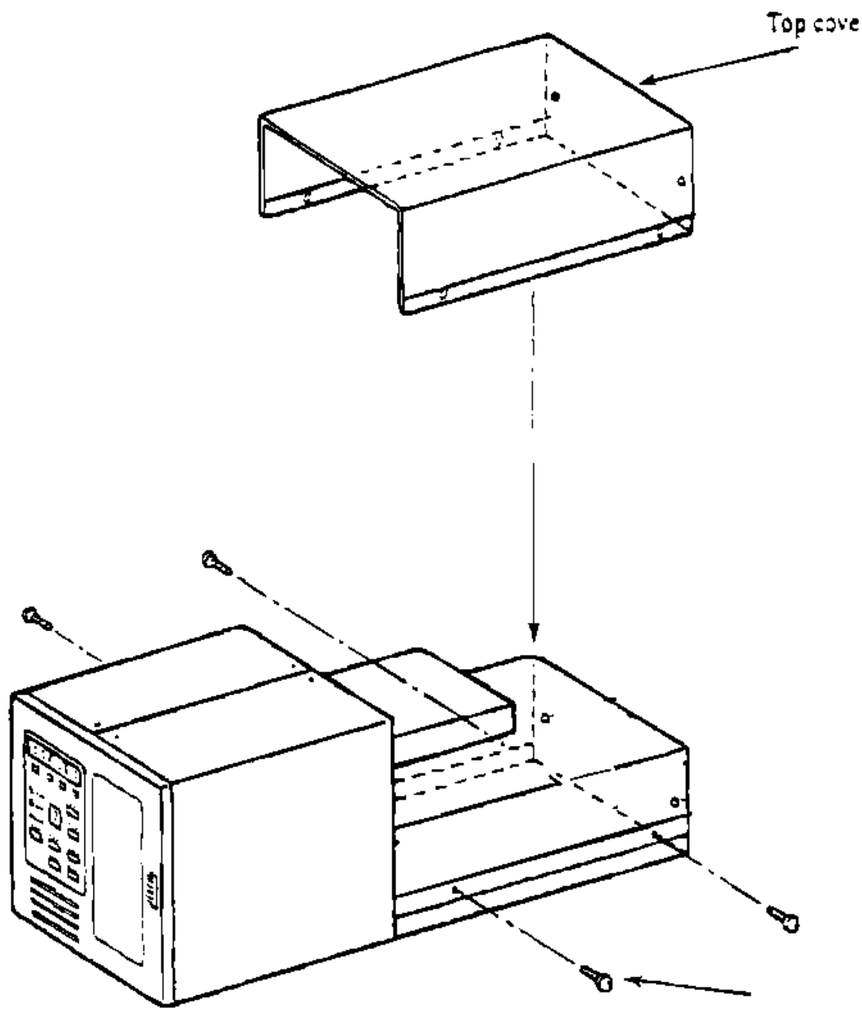


Figure 1-31. Replace Top Covers

1-7 PREPARATION FOR USE

See the User’s Guide for configuration information.

CHAPTER 2

DESIGN ARCHITECTURE

2-1 INTRODUCTION

This chapters provides information on the principles of operation of the M2488 tape drive. This chapter begins with a a high level description of the M2488, then progresses to a more detailed description of the individual circuits. Refer to the appropriate paragraphs for the necessary level of detail.

2-2 OPERATION OF THE M2488

2-3 OPERATION OF THE MAGNETIC TAPE CONTROLLER (MTC)

2-4 OPERATION OF THE MAGNETIC TAPE UNIT (MTU)

2-2 OPERATION OF THE M2488

The following paragraphs describe the operation of the M2488. Refer to the block diagram in Figure 2-1.

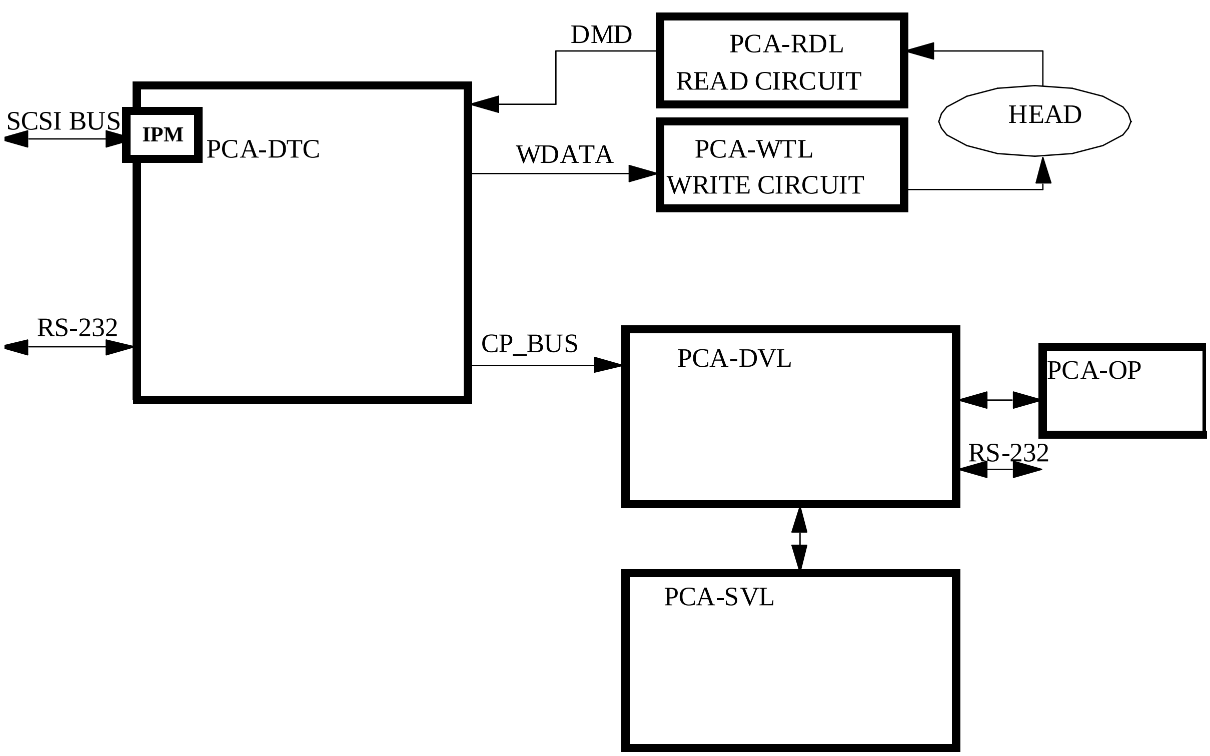


Figure 2-1. M2488 Block Diagram

The M2488 is a highly reliable, compact tape unit using IBM 3490/349E compatible half-inch tape cartridges. It is fully contained with the power supply integrated into the compact 8-inch form factor. The M2488 architecture consists of the magnetic tape controller (MTC) which performs the host interface, data buffering, compression, and formatter functions and the magnetic tape unit (MTU) that performs the mechanical control and read/write functions. Descriptions of the MTC and MTU are presented in the following sections.

2-3 OPERATION OF THE MAGNETIC TAPE CONTROLLER (MTC)

The DTC PCA contains all of the MTC (Magnetic Tape Controller) logic in a highly integrated implementation. This double-sided PCBA has extensive VLSI for reduced cost and increased reliability. The M2488 uses one of four Interface Personality Modules (IPM) to configure the SCSI-2 interface for the four combinations of wide or narrow and differential or single-ended operation.

The main functions contained on the DTC PCBA include:

1) Main Processor with all associated memory and support logic

2) Full SCSI-2 interface with RISC-based SCSI Protocol Controller (SPC)

3) 20 MB/s Host data path with EDRC logic

4) 2 MB Data Buffer

5) MTU (Formatter) digital read/write logic.

The processes performed by the DTC involve coordination of M2488 operation by the Main Processor (CP):

- High-level SCSI I/F control of SPC
- Full control of data transfers on Host and MTU Data Paths
- Active Data Buffer management
- High-level control of MTU servo (tape motion)

Refer to the block diagram in Figure 2-2.

2-3.1 Data Path

The M2488 data path has been designed to allow data transfers up to a rate of 10Mbyte/s on a single or two-byte wide SCSI interface and data transfers up to 20 Mbyte/s across a two-byte bus into the controller buffer.

The SPC used is the Fujitsu MB86603 which is a fast and wide capable protocol controller intended for high-performance systems. This controller operates in target mode and supports synchronous or asynchronous data transfers. Performance enhancing features of the MB86603 are:

1) Programmable commands (512 bytes internal program memory).
2) Data FIFO register (64 bytes).
3) Automatic selection, reselection retry, and attention handling (e.g. combined sequences that allow hardware to handle all SCSI protocols up through CDB acquisition).
4) Support of high-level commands.

Various data transfer rates can be set by programming the SPC internally from the default clock rate of 20 MHz or an alternate 30 MHz clock.

2-3.2 Data Buffer

The remaining data path functions; host interface logic, host packet processor, buffer function control, and formatter packet processor; have been combined into a single data path LSI (SDDP). Buffer performance has also been greatly enhanced. The SDDP buffer function control supports a three port buffer with a 32 Mbyte/s bandwidth and 20 MHz clock. This allows 20 Mbyte/s data transfer rate on the host port, up to 10 Mbyte/s burst transfers on the formatter port, and a microprocessor port overhead up to 2 Mbyte/s. The host port is two bytes wide and the formatter port is a single byte wide. The SDDP can support up to 8 Mbyte of buffer memory with a standard size of 2 Mbyte for the M2488.

2-3.3 ERDC Compression Feature

Compression is performed by an improved design EDRC chip set prior to the data buffer. Placement of compression before the buffer effectively extends buffer capacity by a factor equal to the average compression rate. It also allows packet headers, which contain compression information for the entire

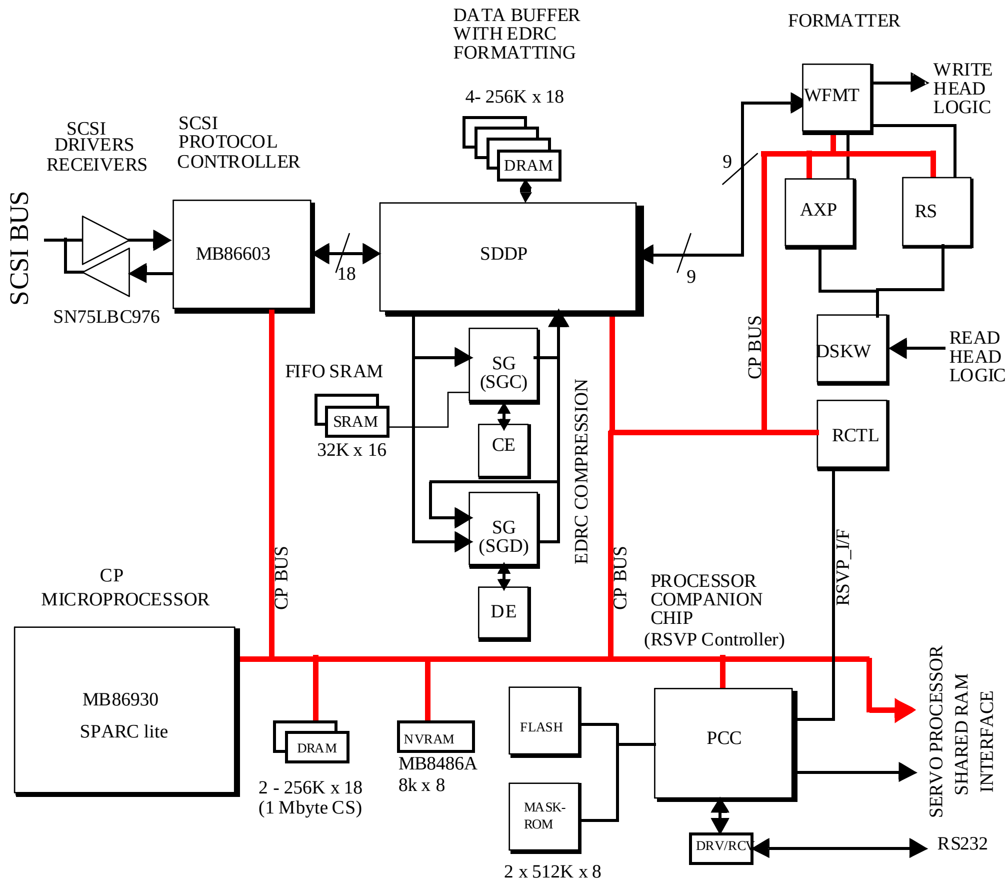


Figure 2-2. DTC PCA Block Diagram

packet, to be built without requiring additional buffering. Data buffering increases overall performance by allowing data streaming since the buffer can mask or eliminate some tape repositions.

The EDRC chip set consists of a compression engine (CE), a decompression engine (DE), and a data control function (SG). The SG LSI is used twice in the design, once each for the CE and DE. The complete chip set is designed to operate at the full data path rate of 20 MB/s. In addition, The compression SG input FIFO is 64k bytes for compression data caching. If compression retries are ever required, retries can automatically be performed without host intervention.

2-3.4 Microprocessor Control

A 20MHz MB68930 Sparc-lite MPU is the single Control Processor (CP) used for the controller requirements. The controller CP communicates directly to the drive servo CP via dual-port RAM. The RSVP (Read Signal Verification Processor) is a 10 Mhz, 24-bit, fixed instruction sequencer that is embedded inside the PCC (Processor Companion Chip). It requires less than 4200 basic cells of the 22,800 cells in the PCC. The RSVP provides the dedicated formatter signal processing needed to support the CP with the time critical formatter control. It allows the controller firmware architecture to use event driven multi-tasking for the CP code and allow the RSVP to handle dedicated read signal polling. The RSVP presents interrupts to the CP based on drive read interface signals which are preprocessed; polled, monitored, filtered, and conditioned as required.

2-3.5 Firmware

The M2488 microcode is partitioned into functional modules and stored in mask ROM and flash memory. The code partitions serve to minimize communication paths within the code structure and to segregate functions dealing with the host interface from those dealing with generic tape operation. The mask ROM provides a resident code version for power-on and code download. New code versions are downloaded into flash memory from the host SCSI interface or from tape. After power-on, control store for all processors is loaded from flash memory if valid. If invalid, the mask ROM code is used for recovery.

The core microcode is a multi-tasking operating system (OS) allowing a configurable number of tasks. The present design allows a total of thirty two active tasks; four fixed tasks and twenty-eight SCSI tasks. This custom OS allows functions to run until a resource is unavailable, places itself into a suspended state until the resource becomes available, and then proceeds with execution. Many overlapped operations are possible because of a sophisticated interrupt structure. Servo, formatter, maintenance, and SCSI events are signalled via interrupts which in turn initiate processes via the OS to service the events. Signals generated from the read detection circuitry are given highest priority by polling them with the read signal verification processor (RSVP) embedded in the PCC LSI.

2-4 OPERATION OF THE MAGNETIC TAPE UNIT (MTU)

The magnetic tape unit consists of the read and write head, all mechanical assemblies (loader assembly, threader assembly, and servo motors), and five printed circuit assemblies that perform the following functions:

1) DVL PCA - control processor and logic for all servo and mechanical control functions. and operator panel control processor. A logical block diagram for the DVL is shown in Figure 2-3. The interface and control logic is integrated into the MMCL LSI (denoted by the dotted line in the block diagram).
2) OP PCA - contains the M2488 unit operator panel and associated drive circuitry
3) SVL PCA - contains servo control circuitry including I/O registers, control logic LSI, PWM control, and control DAC.
4) WTL PCA - contains the write drive circuits.
5) RDL PCA - contains the read analog circuits.

Other features of the MTU are described in the following sections.

2-4.1 Airless Tape Path

The M2488 has been able to realize an airless tape path while maintaining excellent reliability. This system removes the failure-prone pump and pack arm assemblies with an improved roller guide tape path. One new roller guide has been added that replaces the pack arm to keep tape aligned with the tape machine reel. Alignment of tape with the head is accomplished with two roller guides as in previous models. During running, a slight air film is produced between the head and tape which prevents direct contact. A patrol reposition function has been added that periodically moves the tape to prevent any problem when tape is not moving.

The reel motor of the M2488 has also been changed to dramatically improve tape reposition time and access times.

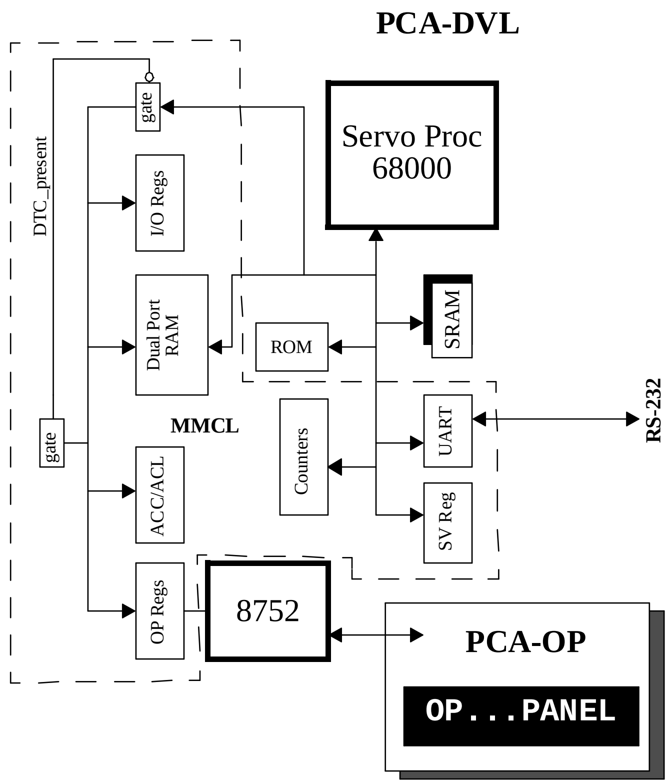


Figure 2-3. DVL PCA Block Diagram

2-4.2 Read and Write Electronics

The read circuits for the M2488 utilize fifteen analog LSI that were developed for the M2483. These components have been field proven to be a stable and low cost design.

The write circuits of the M2488 use enhanced head driver ICs developed with the latest semiconductor technology. This technology allows the integration of six write channels (tracks) into one chip.

CHAPTER 3

SCSI MESSAGES

3-1 INTRODUCTION

Chapters 3 through 6 are the Host Interface Specification for the M2488.

This chapter describes the messages for the M2488 tape drive and the medium changers. The following information is located in this chapter:

3-2 M2488 TAPE AND MEDIUM CHANGER SCSI MESSAGES

3-3 SCSI BUS STATUS

3-2 M2488 TAPE AND MEDIUM CHANGER SCSI MESSAGES

Table 3-1 describes the SCSI messages used with the M2488. For more detailed information on the SCSI message, refer to the paragraph listed in the PARAGRAPH column.

Table 3-1. M2488 SCSI Messages

CODE	MESSAGE	DESCRIPTION	PARAGRAPH
00h	COMMAND COMPLETE	Indicates the execution of a command has terminated and valid status was sent to the initiator.	3-2.3 on page 3-2
01h	EXTENDED MESSAGE	Sent as the first byte of a multiple-byte message.	3-2.5 on page 3-3
02h	SAVE DATA POINTER	Directs the initiator to save a copy of the present active data pointer for the currently attached logical unit.	3-2.15 on page 3-9
03h	RESTORE POINTERS	Restores the most recently saved pointers (for the currently attached logical unit) to the active state.	3-2.14 on page 3-9
04h	DISCONNECT	Informs the initiator that the present physical path is going to be broken.	3-2.4 on page 3-2
05h	INITIATOR DETECTED ERROR	Informs a target an error has occurred.	3-2.8 on page 3-8
06h	ABORT	Sent to the target to clear the present operation.	3-2.1 on page 3-2
07h	MESSAGE REJECT	Indicates the last message received was inappropriate or was not implemented.	3-2.12 on page 3-8
08h	NO OPERATION	Sent in response to a target's request for a message when the initiator does not currently have any other valid message to send.	3-2.13 on page 3-9
09h	MESSAGE PARITY ERROR	Indicates one or more bytes in the last message, received by the initiator, had a parity error.	3-2.11 on page 3-8
0Ah	LINKED COMMAND COMPLETE	Indicates to the initiator that the completion and execution of a linked command and status was sent.	3-2.9 on page 3-8
0Bh	LINKED COMMAND COMPLETE (with flag)	Indicates to the initiator that the completion and execution of a linked command with the flag bit set to 1 and status was sent.	3-2.10 on page 3-8

Table 3-1. M2488 SCSI Messages (Continued)

CODE	MESSAGE	DESCRIPTION	PARAGRAPH
0Ch	BUS DEVICE RESET	Directs the target to clear all current commands on that SCSI device.	3-2.2 on page 3-2
23h	IGNORE WIDE RESIDUE	Sent to an initiator to indicate the number of valid bytes sent during the last REQ/ACK handshake and REQB/ACKB handshake of a DATA IN phase is less than the negotiated transfer width.	3-2.7 on page 3-7
80h-FFh	IDENTIFY	Sent to establish the physical path connection between an initiator and target for a particular logical unit.	3-2.6 on page 3-7

3-2.1 ABORT code 06h

This message is sent from the initiator to the target to clear the present operation.

If a logical unit has been identified, all pending data and status for the issuing initiator from the affected logical unit are cleared, and the target goes to the BUS FREE phase. Pending data and status for other initiators are not cleared. If a logical unit is not identified, the target goes to the BUS FREE phase. No status or ending message is sent for the operation. It is not an error to issue this message to a logical unit that is not currently performing an operation for the initiator.

3-2.2 BUS DEVICE RESET code 0Ch

This message is sent from an initiator to direct a target to clear all current commands on that SCSI device.

This message forces the SCSI device to an initial state with no operations pending for any initiator. Upon recognizing this message, the target goes to the BUS FREE phase.

3-2.3 COMMAND COMPLETE code 00h

This message is sent from a target to an initiator to indicate the execution of a command or a series of linked commands has terminated and valid status was sent to the initiator.

After successfully sending this message, the target goes to the BUS FREE phase by releasing BSY. The target considers the message transmission to be successful when it detects the negation of ACK for the COMMAND COMPLETE message with the ATN signal false.

**** NOTE ****

> The command may have been executed successfully or unsuccessfully as indicated in the status.

3-2.4 DISCONNECT code 04h

This message is sent from a target to inform the initiator that the present physical path is going to be broken (the target plans to disconnect by releasing BSY), but a later reconnect is required in order to complete the current operation.

This message does not cause the initiator to save the data pointer. After successfully sending this message, the target goes to the BUS FREE phase by releasing BSY. The target considers the message transmission to be successful when it detects the negation of ACK for the DISCONNECT message with the ATN signal false.

3-2.5 EXTENDED MESSAGE FORMAT code 01h

This message is sent from either the initiator or the target as the first byte of a multiple-byte message.

CODE	MESSAGE	LENGTH (BYTES)
01h	Synchronous Data Transfer Request	5
03h	Wide Data Transfer Request	4

3-2.5.1 Synchronous Data Transfer Request (SDTR)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Extended Message (01h)							
1	Extended Message Length (03h)							
2	SYNCHRONOUS DATA TRANSFER REQUEST code (01h)							
3	Transfer Period Factor							
4	REQ/ACK Offset							

A SYNCHRONOUS DATA TRANSFER REQUEST (SDTR) message exchange is initiated by a SCSI device whenever a previously arranged data transfer agreement may have become invalid. The agreement becomes invalid after any condition which may leave the data transfer agreement in an indeterminate state such as:

a) after a hard reset condition;

b) after a BUS DEVICE RESET message and;

c) after a power cycle.

In addition, a SCSI device may initiate an SDTR message exchange whenever it is appropriate to negotiate a new data transfer agreement (either synchronous or asynchronous). SCSI devices that are capable of synchronous data transfers shall not respond to an SDTR message with a MESSAGE REJECT message.

Renegotiation at every selection is not recommended, since a significant performance impact is likely.

The SDTR message exchange establishes the permissible transfer periods and the REQ/ACK offsets for all logical units and target routines on the two devices. This agreement only applies to data phases.

Byte 3: The transfer period factor times four is the value of the transfer period. The transfer period is the minimum time allowed between leading edges of successive REQ pulses and of successive ACK pulses to meet the device requirements for successful reception of data.

Byte 4: The REQ/ACK offset is the maximum number of REQ pulses allowed to be outstanding before the leading edge of its corresponding ACK pulse is received at the target. This value is chosen to prevent overflow conditions in the device's reception buffer and offset counter. A REQ/ACK offset value of zero shall indicate asynchronous data transfer mode; a value of FFh shall indicate unlimited REQ/ACK offset.

**** NOTE ****

The supported SCSI transfer rates are listed in Appendix G.

The originating device (the device that sends the first of the pair of SDTR messages) sets its values according to the rules above to permit it to receive data successfully. If the responding device can also receive data successfully with these values (or smaller transfer periods or larger REQ/ACK offsets or both), it returns the same values in its SDTR message. If it requires a larger transfer period, a smaller REQ/ACK offset, or both in order to receive data successfully, it substitutes values in its SDTR message as required, returning unchanged any value not required to be changed. Each device when transmitting data respects the limits set by the other's SDTR message, but it is permitted to transfer data with larger transfer periods, smaller REQ/ACK offsets, or both than specified in the other's SDTR message. The successful completion of an exchange of SDTR messages implies an agreement as follows:

Responding device SDTR response	Implied agreement
a) Non-zero REQ/ACK offset	Each device transmits data with a transfer period equal to or greater than and a REQ/ACK offset equal to or less than the values received in the other device's SDTR message.
b) REQ/ACK offset equal to zero	Asynchronous transfer
c) MESSAGE REJECT message	Asynchronous transfer

If the initiator recognizes that negotiation is required, it asserts the ATN signal and sends a SDTR message to begin the negotiating process. After successfully completing the MESSAGE OUT phase, the target shall respond with the proper SDTR message. If an abnormal condition prevents the target from returning an appropriate response, both devices shall go to asynchronous data transfer mode for data transfers between the two devices.

Following target response (a) above, the implied agreement for synchronous operation shall be considered to be negated by both the initiator and the target if the initiator asserts the ATN signal and the first message out is either MESSAGE PARITY ERROR or MESSAGE REJECT. In this case, both devices shall go to asynchronous data transfer mode for data transfers between the two devices. For the MESSAGE PARITY ERROR case, the implied agreement shall be reinstated if a retransmittal of the second of the pair of messages is successfully accomplished. After a vendor-specific number of retry attempts (greater than zero), if the target receives a MESSAGE PARITY ERROR message, it shall terminate the retry activity. This may be done either by changing to any other information transfer phase and transferring at least one byte of information or by going to the BUS FREE phase. The initiator shall accept such action as aborting the negotiation, and both devices shall go to asynchronous data transfer mode for data transfers between the two devices.

If the target recognizes that negotiation is required, it sends an SDTR message to the initiator. Prior to releasing the ACK signal on the last byte of the SDTR message from the target, the initiator shall assert the ATN signal and respond with its SDTR message or with a MESSAGE REJECT message. If an abnormal condition prevents the initiator from returning an appropriate response, both devices shall go to asynchronous data transfer mode for data transfers between the two devices.

Following an initiator's responding SDTR message, an implied agreement for synchronous operation shall not be considered to exist until the target leaves the MESSAGE OUT phase, indicating that the target has accepted the negotiation. After a vendor-specific number of retry attempts (greater than zero), if the target has not received the initiator's responding SDTR message, it shall go to the BUS FREE phase without any further information transfer attempt. This indicates that a catastrophic error condition has occurred. Both devices shall go to asynchronous data transfer mode for data transfers between the two devices.

If, following an initiator's responding SDTR message, the target shifts to MESSAGE IN phase and the first message in is MESSAGE REJECT, the implied agreement shall be considered to be negated and both devices shall go to asynchronous data transfer mode for data transfers between the two devices.

The implied synchronous agreement shall remain in effect until a BUS DEVICE RESET message is received, until a hard reset condition occurs, or until one of the two SCSI devices elects to modify the agreement. The default data transfer mode is asynchronous data transfer mode. The default data transfer mode is entered at power on, after a BUS DEVICE RESET message, or after a hard reset condition.

3-2.5.2 Wide Data Transfer Request (WDTR)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Extended Message (01h)							
1	Extended Message Length (02h)							
2	WIDE DATA TRANSFER REQUEST code (03h)							
3	Transfer Width Exponent							

A WIDE DATA TRANSFER REQUEST (WDTR) message exchange is initiated by a SCSI device whenever a previously arranged transfer width agreement may have become invalid. The agreement becomes invalid after any condition which may leave the data transfer agreement in an indeterminate state such as:

a) after a hard reset condition;

b) after a BUS DEVICE RESET message and;

c) after a power cycle.

In addition, an SCSI device may initiate a WDTR message exchange whenever it is appropriate to negotiate a new transfer width agreement. SCSI devices that are capable of wide data transfers (greater than eight bits) do not respond to a WDTR message with a MESSAGE REJECT message.

Renegotiation at every selection is not recommended, since a significant performance impact is likely.

The WDTR message exchange establishes an agreement between two SCSI devices on the width of the data path to be used for DATA phase transfers between the two devices. This agreement applies to DATA IN and DATA OUT phases only. All other information transfer phases shall use an eight-bit data path.

If an SCSI device implements both wide data transfer option and synchronous data transfer option, then it shall negotiate the wide data transfer agreement prior to negotiating the synchronous data transfer agreement. If a synchronous data transfer agreement is in effect, then an SCSI device that accepts a WDTR message shall reset the synchronous agreement to asynchronous mode.

Byte 3: The transfer width is two to the transfer width exponent bytes wide. The transfer width that is established applies to all logical units on both SCSI devices. Valid transfer widths are 8 bits (m = 00h), 16 bits (m = 01h), and 32 bits (m = 02h). Values of m greater than 02h are reserved.

The originating SCSI device (the SCSI device that sends the first of the pair of WDTR messages) sets its transfer width value to the maximum data path width it elects to accommodate. If the responding SCSI device can also accommodate this transfer width, it returns the same value in its WDTR message. If it requires a smaller transfer width, it substitutes the smaller value in its WDTR message. The successful completion of an exchange of WDTR messages implies an agreement as follows:

Responding device WDTR response	Implied agreement
a) Non-zero transfer width	Each device transmits and receives data with a transfer width equal to the responding SCSI device's transfer width.
b) Transfer width equal to zero	Eight-bit data transfer
c) MESSAGE REJECT message	Eight-bit data transfer

If the initiator recognizes that negotiation is required, it asserts the ATN signal and sends a WDTR message to begin the negotiating process. After successfully completing the MESSAGE OUT phase, the target shall respond with the proper WDTR message. If an abnormal condition prevents the target from returning an appropriate response, both devices shall go to eight-bit data transfer mode for data transfers between the two devices.

Following target response a) above, the implied agreement for wide data transfers shall be considered to be negated by both the initiator and the target if the initiator asserts ATN and the first message out is either MESSAGE PARITY ERROR or MESSAGE REJECT. In this case, both devices shall go to eight-bit data transfer mode for data transfers between the two devices. For the MESSAGE PARITY ERROR case, the implied agreement shall be reinstated if a retransmittal of the second of the pair of messages is successfully accomplished. After a vendor-specific number of retry attempts (greater than zero), if the target receives a MESSAGE PARITY ERROR message, it shall terminate the retry activity. This may be done either by changing to any other information transfer phase and transferring at least one byte of information or by going to the BUS FREE phase. The initiator shall accept such action as aborting the negotiation, and both devices shall go to eight-bit data transfer mode for data transfers between the two devices.

If the target recognizes that negotiation is required, it sends a WDTR message to the initiator. Prior to releasing the ACK signal on the last byte of the WDTR message from the target, the initiator shall assert the ATN signal and respond with its WDTR message or with a MESSAGE REJECT message. If an abnormal condition prevents the initiator from returning an appropriate response, both devices shall go to eight-bit data transfer mode for data transfers between the two devices.

Following an initiator's responding WDTR message, an implied agreement for wide data transfer operation shall not be considered to exist until the target leaves the MESSAGE OUT phase, indicating that the target has accepted the negotiation. After a vendor-specific number of retry attempts (greater than zero), if the target has not received the initiator's responding WDTR message, it shall go to the BUS FREE phase without any further information transfer attempt (see 6.1.1). This indicates that a catastrophic error condition has occurred. Both devices shall go to eight-bit data transfer mode for data transfers between the two devices.

If, following an initiator's responding WDTR message, the target shifts to MESSAGE IN phase and the first message in is MESSAGE REJECT, the implied agreement shall be considered to be negated and both devices shall go to eight-bit data transfer mode for data transfers between the two devices.

The implied transfer width agreement shall remain in effect until a BUS DEVICE RESET message is received, until a hard reset condition occurs, or until one of the two SCSI devices elects to modify the agreement. The default data transfer width is eight-bit data transfer mode. The default data transfer mode is entered at power on, after a BUS DEVICE RESET message, or after a hard reset condition.

Note: we recommend testing at INQUIRY DATA byte seven (07h) bits six and 5 (60h) to determine if the M2488 has an installed 16 bit interface (20h) and, therefore, supports WDTR with a transfer width of 01h (16 bits). If the 16 bit interface is not installed. Then negotiation for 16 bits is not recommended, since the negotiation will be rejected and a significant performance impact is likely.

3-2.6 IDENTIFY code 80h-FFh

These messages are sent by either the initiator or the target to establish the physical path connection between an initiator and target for a particular logical unit. The logical unit number addresses one of up to eight physical or virtual devices attached to a target.

Bit 7	This bit is set to one to distinguish an IDENTIFY message from other messages.
Bit 6	This bit is only set to one by the initiator to grant the target the privilege of disconnecting. If this bit is zero, the target does not disconnect. This bit is set to zero if sent by the target. Reference sections 8-6 ERROR RECOVERY PROCEDURES and 4-4 COMMAND DISCONNECTION for additional information on this bit.
Bit 5	LUNTAR = 0 to specify target LUN in bits 2-0.
Bits 4-3	Reserved.
Bits 2-0	These bits specify a LUN in a target.

Only one logical unit number is identified for any one selection sequence; a second IDENTIFY message with a new logical unit number is not issued before the bus is released (BUS FREE phase). The initiator may send one or more IDENTIFY messages during a selection sequence. However, the logical unit number in any additional IDENTIFY messages is the same as the logical unit number specified in the first IDENTIFY message sent by the initiator.

When sent from a target to an initiator during reconnection, an implied RESTORE POINTERS message is performed by the initiator prior to completion of this message.

3-2.7 IGNORE WIDE RESIDUE code 23h

BYTE	VALUE	DESCRIPTION
0	23h	Message Code
1	01h, 02h, 03h	Ignore

This message is sent from a target to an initiator to indicate the number of valid bytes sent during the last REQ/ACK handshake and REQB/ACKB handshake of a DATA IN phase is less than the negotiated transfer width. The ignore field indicates the number of invalid data bytes transferred. This message is sent immediately following that DATA IN phase and prior to any other messages. The ignore field is defined in Table 3-2.

Table 3-2. Ignore Field Description

IGNORE	INVALID DATA BITS	
	32-BIT TRANSFERS	16-BIT TRANSFERS
00h	Reserved	Reserved
01h	DB (31-24)	DB (15-8)
02h	DB (31-16)	Reserved
03h	DB (31-8)	Reserved
04-FFh	Reserved	Reserved

3-2.8 INITIATOR DETECTED ERROR code 05h

This message is sent from an initiator to inform a target an error (e.g., parity error) has occurred that does not preclude the target from retrying the operation. Although present pointer integrity is not assured, a RESTORE POINTERS message or a disconnect followed by a reconnect, causes the pointers to be restored to their defined prior state.

The message is rejected unless it occurs immediately following a DATA or STATUS TRANSFER phase.

3-2.9 LINKED COMMAND COMPLETE code 0Ah

This message is sent by a target to an initiator to indicate the completion and execution of a linked command and status was sent. The initiator sets the pointers to the initial state for the next linked command.

3-2.10 LINKED COMMAND COMPLETE (WITH FLAG) code 0Bh

This message is sent from a target to an initiator to indicate the execution of a linked command, with the flag bit set to one, has completed and that status was sent. The initiator sets the pointers to the initial state of the next linked command. Typically this message is used to cause an interrupt in the initiator between two linked commands.

3-2.11 MESSAGE PARITY ERROR code 09h

This message is sent from the initiator to the target to indicate one or more bytes in the last message it received had a parity error.

In order to indicate its intentions of sending this message, the initiator asserts the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that has the parity error. This provides an interlock so the target can determine which message has the parity error.

The message is rejected unless it occurs immediately following a MESSAGE IN phase.

3-2.12 MESSAGE REJECT code 07h

This message is sent from either the initiator or target indicating the last message it received was inappropriate or was not implemented.

In order to indicate its intentions of sending this message, the initiator asserts the ATN signal prior to its release of ACK for the REQ/ACK handshake of the message that is to be rejected. If the target receives this message under any other circumstance, the target rejects this message.

When a target sends this message, it changes to MESSAGE IN phase and sends this message prior to requesting additional message bytes from the initiator. This provides an interlock so that the initiator can determine which message was rejected.

3-2.13 NO OPERATION code 08h

This message is sent from an initiator in response to a target's request for a message when the initiator does not currently have any other valid message to send.

3-2.14 RESTORE POINTERS code 03h

This message is sent from a target to direct the initiator to restore the most recently saved pointers, for the currently attached logical unit, to the active state. Pointers to the command, data, and status locations for the logical unit are restored to the active pointers. Command and status pointers are restored to the beginning of the present command and status areas. The data pointer is restored to the value at the beginning of the data area in the absence of a SAVE DATA POINTER message or to the value at the point at which the last SAVE DATA POINTER message occurred for that logical unit.

**** NOTE ****

If a DISCONNECT message is used to break a long data transfer into two or more shorter transfers, then a SAVE DATA POINTER is issued before each DISCONNECT message.

3-2.15 SAVE DATA POINTER code 02h

This message is sent from a target to direct the initiator to save a copy of the present active data pointer for the currently attached logical unit.

3-3 SCSI BUS STATUS

A status byte, Table 3-3, is sent from the target to the initiator during the STATUS phase at the termination of each command unless the command is cleared by:

An ABORT message,

A BUS DEVICE RESET message,

A “hard” RESET condition, or

An unexpected BUS FREE condition.

Table 3-3. Status Byte

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved		Status Byte Code					Reserved

Table 3-4 describes the status byte codes:

Table 3-4. Status Byte Code Bit Values

STATUS BYTE BITS								STATUS REPRESENTED
7	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
R	R	0	0	0	0	0	R	Good
R	R	0	0	0	0	1	R	Check condition
R	R	0	0	0	1	0	R	Condition met/good *
R	R	0	0	1	0	0	R	Busy
R	R	0	1	0	0	0	R	Intermediate/good
R	R	0	1	0	1	0	R	Intermediate condition met/good *
R	R	0	1	1	0	0	R	Reservation conflict
R	R	1	0	0	0	1	R	Command terminated *
R	R	1	0	1	0	0	R	Queue full *
All Other Codes								Reserved
R- Reserved bit *- Not supported by this controller								

3-3.1 Good Status

This status indicates the target has successfully completed the command.

3-3.2 Check Condition

Any error, exception, or abnormal condition that causes sense data to be set, causes a CHECK CONDITION status. The REQUEST SENSE command is issued following a CHECK CONDITION status, to determine the nature of the condition.

3-3.3 Busy Status

The target is busy. This status is returned whenever a target is unable to accept a command from an otherwise acceptable initiator. The normal initiator recovery action is to issue the command again at a later time.

3-3.4 Intermediate Status

This status is returned for every command in a series of linked commands (except the last command), unless an error, exception, or abnormal condition causes a CHECK CONDITION status or a RESER-

VATION CONFLICT status to be set. If this status is not returned, the chain of linked commands is broken; no further commands in the series are executed.

1. Intermediate/good. The Intermediate/good status is returned if the command completed successfully and is linked. If not linked, Good status is returned.

2. Intermediate/condition met/good. Not used.

3-3.5 Reservation Conflict Status

This status is returned whenever a SCSI device attempts to access a logical unit that is reserved with a conflicting reservation type for another SCSI device (see RESERVE UNIT 16h command). The normal initiator recovery action is to issue the command again at a later time.

CHAPTER 4

TAPE UNIT SCSI COMMANDS

4-1 INTRODUCTION

This chapter describes the commands and messages for the M2488. The following information is located in this chapter:

4-2 LOGICAL UNITS AND SCSI IDS

4-3 M2488 TAPE SCSI COMMANDS

4-4 COMMAND DISCONNECTION

4-5 SCSI RESET

4-2 LOGICAL UNITS AND SCSI IDS

4-2.1 Target ID

The default target ID for the M2488 tape drive is 0h. The target ID can be configured to any value, 0 through 7, not used by another device connected to the SCSI bus. The target ID is configured via the operator panel as described in Chapter 6.

4-2.2 Initiator ID

When installed with a WIDE IPM (Interface Personality Module) having 68 pins, the tape unit will recognize initiators with ID’s 0 through 15.

When installed with a 50 pin NARROW IPM, the tape unit will recognize initiators with ID’s 0 through 7.

4-2.3 Tape LUN 0

The default Logical Unit Number (LUN) assigned to the tape drive is 0.

4-2.4 Media Changer LUN 4

The default Logical Unit Number (LUN) assigned to an attached media changer (MC) is 4. The attached medium changer may be either and ACL or FACL.

4-2.5 LUN

The LUN for the tape drive and attached medium changer may be configured to any value from 0 through 7. The tape drive LUN value must not be the same as the MC LUN value. The LUN value is configured via the operator panel as described in Chapter 6.

SCSI COMMANDS

4-3 M2488 TAPE SCSI COMMANDS

The SCSI commands used with the M2488 are described in Table 4-1. For a more detailed description of each command, refer to the paragraph listed in the PARAGRAPH column. The Command Description Block format is shown in paragraph 4-3.1 on page 4-4.

Table 4-1. M2488 SCSI Commands

OP CODE	COMMAND	DESCRIPTION	PARAGRAPH
00h	TEST UNIT READY	Provides a means to check if the logical unit is ready.	4-3.30 on page 4-138
01h	REWIND	Causes a rewind to BOT.	4-3.26 on page 4-115
03h	REQUEST SENSE	Requests that the target transfer sense data to the initiator.	4-3.23 on page 4-103
05h	READ BLOCK LIMITS	Requests the target's block length limits for the logical unit.	4-3.15 on page 4-68
08h	READ	Transfers zero or more blocks to the initiator beginning with the next block on the logical unit.	4-3.14 on page 4-63
0Ah	WRITE	Transfers zero or more blocks from the initiator to the current position on the logical unit.	4-3.31 on page 4-140
0Fh	READ REVERSE (optional)	Requests that the tape unit transfer zero or more blocks of data to the initiator.	4-3.18 on page 4-80
10h	WRITE FILEMARKS	Requests the write of zero or more filemarks to tape.	4-3.33 on page 4-150
11h	SPACE	Changes the logical unit position relative to the current position.	4-3.29 on page 4-135
12h	INQUIRY	Provides a means for an initiator to request information regarding parameters of the target and any attached peripheral devices.	4-3.6 on page 4-18 & 5-3 on page 5-17
14h	RECOVER BUFFERED DATA (optional)	Requests that the tape unit transfer zero or more blocks of data from the tape unit's buffer to the initiator. The command is used to retrieve data contained in the buffer that had been sent earlier by the initiator to be written to the medium [tape].	4-3.21 on page 4-98
15h	MODE SELECT	Provides a means for the initiator to specify medium, logical unit, and peripheral device parameters to the target by sending data relevant to such parameters in a data phase during the command.	4-3.12 on page 4-51 & 5-2 on page 5-1
16h	RESERVE UNIT	Reserves the specified logical unit for the exclusive use of the requesting initiator.	4-3.25 on page 4-112
17h	RELEASE UNIT	Release previously reserved logical units for the requesting initiator.	4-3.22 on page 4-101
19h	ERASE	Causes part or all of the remaining medium to be erased beginning from the current logical position.	4-3.5 on page 4-15
1Ah	MODE SENSE	Provides a means for the target to report medium, logical unit, and peripheral device parameters to the initiator by sending data relevant to such parameters in a data phase during the command.	4-3.13 on page 4-56 & 5-2 on page 5-1

Table 4-1. M2488 SCSI Commands (Continued)

OP CODE	COMMAND	DESCRIPTION	PARAGRAPH
1Bh	LOAD UNLOAD (optional)	Performs either a rewind operation or a rewind and unload operation.	4-3.7 on page 4-25
1Ch	RECEIVE DIAGNOSTIC RESULTS (optional)	Requests that result data generated for a previous SEND DIAGNOSTIC command be sent to the initiator.	4-3.19 on page 4-83
1Dh	SEND DIAGNOSTIC	Requests the target to perform diagnostic tests on itself, or on the attached peripheral devices.	4-3.27 on page 4-117
2Bh	LOCATE (optional)	Causes the tape unit to position to a specific logical location.	4-3.8 on page 4-28
34h	READ POSITION (optional)	Causes 20 bytes to be sent from the target to the initiator. The 20 bytes are a report of the position of the tape unit and information about blocks stored in the buffer.	4-3.17 on page 4-75
3Bh	WRITE BUFFER (optional)	Used in conjunction with the READ BUFFER command as a diagnostic function for testing target memory and the SCSI bus integrity.	4-3.32 on page 4-144
3Ch	READ BUFFER (optional)	Used in conjunction with the WRITE BUFFER command as a diagnostic function for testing target memory and the SCSI bus integrity.	4-3.16 on page 4-70
40h	CHANGE DEFINITION (optional)	Used to modify the operating definition of the selected target with respect to all initiators. This command is used in conjunction with the Inquiry command to change (and optionally save) parameters that affect the operation of the target.	4-3.2 on page 4-5 & 5-3 on page 5-17
44h	REPORT DENSITY SUPPORT (configuration dependent)	Provides a means for the initiator to retrieve information maintained by the target about the supported densities for the MTU logical unit. Note: Support of this command is configuration dependent. In order for this command to be supported, FT4 (Feature Mode 4), bit 6 (40h) must be set to 1. See the command description for more information.	4-3.24 on page 4-105
4Ch	LOG SELECT (optional)	Provides a means for the initiator to manage statistical information maintained by the target about itself and attached logical units.	4-3.9 on page 4-32
4Dh	LOG SENSE (optional)	Provides a means for the initiator to retrieve statistical information maintained by the target about itself and attached logical units.	4-3.10 on page 4-33
C1h	LOOP WRITE TO READ (vendor unique)	Used to check the controller's data and control path.	4-3.11 on page 4-49
CFh	DISPLAY (vendor unique)	Used to display a message on the operator panel of the tape drive or cartridge loader (if installed.)	4-3.3 on page 4-8 or 4-3.4 on page 4-12

4-3.1 Command Description Block Format

A command is executed by sending a Command Descriptor Block (CDB) to a target. See the example for a six-byte command below. The CDB may be 6, 10 or 12-bytes in length depending on the type of command. Some commands have additional fields which are described in the individual command. Use the description in Table 4-2 to interpret the common fields of the commands that follow.

<table>
<tr><th></th><th colspan="8">BITS</th></tr>
<tr><th>BYTES</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td colspan="3">Group Code</td><td colspan="5">Command Code</td></tr>
<tr><td>1</td><td colspan="3">LUN</td><td colspan="5">Reserved</td></tr>
<tr><td>2</td><td colspan="8" rowspan="3">Reserved</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td colspan="6">Reserved</td><td>Flag</td><td>Link</td></tr>
</table>

Note: Changeable fields in the CDB are shaded.

Table 4-2. CDB Field Description

FIELD	DESCRIPTION
Operation Code (Op Code)	All commands have one Op Code in byte 0. This is the operation to be performed. Consists of a command code and a group code.
Command Code	Identifies the command to be executed.
Group Code	Specifies a CDB format, length in bytes, and classifies the type of operation. For CDBs using reserved group codes 3 and 4, the controller will accept only one byte of CDB, then go to the Bus Free phase. The host system should not send more than one byte of CDB in this case.
LUN (Logical Unit Number)	The LUN is defined in the IDENTIFY message. The target ignores the logical unit number specified within the CDB. The LUN in the CDB should be zero. The LUN field is included in the CDB for compatibility with some SCSI-1 devices. This field may be reclaimed in SCSI-3. New implementations should use the outbound IDENTIFY message, which is mandatory in SCSI-2, to establish the I_T_L nexus.
Reserved	Set aside fields for future use. Default value is 0 for all bits.
Control	Last byte of all commands. Used for linked commands. Consists of a link bit, a flag bit, and reserved bits.
Link Bit	Used to continue I/O processes across multiple commands. Creates an automatic link to the next command upon successful completion of the current command. If Link=0, then no link to next command. If Link=1, then an automatic link to the next command occurs.
Flag Bit	Interrupts the initiator between linked commands. Used with the link bit to specify which message is returned to the initiator when the command completes without error; if Flag=0, LINKED COMMAND COMPLETE message; if Flag=1, LINKED COMMAND COMPLETE (with Flag) message.

4-3.2 CHANGE DEFINITION command 40h

The CHANGE DEFINITION command is used to modify the operating definition of the selected target with respect to all initiators. This command is executed even if the Magnetic Tape Unit (MTU) is NOT READY. It is not executed if the selected LUN is nonexistent. This command is used in conjunction with the INQUIRY command to change (and optionally save) parameters that affect the operation of the target.

4-3.2.1 CHANGE DEFINITION CDB Description

CHANGE DEFINITION is a ten-byte command. The bytes are shown below and described in Table 4-3. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	0	0	0	0	0	0
1	LUN			Reserved				
2	Reserved							Save
3	0	Definition Parameters						
4	Reserved							
5								
6								
7								
8	Parameter Data Length							
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-3. CHANGE DEFINITION Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	40h	Operation code.
2	0	0 1	A Save control bit of zero indicates that the target shall not save the operating definition. A Save bit of one indicates that the target shall save the operating definition to non-volatile memory. This target will not apply the new parameters until a power cycle is performed, so sending a Save bit of zero is a means of performing a parameter validity check.
3	0-6		See Table 4-4 for a description of the Definition Parameter field.

CHANGE DEFINITION

Table 4-3. CHANGE DEFINITION Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
8	0-7		The Parameter Data Length specifies the length in bytes of the parameter data that shall be transferred from the initiator to the target.
		0	A parameter data length of zero indicates that no data shall be transferred. This condition shall not be considered an error.
		>0	Parameter data lengths greater than zero indicate the number of bytes of parameter data that shall be transferred. The data that may be transferred is defined in section 5-3 for the MTU device and section 6-4 for the Media Changer device and consists of Vital Product Data Pages that may be read via the Inquiry command.

Table 4-4. Definition Parameter Description

VALUE	MEANING OF DEFINITION PARAMETER
00h	Use current operating definition.
03h	SCSI-2 operating definition.
40h	Change user product data.
41h	Change factory product data.

Definition parameter values of 00h and 03h have no effect on the target since this is the normal operating definition for this product. These values are accepted to maintain ANSI compliance.

Definition parameter 40h selects INQUIRY Vital Product Data (VPD) Page code C2h and is used to change the Product Identification data that is reported in standard INQUIRY bytes 8 through 31. This data includes Vendor ID, Controller Product ID and Logical Unit Product ID. This value will be accepted at any time. Using this parameter has little effect on target operation in that it only changes constant data returned by the INQUIRY command.

Definition parameter 41h is intended for factory use and will be accepted only if the target is in factory mode. Change Definition data sent in this mode includes INQUIRY VPD pages 80h, C0h, C1h and C2h. This data contains such information as Unit Serial Number, Unit Usage Data, Unit Configuration and Product Identification Data. Using this parameter may cause the target to appear not operational and have serious side effects.

4-3.2.2 CHANGE DEFINITION Changes

It is suggested that the required page is first obtained from the target via the Inquiry command, data is then changed to the desired value and the data returned to the target via Change Definition in the same format as it was received.

Single or multiple pages may be sent with a single Change Definition data transfer. The target will not accept partial pages or pages not defined as changeable. The pages may be sent in any order but must be of correct format and length.

The requested changes to the VPD pages will take effect as follows:

a. Changes to VPD page 80h Unit Serial Number Page and C2h Product Identification Page take effect following a hard reset condition, i.e.; power-on, Bus Device, or SCSI bus reset.

b. Changes to VPD page C0h Unit Usage Page take effect upon the successful completion of the CHANGE DEFINITION command.

c. Changes to VPD page C1h Configuration Page take effect following a power-on reset condition.

4-3.2.3 CHANGE DEFINITION CHECK CONDITION Status

If a CHECK CONDITION is returned as a result of the Change Definition CDB, the change is not performed.

4-3.2.4 CHANGE DEFINITION Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed while writing buffered data before the CHANGE DEFINITION was received.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware failure. 2. SCSI interface error occurred due to hardware failure (i.e. unable to transfer parameters) 3. Writing of the Change Definition data to the non-volatile RAM failed due to a hardware error.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the CHANGE DEFINITION command. 2. Flag bit was set and Link bit was not set. 3. Definition parameter 41h is sent to target without the factory mode set. 4. Parameter data contains a partial page 5. Parameter data contains an unchangeable page 6. Parameter data contains invalid (non-ASCII) data.
6h	UNIT ATTENTION	Indicates the CHANGE DEFINITION command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.

CHANGE DEFINITION

DISPLAY

4-3.3 DISPLAY command CFh (11h)

For display data length of 11h (default value), refer toFT4, bit 7 described in the M2488 User's Guide.

The DISPLAY command is used to display a message on the operator panel of the tape drive or cartridge loader (if installed). This command is executed even if the Magnetic Tape Unit (MTU) is NOT READY. The Display Data is described in paragraph 4-3.3.2.

4-3.3.1 DISPLAY CDB Description (11h)

DISPLAY is a ten-byte command. The bytes are shown below and described in Table 4-5. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	1	0	0	1	1	1	1
1	LUN			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Parameter List Length = 11h							
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-5. DISPLAY Field Description (11h)

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	CFh	Operation Code.
8	0-7	11h	The Parameter List Length specifies the length of control and display information to be transferred from the initiator.

The parameter list length specifies the length of control and display information to be transferred from the initiator. A CHECK CONDITION is returned if the specified length is not 0 or 17 bytes (11h).

4-3.3.2 Display Data (11h)

The 17 bytes of DISPLAY data consists of a format control byte followed by two eight-byte messages. See Table 4-6, Table 4-7 and Table 4-8 on page 4-10. If the Parameter List Length is set to 0 no action is performed and it is not considered an error.

Table 4-6. DISPLAY Parameter (11h)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Display Mode Selection			Display Length	Flash	Half Msg	0	Data Format
1-8	First Half Message							
9-16	Second Half Message							

Note: All bytes should not be set to spaces, because this would appear as a MTU powered down state.

DISPLAY

Table 4-7. Display Parameter Field Description (11h)

BYTE	BIT	VALUE	DESCRIPTION
0	0	 1 0	The Data Format bit describes the type of data contained in bytes 1 through 16. If this bit is set to 1, the data in bytes 1 through 16 is considered to be ASCII format. If bit is 0, the data is EBCDIC format.
0	2	 0 1	The Half Msg bit selects which half of the message is to be displayed. This bit is valid only when the Display length bit is set to zero. When the Half Msg bit is set to zero, the first half of the message (bytes 1 to 8) is displayed. When the Half Msg bit is set to one, the second half of the message (bytes 9 to 16) is displayed.
0	3	0 1	When the Flash bit is set to zero, the display does not flash. A Flash bit set to one causes the display to flash.
0	4	0 1	When the Display Length bit is set to zero, only 8 bytes are displayed. Whether bytes 1 to 8 or bytes 9 to 16 are displayed is selected by bit 2. If bit 2 is set to 0b then bytes 1 through 8 are displayed. If bit 2 is set to 1b bytes 9 to 16 are displayed. When the display length bit is set to one, bytes 1 to 8 and bytes 9 to 16 are displayed alternately. Bits 2-3 are ignored for this selection.
0	5-7		Table 4-9 defines the Display Mode Selection bits.
1-16			The message bytes contain the data to be displayed.

Table 4-8. Display Data

CHARACTER	ASCII	EBCDIC *	CHARACTER	ASCII	EBCDIC *
(space)	20h	00h	**-**	2Dh	20h
A	41h	01h	**/**	2Fh	21h
B	42h	02h	**S**	53h	22h
C	43h	03h	**T**	54h	23h
D	44h	04h	**U**	55h	24h
E	45h	05h	**V**	56h	25h
F	46h	06h	**W**	57h	26h
G	47h	07h	**X**	58h	27h
H	48h	08h	**Y**	59h	28h
I	49h	09h	**Z**	5Ah	29h
‘	60h	0Ah	**(space)**	20h	2Ah
.	25h	0Bh	,	2Ch	2Bh
<	3Ch	0Ch	%	25h	2Ch
(	28h	0Dh	_	5Fh	2Dh
+	2Bh	0Eh	>	3Eh	2Eh
|	7Ch	0Fh	?	3Fh	2Fh
&	26h	10h	**0**	30h	30h
J	4Ah	11h	**1**	31h	31h
K	4Bh	12h	**2**	32h	32h
L	4Ch	13h	**3**	33h	33h
M	4Dh	14h	**4**	34h	34h
N	4Eh	15h	**5**	35h	35h
O	4Fh	16h	**6**	36h	36h
P	50h	17h	**7**	37h	37h
Q	51h	18h	**8**	38h	38h
R	52h	19h	**9**	39h	39h
!	21h	1Ah	:	3Ah	3Ah
$	24h	1Bh	#	23h	3Bh
*	2Ah	1Ch	@	40h	3Ch
)	29h	1Dh	’	27h	3Dh
;	3Bh	1Eh	=	3Dh	3Eh
^	5Eh	1Fh	”	22h	3Fh

* The two most significant bits’ values are don’t care.

Table 4-9. Display Mode Selection Bits (11h)

QUALIFIER	DESCRIPTION
000b	Bytes 1 to 8 or bytes 9 to 16 are displayed based on the instructions in bits 2-4 of control byte. The message is displayed until the next tape operation starts or until a new DISPLAY command is received.
001b	If the DISPLAY command is received when there is a cartridge in the MTU, Bytes 1 to 8 or bytes 9 to 16 are displayed based on the instructions in bits 2-4 of the control byte. The message is displayed until the cartridge is removed from the MTU or a new DISPLAY command is received. No message is displayed if there is no cartridge in the MTU.
010b	If the DISPLAY command is received when the MTU is in a ready state, nothing happens. If the DISPLAY command is received when the MTU is not in the ready state, Bytes 1 to 8 or bytes 9 to 16 are displayed based on the instructions in bits 2-4 of the control byte. The attention lamp blinks. The message is displayed until the MTU becomes ready.
011b	Display left unchanged.
100b	The host message being displayed is cancelled and a unit message is displayed instead.
101b	Display left unchanged.
110b	Display left unchanged.
111b	If the DISPLAY command is received when there is a cartridge in the MTU, Bytes 1 to 8 or bytes 9 to 16 are displayed based on the instructions in bits 2-4 of the control byte. The message is displayed until the cartridge is removed. After the cartridge is removed and until the next cartridge is loaded and becomes ready, only bytes 9 to 16 are displayed. The display flashes. The attention lamp blinks.

4-3.3.3 DISPLAY Sense Keys (11h)

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed while writing buffered data before the DISPLAY was received.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware failure. 2. SCSI interface error occurred due to hardware failure (i.e. unable to transfer display parameters) 3. The display panel is currently in use displaying check information for the operator.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the DISPLAY command. 2. Flag bit was set and Link bit was not set. 3. The parameter list length is neither 0 nor 17.
6h	UNIT ATTENTION	Indicates the DISPLAY command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.

DISPLAY

4-3.4 DISPLAY command CFh (10h)

For display data length of 10h, refer toFT4, bit 7 described in the M2488 User's Guide.

The DISPLAY command is used to display a message on the operator panel of the tape drive or cartridge loader (if installed). This command is executed even if the Magnetic Tape Unit (MTU) is NOT READY. The Display Data is described in paragraph 4-3.4.2.

4-3.4.1 DISPLAY CDB Description (10h)

DISPLAY is a ten-byte command. The bytes are shown below and described in Table 4-10. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	1	0	0	1	1	1	1
1	LUN			Reserved				
2	Reserved							
3	Display Mode Selection			Display Length	Flash	Half Msg	Reserved	Data Format
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Parameter List Length = 10h							
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-10. DISPLAY Field Description (10h)

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	CFh	Operation Code.
3	0-7		This byte is the display format control byte. The fields in this control byte are described in Table 4-11.
8	0-7	10h	The Parameter List Length specifies the length of c display information to be transferred from the initiator.

The parameter list length specifies the length of display information to be transferred from the initiator. A CHECK CONDITION is returned if the specified length is not 0 or 16 bytes (10h).

Table 4-11. Display Format Control Byte Description (10h)

BYTE	BIT	VALUE	DESCRIPTION
3	0	 0 1	The Data Format bit describes the type of data contained in bytes 0 through 15. If this bit is 0, the data in bytes 0 through 15 is in EBCDIC format. If this bit is 1, the data in bytes 0 through 15 is in ASCII format.
3	1		Reserved.
3	2	 0 1	The Half Msg bit selects which half of the message is to be displayed. This bit is valid only when the Display length bit is set to zero. When the Half Msg bit is set to zero, the first half of the message (bytes 0 to 7) is displayed. When the Half Msg bit is set to one, the second half of the message (bytes 8 to 15) is displayed.
3	3	0 1	When the Flash bit is set to zero, the display does not flash. A Flash bit set to one causes the display to flash.
3	4	0 1	When the Display Length bit is set to zero, only 8 bytes are displayed. Whether bytes 0 to 7 or bytes 8 to 15 are displayed is selected by bit 2. If bit 2 is set to 0b then bytes 0 through 7 are displayed. If bit 2 is set to 1b bytes 8 to 15 are displayed. When the display length bit is set to one, bytes 0 to 7 and bytes 8 to 15 are displayed alternately. Bits 2-3 are ignored for this selection.
3	5-7		Table 4-13 defines the Display Mode Selection bits.

DISPLAY

4-3.4.2 Display Data (10h)

The 16 bytes of DISPLAY data consists of two eight-byte messages. See Table 4-12, Table 4-13 and Table 4-8 on page 4-10. If the Parameter List Length is set to 0, no action is performed and it is not considered an error.

Table 4-12. DISPLAY Parameter (10h)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0-7	First Half Message							
8-15	Second Half Message							

Note: All bytes should not be set to spaces, because this would appear as a MTU powered down state.

Table 4-13. Display Mode Selection Bits (10h)

QUALIFIER	DESCRIPTION
000b	Bytes 0 to 7 or bytes 8 to 15 are displayed based on the instructions in bits 2-4 of the format control byte. The message is displayed until the next tape operation starts or until a new DISPLAY command is received.
001b	If the DISPLAY command is received when there is a cartridge in the MTU, Bytes 0 to 7 or bytes 8 to 15 are displayed based on the instructions in bits 2-4 of the control byte. The message is displayed until the cartridge is removed from the MTU or a new DISPLAY command is received. No message is displayed if there is no cartridge in the MTU.
010b	If the DISPLAY command is received when the MTU is in a ready state, nothing happens. If the DISPLAY command is received when the MTU is not in the ready state, Bytes 0 to 7 or bytes 8 to 15 are displayed based on the instructions in bits 2-4 of the control byte. The attention lamp blinks. The message is displayed until the MTU becomes ready.
011b	Display left unchanged.
100b	The host message being displayed is cancelled and a unit message is displayed instead.
101b	Display left unchanged.
110b	Display left unchanged.
111b	If the DISPLAY command is received when there is a cartridge in the MTU, Bytes 0 to 7 or bytes 8 to 15 are displayed based on the instructions in bits 2-4 of the control byte. The message is displayed until the cartridge is removed. After the cartridge is removed and until the next cartridge is loaded and becomes ready, only bytes 8 to 15 are displayed. The display flashes. The attention lamp blinks.

4-3.4.3 DISPLAY Sense Keys (10h)

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed while writing buffered data before the DISPLAY was received.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware failure. 2. SCSI interface error occurred due to hardware failure (i.e. unable to transfer display parameters) 3. The display panel is currently in use displaying check information for the operator.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the DISPLAY command. 2. Flag bit was set and Link bit was not set. 3. The parameter list length is neither 0 nor 16.
6h	UNIT ATTENTION	Indicates the DISPLAY command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.

4-3.5 ERASE command 19h

The ERASE command causes part or all of the remaining medium to be erased beginning from the current logical position.

After the receipt of a valid ERASE command, tape synchronization is performed prior to execution of the ERASE operation. If tape is positioned at BOT, the ERASE command will cause an ID area to be written before the Erase operation.

4-3.5.1 ERASE CDB Description

ERASE is a six-byte command as shown below and described in Table 4-14. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	0	1
1	LUN			Reserved			Immed	Long
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-14. ERASE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	19h	Operation code.
1	0	0 1	If Long bit=0, Erase gap. If Long bit=1, Data security erase.
1	0-1		The Immediate (Immed) bit controls the time at which status is to be returned. Actions taken by the target depend on the settings of the Immed and Long bits as described in the next table.

IMMED BIT	LONG BIT	ACTION TAKEN
0	Don't care	Status is returned after the Erase operation is complete.
1	0	Status is returned after the CDB is validated. *
1	1	Status is returned after all previously buffered commands are completed and the CDB is validated. *
* If a CHECK CONDITION status is returned for this case, the ERASE operation is not performed.		

ERASE

ERASE

A Long bit set to zero causes a 7.8 +/- 0.4 mm of the medium to be recorded with an erase tone (special pattern along with a 2-mm IBG). This is known as the Erase Gap based on the Gap Size field in the Device Configuration Mode Page. An End-of-Data (EOD) mark is written after this type of erase operation. If the early warning condition is encountered while erasing with the long bit set to zero a CHECK CONDITION status is sent by the target after completion of the erase operation. The valid and EOM bits in the sense data are set to one. The information field will not report any buffered erases.

A Long bit set to 1 indicates erasure of all remaining media on the logical unit (Data Security Erase) by writing the tape with a random frequency two times that used for regular writes. Before the Data Security Erase is performed, an Erase Gap is written. Following such a command, the tape position is at end-of-partition (EOP).

**** NOTE ****

There is no limit to the number of sequential erase patterns that can be written. However, if more than 680 mm of tape (68 +/- 2 erase patterns +2.0 mm IBG) is read by the controller, a BLANK CHECK is signaled.

4-3.5.2 ERASE Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	1. Recovery was performed when writing buffered data before the erase occurred. 2. Retries were needed to complete the ERASE.
2h	NOT READY	Logical unit was not ready (tape was not loaded or was not ready).
3h	MEDIUM ERROR	1. Write of buffered data failed due to defective tape. 2. End-of-Medium was encountered when performing an Erase Gap operation (Long bit =0). 3. An attempt was made to write 36-track data on 18-track formatted medium. 4. The tape length in the cartridge is too long or too short.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware error. 2. ERASE command failed due to unrecoverable errors on the SCSI interface.
5h	ILLEGAL REQUEST	Reserved bit was set in the CDB of the ERASE command.
6h	UNIT ATTENTION	Indicates the ERASE command was not performed due to one of the following: 1. The tape cartridge was changed. 2. The target was reset. 3. The Mode parameters were changed by another initiator. 4. The version of the microcode was changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.

SENSE KEY	CONDITION	DESCRIPTION
7h	DATA PROTECT	Attempted write-type operation to write-protected tape cartridge.
Bh	ABORTED COMMAND	The ERASE command was aborted.

4-3.6 INQUIRY command 12h

The INQUIRY command provides a means for an initiator to request information regarding parameters of the target and any attached peripheral devices.

4-3.6.1 INQUIRY CDB Description

The INQUIRY CDB is a six-byte command. The bytes are shown below and described in Table 4-15. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	0	1	0
1	LUN			Reserved				EVPD
2	Page Code							
3	Reserved							
4	Allocation Length							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-15. INQUIRY Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	12h	Operation code.
1	0	1 0	An Enable Vital Product Data (EVPD) bit of one specifies that the target returns the optional Vital Product Data (VPD) specified by the Page Code field. See section 5-3 for the description of the MTU VPD pages or section 6-4 for the description of the MC VPD pages supported by the INQUIRY command.The EVPD bit and its relationship to the Page Code field is shown in Table 4-16. An EVPD bit of 0 indicates transfer of normal INQUIRY data.
2	0-7		The Page Code codes are described in Table 4-17.
4	0-7		The Allocation Length field specifies the maximum number of bytes that the initiator has allocated for returned INQUIRY data. An allocation length of zero indicates no INQUIRY data is to be transferred. This condition is not considered as an error. The target terminates the DATA IN phase when allocation length bytes are transferred or when all available INQUIRY data is transferred to the initiator, whichever is less. The user should specify an allocation length of at least 68h (104) when normal Inquiry data (EVPD=0) is requested.

Table 4-16. EVPD Bit

EVPD BIT	PAGE CODE BYTE	ACTION
0	00h	When the EVPD bit is zero, the Page Code field must be zero. This returns normal INQUIRY data. See Table 4-18 for data returned.
0	¼¼not = 00h	If the EVPD bit is zero and the Page Code field is not zero, then the target terminates the command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST, and the ASC/ASCQ is set to INVALID FIELD IN CDB
1	xxh	Specifies that the target return the optional Vital Product Data (VPD) specified by the Page Code field. See Table 4-17.

Table 4-17. Supported VPD Page Codes

VPD PAGE CODE	DESCRIPTION
00h	List of the vital product data pages supported by this target.
80h	Unit serial number page.
81h	Implemented operating definition page.
82h	ASCII implemented operating definition page.
C0h	Unit usage page. Note: This is a vendor unique page containing the tape motion timer and power-on time.
C1h	Configuration page.
C2h	Product identification page.

4-3.6.2 INQUIRY CHECK CONDITION Status

If an INQUIRY command is received from an initiator with a pending unit attention condition (i.e., before the target reports CHECK CONDITION status), the target performs the INQUIRY command and does not clear the unit attention condition. If an INQUIRY command is received after CHECK CONDITION status has been presented for the unit attention condition, then the unit attention condition is cleared and the INQUIRY command is performed.

CHECK CONDITION status is only generated for the INQUIRY command when the target cannot return the requested INQUIRY data due to a hardware error or invalid INQUIRY CDB contents.

Inquiry data is returned to the initiator regardless of the state of the selected LUN (e.g. NOT READY, Non-Existent).

If the initiator requests a VPD page that is not supported, a CHECK CONDITION status with a sense key of ILLEGAL REQUEST and an additional sense code of ILLEGAL FIELD in CDB is returned.

4-3.6.3 Inquiry Data

See section 5-3 for a description of INQUIRY return data when the EVPD bit is 1. The following Inquiry Data is returned when the EVPD bit = 0:

Table 4-18. INQUIRY Data Format

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type				
1	RMB=1	Device-Type Modifier = 00h						
2	ISO Version=0		ECMA Version=0			ANSI Version=2h		
3	AENC= 0	TrmIOP= 0	0	0	Response Data Format=2h			
4	Additional Length = 63h							
5	Reserved							
6	Reserved							
7	RelAdr = 0	WBus 32=0	WBus 16	Sync=1	Linked=1	Reserved	CmdQ=0	SftRe=0
VENDOR IDENTIFICATION INFORMATION								
8-15	Vendor Identification = “FUJITSU”							
PRODUCT IDENTIFICATION INFORMATION								
16-23	Controller Product ID							
24-31	Logical Unit Product ID							
PRODUCT REVISION LEVEL INFORMATION								
32-35	Controller Microcode Version and Revision Levels							
VENDOR SPECIFIC PARAMETERS (BYTES 36-55)								
36	Reserved (vendor unique)							MC
CONTROLLER MICROCODE BUILD DATE								
37-38	Month (MM)							
39-40	Day (DD)							
41	Last Digit OF Year (Y)							
MTU (SERVO) MICROCODE LEVEL INFORMATION								
42-43	MTU Engineering Control (EC) Level							
44-45	MTU Microcode Version Number							
MTU (SERVO) MICROCODE CHECKSUM INFORMATION								
46-53	MTU (servo) Microcode Checksum							
VENDOR UNIQUE RESERVED BYTES								
54-55	Reserved (vendor unique)							
ANSI RESERVED BYTES								
56-95	Reserved							
VENDOR SPECIFIC PARAMETERS (BYTES 96-103)								
CONTROLLER MICROCODE CHECKSUM INFORMATION								
96-103	Controller Microcode Checksum							

Table 4-19. INQUIRY Data Format Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-4 & 5-7		The Peripheral Device Type and Peripheral Qualifier fields identify the physical device currently connected to the logical unit. The Peripheral Qualifier is described in Table 4-20 and the Peripheral Device Type is described in Table 4-21. Table 4-22 shows the possible combinations of peripheral qualifiers and device types generated based on which LUN the INQUIRY command is sent to. In the case where INQUIRY data byte 0 is 7Fh (i.e. an unknown or no device type is connected to this LUN) the logical unit product ID (bytes 24-31) will contain ASCII spaces (20h).
1	0-6	00h	The Device-type Modifier field is not supported and is returned as all zeroes.
1	7	1	The RMB (Removable Medium) bit is set to one indicating that the medium is removable.
2	0-2	2h	The ANSI-approved version field of 2h indicates this device complies to the ANSI SCSI-2 standard (X3.131-1994, version 10L).
2	3-5 & 6-7	0	Zero codes in the ISO version and ECMA version fields indicate no compliance is claimed with the ISO version of SCSI (ISO 9316) or the ECMA version of SCSI (ECMA-111).
3	0-3	2h	A Response Data Format is set to a value of 2 indicating that this INQUIRY data is formatted based on the format specified by the ANSI SCSI-2 standard (X3.131-1994, version 10L).
3	6	0	The Terminate I/O Process (TrmIOP) bit is set to zero, indicating the device does not support the Terminate I/O Process message.
3	7	0	The Asynchronous Event Notification Capability (AENC) bit is set to zero, indicating the device does not support SCSI-2 defined asynchronous event notifications.
4	0-7	63h	The Additional Length field indicates 99 additional bytes of parameters are supplied. If the allocation length in the INQUIRY CDB is too small to transfer all of these parameters, the additional length is not adjusted to reflect the truncation by the initiator.
7	0	0	The Soft Reset (SFTRE) bit is set to zero indicating the target does not support the Soft Reset option.
7	1	0	The Command Queuing (CmdQ) bit is set to zero indicating the target does not support command queuing for this logical unit.
7	3	1	The Linked command (Link) bit is set to one indicating the target supports linked commands for this logical unit.
7	4	1	The Synchronous Transfer (Sync) bit is set to one indicating the target supports synchronous data transfer.

Table 4-19. INQUIRY Data Format Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
7	5	1 0	A Wide bus 16 (WBus16) bit set to one indicates the target supports 16-bit wide data transfers. A value of zero indicates that the device does not support 16-bit wide data transfers. The value this bit depends on the type of SCSI Interface Personality Module (IPM) installed in the target (i.e. 50 pin or 68 pin SCSI connector type). NOTE: In order for 16-bit wide data transfers to occur, the 68 pin IPM must be installed in the target (i.e. WBus16 bit in INQUIRY data is reported as set to one) and Wide Data Transfer negotiation (via the Wide Data Transfer Request message) is required.
7	6	0	The Wide bus 32 (WBus32) bit is set to zero indicating the target does not support 32-bit wide data transfers.
7	7	0	The Relative Addressing (RelAdr) bit is set to zero indicating the target does not support relative addressing for this logical unit.
8-31			The Vendor and Product Identification fields contain ASCII data retrieved from NVRAM during power-up/reset. The first time the controller is powered-up, the corresponding NVRAM fields are initialized to the default values. The default values for these fields are shown in Table 4-23 (note: all ASCII data shown is left aligned within each field). When being read from NVRAM, if these fields are not available due to an NVRAM error, then ASCII spaces will be returned in the corresponding Inquiry data field. The values in these fields in NVRAM can be changed via the CHANGE DEFINITION command. It is possible to assign unique values in these fields for both the MTU and MC INQUIRY data. Reference the CHANGE DEFINITION command for more information on changing these fields.
32-35			The Controller Microcode Version and Revision Level information contains vendor unique ASCII data.
36	0	1 0	A MC (Medium Changer) bit set to one indicates that a Medium Changer is installed. A MC bit set to zero indicates that a Medium Changer is not installed. If a Medium Changer is installed, then the MC bit will be set in INQUIRY data generated for any logical unit whether or not the logical unit is attached. If the MC bit indicates that a Medium Changer is installed, then INQUIRY Vital Product Data page C1h (Configuration page), byte 15 (mc_l_addr) indicates the logical unit address of the installed Medium Changer.
37-41			The Microcode Build Date information fields contain the following ASCII data: The month, day and year when the controller microcode was generated.
42-45			The MTU (servo) Microcode Level information fields contain the following ASCII data: (a) MTU Engineering Control (EC) level. (b) MTU Microcode Version.
46-53			The MTU (servo) Microcode Checksum information field contains the checksum of the MTU microcode (i.e. not including the controller microcode) in ASCII data.
96-103			The Controller Microcode Checksum information field contains the checksum of the controller microcode (i.e. not including the MTU microcode) in ASCII data.

Table 4-20. Peripheral Qualifiers

QUALIFIER	DESCRIPTION
0 0 0 b	The peripheral device type in bits 0 through 4 is currently connected to this logical unit. Note: This peripheral qualifier does not imply that the device is ready for access by the initiator.
0 0 1 b	The target is capable of supporting the specified peripheral device type. However, the physical device is not currently connected to this logical unit.
0 1 0 b	Reserved
0 1 1 b	The logical unit is not capable of supporting a physical device. Note: For this peripheral qualifier, the peripheral device type is set to 1Fh, indicating unknown or no device type.
1 X X b	NOT USED

Table 4-21. Peripheral Device Type

CODE	DESCRIPTION
01h	Sequential-access tape device. Note: When the INQUIRY command is issued for the MTU LUN, the peripheral device type is set to 01h. This indicates a tape device.
08h	Medium changer device type.
1Fh	Unknown or no device type. Note: This code is generated when the INQUIRY command is issued for a LUN which is neither the MTU or Medium Changer.

Table 4-22. Possible Peripheral Qualifier and Device Types Generated

LUN	PERIPHERAL QUALIFIER	PERIPHERAL DEVICE TYPE	DESCRIPTION
MTU	000b	01h	A sequential access device is currently connected to this logical unit.
MC	000b	08h	A medium changer device is currently connected to this logical unit.
Unknown or not connected	011b	1Fh	An unknown or no device type is currently connected to this logical unit.

INQUIRY

Table 4-23. Default Vendor and Product Identification Fields

LUN	VENDOR ID	CONTROLLER PRODUCT ID	LUN PRODUCT ID
MTU	“FUJITSU”	“M2488” (single-ended SCSI interface)	“M2488”
		“M2488D” (differential SCSI interface)	
MC	“FUJITSU”	“M2488” (single-ended SCSI interface)	“M2488A11” (ACL Medium Changer)
			“M2488A12” (FACL Medium Changer)
		“M2488D” (differential SCSI interface)	“M2488A11” (ACL Medium Changer)
			“M2488A12” (FACL Medium Changer)
Unknown or not connected	“FUJITSU”	“M2488” (single-ended SCSI interface)	“ ”(i.e. all ASCII spaces)
		“M2488D” (differential SCSI interface)	

4-3.6.4 INQUIRY Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
4h	HARDWARE ERROR	1. SCSI interface error occurred due to hardware failure (e.g. transfer of INQUIRY data failed due to hardware failure). 2. Inquiry data could not be read from NVRAM due to a hardware error.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the INQUIRY command. 2. The EVPD bit in the INQUIRY CDB is zero, but the Page Code field is not zero. 3. An unsupported VPD page was requested in the INQUIRY CDB. 4. A VPD page was requested from a LUN device type that is unknown or not connected. 5. Flag bit in the INQUIRY CDB was set and Link bit was not set.

4-3.7 LOAD UNLOAD command 1Bh

The LOAD UNLOAD command performs either a rewind operation or a rewind and unload operation. Prior to performing either of these operations, any buffered write data and buffered filemarks are written to the tape. Also, prior to unloading a cartridge the Statistical Log Sense data is cleared.

4-3.7.1 LOAD UNLOAD CDB Description

LOAD UNLOAD is a six-byte command. The bytes are shown below and described in Table 4-24. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	1	1
1	LUN			Reserved				Immed
2	Reserved							
3	Reserved							
4	Reserved					Reserved *	Reten	Load
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

* This bit has an ANSI definition other than reserved; however the ANSI definition of the bit is not applicable for this product. The bit is indicated as reserved since it should always be set to 0 for this product.

Table 4-24. LOAD UNLOAD Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	1Bh	Operation code.
1	0	0	If Immed (Immediate) bit is 0, status is not returned for the LOAD UNLOAD command until the load or unload operation has completed or has failed.
		1	If Immed is 1, Status is returned for the LOAD UNLOAD command as soon as the CDB has been validated and any buffered write data and filemarks have been written to tape. The load or unload operation has been started but not necessarily completed when status is returned.
4	0	0	If Load is 0, rewind tape and unload tape cartridge.
		1	If Load is 1, rewind tape.
4	1	0 or 1	The Reten (retension) bit can be set to 0 or 1. The tape unit performs no extra actions whether or not the bit is set.

Medium Changer:

If a Medium Changer is attached, then an automatic load of the next tape cartridge may occur following the Tape Unit unload operation (Load bit = 0). The decision to perform this automatic load is based upon:

(a) the Medium Changer's mode setting (Manual, Automatic or System),

(b) the presence of other tape cartridges and

(c) the mode page settings of the Medium Changer.

See the description of the Medium Changer for more details. If an automatic load occurs, the LOAD UNLOAD command will not return status until the automatic load completes.

4-3.7.2 LOAD UNLOAD CHECK CONDITION Status

If the status reported for the previous command was a CHECK CONDITION because data could no longer be written to the tape, then any buffered data is discarded before any load or unload operation occurs.

If a Medium Changer is attached but the changer is in System Mode[1], then no load or unload operation is performed and CHECK CONDITION status is reported. The sense key reported is ILLEGAL REQUEST.

If CHECK CONDITION status is reported for a LOAD UNLOAD command with the Immediate bit set to 1 then the load or unload operation is not performed.

1. The mode of the Medium Changer can be set either by using the Medium Changer's operator panel or by using the Medium Changer's MODE SELECT command.

4-3.7.3 LOAD UNLOAD Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data before the load or unload operation occurred.
2h	NOT READY	Logical Unit was not ready. (Tape cartridge was not loaded or logical unit was not made ready)
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware failure. 2. The load or unload operation was not completed because of a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the LOAD UNLOAD command. 2. Medium Changer is attached but it was in System Mode when the LOAD UNLOAD command was issued.
6h	UNIT ATTENTION	Indicates the LOAD UNLOAD command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	LOAD UNLOAD command was aborted. The LOAD UNLOAD command can be reissued.

4-3.8 LOCATE command 2Bh

The LOCATE command causes the tape unit to position to a specific logical location. The Block address field specifies the target location; the logical unit positions in front of the block associated with the Block address (i.e. on the BOT side of the block.) Any buffered write data and filemarks are written to the tape before the locate operation occurs.

4-3.8.1 LOCATE CDB Description

LOCATE is a ten-byte command. The bytes are shown below and described in Table 4-25. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	0	1	0	1	1
1	LUN			Reserved		BT	CP	Immed
2	Reserved							
3	MSB							
4	Block Address							
5								
6								LSB
7	Reserved							
8	Partition							
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-25. LOCATE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	2Bh	Operation code.
1	0	0	If Immed (Immediate) =0, status is not returned for the LOCATE command until the locate operation has completed or has failed
		1	If Immed bit = 1, status is returned for the LOCATE command as soon as the CDB has been validated and any buffered write data and filemarks have been written to tape. The locate operation has been started but not necessarily completed when status is returned.
1	1	0	If CP bit =0, the Change Partition field is ignored. (The tape format only supports one partition, partition 0, so this field should only be set to 0 when the CP bit is set to 1.)
		1	If CP bit =1, the Change Partition field specifies the target partition.

Table 4-25. LOCATE Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
1	2	0	The Block Address Type (BT) is interpreted as a logical block address. The first filemark or data block on tape is assigned logical block address 0; logical block addresses increase by 1 for each data block and filemark thereafter. The maximum Logical block address is 3FFEFFh.
		1	The Block address is interpreted as a device specific block address. For this tape unit these addresses are also known as Block IDs. The Block ID consists of four fields: Wrap, Physical reference, Format code and Logical block position. The format of a Block ID is shown in Table 4-26.
3-6			Block Address
8			The Partition field specifies the target position.

The high speed locate is at 4 meters per second. High speed positioning will not occur if the Block Address Type (BT) bit is 0. It will also not occur if the BT bit is 1 and the Wrap and Physical reference fields of the Block address are both 0.

Table 4-26. Block ID Format

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Wrap	Physical Reference						
1	Format Code		Logical Block Position (MSB)					
2	Logical Block Position (middle significant bits)							
3	Logical Block Position (LSB)							

LOCATE

Table 4-27. Block ID Format Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-6	 0 1 to 95	The Physical reference field can either be 0 or in the range 1 to 95. The value 0 indicates that a valid physical reference value is not known for the target position. The values in the range 1 to 95 indicate an approximate physical location on tape close to the target position. When the Physical reference value is not 0, the tape unit can use the value to perform a high speed locate to get close to the target position.
0	7	 0 1	The Wrap field indicates whether the target position is in the first wrap or second wrap [a] of tape. If Wrap equals 0 then the target position is in the first wrap. If Wrap equals 1 then the target position is in the second wrap. If the wrap of the target position is unknown then the Wrap field should be set to 0.
1	6-7		The Format code field indicates the format of the tape cartridge. The meaning of the possible values are described in Table 4-28.
1 2-3	0-5 0-7		A unique Logical block position is associated with each data block and filemark written on a tape. The first filemark or data block on tape is assigned Logical block position 0; the Logical block position increases by 1 for each data block and filemark thereafter. The maximum Logical block position is 3FFFEFh.

a. A 36 track tape consists of two interleaved groups of 18 tracks; each group is called a wrap. The first wrap is written first and runs from Physical BOT towards Physical EOT. The second wrap is written second and runs from Physical EOT towards Physical BOT. The tape unit hides the transition from the first wrap to the second wrap so that the user sees an [abstract] continuous length of tape running from Logical BOT (the beginning of the first wrap) to Logical EOT (the end of the second wrap).

Table 4-28. Format Mode Values

FORMAT CODE VALUE	FORMAT
00b	18 track, non-packeted
01b	36 track, packeted
10b	18 track, packeted
11b	reserved

If the Format code field is set to 11b then the LOCATE command is rejected. The Format code field is not checked against the actual format of the tape. This field is ignored except when it contains the reserved value 11b.

Values for the Wrap, Physical reference and Format mode fields are reported by the READ POSITION command (with its BT bit set to 1.) These values are also reported in Sense data when the Sense data contains a Block ID.

4-3.8.2 LOCATE CHECK CONDITION Status

If CHECK CONDITION status is reported for a LOCATE command with the Immediate bit set to 1, then the locate operation is not performed.

4-3.8.3 LOCATE Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data before the locate occurred.
2h	NOT READY	Logical Unit was not ready. (Tape cartridge was not loaded or logical unit was not made ready).
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium. 3. The tape length in the cartridge is too long or too short.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware failure. 2. The locate operation was not completed because of a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the LOCATE command. 2. Block address field contains an illegal address. 3. Change Partition bit was set to 1 and the Partition field was not 0. 4. Format code field of the Device Specific Block Address contains an illegal value. 5. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the LOCATE command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	LOCATE command was aborted. The LOCATE command can be reissued.

4-3.9 LOG SELECT command 4Ch

The LOG SELECT command provides a means for the initiator to manage statistical information maintained by the target about itself and attached logical units. It is a complementary command to the LOG SENSE command. Log data is collected within the target on a per event basis regardless of the initiator ID.

4-3.9.1 LOG SELECT CDB Description

LOG SELECT is a ten-byte command. The bytes are shown below and described in Table 4-29. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	0	0	1	1	0	0
1	LUN			Reserved			PCR=1	0
2	PC		Reserved					
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	MSB	Parameter List Length						
8								LSB
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-29. LOG SELECT Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	4Ch	Operation code.
1	1	1b	Parameter Code Reset (PCR)
2	6-7	01b	The Page Control (PC) field defines the type of parameter values to be selected. The only supported PC value is 01b (current cumulative values).
7-8		0	Parameter List Length

4-3.9.2 LOG SELECT CHECK CONDITION Status

A LOG SELECT command, with the parameter code reset bit (PCR) set, a PC of 01b, and a parameter list length of zero from any initiator, causes the target to reset parameters maintained in its Log pages.

Any values other than those indicated will result in CHECK CONDITION status with ILLEGAL REQUEST.

4-3.10 LOG SENSE command 4Dh

The LOG SENSE Command provides a means for the initiator to retrieve statistical information maintained by the target about itself and attached logical units. It is a complementary command to the LOG SELECT command. Log data is collected within the target on a per event basis regardless of the initiator ID.

4-3.10.1 LOG SENSE CDB Description

LOG SENSE is a ten-byte command. The bytes are shown below and described in Table 4-34. Common fields are described in paragraph 4-3.1 on page 4-4.

<table>
<tr><th></th><th colspan="8">BITS</th></tr>
<tr><th>BYTES</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td colspan="3">LUN</td><td colspan="3">Reserved</td><td>PPC=0b</td><td>0</td></tr>
<tr><td>2</td><td colspan="2">PC=01b</td><td colspan="6">Page Code</td></tr>
<tr><td>3</td><td colspan="8">Reserved</td></tr>
<tr><td>4</td><td colspan="8">Reserved</td></tr>
<tr><td>5</td><td colspan="8">MSB
Parameter Pointer</td></tr>
<tr><td>6</td><td colspan="8">LSB</td></tr>
<tr><td>7</td><td colspan="8">MSB
Allocation Length</td></tr>
<tr><td>8</td><td colspan="8">LSB</td></tr>
<tr><td>9</td><td colspan="6">Reserved</td><td>Flag</td><td>Link</td></tr>
</table>

Note: Changeable fields in the CDB are shaded.

LOG SENSE

Table 4-30. LOG SENSE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	4Dh	Operation code.
1	1	0b	The Parameter Pointer Control (PPC) bit controls the type of parameters requested from the target. The PPC bit must be zero indicating that the log parameter requested from the target shall begin with the parameter code specified in the Parameter Pointer field and return the number of bytes specified by the Allocation Length field in ascending order of parameter codes from the specified log page. A PPC bit of zero and a Parameter Pointer field of zero shall cause all available log parameters for the specified log page to be returned to the initiator subject to the specified allocation length.
2	0-5		The Page Code field identifies which page of data is being requested. The page codes are described in Table 4-31.
2	6-7	01b	A Page Control field (PC) of 01b must be specified to indicate that the target's current cumulative counter values for the specified log pages are returned.

Table 4-30. LOG SENSE Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
5-6			The Parameter Pointer field allows the initiator to request parameter data beginning from a specific parameter code to the maximum allocation length or the maximum parameter code supported by the target, whichever is less. If the value of the Parameter Pointer field is larger than the largest available parameter code that can be returned by the target on the specified page, the target shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to INVALID FIELD IN CDB.
7-8		0-1E9h	Allocation Length

Table 4-31. Page Codes

PAGE CODE	DESCRIPTION
00h	Supported Log Pages
02h	Error Counter Page (Write)
03h	Error Counter Page (Read)
0Ch	Sequential-access device page (support for this feature is dependent on the setting of bit 6 (0x40) in feature setting FT5 as described in the M2488 User's Guide).
31h	Track Error Statistics
3Eh	Return All Supported Pages

Any other value in the Page Code field will result in CHECK CONDITION status with a sense key of ILLEGAL REQUEST.

A value in the PPC field of other than 0b will be rejected with a CHECK CONDITION status with a sense key of ILLEGAL REQUEST.

A value in the PC field of other than 01b will be rejected with a CHECK CONDITION status with a sense key of ILLEGAL REQUEST.

When the Page Code Field contains 3Eh, the controller will attempt to return pages 00h, 02h,03h, 0Ch, and 31h in this order. A minimum allocation length of 1E9h is required to receive all page data. If fewer than 1E9h bytes are requested, then that number of bytes are returned. If more than 1E9h are requested, then only 1E9h bytes are returned.

4-3.10.2 LOG SENSE Operation

All available log parameters for the specified log page are returned to the initiator during a Data In phase subject to the specified allocation length. The page requested by the Page Code is transferred in ascending order of parameter codes. A page control field (PC) of 01b must be specified to indicate that the target's current cumulative counter values for the specified log page(s) are returned.

Log data is cleared under the following ANSI defined conditions:

1. SCSI BUS RESET (if operating in hard reset mode).
2. BUS DEVICE RESET.
3. Power on.
4. Valid Log Select command with the parameter code reset bit (PCR) set to 1.

In addition to the ANSI defined conditions for clearing of log data, log data will be cleared by the following:

1. A LOG SENSE command (clears counters only for the page requested). The specified page is returned to its default value even if the Allocation Length field was zero. NOTE: This condition for clearing the log counters is dependent on the state of bit 7 (0x80) in feature setting FT5 as described in the M2488 User's Guide.

2. When a cartridge is unloaded via the LOAD/UNLOAD command, or MOVE MEDIUM command.

3. MTU not ready to ready transition (e.g. cartridge load operation or pressing the op-panel Reset key followed by the Start key while a cartridge is in the MTU).

Log counters are not allowed to overflow. When a log counter reaches its maximum value, incrementing of all counters within that log page cease until they are cleared by one of the actions listed above. If a log counter has reached its maximum value and the RLEC bit in the MTU mode page 0Ah is one, the next successful command issued to the device associated with that counter will receive CHECK CONDITION status with RECOVERED ERROR set in the sense key. The ASC/ASCQ field will be returned as 5B02h, LOG COUNTERS AT MAXIMUM.

To disable the reporting of log overflow conditions, set the RLEC bit to zero in the Mode Select page 0Ah (Common device types control parameters).

4-3.10.3 LOG SENSE Parameters

The LOG SENSE command returns data in a page format. Each log page begins with a four-byte page header followed by zero or more variable length log parameters defined for that page. The log page format and log parameter format are defined below:

Table 4-32. Log Page Format

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved		Page Code					
1	Reserved							
2-3	Page Length (n-3)							
4 TO X+3	First Log Parameter (Length x)							
. . .	More Log Parameters							
N-Y TO N	Last Log Parameter (Length y)							

LOG SENSE

Table 4-33. Log Parameter Format

BYTES	BITS 7	6	5	4	3	2	1	0
0-1	Parameter Code							
2	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0
3	Parameter Length = 08h							
4-11	Parameter Value							

Table 4-34. LOG Parameter Field Description

BYTE	BIT	VALUE	DESCRIPTION
2			Parameter Control Byte
2	0	0b	The LP bit is returned as a 0b to indicate that this parameter is not an ASCII list parameter.
2	2-3	00b	The Threshold Met Criteria field (TMC) is returned as 00b.
2	4	0b	The Enable Threshold Comparison bit (ETC) is returned as 0b, indicating that threshold comparisons is not enabled.
2	5	1b	The Target Save Disable (TSD) bit is returned a 1b, indicating that the target does not provide a target defined method of saving log parameters.
2	6	1b	The Disable Save bit (DS) is returned as a 1b, indicating that the saving that of log parameter is not supported.
2	7	0b	This log parameter has not caused a "LOG COUNTERS AT MAXIMUM" condition for this page.
		1b	The Disable Update bit (DU) is returned as a 1b if updating of counters within this page is currently disabled as a result of a "LOG COUNTERS AT MAXIMUM" condition for this log parameter.
3	0-7	08h	The parameter length field specifies the length in bytes of the following parameter value.

If the initiator sends a parameter length value that results in the truncation of the parameter value, the target shall terminate the command with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

4-3.10.3.1 Log Sense Pages

Table 4-35. Log Sense Page 00h, Supported Log Pages (default)

	BITS								DEFAULT VALUE
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	Reserved		Page Code						00h
1	Reserved								00h
2-3	Page Length								0005h
4	Page supported								00h
5	Page supported								02h
6	Page supported								03h
7	Page supported								31h
8	Page supported								3Eh

Table 4-36. Log Sense Page 00h, Supported Log Pages *

	BITS								DEFAULT VALUE
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	Reserved		Page Code						00h
1	Reserved								00h
2-3	Page Length								0006h
4	Page supported								00h
5	Page supported								02h
6	Page supported								03h
7	Page supported								0Ch
8	Page supported								31h
9	Page supported								3Eh

* With “Support Log Page 0Ch” feature active in FT5 setting as described in the M2488 User’s Guide.

Table 4-37. Log Sense Page 02h, Error Counter Page - Write

BYTES	BITS 7	6	5	4	3	2	1	0	DEFAULT VALUE
0	Reserved		Page Code						02h
1	Reserved								00h
2-3	MSB	Page Length						LSB	0084h
WRITE ERRORS RECOVERED BY ECC									
4-5	MSB	Parameter Code						LSB	0000h
6	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
7	Parameter Length (08h)								08h
8-15	MSB	Number of Write Data Checks Recovered By ECC (i.e. Errors corrected without substantial delay)						LSB	
WRITE ERRORS DETECTED BY FIRMWARE									
16-17	MSB	Parameter Code						LSB	0001h
18	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
19	Parameter Length								08h
20-27	MSB	Number of Write Data Checks Detected By Firmware (i.e. Error corrected with possible delays)						LSB	
TOTAL WRITE BLOCKS CORRECTED BY INTERNAL ERROR RECOVERY ACTIONS									
28-29	MSB	Parameter Code						LSB	0003h
30	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
31	Parameter Length								08h
32-39	MSB	Total Write Blocks Corrected by internal Error Recovery Actions						LSB	
TOTAL WRITE BYTES									
40-41	MSB	Parameter Code						LSB	0005h
42	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
43	Parameter Length								08h
44-51	MSB	Total Bytes Written to Tape						LSB	

LOG SENSE

Table 4-37. Log Sense Page 02h, Error Counter Page - Write (Continued)

BYTES	7	6	5	4	3	2	1	0	DEFAULT VALUE
BYTES TRANSFERRED FROM INITIATOR									
52-53	MSB	Parameter Code						LSB	9000h
54	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
55	Parameter Length								08h
56-63	MSB	Total Bytes Transferred from Initiator						LSB	
HOST WRITE DATA RETRANSMISSIONS REQUIRED FOR OTHER THAN SCSI INTERFACE ERRORS									
64-65	MSB	Parameter Code						LSB	9001h
66	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
67	Parameter Length								08h
68-75	MSB	Total Host Write data transfer operations that had to be retried for other than SCSI interface errors (e.g., compression failures, excessive expansion, etc.)						LSB	
HOST WRITE BLOCKS RECOVERED BY USE OF INTERNAL RECOVERY BUFFER									
76-77	MSB	Parameter Code						LSB	9002h
78	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
79	Parameter Length								08h
80-87	MSB	Total Host Write Operations Recovered by use of internal recovery buffer						LSB	
TOTAL WRITE BLOCKS									
88-89	MSB	Parameter Code						LSB	9003h
90	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
91	Parameter Length								08h
92-99	MSB	Total Blocks Written to tape (excluding tapemarks)						LSB	
TOTAL TAPEMARKS WRITTEN									
100-101	MSB	Parameter Code						LSB	9004h
102	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
103	Parameter Length								08h
104-111	MSB	Total Tapemarks Written to Tape						LSB	

LOG SENSE

Table 4-37. Log Sense Page 02h, Error Counter Page - Write (Continued)

BYTES	BITS 7	6	5	4	3	2	1	0	DEFAULT VALUE
ERASE GAPS DUE TO RETRY									
112-113	MSB			Parameter Code				LSB	9005h
114	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
115	Parameter Length								08h
116-123	MSB			Total Number of Erase Gaps (ERG) Due to Retry				LSB	
HOST BLOCKS WRITTEN INTO AN EDRC SUPERBLOCK									
124-125	MSB			Parameter Code				LSB	9006h
126	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
127	Parameter Length								08h
128-135	MSB			Total Host Blocks Written into an EDRC Superblock				LSB	

Table 4-38. Log Sense Page 03h, Error Counter Page - Read

BYTES	BITS 7	6	5	4	3	2	1	0	DEFAULT VALUE
0	Reserved		Page Code						03h
1	Reserved								00h
2-3	MSB			Page Length				LSB	0078h
READ ERRORS RECOVERED BY ECC									
4-5	MSB			Parameter Code				LSB	0000h
6	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
7	Parameter Length								08h
8-15	MSB			Number of Read Data Checks Recovered by ECC (i.e. Errors corrected without substantial delay)				LSB	
READ ERRORS DETECTED BY FIRMWARE									
16-17	MSB			Parameter Code				LSB	0001h
18	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h

LOG SENSE

Table 4-38. Log Sense Page 03h, Error Counter Page - Read (Continued)

	BITS								DEFAULT VALUE
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
19	Parameter Length								08h
20-27	MSB	Number of Read Data Checks Detected By Firmware (i.e. Errors corrected with possible delays)						LSB	
TOTAL ERRORS CORRECTED									
28-29	MSB	Parameter Code						LSB	0003h
30	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
31	Parameter Length								08h
32-39	MSB	Total Read Errors Corrected by Internal Error recovery						LSB	
TOTAL READ (FORWARD) BYTES									
40-41	MSB	Parameter Code						LSB	0005h
42	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
43	Parameter Length								08h
44-51	MSB	Total Bytes Read from Tape						LSB	
BYTES TRANSFERRED TO INITIATOR									
52-53	MSB	Parameter Code						LSB	9010h
54	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
55	Parameter Length								08h
56-63	MSB	Total Bytes Transferred to Initiator						LSB	
TOTAL READ BLOCKS THAT WERE RECORDED IN EDRC FORMAT									
64-65	MSB	Parameter Code						LSB	9011h
66	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
67	Parameter Length								08h
68-75	MSB	Total Blocks Read (excluding filemarks)						LSB	
TOTAL TAPE MARKS READ									
76-77	MSB	Parameter Code						LSB	9012h
78	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h

Table 4-38. Log Sense Page 03h, Error Counter Page - Read (Continued)

BYTES	BITS 7	6	5	4	3	2	1	0	DEFAULT VALUE
79	Parameter Length								08h
80-87	MSB Total Tape Marks Read LSB								
TOTAL READ BLOCKS THAT WERE NOT RECORDED IN EDRC FORMAT									
88-89	MSB Parameter Code LSB								9013h
90	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
91	Parameter Length								08h
92-99	MSB Total Blocks Read that were not recorded in EDRC format (excluding filemarks) LSB								
TOTAL HOST BLOCKS CONTAINED IN PHYSICAL BLOCKS READ FROM TAPE									
100-101	MSB Parameter Code LSB								9014h
102	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
103	Parameter Length								08h
104-111	MSB Total Host Blocks Contained in Physical Blocks Read From Tape LSB								
READ RETRIES									
112-113	MSB Parameter Code LSB								9015h
114	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
115	Parameter Length								08h
116-123	MSB Read Retries LSB								

LOG SENSE

Table 4-39. Log Sense Page 0Ch, Sequential-Access Device Page

BYTES	BITS 7	6	5	4	3	2	1	0	DEFAULT VALUE
0	Reserved		Page Code						0Ch
1	Reserved								00h
2-3	MSB	Page Length						LSB	003Ch
WRITE DATA BYTES RECEIVED FROM THE INITIATOR									
4-5	MSB	Parameter Code						LSB	0000h
6	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
7	Parameter Length (08h)								08h
8-15	MSB	Number of data bytes received from the initiator during Write command operations.						LSB	
DATA BYTES WRITTEN TO TAPE									
16-17	MSB	Parameter Code						LSB	0001h
18	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
19	Parameter Length								08h
20-27	MSB	Number of data bytes written to tape as a result of Write command operations, not counting ECC and formatting overhead.						LSB	
DATA BYTES READ FROM TAPE									
28-29	MSB	Parameter Code						LSB	0002h
30	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
31	Parameter Length								08h
32-39	MSB	Number of data bytes read from the tape during Read command operations, not counting ECC and formatting overhead.						LSB	
READ DATA BYTES SENT TO THE INITIATOR									
40-41	MSB	Parameter Code						LSB	0003h
42	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
43	Parameter Length								08h
44-51	MSB	Number of data bytes sent to the initiator during Read command operations.						LSB	
CLEANING REQUIRED									

LOG SENSE

Table 4-39. Log Sense Page 0Ch, Sequential-Access Device Page (Continued)

BYTES	BITS 7	6	5	4	3	2	1	0	DEFAULT VALUE
52-53	MSB	Parameter Code						LSB	0100h
54	DU	DS=1	TSD=1	ETC=0	TMC=0		Reserved	LP=0	E0h or 60h
55	Parameter Length								08h
56	Cln Req *	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	00h
57-63	MSB	Reserved						LSB	00h

* Note: The Cln Req bit of 1 indicates cleaning is required and a subsequent cleaning cycle has not been completed. The cleaning required parameter persists across hard resets and power cycles. This bit is reported as 0 following a successful cleaning cycle.

LOG SENSE

Table 4-40. Log Sense Page 31h, Track Error Statistics

BYTES	BITS 7	6	5	4	3	2	1	0	DEFAULT VALUE
0	Reserved		Page Code						31h
1	Reserved								00h
2-3	MSB	Page Length						LSB	00D8h
ERROR STATISTICS BY TRACK									
4-5	MSB	Parameter Code						LSB	9001h
6	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
7	Parameter Length								08h
8-15	MSB	Number of ECC correctable read/write errors detected on track 1						LSB	
16-17	MSB	Parameter Code						LSB	9002h
18	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
19	Parameter Length								08h
20-27	MSB	Number of ECC correctable read/write errors detected on track 2						LSB	
28-29	MSB	Parameter Code						LSB	9003h
30	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h

Table 4-40. Log Sense Page 31h, Track Error Statistics (Continued)

BYTES	7	6	5	4	3	2	1	0	DEFAULT VALUE
31	Parameter Length								08h
32-39	MSB Number of ECC correctable read/write errors detected on track 3 LSB								
40-41	MSB Parameter Code LSB								9004h
42	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
43	Parameter Length								08h
44-51	MSB Number of ECC correctable read/write errors detected on track 4 LSB								
52-53	MSB Parameter Code LSB								9005h
54	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
55	Parameter Length								08h
56-63	MSB Number of ECC correctable read/write errors detected on track 5 LSB								
64-65	MSB Parameter Code LSB								9006h
66	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
67	Parameter Length (08h)								08h
68-75	MSB Number of ECC correctable read/write errors detected on track 6 LSB								
76-77	MSB Parameter Code LSB								9007h
78	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
79	Parameter Length (08h)								08h
80-87	MSB Number of ECC correctable read/write errors detected on track 7 LSB								
88-89	MSB Parameter Code LSB								9008h
90	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
91	Parameter Length								08h
92-99	MSB Number of ECC correctable read/write errors detected on track 8 LSB								
100-101	MSB Parameter Code LSB								9009h
102	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h

LOG SENSE

Table 4-40. Log Sense Page 31h, Track Error Statistics (Continued)

	BITS								
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	**DEFAULT VALUE**
103	Parameter Length								08h
104-111	MSB	Number of ECC correctable read/write errors detected on track 9						LSB	
112-113	MSB	Parameter Code						LSB	900Ah
114	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
115	Parameter Length								08h
116-123	MSB	Number of ECC correctable read/write errors detected on track 10						LSB	
124-125	MSB	Parameter Code						LSB	900Bh
126	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
127	Parameter Length								08h
128-135	MSB	Number of ECC correctable read/write errors detected on track 11						LSB	
136-137	MSB	Parameter Code						LSB	900Ch
138	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
139	Parameter Length								08h
140-147	MSB	Number of ECC correctable read/write errors detected on track 12						LSB	
148-149	MSB	Parameter Code						LSB	900Dh
150	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
151	Parameter Length								08h
152-159	MSB	Number of ECC correctable read/write errors detected on track 13						LSB	
160-161	MSB	Parameter Code						LSB	900Eh
162	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
163	Parameter Length								08h
164-171	MSB	Number of ECC correctable read/write errors detected on track 14						LSB	
172-173	MSB	Parameter Code						LSB	900Fh
174	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h

Table 4-40. Log Sense Page 31h, Track Error Statistics (Continued)

BYTES	7	6	5	4	3	2	1	0	DEFAULT VALUE
175	Parameter Length								08h
176-183	MSB	Number of ECC correctable read/write errors detected on track 15						LSB	
184-185	MSB	Parameter Code						LSB	9010h
186	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
187	Parameter Length								08h
188-195	MSB	Number of ECC correctable read/write errors detected on track 16						LSB	
196-197	MSB	Parameter Code						LSB	9011h
198	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
199	Parameter Length								08h
200-207	MSB	Number of ECC correctable read/write errors detected on track 17						LSB	
208-209	MSB	Parameter Code						LSB	9012h
210	DU	DS=1	TSD=1	ETC=0	TMC=0		0	LP=0	E0h or 60h
211	Parameter Length								08h
212-219	MSB	Number of ECC correctable read/write errors detected on track 18						LSB	

**** NOTE ****

The sum of ECC correctable errors by track may not be equal to the total number of Read Data checks recovered by ECC. These hardware indicators are transitory and reflect only the tracks correcting at the end of the read or read after write operation.

4-3.10.4 LOG SENSE Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data to tape.
3h	MEDIUM ERROR	1. Writing buffered data to tape failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	Write buffered data to tape failed due to a hardware error.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the LOG SENSE command. 2. The Flag bit was set but the Link bit was not set. 3. The Page Code field contained values other than 00h, 02h, 03h, 0Ch, 31h, and 3Eh. 4. The PPC field contained a value other than 0b. 5. The PC field contained a value other than 01b.
6h	UNIT ATTENTION	Indicates the LOG SENSE command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.

4-3.11 LOOP WRITE TO READ command C1h

The LOOP WRITE TO READ (LWR) command transfers one block of data from the initiator and performs an internal LWR operation. This command is used to check the controller's data and control path; the data path checked includes the analog circuitry. After the receipt of a valid LWR command, tape synchronization is performed prior to execution of the LOOP WRITE TO READ operation.

4-3.11.1 LOOP WRITE TO READ CDB Description

LOOP WRITE TO READ is a ten-byte command. The bytes are shown below and described in Table 4-41. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	1	0	0	0	0	0	1
1	LUN			Reserved				Fixed
2	MSB							
3	Transfer Length							
4								LSB
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-41. LOOP WRITE TO READ Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	C1h	Operation code.
1	0	 0 1	The Fixed bit specifies both the meaning of the transfer length field and whether fixed-length or variable-length block(s) are to be transferred. If the Fixed bit is zero, a single block is transferred from the initiator and looped through the controller. If the Fixed bit is set to one, the transfer length field specifies the number of block(s) to be transferred from the initiator. This form of the LWR command is valid only if the logical unit is currently operating in fixed block mode (i.e., it has been instructed to use fixed-length blocks by a MODE SELECT command). Only a block count of 0 or 1 may be specified.
2-4			The Transfer Length specifies the length of the block to be transferred from the initiator. If the transfer length specified by the LWR command is 0, no data is transferred and this condition is not considered an error.

Data is transferred in the mode selected by the MODE SELECT command.

4-3.11.2 LOOP WRITE TO READ CHECK CONDITION Status

This control unit implements both fixed-block and variable-block modes. If the Fixed bit is one and the current mode is variable (as set by MODE SELECT command or default power on condition) the command is rejected with a CHECK CONDITION and a sense key of ILLEGAL REQUEST. If the Fixed bit is zero, the LWR command operates in variable block mode regardless of the current mode set by MODE SELECT.

If the LWR operation fails, CHECK CONDITION status is generated and the sense key is set to HARDWARE ERROR.

4-3.11.3 LOOP WRITE TO READ Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	1. Recovery was performed when transferring data from the initiator. 2. Recovery was performed when writing buffered data to tape.
3h	MEDIUM ERROR	Writing buffered data to tape failed due to defective tape.
4h	HARDWARE ERROR	1. Transferring data from the initiator failed due to a hardware failure. 2. Writing buffered data to tape failed due to a hardware failure. 3. The loop write to read operation failed.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the LWR command. 2. The Fixed bit was set to one, but the current mode is variable (as set by MODE SELECT or default power on condition). 3. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the LOOP WRITE TO READ command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	LWR command was aborted.
Dh	VOLUME OVERFLOW	Buffered write data could not be written to tape because physical End-of-Tape has been reached.

4-3.12 MODE SELECT command 15h

The MODE SELECT command provides a means for the initiator to specify medium, logical unit, and peripheral device parameters to the target by sending data relevant to such parameters in a DATA OUT phase during the command. Initiators should issue MODE SENSE prior to MODE SELECT to determine supported pages, page lengths, and other parameters. A single set of MODE SELECT parameters kept by the controller is common to all initiators for a specific LUN. The MODE SELECT command can be completed without error whether or not the LUN is ready. Buffered write data is synchronized to tape prior to activating the new mode parameters.

4-3.12.1 MODE SELECT CDB Description

MODE SELECT is a six-byte command. The bytes are shown below and described in Table 4-42. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	0	1
1	LUN			PF	Reserved			SP
2	Reserved							
3	Reserved							
4	Parameter List Length							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-42. MODE SELECT Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	15h	Operation Code.
1	0	0 1	A Save Pages (SP) bit of zero indicates the target shall perform the specified MODE SELECT operation, and shall not save any pages in non-volatile memory. A SP bit of one indicates that the target shall perform the specified MODE SELECT operation, and shall save to a non-volatile location all the savable pages sent during the DATA OUT phase.
1	4	0 or 1	A PF (Page Format) bit of 0 or 1 both indicate that the MODE SELECT parameters are structured as pages of related parameters as defined by the ANSI standard.
4	0-7		The Parameter List Length field specifies the length in bytes of the MODE SELECT parameter list to be transferred from the initiator to the target. A parameter list length of zero indicates that no data is transferred. This condition is not considered an error.

The Unit Attention/Mode Parameters Changed sense data will be reported to other initiators after a Mode Select command if and only if the setting of at least one parameter was actually changed from its previous setting. Therefore, issuing a Mode Select command with parameters that are the same as the current parameters will not result in any change or the reporting of a Unit Attention to other initiators. In any case, a Unit Attention condition due to mode parameters being changed will not be generated for the initiator that performed the MODE SELECT command.

4-3.12.2 Mode Select Data

The Mode Select data to be sent by the initiator should be in the form of a four-byte header, followed by a zero or an eight-byte block descriptor, followed by zero or more variable length pages. The following table illustrates the format of the Mode Select parameter list:

Table 4-43. MODE SELECT Parameter List Format

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0 - n	Mode Parameter Header (4 bytes). See Table 4-44.							
0 - n	Block Descriptor (0 or 8 bytes). See Table 4-47.							
0 - n	Pages. See Table 4-49.							

Mode Select Parameter List Header:

Table 4-44. MODE SELECT Parameter Header

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	Reserved							
2	0	Buffered Mode			Speed			
3	Block Descriptor Length (00h or 08h)							

Table 4-45. MODE SELECT Parameter Header Field Description

BYTE	BIT	VALUE	DESCRIPTION
2	0-3		The Speed field is ignored since the attached peripherals support only a single speed.
2	4-6	0h-7h	The Buffered Modes are described in Table 4-46.
3	0-7		A single block descriptor may be specified. The Block Descriptor Length specifies the length in bytes (8) of the block descriptor, if included.

MODE SELECT

Table 4-46. Buffered Mode Values

BUFFERED MODE	DESCRIPTION
0h	Target does not report a GOOD status on WRITE commands until the data blocks are actually written on the medium.
1h	The Target may report GOOD status on WRITE commands as soon as all of the data specified in the WRITE command has been transferred to the buffer. Write data from multiple initiators can reside in the buffer prior to writing the data to the medium (default).
2h	The Target may report GOOD status on WRITE commands as soon as all of the write data has successfully transferred to the target's buffer from any one initiator prior to writing the block(s) to the medium. If an initiator issued a WRITE command while the buffer contains write data from a different initiator, the target writes any buffered data to the medium prior to accepting any data from the new initiator.
3h -7h	Reserved

Block Descriptor:

A Block Descriptor Length of 0 indicates no block descriptors are included in the parameter list. This condition is not considered an error. The block descriptor length does not include the length of the pages.

The block descriptor specifies the medium characteristics for all of a logical unit. The block descriptor contains the Density Code, number of blocks, and block length fields.

Table 4-47. Block Descriptor

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Density Code							
1-3	Number of Blocks = 000000h							
4	Reserved							
5-7	Block Length							

Table 4-48. Block Descriptor Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-3		Density Codes of 00h and 09h write tapes in the format described by ANSI standard X3B5/94-043 (36-track), and read tapes in the formats described by ANSI standard X3B5/94-043 (36-track), X3.180-1990 (18-track) and X3.224.1992 (18-track extended). A Density Code of 7Fh indicates the Density Code is not changed. Any other code specification is rejected with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense key set to INVALID FIELD IN PARAMETER LIST. NOTE: Since the ANSI SCSI-2 Standard does not define a 36-track format, we use Density Code 09h to represent the 36-track format. Density Code 28h is described in Chapter 5.
1-3		0	The Number of Blocks field must contain 0. This indicates that all of the remaining logical blocks of the logical unit have the medium characteristics specified by the block descriptor unless a subsequent MODE SELECT command changes those parameters.

Table 4-48. Block Descriptor Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
5-7			The Block Length field specifies the length in bytes of each logical block described by the block descriptor. A block length of 0 indicates the length is variable. Reference the READ BLOCK LIMITS command description for the minimum and maximum block lengths supported.

Page Descriptor:

Table 4-49. Page Descriptors

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS=0	Reserved	Page Code					
1	Additional Page Length (see section 5-2 on page 5-1)							
2 - N	Page Defined or Vendor Unique Parameter Bytes							

Table 4-50. Page Descriptor Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-5		Following the block descriptor (if supplied) are MODE SELECT pages. The Page Code field identifies the format and parameters for that page. This controller supports pages 01h (Error Recovery and Reporting), 02h (Disconnect/Reconnect control), 0Ah (Control Mode Page), 10h (Device Configuration Parameters) and 00h (Vendor Unique Parameters).
0	7	0h	When using a MODE SELECT command, the PS (Parameters Savable) bit is reserved and must be zero.
1	0-7		The Additional Page Length indicates the number of bytes in that page. The additional page length field value does not include bytes 0 and 1 of that page (the page code and additional page length fields, respectively). If the initiator does not set this value to the value that is returned for the page by the MODE SENSE command, the target will present CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the initiator sends page fields with values that are not supported by the target or are not Changeable, the target returns a CHECK CONDITION status with the sense key field set to ILLEGAL REQUEST in the sense data. In this case, no parameters are changed by this command.

More information on the MODE SELECT command can be found in paragraph 5-2 on page 5-1.

4-3.12.3 MODE SELECT Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data before the buffered mode operation occurred in MODE SELECT command.
3h	MEDIUM ERROR	1. Write of buffered data failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. SCSI interface error occurred due to hardware failure (e.g. transfer of MODE SELECT data failed due to hardware failure). 2. Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the MODE SELECT command. 2. Flag bit in the MODE SELECT CDB was set and Link bit was not set. 3. There is a parameter list error.
6h	UNIT ATTENTION	Indicates the MODE SELECT command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	MODE SELECT command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the MODE SELECT operation failed because physical End-of-Tape has been reached.

4-3.13 MODE SENSE command 1Ah

The MODE SENSE command provides a means for a target to report its medium, logical unit, or peripheral device parameters to the initiator by sending the parameters during the data phase of this command. The MODE SENSE command is a complementary command to the MODE SELECT command.

4-3.13.1 MODE SENSE CDB Description

MODE SENSE is a six-byte command. The bytes are shown below and described in Table 4-51. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	1	0
1	LUN			Reserved	DBD	Reserved		
2	PC		Page Code					
3	Reserved							
4	Allocation Length							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-51. MODE SENSE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	1Ah	Operation code.
1	3	1 0	The Disable Block Descriptor (DBD) bit value of 1 specifies that no block descriptor is returned in the MODE SENSE data. When this bit is set to 0, the target will return a block descriptor in the MODE SENSE data.
2	0-5		The Page Code allows the initiator to select any one specific page or all of the pages supported by a target. Pages are used to set and return device parameters. Refer to the Page Code descriptions in Table 5-1 on page 5-1.
2	6-7		The Page Control (PC) field indicates the type of page parameter values to be returned by the target. The PC field is defined in Table 4-52.
4	0-7		The Allocation Length specifies the number of bytes the initiator has allocated for returned Mode Sense data. An Allocation Length of 00h indicates no Mode Sense data is to be transferred; this condition is not considered an error.

Table 4-52. PC Field

PC FIELD BITS 7 6	DESCRIPTION
0 0	**Report Current Values:** The current values are those parameters under which the target is presently configured. The current values are defined to be the following: 1. those values set in the last successfully completed MODE SELECT command, 2. saved values if a MODE SELECT hasn't successfully completed since the last power-on, hard reset condition, or BUS DEVICE RESET message, or 3. default values if saved values are not available. Page fields not supported are set to zero. The additional page length field returned by the target indicates the number of bytes supported in that page.
0 1	**Report Changeable Values:** The changeable values of any page indicate which parameters the initiator may change by a subsequent MODE SELECT command. Any field allowed to change is set to all ones. Fields and bits not allowed to be changed by the initiator are set to zero. Attempting to change any field, via the MODE SELECT command, that is not changeable causes the target to return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST in the sense data. In this case, no parameters in that page are changed. The additional page length field of each page returned by the target indicates the number of bytes which are supported for that particular page.
1 0	**Report Default Values:** The target returns to the initiator the field values set to the target's or LUN's default values. The additional pages length field of each page returned by the target indicates the number of bytes supported for that particular page.
1 1	**Report Saved Values:** The target returns the saved values of the mode parameters. Until the first successful MODE SELECT command is completed with the SP (Save Pages) bit set to 1, the default values will be returned for this PC field setting.

The Page Code allows the initiator to select any one specific page or all of the pages supported by a target. Pages are used to set and return device parameters. If the initiator uses a page code value not implemented by the target, the target will return CHECK CONDITION status with sense key set to ILLEGAL REQUEST, and additional sense code to INVALID FIELD IN CDB.

The Allocation Length specifies the number of bytes the initiator has allocated for returned Mode Sense data. An Allocation Length of 0 indicates no Mode Sense data is to be transferred. This condition is not considered an error. Any other value indicates the maximum number of bytes transferred. The target terminates the DATA IN phase when allocation length bytes have been transferred or when all available Mode Sense data have been transferred to the initiator, whichever is less.

4-3.13.2 Mode Sense Data

The MODE SENSE data contains a four-byte header, followed by 0 or one eight-byte block descriptors, followed by zero or more variable length pages.

Mode Sense Data Header:

Table 4-53. MODE SENSE Data Header

	BITS								DEFAULT
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	MODE SENSE Data Length								N.A.
1	Reserved								00h
2	WP	Buffered Mode			Speed =0h				90h or 10h
3	Block Descriptor Length								00h /08h

Table 4-54. MODE SENSE Data Header Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		The MODE SENSE data length specifies the length in bytes, after the data length field, that are available to be transferred during the DATA IN phase. The sense data length does not include itself.
2	0-3	0h	The code value for the Speed field is set to 0h (default).
2	4-6		The Buffered Modes are described in Table 4-55.
2	7	0 1	A Write Protected (WP) bit of zero indicates the medium is write enabled. A WP bit of one indicates the medium is write protected.
3	0-7	08h 00h	The block descriptor length specifies a length of eight if a block descriptor is included. A block descriptor length of zero indicates no block descriptors are included in the parameter list. This condition is not considered an error. The block descriptor length does not include the length of the pages.

Table 4-55. Buffered Mode Description

BUFFERED MODE	DESCRIPTION
0h	Target does not report a GOOD status on WRITE commands until the data blocks are actually written on the medium.
1h	The Target may report GOOD status on WRITE commands as soon as all of the data specified in the WRITE command has been transferred to the buffer. Write data from multiple initiators can reside in the buffer prior to writing the data to the medium (default).
2h	The Target may report GOOD status on WRITE commands as soon as all of the write data has successfully transferred to the target's buffer from any one initiator prior to writing the block(s) to the medium. If an initiator issued a WRITE command while the buffer contains write data from a different initiator, the target writes any buffered data to the medium prior to accepting any data from the new initiator.
3h -7h	Reserved

Block Descriptor:

The block descriptor specifies the medium characteristics for all of a logical unit. The block descriptor contains a density code of 00h or 09h (default), a number of blocks, and a block length.

Table 4-56. Block Descriptor

	BITS								DEFAULT
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	Density Code = 09h								09h
1-3	Number of Blocks = 000000h								000000h
4	Reserved								00h
5-7	Block Length								00h

Table 4-57. MODE SELECT Parameter Header Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	00h, 09h	Density codes of 00h and 09h (default) create tapes in the format described by ANSI standard X3B5/94-043. Density Code 28h is described in CHAPTER 5.
1-3		000000h	The number of blocks field is always set to zero, indicating that any remaining logical blocks of the logical unit have the medium characteristics specified by the block descriptor.
5-7		00h	The block length specifies the length in bytes of each logical block described by the block descriptor. A block length of zero indicates the length is variable.

Page Descriptor:

Table 4-58. Page Descriptors

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS	Reserved	Page Code					
1	Additional Page Length							
2 - N	Page Defined or Vendor Unique Parameter Bytes							

MODE SENSE

Table 4-59. Page Descriptor Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-5		Following the block descriptor (if supplied) are MODE SELECT pages. The Page Code field identifies the format and parameters for that page. This controller supports pages 01h (Error Recovery and Reporting), 02h (Disconnect/ Reconnect control), 0Ah (Control Mode Page), 10h (Device Configuration Parameters) and 00h (Vendor Unique Parameters).
0	7	1 0	When using the MODE SENSE command, a PS bit of one indicates that the mode page can be saved by the target in a non-volatile location. A PS bit of zero indicates that the supported parameters cannot be saved.
1	0-7		The Additional Page Length indicates the number of bytes in that page. The additional page length value of each defined page, does not include the Page Length byte. The target may return in the pages of the MODE SENSE commands as many consecutive bytes as it supports, for each page it supports, without splitting fields of multiple bytes. The page length in the pages of the MODE SELECT command must be set to the value returned by the target in the MODE SENSE Page Length bytes. Otherwise, the target creates CHECK CONDITION status with the sense key of ILLEGAL REQUEST.

4-3.13.3 Mode Settings

When the product is manufactured, the saved mode settings are initialized to the default mode settings; the saved mode settings will then change after each successful MODE SELECT with the SP bit equal to 1. Following a power on, SCSI bus reset, or BUS DEVICE RESET message, the saved mode settings are copied into the current mode settings. So, if a MODE SENSE is issued when the box is first shipped (previous to any successful MODE SELECT with SP=1), then the default settings will be reported when the PC field selects default, saved or current parameters. Following a power up (after a successful MODE SELECT with SP=1), the saved settings are reported if current or saved values are selected by the PC field; the default settings are reported if default values are selected by the PC field.

More information on the MODE SENSE command can be found in section 5-2 on page 5-1.

4-3.13.4 Initiator Setup

To ensure that the MODE SELECT command performs the desired operations, it is strongly recommended that the initiator adhere to the following steps:

a. Issue a MODE SENSE command requesting the target to return all Changeable Values (PC field 01b and Page Code 3Fh in byte two of the MODE SENSE CDB) and preserve the “changeable” values,

b. Issue a MODE SENSE command requesting the target to return all Current Values (PC field 00b and Page Code 3Fh in byte two of the MODE SENSE CDB) and preserve the “current” values,

c. Perform a bitwise AND operation of the “current” values with the one’s complement of the “changeable” values, (this step is important because the target will not accept the command if any non-changeable field is set to a value other than the “current” value)

d. Make further desired changes to bytes which are changeable,

e. Make sure that the PS bit in every mode page is 0 (the MODE SENSE command will report a 1 in the PS bit, but a MODE SELECT command will fail if mode pages are sent with the PS bit set to 1) with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense key set to INVALID FIELD IN PARAMETER LIST,

f. Issue a MODE SELECT command, sending these parameters,

The Disable Block Descriptor (DBD) bit value of 1 specifies that no block descriptor is returned in the MODE SENSE data. When this bit is set to 0, the target will return a block descriptor in the MODE SENSE data.

The Page Control (PC) field indicates the type of page parameter values to be returned by the target. The target returns the same page length for each supported page regardless of the value in the PC. The combination of the page control field value and the page code being set causes the target to return the appropriate values for the page selected by its respective page code. A page code value of 3Fh indicates all pages implemented by the target are returned to the initiator with the values reported defined by the page control field. For a page code value of 3Fh, all pages are returned in ascending page code order, except for mode page 00h which will always be reported last.

Regardless of the setting of the PC field, the Mode Sense data header and block descriptor will return the current values for the fields contained in them.

4-3.13.5 MODE SENSE Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data, before the buffered mode operation occurred in MODE SENSE command.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. SCSI interface error occurred due to a hardware failure (e.g. transfer of MODE SENSE data failed due to a hardware failure). 2. Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the MODE SENSE command. 2. Flag bit in the MODE SENSE CDB was set and the Link bit was not set.
6h	UNIT ATTENTION	Indicates the MODE SENSE command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	MODE SENSE command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the MODE SENSE operation failed because physical End-of-Tape has been reached.

4-3.14 READ command 08h

The READ command transfers one or more blocks to the initiator beginning with the next block on the logical unit.

Upon termination of the READ command, the logical position is located after the last block transferred (EOM side).

4-3.14.1 READ CDB Description

READ is a six-byte command. The bytes are as shown below and described in Table 4-60. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	0	0	0
1	LUN			Reserved			SILI	Fixed
2	MSB							
3	Transfer Length							
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-60. READ Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	08h	Operation code.
1	0	 0 1	The Fixed bit specifies both the meaning of the transfer length field and whether fixed-length or variable-length blocks are to be transferred. If the Fixed bit is zero, a single block is transferred with the bytes transferred being the lesser of the actual block length or the requested transfer length. If the Fixed bit is one, the transfer length specifies the number of blocks to be transferred to the initiator.
1	1		Suppress Incorrect Length Indication (SILI) flag.
2-4		 0	The Transfer Length indicates the number of bytes or blocks to transfer. The block length used is the current block length specified in the mode parameters block descriptor (refer to the Mode Select Block Descriptor in Table 4-47 on page 7-53.) When the transfer length is zero, no data is transferred and the current position on the logical unit is not changed. This condition is not considered an error.

READ

4-3.14.2 READ CHECK CONDITION Status

The following table describes how a CHECK CONDITION occurs.

FIXED BIT	SILI BIT	BLOCK MODE *	DESCRIPTION
1	1		Causes CHECK CONDITION status with the sense key being ILLEGAL REQUEST.
0	1	variable	No CHECK CONDITION is set due to an actual block length being different than the length specified in the Transfer Length field, except for the following condition. The target still reports CHECK CONDITION status for an incorrect length condition if the overlength condition exists and the block length field in the mode parameter block descriptor is non-zero (a non-zero value in this field in the Mode Select data implies fixed mode). The overlength condition exits after executing a Read command when the length of the actual block read exceeds the requested transfer length in the CDB.
0	0	variable	With Fixed bit = 0, the transfer will take place in variable block mode independent of the value in the mode parameters block descriptor. In variable block mode, a single block is transferred with the bytes transferred being the lesser of the actual block length or the requested Transfer Length. A successful READ command with the fixed bit of zero, transfers the requested transfer length in bytes to the initiator. If the actual block length is different from the specified transfer length, CHECK CONDITION status is returned to the initiator. The incorrect length indicator (ILI) bit and valid bit in the sense data are set to one, and the sense key is set to NO SENSE. The information bytes contained in the sense data are set to the difference (residue) of the requested transfer length minus the actual block length, and this value will be negative (two’s compliment) when the actual block length exceeds the requested block length. Upon termination, the logical position is located after the incorrect length block (EOM side).
1		fixed	The transfer length specifies the number of blocks to be transferred to the initiator. This form of the READ command is valid only if the logical unit is currently operating in fixed block mode. A logical unit is in fixed block mode if it has been instructed by the MODE SELECT command to use fixed-length blocks. In this case, the current block length is the block length defined in the MODE SELECT command. A successful READ command with the fixed bit of one, transfers the requested transfer length times the current block length in bytes to the initiator. If the actual block length read is different from the current transfer length, as specified in the mode parameters block descriptor, CHECK CONDITION status is generated. The ILI bit and valid bit are both set to one, and the sense key is set to NO SENSE. The information bytes in the sense data are set to the difference of the requested transfer length minus the actual number of blocks read (not including the incorrect length block). Upon termination, the logical position is located after the incorrect length block (EOM side).
1		variable	The target rejects the command by returning CHECK CONDITION status and by setting the sense key to ILLEGAL REQUEST.

FIXED BIT	SILI BIT	BLOCK MODE *	DESCRIPTION
			If a filemark is encountered during a READ command, the target returns CHECK CONDITION status and sets the sense key to NO SENSE. The filemark and valid bits are both set to one.
1			If the Fixed bit is one, the target sets the information bytes to the difference (residue) of the requested transfer count minus the actual number of blocks read (not including the filemark).
0			If the Fixed bit is zero, the target sets the information bytes to the requested transfer length. The logical position is located after the filemark (EOM side).
			If end-of-data is encountered during a READ command the target returns CHECK CONDITION status, sets the sense key to BLANK CHECK, and sets the valid bit to one.
1			If the Fixed bit is one, the target sets the information bytes to the difference (residue) of the requested transfer count minus the actual number of blocks read.
0			If the Fixed bit is zero, the target sets the information bytes to the requested transfer length. The logical position is located after the EOD block (EOM side). Subsequent Read commands issued after EOD has been encountered and reported to the initiator will result in reading into invalid/old data.
			If a logical unit encounters the physical EOM during a READ command, the target returns CHECK CONDITION status to the initiator and sets the End-Of-Medium (EOM) bit to one in extended sense. The sense key is set to MEDIUM ERROR.
1			If the Fixed bit is one, the target sets the valid bit to one and the information bytes to the difference (residue) of the requested transfer length minus the actual number of blocks successfully read.
0			If the Fixed bit is zero the target sets the valid bit to one and the information bytes to the requested transfer length.

* Both fixed block and variable block modes are implemented by this tape controller. Reference the Read Block Limits and Mode Select (mode parameters block descriptor) commands for more information about fixed and variable block modes.

Encountering early-warning (LEOT) on a READ command is not reported to the initiator.

4-3.14.3 READ Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
0h	NO SENSE	1. SILI and Fixed bits are both zero and the actual block length read is different from the specified transfer length in the READ CDB. 2. Filemark encountered during the read operation.
1h	RECOVERED ERROR	1. Recovery was performed when writing buffered data to tape. 2. Recovery was performed when reading data from tape. 3. Recovery was performed when transferring data to the initiator.
2h	NOT READY	Logical Unit was not ready (tape was not loaded or wasn't ready).
3h	MEDIUM ERROR	1. Synchronization of buffered write data prior to the read operation failed due to defective tape. 2. Physical end-of-medium (PEOT) encountered during the read operation. 3. Attempted to read a tape that has not been previously recorded (i.e. the density ID has not been written). 4. An attempt was made to write 36-track data on 18-track formatted medium. 5. The tape length in the cartridge is too long or too short.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware failure. 2. Read operation failed due to a hardware failure. 3. Transfer of Read data to initiator failed due to hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the READ command. 2. The Fixed bit was set to one, but the current mode is variable (as set by MODE SELECT or default power on condition). 3. The SILI and Fixed bits are both set to one. 4. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the READ command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
8h	BLANK CHECK	1. End-of-data (EOD) encountered during the read operation. 2. No data block or filemark was encountered on the medium for a distance of 680 mm. The medium position following this condition is not defined.

SENSE KEY	CONDITION	DESCRIPTION
Bh	ABORTED COMMAND	READ command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the read operation failed because physical End-of-Tape has been reached.

4-3.15 READ BLOCK LIMITS command 05h

The READ BLOCK LIMITS command requests the target's block length limits for the logical unit. The READ BLOCK LIMITS data, shown in Table 4-62, is sent during the DATA IN phase of the command.

4-3.15.1 READ BLOCK LIMITS CDB Description

READ BLOCK LIMITS is a six-byte command. The bytes are as shown below and described in Table 4-61. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	1	0	1
1	LUN			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-61. READ BLOCK LIMITS Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	05h	Operation code.

Variable and fixed length blocks are supported. Refer to Table 4-62 for the READ BLOCK LIMITS data.

Table 4-62. READ BLOCK LIMITS Data

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		Reserved.
1-3		040000h (262,144)	The maximum block length is the maximum number of bytes the host can request via a read or write operation. The maximum block length conforms to the maximum specified in the ANSI Extended Magnetic Tape Format for Information Interchange 36 Track, Parallel Serpentine proposed specification X3B5/94-043 section 8.2.
4-5		0001h	The minimum block length supported is one byte. The minimum block length indicates the minimum number of bytes that can be read from or written to the MTU.

READ BLOCK LIMITS

If a DMA transfer (READ, WRITE, READ BUFFER, WRITE BUFFER, OR LOOP WRITE TO READ) is requested by the host with a transfer length of zero bytes, this is not considered an error. The command is processed with no data transfer. There is no block ID associated with zero length records.

4-3.15.2 READ BLOCK LIMITS Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data.
3h	MEDIUM ERROR	1. Write of buffered data failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	Write of buffered failed due to a hardware error.
5h	ILLEGAL REQUEST	1. Reserved bit was set in the CDB of the READ BLOCK LIMITS command 2. Flag bit was set and Link bit was not set.
6h	UNIT ATTENTION	Indicates the READ BLOCK LIMITS command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.

4-3.16 READ BUFFER command 3Ch

The READ BUFFER command is used in conjunction with the WRITE BUFFER command as a diagnostic function for testing target memory and the SCSI bus integrity. Other than synchronizing any buffered write data to tape prior to performing the read buffer operation, the READ BUFFER command does not alter the tape medium of the target.

4-3.16.1 READ BUFFER CDB Description

READ BUFFER is a ten-byte command. The bytes are shown below and described in Table 4-63. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	1	1	0	0
1	LUN			Reserved		Mode		
2	Buffer ID							
3	MSB							
4	Buffer Offset							
5								LSB
6	MSB							
7	Allocation Length							
8								LSB
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-63. READ BUFFER Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	3Ch	Operation code.
1	0-2		The Mode field is described in Table 4-64.
2			The Buffer ID field identifies a specific buffer within the target.
3-5			The Buffer offset specifies the offset in the buffer for the beginning of the data transfer. The Buffer Offset contains a multiple of the offset boundary field which is in the read buffer descriptor.
6-8			The Allocation Length specifies the maximum number of bytes that are transferred during the DATA IN phase from the assigned buffer beginning at the buffer offset. The transfer length is the lesser of the Allocation Length or capacity of the requested buffer. The capacity of the buffer is shown in Table 4-65.

Table 4-64. READ BUFFER Command Mode

BYTE 1			MODE	IMPLEMENTED
BIT 2	BIT 1	BIT 0		
0	0	0	Combined header and data	No
0	0	1	Vendor unique	Yes
0	1	0	Data (Refer to description below.)	Yes
0	1	1	Descriptor (Refer to description below.)	Yes
1	0	0	Reserved	N/A
1	0	1	Reserved	N/A
1	1	0	Reserved	N/A
1	1	1	Reserved	N/A

Vendor Unique Mode (001b) and Data Mode (010b):

In these modes, the DATA IN phase contains buffer data. The Buffer ID field identifies the specific buffer within the target. The supported Buffer IDs for the vendor unique and data modes are defined in Table 4-65. Data transfer occurs only within the buffer area indicated by the buffer ID. If an unsupported buffer ID value is selected, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of ILLEGAL FIELD IN CDB.

Table 4-65. Supported Buffer ID Values for Read Data Mode

BUFFER ID	DESCRIPTION	CAPACITY
0	Read/Write Data Buffer	Specified in the Buffer Capacity field of the Read Buffer Descriptor obtained via the Read Buffer command.
1	Read/Write nonvolatile (NV) RAM	Specified in the Buffer Capacity field of the Read Buffer Descriptor obtained via the Read Buffer command (512 bytes).

Data is transferred beginning at the offset within the buffer as specified by the buffer offset. If the initiator fails to conform to the offset boundary requirements returned in the READ BUFFER descriptor, CHECK CONDITION status is returned with a sense key set to ILLEGAL REQUEST with an additional sense code of ILLEGAL FIELD in CDB.

NOTES:

1. The read/write data buffer and NVRAM are wrap-around buffers. Therefore, the entire capacity specified by the Read Buffer Descriptor is available, regardless of the offset specified.
2. Prior to allowing READ BUFFER command processing to occur for the read/write data buffer, the controller performs required positioning or synchronization. Buffered write data is written to tape and buffered read data is discarded.
3. There is only one 512-byte NVRAM area available. This area may be accessed by any initiator. The NVRAM is not partitioned into “per initiator” areas.
4. The only difference between the vendor unique mode and data mode is that a READ BUFFER in vendor unique mode reads the number of bytes requested and does not perform any CRC checking. A READ BUFFER in data mode reads the number of bytes requested and an additional 2 bytes of CRC and then verifies the CRC. The CRC is then stripped away and not sent to the initiator with the other Read Buffer data.

Descriptor Mode (011b):

In this mode, a maximum of four bytes of READ BUFFER descriptor information are returned. The descriptor information for the LUN receiving the command is returned. If there is no buffer associated with the specified buffer ID, the target returns all zeroes in the READ BUFFER descriptor. The Buffer Offset field in the CDB is ignored in this mode. The allocation length should be set to four or greater. The target transfers the lesser of the allocation length or four bytes of READ BUFFER descriptor. The READ BUFFER descriptor is defined in Table 4-66.

**** NOTE ****

This controller operates on 32-byte data buffer boundaries, and returns a value of 5 for the offset boundary. The NVRAM operates on a one-byte boundary and returns a value of zero for the offset boundary.

Table 4-66. Read/Write Data Buffer Descriptor (buffer ID 0)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Offset Boundary (05h)							
1	MSB							
2	Buffer Capacity							
3								LSB

**** NOTE ****

When performing Write Buffer operations to the Data Buffer, the maximum Transfer Length that can be written is the Buffer Capacity of the Data Buffer minus two. The two remaining bytes in the Data Buffer are needed to store the two byte CRC which is automatically appended to the data when it is stored in the buffer.

Table 4-67. Read/Write NVRAM Descriptor (buffer ID 1)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Offset Boundary (00h)							
1	MSB							
2	Buffer Capacity							
3								LSB

Table 4-68. Descriptor Mode Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		The Offset Boundary field returns the boundary alignment within the selected buffer for subsequent WRITE BUFFER and READ BUFFER commands. The value contained in the offset boundary field is interpreted as a power of two. The value contained in the buffer offset field of subsequent WRITE BUFFER and READ BUFFER commands must be a multiple of the offset boundary raised to a power of 2 (i.e., a multiple of 32). Refer to Table 4-69
1-3			The Buffer Capacity field returns the size of the selected buffer in bytes.

Table 4-69. Offset

BOUNDARY	2 OFFSET BOUNDARY	BUFFER OFFSETS
0	$2^0=1$	Byte boundaries
1	$2^1=2$	Even-byte boundaries
2	$2^2=4$	Four-byte boundaries
3	$2^3=8$	Eight-byte boundaries
4	$2^4=16$	16-byte boundaries
5	$2^5=32$	32-byte boundaries

**** NOTE ****

1. A buffer may be altered between the WRITE BUFFER and READ BUFFER commands by execution of commands from another initiator or background diagnostics. Buffer testing applications may avoid buffer usage conflicts with other initiators by use of linked command, or by reserving the addressed LUN.

2. There is only one 512-byte NVRAM area available. This area may be accessed by any initiator. The NVRAM is not partitioned into “per initiator” areas.

4-3.16.2 READ BUFFER Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	1. Recovery was performed when synchronizing buffered write data to tape. 2. Recovery was performed when transferring data to the initiator.
3h	MEDIUM ERROR	1. Synchronization of buffered write data prior to the read operation failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. Synchronization of buffered write data failed due to a hardware failure. 2. Transfer of Read Buffer data to initiator failed due to hardware failure. 3. Read Buffer set to Mode 2 has the Allocation Length set > or < the Allocation Length of the prior WRITE BUFFER command.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the READ BUFFER command. 2. The Flag bit was set but the Link bit was not set. 3. An invalid value was encountered in a CDB field.
6h	UNIT ATTENTION	Indicates the READ BUFFER command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	READ BUFFER command was aborted.

4-3.17 READ POSITION command 34h

The READ POSITION command causes 20 bytes to be sent from the target to the initiator. The 20 bytes are a report of the position of the tape unit and information about blocks stored in the buffer; the format of this data is shown in paragraph 4-3.17.2 on page 4-76.

This command can be executed when no tape cartridge is loaded or when the tape unit is not ready. No tape movement is initiated due to this command.

4-3.17.1 READ POSITION CDB Description

READ POSITION is a ten-byte command. The bytes are shown below and described in Table 4-70. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	0	1	0	0
1	LUN			Reserved				BT
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-70. READ POSITION Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	34h	Operation code.
1	0		The BT bit dictates the format of values reported in the First Block Location and Last Block Location fields of the return data.
		0	Values in First Block Location and Last Block Location are to be reported as Logical block addresses. The first filemark or data block on tape is assigned logical block address 0; logical block addresses increase by 1 for each data block and filemark thereafter. The maximum Logical block address is 3FFFEFh.
		1	Values in First Block Location and Last Block Location are to be reported as Device specific block addresses (also known as Block IDs). The format of these device specific block addresses are shown in paragraph 4-3.17.3 on page 4-78.

4-3.17.2 READ POSITION Return Data

The READ POSITION Return Data is shown below and described in Table 4-71.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	BOP	EOP	Reserved			BPU	Reserved	
1	Partition number							
2	Reserved							
3	Reserved							
4	MSB							
5	First block location							
6								
7								LSB
8	MSB							
9	Last block location							
10								
11								LSB
12	Reserved							
13	MSB							
14	Number of blocks in buffer							
15								LSB
16	MSB							
17	Number of bytes in buffer							
18								
19								LSB

Table 4-71. READ POSITION Return Data Description

BYTE	BIT	DESCRIPTION
0	2	The Block Position Unknown (BPU) bit, if one, indicates that the first and last locations could not be determined by the tape unit; in this case the First Block Location field and the Last Block Location field do not contain valid information. If the BPU bit is zero then the First and Last block locations contain valid information. The reported BPU bit will be one if no tape cartridge is loaded.
0	6	The End-of-Partition (EOP) bit, if one, indicates that the tape unit is logically positioned between early-warning (LEOT) and the Physical End of Tape. If this bit is zero then the tape unit is positioned previous to early-warning.
0	7	The Beginning-of-Partition (BOP) bit, if one, indicates that the tape unit is logically positioned at the beginning of the tape; if the bit is zero then the tape unit is not logically positioned at beginning of tape. The tape unit is logically positioned at beginning of tape if and only if the next block to be written or to be read (forward) is block 0 (the first block on tape).[a]
1	0-7	The Partition number field is always set to 0. This tape unit only has one partition; the identification number of this partition is 0.
4-7		The First Block Location field indicates the current logical position. The value in this field is the block address of the next block to be transferred between the initiator and the tape unit if a READ or WRITE command is issued; the format of the block address reported is dictated by the BT bit setting as explained above.
8-11		The Last Block Location field indicates the physical position of the tape. The value in this field is the block address of the next block to be transferred between the buffer and the [tape] medium; the format of the block address reported is dictated by the BT bit setting as explained above. The current logical position and the physical position of tape can be different because blocks can be buffered both when reading and when writing. When writing, the First Block Location will be greater than or equal to the Last Block Location, the difference is the number of blocks that are in the buffer waiting to be written.[b] When reading forward, the Last Block Location will be greater than or equal to the First Block Location, the difference is the number of blocks that are in the buffer waiting to be read.
13-15		The Number of Blocks in Buffer field equals the number of blocks that are in the buffer waiting to be written to the medium. This field is set to zero if the buffer does not contain blocks to be written to tape.
16-19		The Number of Bytes in Buffer field equals the total number of data bytes that are in blocks in the buffer waiting to be written. This field is set to zero if the buffer does not contain blocks to be written to tape. When writing with compression enabled, the buffer actually contains the compressed bytes for the blocks waiting to be written; however the number of bytes reported in the Number of Bytes in Buffer field will always indicate the number of uncompressed bytes.

a. If the tape is positioned at Physical End of Tape then the BOP bit reported will necessarily be zero because no more blocks can be read or written; so if the BOP bit is sampled following a successful ERASE with the Long bit set to one, the BOP bit will be zero even if the ERASE was started from the beginning of tape.

b. When computing the difference between the First and Last Block Locations, only the logical block position portion of the Block IDs should be used if the BT bit is set to one.

READ POSITION

4-3.17.3 Description of Block ID Format

BYTES	7	6	5	4	3	2	1	0
	BITS							
0	Wrap	Physical reference						
1	Format code		Logical block position (MSB)					
2	MSB	Logical block position						
3								LSB

Table 4-72. Block ID Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-6	1-95	The Physical reference field will be in the range 1 to 95. The values in the range 1 to 95 indicate an approximate physical location on tape close to the target position.
0	7	0 1	The Wrap field indicates whether the target position is in the first wrap or second wrap[a] of tape. If Wrap equals 0 then the target position is in the first wrap. If Wrap equals 1 then the target position is in the second wrap.
1	6-7		The Format code field indicates the format of the tape cartridge. The meaning of the possible values are shown in Table 4-73. When writing the format code reported will be 01b (36 track, packeted.) When reading, the format code reported will be the format code contained in the tape being read.
1 2-3	0-5		A unique Logical block position is associated with each data block and filemark written on a tape. The first filemark or data block on tape is assigned Logical block position 0; the Logical block position increases by 1 for each data block and filemark thereafter. The maximum Logical block position is 3FFFEFh.

a. A 36 track tape consists of two interleaved groups of 18 tracks; each group is called a wrap. The first wrap is written first and runs from *Physical* BOT towards *Physical* EOT. The second wrap is written second and runs from *Physical* EOT towards *Physical* BOT. The tape unit hides the transition from the first wrap to the second wrap so that the user sees an [abstract] continuous length of tape running from *Logical* BOT (the beginning of the first wrap) to *Logical* EOT (the end of the second wrap).

Table 4-73. Format Codes

FORMAT CODE VALUE	FORMAT
00b	18 track, non-packeted
01b	36 track, packeted
10b	18 track, packeted
11b	reserved

4-3.17.4 READ POSITION Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the READ POSITION command. 2. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the READ POSITION command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	READ POSITION command was aborted. The READ POSITION command can be reissued.

4-3.18 READ REVERSE command 0Fh

The READ REVERSE command requests that the tape unit transfer blocks of data to the initiator. Any buffered write data or filemarks are written before this operation is executed. This command is similar to the READ command except that the direction of the read is reversed; blocks are transferred starting from the current position and progressing towards BOT.

**** NOTE ****

It is recommended that this command not be used extensively. The overall execution time of the READ REVERSE command is excessive due to the extra tape positioning involved.

4-3.18.1 READ REVERSE CDB Description

READ REVERSE is a six-byte command. The bytes are shown below and described in Table 4-74. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	1	1	1
1	LUN			Reserved			SILI	Fixed
2	MSB							
3	Transfer Length							
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-74. READ REVERSE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	0Fh	Operation code.
1	0	1 or 0	The Fixed bit specifies both the meaning of the transfer length field and whether fixed-length or variable-length blocks are to be transferred. If the Fixed bit is zero, a single block is transferred with the bytes transferred being the lesser of the actual block length or the requested transfer length. If the Fixed bit is one, the transfer length specifies the number of blocks to be transferred to the initiator.
1	1	1 or 0	Suppress Incorrect Length Indication (SILI) flag.
2-4			The Transfer Length indicates the number of bytes or blocks to transfer. The block length used is the current block length specified in the mode parameters block descriptor (refer to the Mode Select Block Descriptor in Table 4-47 on page 4- 53.) When the transfer length is zero, no data is transferred and the current position on the logical unit is not changed. This condition is not considered an error.

4-3.18.2 READ REVERSE CHECK CONDITION Status

If the fixed bit is one, then the Mode Parameter Block Descriptor Block Length must be non-zero. Otherwise CHECK CONDITION status is reported with the sense key as ILLEGAL REQUEST. See description of MODE SENSE for more details about the Mode Parameter Descriptor Block.

For data in EDRC format, it is impossible to transfer the bytes of blocks in reverse order for the tape format being used because of data packeting and data compression. If a block is to be read in the reverse direction, instead of transferring the block's bytes in reverse order, the tape unit spaces backward over the block to be read (logically positions to the BOT side of the block to be read) and then CHECK CONDITION status is reported. Within the sense data reported, the sense key is ILLEGAL REQUEST, the ASC and ASCQ are 30h and 02h respectively (indicating 'Cannot Read Medium - Incompatible Format'), and the Host ERPA code is 26. After receipt of this sense data, the initiator is expected to read forward to transfer the bytes of the block and then space backward one block (i.e. issue a READ command followed by a SPACE command, Code = 0 and Space count of -1.) Note: Even if more than one block is requested to be transferred by the READ REVERSE command in fixed block mode, the tape unit only spaces backward one block.

**** NOTE ****

This procedure is performed regardless of the tape format (i.e., 18-track clear data).

If the SILI bit is set to 1 and the Fixed bit is set to 0 then the tape unit checks for overlength conditions; however since the tape unit will never transfer bytes for the READ REVERSE command, an overlength condition for a READ REVERSE command will never occur. If the SILI bit is set to 1 and the Fixed bit is set to 1 then CHECK CONDITION status is reported. In the sense data reported, the sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN CDB.

If a filemark is encountered when reading in the reverse direction then CHECK CONDITION status is reported. In the sense data reported, the sense key is NO SENSE, the valid bit is 1 and the information field will equal the requested Transfer length. Upon termination, the logical position is the BOT side of the filemark encountered.

If the logical unit encounters BOT during a READ REVERSE command then CHECK CONDITION status is reported. In the sense data reported, the sense key is NO SENSE, the EOM bit is set to 1, the valid bit is 1 and the information field will equal the requested Transfer length.

4-3.18.3 READ REVERSE Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
0h	NO SENSE	1. Filemark encountered. 2. BOT encountered.
1h	RECOVERED ERROR	1. Recovery was performed when writing buffered data before the READ REVERSE command was executed. 2. Recovery was performed when reading data from tape.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. (Synchronize before READ REVERSE attempted.) 2. Error occurred when attempting to space backward over block to be read. 3. An attempt was made to write 36-track data on 18-track formatted medium. 4. The tape length in the cartridge is too long or too short.
4h	HARDWARE ERROR	1.Write of buffered data failed due to a hardware failure. (Synchronize before READ REVERSE attempted.) 2. Error occurred when attempting to space backward over block to be read.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the READ REVERSE command. 2. SILI bit set to 1 and Fixed bit set to 1. 3. Fixed bit is 1 but variable mode was indicated by the most recent MODE SELECT 4. The Flag bit was set but the Link bit was not set. 5. Bytes in block could not be transferred in reverse order.
6h	UNIT ATTENTION	Indicates the READ REVERSE command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	READ REVERSE command was aborted. the READ REVERSE command can be reissued.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the Read Reverse operation failed because physical End-of-Tape has been reached.

4-3.19 RECEIVE DIAGNOSTIC RESULTS command 1Ch

The RECEIVE DIAGNOSTIC RESULTS command requests that result data, generated for a previous SEND DIAGNOSTIC command, be sent to the initiator.

**** NOTE ****

The results of the SEND DIAGNOSTIC command may be lost to another initiator on the SCSI bus if the LUN under test has not been reserved to this initiator, or if the RECEIVE DIAGNOSTIC RESULTS command is not linked after the SEND DIAGNOSTIC command.

4-3.19.1 RECEIVE DIAGNOSTIC RESULTS CDB Description

RECEIVE DIAGNOSTIC RESULTS is a six-byte command. The bytes are shown below and described in Table 4-75. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	0	0
1	LUN			Reserved				
2	Reserved							
3	MSB	Allocation Length						
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-75. RECEIVE DIAGNOSTIC RESULTS Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	1Ch	Operation code.
3-4			The Allocation Length specifies the maximum number of bytes that the initiator has allocated for returned RECEIVE DIAGNOSTIC data. An allocation length of 0 indicates that no RECEIVE DIAGNOSTIC data is transferred. This condition is not considered an error. The target terminates the DATA IN phase when all allocation length bytes have been transferred or when all available RECEIVE DIAGNOSTIC data has been transferred to the initiator, whichever is less.

Table 4-76. RECEIVE DIAGNOSTIC Parameter List Length Field

PAGE CODE	ROUTINE	PARAMETER LIST LENGTH
N/A	SelfTest	N/A
00h	-	6
80h	01h	20
80h	50h	20
80h	51h	20
80h	52h	20
80h	53h	20
80h	54h	20
80h	57h	20
80h	C0h	20
80h	C2h	20
-	01h	16
-	50h	16
-	51h	16
-	52h	16
-	53h	16
-	54h	16
-	57h	16
-	C0h	16
-	C2h	16

4-3.19.2 Diagnostic Page Codes (PF=1 in SEND DIAGNOSTIC command CDB)

If the Page Format (PF) bit was set to 1 in a previous SEND DIAGNOSTIC command, the RECEIVE DIAGNOSTIC RESULTS command will return diagnostic result data in paged format with 00h or 80h as the returned Page Code. Refer to Table 4-77 and Table 4-78.

Table 4-77. Diagnostic Page Codes

QUALIFIER	DESCRIPTION
00h	Supported diagnostics pages (see Table 4-79)
80h	Online diagnostic test page (see Table 4-80)

Table 4-78. Receive Diagnostic Results Page, General Form

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (XXh)							
1	Reserved							
2-3	Page Length (n-3)							
4-N	Diagnostic Parameters							

Description of the Page Code 00h

The Page Code 00h instructs the target to make available the list of all supported diagnostic pages to be returned by a subsequent RECEIVE DIAGNOSTIC RESULTS command.

Table 4-79. Page 00h - Supported Diagnostic Pages

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (00h)							
1	Reserved							
2-3	Page Length (0002h)							
4	Supported page list (00h)							
5	Supported page list (80h)							

Description of the Page Code 80h

Table 4-80. Page 80h - Online Diagnostic Test Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (80h)							
1	Reserved							
2-3	Page Length (0010h)							
4	Routine in error (Routine number)							
5	Execute Count (Pass Count)							
6-7	First Fault Symptom Code							
8-9	Second Fault Symptom Code							
10-11	Third Fault Symptom Code							
12-19	Reserved							

Table 4-81. Page 80h Field Description

BYTE	BIT	VALUE	DESCRIPTION
4	0-7		The Routine in Error field contains the Routine ID of the failing routine. If this field contains 00h, no errors were detected during the last execution of a SEND DIAGNOSTIC command.
5	0-7		The Execute Count field contains the number of passes attempted before an error was detected. If an error is detected on the first pass, this field contains a 1. This field is reset each time a new (different) routine is started. For example: if the SEND DIAGNOSTIC command Parameter list contained a pass count of 4 for Routine 50, and a pass count of 7 for Routine 51, and an error was detected on the third attempt to execute Routine 51, this field would contain a 3.
6-11			This field contains the Fault Symptom Codes that indicate the cause of the error.

4-3.19.3 Diagnostic Parameter List (PF=0 in SEND DIAGNOSTIC command CDB)

If the Page Format (PF) bit was cleared to 0 in a previous SEND DIAGNOSTIC command, the RECEIVE DIAGNOSTIC RESULTS command will return diagnostic result data in parameter list format.

Table 4-82. Online Diagnostic Results data Parameter List

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Routine in error (Routine number)							
1	Execute Count (Pass Count)							
2-3	First Fault Symptom Code							
4-5	Second Fault Symptom Code							
6-7	Third Fault Symptom Code							
8-15	Reserved							

Description of fields in Diagnostic Results data in Parameter List

Table 4-83. Parameter List Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		The Routine in Error field contains the Routine ID of the failing routine. If this field contains 00h, no errors were detected during the last execution of a SEND DIAGNOSTIC command.
1	0-7		The Execute Count field contains the number of passes attempted before an error was detected. If an error is detected on the first pass, this field contains a 1. This field is reset each time a new (different) routine is started. For example: if the SEND DIAGNOSTIC command Parameter list contained a pass count of 4 for Routine 50, and a pass count of 7 for Routine 51, and an error was detected on the third attempt to execute Routine 51, this field would contain a 3.
2-7	0-7		This field contains the Fault Symptom Codes that indicate the cause of the error.

4-3.19.4 RECEIVE DIAGNOSTIC RESULTS CHECK CONDITION Status

If the initiator does not send a SEND DIAGNOSTIC command first, the command is terminated with GOOD status and the target does not transfer any result data.

All reserved bits must be zero. If these bits are set to one, the command is terminated with CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.

4-3.19.5 RECEIVE DIAGNOSTIC RESULTS Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data, before the buffered mode operation occurred in RECEIVE DIAGNOSTIC RESULTS command.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. SCSI interface error occurred due to a hardware failure (e.g. transfer of RECEIVE DIAGNOSTIC RESULTS data failed due to a hardware failure). 2. Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the RECEIVE DIAGNOSTIC RESULTS command. 2. Flag bit in the RECEIVE DIAGNOSTIC RESULTS CDB was set and the Link bit was not set.
6h	UNIT ATTENTION	Indicates the RECEIVE DIAGNOSTIC RESULTS command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	RECEIVE DIAGNOSTIC RESULTS command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the RECEIVE DIAGNOSTIC RESULTS operation failed because physical End-of-Tape has been reached.

4-3.20 RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) command 1Ch

The RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) command requests that result data, generated for a previous SEND DIAGNOSTIC command, be sent to the initiator.

**** NOTE ****

The RECEIVE DIAGNOSTIC RESULTS command as described in this section requires that the tape drive be set in FACTORY MODE.

**** NOTE ****

The results of the SEND DIAGNOSTIC command may be lost to another initiator on the SCSI bus if the LUN under test has not been reserved to this initiator, or if the RECEIVE DIAGNOSTIC RESULTS command is not linked after the SEND DIAGNOSTIC command.

4-3.20.1 RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) CDB Description

RECEIVE DIAGNOSTIC RESULTS is a six-byte command. The bytes are shown below and described in Table 4-84. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	0	0
1	LUN			Reserved				
2	Reserved							
3	MSB	Allocation Length						
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-84. RECEIVE DIAGNOSTIC RESULTS Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	1Ch	Operation code.
3-4			The Allocation Length specifies the maximum number of bytes that the initiator has allocated for returned RECEIVE DIAGNOSTIC data. An allocation length of 0 indicates that no RECEIVE DIAGNOSTIC data is transferred. This condition is not considered an error. The target terminates the DATA IN phase when all allocation length bytes have been transferred or when all available RECEIVE DIAGNOSTIC data has been transferred to the initiator, whichever is less. (Refer to Table 4-76 for parameter list length values for RECEIVE DIAGNOSTIC RESULTS in FACTORY MODE).

RECEIVE DIAGNOSTIC RESULTS

Table 4-85. RECEIVE DIAGNOSTIC (FACTORY MODE) Parameter List Length Field

PAGE CODE	ROUTINE	PARAMETER LIST LENGTH
N/A	SelfTest	N/A
00h	-	23
80h	01h	20
80h	50h	20
80h	51h	20
80h	52h	20
80h	53h	20
80h	54h	20
80h	57h	20
80h	C0h	20
80h	C2h	20
81h	-	68
90h-9Fh	-	36
-	01h	16
-	50h	16
-	51h	16
-	52h	16
-	53h	16
-	54h	16
-	57h	16
-	C0h	16
-	C2h	16

4-3.20.2 Diagnostic Page Codes (PF=1 in SEND DIAGNOSTIC command CDB)

If the Page Format (PF) bit was set to 1 in a previous SEND DIAGNOSTIC command, the RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) command will return diagnostic result data in paged format with 00h, 80h, 81h, and 90h through 9Fh as the returned Page Code. Refer to Table 4-86 and Table 4-87.

Table 4-86. Diagnostic Page Codes

QUALIFIER	DESCRIPTION
00h	Supported diagnostics pages (see Table 4-79)
80h	Online diagnostic test page (see Table 4-80)
81h	Manufacturing Online diagnostic test page (FACTORY MODE only, see Table 4-91)
90-9Fh	MTU Online diagnostic test pages (FACTORY MODE only, see Table 4-93)

Table 4-87. Receive Diagnostic Results Page, General Form

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (XXh)							
1	Reserved							
2-3	Page Length (n-3)							
4-N	Diagnostic Parameters							

Description of the Page Code 00h

The Page Code 00h instructs the target to make available the list of all supported diagnostic pages to be returned by a subsequent RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) command.

Table 4-88. Page 00h - Supported Diagnostic Pages (FACTORY MODE)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (00h)							
1	Reserved							
2-3	Page Length (0013h)							
4	Supported page list (00h)							
5	Supported page list (80h)							
6	Supported page list (81h)							
7	Supported page list (90h)							

Table 4-88. Page 00h - Supported Diagnostic Pages (FACTORY MODE) (Continued)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
8	Supported page list (91h)							
9	Supported page list (92h)							
10	Supported page list (93h)							
11	Supported page list (94h)							
12	Supported page list (95h)							
13	Supported page list (96h)							
14	Supported page list (97h)							
15	Supported page list (98h)							
16	Supported page list (99h)							
17	Supported page list (9Ah)							
18	Supported page list (9Bh)							
19	Supported page list (9Ch)							
20	Supported page list (9Dh)							
21	Supported page list (9Eh)							
22	Supported page list (9Fh)							

Description of the Page Code 80h

Table 4-89. Page 80h - Online Diagnostic Test Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (80h)							
1	Reserved							
2-3	Page Length (0010h)							
4	Routine in error (Routine number)							
5	Execute Count (Pass Count)							
6-7	First Fault Symptom Code							
8-9	Second Fault Symptom Code							
10-11	Third Fault Symptom Code							
12-19	Reserved							

Table 4-90. Page 80h Field Description

BYTE	BIT	VALUE	DESCRIPTION
4	0-7		The Routine in Error field contains the Routine ID of the failing routine. If this field contains 00h, no errors were detected during the last execution of a SEND DIAGNOSTIC command.
5	0-7		The Execute Count field contains the number of passes attempted before an error was detected. If an error is detected on the first pass, this field contains a 1. This field is reset each time a new (different) routine is started. For example: if the SEND DIAGNOSTIC command Parameter list contained a pass count of 4 for Routine 50, and a pass count of 7 for Routine 51, and an error was detected on the third attempt to execute Routine 51, this field would contain a 3.
6-11			This field contains the Fault Symptom Codes that indicate the cause of the error.

Description of the Page Code 81h

Table 4-91. Page 81h - Online Manufacturing Diagnostic Test Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (81h)							
1	Reserved							
2-3	Page Length (0040h)							
4	Routine in error (Routine number)							
5	Execute Count (Pass Count)							
6-7	First Fault Symptom Code							
8-9	Second Fault Symptom Code							
10-11	Third Fault Symptom Code							
12-15	Expected Data							
16-19	Received Data							
20-23	Address							
24	PESSA ERPA code							
25	PESSA FORMAT							
26-41	PESSA DATA							
42-68	Reserved							

RECEIVE DIAGNOSTIC RESULTS

Table 4-92. Page 81h Field Description

BYTE	BIT	VALUE	DESCRIPTION
4	0-7		The Routine in Error field contains the Routine ID of the failing routine. If this field contains 00h, no errors were detected during the last execution of a SEND DIAGNOSTIC command.
5	0-7		The Execute Count field contains the number of passes attempted before an error was detected. If an error is detected on the first pass, this field contains a 1. This field is reset each time a new (different) routine is started. For example: if the SEND DIAGNOSTIC command Parameter list contained a pass count of 4 for Routine 50, and a pass count of 7 for Routine 51, and an error was detected on the third attempt to execute Routine 51, this field would contain a 3.
6-11	0-7		This field contains the Fault Symptom Codes that indicate the cause of the error.
12-15	0-7		This field contains the data that was expected by the diagnostic test reporting an error.
16-19	0-7		This field contains the data that was received by the diagnostic test reporting the error.
20-23	0-7		This field contains the hardware address where the expected and received data comparison was made by the diagnostic test reporting the error.
24	0-7		This field contains the Permanent Error Sense ERPA code relating to the reported error.
25	0-7		This field contains the Permanent Error Sense Format code.
26-41	0-7		This field contains the Permanent Error Sense Data bytes.

Description of the Page Code 90-9Fh

Table 4-93. Page 90-9Fh - Online Diagnostic Test Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page Code (90-9Fh)							
1	Reserved							
2-3	Page Length (0020h)							
4-5	MTU DIAG error code							
6-7	MTU DIAG result data 1							
8-9	MTU DIAG result data 2							
10-11	MTU DIAG result data 3							
12-13	MTU DIAG result data 4							
14-15	MTU DIAG result data 5							

Table 4-93. Page 90-9Fh - Online Diagnostic Test Page (Continued)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
16-17	MTU DIAG result data 6							
18-19	MTU DIAG result data 7							
20-21	MTU DIAG result data 8							
22-23	MTU DIAG result data 9							
24-25	MTU DIAG result data 10							
26-27	MTU DIAG result data 11							
28-29	MTU DIAG result data 12							
30-31	MTU DIAG result data 13							
32-33	MTU DIAG result data 14							
34-35	MTU DIAG result data 15							

Description of fields in Page Codes 90-9Fh

Table 4-94. Page Code 90-9Fh Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		MTU Diagnostic Page Code.
4-5	0-7		The MTU Diagnostic Error Code field will contain a non-zero value if an error was detected during diagnostic operation.
6-35	0-7		MTU Diagnostic result data 1 - 15. These 16-bit fields are used to report details of the diagnostic operation which are specific to the diagnostic test being executed. See Chapter 8 for more information on MTU Diagnostic Result Data.

4-3.20.3 Diagnostic Parameter List (PF=0 in SEND DIAGNOSTIC command CDB)

If the Page Format (PF) bit was cleared to 0 in a previous SEND DIAGNOSTIC command, the RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) command will return diagnostic result data in parameter list format.

Table 4-95. Online Diagnostic Results data Parameter List

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Routine in error (Routine number)							
1	Execute Count (Pass Count)							
2-3	First Fault Symptom Code							
4-5	Second Fault Symptom Code							
6-7	Third Fault Symptom Code							
8-15	Reserved							

Description of fields in Diagnostic Results data in Parameter List

Table 4-96. Parameter List Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		The Routine in Error field contains the Routine ID of the failing routine. If this field contains 00h, no errors were detected during the last execution of a SEND DIAGNOSTIC command.
1	0-7		The Execute Count field contains the number of passes attempted before an error was detected. If an error is detected on the first pass, this field contains a 1. This field is reset each time a new (different) routine is started. For example: if the SEND DIAGNOSTIC command Parameter list contained a pass count of 4 for Routine 50, and a pass count of 7 for Routine 51, and an error was detected on the third attempt to execute Routine 51, this field would contain a 3.
2-7	0-7		This field contains the Fault Symptom Codes that indicate the cause of the error.

4-3.20.4 RECEIVE DIAGNOSTIC RESULTS CHECK CONDITION Status

If the initiator does not send a SEND DIAGNOSTIC command first, the command is terminated with GOOD status and the target does not transfer any result data.

All reserved bits must be zero. If these bits are set to one, the command is terminated with CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.

4-3.20.5 RECEIVE DIAGNOSTIC RESULTS Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data, before the buffered mode operation occurred in RECEIVE DIAGNOSTIC RESULTS command.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. SCSI interface error occurred due to a hardware failure (e.g. transfer of RECEIVE DIAGNOSTIC RESULTS data failed due to a hardware failure). 2. Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the RECEIVE DIAGNOSTIC RESULTS command. 2. Flag bit in the RECEIVE DIAGNOSTIC RESULTS CDB was set and the Link bit was not set.
6h	UNIT ATTENTION	Indicates the RECEIVE DIAGNOSTIC RESULTS command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	RECEIVE DIAGNOSTIC RESULTS command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the RECEIVE DIAGNOSTIC RESULTS operation failed because physical End-of-Tape has been reached.

RECOVER BUFFERED DATA

4-3.21 RECOVER BUFFERED DATA command 14h

RECOVER BUFFERED DATA requests that the tape unit transfer one or more blocks of data from the tape unit's buffer to the initiator. The command is used to retrieve data contained in the buffer that had been sent earlier by the initiator to be written to the medium [tape]. The command is typically used following an error condition which indicates that data could not be written to the medium [tape]. Several RECOVER BUFFERED DATA commands may be needed to retrieve all buffered write blocks.

The Information field of sense data returned for a RECOVER BUFFERED DATA command is analogous to the Information field of sense data returned for a READ command. Please see the READ command description in paragraph 4-3.14 on page 4-63 for a description of this field.

4-3.21.1 RECOVER BUFFERED DATA CDB Description

RECOVER BUFFERED DATA is a six-byte command. The bytes are shown below and described in Table 4-97. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	0	0
1	LUN			Reserved			SILI	Fixed
2	MSB							
3	Transfer Length							
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-97. RECOVER BUFFERED DATA Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	14h	Operation Code.
1	0		The Fixed bit specifies both the meaning of the transfer length field and whether fixed-length or variable-length blocks are to be transferred. If the Fixed bit is zero, a single block is transferred with the bytes transferred being the lesser of the actual block length or the requested transfer length. If the Fixed bit is one, the transfer length specifies the number of blocks to be transferred to the initiator.
1	1		Suppress Incorrect Length Indication (SILI) flag.
2-4			The Transfer Length indicates the number of bytes or blocks to transfer. The block length used is the current block length specified in the mode parameters block descriptor (refer to the Mode Select Block Descriptor in Table 4-47 on page 4- 53.) When the transfer length is zero, no data is transferred and the current position on the logical unit is not changed. This condition is not considered an error.

4-3.21.2 RECOVER BUFFERED DATA Operation

Unlike the READ command, one can control the order that blocks are transferred for the RECOVER BUFFERED DATA command. The Recover Buffer Order (RBO) bit of the Mode Parameter Device Configuration page controls the transfer order. If the RBO bit is set to zero then blocks are transferred in the order that they were received from the initiator (First In First Out, FIFO, order); if the RBO bit is set to one then blocks are transferred in the opposite order that they were received from the initiator (Last In First Out, LIFO, order.)

The RECOVER BUFFERED DATA command is typically used in conjunction with the READ POSITION command following a permanent write error being detected. Here is one possible sequence to perform write error recovery after a write error has been detected:

1. A READ POSITION command is issued. This determines two items: first is how many blocks didn't get written to tape and are still buffered (this will be in the Number of blocks in buffer field) and second is the start location where the buffered blocks are to be written (this will be in the Last block location field.)

2. One or more RECOVER BUFFERED DATA commands are issued by the initiator to recover all blocks that still need to be written.

3. The tape cartridge being written to is unloaded, moved and loaded into a second tape unit.

4. A LOCATE command is issued to the second tape unit using as the target the start location obtained from the READ POSITION command issued earlier.

5. The recovered blocks are sent to the second tape unit using one or more WRITE commands.

4-3.21.3 RECOVER BUFFERED DATA CHECK CONDITION Status

The RECOVER BUFFERED DATA command will cause any buffered write data to be written to tape if the command is issued when no exception condition exists preventing data to be written to tape. In this case, assuming no errors occur when writing the buffered data to tape, CHECK CONDITION status will be reported for the command and the error sense will be as described for the case of requesting more blocks than are available to be recovered.

If a buffered filemark is encountered during a RECOVER BUFFERED DATA command, the target returns CHECK CONDITION status. Within the sense data for the CHECK CONDITION status, the sense key is NO SENSE, and both the Filemark and Valid bits are set to one. If the Fixed bit was one, the Information field will contain the difference (residue) of the requested transfer count minus the actual number of blocks recovered not including the filemark encountered. If the Fixed bit was zero, the Information field contains the requested transfer length.

If the RECOVER BUFFERED DATA command requests to transfer more blocks than remain in the buffer then CHECK CONDITION status will be returned after sending as many blocks as are available. In the sense data for the CHECK CONDITION status, the sense key is NO SENSE, and both the Valid bit and EOM bit are set to one. If the Fixed bit was one, the Information field will contain the difference (residue) of the requested transfer count minus the actual number of blocks recovered. If the Fixed bit was zero, the Information field contains the requested transfer length.

4-3.21.4 RECOVER BUFFERED DATA Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
0h	NO SENSE	1. SILI and Fixed bits are both zero and the actual length of the block transferred is different from the specified Transfer length field of the CDB. 2. Filemark encountered during the recover buffered data operation. 3. More blocks are requested to be transferred than are contained in the buffer
4h	HARDWARE ERROR	Transfer of data to initiator failed due to hardware failure
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB. 2. The Fixed bit was set to one, but the current mode is variable (as defined by the current Mode Select state). 3. The SILI and Fixed bits are both set to one. 4. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the RECOVER BUFFERED DATA command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	RECOVER BUFFERED DATA command was aborted
Dh	VOLUME OVERFLOW	Write of buffered data prior to the RECOVER BUFFERED DATA operation failed because physical End-of-Tape has been reached.

4-3.22 RELEASE UNIT command 17h

The RESERVE UNIT and RELEASE UNIT commands serve to resolve contention in multiple-initiator systems. The RELEASE UNIT command is used to release previously reserved logical units for the requesting initiator, or if it is a third-party release, for another specified SCSI device.

The SCSI device that releases the reservation of the tape logical unit, also automatically releases the reservation of the medium changer logical unit, even though the RELEASE UNIT command was directed to the tape logical unit. This is because the SCSI device that gains the reservation of the tape logical unit also automatically gains the reservation of the medium changer logical unit.

The RESERVE UNIT and RELEASE UNIT commands are not supported for the medium changer logical unit, however, releasing the reservation of the tape logical unit will serve as a method of releasing the medium changer logical unit as well.

4-3.22.1 RELEASE UNIT CDB Description

RELEASE UNIT is a six-byte command. The bytes are shown below and described in Table 4-98. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	1	1
1	LUN			3rd Party	3rd Party Dev ID			Reserved
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-98. RELEASE UNIT Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	17h	Operation Code.
1	1-3		The 3rd Party Dev ID is the SCSI device for whom a third-party reservation has been made.
1	4	0 1	If the 3rd Party bit is zero, then the initiator that made the non-third-party reservation, releases the reserved device. If the 3rd Party bit is one, the initiator that made a third-party reservation for the device specified in the “3rd Party Dev ID” field releases the reservation for that same device.

4-3.22.2 RELEASE UNIT Operation

If a valid reservation exists for the Initiator-Target-LUN combination, the target releases the reservation and returns GOOD status.

A reservation may only be released by the initiator that made it. It is not an error to attempt to release a reservation that is not currently valid. In this case, the target returns GOOD status without altering any other reservation.

Third Party Release allows an initiator to release a logical unit that was previously reserved using a third-party reservation.

4-3.22.3 RELEASE UNIT Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed while writing buffered data before the RELEASE UNIT occurred.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the RELEASE UNIT command. 2. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the RELEASE UNIT command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	The RELEASE UNIT command was aborted.

4-3.23 REQUEST SENSE command 03h

The REQUEST SENSE command requests that the target transfer sense data to the initiator. The controller is capable of supplying 44 bytes (2Ch bytes) of sense. Refer to section 8-3 on page 8-4 for a description of the sense data received via this command.

4-3.23.1 REQUEST SENSE CDB Description

REQUEST SENSE is a six-byte command as shown below and described in Table 4-99. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	1	1
1	LUN			Reserved				
2	Reserved							
3	Reserved							
4	Allocation Length							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-99. REQUEST SENSE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	03h	Operation code.
4	0-7		The Allocation Length field specifies the maximum number of sense data bytes to be returned to the initiator. An allocation length of zero indicates that no sense data is returned and is not considered an error. The target terminates the sense data transfer when the allocation length bytes have been transferred or when all of the sense data have been transferred to the initiator, whichever is less. The additional sense length in the sense data is not altered to reflect truncation due to insufficient allocation length.

4-3.23.2 REQUEST SENSE CHECK CONDITION Status

The sense data is valid for a CHECK CONDITION status returned on the prior command. This sense data is preserved by the target for the initiator until retrieved by the REQUEST SENSE command or until the receipt of any other command for the same logical unit from the initiator that issued the command resulting in the CHECK CONDITION status. Sense data is cleared upon receipt of any subsequent command (including Request Sense) to the logical unit from the initiator receiving the CHECK CONDITION status.

The REQUEST SENSE command returns the CHECK CONDITION status only to report fatal errors for the REQUEST SENSE command.

Example:

a. The target receives a nonzero reserved bit in the command descriptor block.

b. An unrecovered parity error occurs on the DATA BUS.

c. A target malfunction prevents return of the sense data.

If any nonfatal error occurs during the execution of the REQUEST SENSE command, the target returns the sense data with GOOD status. Following a fatal error on a REQUEST SENSE command, sense data may be invalid.

4-3.23.3 REQUEST SENSE Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
4h	HARDWARE ERROR	SCSI interface error occurred due to hardware failure (e.g. transfer of Request Sense data failed due to hardware failure).
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the Request Sense command. 2. Flag bit in the Request Sense CDB was set and Link bit was not set.

4-3.24 Report Density Support command 44h

The REPORT DENSITY SUPPORT command provides a means for the initiator to retrieve information maintained by the target about the supported densities for the MTU logical unit.

**** NOTE ****

The support of the REPORT DENSITY SUPPORT command is configuration dependent. In order for this command to be supported, FT4 (Feature Mode 4), bit 6 (0x40) must be set to 1. This bit can be set via the CHANGE DEFINITION command (VPD page C1h, feature configuration byte 4) or via the operator panel, SETTING menu, option 80:S.FT4 (see Chapter 4 of the M2488 User's Guide). If the REPORT DENSITY SUPPORT command is received when FT4, bit 6 is set to 0, CHECK CONDITION status is generated. The sense key is set to ILLEGAL REQUEST with the additional sense code set to INVALID CDB OP CODE.

4-3.24.1 REPORT DENSITY SUPPORT CDB Description

REPORT DENSITY SUPPORT is a ten-byte command. The bytes are shown below and described in Table 4-100. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	1	0	0	0	1	0	0
1	Reserved							Media
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	MSB	Allocation Length						
8								LSB
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

REPORT DENSITY

Table 4-100. REPORT DENSITY SUPPORT Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	44h	Operation code.
1	0	 0b 1b	The Media bit indicates which DENSITY SUPPORT data blocks are to be returned. DENSITY SUPPORT data blocks are to be returned to the initiator for densities supported by the logical unit for any supported media. This includes density 09h described in Table 4-102 on page 7-107 and density 28h described in Table 4-103 on page 7-108. Density support data block(s) is to be returned to the initiator for densities supported by the mounted medium: a) If the mounted medium is a standard-length tape, there are two DENSITY SUPPORT data blocks returned. This includes density 09h described in Table 4-102 on page 7-107 and density 28h described in Table 4-103 on page 7-108. b) If the mounted medium is an extended-length tape, there is one DENSITY SUPPORT data block returned: density 28h described in Table 4-103 on page 7-108. Notes: a) The DENSITY SUPPORT data block's Capacity field corresponding to density 28h is dependent on the tape length when the Media bit in the CDB is set. Reference the description of the DENSITY SUPPORT data block's Capacity field in Table 4-104 on page 7-109. b) If the Media bit is one and the logical unit is NOT READY, CHECK CONDITION status is generated with a sense key of NOT READY.
7-8		xxh	Allocation Length field specifies the maximum number of bytes that the initiator has allocated for returned REPORT DENSITY SUPPORT data. An allocation length of zero indicates no data is to be transferred. This condition is not considered an error. The target terminates the DATA IN phase when allocation length bytes are transferred or when all available data is transferred to the initiator, whichever is less. An allocation length of at least 6Ah (106) should be specified in order for all of the maximum possible bytes to be returned to the initiator.

4-3.24.2 REPORT DENSITY SUPPORT Data

The REPORT DENSITY SUPPORT data contains a four-byte header, followed by one or two DENSITY SUPPORT data blocks. The DENSITY SUPPORT data blocks are in numerical ascending order of the primary density code value in each block. Each DENSITY SUPPORT data block represents a particular format including physical density information. The information in the DENSITY SUPPORT data blocks is intended to provide the initiator with a detailed description of the recording technologies supported by the logical unit. Density code values returned in the DENSITY SUPPORT data blocks may be used by the initiator in the Block Descriptor of a MODE SELECT command, however, the M2488 always operates in a fixed density support mode (i.e 18-track read; 36-track read/write) independent of the value sent in the Block Descriptor (reference the MODE SELECT command specification in section 4-3.12 on page 4-51).

REPORT DENSITY SUPPORT Header:

Table 4-101. REPORT DENSITY SUPPORT Header

	BITS								DEFAULT
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0-1	REPORT DENSITY SUPPORT Data Length								N.A.
2	Reserved								00h
3	Reserved								00h

The REPORT DENSITY SUPPORT data length indicates the number of bytes in the following data that is available to transfer. This data length does not include itself.

Table 4-102. DENSITY SUPPORT Data Block for density 09h (18-track, standard length tape)

	BITS								DEFAULT
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	Primary Density Code								09h
1	Secondary Density Code								09h
2	WrtOK	Dup	Deflt	Reserved					00h
3	Reserved								00h
4	Reserved								00h
5-7	Bits per mm								05D3h (1491)
8-9	Media Width (tenths of a mm)								0C07h (127)
10-11	Tracks								0012h (18)
12-15	Capacity (MB)								000000F0h (240)
16-23	Assigning Organization (58 33 20 20 20 20 20 20h)								“X3”
24 - 31	Density Name (31 38 20 54 52 41 43 4Bh)								“18 TRACK”
32 - 51	Description (33 34 38 30 2F 33 34 39 30 20 31 2F 32 22 20 54 41 50 45h)								“3480/3490 1/2” TAPE”

REPORT DENSITY

Table 4-103. DENSITY SUPPORT Data Block for density 28h (36-track, standard or extended length tape)

	BITS								DEFAULT
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	Primary Density Code								28h
1	Secondary Density Code								28h
2	WrtOK	Dup	Deflt	Reserved					A0h
3	Reserved								00h
4	Reserved								00h
5-7	Bits per mm								05D3h (1491)
8-9	Media Width (tenths of a mm)								0C07h (127)
10-11	Tracks								0024h (36)
12-15	Capacity (MB)								See Capac-ity field desc. in Table 4-104
16 - 23	Assigning Organization (58 33 20 20 20 20 20 20h)								“X3”
24 - 31	Density Name (33 36 20 54 52 41 43 4Bh)								“36 TRACK”
32 - 51	Description (33 34 39 30 45 20 31 2F 32 22 20 54 41 50 45 20 20 20 20 20h)								“3490E 1/2” TAPE”

REPORT DENSITY

Table 4-104. REPORT DENSITY SUPPORT Data Block Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		The Primary Density Code contains the value returned by a MODE SENSE command for the density described in the remainder of the DENSITY SUPPORT data block (reference the MODE SENSE command specification in section XX for more information on density codes reported by MODE SENSE).
1	0-7		The Secondary Density Code field contains the equivalent density code value when multiple density codes are assigned to the same recording technology (density, format, capacity, etc.). If no secondary density code exists, then this field is set to the Primary Density Code value in byte 0.
2	5	0 1	A Default (Deflt) bit of zero indicates this density is not the default density of the logical unit. A Deflt bit of one indicates this density is the default density of the logical unit.
2	6	0 1	A Dup bit of zero indicates this primary density code has exactly one DENSITY SUPPORT data block. A Dup bit of one indicates this primary density code is specified in more than one DENSITY SUPPORT data block.
2	7	0 1	A Write OK (WrtOK) bit of zero indicates the logical unit support for this density does not include writing to the media. A WrtOK bit of one indicates the logical unit is capable of writing this density to either: a) the currently mounted medium (Media bit in CDB is set to one), or b) for some media (Media bit in CDB is set to zero).
5-7			The Bits per mm field indicates the number of bits per millimeter per track as recorded on the medium. The value in this field shall be rounded up if the fractional value of the actual value is greater than or equal to 0.5. A value of zero indicates the number of bits per millimeter does not apply to this logical unit. **Direct comparison of this value between different vendors (possible products) is discouraged since the definition of bits may vary**.
8-9			The Media Width field indicates the width of the medium supported by this density. This field has units of tenths of millimeters. The value in this field shall be rounded up if the fractional value of the actual value is greater than or equal to 0.5.
10-11			The Tracks field indicates the number of data tracks supported on the medium by this density. **Direct comparison of this value between different vendors (possible products) is discouraged since the definition of the number of tracks may vary**.

Table 4-104. REPORT DENSITY SUPPORT Data Block Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
12-15			The Capacity field is intended to be used to determine that the correct density is being used, particularly when a lower-density format is required for interchange. The meaning of the Capacity field is dependent on the setting of the Media bit in the CDB: a) When the Media bit in the CDB is 0, the capacity field indicates the approximate capacity of the longest supported medium for this density. For density 09h (18-track) the approx. capacity is 240MB (F0h). For density 28h (36-track) the approx. capacity is 800MB (320H) (i.e. approx. capacity of the extended length tape, which is the longest supported medium for this density). b) When the Media bit in the CDB is 1, the capacity field indicates the approximate capacity of the currently mounted medium for this density. For density 09h the approx. capacity is 240MB (F0h). For density 28h, the capacity is dependent on the tape length (standard or extended) of the currently mounted medium. For standard length tapes, the approx. capacity is 400MB (190h). For extended length tapes, the approx. capacity is 800MB (320h). Notes: a) The capacity is based on compression being disabled. b) The capacity is based on the media being in “good” condition and that “normal” data and block sizes are used. c) The logical unit does not guarantee that this space is actually available in all cases. d) **Direct comparison of this value between different vendors (possibly products) is discouraged since the length of media and the method used to measure maximum capacity may vary.**
16-23			The Assigning Organization field contains eight bytes of ASCII data identifying the organization responsible for the information in this DENSITY SUPPORT data block. The data is left aligned within this field. The ASCII value for a space (20h) is used if padding is required.
24-31			The Density Name field contains eight bytes of ASCII data identifying the name that is associated with this DENSITY SUPPORT data block. The data is left aligned within this field.
32-51			The Description field contains 20 bytes of ASCII data describing the density. The data is left aligned within this field. The ASCII value for a space (20h) is used if padding is required.

4-3.24.3 REPORT DENSITY SUPPORT Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
2h	NOT READY	1. The Media bit is one and the logical unit is NOT READY.
3h	MEDIUM ERROR	1. Writing buffered data to tape failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	Write buffered data to tape failed due to a hardware error.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the REPORT DENSITY SUPPORT command. 2. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the REPORT DENSITY SUPPORT command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.

4-3.25 RESERVE UNIT command 16h

The RESERVE UNIT and RELEASE UNIT commands serve to resolve contention in multiple-initiator systems. The RESERVE UNIT command reserves the specified logical unit for the exclusive use of the requesting initiator, or if it is a third-party reservation, for another specified SCSI device.

The SCSI device that gains the reservation of the tape logical unit, also automatically gains the reservation of the medium changer logical unit, even though the RESERVE UNIT command was directed to the tape logical unit.

The RESERVE UNIT command is not supported for the medium changer logical unit, however, reservation of the tape logical unit will serve as a method of reserving the medium changer logical unit as well. The reservation on the medium changer logical unit will be released when a RELEASE UNIT command is issued for the tape logical unit.

4-3.25.1 RESERVE UNIT CDB Description

RESERVE UNIT is a six-byte command. The bytes are shown below and described in Table 4-105. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	1	0
1	LUN			3rd Party	3rd Party Dev ID			Reserved
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

RESERVE UNIT

Table 4-105. RESERVE UNIT Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	16h	Operation Code.
1	1-3		The 3rd Party Device ID specifies the SCSI device the reservation is for. This field is ignored when bit 4=0.
1	4		Third Party Reservation allows an initiator to reserve a logical unit for another SCSI device. If the 3rd Party bit is zero, then the RESERVE UNIT command is to reserve the logical unit for the initiator sending the command. If the 3rd Party bit is one then the logical unit will be reserved for the SCSI device specified in the 3rd Party Dev ID field.

4-3.25.2 RESERVE UNIT Operation

This command will always cause a synchronization unless:

The device is operating in Buffered Mode 1, wherein different initiators may have data in the buffer at the same time, or

A third-party reservation is being requested where the 3rd Party Dev ID is that of the initiator which currently has write data in the buffer.

This command requests that the entire logical unit be reserved for the exclusive use of the initiator until:

the reservation is superseded by another valid RESERVE UNIT command from the initiator that the device is currently reserved for,

the unit is released by a RELEASE UNIT command from the initiator that made the reservation,

a hard reset condition occurs,

a BUS DEVICE RESET message is received from any initiator, or

a power on cycle occurs.

The reservation is not granted if the logical unit is reserved by another initiator. It is permissible for an initiator to issue a RESERVE UNIT command to a logical unit that it has already reserved.

If the logical unit is reserved for another initiator, the target returns RESERVATION CONFLICT status.

If, after honoring the reservation, any other initiator tries to perform any command on the reserved logical unit other than an INQUIRY, REQUEST SENSE or RELEASE UNIT command, then the command is rejected with RESERVATION CONFLICT status. A RELEASE UNIT command is ignored by returning GOOD status without altering any reservations, if received from an initiator other than the one reserving the initiator.

The initiator will receive a BUSY (instead of a RESERVATION CONFLICT) status if the reserved device is in the process of executing a command for the initiator or third-party device that holds the reservation. The logical unit receiving the commands is checked for activity in progress before being checked for reservation rights. If the reserved logical unit was not busy with a command for the device that holds the reservation rights, then other initiators' commands will be rejected with the RESERVATION CONFLICT status.

If an initiator attempts to make a third-party reservation for itself (i.e. the 3rdParty Dev ID field has the same value as the ID of the initiator issuing the command), a CHECK CONDITION status will be returned with sense data indicating ILLEGAL REQUEST/INVALID FIELD IN CDB.

The target preserves a successful third-party reservation until:

it is superseded by another valid RESERVE UNIT command from the initiator that made the third-party reservation,

it is released by the initiator that made the third-party reservation,

a BUS DEVICE RESET message is received from any initiator, or

a hard reset condition occurs.

While a third party reservation is active, the target ignores any attempt to release the reservation made by any other initiator.

Superseding reservations. An initiator that currently has a logical unit reserved may modify the current reservation by issuing another RESERVE UNIT command to the same logical unit. The superseding reservation releases the current reservation if the superseding reservation request is granted. The current reservation is not modified if the superseding reservation request cannot be granted. If the superseding reservation cannot be granted because of conflicts with a previous reservation (other than the current reservation), then the target returns RESERVATION CONFLICT status.

4-3.25.3 RESERVE UNIT Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed while writing buffered data before the RESERVE UNIT occurred.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the RESERVE UNIT command. 2. Initiator attempted to perform a third-party reservation for its own ID. 3. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the RESERVE UNIT command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	The RESERVE UNIT command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the RESERVE UNIT operation failed because physical End-of-Tape has been reached.

4-3.26 REWIND command 01h

The REWIND command causes the logical unit to position to the beginning of tape. Any buffered write data and filemarks are written to the tape before the positioning is performed.

A single REWIND command may not actually cause the tape head to be physically positioned at the beginning of the tape; positioning may occur only in the buffer or the tape head may be physically positioned just before the first block but after the Density ID mark on the tape. Issuing two consecutive REWIND commands forces the logical unit to position the tape head at the physical beginning of tape. (This may prove useful for test purposes; e.g. The Density ID mark will always be read for a Read command following two consecutive REWIND commands.

4-3.26.1 REWIND CDB Description

REWIND is a six-byte command. The bytes are as shown below and described in Table 4-106. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	1
1	LUN			Reserved				Immed
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-106. REWIND Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	01h	Operation code for the rewind command.
1	0	0	If the Immed (Immediate) bit is 0, Status is not returned for the REWIND command until the rewind has completed or has failed.
		1	If the Immed (Immediate) bit is 1, Status is retumed for the REWIND command as soon as the CDB has been validated and any buffered write data and filemarks have been written to tape. The rewind operation has been started but not necessarily completed when status is returned.

4-3.26.2 REWIND CHECK CONDITION Status

If the status reported for the previous command was a CHECK CONDITION because data could not be written to the tape, then any buffered data is discarded before the rewind occurs.

If CHECK CONDITION status is reported for a REWIND command with the Immediate bit set to 1, then the rewind will not occur.

4-3.26.3 REWIND Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	1. Recovery was performed when writing buffered data before the rewind occurred. 2. Retries were needed to complete the rewind operation.
2h	NOT READY	Logical Unit was not ready. The tape cartridge was not loaded or the logical unit was not made ready.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware failure. 2. The rewind operation was not completed because of a hardware failure.
5h	ILLEGAL REQUEST	1. Illegal parameter was found in REWIND command CDB. The rewind operation was not performed. 2. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the REWIND command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	REWIND command was aborted. The REWIND command can be reissued.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the Read Reverse operation failed because physical End-of-Tape has been reached.

4-3.27 SEND DIAGNOSTIC command 1Dh

The SEND DIAGNOSTIC command requests the target to perform diagnostic tests on itself, or on the attached peripheral devices. After the receipt of a valid SEND DIAGNOSTIC command, the unit performs synchronization prior to execution of the SEND DIAGNOSTIC operation. Disconnection occurs, if allowed, during the execution of the function. When the Selftest bit is zero, this command is usually followed by a RECEIVE DIAGNOSTIC RESULTS command.

4-3.27.1 SEND DIAGNOSTIC CDB Description

SEND DIAGNOSTIC is a six-byte command. The bytes are shown below and described in Table 4-107. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	0	1
1	LUN			PF	Reserved	Selftest	DevOfL	UnitOfL
2	Reserved							
3	MSB	Parameter List Length						
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

The following Field Description table specifies the use of each field of the SEND DIAGNOSTIC CDB. Refer to Table 4-108 in conjunction with the following table for a more concise overview of how each field is used.

Table 4-107. SEND DIAGNOSTIC Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	1Dh	Operation code.
1	0	1	A UnitOfL (Unit Offline) bit of 1 enables write operations on user medium or operations that affect user visible medium positioning.
1	1	1	A DevOfL (Device Offline) bit of 1 enables diagnostic operations that may adversely affect operations to other logical units on the same target.
1	2	1 0	A Selftest bit of 1 directs the target to complete its default selftest. A Selftest bit of 0 directs the target to perform tests defined by the bytes in the parameter list. Successful completion of the function and preparation of a response is indicated by presentation of GOOD status. The response is then recovered by execution of the RECEIVE DIAGNOSTIC RESULTS command.

SEND DIAGNOSTIC

Table 4-107. SEND DIAGNOSTIC Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
1	4	1 0	A page format (PF) bit of one indicates the SEND DIAGNOSTIC parameters defined by ANSI standard X3.131-1994 are used. The PF bit specifies the parameter list consists of zero or more diagnostic pages and that the data returned by subsequent RECEIVED DIAGNOSTIC RESULTS command shall use the diagnostic page format. A PF bit of 0 indicates the SEND DIAGNOSTICS parameters are vendor specific. When the Self Test bit is 1, the PF bit can be 0 or 1 and the parameter list length must be 0. When the Self Test bit is 0 and the PF bit is 0, the parameter list length must be 0 or 16.
3-4			The Parameter List Length field specifies the length, in bytes, of the SEND DIAGNOSTIC parameter list to be transferred from the initiator to the target.

Table 4-108. SEND DIAGNOSTIC CDB Field Description Overview

PAGE CODE	ROUTINE	PF	SELFTEST	DEVOFL	UNITOFL	PARAMETER LIST LENGTH
N/A	SelfTest	X	1	X	X	0
00h	-	1	0	X	X	4
80h	01h	1	0	X	X	20
80h	50h	1	0	X	X	20
80h	51h	1	0	X	X	20
80h	52h	1	0	1	1	20
80h	53h	1	0	1	1	20
80h	54h	1	0	1	1	20
80h	57h	1	0	1	1	20
80h	C0h	1	0	1	1	20
80h	C2h	1	0	1	1	20
-	01h	0	0	X	X	16
-	50h	0	0	X	X	16
-	51h	0	0	X	X	16
-	52h	0	0	1	1	16
-	53h	0	0	1	1	16
-	54h	0	0	1	1	16

Table 4-108. SEND DIAGNOSTIC CDB Field Description Overview (Continued)

PAGE CODE	ROUTINE	PF	SELFTEST	DEVOFL	UNITOFL	PARAMETER LIST LENGTH
-	57h	0	0	1	1	16
-	C0h	0	0	1	1	16
-	C2h	0	0	1	1	16

NOTE: An “X” denotes “don’t care”.

4-3.27.2 SEND DIAGNOSTIC CHECK CONDITION Status

All reserved bits must be set to zero. If these bits are set to one, the command is terminated with CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.

A self test bit of one directs the target to complete its default self test, refer to the self test routine in Online Diagnostic Routine description in Chapter 8.

If the self test is requested, the parameter list length must be zero, indicating that no data is to be transferred. If it is not zero, the command is terminated with CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST. If the self test successfully passes, the command is terminated with GOOD status; otherwise, the command is terminated with CHECK CONDITION status and the sense key is set to HARDWARE ERROR. No Diagnostic Result file is prepared if the self test bit is 1. If the command completes with CHECK CONDITION, the resulting sense data contains the Fault Symptom Code. See Chapter 8 for a description of the sense data.

If the PF bit is 0 and the self test bit is 0, then the parameter list length must be 0 or 16, or else the command is terminated with CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.

A parameter list length of zero indicates that no data is transferred. This condition is not an error, no result file is prepared, and the command is terminated with GOOD status in this case. If the specified parameter list length results in truncation of one or more pages with the PF bit is set to one, the target terminates the SEND DIAGNOSTIC command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and additional sense key is set to INVALID FIELD IN CDB.

4-3.27.3 Diagnostic Pages (PF=1)

Refer to Chapter 8 for the test descriptions.

To use diagnostic pages, the Page Format (PF) bit must be set to 1. Data in the diagnostic pages is primarily used to select the tests to be executed and the number of times each test is to be run (execute count). A page code can not be used more than once within the command. If the same page code is sent, the target terminates the SEND DIAGNOSTIC command with CHECK CONDITION status.

The Diagnostic pages for the SEND DIAGNOSTIC command are 00h and 80h. If the page code is set to any unsupported value, the target terminates the SEND DIAGNOSTIC command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and additional sense key is set to INVALID FIELD IN PARAMETER LIST.

For all pages, the Page Length bytes must be set as indicated for bytes 2-3 in the following Page Code descriptions. If the page length is set to any other value, the target terminates the SEND

DIAGNOSTIC command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and an additional sense key is set to INVALID FIELD IN PARAMETER LIST.

Table 4-109. Send Diagnostic Page, General Form

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page code (XXh)							
1	Reserved (All bits are set to zero)							
2-3	Page Length (n-3)							
4-N	Page Parameter (If the Page Code is 00h, this parameter is not required)							

The Diagnostic page codes are shown in the following table.

Table 4-110. Diagnostic Page Codes

PAGE CODE	DESCRIPTION
00h	Supported diagnostics pages. See Table 4-111.
80h	Online diagnostic test page. See Table 4-112.

Description of the Page Code 00h

This page instructs the target to make available the list of all supported diagnostic pages to be returned by subsequent RECEIVE DIAGNOSTIC RESULTS command.

Table 4-111. Page 00h - Supported Diagnostic Pages

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page code (00h)							
1	Reserved (All bits are set to zero)							
2-3	Page Length (0000h)							

For Page Code 00h, the Page Length bytes must both be set to 00h. If the page length is set to any other value, the target terminates the SEND DIAGNOSTIC command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and an additional sense key is set to INVALID FIELD IN PARAMETER LIST.

Description of the Page Code 80h

This page allows user selection of Online Diagnostic Routines and control over the number of times each routine is to be executed.

Table 4-112. Page 80h - Online Diagnostic Test Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page code (80h)							
1	Reserved (All bits are set to zero)							
2-3	Page Length (0010h)							
4	Execute Count (Pass Count) of Online Routine 01h (Self Test)							
5	Execute Count (Pass Count) of Online Routine 50h							
6	Execute Count (Pass Count) of Online Routine 51h							
7	Execute Count (Pass Count) of Online Routine 52h							
8	Execute Count (Pass Count) of Online Routine 53h							
9	Execute Count (Pass Count) of Online Routine 54h							
10-11	Reserved (All bits are set to zero)							
12	Execute Count (Pass Count) of Online Routine 57h							
13	Execute Count (Pass Count) of Online Routine C0h							
14	Execute Count (Pass Count) of Online Routine C2h							
15-19	Reserved (All bits are set to zero)							

Selection of a diagnostic routine is accomplished by assigning a routine's corresponding Execute Count byte a non-zero value. Routines 50 to 57 are diagnostic specific to the Tape Drive logical unit, and routines C0 and C2 are specific to the Medium Changer logical unit. Therefore, if the Tape Drive logical unit is selected, only the Execute Count bytes corresponding to the Selftest routine (Routine 01) and routines 50 to 57 may have non-zero values. Bytes 1, 10-11, and 13-19 must be zero; otherwise a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key set to INVALID FIELD IN PARAMETER LIST. Conversely, if the Medium Changer logical unit has been selected, only the Execute Count bytes corresponding to routine C0 and/or C2 may have non-zero values. Bytes 1, 4-12, and 15-19 must be zero; otherwise a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key set to INVALID FIELD IN PARAMETER LIST.

Selection of routines 50 and 51 do not require either DevOfl or UnitOfl to be set. Selection of routines 52 to 57, or C0 to C2 require both DevOfl and UnitOfl to be set. If a parameter list is received by the controller which indicates selection of any of the routines 52 to 57, or C0 and/or C2, and both UnitOfl and DevOfl are not set, a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key is set to INVALID FIELD IN PARAMETER LIST.

If any error condition is encountered during execution of a routine, diagnostic result data is generated at that time and no further routine execution occurs.

4-3.27.4 Diagnostic Parameter List (PF=0)

Refer to Chapter 8 for the test descriptions.

To use the Diagnostic Parameter List, the Page Format (PF) bit must be cleared to 0. Data in the Diagnostic Parameter List indicates which tests are to be executed and the number of times each test is to be run (execute count). Use of the Diagnostic Parameter List is very similar to Diagnostic Page 80h described above. The format of the Diagnostic Parameter List is given in Table 4-113 below:.

Table 4-113. Diagnostic Parameter List

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Execute Count (Pass Count) of Online Routine 01h (Self Test)							
1	Execute Count (Pass Count) of Online Routine 50h							
2	Execute Count (Pass Count) of Online Routine 51h							
3	Execute Count (Pass Count) of Online Routine 52h							
4	Execute Count (Pass Count) of Online Routine 53h							
5	Execute Count (Pass Count) of Online Routine 54h							
6-7	Reserved (All bits are set to zero)							
8	Execute Count (Pass Count) of Online Routine 57h							
9	Execute Count (Pass Count) of Online Routine C0h							
10	Execute Count (Pass Count) of Online Routine C2h							
11-15	Reserved (All bits are set to zero)							

Selection of a diagnostic routine is accomplished by assigning a routine's corresponding Execute Count byte a non-zero value. Routines 01, and 50 to 57 are diagnostic specific to the Tape Drive logical unit, and routines C0 and C2 are specific to the Medium Changer logical unit. Therefore, if the Tape Drive logical unit is selected, only the Execute Count bytes corresponding to the Selftest routine (Routine 01) and routines 50 to 57 may have non-zero values. Bytes 6-7 and 9-15 must be zero; otherwise a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key set to INVALID FIELD IN PARAMETER LIST. Conversely, if the Medium Changer logical unit has been selected, only the Execute Count bytes corresponding to routine C0 and/or C2 may have non-zero values. Bytes 0-8 and 15-19 must be zero; otherwise a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key set to INVALID FIELD IN PARAMETER LIST.

Selection of routines 50 and 51 do not require either DevOfl or UnitOfl to be set. Selection of routines 52 to 57, or C0 to C2 require both DevOfl and UnitOfl to be set. If a parameter list is received by the controller which indicates selection of any of the routines 52 to 57, or C0 and/or C2, and both UnitOfl and DevOfl are not set, a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key is set to INVALID FIELD IN PARAMETER LIST. A summary of DevOfl and UnitOfl usage may be found in Table 4-108.

If any error condition is encountered during execution of a routine, diagnostic result data is generated at that time and no further routine execution occurs.

4-3.27.5 SEND DIAGNOSTIC Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data before the buffered mode operation occurred in SEND DIAGNOSTIC command.
3h	MEDIUM ERROR	1. Write of buffered data failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. SCSI interface error occurred due to hardware failure (e.g. transfer of SEND DIAGNOSTIC data failed due to hardware failure). 2. Write of buffered data failed due to a hardware failure. 3. The self-test is not successful in SEND DIAGNOSTIC command.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the SEND DIAGNOSTIC command. 2. Flag bit in the SEND DIAGNOSTIC CDB was set and Link bit was not set. 3. There is a parameter list error.
6h	UNIT ATTENTION	Indicates the SEND DIAGNOSTIC command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	SEND DIAGNOSTIC command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the SEND DIAGNOSTIC operation failed because physical End-of-Tape has been reached.

4-3.28 SEND DIAGNOSTIC (FACTORY MODE) command 1Dh

The SEND DIAGNOSTIC (FACTORY MODE) command requests the target to perform diagnostic tests on itself, or on the attached peripheral devices. After the receipt of a valid SEND DIAGNOSTIC command, the unit performs synchronization prior to execution of the SEND DIAGNOSTIC operation. Disconnection occurs, if allowed, during the execution of the function. When the self-test bit is zero, this command is usually followed by a RECEIVE DIAGNOSTIC RESULTS command.

**** NOTE ****

The SEND DIAGNOSTIC command as described in this section requires that the tape drive be set in FACTORY MODE.

4-3.28.1 SEND DIAGNOSTIC CDB Description

SEND DIAGNOSTIC is a six-byte command. The bytes are shown below and described in Table 4-114. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	1	0	1
1	LUN			PF	Reserved	Selftest	DevOfL	UnitOfL
2	Reserved							
3	MSB	Parameter List Length						
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

The following Field Description table specifies the use of each field of the SEND DIAGNOSTIC CDB. Refer to Table 4-115 in conjunction with the following table for a more concise overview of how each field is used.

Table 4-114. SEND DIAGNOSTIC (FACTORY MODE) Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	1Dh	Operation code.
1	0	1	A UnitOfL (Unit Offline) bit of 1 enables write operations on user medium or operations that affect user visible medium positioning.
1	1	1	A DevOfL (Device Offline) bit of 1 enables diagnostic operations that may adversely affect operations to other logical units on the same target.
1	2	1 0	A Selftest bit of 1 directs the target to complete its default selftest. A Selftest bit of 0 directs the target to perform tests defined by the bytes in the parameter list. Successful completion of the function and preparation of a response is indicated by presentation of GOOD status. The response is then recovered by execution of the RECEIVE DIAGNOSTIC RESULTS command.

SEND DIAGNOSTIC

Table 4-114. SEND DIAGNOSTIC (FACTORY MODE) Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
1	4	1 0	A Page Format (PF) bit of 1 indicates the SEND DIAGNOSTIC parameters defined by ANSI standard X3.131-1994 are used. The PF bit specifies the parameter list consists of zero or more diagnostic pages and that the data returned by subsequent RECEIVED DIAGNOSTIC RESULTS command shall use the diagnostic page format. A PF bit of 0 indicates the SEND DIAGNOSTICS parameters are vendor specific. When the Self Test bit is 1, the PF bit can be 0 or 1 and the parameter list length must be 0. When the Self Test bit is 0 and the PF bit is 0, the parameter list length must be 0 or 16.
3-4			The Parameter List Length field specifies the length, in bytes, of the SEND DIAGNOSTIC parameter list to be transferred from the initiator to the target.

Table 4-115. SEND DIAGNOSTIC (FACTORY MODE) CDB Field Description Overview

PAGE CODE	ROUTINE	PF	SELFTEST	DEVOFL	UNITOFL	PARAMETER LIST LENGTH
N/A	SelfTest	X	1	X	X	0
00h	-	1	0	X	X	4
80h	01h	1	0	X	X	20
80h	50h	1	0	X	X	20
80h	51h	1	0	X	X	20
80h	52h	1	0	1	1	20
80h	53h	1	0	1	1	20
80h	54h	1	0	1	1	20
80h	57h	1	0	1	1	20
80h	C0h	1	0	1	1	20
80h	C2h	1	0	1	1	20
81h	MFG TEST	1	0	1	1	34
90h-9Fh	MTU TEST	1	0	1	1	34
-	01h	0	0	X	X	16
-	50h	0	0	X	X	16
-	51h	0	0	X	X	16
-	52h	0	0	1	1	16

Table 4-115. SEND DIAGNOSTIC (FACTORY MODE) CDB Field Description Overview (Continued)

PAGE CODE	ROUTINE	PF	SELFTEST	DEVOFL	UNITOFL	PARAMETER LIST LENGTH
-	53h	0	0	1	1	16
-	54h	0	0	1	1	16
-	57h	0	0	1	1	16
-	C0h	0	0	1	1	16
-	C2h	0	0	1	1	16

NOTE: An “X” denotes “don’t care”.

4-3.28.2 SEND DIAGNOSTIC (FACTORY MODE) CHECK CONDITION Status

All reserved bits must be set to zero. If these bits are set to one, the command is terminated with CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.

A self test bit of one directs the target to complete its default self test, refer to the self test routine in Online Diagnostic Routine description in Chapter 8.

If the self test is requested, the parameter list length must be zero, indicating that no data is to be transferred. If it is not zero, the command is terminated with CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST. If the self test successfully passes, the command is terminated with GOOD status; otherwise, the command is terminated with CHECK CONDITION status and the sense key is set to HARDWARE ERROR. No Diagnostic Result file is prepared if the self test bit is 1. If the command completes with CHECK CONDITION, the resulting sense data contains the Fault Symptom Code. See Chapter 8 for a description of the sense data.

If the PF bit is 0 and the self test bit is 0, then the parameter list length must be 0 or 16, or else the command is terminated with CHECK CONDITION status and the sense key is set to ILLEGAL REQUEST.

A parameter list length of zero indicates that no data is transferred. This condition is not an error, no result file is prepared, and the command is terminated with GOOD status in this case. If the specified parameter list length results in truncation of one or more pages with the PF bit is set to one, the target terminates the SEND DIAGNOSTIC command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and additional sense key is set to INVALID FIELD IN CDB.

4-3.28.3 Diagnostic Pages (PF=1)

Refer to Chapter 8 for the test descriptions.

To use diagnostic pages, the Page Format (PF) bit must be set to 1. Data in the diagnostic pages is primarily used to select the tests to be executed and the number of times each test is to be run (execute count). A page code can not be used more than once within the command. If the same page code is sent, the target terminates the SEND DIAGNOSTIC command with CHECK CONDITION status.

The Diagnostic pages for the SEND DIAGNOSTIC (FACTORY MODE) command are 00h, 80h, 81h, and 90h through 9Fh. Pages 81h, and 90h through 9Fh require that FACTORY MODE be set before the SEND DIAGNOSTIC command is issued, otherwise these page codes are treated as unsupported values. If the page code is set to any unsupported value, the target terminates the

SEND DIAGNOSTIC command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and additional sense key is set to INVALID FIELD IN PARAMETER LIST.

For all pages, the Page Length bytes must be set as indicated for bytes 2-3 in the following Page Code descriptions. If the page length is set to any other value, the target terminates the SEND DIAGNOSTIC command with CHECK CONDITION status, the sense key is set to ILLEGAL REQUEST and an additional sense key is set to INVALID FIELD IN PARAMETER LIST.

Table 4-116. Send Diagnostic Page, General Form

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page code (XXh)							
1	Reserved (All bits are set to zero)							
2-3	Page Length (n-3)							
4-N	Page Parameter (If the Page Code is 00h, this parameter is not required)							

The Diagnostic Page Codes are shown in the following table.

Table 4-117. Diagnostic Page Codes

QUALIFIER	DESCRIPTION
00h	Supported diagnostics pages (see Table 4-118)
80h	Online diagnostic test page (see Table 4-119)
81h	Manufacturing Online diagnostic test page (FACTORY MODE only, see Table 4-120)
90-9Fh	MTU Online diagnostic test pages (FACTORY MODE only, see Table 4-122)

Description of Page Code 00h

This page instructs the target to make available the list of all supported diagnostic pages to be returned by subsequent RECEIVE DIAGNOSTIC RESULTS command.

Table 4-118. Page 00h - Supported Diagnostic Pages

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page code (00h)							
1	Reserved							
2-3	Page Length (0000h)							

Description of Page Code 80h

This page allows user selection of Online Diagnostic Routines and control over the number of times each routine is to be executed.

Table 4-119. Page 80h - Online Diagnostic Test Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page code (80h)							
1	Reserved (All bits are set to zero)							
2-3	Page Length (0010h)							
4	Execute Count (Pass Count) of Online Routine 01h (Self Test)							
5	Execute Count (Pass Count) of Online Routine 50h							
6	Execute Count (Pass Count) of Online Routine 51h							
7	Execute Count (Pass Count) of Online Routine 52h							
8	Execute Count (Pass Count) of Online Routine 53h							
9	Execute Count (Pass Count) of Online Routine 54h							
10-11	Reserved (All bits are set to zero)							
12	Execute Count (Pass Count) of Online Routine 57h							
13	Execute Count (Pass Count) of Online Routine C0h							
14	Execute Count (Pass Count) of Online Routine C2h							
15-19	Reserved (All bits are set to zero)							

Selection of a diagnostic routine is accomplished by assigning a routine's corresponding Execute Count byte a non-zero value. Routines 50 to 57 are diagnostic specific to the Tape Drive logical unit, and routines C0 and C2 are specific to the Medium Changer logical unit. Therefore, if the Tape Drive logical unit is selected, only the Execute Count bytes corresponding to the Selftest routine (Routine 01) and routines 50 to 57 may have non-zero values. Bytes 1, 10-11, and 13-19 must be zero; otherwise a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key set to INVALID FIELD IN PARAMETER LIST. Conversely, if the Medium Changer logical unit has been selected, only the Execute Count bytes corresponding to routine C0 and/or C2 may have non-zero values. Bytes 1, 4-12, and 15-19 must be zero; otherwise a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key set to INVALID FIELD IN PARAMETER LIST.

Selection of routines 50 and 51 do not require either DevOfl or UnitOfl to be set. Selection of routines 52 to 57, or C0 to C2 require both DevOfl and UnitOfl to be set. If a parameter list is received by the controller which indicates selection of any of the routines 52 to 57, or C0 and/or C2, and both UnitOfl and DevOfl are not set, a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key is set to INVALID FIELD IN PARAMETER LIST.

If any error condition is encountered during execution of a routine, diagnostic result data is generated at that time and no further diagnostic execution occurs.

Description of Page Code 81h

This page allows user selection of Manufacturing Online Diagnostic Routines and control over the number of times each routine is to be executed.

Table 4-120. Page 81h - Manufacturing Online Diagnostic Test Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page code (81h)							
1	Reserved (All bits are set to zero)							
2-3	Page Length (001Eh)							
4	Manufacturing Routine number							
5	Execute Count							
6	EDRC Compression Mode							
7	Block Delay (ms)							
8	Block Length (KB)							
9-11	Block Count							
12-13	Block Data Pattern							
14-15	Data Pattern Increment							
16-19	Block Number							
20-23	Space Count							
24-27	Write Filemark Count							
28-33	Reserved (All bits are set to zero)							

Description of fields in Page Code 81h

Table 4-121. Page Code 81h Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	81h	Page Code for Manufacturing Online Diagnostics.
4	0-7		Manufacturing Routine number (refer to Chapter 8 for a list of Manufacturing routines).
5	0-7		Execute Count. The number of times to repeat the Manufacturing Online Diagnostic Routine. A value of 0 indicates that the diagnostic will repeat until one of the following conditions is met: a SCSI BUS RESET is issued, the initiator ABORTS this command, or a failure is detected during the execution of the Manufacturing Online Diagnostic.

Table 4-121. Page Code 81h Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
6	0	0 1	A value of 0 indicates EDRC Compacted data transfer mode is used. A value of 1 is used to select EDRC Clear data transfer mode. Any other value will default to EDRC Compacted data transfer mode.
7	0-7		Number of milliseconds of delay inserted between each block to be transferred.
8	0-7		The length in KBytes (1 KByte = 1024 bytes) of each block to be transferred.
9-11	0-7		The number of blocks to be transferred. A value of zero is used to transfer from logical BOT to logical EOT.
12-13	0-7		A 16 bit data pattern to use for the first block written to tape. The same data pattern is used throughout the block.
14-15	0-7		A 16 bit value added to each subsequent block after the first block to be used to modify each block written. A value of 0 will cause every block to be written with the same data pattern. A most significant bit of 1 in this field has the effect of decrementing each block.
16-19	0-7		Block number. In Space/Locate operations, this is the block number to move to. In other operations, the value in this field will have no effect.
20-23	0-7		Number of Filemarks to Space/Locate past. In other operations, the value in this field will have no effect.
24-27	0-7		Number of Filemarks to locate to in Space/Locate operations. In other operations, the value in this field will have no effect.

A description of each Manufacturing Routine is provided in Chapter 8.

Selection of a Manufacturing Routine is achieved by assigning the routine number, execute count, and any other parameters (in bytes 6-27) associated with tests to be executed in the given Manufacturing Routine. Values in any field not used by a test in the given Manufacturing Routine are ignored.

Selection of a Manufacturing Routine requires that both the DevOfl and UnitOfl bits must be set to 1. If either of these bits is not set to 1, a CHECK CONDITION is returned with the sense key set to ILLEGAL REQUEST and the ASC set to INVALID FIELD IN PARAMETER LIST.

If any error condition is encountered during the execution of a routine, diagnostic result data is generated at that time nd no further diagnostic execution occurs.

Description of Page Codes 90-9Fh

This page allows user selection of MTU Online Diagnostic Routines and control over the number of times each routine is to be executed.

Table 4-122. Page 90-9Fh - MTU Online Diagnostic Test Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Page code (90-9Fh)							
1	Reserved (All bits are set to zero)							
2-3	Page Length (001Eh)							
4	MTU DIAG command code							
5	MTU DIAG parameter 1							
6	MTU DIAG parameter 2							
7	MTU DIAG parameter 3							
8	MTU DIAG parameter 4							
9	MTU DIAG parameter 5							
10	MTU DIAG parameter 6							
11	MTU DIAG parameter 7							
12	MTU DIAG parameter 8							
13	MTU DIAG parameter 9							
14-17	Execute Time							
18-21	Stop Time							
22-25	Execute Count (Pass Count)							
26-33	Reserved							

Description of fields in Page Codes 90-9Fh

Table 4-123. Page Code 90-9Fh Field Description

BYTE	BIT	VALUE	DESCRIPTION
4	0-7	00h-7Fh	MTU Diagnostic Command Code. The value in this field must be in the range of 00h to 7Fh or a CHECK CONDITION will result with Sense Key set to ILLEGAL REQUEST and additional Sense Key set to INVALID FIELD IN PARAMETER LIST.
5	0-7		MTU Diagnostic command parameter 1.

SEND DIAGNOSTIC

Table 4-123. Page Code 90-9Fh Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
6	0-7		MTU Diagnostic command parameter 2.
7	0-7		MTU Diagnostic command parameter 3.
8	0-7		MTU Diagnostic command parameter 4.
9	0-7		MTU Diagnostic command parameter 5.
10	0-7		MTU Diagnostic command parameter 6.
11	0-7		MTU Diagnostic command parameter 7.
12	0-7		MTU Diagnostic command parameter 8.
13	0-7		MTU Diagnostic command parameter 9.
14-17	0-7		This field has several meanings depending on which MTU Diagnostic command was issued. For read/write MTU Diagnostics, this field specifies the execution time of the read/write. For path test MTU Diagnostics, this field specifies start position. For Medium Changer MTU Diagnostics, this field specifies a cleaning count (FACL only).
18-21	0-7		This field has different meanings depending on which MTU Diagnostic command was issued. For the read/write DIAG, this field specifies the stop time of the read/write. For path test MTU Diagnostics, this field specifies the end position.
22-25	0-7		Number of times to execute a MTU diagnostic test.

A description of each MTU Diagnostic command is provided in Chapter 8.

Selection of MTU diagnostic commands is achieved by entering the MTU Diagnostic Command Code in byte 4, and any associated parameters in bytes 5-21. Bytes 22-25 are generally used to specify the number of times to execute the MTU Diagnostic command.

If an error condition is encountered during MTU Diagnostic command execution, diagnostic result data is generated at that time and no further diagnostic execution occurs.

4-3.28.4 Diagnostic Parameter List (PF=0)

Refer to Chapter 8 for the test descriptions.

To use the Diagnostic Parameter List, the Page Format (PF) bit must be cleared to 0. Data in the Diagnostic Parameter List indicates which tests are to be executed and the number of times each test is to be run (execute count). Use of the Diagnostic Parameter List is very similar to Diagnostic

Page 80h described above. The format of the Diagnostic Parameter List is given in Table 4-124 below.

Table 4-124. Diagnostic Parameter List

BYTES	BITS 7	6	5	4	3	2	1	0
0	Execute Count (Pass Count) of Online Routine 01h (Self Test)							
1	Execute Count (Pass Count) of Online Routine 50h							
2	Execute Count (Pass Count) of Online Routine 51h							
3	Execute Count (Pass Count) of Online Routine 52h							
4	Execute Count (Pass Count) of Online Routine 53h							
5	Execute Count (Pass Count) of Online Routine 54h							
6-7	Reserved (All bits are set to zero)							
8	Execute Count (Pass Count) of Online Routine 57h							
9	Execute Count (Pass Count) of Online Routine C0h							
10	Execute Count (Pass Count) of Online Routine C2h							
11-15	Reserved (All bits are set to zero)							

Selection of a diagnostic routine is accomplished by assigning a routine's corresponding Execute Count byte a non-zero value. Routines 01, and 50 to 57 are diagnostic specific to the Tape Drive logical unit, and routines C0 and C2 are specific to the Medium Changer logical unit. Therefore, if the Tape Drive logical unit is selected, only the Execute Count bytes corresponding to the Selftest routine (Routine 01) and routines 50 to 57 may have non-zero values. Bytes 6-7 and 9-15 must be zero; otherwise a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key set to INVALID FIELD IN PARAMETER LIST. Conversely, if the Medium Changer logical unit has been selected, only the Execute Count bytes corresponding to routine C0 and/or C2 may have non-zero values. Bytes 0-8 and 11-15 must be zero; otherwise a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key set to INVALID FIELD IN PARAMETER LIST.

Selection of routines 50 and 51 do not require either DevOfl or UnitOfl to be set. Selection of routines 52 to 57, or C0 to C2 require both DevOfl and UnitOfl to be set. If a parameter list is received by the controller which indicates selection of any of the routines 52 to 57, or C0 and/or C2, and both UnitOfl and DevOfl are not set, a CHECK CONDITION is returned with Sense Key set to ILLEGAL REQUEST and Additional Sense Key is set to INVALID FIELD IN PARAMETER LIST. A summary of DevOfl and UnitOfl usage may be found in Table 4-114.

If any error condition is encountered during execution of a routine, diagnostic results are generated at that time and no further routine execution occurs.

4-3.28.5 SEND DIAGNOSTIC Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data before the buffered mode operation occurred in SEND DIAGNOSTIC command.
3h	MEDIUM ERROR	1. Write of buffered data failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. SCSI interface error occurred due to hardware failure (e.g. transfer of SEND DIAGNOSTIC data failed due to hardware failure). 2. Write of buffered data failed due to a hardware failure. 3. The self-test is not successful in SEND DIAGNOSTIC command.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the SEND DIAGNOSTIC command. 2. Flag bit in the SEND DIAGNOSTIC CDB was set and Link bit was not set. 3. There is a parameter list error.
6h	UNIT ATTENTION	Indicates the SEND DIAGNOSTIC command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	SEND DIAGNOSTIC command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the SEND DIAGNOSTIC operation failed because physical End-of-Tape has been reached.

4-3.29 SPACE command 11h

The Space command changes the logical unit position relative to the current position. The Code and Count fields determine how this relative positioning is to be performed. Before the position change occurs, any buffered write data and filemarks are written to the tape.

4-3.29.1 SPACE CDB Description

SPACE is a six-byte command. The bytes are shown below and described in Table 4-125. Common fields are described in paragraph 4-3.1 on page 4-4.:

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	0	0	1
1	LUN			Reserved		Code Field		
2	MSB	Count Field						
3								
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-125. SPACE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	11h	Operation code.
1	0-2		The Code Field bits are described in Table 4-126.
2-4			The 3 byte Count Field is a 24-bit signed number (two's complement). When the count field is 0, no position change occurs and buffered write data will not necessarily be written to tape. To force buffered write data to tape, issue a WRITE FILEMARK command with a count of 0.

Table 4-126. Code Field Bits

CODE FIELD	TYPE	DESCRIPTION
000b	Space N Blocks	If the Count field is positive then space forward N blocks; N = Count. If the Count field is negative then space backward N blocks; N = -Count.
001b	Space N Filemarks	If the Count field is positive then position forward to the End-of-Tape side of the Nth filemark encountered; N = Count. If the Count field is negative then position backward to the Beginning-of-Tape side of the Nth filemark encountered; N = -Count.
010b	Space to N Sequential Filemarks	If the Count field is positive then position forward to the End-of-Tape side of the next occurrence of N consecutive filemarks; N = Count. If the Count field is negative then position backward to the Beginning-of-Tape side of the next occurrence of N consecutive filemarks; N = -Count.
011b	Space to End-of-Data	The count field is ignored. Upon successful completion, the tape is positioned such that a subsequent write command will append data after the last recorded block. If the tape is in 18-track format, end-of-data is defined as two sequential filemarks.

Table 4-126. Code Field Bits (Continued)

CODE FIELD	TYPE	DESCRIPTION
100b-111b	Invalid	These codes are not used by the unit.

4-3.29.2 SPACE CHECK CONDITION Status

If the Valid bit is set to 1 for Sense data for a CHECK CONDITION for a SPACE command, then the Information field in the Sense data contains a count of the remainder of blocks or filemarks not spaced over. If the spacing was in the reverse direction then the Information field value will be the negative of this remainder. The Information field in this case is a 32 bit signed number, 2's complement. In the case of a SPACE command by blocks stopped because a filemark was encountered, the filemark is not counted as a block that was spaced over. The Information field is not valid (the Valid bit is 0) for Sense data for a CHECK CONDITION when spacing to sequential filemarks.

Filemark Parameter:

If a filemark is encountered when spacing by blocks, the operation will stop. For forward spacing the final position will be the End-of-Tape side of the filemark. For backward spacing the final position will be the Beginning-of-Tape side of the filemark. CHECK CONDITION status will be reported for the Space command. Sense data will indicate NO SENSE; the Filemark bit will be 1; the Valid bit will be 1 and the Information field will be set as stated above.

End-of-Data Parameter:

If End-of-Data is encountered when spacing forward by blocks or filemarks (not to sequential filemarks), the operation will stop and the tape-unit remains positioned at End-of-Data. CHECK CONDITION status will be reported for the Space command. Sense data will indicate BLANK CHECK; the Valid bit will be 1 and the Information field will be set as stated above.

If End-of-Data is encountered when spacing forward to sequential filemarks, the operation will stop and the tape-unit remains positioned at End-of-Data. CHECK CONDITION status will be reported for the Space command. Sense data will indicate BLANK CHECK; the Valid bit will be 0.

End-of-Tape Parameter:

If End-of-Tape is encountered when spacing forward, the operation will stop and the tape-unit remains positioned at End-of-Tape. CHECK CONDITION status will be reported for the Space command. Sense data will indicate MEDIUM ERROR; the EOM bit will be 1; the Valid bit will be 1 and the Information field will be set as stated above.

Beginning-of-Tape Parameter:

If Beginning-of-Tape is encountered when spacing backward by blocks or filemarks (not to sequential filemarks), the operation will stop and the tape-unit remains positioned at Beginning-of-Tape. CHECK CONDITION status will be reported for the Space command. Sense data will indicate NO SENSE; the EOM bit will be 1; the Valid bit will be 1 and the Information field will be set as stated above.

If Beginning-of-Tape is encountered when spacing backward to sequential filemarks, the operation will stop and the tape-unit remains positioned at Beginning-of-Tape. CHECK CONDITION status will be reported for the Space command. Sense data will indicate NO SENSE; the EOM bit will be 1; the Valid bit will be 0.

The Report Early-Warning (REW) bit in the Device Configuration Page is not supported by this tape unit. No Early-Warning indication will occur when spacing.

4-3.29.3 SPACE Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
0h	NO SENSE	1. A filemark was encountered while spacing over blocks. 2. Beginning-of-Tape was encountered while spacing backward.
8h	BLANK CHECK	End-of-Data was encountered while spacing forward.
1h	RECOVERED ERROR	1. Recovery was performed when writing buffered data before the positioning occurred. 2. Retries were needed to complete the positioning.
2h	NOT READY	Logical Unit was not ready (tape was not loaded or wasn't ready).
3h	MEDIUM ERROR	1. Write of buffered data failed due to defective tape. 2. End-of-Tape was encountered while spacing forward. 3. An attempt was made to write 36-track data on 18-track formatted medium. 4. The tape length in the cartridge is too long or too short.
4h	HARDWARE ERROR	1. Write of buffered data failed due to a hardware failure. 2. The spacing operation was not completed because of a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the SPACE command. 2. Illegal Code field specified for SPACE command. 3. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the SPACE command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	Space command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the SPACE operation failed because physical End-of-Tape has been reached.

4-3.30 TEST UNIT READY command 00h

The TEST UNIT READY command provides a means to check if the logical unit is ready. This is not a request for a self-test. If the logical unit would accept an appropriate medium-access command without returning CHECK CONDITION status, this command returns a GOOD status.

4-3.30.1 TEST UNIT READY CDB Description

TEST UNIT READY is a six-byte command. The bytes are as shown below and described in Table 4-127. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	LUN			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-127. TEST UNIT READY Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	00H	Operation code.

4-3.30.2 TEST UNIT READY CHECK CONDITION Status

If a tape is not inserted or the drive is not ready, CHECK CONDITION status is returned with the sense key set to NOT READY.

4-3.30.3 TEST UNIT READY Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed while writing buffered data before the TEST UNIT READY occurred.
2h	NOT READY	Logical unit is not ready (tape is not inserted, or the drive is not ready).
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the TEST UNIT READY command. 2. Flag bit was set and link bit was not set.
6h	UNIT ATTENTION	Indicates the TEST UNIT READY command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the TEST UNIT READY operation failed because physical End-of-Tape has been reached.

4-3.31 WRITE command 0Ah

The WRITE command transfers one or more blocks from the initiator to the current position on the logical unit.

4-3.31.1 WRITE CDB Description

WRITE is a six-byte command. The bytes are as shown below and described in Table 4-128. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	1	0	1	0
1	LUN			Reserved				Fixed
2	MSB							
3				Transfer Length				
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-128. WRITE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	0Ah	Operation code.
1	0		The Fixed bit specifies both the meaning of the transfer length field and whether fixed-length or variable-length blocks are to be transferred. If the Fixed bit is zero, a single block is transferred with the bytes transferred being the lesser of the actual block length or the requested transfer length. If the Fixed bit is one, the transfer length specifies the number of blocks to be transferred to the initiator.
2-4			The Transfer Length indicates the number of bytes or blocks to transfer. The block length used is the current block length specified in the mode parameters block descriptor (refer to the Mode Select Block Descriptor in Table 4-47 on page 4- 53.) When the transfer length is zero, no data is transferred and the current position on the logical unit is not changed. This condition is not considered an error.

4-3.31.2 WRITE CHECK CONDITION Status

This control unit implements both fixed-block and variable-block modes. Reference the Read Block Limits and Mode Select (mode parameters block descriptor) commands for more information about fixed and variable block modes. If the Fixed bit is one and the current mode is variable (as set by MODE SELECT command or default power on condition) the command is rejected with a CHECK CONDITION and a sense key of Illegal Request. If the Fixed bit is zero, the WRITE command operates in variable block mode regardless of the current mode set by MODE SELECT.

If the Fixed bit is set to zero, a single block is transferred from the initiator and is written to the logical unit beginning at the current medium position. The transfer length specifies the length of the block to be written (in bytes). Upon successful termination, the logical position is located after the block written by this command (EOM side).

If the Fixed bit is set to one, the transfer length field specifies the number of block(s) to be transferred to the logical unit beginning at the current medium position. This form of the WRITE command is valid only if the logical unit is currently operating in fixed block mode (i.e., it has been instructed to use fixed-length blocks by a MODE SELECT command). Upon termination, the logical position is located after the block(s) written by this command (EOM side).

A successful WRITE command with the fixed bit of one, transfers the requested transfer length times the current block length in bytes from the initiator. A successful WRITE command with the fixed bit of zero, transfers the requested transfer length in bytes from the initiator.

If the transfer length specified by the WRITE command is 0, no data is transferred and the current position on the logical unit is not changed. This condition is not considered an error.

Buffered Mode:

Write data may be buffered or unbuffered, as indicated by the Buffered Mode field of the MODE SENSE command. For unbuffered operation, GOOD status is not returned until all data block(s) are successfully written to the medium. For buffered operation, GOOD status is returned as soon as all data block(s) are successfully transferred to the buffer.

If the early-warning condition is encountered while writing, an attempt to finish writing any buffered data is made depending on the value of the SEW (Synchronize at Early Warning) bit in the mode parameters (reference MODE SENSE/SELECT mode page 10h). The command terminates with a CHECK CONDITION status and the EOM and valid bits are set to one in the sense data. If all of the data has been written to tape, the sense key is set to NO SENSE. If any data that is to be written after encountering the early-warning condition cannot be written to tape due to physical EOM being encountered, the sense key is set to VOLUME OVERFLOW.

Sense Data Information Bytes:

When the valid bit is set to one in the sense data generated when CHECK CONDITION status is presented to the initiator for a WRITE command, then the information bytes in the sense data are defined as follows:

1) If the target is in unbuffered mode (Buffered Mode of the MODE SENSE command is 0) and the Fixed bit is one, the information bytes are set to the difference between the requested transfer length and the actual number of blocks written to the medium.

2) If the target is in unbuffered mode (Buffered Mode of the MODE SENSE command is 0) and the Fixed bit is zero, the information bytes are set to the requested transfer length.

3) If the target is in Buffered Mode (Buffered Mode of the MODE SENSE command is one or two) and the Fixed bit is one, the information bytes are set to the total number of blocks and filemarks not written (the number of blocks not transferred from the initiator plus the number of blocks and filemarks remaining in the target's buffer).

4) If the target is in Buffered Mode (Buffered Mode of the MODE SENSE command is one or two) and the Fixed bit is zero, the information bytes are set to the total number of bytes and filemarks not written (the number of bytes not transferred from the initiator plus the number of bytes and filemarks remaining in the target's buffer).

It is possible for the value in the information bytes of the sense data generated when a CHECK CONDITION is returned for a WRITE command to exceed the transfer length specified in the CDB of the WRITE command.

Early Warning Indication:

If a WRITE command is received while the logical unit is positioned after the early-warning indication (but before physical EOM), the target continues to operate in the current Buffered Mode as indicated in the mode parameters (reference MODE SENSE/SELECT data header) using the buffer size indicated by the Buffer Size at Early-Warning mode parameter (reference MODE SENSE/SELECT page 10h). The target also returns a CHECK CONDITION status for each of these WRITE commands. If all of the data is successfully transferred into the buffer and physical EOM has not been encountered, the sense key is set to NO SENSE, the valid and EOM bits are set to one, and the information bytes are set to zero. If physical EOM is encountered, the sense key is set to VOLUME OVERFLOW, the EOM bit is set to one, the valid bit is set to one, and the value of the information bytes are as described above.

Deferred Write Errors:

A deferred write error condition occurs when the target detects an error has occurred on a buffered WRITE command that previously reported GOOD status. This condition persists until one of the following occurs:

1) The deferred error is reported and the buffered data is recovered by the initiator via the Recover Buffered Data command.
2) The deferred error is reported and the buffered data is discarded by the initiator via the Rewind or Load/Unload command.
3) A BUS DEVICE RESET message is received from any initiator.
4) A hard reset condition is detected by the target.

If a deferred write error occurs while operating in Buffered Mode 1 (data from multiple initiators can reside in the buffer at once), the deferred write error is reported to the first initiator issuing the next command if other than INQUIRY or REQUEST SENSE. If a deferred write error occurs while operating in Buffered Mode 2 (the buffer can contain data from only one initiator), the error is reported to the initiator with unwritten data in the buffer. All other initiators receive BUSY status until the deferred error condition is cleared.

Additional Information:

The target ensures that some additional data can be written to the medium (e.g. filemarks) after the first EOM indication has been returned to the initiator.

The data written to the tape is written in EDRC compressed format depending on the Select Data Compression Algorithm field in the Mode (SENSE/SELECT) parameters, Mode Page 10h. See the description of the Mode SENSE/SELECT parameters for more information on the compression mode based on these items.

This device writes all data to tape in 36-track format. Therefor, if an attempt is made to write over 18-track data away from BOT, CHECK CONDITION status is generated. The sense key is set to MEDIUM ERROR and the additional sense code is set to INCOMPATIBLE MEDIUM INSTALLED.

4-3.31.3 WRITE Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
0h	NO SENSE	Tape is positioned between the Early-Warning position and End-of-Tape.
1h	RECOVERED ERROR	1. Recovery was performed when transferring data from the initiator. 2. Recovery was performed when writing data to tape.
2h	NOT READY	Logical Unit was not ready (tape was not loaded or wasn't ready).
3h	MEDIUM ERROR	1. Writing data to tape failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium. 3. The tape length in the cartridge is too long or too short.
4h	HARDWARE ERROR	1. Transferring data from the initiator failed due to a hardware failure 2. Writing data to tape failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the WRITE command. 2. The Fixed bit was set to one, but the current mode is variable (as set by MODE SELECT or default power on condition). 3. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the WRITE command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
7h	DATA PROTECT	Attempting write-type operation to a write-protected cartridge.
Bh	ABORTED COMMAND	WRITE command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the WRITE operation failed because physical End-of-Tape has been reached.

4-3.32 WRITE BUFFER command 3Bh

The WRITE BUFFER command is used in conjunction with the READ BUFFER command as a diagnostic function for testing target memory and the SCSI bus integrity. Additional modes are supported for downloading and saving microcode and writing data to NVRAM. All modes supported involve the transfer of data from the initiator to the target. Other than synchronizing any buffered write data to tape prior to performing the write buffer operation, this command does not alter tape medium of the target.

Operational Note. For initiators which do not have enough memory space from which to send the microcode image being downloaded with one WRITE BUFFER command in download microcode or download microcode and save modes, it is possible to use multiple WRITE BUFFER commands with the Mode of Write Data, incrementing the Buffer Offset appropriately, and then for the last WRITE BUFFER command, request the Mode of Download Microcode or Download Microcode and Save with the appropriate Buffer Offset and Transfer Length for the last portion of the microcode being downloaded. This requires that the microcode being downloaded always be written into the buffer starting at byte 0 (i.e. the first WRITE BUFFER command must have a Buffer Offset of zero).

4-3.32.1 WRITE BUFFER CDB Description

WRITE BUFFER is a ten-byte command. The bytes are shown below and described in Table 4-129. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	1	1	1	0	1	1
1	LUN			Reserved		Mode		
2	Buffer ID							
3	MSB							
4	Buffer Offset							
5								LSB
6	MSB							
7	Transfer Length							
8								LSB
9	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-129. WRITE BUFFER Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	3Bh	Operation code.
1	0-2		The Mode field is described in Table 4-130.
2	0-7		The Buffer ID field identifies a specific buffer within the target.
3-5			The Buffer Offset field specifies the offset in the buffer for the beginning of the data transfer. The Buffer Offset contains a multiple of the offset boundary specified in the offset boundary field of the READ BUFFER description.
6-8			The Transfer Length specifies the maximum number of bytes transferred during the DATA OUT phase to be stored in the specified buffer beginning at the Buffer Offset. The transfer length must not exceed the capacity of the specified buffer. The capacity of the buffer is shown in Table 4-131.

Table 4-130. WRITE BUFFER Modes

MODE BITS			IMPLEMENTED	MODES
2	1	0		
0	0	0	No	Write combined header and data
0	0	1	Yes	Vendor unique
0	1	0	Yes	Write data
0	1	1	No	Reserved
1	0	0	Yes	Download Microcode
1	0	1	Yes	Download Microcode and Save
1	1	0	Support based on bit 3 (0x08) in FT4 config. setting as described in M2488 User's Guide.	1) Feature in FT4 disabled: Reserved. 2) Feature in FT4 enabled: Download microcode with offsets.
1	1	1	Support based on bit 3 (0x08) in FT4 config. setting as described in M2488 User's Guide.	1) Feature in FT4 disabled: Reserved. 2) Feature in FT4 enabled: Download microcode with offsets and save.

Vendor Unique Mode (001b) and Write Data Mode (010b) Description. In these modes, the DATA OUT phase contains buffer data. The Buffer ID field identifies a specific buffer within the target. The supported buffer IDs for the vendor unique and write data modes are shown in Table 4-131. Data transfer occurs only within the buffer area indicated by the buffer ID. If an unsupported buffer ID value is selected, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of ILLEGAL FIELD IN CDB.

Table 4-131. Supported Buffer ID Values for Vendor Unique and Write Data Modes

BUFFER ID	DESCRIPTION	CAPACITY
0	Read/Write Data Buffer	Specified in the Buffer Capacity field of the Read Buffer Descriptor obtained via the Read Buffer command.
1	Read/Write non-volatile RAM	Specified in the Buffer Capacity field of the Read Buffer Descriptor obtained via the Read Buffer command (512 bytes).

NOTES:

1. The read/write data buffer and NVRAM are wrap-around buffers. Therefore, the entire capacity specified by the Read Buffer Descriptor is available, regardless of the offset specified.
2. Prior to allowing WRITE BUFFER command processing to occur for the read/write data buffer, the controller performs required positioning or synchronization. Buffered write data is written to tape and buffered read data is discarded.
3. There is only one 512-byte NVRAM area available. This area may be accessed by any initiator. The NVRAM is not partitioned into “per initiator” areas.
4. When a write buffer operation is performed in vendor unique or write data modes, a two byte CRC is appended. This CRC is handled in two ways when performing a read buffer operation depending on the Read Buffer mode. A Read Buffer in vendor unique mode reads the number of bytes requested and does not perform any CRC checking. A Read Buffer operation in data mode reads the number of bytes requested and an additional two bytes of CRC and then verifies the CRC. The CRC is then stripped away and not sent to the initiator with the other Read Buffer data.

**** NOTE ****

When performing Write Buffer operations to the Data Buffer, the maximum Transfer Length that can be written is the Buffer Capacity of the Data Buffer minus two. The two remaining bytes in the Data Buffer are needed to store the two byte CRC which is automatically appended to the data when it is stored in the buffer

Download Microcode Mode (100b) Description. In this mode, vendor-specific microcode is transferred to the control store memory of the target via the data buffer and then an automatic reset is performed causing the target to run from the new microcode. The downloaded microcode is not saved into non-volatile memory (i.e. flash memory), therefore; after a power-cycle, the target reverts to the previous version of microcode. After SCSI bus or Bus Device resets, the target continues to run from the downloaded code.

In the download microcode mode, Buffer ID 0 is the only Buffer ID supported. If any other Buffer ID value is selected, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

NOTES:

1. Since an automatic reset is performed upon completing the Write Buffer command in Download Microcode mode, the MICROCODE HAS BEEN CHANGED unit attention condition is replaced with the POWER ON/RESET unit attention condition.
2. The microcode image that is downloaded via the WRITE BUFFER command includes the controller and servo microcode. In the Download Microcode mode, only the controller microcode is copied to control store and activated. The downloaded servo microcode is not used and the previous servo code remains active. In order to change the servo code, a WRITE BUFFER command in Download Microcode and Save mode must be performed, followed by a power-cycle.

Download Microcode and Save Mode (101b) Description. In this mode, vendor-specific microcode is transferred to the target and, if the WRITE BUFFER command is completed successfully, is saved into a non-volatile memory (i.e. flash memory). The downloaded code shall then be effective after each power-cycle and reset until another download microcode and save operation is performed. When the download microcode and save command has completed successfully, the target shall generate a unit attention condition for all initiators except the one that issued the WRITE BUFFER command. When reporting the unit attention condition, the target shall set the additional sense code to MICROCODE HAS BEEN CHANGED.

NOTE: The saved microcode does not become the active code load until a power on reset is performed.

In the download microcode and save mode, Buffer ID 0 is the only Buffer ID supported. If any other Buffer ID value is selected, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

NOTES:

1. Following a successful microcode download and save operation, the target does not do an automatic reset and will continue running off of the old microcode. In order to run off of the new microcode which has been downloaded and saved, a power-cycle is required.
2. When a WRITE BUFFER command, with a mode of Download Microcode and Save is processed, the length of the microcode saved into flash will be calculated based on the buffer position of the last byte written into the buffer relative to buffer offset 0, byte 0. This requires that the microcode being downloaded always be written into the buffer starting at byte 0 (i.e. the first WRITE BUFFER command must have a Buffer Offset of zero).
3. The microcode image that is downloaded via the WRITE BUFFER command includes the controller and servo microcode. In the Download Microcode and Save mode, both the controller microcode and servo microcode are saved into flash following a successful download.

Download Microcode With Offsets Mode (110b) Description. In this mode, the transfer of vendor-specific microcode from the initiator to the target may be split over two or more Write Buffer commands. After the complete vendor-specific microcode image has been transferred from the initiator into the data buffer, the checksum is then verified and the microcode transferred to the control store memory of the target. After the transfer of the microcode into the control store memory is complete, an automatic reset is performed causing the target to run from the new microcode. The downloaded microcode is not saved into non-volatile memory (i.e. flash memory), therefore; after a power-cycle, the target reverts to the previous version of microcode. After SCSI bus or Bus Device resets, the target continues to run from the downloaded code.

In the download microcode with offsets mode, Buffer ID 0 is the only Buffer ID supported. If any other Buffer ID value is selected, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

The microcode is written into the data buffer starting at the location specified by the Buffer Offset. The first Write Buffer command initiating a download microcode with offsets mode operation must contain a Buffer Offset of zero. If this Buffer Offset is not zero, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB. Subsequent Write Buffer commands must contain a Buffer Offset such that the microcode is being downloaded contiguously (i.e. microcode bytes are being downloaded in sequential order with no gaps). If this Buffer Offset is incorrect, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

NOTES:

1. Since an automatic reset is performed upon completing the Write Buffer command in Download Microcode With Offsets mode, the MICROCODE HAS BEEN CHANGED unit attention condition is replaced with the POWER ON/RESET unit attention condition.
2. The microcode image that is downloaded via the WRITE BUFFER command includes the controller and servo microcode. In the Download Microcode With Offsets mode, only the controller microcode is copied to control store and activated. The downloaded servo microcode is not used and the previous servo code remains active. In order to change the servo code, a WRITE BUFFER command in modes five or seven must be performed, followed by a power-cycle.

Download Microcode With Offsets and Save Mode (111b) Description. In this mode, the transfer of vendor-specific microcode from the initiator to the target may be split over two or more Write Buffer commands. After the complete vendor-specific microcode image has been transferred from the initiator into the data buffer, the checksum is then verified and the microcode is saved into a non-volatile memory (i.e. flash memory). The downloaded code shall then be effective after each power-cycle and reset until another download microcode and save operation is performed. When the Write Buffer command has completed successfully, the target generates a unit attention condition for all initiators except the one that issued the WRITE BUFFER command. When reporting the unit attention condition, the target shall set the additional sense code to MICROCODE HAS BEEN CHANGED.

NOTE: The saved microcode does not become the active code load until a power on reset is performed.

In the Download Microcode With Offsets and Save mode, Buffer ID 0 is the only Buffer ID supported. If any other Buffer ID value is selected, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

The microcode is written into the data buffer starting at the location specified by the Buffer Offset. The first Write Buffer command initiating a download microcode with offsets mode operation must contain a Buffer Offset of zero. If this Buffer Offset is not zero, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB. Subsequent Write Buffer commands must contain a Buffer Offset such that the microcode is being downloaded contiguously (i.e. microcode bytes are being downloaded in sequential order with no gaps). If this Buffer Offset is incorrect, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

NOTES:

1. Following a successful microcode download and save operation, the target does not do an automatic reset and will continue running off of the old microcode. In order to run off of the new microcode which has been downloaded and saved, a power-cycle is required.
2. The microcode image that is downloaded via the WRITE BUFFER command includes the controller and servo microcode. In the Download Microcode With Offsets and Save mode, both the controller microcode and servo microcode are saved into flash following a successful download.

4-3.32.2 WRITE BUFFER CHECK CONDITION Status

If the Transfer Length field specifies a transfer that exceeds the buffer capacity, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

Data is transferred beginning at the offset within the buffer as specified by the Buffer Offset. If the initiator fails to conform to the offset boundary requirements returned in the Read Buffer descriptor, CHECK CONDITION status is returned with a sense key set to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB. If the requested buffer offset exceeds the buffer capacity, the target returns CHECK CONDITION status and sets the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

4-3.32.3 WRITE BUFFER Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	1. Recovery was performed when transferring data from the initiator. 2. Recovery was performed when synchronizing buffered write data to tape prior to performing the WRITE BUFFER operation.
3h	MEDIUM ERROR	1. Synchronizing buffered write data to tape failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. Transferring data from the initiator failed due to a hardware failure. 2. Synchronizing buffered data to tape failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the WRITE BUFFER command. 2. The Flag bit was set but the Link bit was not set. 3. Buffer ID field contains an invalid value. 4. Buffer Offset field contains an invalid value. 5. Parameter List Length field is contains an invalid value.
6h	UNIT ATTENTION	Indicates the WRITE BUFFER command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	WRITE BUFFER command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the WRITE BUFFER operation failed because physical End-of-Tape has been reached.

4-3.33 WRITE FILEMARKS command 10h

The WRITE FILEMARKS command requests the write of zero or more filemarks to tape. The filemarks will be written at the current logical position on tape. The Filemark count field indicates the number of filemarks to be written.

With a Filemark count of 0 and the Immediate bit set to 0, the WRITE FILEMARKS command will cause any data or filemarks previously buffered for writes to be written to tape. This is the SCSI-2 recommended method of causing buffered data and filemarks to be written to tape.

4-3.33.1 WRITE FILEMARKS CDB Description

WRITE FILEMARKS is a six-byte command. The bytes are shown below and described in Table 4-132. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	0	0	0
1	LUN			Reserved				Immed
2	MSB							
3	Filemark Count							
4								LSB
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 4-132. WRITE FILEMARKS Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	10h	Operation code.
1	0	0 or 1	See Table 4-133 for description of Immediate (Immed) bit operation.
2-4			The 3 byte Filemark Count field is a 24 -bit unsigned number that indicates the number of filemarks to be written.

Table 4-133. WRITE FILEMARK Command Operations

BUFFER MODE *	IMMED BIT	OPERATION
0h (non-buffered mode)	0	Write requested filemarks to tape
	1	Illegal (ILLEGAL REQUEST) sense data will be presented
1h, 2h (buffered modes	0	Buffer new filemarks for write and then write all previously buffered data and filemarks to tape.
	1	Buffer new filemarks for write
* This is the Buffer Mode reported by the MODE SENSE command. It is contained in the device specific parameter byte of the mode parameter header		

4-3.33.2 WRITE FILEMARKS CHECK CONDITION Status

If the Valid bit is set to 1 of Sense data for a CHECK CONDITION presented for a WRITE FILEMARKS command then the Information field in the Sense data is set as follows:

BUFFER MODE	BLOCK MODE	INFORMATION FIELD
non-buffered		Contains the number of new filemarks that were not written.
buffered	fixed	Contains the number of buffered blocks and buffered filemarks and new filemarks that were not written.
buffered	variable	Contains the number of buffered bytes and buffered filemarks and new filemarks that were not written.

When the WRITE FILEMARKS command is received, the tape unit tries to determine if there is a reason why all of the requested filemarks can't be written. The tape unit will check if the block IDs for the requested filemarks are within the tape format limits. The tape unit may also check if the requested number of filemarks will fit upon the remaining length of unwritten tape.

If the tape unit determines that the requested filemarks cannot all be written then it will not buffer any of the filemarks and will present CHECK CONDITION status. The error sense data will indicate VOLUME OVERFLOW, the Valid bit will be set to 1 and the Information field will be set as described above. Note that if the tape unit does not present this type of error, it does not necessarily mean that the requested filemarks will all fit on tape; the tape unit can only roughly estimate how many filemarks will fit upon the remaining length of unwritten tape.

4-3.33.3 WRITE FILEMARKS Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
0h	NO SENSE	Tape is positioned between the Early-Warning position and End-of-Tape with Immed=0, all buffered data and buffered filemarks and new filemarks were written successfully.
1h	RECOVERED ERROR	1. Recovery was performed when writing buffered data 2. Retries were needed to complete the write of the new filemarks.
2h	NOT READY	Logical Unit was not ready (tape was not loaded or wasn't ready).
3h	MEDIUM ERROR	1. Write of data or filemarks failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium. 3. The tape length in the cartridge is too long or too short.
4h	HARDWARE ERROR	Write of data or filemarks failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the WRITE FILEMARKS command. 2. Immediate bit set to 1 when not operating in buffered mode. (Immed = 1, Buffer Mode = 0h) 3. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the WRITE FILEMARKS command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
7h	DATA PROTECT	Attempting write-type operation to a write-protected cartridge.
8h	BLANK CHECK	
Bh	ABORTED COMMAND	WRITE FILEMARKS command was aborted.
Dh	VOLUME OVERFLOW	New filemarks or previously buffered filemarks or data could not be written to tape because End-of-Tape has been reached.

4-4 COMMAND DISCONNECTION

After receiving any command, the controller disconnects if disconnection is not inhibited by the IDENTIFY message and the controller requires device activity to complete the request.

The controller reconnects to perform parameter or data transfers or to present command completion status as required.

Multiple disconnect and reconnect sequences may be performed for a single READ or WRITE command as space or data becomes available in the buffer.

4-5 SCSI RESET

The SCSI Reset is performed in response to a SCSI BUS RESET or a BUS DEVICE RESET Message. The M2488 supports the SCSI hard reset alternative as follows:

- All SCSI I/O processes are cleared; i.e., the SCSI I/O process ends with the BUS FREE phase.
- Any back-end (tape motion or medium changer motion) operation in progress (rewind, synchronize, erase, locate, space, unload, or write filemarks, etc.) is allowed to complete after all of the SCSI I/O processes are cleared.
- Buffered write data is synchronized to tape.
- Buffered write data error is discarded.
- All SCSI device reservations are released.
- Power-on/Reset Unit Attention is generated.

CHAPTER 5

TAPE UNIT PARAMETERS

5-1 INTRODUCTION

This chapter describes the parameters for the M2488. The following information is located in this chapter:

5-2 ADDITIONAL COMMAND INFORMATION ON MTU MODE SELECT AND MODE SENSE COMMANDS

5-3 MTU INQUIRY/CHANGE DEFINITION VITAL PRODUCT DATA PAGES

5-2 ADDITIONAL COMMAND INFORMATION ON MTU MODE SELECT AND MODE SENSE COMMANDS

Table 5-1 lists the page codes supported by the MODE SELECT and MODE SENSE commands.

Table 5-1. Page Codes

PAGE CODE	DESCRIPTION
00h	Vendor Unique Parameters
01h	Error Recovery and Reporting Parameters
02h	Disconnect/Reconnect Control Parameters
0Ah	Common Device-Type Control Parameters
10h	Device Configuration Parameters
3Fh	(MODE SENSE ONLY) Target returns all supported pages. The pages are returned in the MODE SENSE data in the following order: Page 01h, page 02h, page 0Ah, page 10h, page 00h.

**** NOTE ****

The current value of non-changeable Mode Parameters must be returned in MODE SELECT command data.

5-2.1 The Parameters Savable Bit (All pages)

When using the MODE SENSE command, a Parameters Savable (PS) bit of one indicates that the mode page can be saved by the target in a non-volatile, vendor-specific location. A PS bit of zero indicates that the supported parameters cannot be saved. When using the MODE SELECT command, the PS bit is reserved.

5-2.2 Vendor Unique Parameter

Table 5-2. Page 00 - Vendor Unique Parameter

BYTES	BITS 7	6	5	4	3	2	1	0	MODE SENSE DEFAULT VALUES
0	PS *	Reserved	Page Code						80h
1	Additional Page Length								0Eh
2	Reserved	WRTY	Reserved	PAEB	Reserved				00h
3	Reserved					FRU	Reserved		00h
4	ADTT								FEh
5-15	Reserved								00h

* The PS bit must be set to 0 on a MODE SELECT command.

Table 5-3. Page 00 -Vendor Unique Parameter Field Description

BYTE	BIT	VALUE	DESCRIPTION
2	6	1	When the WRTY bit is set to one, the following feature will be activated: * if bit 7 of the Write Retry Count field in Mode Page 01h is set to zero, permanent write errors are to be reported after the retry count in bits 6-0 of the Write Retry Count field have been exhausted. * if bit 7 of the Write Retry Count field in Mode Page 01h is set to one, write errors are not reported, and writing is continued on the next block unless the tape position is lost while attempting the write operations. CAUTION: This setting may produce unreadable tapes.
		0	When WRTY is set to zero, bits 7-0 of the Write Retry Count field all represent the retry count setting and permanent write errors will always be reported. The WRTY bit is reported as changeable on a MODE SENSE command, and the default value is zero.
2	4	1	When the Position After Error Block (PAEB) bit is set to one, and there is a permanent read error on tape, the read head is positioned on the opposite side of the error block from the direction being read (i.e. EOT side for a read forward operation or BOT side for a read reverse operation). When the read error occurs during a Read (forward) operation, a Read Position command gives the BID of the block following the block in error.When the read error occurs during a Read Reverse operation, a Read Position command gives the BID of the actual block in error.
		0	When PAEB is set to zero, everything remains the same except for the Read Position data, which would give the BID of the block to position to in order to retry the same read operation on the bad block. This allows alternate device retry by the host.The host system requests the cartridge be moved to another device, does a Locate to the block indicated in the Read Position data, followed by a read operation in the same direction as when the read data check originally occurred (Read or Read Reverse). The PAEB bit is reported as changeable on a MODE SENSE command and the default value is zero.

Table 5-3. Page 00 -Vendor Unique Parameter Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
3	2	1 0	When the FRU bit is set to one, the Diagnostic Error codes listed in Appendix F are displayed on the op panel display. When the FRU bit is set to zero, the Diagnostic Error codes are not displayed on the op panel display. The FRU bit is reported as changeable on a MODE SENSE command and the default value is zero.
4	0-7	FEh	The Automatic Data Transfer Timeout (ADTT) field indicates an automatic data transfer timeout value in 200ms increments with 00h representing an initial 200ms timeout; i.e., actual_timeout = 200ms + (selected_timeout_value*200ms). For example, a value of 01h indicates automatic data transfers will timeout in 400ms; i.e., 200ms + (1*200ms) = 400ms. The ADTT is calculated in 200ms increments for values of 00h to FEh in the ADTT field. The ADTT value of FFh indicates a timeout of 2 minutes. If a value of 00h or 01h is set in this field (200ms or 400ms timeouts respectively), the Retry Buffer Retries is automatically disabled. The ADTT is active only during the data phases (DATA-IN/DATA-OUT) while transferring data blocks between the initiator and the target using commands such as READ, READ REVERSE, WRITE, etc. The ADTT is not active for manual data transfers such as REQUEST SENSE DATA, LOG SENSE DATA, MODE SENSE DATA, etc. The ADTT field is reported as changeable on a MODE SENSE command and the default value is FEh.

5-2.3 Error Recovery and Reporting Parameters

The Page 01 Error Recovery and Reporting Parameters CDB is illustrated in Table 5-4 and described in Table 5-5.

The parameters on this page specify the error recovery and reporting parameters that the target uses when transferring data between the initiator and the target. The parameters on this page do not apply to message system retries or positioning error recovery procedures.

Table 5-4. Page 01 - Error Recovery and Reporting Parameters

	BITS								MODE SENSE DEFAULT VALUES
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	PS *	Reserved	Page Code						81h
1	Additional Page Length								0Eh
2	Reserved		TB	Reserved	EER	PER	DTE	DCR	08h
3	Read Retry Count								10h
4-7	Reserved								00000000h
8	Write Retry Count								10h
9-11	Reserved								000000h

* The PS bit must be set to 0 on a MODE SELECT command.
Note: Changeable fields in this page are shaded.

Table 5-5. Error Recovery and Reporting Parameters Field Description

BYTE	BIT	VALUE	DESCRIPTION
2	0	1 0	When the Disable Correction (DCR) bit is set to one, this bit indicates error correction is not applied in the course of error recovery. Other normal error recovery operations are not affected by this bit. When DCR is set to zero, this bit enables error correction. The DCR bit is reported as not changeable on a MODE SENSE command, and the default value is zero.
2	1	1 0	When the Disable Transfer on Error (DTE) bit set to one, and the PER bit is set to one, the target creates the CHECK CONDITION status and terminates the data transfer to the initiator immediately upon detection of an error. The transfer length is then not exhausted. The data of the block in error, which is the first erring block encountered, may not be transferred to the initiator depending upon the setting of the TB bit. The DTE bit can only be set to one if the PER bit is set to one. The target creates the CHECK CONDITION status with an ILLEGAL REQUEST sense key if PER bit is set to zero and the DTE bit set to one. When DTE is set to zero, this bit enables data transfer for any data which is recovered within the limits of the error recovery flags. Any erring block that would be posted, which is the last recovered block encountered, is not posted until the transfer length is exhausted. The DTE bit is reported as changeable on a MODE SENSE command, and the default value is zero.

Table 5-5. Error Recovery and Reporting Parameters Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
2	2	1 0	When the Post Error (PER) bit is set to one, this bit indicates that the target enables reporting of CHECK CONDITION status for recovered errors, with the appropriate sense key being returned. CHECK CONDITION status occurs during the data transfer depending either on the DTE bit value or if an unrecoverable error occurred. If multiple errors occur, the REQUEST SENSE data reports the block address of either the last block on which recovered error occurred or of the first unrecovered error. If this bit is 0, the DTE bit must also be 0. When PER is set to zero, this bit indicates that the target does not create the CHECK CONDITION status for errors recovered within the limits established by the other error recovery flags. Recovery procedures exceeding the limits established by the other error recovery flags are posted accordingly by the target. The transfer of data may terminate prior to exhausting the transfer length depending on the error and the state of the other error recovery flags. The PER bit is reported as changeable on a MODE SENSE command, and the default value is zero.
2	3	1 0	When the Enable Early Recovery (EER) bit is set to one, this bit indicates that the target enables the use of the most expedient form of error recovery, such as error correction, before applying retries. Seek or positioning retries and the recovery procedure retries of the message system are not affected by the value of this bit. When EER is set to zero, this bit indicates that the target exhausts the defined retry limit prior to enabling error correction. The EER bit is reported as not changeable on a MODE SENSE command and the default value is one.
2	5	1 0	When Transfer Block (TB) is set to one, this bit indicates that the failing data block (recovered or unrecovered) is transferred to the initiator. When TB is set to zero, this bit indicates that an unrecovered failing data block is not transferred to the initiator. Recovered data blocks are always transferred, regardless of the values of the TB bit. In both cases the block reported in the Request Sense data is the block in error, not the preceding block. The TB bit is reported as changeable on a MODE SENSE command, and the default value is zero.
3	0-7	>0 0	A non-zero value in Read Retry Count field specifies the number of times that the target attempts its recovery algorithm during a read operation before an unrecoverable error is reported. A value of zero in this field indicates that the target shall not use its recovery algorithm during read operations. The Read Retry Count field is reported as changeable, and the default value is 10h.
8	0-6	>0 0	A non-zero value in the Write Retry Count field specifies the number of times that the target attempts its recovery algorithm during a write operation before an unrecoverable error is reported. A value of zero in this field indicates that the target shall not use its recovery algorithm during write operations. The Write Retry Count field is reported as changeable and the default value is 10h.
8	7	 0 1	The meaning of this bit is dependent upon the setting of the WRTY bit in Mode Page 00. With WRTY set to 0, this bit is defined as the MSB of the Write Retry Count. Otherwise: Report permanent error when count in bits 0-6 is exhausted. Do not report error, continue writing next block. **CAUTION**: This setting may produce unreadable tapes.

MODE SELECT/SENSE

Table 5-6 summarizes the valid modes of operation for the bits in byte 2 as described previously.

Table 5-6. Valid Combinations of Error Recovery Parameters

EER	PER	DTE	DCR	DESCRIPTION
1	0	0	0	Correction, then retries are attempted. Recovered and/or corrected data (if any) is transferred without the ending portion of the transfer. This is the default setting. - Transfer Length is exhausted. Data transfer stops only if an unrecoverable error is encountered. The target then creates CHECK CONDITION status with the appropriate Sense Key. The data of the unrecoverable Block (if any), may not be transferred to the initiator depending on the setting of the TB bit.
1	0	1	0	Invalid Request (DTE on, PER off).
1	1	0	0	Correction, then retries are attempted. Report Last Data Block in error at the end of transfer. Recovered data (if any) is transferred corrected. - The Transfer Length is exhausted if no unrecoverable error occurred (DTE off). - The target creates CHECK CONDITION status with RECOVERED ERROR Sense Key and reports (in the Information bytes field of the Extended Sense data) the last block for which recovered error occurred, if any. (PER on). The data of the unrecoverable Block (if any), may or may not be transferred to the initiator depending on the setting of the TB bit.
1	1	1	0	Correction, then retries are attempted. Stop Transfer on First Recovered Error Encountered. Recovered data is transferred. Check status with Recovered Error sense key is set following transfer of the recovered or corrected block.

5-2.4 Disconnect/Reconnect Control Parameters

These parameters provide the initiator with the means to tune the SCSI bus.

Table 5-7. Page 02 - Disconnect/Reconnect Parameters

BYTES	BITS 7	6	5	4	3	2	1	0	MODE SENSE DEFAULT VALUES
0	PS *	Reserved	Page Code						82h
1	Additional Page Length								0Eh
2	Read Buffer Full Ratio								00h
3	Write Buffer Empty Ratio								00h
4-5	Bus Inactivity Time								0000h
6-7	Disconnect Time Limit								0000h
8-9	Connect Time Limit								0000h
10-11	Maximum Burst Size								0000h
12	Reserved						DTDC		0000h
13-15	Reserved								0000h

* The PS bit must be set to 0 on a MODE SELECT command.
Note: Changeable fields in this page are shaded.

Table 5-8. Page 02 - Disconnect/Reconnect Parameters Field Description

BYTE	BIT	VALUE	DESCRIPTION
2-3		0	The Read Buffer Full Ratio and Write Buffer Empty Ratio fields indicate how full the buffer should be on a read command or how empty the buffer should be on a write command before the target attempts reselection. These fields are not supported, and are reported as NOT changeable on a MODE SENSE command. The default values are zero.
4-5		0	The Bus Inactivity Limit field indicates the maximum time, in 100 microsecond increments, that the target is allowed to maintain the bus busy without handshakes until it must disconnect. A value of zero in this field indicates that there is no Bus Inactivity Limit. The Bus Inactivity Limit field is reported as not changeable on a MODE SENSE command, and the default value is zero.
6-7		>0 0	A non-zero value in the Disconnect Time Limit field indicates the minimum time, in 100 microsecond increments, that the target remains disconnected for the specified LUN until it attempts to reconnect. A value of zero in this field indicates that the target is allowed to reconnect immediately. The Disconnect Time Limit field is reported as changeable on a MODE SELECT command, and the default value is zero.

MODE SELECT/SENSE

Table 5-8. Page 02 - Disconnect/Reconnect Parameters Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
8-9		0	The Connect Time Limit field indicates the maximum time, in 100 microsecond increments, that the target remains connected until it attempts to disconnect. A value of zero in this field indicates that there is no Connect Time Limit. The Connect Time Limit field is reported as not changeable on a MODE SENSE command, and the default value is zero.
10-11			The Maximum Burst Size field indicates the maximum amount of data to be transferred between SCSI bus disconnects when disconnects are allowed. The value in this field is multiplied by 512 bytes to signify the maximum amount of data. For example, a “1” in this field signifies 512 bytes and a “2” signifies 1024 bytes. A value of zero in this field indicates no limit on the amount of data transferred. The controller attempts to honor the specified value. However, in no case does the controller transfer only a portion of a record. When reading a compressed tape, the controller does not know how much uncompressed data is produced by a record about to be transferred. In this case, the compressed record length (rather than the actual bus transferred size) is used to determine if the maximum burst size is exceeded. The Maximum Burst Size field is reported as not changeable on a MODE SENSE command, and the default value is zero.
12	0-1		The Data Transfer Disconnect Control (DTDC) field defines further restrictions on when a disconnect is permitted. Table 5-9 relates the significance of different values in this field.

Table 5-9. Data Transfer Disconnect Control

DTDC	DESCRIPTION
00b	Data transfer disconnect control is not used. Disconnect is controlled by the other fields in this page.
01b	A target will not disconnect once the data transfer of a command has started until all data the command is to transfer has been transferred. The connect time limit and bus inactivity limit are ignored during the data transfer.
10b	Reserved
11b	A target will not disconnect once the data transfer of a command has started until the command is complete. The connect time limit and bus inactivity limit are ignored once data transfer has started.

If the DTDC field is non-zero and the Maximum Burst Size is non-zero, the target shall return CHECK CONDITION status. The sense key will be set to ILLEGAL REQUEST and the additional sense code set to ILLEGAL FIELD IN PARAMETER LIST.

The DTDC field is reported as changeable on a MODE SENSE command, and the default value is zero.

5-2.5 Common Device-Type Control Parameters

Table 5-10. Page 0Ah - Common Device-type Control Parameters

	BITS								MODE SENSE DEFAULT VALUES
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	PS *	Reserved	Page Code						8Ah
1	Additional Page Length								06h
2	Reserved							RLEC	01h
3	Queue Algorithm Modifier				Reserved		QErr	DQue	01h
4	EECA	Reserved				RAENP	UAAENP	EAENP	00h
5	Reserved								00h
6-7	Ready AEN Holdoff Period (0-0FFFFh microsecond)								0000h

* The PS bit must be set to 0 on a MODE SELECT command.
Note: Changeable fields in the page are shaded.

MODE SELECT/SENSE

**** NOTE ****

The only field that may be modified in this page is the RLEC bit. On a MODE SELECT command, all other fields must be zero. On a MODE SENSE command, only the RLEC field is reported as changeable.

Table 5-11. Page 0Ah - Common Device-type Control Parameters Field Description

BYTE	BIT	VALUE	DESCRIPTION
2	1	1 0	When set to one, the Report Log Exception Condition (RLEC) bit indicates that the target reports log overflow conditions. When set to zero, this bit indicates that log overflow conditions are not reported. The RLEC bit is reported as changeable on a MODE SENSE command, and the default value is one.
3	0	1	When set to one, the Disable Queuing (DQUE) bit indicates that tagged queueing shall be disabled. The default value reported for this field on a MODE SENSE command is one and not changeable.
3	1	0	When set to zero, the Queue Error Management bit indicates that remaining suspended I/O process shall resume after the contingent allegiance condition or extended contingent allegiance condition. The default value reported for this field on a MODE SENSE command is zero and not changeable.
3	4-7	0	The Queue Algorithm Modifier field specifies restrictions on the algorithm used for reordering commands that are tagged with the SIMPLE QUEUE TAG message. The default value reported for this field on a MODE SENSE command is zero and not changeable.

Table 5-11. Page 0Ah - Common Device-type Control Parameters Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
4	0-2	0	The **RAENP**, **UAAENP**, and **EAENP** bits enable specific events to be reported via the asynchronous event notification protocol. This product does not support asynchronous event notification. When all three bits are zero, the target shall not create asynchronous event notifications. The default values reported for these fields on a MODE SENSE command are zeros and not changeable.
4	7	0	When set to zero, the Enable Extended Contingent Allegiance (EECA) bit indicates that the extension of the contingent allegiance condition is disabled. The default value reported for this field on a MODE SENSE command is zero and not changeable.
6-7		0	The Ready AEN Holdoff Period field specifies the minimum time in microseconds after the target starts its initialization sequence that it shall delay before attempting to issue an asynchronous event notification. The default value reported for this field on a MODE SENSE command is zero and not changeable.

5-2.6 Device Configuration Parameters

Table 5-12. Page 10h - Device Configuration Parameters

BYTES	BITS 7	6	5	4	3	2	1	0	MODE SENSE DEFAULT VALUES
0	PS *	Reserved	Page Code						90h
1	Additional Page Length								0Eh
2	Reserved	CAP	CAF	Active Format					00h
3	Active Partition								00h
4	Write Buffer Full Ratio								80h
5	Read Buffer Empty Ratio								40h
6-7	Write Delay Time								0032h
8	DBR	BIS	Reserved	AVC	SOCF		RBO	REW	C4h
9	Gap Size								00h
10	EOD Defined			EEG	SEW	Reserved			00h
11-13	Buffer Size at Early Warning								060000h
14	Select Data Compression Algorithm								01h
15	Reserved								00h

* The PS bit must be set to 0 on a MODE SELECT command.
Note: Changeable fields in the page are shaded.

**** NOTE ****

The only fields that may be modified in this page are Read Buffer Empty Ratio, the SOCF field, Read Buffer Empty Ratio, the RBO bit and the Select Data Compression Algorithm field. On a MODE SENSE command, only these fields are reported as changeable.

Table 5-13. Page 10h - Device Configuration Parameters Field Description

BYTE	BIT	VALUE	DESCRIPTION
2	0-4	0	The Active Format field indicates the format that is to be used to record on that medium. This field is reported as not changeable on a MODE SENSE command, and the default value is zero.
2	5	1 0	When set to one, the Change active Format (CAF) bit indicates that the active format is changed to the value specified in the active format field. The CAF bit is reported as not changeable on a MODE SENSE command, and the default value is zero.
2	6	1 0	When set to one, the Change Active Partition (CAP) bit indicates that the logical partition is to be changed to the one specified by the active partition field. The CAP bit is reported as not changeable on a MODE SENSE command, and the default value is zero.
3	0-7	0	The Active Partition indicates the current logical partition number in use on that medium. This field is reported as not changeable on a MODE SENSE command, and the default value is zero
4	0-7	80h	The Write Buffer Full Ratio field, on WRITE commands, indicates to the target how full the buffer is before writing data to the medium. This field is reported as not changeable on a MODE SENSE command, and the default value is 80h.
5	0-7	40h	The Read Buffer Empty Ratio field, on READ commands, indicates to the target how empty the buffer is before retrieving additional data from the medium. This field is reported as changeable on a MODE SENSE command, and the default value is 40h.
6-7		0032h	The Write Delay Time field indicates the maximum time, in 100 millisecond increments, the target should wait before any buffered data that is to be written, is forced to the medium after the last buffered WRITE command that did not cause the buffer to exceed the buffer full ratio. This field is reported as not changeable on a MODE SENSE command, and the default value is 0032h (5 seconds).
8	0	0	When set to zero, the Report Early Warning (REW) bit indicates that the target will report early-warning at or before any medium defined early-warning position during write operations, but will not report the early-warning condition for read operations. The REW bit is reported as not changeable on a MODE SENSE command, and the default value is zero.
8	1	0	When set to zero, the Recover Buffer Order (RBO) bit indicates that data blocks are returned from the target's buffer on a RECOVER BUFFERED DATA command in First In First Out (FIFO) order. When set to one, the RBO bit indicates that data blocks are returned from the target's buffer on a RECOVER BUFFERED DATA command in Last In First Out (LIFO) order. The RBO bit is reported as changeable on a MODE SENSE command, and the default value is 0b (FIFO).

Table 5-13. Page 10h - Device Configuration Parameters Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
8	2-3	01b	When set to 00b, the Stop On Consecutive Filemarks (SOCF) field indicates the device pre-read data from the medium in Buffered Mode to the limits of the buffer capacity without regard for filemarks. This implies the device can differentiate between data blocks and filemarks in the buffer. Values 01b, 10b, and 11b specify the device terminates the pre-read operation if 1, 2, or 3 consecutive filemarks are detected, respectively. The SOCF field is reported as changeable on a MODE SENSE command, and the default value is 01b.
8	4	0	When set to zero, the Automatic Velocity Control (AVC) bit indicates that the device speed chosen will be the device's internally selected speed. The AVC bit is reported as not changeable on a MODE SENSE command, and the default value is zero.
8	6	1	When set to one, the Block Identifiers Supported (BIS) bit indicates that the format on the medium has recorded information about the logical block ID relative to a partition. The BIS bit is reported as not changeable on a MODE SENSE command, and the default value is one.
8	7	1	When set to one, the Data Buffer Recovery (DBR) bit indicates that the target supports data buffer recovery using the RECOVER BUFFERED DATA command. The DBR bit is reported as not changeable on a MODE SENSE command, and the default value is one.
9	0-7	00h	The Gap Size field determines the size of the interblock gap when writing data. A value of 00h specifies the device's defined gap size. This field is reported as not changeable on a MODE SENSE command, and the default value is zero.
10	3	1	When set to one, the Synchronize at Early Warning (SEW) bit indicates the target causes any buffered write data and filemarks to be transferred to the medium when EOM early-warning is encountered. This field is reported as not changeable on a MODE SENSE command, and the default value is one.
10	4	0	When set to zero, the Enable EOD Generation (EEG) bit indicates that EOD generation is disabled in the logical unit. The EEG bit is reported as not changeable on a MODE SENSE command, and the default value is zero.
10	5-7	000b	The End-of-Data (EOD) Defined field indicates which format type the logical unit uses to detect and generate the EOD area. A value of 000b in this field indicates the logical unit will use its own default EOD definition. The EOD Defined field is reported as not changeable on a MODE SENSE command, and the default value is zero.

Table 5-13. Page 10h - Device Configuration Parameters Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
11-13		060000h	The Buffer Size at Early Warning field indicates the value, in bytes, to which the target reduces its logical buffer size when writing between early-warning and physical EOM. This field is reported as not changeable on a MODE SENSE command, and the default value is 60000h.
14	0-7	00h 01h	When set to 00h, the Select Data Compression Algorithm field indicates that the controller will write in EDRC uncompressed format. Uncompressed format does not encode the customer's data with the Binary Arithmetic Encoding hardware, but does combine multiple customer records into a single tape block. When set to 01h, this field indicates that the controller will first encode customer data using the Binary Arithmetic Encoding hardware (compress the data), and to also combine multiple compressed customer data records into a single tape block. NOTES: 1) It is permissible to modify the data compression algorithm mode away from BOT and in between write operations; however, buffered write data is automatically synchronized to tape prior to activating the new mode. 2) For backwards compatibility reasons, the values 83h and 84h will be accepted in this field and treated as 00h and 01h, respectively.

MODE SELECT/SENSE

5-2.7 Density Code 28h

Until now, when sending Mode Parameters with a Mode Select command, the initiator could only set 00h, 09h or 7Fh in the Density Code field in the Block Descriptor (byte 00h). The Mode Parameter data returned by a Mode Sense command would always return the value of 09h in the Density Code field. According to the ANSI SCSI-2 standard, a Density Code value of 09h referred to 18Track format tape densities. The M2488 product tape drive is capable of reading both 18Track and 36Track format tapes, but will only write in the 36Track (36T) format. Since the ANSI SCSI-2 standard had not defined a Density Code value representing the 36T format, the M2483 and the early M2488 drives used Density Code 09h to represent both the 18T and 36T formats.

Since the ANSI SCSI-3 standard has defined a Density Code to represent the 36T format, the M2488 drive will now differentiate between 18T and 36T densities by using two different Density Code values. Configuring feature mode bit 6 (0x40) in byte FT4 (see the M2488 User's Guide) will cause the M2488 to associate Density Code 09h with the 18T format, and Density Code 28h with the 36T format. If this feature mode configuration is not performed, the M2488 will use Density Code 09h to represent both 18T and 36T formats.

For information and instructions on configuration settings, refer to the Configuration chapter in the M2488 User's Guide.

5-2.7.1 M2488 Operation When Density Code 28h Is Not Configured

In its default mode, the M2488 does not use Density Code 28h. The Mode Select command will accept the following settings in the Density Code field (Mode Parameter Block Descriptor Byte 00h):

Table 5-14. Density Code Settings Accepted by Mode Select Command in Default Operation

DENSITY CODE	DESCRIPTION
00h	Write tapes in 36T format. Read tapes in 18T and 36T formats.
09h	Write tapes in 36T format. Read tapes in 18T and 36T formats.
7Fh	Retain current Density Code setting.

Regardless of the Density Code setting used in the Mode Select command, the Mode Sense command will always report a Density Code value of 09h.

5-2.7.2 M2488 Operation When Density Code 28h Is Configured

Once the DENSITY_CODE_28H feature mode has been configured, the Mode Select command will accept the following settings in the Density Code field (Mode Parameter Block Descriptor Byte 00h):

Table 5-15. Density Code Settings Accepted by Mode Select Command with Density Code 28h Configured

DENSITY CODE	DESCRIPTION
00h	Write tapes in 36T format. Read tapes in 18T and 36T formats.
09h	Write tapes in 36T format. Read tapes in 18T and 36T formats.
28h	Write tapes in 36T format. Read tapes in 18T and 36T formats.
7Fh	Retain current Density Code setting.

The Mode Sense command will report Density Codes in compliance with the following guidelines:

Table 5-16. Density Codes Reported by Mode Sense Command with DENSITY_CODE_28H Configured

WHEN THE FOLLOWING IS TRUE	MODE SENSE WILL REPORT
After a Power Up sequence, while the unit is in the NOT READY state and no previous UNLOAD* has been performed.	Density Code 28h
When the unit is in the NOT READY state, and a previous UNLOAD* has been performed.	Density Code as reported in the most recent Mode Sense command.
After a Power Up sequence, when the unit is the READY state, but the tape format has not yet been determined by the unit.	Density Code 28h

Table 5-16. Density Codes Reported by Mode Sense Command with DENSITY_CODE_28H Configured

WHEN THE FOLLOWING IS TRUE	MODE SENSE WILL REPORT
After a Power Up sequence, when the unit is in the READY state, and the tape format has been determined by the unit.	Density Code relating to the tape format as determined by the unit.
When the unit is in the READY state, and a successful read has been done from an 18T tape.	Density Code 09h
When the unit is in the READY state, and a successful read has been done from an 36T tape.	Density Code 28h
After a successful read or unsuccessful write at BOP, if a previous Mode Select command had been issued to set the Density Code.	Density Code as set by the Mode Select command.
After a successful read or unsuccessful write at BOP, if the unit has not identified the tape format.	Density Code 28h
After a successful read or unsuccessful write at BOP, if the unit has identified the tape format.	Density Code relating to the tape format as determined by the unit.

* An Unload is considered to be a ready-to-not-ready transition which can result from the Unload command, the Move Medium command, or by pressing Reset on the op-panel.

5-3 MTU INQUIRY/CHANGE DEFINITION VITAL PRODUCT DATA PAGES

This section describes the VPD (Vital Product Data) pages and parameters used by the MTU Inquiry and Change Definition commands. The MTU VPD parameters include information such as configuration data (vendor identification, product identification, model, serial number), usage data, and other vendor or device-specific data. The supported MTU VPD pages are shown in the following table.

Table 5-17. Supported MTU VPD Page Codes

VPD PAGE CODE	VENDOR UNIQUE PAGE	DESCRIPTION	USED BY	
			INQUIRY CMD.	CHANGE DEF.CMD.
00h	N	List of the vital product data pages supported by this target.	Y	N
80h	N	Unit serial number page.	Y	N
81h	N	Implemented operating definition page.	Y	N
82h	N	ASCII implemented operating definition page.	Y	N
C0h	Y	Unit usage page.	Y	N
C1h	Y	Configuration page.	Y	N
C2h	Y	Product identification page.	Y	Y

5-3.1 General VPD Page Format

The General VPD page format is shown in Table 5-18 and described in Table 5-23.

Table 5-18. VPD Page Format

	BITS							
BYTES	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code							
2	Reserved							
3	Page Length (n - 1)							
4-N	VPD Parameters							

MTU VPD PAGES

Table 5-19. VPD Page Format Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-4 5-7		The meaning of the Peripheral Qualifier and Peripheral Device Type fields depend on whether the VPD page is being sent to the initiator as INQUIRY data or is being received from the initiator as CHANGE DEFINITION data. When being sent as INQUIRY data, these fields are the same as those defined in the INQUIRY command description. When being received as CHANGE DEFINITION data, these fields are ignored.
1	0-7		The Page Code field identifies the format and parameters defined for that VPD page.
3	0-7		The Page Length field indicates the length in bytes of the VPD parameters that follow. For VPD pages that are permitted to be sent from an initiator via the CHANGE DEFINITION command, if the initiator does not set this value to the value that is returned for that page by the INQUIRY command, the target terminates the CHANGE DEFINITION command with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN PARAMETER LIST. For VPD pages requested by an initiator via the INQUIRY command, if the allocation length in the INQUIRY CDB is too small to transfer all bytes in the VPD page, the page length is not adjusted to reflect the truncation.
4-n			The VPD parameters for each page are described in the following sections.

**** NOTE ****

All Inquiry ASCII data generated in fields representing numerical values (e.g. power-on time, cleaning count, etc.) is the ASCII equivalent to the hexadecimal numerical value.

5-3.2 Supported VPD Pages - Page 00h

VPD page 00h returns a list of the vital product data pages supported by this target. The format for VPD Page 00h is:

Table 5-20. INQUIRY Data Format VPD Page 00h - Supported VPD Pages

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type =01h				
1	Page Code = 00h							
2	Reserved							
3	Page Length = 07h							
SUPPORTED PAGE LIST								
4	00h							
5	80h							
6	81h							
7	82h							
8	C0h							
9	C1h							
10	C2h							

The Supported Page List contains a list of all implemented vital product data page codes for this target. The page codes are listed in ascending order beginning with page code 00h.

5-3.3 Unit Serial Number Page - Page 80h

VPD page 80h returns the product serial number for the target. The format for VPD page 80h is:

Table 5-21. INQUIRY Data Format VPD Page 80h - Unit Serial Number Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type =01h				
1	Page code = 80h							
2	Reserved							
3	Page length = 10h							
4-19	Product serial number							

MTU VPD PAGES

The product serial number field contains 16 bytes of ASCII data that is vendor-specific. The product serial number is stored in NVRAM and is maintained across power cycles and resets. If the product serial number is not available due to a NVRAM error, then ASCII spaces (20h) are returned in this field.

5-3.4 Implemented Operating Definition Page - Page 81h

VPD page 81h returns the list of implemented operating definitions for the target. The format for VPD page 81h is:

Table 5-22. INQUIRY Data Format VPD Page 81h - Implemented Operating Definition Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type =01h				
1	Page code = 81h							
2	Reserved							
3	Page length = 06h							
4	Reserved	Current operating definition = 03h						
5	SavImp = 0b	Default operating definition = 03h						
6	SavImp = 0b	Supported operating definition = 00h						
7	SavImp = 0b	Supported operating definition = 03h						
8	SavImp = 1b	Supported operating definition = 40h						
9	SavImp = 1b	Supported operating definition = 41h						

Table 5-23. INQUIRY Data Format VPD Page 81h Field Description

BYTE	BIT	VALUE	DESCRIPTION
4	0-6	03h	The current operating definition field indicates the present operating definition.
5-9	7	1 0	For each of the following operating definition fields, there is a corresponding SavImp (Save Implemented) bit. A SavImp bit set to one indicates that the corresponding operating definition parameter can be saved. A SavImp bit set to zero indicates that the corresponding operating definition parameter cannot be saved.
5	0-6	03h	The default operating definition field indicates the value of the operating definition the target uses upon power-up. The current and default operating definitions are always reported as 03h (SCSI-2 operating definition).
6-9	0-6		Reference the Change Definition SCSI command specification (CDB byte 3) for a description of the supported operating definitions listed in this page (i.e. 00h, 03h, 40h, and 41h).

5-3.5 ASCII Implemented Operating Definition Page - Page 82h

VPD page 82h returns the target's implemented operating definitions in ASCII format. The format for VPD page 82h is:

Table 5-24. INQUIRY Data Format VPD Page 82h - ASCII Implemented Operating Definition Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type =01h				
1	Page code = 82h							
2	Reserved							
3	Page length = 9Dh							
4	ASCII operating definition description length = 9Ch							
ASCII OPERATING DEFINITION DESCRIPTION DATA								
5-42	"00h - Use current operating definition"							
43	NULL (00h)							
44-81	"03h - SCSI-2 operating definition"							
82	NULL (00h)							
83-120	"40h - Change user product data"							
121	NULL (00h)							
122-159	"41h - Change factory product data"							
160	NULL (00h)							

Table 5-25. INQUIRY Data Format VPD Page 82h Field Description

BYTE	BIT	VALUE	DESCRIPTION
4	0-7		The ASCII operating definition description length field indicates the length in bytes of the ASCII operating definition description data that follows. If the allocation length is less than the length of data to be returned, the ASCII operation definition description length is not adjusted to reflect the truncation.
5-160			The ASCII operating definition description data field contains the ASCII operating definition description data. The data in this field is formatted in lines, where each line is terminated with a NULL (00h) character. The ASCII characters in each line shown in the table above are left aligned and ASCII spaces (20h) are used to pad each line up to the NULL (00h) character. Each line has a total length of 39 (27h) bytes, including the NULL character.

Reference the Change Definition SCSI command specification (CDB byte 3) for a description of the supported operating definitions.

5-3.6 Unit Usage Page - Page C0h

VPD page C0h returns usage parameters. The format for VPD page C0h is:

Table 5-26. INQUIRY Data Format VPD Page C0h - Unit Usage Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type =01h				
1	Page code = C0h							
2	Reserved							
3	Page length = 18h							
4-11	Tape motion time							
12-19	Power-on time							
20-27	Cleaning count							

The following fields defined for this page are stored in NVRAM and are maintained across power cycles and resets. If any of these fields cannot be read from NVRAM due to a NVRAM error, then the SCSI command requesting access to these fields is terminated with CHECK CONDITION status, the sense key is set to HARDWARE ERROR, and the ASC/ASCQ is set to Internal Target Failure.

Table 5-27. INQUIRY Data Format VPD Page C0h Field Description

BYTE	BIT	VALUE	DESCRIPTION
4-11			The tape motion time field contains 8 bytes of ASCII data that is vendor-specific. The tape motion time is in units of seconds and is incremented based on the speed of tape motion. For example: This time is not incremented when there is no tape motion. This time is incremented at a faster rate during a rewind and at a slower rate during a read operation. The tape motion time (TMT) value can be used to calculate the total meters of tape that passed over the head, based on the speed of the MTU, using the following equation: # of meters = (TMT seconds) * (2 meters/second)
12-19			The power-on time field contains 8 bytes of ASCII data that is vendor-specific. The power-on time indicates the total number of minutes the unit has been powered-on.
20-27			The cleaning count field contains 8 bytes of ASCII data that is vendor-specific. The cleaning count value is in units of tape sectors processed and is used to determine when MTU head cleaning is required. After a cleaning operation is performed, the cleaning count value is automatically set to 0.

5-3.7 Configuration Page - Page C1h

VPD page C1h returns configuration information. For a description of each of the configuration fields in this VPD page, refer to the M2488 User's Guide, CHAPTER 4.

The format for VPD page C1h is:

Table 5-28. INQUIRY Data Format VPD Page C1h - Configuration Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type = 01h				
1	Page code = C1h							
2	Reserved							
3	Page length = 3Dh							
DRIVE (MTU) CONFIGURATION SETTINGS								
4	MTU Logical Unit Number (S.LUN)							
5	Reserved (00h)							
6	Display Language (S.LNG)							
7	Display BOT with Ready (S.RDY)							
8	Display Target ID with ❋ (S.❋N)							
9	Display Intensity (S.ITS)							
10	xCL Power On Mode (S.ACL)							
11	Feature Configuration Byte 1 (S.FT1)							
12	Feature Configuration Byte 2 (S.FT2)							
13	Feature Configuration Byte 3 (S.FT3)							
14	Feature Configuration Byte 4 (S.FT4)							
15	Medium Changer Logical Unit Number (S.MCL)							
16	fgroup_code							
17	Feature Configuration Byte 5 (S.FT5)							
18-24	Reserved							
DRIVE (MTU) FACTORY CONFIGURATION SETTINGS								
25	Factory Setting Byte 0							
26	Factory Setting Byte 1							
27	Factory Setting Byte 2							
28	Factory Setting Byte 3							
29	factory_mode							
30-44	Reserved							

Table 5-28. INQUIRY Data Format VPD Page C1h - Configuration Page (Continued)

	BITS							
BYTES	7	6	5	4	3	2	1	0
CONTROLLER (TARGET) CONFIGURATION SETTINGS								
45	Target ID (S.TAR)							
46	SDTR (S.SDT)							
47	WDTR (S.WDT)							
48-64	Reserved							

5-3.8 Product Identification Page - Page C2h

VPD page C2h contains product identification information. The format for VPD page C2h is:

Table 5-29. INQUIRY data format VPD Page C2h - Product Identification Page

	BITS							
BYTES	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type = 01h				
1	Page code = C2h							
2	Reserved							
3	Page length = 18h							
4-11	Vendor ID							
12-19	Controller Product ID							
20-27	Logical Unit Product ID							

MTU VPD PAGES

The following fields defined for this page are stored in NVRAM and are maintained across power cycles and resets. These fields correspond to bytes 8 through 31 in the MTU non-VPD INQUIRY data described in the INQUIRY command description. Reference the INQUIRY command description for additional information on these fields.

Table 5-30. INQUIRY Data Format VPD Page C0h Field Description

BYTE	BIT	VALUE	DESCRIPTION
4-11			The Vendor ID field contains 8 bytes of ASCII data that is vendor-specific. This field corresponds to bytes 8-15 in the MTU non-VPD INQUIRY data described in the INQUIRY command description.
12-19			The Controller Product ID field contains 8 bytes of ASCII data that is vendor-specific. This field corresponds to bytes 16-23 in the MTU non-VPD INQUIRY data described in the INQUIRY command description.
20-27			The Logical Unit Product ID field contains 8 bytes of ASCII data that is vendor-specific. This field corresponds to bytes 24-31 in the MTU non-VPD INQUIRY data described in the INQUIRY command description.

CHAPTER 6

MEDIA CHANGER SCSI COMMANDS

6-1 INTRODUCTION

This chapter describes the medium changer commands for the M2488. The following information is located in this chapter:

6-2 MEDIA CHANGER COMMANDS

6-3 ADDITIONAL COMMAND INFORMATION ON MEDIUM CHANGER MODE SELECT AND MODE SENSE COMMANDS

6-4 MC (Medium Changer) Inquiry/Change Definition Vital Product Data Pages

6-2 MEDIA CHANGER COMMANDS

The media changer commands are described in Table 6-1. For more details on the commands, refer to the paragraph listed in the table for that command.

Table 6-1. Commands for Medium Changer Devices

OP CODE	COMMAND NAME	DESCRIPTION	PARAGRAPH
00h	TEST UNIT READY	Provides a means to check if the logical unit is ready.	6-2.6 on page 6-30
03h	REQUEST SENSE	Requests the target transfer sense data to the initiator.	4-3.23 on page 4-103
12h	INQUIRY	Provides a means for an initiator to request information regarding parameters of the target and any attached peripheral devices.	4-3.6 on page 4-18 & 5-3 on page 5-17
15h	MODE SELECT	Provides a means for the initiator to specify medium, logical unit, or peripheral device parameters to the target.	6-2.2 on page 6-6 & 6-3 on page 6-32
1Ah	MODE SENSE	Provides a means for a target to report its medium, logical unit, or peripheral device parameters to the initiator.	6-2.3 on page 6-11 & 6-3 on page 6-32
1Ch	RECEIVE DIAGNOSTIC RESULTS	Requests that analysis data generated by a previous SEND DIAGNOSTIC command be sent to the initiator.	4-3.19 on page 4-83
1Dh	SEND DIAGNOSTIC	Requests the target to perform diagnostic tests on itself, or on the attached peripheral devices.	4-3.27 on page 4-117
40h	CHANGE DEFINITION	Used to modify the operating definition of the selected target with respect to all initiators.	4-3.2 on page 4-5 & 6-4 on page 6-41
A5h	MOVE MEDIUM	Requests that the target move a unit of media from a source element to a destination element.	6-2.4 on page 6-16
A6h	EXCHANGE MEDIUM	Provides a means to exchange the medium in the source element, with the medium located at a destination element.	6-2.1 on page 6-2
B8h	READ ELEMENT STATUS	Requests that the target report status information for the medium-changer elements.	6-2.5 on page 6-19

6-2.1 EXCHANGE MEDIUM MC command A6h

The EXCHANGE MEDIUM medium-changer command provides a means to exchange the medium in the source element, with the medium located at a destination element.

The medium in the source element is moved to the first destination element and the medium that previously occupied the first destination element is moved to the second destination element. The second destination element may or may not be the same element as the source element. In the case of a simple exchange, the source element and the second destination element are the same.

This device can emulate the capability of handling two units of media at the same time. The ACL cannot perform exchange medium operations. The FACL can perform an exchange medium operations if the tape unit is empty.

6-2.1.1 EXCHANGE MEDIUM CDB Description

EXCHANGE MEDIUM is a twelve-byte command. The bytes are shown below and described in the following paragraphs. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	0	1	0	0	1	1	0
1	LUN			Reserved				
2-3	MSB	Transport Element Address						LSB
4-5	MSB	Source Address						LSB
6-7	MSB	First Destination Address						LSB
8-9	MSB	Second Destination Address						LSB
10	Reserved							
11	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

This command will only accept Transport element addresses of 0000h (default) or 000Eh (Transport Element address).

For this product, the Source address, First destination address, and Second destination addresses are storage elements.

When the Source address, First destination address, and Second destination addresses have the same value, this command performs no operation.

When the Source address and the First destination address have the same value and the second destination addresses has a different value, you are attempting to perform a simple MOVE MEDIUM and this EXCHANGE MEDIUM command is accepted.

The device capabilities page (XCL MODE parameters page 1Fh) provides a matrix which defines the supported source element type and first destination element type combinations for

EXCHANGE MEDIUM commands when the source element type is the same as second destination element type.

Send a READ ELEMENT STATUS command before sending an EXCHANGE MEDIUM command to determine if an exchange is possible.

6-2.1.2 Exchange Medium Examples

The data in XCL MODE parameter pages 1Dh (Element Address Assignments) and 1Fh (Device Capabilities) define the valid MOVE MEDIUM SOURCE and DESTINATION pairs. However, that information is difficult to read.

The following tables show data inputs to and the result of an EXCHANGE MEDIUM command using the data.

Table 6-2. M2488A11 (ACL) Exchange Medium Examples

SOURCE	FIRST DESTINATION	SECOND DESTINATION	RESULT
11h	12h	11h	This is not valid for an ACL. It will be rejected with CHECK CONDITION status and the sense key set to ILLEGAL REQUEST.
11h	12h	13h	Move cartridge in slot 02h to empty slot 03h then move cartridge from 01h to 02h
X	Y	X	This is not valid for an ACL. It will be rejected with CHECK CONDITION status and the sense key set to ILLEGAL REQUEST.
X	Y	Z	Move cartridge in slot Y-10h to empty slot Z-10h then move cartridge in slot X-10h to slot Y-10h.

[1]The magazine size can be determined by looking at XCL MODE parameter page 00h.

Table 6-3. M2488A12 (FACL) Exchange Medium Examples

SOURCE	FIRST DESTINATION	SECOND DESTINATION	RESULT
17h	16h	17h	Exchange cartridges in slots 06h and 07h. This will work with a full magazine.
16h	15h	14h	Move cartridge in slot 05h to empty slot 04h then move cartridge from slot 06h to 05h
X	Y	X	Where: X={11h,12h,...,17h} and Y<>X. Exchange cartridges in slots X-10h and Y-10h. This will work with a full magazine.
X	Y	Z	Move cartridge in slot Y-10h to empty slot Z-10h then move cartridge in slot X-10h to slot Y-10h.

6-2.1.3 EXCHANGE MEDIUM Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
2h	NOT READY	Logical Unit is not ready (magazine not set or if set, then START button not pressed or magazine not loaded via host command).
3h	MEDIUM ERROR	1. Medium exchange failed due to synchronization failure. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	Medium exchange failed due to hardware failure.
5h	ILLEGAL REQUEST	1. If this command is received and the XCL (ACL or FACL) is not attached, the target shall return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST. 2. If this command is received and the XCL (ACL or FACL) is not in SYSTEM MODE, the target shall return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST. 3. If this command is received and the source element is empty or the first destination element is empty, or the second destination element (if different from the source element) is full, or the second destination element (if the same as the source element) is empty, the target shall return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST. 4. The transport element address specifies the medium transport element that is to be used in executing this command. The default transport element address of zero may be used if this functionality is supported by the medium changer device. If the transport element address specified has not been assigned or has been assigned to an element other than a medium transport element, the target shall return CHECK CONDITION status and the set the sense key to ILLEGAL REQUEST. 5. If this command is received and the source, first destination, or second destination addresses are not valid element addresses, the target shall return CHECK CONDITION status and the set the sense key to ILLEGAL REQUEST. 6. If the device is an ACL and the source and second destination addresses are the same (simple exchange), the target shall return CHECK CONDITION status and the set the sense key to ILLEGAL REQUEST. 7. Reserved bit was found set in the CDB. 8. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the EXCHANGE MEDIUM command was not performed due to one of the following: 1. A NOT READY TO READY transition has occurred. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.

SENSE KEY	CONDITION	DESCRIPTION
Bh	ABORTED COMMAND	EXCHANGE MEDIUM command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the Read Reverse operation failed because physical End-of-Tape has been reached.

6-2.2 MODE SELECT MC command 15h

The MODE SELECT medium-changer command provides a means for the initiator to specify medium changer device parameters to the target by sending data relevant to such parameters in a data phase following the command. Initiators should issue MODE SENSE prior to MODE SELECT to determine supported pages, page lengths, and other parameters. A single set of Mode Select parameters kept by the controller are common to all initiators for a specific LUN. Buffered write data is synchronized to tape prior to activating the new mode parameters.

Mode Select parameters remain in effect until modified by another MODE SELECT command or until reset to their saved values following a power on sequence, SCSI bus reset, or SCSI device reset. Refer to the description of the Mode Sense command for an explanation of the different types of parameters (PC field).

6-2.2.1 MODE SELECT CDB Description

MODE SELECT is a six-byte command. The bytes are shown below and described in the following paragraphs. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	0	1	0	1
1	LUN			PF	Reserved			SP
2	Reserved							
3	Reserved							
4	Parameter List Length							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 6-4. MODE SELECT Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	15h	Operation code.
1	0	0 1	A Save Pages (SP) bit of zero indicates the target shall perform the specified MODE SELECT operation, and shall not save any pages in non-volatile memory. An SP bit of one indicates that the target shall perform the specified MODE SELECT operation, and shall save to a non-volatile location all the savable pages sent during the DATA OUT phase.
1	4	0, 1	A PF bit of 0 or 1 both indicate that the Mode Select parameters are structured as pages of related parameters as defined by the ANSI standard.
4	0-7	>0	The parameter list length field specifies the length in bytes of the MODE SELECT parameter list to be transferred from the initiator to the target. A parameter list length of zero indicates that no data is transferred. This condition is not an error.

For both an ACL or a FACL, the target will perform the MODE SELECT command even if the Medium Changer LUN is NOT READY.

If the target completes a MODE SELECT command successfully, it generates a Unit Attention Condition for all initiators except the one that issued the MODE SELECT command. The additional sense code reported for the Unit Attention Condition is MODE PARAMETERS CHANGED.

The Unit Attention/Mode Parameters Changed sense data will be reported to other initiators after a Mode Select command only if the setting of at least one parameter was actually changed from its previous setting. Therefore, issuing a Mode Select command with parameters that are the same as the current parameters will not result in any change or the reporting of a Unit Attention to other initiators.

To ensure that the MODE SELECT command performs the desired operations, it is strongly recommended that the initiator adhere to the following steps:

1. issue a MODE SENSE command requesting the target to return all Changeable Values (PC field 01b and Page Code 3Fh in byte two of the MODE SENSE CDB) and preserve the “changeable” values,
2. issue a MODE SENSE command requesting the target to return all Current Values (PC field 00b and Page Code 3Fh in byte two of the MODE SENSE CDB) and preserve the “current” values,
3. perform a bitwise AND operation of the “current” values with the one’s complement of the “changeable” values, (this step is important because the target will not accept the command if any non-changeable field is set to a value other than the “current” value)
4. make further desired changes to bytes which are changeable,
5. make sure that the PS bit in every mode page is 0 (the MODE SENSE command will report a 1 in the PS bit, but a MODE SELECT command will fail if mode pages are sent with the PS bit set to 1),
6. issue a MODE SELECT command, sending these parameters,

A PF bit of 0 or 1 both indicate that the Mode Select parameters are structured as pages of related parameters as defined by the ANSI standard.

Pages which can be saved are identified by the Parameter Savable (PS) bit that is returned in the page header by the MODE SENSE command. If the PS bit is set in the MODE SENSE data, the page can be saved by issuing a MODE SELECT command with the SP bit set. Once a MODE SELECT command with an SP bit of one is completed successfully, the parameters set during that command become the “saved parameters”. The “saved parameters” become the active or “current parameters” until another MODE SELECT command is completed. If the new MODE SELECT command has an SP bit of 0, the newly set parameters become the “current parameters” and remain in effect until any of the following occurs:

a) a new MODE SELECT command is successfully performed,

b) a RESET CONDITION is detected,

c) a power-on cycle is performed, or

d) a BUS DEVICE RESET message is received,

in which case the “saved parameters” are restored as the active or “current parameters”. If the new MODE SELECT command has an SP bit of 1, the newly set parameters become the “saved parameters” as well as the active or “current parameters”. Therefore, following any of the conditions described in b) through d) above, the newly set “saved parameters” will be restored as the “current parameters”.

MODE SELECT

6-2.2.2 MODE SELECT CHECK CONDITION Status

For the following conditions, a MODE SELECT command will fail with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. The requested mode settings/changes, will not be performed.

(a) If the initiator attempts to change any field that is not changeable as reported by the target.

(b) If the initiator sends a value for a parameter that is outside the range supported by the target and rounding is not permitted for that parameter.

(c) If the initiator sets any field in the mode parameter header or block descriptor to an unsupported value.

(d) If the initiator sends a mode page with a page length not equal to the page length returned by the MODE SENSE command for that page.

(e) If the initiator sets any reserved field in the mode parameter list to a non-zero value.

Certain parameters sent to a target with the MODE SELECT command contain a range of values. The target rejects unsupported values unless rounding is permitted in the description of the parameter. If rounding is permitted, then when the target receives a value not supported, it rounds the value received to a supported value.

Rounding of MODE SELECT parameter values, when permitted, is performed as follows: A target that receives a MODE SELECT parameter value that is not an exact supported value, adjusts the value to one that it supports, and returns CHECK CONDITION status with a sense key of RECOVERED ERROR. The additional sense code is set to ROUNDED PARAMETER. The initiator is responsible to issue a MODE SENSE command to learn what value the target has rounded.

A parameter list length that results in the truncation of any header or mode page causes the target to terminate the command with a CHECK CONDITION status, with a sense key of ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

6-2.2.3 MODE SELECT Data

The MODE SELECT data to be sent by the initiator should be in the form of a four-byte header, followed by zero or more variable length pages. The following table illustrates the format of the MODE SELECT parameter list:

Table 6-5. MODE SELECT Parameter List Format

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0 - 3	Mode Parameter Header (4 bytes)							
4 - N	Pages							

MODE SELECT Parameter Header

The four bytes of the Mode Parameter Header are shown in Table 6-6.

Table 6-6. MODE SELECT Mode Parameter Header

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Reserved							
1	Reserved							
2	Reserved							
3	Block Descriptor Length (00h)							

The block descriptor is not supported for the Medium Changer so its length must be specified as 00h.

Page Descriptors

Following the parameter list header are the MODE SELECT pages.

Table 6-7. Page Descriptors

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	PS=0	Reserved	Page Code					
1	Additional Page Length							
2-N	Page Defined or Vendor Unique Parameter Bytes							

Table 6-8. Page Descriptor Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-5		The Page Code field identifies the format and parameters for that page. For Medium Changer LUNs, this controller supports page 1Dh (Element Address Assignments), 1Eh (Transport Geometry Parameters), 1Fh (Device Capabilities Page), and 00h (Vendor Unique Parameters)
0	7	0	When using a MODE SELECT command, the PS (Parameters Savable) bit is reserved and must be zero.
1	0-7		The additional page length indicates the number of bytes in that page. The additional page length field value does not include bytes 0 and 1 of that page (the page code and additional page length fields, respectively).

If the initiator sends an incorrect length in the Page Length field or sends page fields with values that are not supported by the target or are not changeable, the target returns a CHECK CONDITION status with the sense key field set to ILLEGAL REQUEST in the sense data. In this case, no parameters are changed by this command.

For more information on the Medium Changer Mode Parameters see section 6-3 on page 6-32.

6-2.2.4 MODE SELECT MC Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data before the buffered mode operation occurred in MODE SELECT command.
3h	MEDIUM ERROR	1. Write of buffered data failed due to defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. SCSI interface error occurred due to hardware failure (e.g. transfer of MODE SELECT data failed due to hardware failure). 2. Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the MODE SELECT command. 2. Flag bit in the MODE SELECT CDB was set and Link bit was not set. 3. There is a parameter list error.
6h	UNIT ATTENTION	Indicates the MODE SELECT command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	MODE SELECT command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the MODE SELECT operation failed because physical End-of-Tape has been reached.

6-2.3 MODE SENSE MC command 1Ah

The MODE SENSE medium-changer command provides a means for a target to report its medium changer device parameters to the initiator. The MODE SENSE command is a complementary command to the MODE SELECT command. Please refer to the description of the MODE SELECT command for recommendations on how to ensure that the MODE SELECT command performs the desired operations.

6-2.3.1 MODE SENSE CDB Description

MODE SENSE is a six-byte command. The bytes are shown below and described in the following paragraphs. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	1	1	0	1	0
1	LUN			0	DBD	Reserved		
2	PC		Page Code (see section 6-3 on page 6-32)					
3	Reserved							
4	Allocation Length							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

For both an ACL or an FACL, the target will perform the MODE SELECT command even if the Medium Changer LUN is NOT READY.

Table 6-9. MODE SENSE Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	1Ah	Operation code.
1	3	1 0	The Disable Block Descriptor (DBD) bit value of 1 specifies that no block descriptor is returned in the MODE SENSE data. Since the Medium Changer does not provide a block descriptor, the Block Descriptor Length field in the MODE SENSE data read will always be set to zero independent of the setting of the DBD bit in the MODE SENSE command.
2	0-5		The Page Code allows the initiator to select any specific page or all of the pages supported by a target. Pages are used to set and return device parameters. If the initiator uses a Page Code value not implemented by the target, the target will return CHECK CONDITION status with sense key set to ILLEGAL REQUEST, and additional sense code to INVALID FIELD IN CDB.

Table 6-9. MODE SENSE Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
2	6-7		The Page Control (PC) field indicates the type of page parameter values to be returned by the target. The target returns the same page length for each supported page regardless of the value in the PC. The combination of the page control field value and the page code being set causes the target to return the appropriate values for the page selected by its respective page code. A Page Code value of 3Fh indicates all pages implemented by the target are returned to the initiator with the values reported defined by the page control field. For a Page Code value of 3Fh, all pages are returned in ascending page code order, except for mode page 00h, which will always be reported last. The PC field is defined in Table 6-10. Regardless of the setting of the PC field, the Mode Sense data header will return the current values for the fields contained in it, since the SP (Save Pages) bit only applies to the Mode Pages, and not the header.
4			The Allocation Length specifies the number of bytes the initiator has allocated for returned MODE SENSE data. An Allocation Length of zero indicates no MODE SENSE data is to be transferred. This condition is not considered as an error. Any other value indicates the maximum number of bytes transferred. The target terminates the DATA IN phase when allocation length bytes have been transferred or when all available MODE SENSE data has been transferred to the initiator, whichever is less.

MODE SENSE

Table 6-10. PC Field

PC FIELD BITS 7 6	DESCRIPTION
0 0	Report Current Values: The current values are those parameters under which the target is presently configured. The current values are defined to be the following: 1. those values set in the last successfully completed MODE SELECT command 2. saved values if a MODE SELECT hasn't successfully completed since the last power-on, hard reset condition or BUS DEVICE RESET message, 3. default values if saved values are not available. Page fields not supported are set to zero. The additional page length field returned by the target indicates the number of bytes supported in that page.
0 1	Report Changeable Values: The changeable values of any page indicate which parameters the initiator may change by a subsequent MODE SELECT command. Any field allowed to change is set to all ones. Fields and bits not allowed to be changed by the initiator are set to zero. Attempting to change any field, via MODE SELECT command, that is not changeable causes the target to return a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST in the sense data. The additional page length field of each page returned by the target indicates the number of bytes which are supported for that particular page.
1 0	Report Default Values: The target returns to the initiator the field values set to the target's or device's default values. The additional pages length field of each page returned by the target indicates the number of bytes supported for that particular page.
1 1	Report Saved Values: The target returns the saved values of the mode parameters. Until the first successful MODE SELECT command is completed with the SP (Save Pages) bit set to 1, the default values will be returned for this PC field setting.

6-2.3.2 MODE SENSE Data

The MODE SENSE data contains a four-byte header, followed by zero or more variable length pages.

Table 6-11. MODE SENSE Data Header

BYTES	7	6	5	4	3	2	1	0
0	Mode Sense Data Length							
1	Reserved							
2	Reserved							
3	Block Descriptor Length = 00h							

Table 6-12. MODE SENSE Data Header Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		The Mode Sense Data Length specifies the length in bytes of the following MODE SENSE data bytes after the data length field that are available to be transferred during the DATA IN phase. The sense data length does not include itself.
3	0-7	00h	A block descriptor length of zero indicates no block descriptors are included in the parameter list.

Page Descriptor

The page formats are defined as shown in Table 6-13 and described in Table 6-4.

Table 6-13. Page Descriptors

BYTES	7	6	5	4	3	2	1	0
0	PS	Reserved	Page Code					
1	Additional Page Length							
2-N	Page Defined or Vendor Unique Parameter Bytes							

Table 6-14. MODE SENSE Page Descriptors Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-5		Page code identifies the meaning of the bytes in that page.
0	7	1 0	When using the MODE SENSE command, a PS (Parameters Savable) bit of one indicates that the mode page can be saved by the target in a non-volatile location. A PS bit of zero indicates that the supported parameters cannot be saved. When using the MODE SELECT command, the PS bit is reserved.
1			The Additional Page length field indicates the number of bytes the target supports in each page. The additional page length value of each defined page, does not include the Page Length byte. The target may return in the pages of the MODE SENSE commands as many consecutive bytes as it supports, for each page it supports, without splitting fields of multiple bytes. The page length is set in the pages of the MODE SELECT command to the value returned by the target in the MODE SENSE Page Length bytes. Otherwise, the target creates CHECK CONDITION status with the sense key of ILLEGAL REQUEST.

If a MODE SELECT command with SP=1 has never been successfully performed on the target, then following a power on, SCSI bus reset, BUS DEVICE RESET message, the controller reports its default mode setting whenever current, or default values are requested. If a MODE SELECT command with SP=1 was ever performed successfully, the controller will report the "saved parameters" whenever the current or saved values are requested, and it will report the default mode settings only when the default parameters are requested.

6-2.3.3 MODE SENSE MC Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
1h	RECOVERED ERROR	Recovery was performed when writing buffered data, before the buffered mode operation occurred in MODE SENSE command.
3h	MEDIUM ERROR	1. Write of buffered data failed due to a defective tape. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	1. SCSI interface error occurred due to a hardware failure (e.g. transfer of MODE SENSE data failed due to a hardware failure). 2. Write of buffered data failed due to a hardware failure.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the MODE SENSE command. 2. Flag bit in the MODE SENSE CDB was set and the Link bit was not set.

SENSE KEY	CONDITION	DESCRIPTION
6h	UNIT ATTENTION	Indicates the MODE SENSE command was not performed due to one of the following: 1. The tape cartridge may have been changed. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	MODE SENSE command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the MODE SENSE operation failed because physical End-of-Tape has been reached.

6-2.4 MOVE MEDIUM MC command A5h

The MOVE MEDIUM medium-changer command requests that the target move a unit of media from a source element to a destination element.

6-2.4.1 MOVE MEDIUM CDB Description

MOVE MEDIUM is a twelve-byte command. The bytes are shown below and described in the following paragraphs. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	0	1	0	0	1	0	1
1	LUN			Reserved				
2	MSB	Transport Element Address						
3								LSB
4	MSB	Source Address						
5								LSB
6	MSB	Destination Address						
7								LSB
8	Reserved							
9								
10	Reserved							0
11	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 6-15. MOVE MEDIUM Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	A5h	Operation code.
2-3		0000h or 000Eh	This command will only accept Transport element addresses of 0000h (default) or 000Eh (Transport Element address).
4-5			The source address specifies the location that the medium is taken from.
6-7			The destination address specifies the location that the medium is moved to.

The device capabilities page (XCL MODE parameters page 1Fh) provides a matrix with the supported source element or destination element combinations for the MOVE MEDIUM command.

If the move addresses are valid and one of the addresses is the Data Transfer Element, a synchronize operation is performed before the media movement begins.

The xCL supports Storage element to Storage element moves only when no cartridges are loaded in the drive.

Send a READ ELEMENT STATUS command before sending a MOVE MEDIUM command to determine if a move operation is possible.

6-2.4.2 ACL/FACL Tables of Allowed Moves

The data in XCL MODE parameter pages 1Dh (Element Address Assignments) and 1Fh (Device Capabilities) define the valid MOVE MEDIUM SOURCE and DESTINATION pairs. However, that information is difficult to read.

The following table shows valid SOURCE/DESTINATION pairs and the result of a MOVE MEDIUM command using a valid pair.

Table 6-16. XCL Allowed Moves

SOURCE ADDRESS	DESTINATION ADDRESS	RESULT
0001h	0010h	LOAD MAGAZINE
0011h-0015h	000Dh	LOAD CTG (ACL 5 CTG MAGAZINE)[1]
0011h-0017h	000Dh	LOAD CTG (FACL 7 CTG MAGAZINE)[1]
0011h-001Ah	000Dh	LOAD CTG (ACL 10 CTG MAGAZINE)[1]
0010h	0001h	EJECT MAGAZINE
000Dh	0002h	UNLOAD CTG TO ORIGINAL POSITION
000Dh	001Nh	UNLOAD CTG TO EMPTY SLOT N
0011h-0015h	0011h-0015h	MOVE FROM FULLSLOT S-10h TO EMPTY SLOT D-10h (5 CTG MAGAZINE)[1]
0011h-0017h	0011h-0017h	MOVE FROM FULLSLOT S-10h TO EMPTY SLOT D-10h (7 CTG MAGAZINE)[1]
0011h-001Ah	0011h-001Ah	MOVE FROM FULLSLOT S-10h TO EMPTY SLOT D-10h (10 CTG MAGAZINE)[1]

[1] The magazine size can be determined by looking at XCL MODE parameter page 1Dh, bytes 8 and 9.

MOVE MEDIUM

6-2.4.3 MOVE MEDIUM Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
2h	NOT READY	Logical Unit is not ready (magazine not set or if set, then START button not pressed or magazine not loaded via host command).
3h	MEDIUM ERROR	1. Medium exchange failed due to synchronization failure. 2. An attempt was made to write 36-track data on 18-track formatted medium.
4h	HARDWARE ERROR	Medium move failed due to hardware failure.
5h	ILLEGAL REQUEST	1. If this command is received and the XCL (ACL or FACL) is not attached, the target shall return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST. 2. If this command is received and the XCL (ACL or FACL) is not in SYSTEM MODE, the target shall return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST. 3. If this command is received and the source element is empty or the destination element (if different from the source element) is full, the target shall return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST. 4. The transport element address specifies the medium transport element that is to be used in executing this command. The default medium transport element address of zero may be used if this functionality is supported by the medium changer device. If the address specified has not been assigned or has been assigned to an element other than a medium transport element, the target shall return CHECK CONDITION status and the set the sense key to ILLEGAL REQUEST. 5. The source address and the destination address may represent a storage element, an import export element, a data transfer element, or a medium transport element. If the address specified has not been assigned to a specific element of the medium changer, the target shall return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST. 6. Reserved bit was found set in the CDB. 7. The **Flag** bit was set but the **Link** bit was not set.
6h	UNIT ATTENTION	Indicates the MOVE MEDIUM command was not performed due to one of the following: 1. A NOT READY TO READY transition has occurred. 2. The target has been reset. 3. The Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	MOVE MEDIUM command was aborted.
Dh	VOLUME OVERFLOW	Write of buffered data prior to the MOVE MEDIUM operation failed because physical End-of-Tape has been reached.

6-2.5 READ ELEMENT STATUS MC command B8h

The READ ELEMENT STATUS medium changer command requests that the target report status information for the medium-changer elements. Status for the elements is returned in blocks of bytes called element descriptors, one descriptor per element.

This command can be used to determine which elements are defined and the state of each defined element. The READ ELEMENT STATUS command is typically used preceding a MOVE MEDIUM or EXCHANGE MEDIUM command to help determine if a move or exchange operation is possible.

6-2.5.1 READ ELEMENT STATUS CDB Description

READ ELEMENT STATUS is a twelve-byte command. The bytes are shown below and described in Table 6-4. Common fields are described in paragraph 4-3.1 on page 4-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	1	0	1	1	1	0	0	0
1	LUN			Reserved	Element Type Code			
2-3	MSB	Starting Element Address						LSB
4-5	MSB	Number of Elements						LSB
6	Reserved							
7-9	MSB	Allocation Length						LSB
10	Reserved							
11	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

READ ELEMENT STATUS

READ ELEMENT STATUS

Table 6-17. READ ELEMENT STATUS Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	B8h	Operation code.
1	0-3		The Element type code field specifies an element type; element descriptors are only returned for those elements that are of the same type as specified by this field. Table 6-18 shows the codes used for the Element type code field. The special value 0h can be used in the Element type code field when element descriptors for all element types are to be reported. If any reserved value (05h to 0Fh) is used in the Element type code field, then no data is sent and CHECK CONDITION status will be reported. The sense data for this error will contain a sense key of ILLEGAL REQUEST.
2-3			The Starting element address field specifies a minimum element address; element descriptors are only returned for those elements with addresses greater than or equal to the value in this field. The defined element addresses for the Flush-Mount Cartridge Loader (FACL) and Automatic Cartridge Loader (ACL) are shown in Table 6-19
4-5			The Number of elements field specifies a maximum number of element descriptors to be reported. If the set of element descriptors to be reported as defined by the Element type code field and Starting element address field contains more element descriptors than are allowed to be reported by the Number of elements field then only a subset of these element descriptors will be reported. Which elements are chosen for this subset is not specified.
7-9			The Allocation length field describes the maximum number of bytes that are to be transferred for the READ ELEMENT STATUS command. If the allocation length is not sufficient to transfer all element descriptors to be reported then the target transfers as many bytes as possible stopping at the end of a full element descriptor. It is not considered an error if the value in the Allocation length field is zero or is not sufficient to transfer all element descriptors to be reported. Given a sufficient allocation length, element descriptors will be reported for all defined elements if the Element type code is 0h, the Starting element address is 0 and the Number of elements is FFFFh.
			All reserved fields of the CDB should be set to 0. If any reserved field is set to a non-zero value then CHECK CONDITION status is reported. The sense data for this error will contain a sense key of ILLEGAL REQUEST.

Table 6-18. Element Type Codes

CODE	DESCRIPTION
0h	All element types reported
1h	Medium Transport Element
2h	Storage Element
3h	Import Export Element
4h	Data Transfer Element
5h-Fh	Reserved

Table 6-19. Element Addresses

TYPE	ADDRESS
Medium Transport Element	000Eh
Storage Elements	0011h - 002Fh[a]
Import Export Element	0001h
Data Transfer Element	000Dh

a. 31 storage elements are defined but only a subset will be available for use depending upon the magazine size.

6-2.5.2 READ ELEMENT STATUS Data

The data transferred for the READ ELEMENT STATUS command is structured. The data starts with an Element status data header. This is followed by one or more Element status pages. Each Element status page consists of an Element status page header followed by one or more Element descriptor blocks.

An example block structure is shown in Table 6-20. In the example there are two Element status pages; the first page contains four Element descriptor blocks and the second page contains one Element descriptor block.

Table 6-20. Block Structure of READ ELEMENT STATUS Data

	Element status data header
Element status page	**Element status page header**
	Element descriptor
	Element descriptor
	Element descriptor
	Element descriptor
Element status page	**Element status page header**
	Element descriptor

READ ELEMENT STATUS

6-2.5.2.1 Element Status Data

The Element status data header is an 8 byte block; a diagram of this block is shown in Table 6-21 and described in Table 6-22.

Table 6-21. Element Status Data Header

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0-1	MSB	First Element Address Reported						LSB
2-3	MSB	Number of Elements Available						LSB
4	Reserved							
5-7	MSB)	Byte Count of Report Available						LSB

Table 6-22. Element Status Data Header Field Description

BYTE	BIT	VALUE	DESCRIPTION
0-1			The First element address reported field contains the smallest element address of those elements that meet the requirements defined in the CDB parameters. This value is not adjusted for the allocation length.
2-3	0		The Number of elements available field indicates the number of element descriptors that meet the requirements defined in the CDB request. This value is not changed because of insufficient allocation length. By definition, the value in the Number of elements available field will always be less than or equal to the Number of elements field in the CDB. This value is not adjusted for the allocation length.
5-7	2		The Byte count of report available field indicates the total number of bytes in the element status pages based upon the requirements of the CDB request. This value is not adjusted for the allocation length.

None of the fields in the Element status data header are adjusted if the allocation length is insufficient to send all status data available. Note that a READ ELEMENT STATUS command can be issued with an Allocation length of 8 to determine the allocation length needed to transfer all element status page bytes specified by the command; the allocation length needed is the value reported in the Byte Count of Report Available field plus 8.

6-2.5.2.2 Element Status Page

Each Element status page contains one 8 byte header followed by one or more Element descriptors. A diagram of the Element Status Page header is shown in Table 6-23 and described in Table 6-24. All Element descriptors in one page are for the same type of medium-changer element and are of equal length.

Table 6-23. Element Status Page Header

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Element Type Code							
1	Reserved							
2-3	MSB	Element Descriptor Length						LSB
4	Reserved							
5-7	MSB	Byte Count of Descriptor Data Available						LSB

Table 6-24. Element Status Page Header Field Description

BYTE	BIT	VALUE	DESCRIPTION
0			All element descriptors in one page are of the same type, the Element type code field indicates the medium-changer element type for the element descriptors in the page. The upper four bits of this field are always 0; the bottom four bits contain one of the code values shown in Table 6-18 on page 6- 20.
2-3	0		The Element descriptor length field indicates the number of bytes in each of the Element descriptors within the page. The value in this field is not adjusted for the allocation length.
5-7	2		The byte count of the descriptor data available field indicates the number of bytes of element descriptor data available for elements of this element type meeting the request in the CDB. This value is not adjusted to match the allocation length available.

6-2.5.2.3 Element Descriptors

See Table 6-25 through Table 6-31 for descriptions of the Element Descriptors.

Table 6-25. Medium Transport Element Descriptor (Type Code = 1h)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0-1	MSB	Element Address						LSB
2	Reserved					Exception	Reserved	Full
3	Reserved							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	Reserved							
9	SValid	Invert=0	Reserved					
10	MSB	Source Storage Element Address						
11								LSB
12-15	Reserved							

Table 6-26. Medium Transport Element Descriptor Field Description

BYTE	BIT	VALUE	DESCRIPTION
0-1			The Element address field indicates the address of the element for which status is being reported in the descriptor.
2	0	1 0	The Full bit, if one, indicates that a cartridge is present in the Medium transport element. If the Full bit is zero then no cartridge is present in the element.
2	2	1 0	The Exception bit, if one, indicates that the medium transport element is in an error condition. If the Exception bit is zero then the medium transport element is not in an error condition. When the Exception bit is one, the Additional Sense code and Additional sense code qualifier fields give detailed information about the error condition.
9	6	0	The Invert bit is always set to 0. The cartridges for the supported tape format cannot be inverted.
9	7	1 0	If the SValid bit is set to one then the Source storage element address field indicates the address of the element where the current unit of media [cartridge] in the medium transport element was previously stored. If the SValid bit is zero then the value in the Source storage element address field is not valid.

Table 6-27. Storage Element Descriptor (Type Code=2h)

BYTES	7	6	5	4	3	2	1	0
	BITS							
0	MSB	Element Address						
1								LSB
2	Reserved				Access	Exception	Reserved	Full
3	Reserved							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	Reserved							
9	SValid	Invert=0	Reserved					
10	MSB	Source storage element address						
11								LSB
12-15	Reserved							

Table 6-28. Storage Element Descriptor Field Description

BYTE	BIT	VALUE	DESCRIPTION
0-1			The Element address field indicates the address of the element for which status is being reported in the descriptor.
2	0	1 0	The Full bit, if one, indicates that a cartridge is present in the storage element. If the Full bit is zero then no cartridge is present in the element.
2	2	1 0	The Exception bit, if one, indicates that the element is in an error condition. If the Exception bit is zero then the element is not in an error condition. When the Exception bit is one, the Additional Sense code and Additional sense code qualifier fields give detailed information about the error condition.
2	3	1 0	If the Access bit is one then the storage element is accessible to the medium transfer element. If the Access bit is zero the storage element is not accessible to the medium transfer element.
9	6	0	The Invert bit is always set to 0. The cartridges for the supported tape format cannot be inverted.
9	7	1 0	If the SValid bit is set to one then the Source storage element address field indicates the address of the element where the current unit of media [cartridge] in the element was previously stored. If the SValid bit is zero then the value in the Source storage element address field is not valid.

READ ELEMENT STATUS

READ ELEMENT STATUS

Table 6-29. Import Export Element Descriptor (Type Code=3h)

BYTES	7	6	5	4	3	2	1	0
	BITS							
0-1	MSB	Element Address						LSB
2	Reserved		Import Enable =1	Export Enable=1	Access	Exception	ImpExp	Full
3	Reserved							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6-8	Reserved							
9	SValid	Invert=0	Reserved					
10-11	MSB	Source storage element address						LSB
12-15	Reserved							

Table 6-30. Import Export Element Descriptor Field Description

BYTE	BIT	VALUE	DESCRIPTION
0-1			The Element address field indicates the address of the element for which status is being reported in the descriptor.
2	0	1 0	The Full bit, if one, indicates that a magazine or cartridge is present in the import export element. If the Full bit is zero then no magazine or cartridge is present in the element.
2	1	1 0	The ImpExp bit, if one, indicates that the magazine was put into the import export element by the operator. If this bit zero then the magazine was placed into the import export element by the medium-changer’s medium transfer element; immediately following a magazine unload the ImpExp bit will be zero. This bit is not defined when the import export element’s Full bit is zero.
2	2	1 0	The Exception bit, if one, indicates that the element is in an error condition. If the Exception bit is zero then the element is not in an error condition. When the Exception bit is one, the Additional Sense code and Additional sense code qualifier fields give detailed information about the error condition.
2	3	1 0	If the Access bit is one then the import export element is accessible to the medium transfer element. If the Access bit is zero the import export element is not accessible to the medium transfer element.

Table 6-30. Import Export Element Descriptor Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
2	4	1	The Export Enable bit is always set to one to indicate that the medium-changer's import export element supports export operations.
2	5	1	The Import Enable bit is always set to one to indicate that the medium-changer's import export element supports import operations.
9	6	0	The Invert bit is always set to 0. The cartridges for the supported tape format cannot be inverted.
9	7	1 0	If the SValid bit is set to one then the Source storage element address field indicates the address of the element where the current unit of media in the element was previously stored. If the SValid bit is zero then the value in the Source storage element address field is not valid.

Table 6-31. Data Transfer Element Descriptor (Type Code=4h)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	MSB	Element Address						
1								LSB
2	Reserved				Access	Exception	Reserved	Full
3	Reserved							
4	Additional Sense Code							
5	Additional Sense Code Qualifier							
6	Not bus=0	Reserved	ID Valid=0	LUN Valid =0	Reserved	Logical Unit Number=0		
7	SCSI Bus Address=0							
8	Reserved							
9	SValid	Invert=0	Reserved					
10	MSB	Source storage element address						
11								LSB
12-15	Reserved							

READ ELEMENT STATUS

READ ELEMENT STATUS

Table 6-32. Data Transfer Element Descriptor Field Description

BYTE	BIT	VALUE	DESCRIPTION
0-1			The Element address field indicates the address of the element for which status is being reported in the descriptor.
2	0	1 0	The Full bit, if one, indicates that a cartridge is present in the data transfer element (tape unit). If the Full bit is zero then no cartridge is present in the element.
2	2	1 0	The Exception bit, if one, indicates that the element is in an error condition. If the Exception bit is zero then the element is not in an error condition. When the Exception bit is one, the Additional Sense code and Additional sense code qualifier fields give detailed information about the error condition.
2	3	1 0	If the Access bit is one then the data transfer element is accessible to the medium transfer element. If the Access bit is zero the data transfer element is not accessible to the medium transfer element.
6	4-5	0	The LU valid and ID valid bits are always set to zero. The zero values indicate that the Logical unit number field (in the data transfer element descriptor) and the SCSI bus address field are invalid.
6	7	0	The Not bus bit is always set to zero, this indicates that the medium changer is connected to the same SCSI bus as the data transfer element (i.e. the tape unit).
9	6	0	The Invert bit is always set to 0. The cartridges for the supported tape format cannot be inverted.
9	7	1 0	If the SValid bit is set to one then the Source storage element address field indicates the address of the element where the current unit of media in the element was previously stored. If the SValid bit is zero then the value in the Source storage element address field is not valid.

6-2.5.3 Source and Destination Elements

Table 6-33 shows when an element is allowed to be source or destination for a MOVE MEDIUM or EXCHANGE MEDIUM command based upon the element's Full and Access status bits.

Table 6-33. Allowed Source and Destination Elements

ELEMENT ACCESS STATUS	ELEMENT FULL STATUS	ALLOWED AS SOURCE ELEMENT	ALLOWED AS DESTINATION ELEMENT FOR MOVE MEDIUM	ALLOWED AS FIRST DESTINATION ELEMENT FOR EXCHANGE MEDIUM	ALLOWED AS SECOND DESTINATION ELEMENT FOR EXCHANGE MEDIUM
0	0	N	N	N	N
0	1	N	N	N	N
1	0	N	Y	N	Y[a]
1	1	Y	N	Y	Y[b]

a. Only if the Second destination element is different from the Source element.
b. Only if the Second destination element is the same as the Source element.

6-2.5.4 READ ELEMENT STATUS Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
5h	ILLEGAL REQUEST	1.Reserved bit was found set in the CDB of the READ ELEMENT STATUS command. 2. Illegal value used in **Element type** code field of the CDB. 3. The Flag bit was set but the Link bit was not set.
6h	UNIT ATTENTION	Indicates the READ ELEMENT STATUS command was not performed due to one of the following: 1. A NOT READY TO READY transition has occurred. 2. The target has been reset. 3. The Medium-changer Mode parameters have been changed by another initiator. 4. The version of the microcode has been changed (microcode downloaded). 5. A cartridge was loaded with a tape length that is too long or too short.
Bh	ABORTED COMMAND	READ ELEMENT STATUS command was aborted. The READ ELEMENT STATUS command can be reissued.

6-2.6 TEST UNIT READY MC command 00h

The TEST UNIT READY command provides a means to check if the logical unit is ready. This is not a request for a self-test. If the logical unit would accept an appropriate medium-access command without returning CHECK CONDITION status, this command returns a GOOD status.

6-2.6.1 TEST UNIT READY CDB Description

TEST UNIT READY is a six-byte command. The bytes are as shown below and described in Table 6-34. Common fields are described in paragraph 4-3.1 on page 7-4.

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	0	0	0	0	0	0	0	0
1	LUN			Reserved				
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved						Flag	Link

Note: Changeable fields in the CDB are shaded.

Table 6-34. TEST UNIT READY Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7	00H	Operation code.

6-2.6.2 TEST UNIT READY CHECK CONDITION Status

The medium-changer logical unit is Ready if the following conditions are met:

A. the medium-changer mode is System Mode

B. a magazine is present or a cartridge is loaded in the tape drive

If medium-changer is not Ready then CHECK CONDITION status is returned with the sense key equal to NOT READY.

6-2.6.3 TEST UNIT READY Sense Keys

One of the following sense keys may be returned if a CHECK CONDITION was indicated:

SENSE KEY	CONDITION	DESCRIPTION
2h	NOT READY	Logical unit is not ready (magazine is not present).
4h	HARDWARE ERROR	Medium-changer hardware is broken.
5h	ILLEGAL REQUEST	1. Reserved bit was found set in the CDB of the TEST UNIT READY command. 2. Flag bit was set and link bit was not set.
6h	UNIT ATTENTION	Indicates the TEST UNIT READY command was not performed due to one of the following: 1. The target has been reset. 2. The Mode parameters have been changed by another initiator. 3. The version of the microcode has been changed (microcode downloaded).

TEST UNIT READY

6-3 ADDITIONAL COMMAND INFORMATION ON MEDIUM CHANGER MODE SELECT AND MODE SENSE COMMANDS

Table 6-35 lists the page codes supported by the Medium Changer MODE SELECT and MODE SENSE commands.

Table 6-35. Page Codes

PAGE CODE	DESCRIPTION
00h	Device Unique Parameters
1Dh	Element Address Assignments
1Eh	Transport Geometry Parameters
1Fh	Device Capabilities

**** NOTE ****

The current value of non-changeable Mode Parameters must be returned in MODE SELECT command data.

6-3.1 Page Code 00h, Device Unique Parameters

Table 6-36. Page Code 00 - Device Unique Parameters

	BITS								MODE SENSE DEFAULT VALUES	
BYTES	7	6	5	4	3	2	1	0	ACL	FACL
0	PS *	Reserved	Page Code						80h	
1	Additional Page Length								0Eh	
2	Reserved			HltLd	Eject Code		Mode Code		09h	01h
3	Position								00h	
4 - 7	Cartridge Map								00000000h	
8 - 15	Reserved								00h	

* The PS bit must be set to 0 on a MODE SELECT command.

Bits are changeable (HltLd, Mode Code) Changeable only if ACL attached. (Eject Code)

Table 6-37. Page Code 00 - Device Unique Parameters Field Description

BYTE	BIT	VALUE	DESCRIPTION
2	0-1		The Mode Code field allows the host to configure the Medium Changer to operate in one of three operating modes. In the Manual Mode, a single cartridge may be inserted manually into the tape unit and removed in conjunction with the operator panel keys. This mode is not selectable by the MODE SELECT command. When in Manual Mode, the Load/Unload and Move Medium commands can be used to unload a cartridge. In the Auto Mode, when a cartridge is unloaded, the next cartridge is automatically loaded. In the System Mode, the host system is responsible for cartridge movement activity through the use of Medium Changer commands. The Mode Code is reported as changeable on a MODE SENSE command. The default value is 01b (Auto Mode). Modes codes are defined in Table 6-38.
2	2-3		The Eject Code is reserved and not changeable for an FACL, and will result in a CHECK CONDITION status if not set to 00b. For an ACL, the Eject Codes are specified in Table 6-39.
2	4		The purpose of the HltLd bit is to facilitate Dynamic Device Reconfiguration (DDR). This function allows the host software to suspend the automatic loading of a cartridge until the operator can move the selected cartridge to another MTU. This bit
		0	is reported as changeable on a MODE SENSE command. The default value is zero.
		1	If the HltLd (Halt Load) bit is set to 1, the Medium Changer is instructed to suspend loading of the next cartridge following an unload of the currently loaded cartridge when the Medium Changer is set in Automatic Mode.
3			The Position field describes the current location of the elevator with respect to the magazine. A value of 00h indicates that the magazine is not loaded. A value of 01h indicates the magazine position 1 is located at the Tape Load Port. This field is reported as NOT changeable on a MODE SENSE command. For an FACL, the Position field is unused, i.e. contains 00h. This field is reported as NOT changeable on a MODE SENSE command.
4-7			The Cartridge Map field is returned in Mode Sense data to indicate which positions in the magazine contain units of media (cartridges). A one indicates a cartridge is present in that position. A zero indicates a cartridge is not present in that position. The Magazine Present bit in the Cartridge Map field indicates whether or not a magazine is present (1 indicates presence of magazine). P1 refers to magazine slot 1 which is the first slot in the magazine, located at the topmost position of the magazine. The Cartridge Map field is reported as NOT changeable on a MODE SENSE command. The cartridge map bits are shown in Table 6-41.

**** NOTE ****

Since the Mode can also be set via the Medium Changer operator panel, the actual mode of operation (and the Mode reported via the MODE SENSE command) will be the current Mode. The current Mode is the most recent Mode set by either a MODE SELECT command from the initiator, or a Mode change reported by the Medium Changer (operator panel).

The following MODE CODES are specified:

Table 6-38. Mode Codes

CODE	MODE SENSE	MODE SELECT
00b	Manual Mode is set	Leave Mode as currently set
01b	Auto Mode is set	Set Auto Mode
10b	System Mode Is set	Set System Mode
11b	Reserved	Reserved

Table 6-39. Eject Codes

CODE	ACL ACTION
00b	No change of Eject Function
01b	Inhibit Magazine Eject
10b	Enable Magazine Eject (default)
11b	Reserved

When the Inhibit Magazine Eject code is set, the Medium Changer does NOT eject the Magazine upon either the receipt of a MOVE MEDIUM command that specifies move Import/Export Element to Medium Transport Element (eject Magazine), or after processing the last cartridge in a Magazine while in Automatic Mode. If Inhibit Magazine Eject is set when either of these situations occur, the Magazine is moved to the first available cartridge (see Table 6-40 on page 6-34 for operation of cartridge unloading). If an ACL is attached, the Eject code is reported as changeable and defaults to a value of 10b.

For an FACL, the Eject code is not supported. If an FACL is attached, the Eject code is reported as NOT changeable on a MODE SENSE command and defaults to a value of zero. See Table 6-40 for operation of cartridge unloading.

Table 6-40. Operation of Cartridge Unload

		Is the cartridge being unloaded, the last cartridge in the magazine			
Mode	Is Inhibit Magazine Eject set? (Eject Code=01b)	with an ACL?		with an FACL?	
		Yes	No	Yes	No
AUTO	Yes	1 & 3	1 & 2	1	1 & 2
	No	1 & 4	1 & 2	1	1 & 2
SYSTEM	Yes	1	1	1	1
	No	1	1	1	1

1) Move cartridge from MTU to magazine.

2) Load next cartridge.

3) Position magazine to cartridge position number 1.

4) Eject magazine.

If the HltLd (Halt Load) bit is set to 1, the Medium Changer is instructed to suspend loading of the next cartridge following an unload of the currently loaded cartridge when the Medium Changer is set in Automatic Mode. This function is cleared and the bit reset

a) by depressing the START key after loading has been suspended in Automatic Mode or

b) by depressing the RESET key followed by the START key when the Medium Changer is in Automatic Mode, or

c) by a new Mode Select command with the HLTLD bit set to 0b.

**** NOTE ****

The Cartridge Map may be returned as zeros if the Medium Changer is NOT READY.

Table 6-41. Cartridge Map

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
4	P31	P30	P29	P28	P27	P26	P25	P24
5	P23	P22	P21	P20	P19	P18	P17	P16
6	P15	P14	P13	P12	P11	P10	P9	P8
7	P7	P6	P5	P4	P3P	P2	P1	Mag. Present

6-3.2 Page Code 1Dh, Element Address Assignments

Table 6-42. ACL Page Code 1Dh, Element Address Assignments

	BITS								MODE SENSE DEFAULT VALUES
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	PS *	Reserved		Page Code					9Dh
1	Additional Page Length								12h
2-3	MSB	Medium Transport Element Address						LSB	000Eh
4-5	MSB	Number of Medium Transport Elements						LSB	0001h
6-7	MSB	First Storage Element Address						LSB	0011h
8-9	MSB	Number of Storage Elements						LSB	001Fh
10-11	MSB	First Import/Export Element Address						LSB	0001h
12-13	MSB	Number of Import/Export Elements						LSB	0001h
14-15	MSB	First Data Transfer Element Address						LSB	000Dh
16-17	MSB	Number of Data Transfer Elements						LSB	0001h
18-19	Reserved								0000h

* The PS bit must be set to 0 on a MODE SELECT command.

**** NOTE ****

All fields in this page are reported as NOT changeable. The default values are the same as the current values shown above and described below.

Table 6-43. ACL Page Code 1Dh, Element Address Assignments Field Description

BYTE	BIT	VALUE	DESCRIPTION
2-5		000Eh	There is one Medium Transport Element and it is referred to as address 000Eh.
6-9			The First Storage Element Address is 0011h. Storage Elements are the "slots" that may hold tape cartridges in a Magazine. There are 31 logical storage elements. A 5-volume Magazine has five Storage Elements and a 10-volume Magazine has ten storage elements.
10-13		0001h	There is one Import/Export Element address at 0001h. This is the Magazine Port.
14-17		000Dh	There is one Data Transfer Element address at 000Dh. This is the Cartridge load port in the MTU.

Table 6-44. FACL Page Code 1Dh, Element Address Assignments

	BITS								MODE SENSE DEFAULT VALUES
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	PS *	Reserved		Page Code					9Dh
1	Additional Page Length								12h
2-3	MSB Medium Transport Element Address LSB								000Eh
4-5	MSB Number of Medium Transport Elements LSB								0001h
6-7	MSB First Storage Element Address LSB								0011h
8-9	MSB Number of Storage Elements LSB								001Fh
10-11	MSB First Import/Export Element Address LSB								0001h
12-13	MSB Number of Import/Export Elements LSB								0001h
14-15	MSB First Data Transfer Element Address LSB								000Dh
16-17	MSB Number of Data Transfer Elements LSB								0001h
18-19	Reserved								0000h

* The PS bit must be set to 0 on a MODE SELECT command.

MODE SELECT/SENSE

**** NOTE ****

All fields in this page are reported as NOT changeable. The default values are the same as the current values shown above and described below.

Table 6-45. FACL Page Code 1Dh, Element Address Assignments Field Description

BYTE	BIT	VALUE	DESCRIPTION
2-5		000Eh	There is one Medium Transport Element and it is referred to as address 000Eh.
6-9		0011h	The First Storage Element address is 0011h. The First Storage Element Address is 0011h. Storage Elements are the "slots" that may hold tape cartridges in a Magazine. There are 31 logical storage elements. An FACL has seven Storage Elements.
10-13		0001h	There is one Import/Export Element address at 0001h. This is the Magazine Port.
14-17		000Dh	There is one Data Transfer Element address at 000Dh. This is the Cartridge load port in the MTU.

6-3.3 Page Code 1Eh, Transport Geometry Parameters

Table 6-46. Page code 1Eh, Transport Geometry Parameters

	BITS								MODE SENSE DEFAULT VALUES
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**	
0	PS *	Reserved	Page Code						9Eh
1	Additional Page Length								02h
2	Reserved							Rotate	00h
3	Member Number in Transport Element Set								00h

* The PS bit must be set to 0 on a MODE SELECT command.

**** NOTE ****

All fields in this page are reported as NOT changeable and default to a value of zero.

Table 6-47. Page code 1Eh, Transport Geometry Parameters Field Description

BYTE	BIT	VALUE	DESCRIPTION
2	0	0	This Element is not able to rotate the medium so the Rotate bit is 0.
3		00h	There can be only one Medium Transport Element (Magazine) in the system at any given time and it is defined here.

6-3.4 Page Code 1Fh, Device Capabilities

Table 6-48. ACL Page Code 1Fh, Device Capabilities

BYTES	BITS 7	6	5	4	3	2	1	0	MODE SENSE DEFAULT VALUES
0	PS *	Reserved	Page Code						9Fh
1	Additional Page Length								0Eh
2	Reserved				StorDT 0b	StorIE 0b	StorST 1b	StorMT 1b	03h
3	Reserved								00h
4	Reserved				MT→DT 0b	MT→IE 0b	MT→ST 0b	MT→MT 0b	00h
5	Reserved				ST→DT 1b	ST→IE 1b	ST→ST 0b	ST→MT 0b	0Ch
6	Reserved				IE→DT 1b	IE→IE 0b	IE→ST 1b	IE→MT 0b	0Ah
7	Reserved				DT→DT 0b	DT→IE 1b	DT→ST 1b	DT→MT 0b	06h
8-11	Reserved								00h
12	Reserved				MT↔DT 0	MT↔IE 0	MT↔ST 0	MT↔MT 0	00h
13	Reserved				ST↔DT 0	ST↔IE 0	ST↔ST 0	ST↔MT 0	02h
14	Reserved				IE↔DT 0	IE↔IE 0	IE↔ST 0	IE↔MT 0	00h
15	Reserved				DT↔DT 0	DT↔IE 0	DT↔ST 0	DT↔MT 0	00h

Key:
MT - Medium Transport Element ST - Storage Element
IE - Import/Export Element DT - Data Transfer Element

* The PS bit must be set to 0 on a MODE SELECT command.

**** NOTE ****

All fields are reported as NOT changeable. The default values are shown in the table. Reserved fields always have a default value of zero.

For more information about how the Device Capabilities page can be used for MOVE MEDIUM operations, see Table 6-16 for XCL allowed moves.

An XX → YY bit value of one indicates that the Medium Changer supports MOVE MEDIUM commands where the source element is type XX and the destination element is type YY. The following sources and destinations are supported:

ST → DT Select cartridge from magazine and load cartridge into tape unit.

ST → IE Unload magazine.

ST → ST Move cartridge in magazine to empty slot in magazine.

IE → ST Load magazine.

DT → IE Unload cartridge from tape unit and place it into magazine, then unload.

DT → ST Unload cartridge from tape unit and place it into magazine.

Table 6-49. FACL Page Code 1Fh, Device Capabilities Page

BYTES	BITS 7	6	5	4	3	2	1	0	MODE SENSE DEFAULT VALUES
0	PS *	Reserved	Page Code						9Fh
1	Additional Page Length								0Eh
2	Reserved				StorDT 0b	StorIE 0b	StorST 1b	StorMT 1b	03h
3	Reserved								00h
4	Reserved				MT→DT 0b	MT→IE 0b	MT→ST 0b	MT→MT 0b	00h
5	Reserved				ST→DT 1b	ST→IE 1b	ST→ST 1b	ST→MT 0b	0Eh
6	Reserved				IE→DT 1b	IE→IE 0b	IE→ST 1b	IE→MT 0b	0Ah
7	Reserved				DT→DT 0b	DT→IE 1b	DT→ST 1b	DT→MT 0b	06h
8-11	Reserved								00h
12	Reserved				MT↔DT 0	MT↔IE 0	MT↔ST 0	MT↔MT 0	00h
13	Reserved				ST↔DT 0	ST↔IE 0	ST↔ST 1	ST↔MT 0	02h
14	Reserved				IE↔DT 0	IE↔IE 0	IE↔ST 0	IE↔MT 0	00h
15	Reserved				DT↔DT 0	DT↔IE 0	DT↔ST 0	DT↔MT 0	00h

Key:
MT - Medium Transport Element ST - Storage Element
IE - Import/Export Element DT - Data Transfer Element

* The PS bit must be set to 0 on a MODE SELECT command.

**** NOTE ****

All fields are reported as NOT changeable. The default values are shown in the table. Reserved fields always have a default value of zero.

A StorXX bit value of one indicates that the defined elements of type XX may provide independent storage of a unit of media.

For more information about how the Device Capabilities page can be used for MOVE MEDIUM operations, see Table 6-16 for XCL allowed moves.

MODE SELECT/SENSE

An XX → YY bit value of one indicates that the Medium Changer supports MOVE MEDIUM commands where the source element is type XX and the destination element is type YY. The following sources and destinations are supported:

ST → DT	Select cartridge from magazine and load cartridge into tape unit.
ST → IE	Unload magazine.
ST → ST	Move cartridge in magazine to empty slot in magazine.
IE → ST	Load magazine.
DT → IE	Unload cartridge from tape unit and place it into magazine, then unload.
DT → ST	Unload cartridge from tape unit and place it into magazine.

6-4 MC (MEDIUM CHANGER) INQUIRY/CHANGE DEFINITION VITAL PRODUCT DATA PAGES

This section describes the VPD (Vital Product Data) pages and parameters used by the MC Inquiry and Change Definition commands. The MC VPD parameters include information such as configuration data (vendor identification, product identification, model). The supported MC VPD pages are shown in the following table.

Table 6-50. Supported MC VPD Page Codes

VPD PAGE CODE	VENDOR UNIQUE PAGE	DESCRIPTION	USED BY THE FOLLOWING MC CMDS.	
			INQUIRY CMD.	CHANGE DEF. CMD.
00	N	List of the vital product data pages supported by this target.	Y	N
81h	N	Implemented operating definition page.	Y	N
82h	N	ASCII implemented operating definition page.	Y	N
C2h	Y	Product identification page.	Y	Y

6-4.1 General VPD Page Format

The General VPD page format is:

Table 6-51. VPD Page Format

	BITS							
BYTES	7	6	5	4	3	2	1	0
0	Peripheral Qualifier			Peripheral Device Type				
1	Page Code							
2	Reserved							
3	Page Length (n - 1)							
4-N	VPD parameters							

Table 6-52. VPD Page Format Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	0-7		The meaning of the Peripheral Qualifier and Peripheral Device Type fields depend on whether the VPD page is being sent to the initiator as INQUIRY data or is being received from the initiator as CHANGE DEFINITION data. When being sent as INQUIRY data, these fields are the same as those defined in the INQUIRY command description. When being received as CHANGE DEFINITION data, these fields are ignored.
1	0-7		The Page Code field identifies the format and parameters defined for that VPD page.
3	0-7		The Page Length field indicates the length in bytes of the VPD parameters that follow. For VPD pages that are permitted to be sent from an initiator via the CHANGE DEFINITION command, if the initiator does not set this value to the value that is returned for that page by the INQUIRY command, the target terminates the CHANGE DEFINITION command with CHECK CONDITION status. The sense key is set to ILLEGAL REQUEST and the additional sense code is set to INVALID FIELD IN PARAMETER LIST. For VPD pages requested by an initiator via the INQUIRY command, if the allocation length in the INQUIRY CDB is too small to transfer all bytes in the VPD page, the page length is not adjusted to reflect the truncation.
4-N			The VPD parameters for each page are described in the following sections.

6-4.2 Supported VPD Pages - Page 00h

VPD page 00h returns a list of the vital product data pages supported by this target. The format for VPD Page 00h is:

Table 6-53. INQUIRY Data Format VPD Page 00h - Supported VPD Pages

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type =08h				
1	Page Code = 00h							
2	Reserved							
3	Page Length = 04h							
SUPPORTED PAGE LIST								
4	00h							
5	81h							
6	82h							
7	C2h							

MC VPD PAGES

The Supported Page List contains a list of all implemented vital product data page codes for this target. The page codes are listed in ascending order beginning with page code 00h.

6-4.3 Implemented Operating Definition Page 81h

VPD page 81h returns the list of implemented operating definitions for the target. The format for VPD page 81h is:

Table 6-54. INQUIRY data format VPD Page 81h - Implemented Operating Definition Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type =08h				
1	Page code = 81h							
2	Reserved							
3	Page length = 05h							
4	Reserved	Current operating definition = 03h						
5	SavImp = 0b	Default operating definition = 03h						
6	SavImp = 0b	Supported operating definition = 00h						
7	SavImp = 0b	Supported operating definition = 03h						
8	SavImp = 1b	Supported operating definition = 40h						

The current operating definition field indicates the present operating definition.

For each of the following operating definition fields, there is a corresponding SavImp (Save Implemented) bit. A SavImp bit set to one indicates that the corresponding operating definition parameter can be saved. A SavImp bit set to zero indicates that the corresponding operating definition parameter cannot be saved.

The default operating definition field indicates the value of the operating definition the target uses upon power-up. The current and default operating definitions are always reported as 03h (SCSI-2 operating definition).

Reference the Change Definition SCSI command specification (CDB byte 3) for a description of the supported operating definitions listed in this page (i.e. 00h, 03h, and 40h).

6-4.4 ASCII Implemented Operating Definition Page 82h

VPD page 82h returns the target's implemented operating definitions in ASCII format. The format for VPD page 82h is:

Table 6-55. INQUIRY Data Format VPD Page 82h - ASCII Implemented Operating Definition Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type =08h				
1	Page code = 82h							
2	Reserved							
3	Page length = 76h							
4	ASCII operating definition description length = 75h							
ASCII OPERATING DEFINITION DESCRIPTION DATA								
5-42	"00h - Use current operating definition"							
43	NULL (00h)							
44-81	"03h - SCSI-2 operating definition"							
82	NULL (00h)							
83-120	"40h - Change user product data"							
121	NULL (00h)							

The ASCII operating definition description length field indicates the length in bytes of the ASCII operating definition description data that follows. If the allocation length is less than the length of data to be returned, the ASCII operation definition description length is not adjusted to reflect the truncation.

The ASCII operating definition description data field contains the ASCII operating definition description data. The data in this field is formatted in lines, where each line is terminated with a NULL (00h) character. The ASCII characters in each line shown in the table above are left aligned and ASCII spaces (20h) are used to pad each line up to the NULL (00h) character. Each line has a total length of 39 (27h) bytes, including the NULL character.

Reference the Change Definition SCSI command specification (CDB byte 3) for a description of the supported operating definitions.

6-4.5 Product Identification Page C2h

VPD page C2h contains product identification information. The format for VPD page C2h is:

Table 6-56. INQUIRY Data Format VPD Page C2h - Product Identification Page

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Peripheral Qualifier			Peripheral Device Type = 08h				
1	Page code = C2h							
2	Reserved							
3	Page length = 18h							
4-11	Vendor ID							
12-19	Controller Product ID							
20-27	Logical Unit Product ID							

The following fields defined for this page are stored in NVRAM and are maintained across power cycles and resets. These fields correspond to bytes 8 through 31 in the MC non-VPD INQUIRY data described in the INQUIRY command description. Reference the INQUIRY command description for additional information on these fields.

The Vendor ID field contains 8 bytes of ASCII data that is vendor-specific. This field corresponds to bytes 8-15 in the non-VPD INQUIRY data described in the INQUIRY command description.

The Controller Product ID field contains 8 bytes of ASCII data that is vendor-specific. This field corresponds to bytes 16-23 in the non-VPD INQUIRY data described in the INQUIRY command description.

The Logical Unit Product ID field contains 8 bytes of ASCII data that is vendor-specific. This field corresponds to bytes 24-31 in the non-VPD INQUIRY data described in the INQUIRY command description.

CHAPTER 7

TAPE PROCESSING

7-1 INTRODUCTION

The following information is located in this chapter:

7-2 CHANGING MODE PARAMETERS

7-3 PERMANENT ERROR HANDLING

7-2 CHANGING MODE PARAMETERS

7-2.1 Initiator Setup

To ensure that the MODE SELECT command performs the desired operations, it is strongly recommended that the initiator adhere to the following steps:

1. Issue a MODE SENSE command requesting the target to return all Changeable Values (PC field 01b and Page Code 3Fh in byte two of the MODE SENSE CDB) and preserve the “changeable” values.
2. Issue a MODE SENSE command requesting the target to return all Current Values (PC field 00b and Page Code 3Fh in byte two of the MODE SENSE CDB) and preserve the “current” values.
3. Perform a bitwise AND operation of the “current” values with the one’s complement of the “changeable” values, (this step is important because the target will not accept the command if any non-changeable field is set to a value other than the “current” value).
4. Make further desired changes to bytes which are changeable.
5. Make sure that the PS bit in every mode page is 0 (the MODE SENSE command will report a 1 in the PS bit, but a MODE SELECT command will fail if mode pages are sent with the PS bit set to 1).
6. Issue a MODE SELECT command, sending these parameters:

   A PF bit of 0 or 1 both indicate that the MODE SELECT parameters are structured as pages of related parameters as defined by the ANSI standard.

   A Save Pages (SP) bit of zero indicates the target shall perform the specified MODE SELECT operation, and shall not save any pages in non-volatile memory. A SP bit of one indicates that the target shall perform the specified MODE SELECT operation, and shall save to a non-volatile location all the savable pages including any sent during the DATA OUT phase. Pages which are saved are identified by the Parameter Savable(PS) bit that is returned in the page header by the MODE SENSE command. If the PS bit is set in the MODE SENSE data the page shall be savable by issuing a MODE SELECT command with the SP bit set. Once a MODE SELECT command with an SP bit of one is completed successfully, the parameters set during that command become the “saved parameters”. The “saved parameters” become the active or “current parameters” until another MODE SELECT command is completed. If the new MODE SELECT command has an SP bit of 0, the new parameters are kept as the “current parameters” (the “saved parameters” remain unchanged) and remain in effect until any of the following occurs:

   a) a new MODE SELECT command is successfully performed,

   b) a RESET CONDITION is detected,

   c) a power on cycle is performed, or

d) a BUS DEVICE RESET message is received,

in which case the “saved parameters” are restored as the active or “current parameters”. If the new MODE SELECT command has an SP bit of 1, the new parameters are kept as the “saved parameters” and as the active or “current parameters”. Therefore, following any of the conditions described in b) through d) above, the newly set “saved parameters” will be restored as the “current parameters”.

Without performing the requested mode settings/changes, a MODE SELECT command will fail with a CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST for the following conditions:

1) If the initiator attempts to change any field that is not changeable as reported by the target, if the initiator sends a value for a parameter that is outside the range supported by the target and rounding is not implemented for that parameter,

2) if the initiator sets any field in the mode parameter header or block descriptor to an unsupported value,

3) if the initiator sends a mode page with a page length not equal to the page length returned by the MODE SENSE command for that page, or

4) if the initiator sets any reserved field in the mode parameter list to a non-zero value.

Certain parameters sent to a target with the MODE SELECT command contain a range of values. When the target receives a value not supported, the target rounds the value received to a supported value. The target rejects unsupported values unless rounding is permitted in the description of the parameter.

Rounding of Mode Select parameter values, when permitted, is performed as follows: A target that receives a Mode Select parameter value that is not an exact supported value, adjusts the value to one that it supports, and returns CHECK CONDITION status with a sense key of RECOVERED ERROR. The additional sense code is set to ROUNDED PARAMETER. The initiator is responsible to issue a MODE SENSE command to learn what value the target has selected.

A parameter list length that results in the truncation of any descriptor, header, or mode page causes the target to terminate the command with CHECK CONDITION status, with a sense key of ILLEGAL REQUEST, and the additional sense code set to PARAMETER LIST LENGTH ERROR.

7-3 PERMANENT ERROR HANDLING

Basic operating procedures, such as rewind and unload, are described in Chapter 5 of the User's Guide.

7-3.1 PERMANENT WRITE ERROR

If a permanent write error occurs, the most common error recovery method is to attempt to re-write the data, on the failing media, with a different tape drive. Here are the steps to perform this error recovery:

1) Issue a READ POSITION command, with the BT bit set to 1b (34 01 ... 00), to find out the following four things:

    - First Block Location
    - Last Block Location
    - Number of Blocks in Buffer
    - Number of Bytes in Buffer

2) Use the RECOVER BUFFERED DATA command to retrieve and save the data from the buffer. Several RECOVER BUFFERED DATA commands may be needed to retrieve all buffered write blocks. The READ POSITION data will tell you the number of blocks and bytes in the buffer.

3) REWIND and UNLOAD the cartridge from this tape drive.

4) LOAD the cartridge into a different tape drive.

5) Issue a LOCATE command to position to the end of the last record on the tape. The value to use for the LOCATE blockid is the READ POSITION Last Block Location field. This field indicates the physical position of the tape. The value in this field is the block address of the next block to be transferred between the buffer and the [tape] medium.

6) WRITE the recovered data. If the write error occurs again, it is possible that the media in the cartridge is so badly worn, or damaged, that it is not possible to write on the tape.

Other things to try:

- If you determine that the tape is worn/damaged, then replace the cartridge and re-write the data on the new cartridge.
- If you only have one tape drive, you can attempt the previous procedure with a cleaning cycle performed between steps three (3) and four (4).
- The drive may need to be cleaned. If you are not sure how to clean the tape drive, then contact your product support representative for more information.
- Contact your product support representative for more information about additional recovery procedures.

7-3.2 PERMANENT READ ERROR

Two common causes of permanent read errors are worn/damaged media and dirty tape drive heads and/or tape path. The procedure to recover from a permanent read error is similar to the procedure for recovery from a permanent write error:

1) Issue a READ POSITION command, with the BT bit set to 1b (34 01 ... 00), to find out the following four things:

    - First Block Location
    - Last Block Location
    - Number of Blocks in Buffer
    - Number of Bytes in Buffer

2) REWIND and UNLOAD the cartridge from this tape drive.

3) LOAD the cartridge into a different tape drive.

4) Issue a LOCATE command to position to the end of the last record successfully read from the tape. The value to use for the LOCATE blockid is the READ POSITION First Block Location field.
   This field indicates the logical position of the tape. The value in this field is the block address of the next block to be transferred between the buffer and the initiator.

5) READ the tape. If the read error occurs again, it is possible that the media in the cartridge is so badly worn, or damaged, that it is not possible to read from the tape.

Other things to try:

- If you only have one tape drive, you can attempt the previous procedure with a cleaning cycle performed between steps two (2) and three (3).
- The drive may need to be cleaned. If you are not sure how to clean the tape drive, then contact your product support representative for more information.
- If you determine that the tape is worn/damaged, there are service bureaus that specialize in data recovery. Your product support representative may have more information about these companies.

CHAPTER 8

MAINTENANCE AND SERVICING

8-1 INTRODUCTION

This chapter describes the maintenance and servicing information for the M2488 Tape drive. The following information is located in this chapter:

8-2 OPERATOR PANEL DISPLAYED ERROR MESSAGES
8-3 SENSE DATA
8-4 DIAGNOSTICS
8-5 FACTORY SETTINGS
8-6 ERROR RECOVERY PROCEDURES
8-7 MAINTENANCE TERMINAL
8-8 PREVENTIVE MAINTENANCE
8-11 REMOVE AND REPLACE PROCEDURES
8-10 MANUAL TAPE REMOVAL PROCEDURE

8-2 OPERATOR PANEL DISPLAYED ERROR MESSAGES

When specific error types are detected by the tape subsystem, messages are displayed on the operator panel display. This section describes the various error types that may be displayed and the appropriate operator and system action required when the error is displayed. Detailed information describing the error codes is in Appendix F.

8-2.1 OZONE:xxxxyyyy <text>

Ozone messages signal the operator that a non-recoverable microcode error has just occurred. The microcode controlling the tape unit operation has detected a condition that should “never” occur or a condition that may compromise data integrity. The tape unit has performed an internal reset and returns to a known state. All buffered data is discarded and tape motion is halted. Power On and Not Ready to Ready Unit Attention check conditions are returned to the SCSI host.

Ozone messages may be caused by the following:

- Incorrect and complicated SCSI operation/sequences by
  1) Host adaptor under abnormal conditions
  2) incorrect conditions of SCSI termination or cables.
- Abnormal system configuration such as a duplicated SCSI ID Setting, etc.
- During an error recovery operation for excessively damaged tape medias.
- Broken hardware in a complicated manner.

xxxxyyyy specify a unique error condition that the microcode has detected. <text> gives a short description of the condition that caused the Ozone. These error codes and text descriptions hold little information for anyone except the firmware developers.

When an Ozone message is displayed, the current job at the host computer should be aborted as data integrity is compromised. Data being written to tape is no longer valid. Read data on tape is not affected on the media.

When an Ozone message is observed, the check code and text message should be recorded as well as the current operating conditions and all data forwarded to Product Support for problem resolution. If possible a Read Buffer CDB specifying the entire 2MB data buffer as a data length and a buffer start address of zero should be issued from the host computer. This data should be made available to your maintenance provider.

A table of ozone codes is not provided in this document as they are of little use to the user of the product and are generated for the use of firmware developers only.

8-2.2 NVRAM Initialization Required

This message is displayed after power on if the non-volatile RAM that contains configuration and setting information is not initialized, i.e.; CRC error when reading the configuration file. It is possible that the NVRAM was previously initialized but has since failed. When this message is displayed the tape unit will not respond to SCSI selection until the configuration is performed via the operator panel. See the User’s Guide, Chapter 4, SETTING MENU.

8-2.3 CHK XX

CHK xx errors signal drive or ACL/FACL errors when displayed on the operator panel. xx may be any hexadecimal value from 00 to FF. When **CHK XX** is displayed, pressing the *TEST* key will cause the operator panel to scroll a short descriptive text message describing the cause of the error. Pressing the *RESET* key when a **CHK XX** message is displayed erases the message and unloads the tape cartridge and, when an autoloader is installed, ejects the magazine. A description of each check code is contained in Appendix E.

The operator should press the reset key to eject the cartridge and magazine after recording the check code and associated text. This information should be provided to the service engineer. Host jobs in progress and using the tape unit should be aborted. Write data should be considered not valid. Read data on the media is not effected.

8-2.4 Diagnostic Error Codes

The diagnostic error codes, as displayed on the operator panel or the maintenance terminal display, are described in Appendix F.

8-2.4.1 Operator Panel Error Code Display

If an error occurs during power-on Go/No Go testing, an error message scrolls across the operator panel display; i.e., **SELFTEST FAILED ERROR=E:04070101**. Refer to Appendix F for a list of error codes with descriptions.

	Routine	Test	Loop	Error Code
E:	**04**	**07**	**01**	**01**

8-2.4.2 Maintenance Terminal Error Code Display

The Maintenance Terminal computer display shows error messages as follows:

```
RUNNING TESTS:  (RETURN to abort)
TEST LIST OPTIONS: display status, display errors, stop on error
MODE  RTN  TEST   TITLE                                          LOOPS  ERRORS
   1     20     01     Loop write to read 0 test - 36 Track
>>> Off-Line Diagnostic Error Detected <<<
                         Routine  = 20,  Test = 01,  Error Code = E0,  Loop = 01
                         Expected= 0000
                         Received= 0800
                         Address  = 00500182
                         Initialization ERROR - FDXS Xreg not zero prior to ADT_RUN

Off-Line Diagnostic Failure - STOP ON ERROR

Press [RETURN] key or [RESET] switch to continue

_______ ____ ______ _______________________________ ____01__ ______1
RUN COUNT: 1   ERROR COUNT: 1   TEST TIME:  00:00:01.184
```

8-3 SENSE DATA

The sense bytes, contained in the controller, indicate error, status, and statistical information about the controller or the drive. Error information is set in the sense bytes when the CHECK CONDITION status is reported as a completion status. The sense bytes are transmitted to an initiator by the REQUEST SENSE command.

8-3.1 Error Code Sense Format

An Error Code (EC) of 70h (sense byte 0 of 70h or F0h) indicates that the CHECK CONDITION status returned is a result of an error or exception condition on the command that returned the CHECK CONDITION status.

Error code 71h (sense byte 0 of 71h or F1h) indicates the CHECK CONDITION status returned is the result of an error or exception condition not related to the command that returned the CHECK CONDITION STATUS (i.e., deferred error). After detecting a deferred error condition on a logical unit, the controller reports CHECK CONDITION status to the next initiator attempting to access that logical unit.

The following tables and text define the sense data and log data returned to the initiator in the data phase of the REQUEST SENSE command.

Table 8-1. Error Code 70 - Sense Format (on current command)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Valid	1	1	1	0	0	0	0
1	Segment Number (00h)							
2	FMark	EOM	ILI	Rsvd	Sense Key			
3-6	Information Bytes							
7	Additional Sense Length = 24h							
8-11	00000000h (SCSI-2 Command Specific Information Bytes)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	FRU Code (00h)							
15	SKSV	C/D	Rsvd	Rsvd	BPV	Bit Pointer		
16-17	MSB Field Pointer LSB							
18	Format of additional sense							
19	Host ERPA							
20-43	Additional Sense Bytes as Defined by the Format Indicated in Byte 18.							

Table 8-2. Error Code 70 Sense Format Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	7	1	When the valid bit is a one, sense bytes 3 to 6 indicate the difference between the number of bytes, blocks, or filemarks requested by a command and the number of bytes, blocks, or filemarks actually executed.
1	0-7	00h	The segment number field contains the number of the current segment descriptor, if the REQUEST SENSE command is in response to a COPY, COMPARE or COPY AND VERIFY command. Up to 256 segments are supported beginning with segment zero.
2	0-3		Sense Key. See Appendix A for sense key descriptions.
2	5		The Incorrect Length Indicator (ILI) bit indicates the requested logical block length did not match the logical block length of the data on the medium.
2	6		The End-Of-Medium (EOM) bit indicates an End-Of-Tape (EOT) or Beginning-Of-Tape (BOT) condition exists. This bit indicates the unit is at or past the early-warning EOT if the direction of the tape was forward or that the command could not be completed because BOT was encountered when the direction was reverse.
2	7		The filemark bit indicates the current command has read a filemark.
3-6			The contents of the information field is device-type or command-specific and is defined within the appropriate section for the device type or command of interest. The information bytes contain the difference (residue) of the requested length minus the actual length in either bytes or blocks, as determined by the command. When operating in the buffered mode and an unrecoverable write error occurs, the information bytes contain the number of unwritten data blocks and/or filemarks remaining in the buffer.
7	0-7	24h	The additional sense length specifies the number of additional sense bytes to follow. If the allocation length of the Command Descriptor Block is too small to transfer all of the additional sense bytes, the additional sense length is not adjusted to reflect the truncation.
8-11			The command-specific information field contains information that depends on the command which was executed. For this device, bytes 8-11 are zero.
12-13			The Additional Sense Code (ASC) byte 12 and Additional Sense Code Qualifier (ASCQ) byte 13 provide additional error information. The additional sense codes and qualifiers are listed in Appendix B.
14			Nonzero values in the FRU field are used to define a specific FRU or FRU-pair that has failed. The FRU byte contains two nibbles of information. The low order nibble indicates the highest probability FRU. The high-order nibble indicates a secondary FRU that may also be responsible for the reported failure. This field is not used.
15	3	0 1	A bit pointer valid (BPV) bit of zero indicates that the value in the bit pointer field is not valid. A BPV of one indicates that the bit pointer field specifies which bit of the byte, designated by the field pointer field, is in error. When a multiple-bit field is in error, the bit pointer field points to the most significant bit (left most) of the field.
15	6	1 0	A command data (C/D) bit of one indicates that the illegal parameter is in the CDB. A C/D of zero indicates that the illegal parameter is in the data parameters sent by the initiator during the DATA OUT phase.

SENSE DATA

Table 8-2. Error Code 70 Sense Format Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
15	7	1 0	The meaning of the sense-key specific field depends on which sense key is returned and whether the Sense-Key Specific Valid (SKSV) bit is a one. If the sense key field is set to ILLEGAL REQUEST and the SKSV bit is one, the sense-key specific field is defined as shown in bytes 15 through 17. If the SKSV bit is a zero, the field is not defined.
16-17			The field pointer field indicates which byte of the CDB or of the parameter data was in error. Bytes are numbered starting from zero as shown in the tables describing the commands and parameters. When a multiple-byte field is in error, the pointer points to the most significant byte of the field.
18	0-7		The format byte defines the format of bytes 20 - 43. See Table 8-15 on page 8-15 to identify the format of additional sense.
19	0-7		Byte 19 identifies the error recovery procedure action (ERPA) code. The codes are described in Appendix C.
20-43			The format of sense bytes 20-43 varies depending on whether the sense information is from the SIC, FMT, drive, or hardware registers. See Table 8-15 on page 8-15 to identify the format of its additional sense.

Table 8-3. Error Code 71 - Sense Format (deferred error reporting)

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Valid	1	1	1	0	0	0	1
1	Segment Number (00h)							
2	FMark	EOM	ILI	Rsvd	Sense Key			
3-6	Information Bytes							
7	Additional Sense Length = 24h							
8-11	00000000h (SCSI-2 Command Specific Information Bytes)							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	FRU Code (00h)							
15-17	SKSV	000000h (SCSI-2 Sense-Key Specific)						
18	Format of additional sense							
19	Host ERPA							
20-43	Additional Sense Bytes as Defined by the Format Indicated in Byte 18.							

Table 8-4. Error Code 71 Sense Format Field Description

BYTE	BIT	VALUE	DESCRIPTION
0	7	1	When the valid bit is a one, sense bytes 3 to 6 indicate the difference between the number of bytes, blocks, or filemarks requested by a command and the number of bytes, blocks, or filemarks actually executed.
1	0-7	00h	The segment number field contains the number of the current segment descriptor, if the REQUEST SENSE command is in response to a COPY, COMPARE or COPY AND VERIFY command. Up to 256 segments are supported beginning with segment zero.
2	0-3		Sense Key. See Appendix A for sense key descriptions.
2	5		The Incorrect Length Indicator (ILI) bit indicates the requested logical block length did not match the logical block length of the data on the medium.
2	6		The End-Of-Medium (EOM) bit indicates an End-Of-Tape (EOT) or Beginning-Of-Tape (BOT) condition exists. This bit indicates the unit is at or past the early-warning EOT if the direction of the tape was forward or that the command could not be completed because BOT was encountered when the direction was reverse.
2	7		The filemark bit indicates the current command has read a filemark.
3-6			The contents of the information field is device-type or command-specific and is defined within the appropriate section for the device type or command of interest. The information bytes contain the difference (residue) of the requested length minus the actual length in either bytes or blocks, as determined by the command. When operating in the buffered mode and an unrecoverable write error occurs, the information bytes contain the number of unwritten data blocks and/or filemarks remaining in the buffer.
7	0-7	24h	The additional sense length specifies the number of additional sense bytes to follow. If the allocation length of the Command Descriptor Block is too small to transfer all of the additional sense bytes, the additional sense length is not adjusted to reflect the truncation.
8-11			The command-specific information field contains information that depends on the command which was executed. For this device, bytes 8-11 are zero.
12-13			The Additional Sense Code (ASC) byte 12 and Additional Sense Code Qualifier (ASCQ) byte 13 provide additional error information. The additional sense codes and qualifiers are listed in Appendix B.
14			Nonzero values in the FRU field are used to define a specific FRU or FRU-pair that has failed. The FRU byte contains two nibbles of information. The low order nibble indicates the highest probability FRU. The high-order nibble indicates a secondary FRU that may also be responsible for the reported failure. This field is not used.
15-17			The meaning of the sense-key specific field depends on which sense key is returned and whether the Sense-Key Specific Valid (SKSV) bit is a one. If the SKSV bit is a zero, the field is not defined.
18	0-7		The format byte defines the format of bytes 20 - 43. See Table 8-15 on page 8-15 to identify the format of additional sense.

Table 8-4. Error Code 71 Sense Format Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
19	0-7		Byte 19 identifies the error recovery procedure action (ERPA) code. The codes are described in Appendix C.
20-43			The format of sense bytes 20-43 varies depending on whether the sense information is from the SIC, FMT, drive, or hardware registers. See Table 8-15 on page 8-15 to identify the format of its additional sense.

Table 8-5. Additional Sense Formats

BYTE 18	MOST SIG. NIBBLE OF BYTE 21	TYPE OF ADDITIONAL SENSE	FORMAT OF ADDITIONAL SENSE
00h	N/A	SCSI firmware registers	Currently reserved
01h	xx01b	FMT	Table 8-6 on page 8-9
01h	xx10b	Drive	Table 8-9 on page 8-11
02h	N/A	SCSI hardware registers	Table 8-12 on page 8-13
03h	N/A	EDRC hardware registers	Table 8-13 on page 8-14
04h	N/A	Send Diagnostic Error	Table 8-14 on page 8-15

8-3.2 Sense Information Bytes 20-43

Refer to the correct sense information format in the following paragraphs.

8-3.2.1 Format 0 Sense Information Description for SIC

All bytes are 00h.

8-3.2.2 Format 01h Sense Information for FMT

The Format 01h Sense Information for FMT is shown in Table 8-6 and described in Table 8-7 and Table 8-8.

Table 8-6. Format 01h Sense Information, FMT

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
20	FMT ERPA Code							
21	MC error	MTU error	0	1	Retry Count			
22-23	First Fault Symptom Code							
24-25	Second Fault Symptom Code							
26-27	Last Fault Symptom Code							
28	Error Command Code							
29-39	Additional Format Error Information Type							
40-43	RBID (Block ID)							

Table 8-7. Format 01h Sense Information, FMT Field Description

BYTE	BIT	VALUE	DESCRIPTION
20	0-7		The FMT ERPA codes are the same as the ERPA codes defined for sense byte 19 in Appendix C.
21	0-3		The Retry Count is incremented by one each time a re-read or re-write is performed in the original direction of the command being processed.
21	6		The MTU Error bit is set when the error is known to be in the MTU.
21	7		The MC Error bit is set when the error is know to be in the Medium Changer.
22-27			The first symptom code represents the initial error condition detected, the second symptom code represents the secondary error condition detected, and the third symptom code represents the last error condition detected. See Appendix D for the fault symptom codes.
28	0-7		This is the command code of the command being processed when the error was detected.
29-39			The value in byte 29 determines the register for bytes 30-39. See Table 8-8.
40-43			The tape position at which the error was detected as expressed in the physical (byte 40) and logical (bytes 41-43) Block ID.

Table 8-8. Additional Format Error Information Type

BYTE #	RD/RB ON DATA BLOCK	RD SDDP ERROR	WR SDDP ERROR	WRONG RSVP MESSAGE	RD/RB ON MARK	SERVO ERROR	BID MISCOMPARE	SEARCH MISSED
29	01	02	03	04	05	06	07	08
30	RDC register	RDC register	WCT register	SNDA register	RDC register		RDC register	Interrupt flags
31	RDE register	FDXC	FDXC	RSVP expected response			FDXC	Target BID
32	RBE register	register	register	RSVP actual response			register	
33	CRS register	FDXS	FDXS	FMT_RD. TONE register			FDXS	
34	CRRZ register	register	register	WCT register			register	
35	WES register	PCT	PCT	RDC register			PCT	
36	ETPA register	register	register	RDE register			register	
37	ETPB register		WER register	RBE register			Bottom 3 bytes of the actual read block ID	
38	WRE register			VFC register				
39	WEL register							

8-3.2.3 Description of Format 01h Sense Information for Drive

Table 8-9. Format 01h Sense Information, Drive

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
20	Drive ERPA Code							
21	MC error	MTU error	1	Reserved				
22	00h							
23	Error Code							
24-27	00000000h							
28	Physical Block ID							
29	Error Command Code							
30	Drive Status							
31	Drive Model Number (03h)							
32	DRV ERR CMD Code 1							
33	DRV ERR Code 1							
34	WTERR1							
35	WTERR2							
36	Shared RAM erqst1							
37	Shared RAM ersvrt							
38	Shared RAM ersvcm							
39	Reserved							
40-43	Block ID							

Table 8-10. Format 01h Sense Information, Drive Field Description

BYTE	BIT	VALUE	DESCRIPTION
20	0-7		The MTC performs error recovery on the basis of the drive ERPA code. The drive ERPA codes are internal to the MTC.
21	0-4		Reserved
21	6		The MTU Error bit is set when the error is known to be in the MTU.
21	7		The MC Error bit is set when the error is know to be in the Medium Changer.
23	0-7		The error code indicates the error encountered. A description of error codes can be found in Appendix E. When a CHK XX message is displayed on the operators panel the xx portion of the message will be found as the error code in the sense data.
28	0-7		The Physical Block ID is the approximate current physical location on tape. It is set to one when at BOT and is incremented by one for approximately each 2 m of tape moved across the read/write heads.

Table 8-10. Format 01h Sense Information, Drive Field Description (Continued)

BYTE	BIT	VALUE	DESCRIPTION
29	0-7		This is the command code of the command being processed when the error was detected.
30	0-7		Drive status at the time the error was detected.
31	0-7		The Drive Model Number is 03h.
32	0-7		The DRV ERR CMD Code 1 indicates the command being executed by the MTU when the first error was detected.
33	0-7		The DRV ERR Code 1 is the error code of the first MTU error encountered.
34	0-7		Write error hardware register 1
35	0-7		Write error hardware register 2
36	0-7		Sequence status set when an error has occurred.
37	0-7		Servo status code is set when an error has occurred.
38	0-7		Command code is set when command has occurred.

Table 8-11. MTC to MTU Commands

COMMAND	CODE
STOP	00
CLEAR ERROR	01
DOOR SOLENOID	02
SERVO DIAGNOSTIC	03
LOAD CARTRIDGE	04
REWIND	05
REWIND AND UNLOAD	06
SEARCH SECTOR	07
MOVE FORWARD READ	08
MOVE BACKWARD READ	09
MOVE FOR WRITE	0C
DATA SECURITY ERASE	0E
MOVE MAGAZINE	0F
WRITE ALL ZERO	10
SHUFFLE	11
MICROCODE DOWNLOAD	D0
MICROCODE START	DF

SENSE DATA

8-3.2.4 Format 2 and 3 Sense Information, Hardware Registers

Format 2 and 3 provides a listing of controller hardware registers. Bytes 22 and 23 of Format 2 and Format 3 sense data, however, provide fault symptom codes.

Table 8-12. Format 02h Sense Information, SCSI Hardware Registers

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
20-21	Companion chip's interrupt request mask							
22-23	Fault Symptom Code							
SPC Registers (reference the SPC User Manual for a detailed description of these registers)								
24	Secondary Interrupt Status (or FFh if none stacked)							
25	Secondary Command Step (or FFh if none stacked)							
26	SPC Command Register							
27	Status (FFh = SPC registers not captured due to SPC being busy)							
28	Nexus Status							
29	Primary Interrupt Status							
30	Primary Command Step							
31	Data/MC Byte (MSB)							
32	Data/MC Byte							
33	Data/MC Byte (LSB)							
34	SCSI Control Signal Status							
35	Transfer Mode							
36	Transfer Period							
37	Transfer Offset							
38	Modified Byte							
39	Self ID Setting							
40	Response Mode Setting							
41	Select/Reselect Mode Setting							
42	Parity Error Detection Setting							
43	Interrupt Enable Setting							

Table 8-13. Format 03h Sense Information, EDRC Hardware Registers

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
20	SDDP_HI.rev							
21	00h							
22-23	Fault Symptom Code							
24-27	SDDP_HI.hdxc							
28-31	SDDP_HI.hdxs							
32	SDDP_HI.ph00							
33	SDDP_HI.ph01							
34	SDDP_HI.ph02							
35	SDDP_HI.ph03							
36	SDDP_HI.pho4							
37	SDDP_HI.ph05							
38	SDDP_HI.ph06							
39	SDDP_HI.ph07							
40	SDDP_HI.ph08							
41	SDDP_HI.ph09							
42	SDDP_HI.ph10							
43	SDDP_HI.ph11							

SENSE DATA

8-3.2.5 Format 4 Sense Information for Diagnostic Errors

The Format 4 Sense Information for SCSI SEND DIAGNOSTIC command with SELFTEST bit set is shown in Table 8-14 and described in Table 8-15.

Table 8-14. Format 04h Sense Information, Diagnostic Errors

	BITS							
BYTES	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
20-21	Interrupt Request Controller Mask (IRCM)							
22-23	Fault Symptom Code (FSC)							
24	Diagnostic Test List Node Number							
25	Diagnostic Routine Number							
26	Diagnostic Test Number							
27	Diagnostic Error Code							
28-31	Expected Value							
32-35	Received Value							
36-39	Address							
40-43	Reserved (00000000h)							

Table 8-15. Format 04h Sense Information, Diagnostic Errors Field Description

BYTE	BIT	VALUE	DESCRIPTION
20-21			The current state of the Interrupt Request Controller Mask (IRCM) in the Processor Companion Chip (PCC) at the time the diagnostic error was detected.
22-23		91A0h	The Fault Symptom Code (FSC) indicating an error was detected while executing diagnostic tests invoked through a SCSI SEND DIAGNOSTIC command with the SELFTEST bit set.
24	0-7		The test list node number of the diagnostic test that detected an error from the list of diagnostic tests that were executing.
25	0-7		The Diagnostic Routine number of the test that failed.
26	0-7		The Diagnostic Test number of the test that failed.
27	0-7		The Diagnostic Error Code number of the test that failed.
28-32			The value the diagnostic test expected (if applicable) at the time the error was detected.
33-36			The value the diagnostic test received at the time the error was detected (if applicable.)
37-40			The address that was accessed to obtain the received value at the time the error was detected (if applicable.)

8-4 DIAGNOSTICS

The M2488 tape drive supports three operational modes for diagnostics. The first mode is the Go/No-Go diagnostics that are invoked automatically each time power is applied to the tape drive. The second mode of diagnostics, called Off-Line diagnostics, may be invoked from the Operator Control Panel on the front panel of the tape drive or medium changer, or from an RS-232 terminal or computer running terminal emulation software attached to the RS-232 Maintenance Interface. The third mode of diagnostics are called In-Line diagnostics, and are invoked through the SCSI interface using the SCSI SEND DIAGNOSTIC command sent from a host.

Diagnostic Organization

Diagnostics are arranged by routine number and test number. Each routine is designed to verify a particular hardware function of the M2488 Tape Drive. Routines are comprised of individual tests which are designed to focus on a specific area of a hardware function. This organization allows for finer resolution in diagnostic testing which may be helpful in fault isolation. A list of all the diagnostic tests in the Diagnostic Test Registry for all diagnostic modes (except the Boot Go/No-Go mode) is presented in Appendix F.

Diagnostic Execution

Diagnostic execution is accomplished through the use of a list processing architecture. Each diagnostic routine and test to be executed must first be placed in an ordered list, and then this list is executed sequentially. The ordered list is referred to as a “test list” and each individual routine and test placed in the ordered list is referred to as a “test list node” or, simply a “node”. Therefore, a “test list” is a sequence of “test list nodes” which are individual routines and tests. Test list nodes are numbered in ascending order beginning with node number one.

8-4.1 Go/No-Go Diagnostics

The Go/No-Go diagnostics are performed every time power is initially applied to the M2488 tape drive. These tests are designed to verify the integrity of the tape drive hardware at power-on. No user intervention is required for these tests, however Tasked Go/No-Go diagnostics can be aborted by pressing the <ENTER> key at any time after they begin to execute. In the event of a Go/No-Go test failure, diagnostic error information will be sent to the Remote Maintenance (RS-232) interface, as well as the Operator Control Panel (if possible).

8-4.2 Off-Line Diagnostics

The preferred interface for Off-Line diagnostic operation is the RS-232 Maintenance interface. However, tests in this mode can also be performed from the Operator Control Panel, in which case no RS-232 connection is necessary. The following criteria must be met before Off-Line diagnostic mode can be entered:

No media loaded or obstructing the load slot (if an ACL/FACL is attached, the magazine must be removed).

Data buffer must be empty.

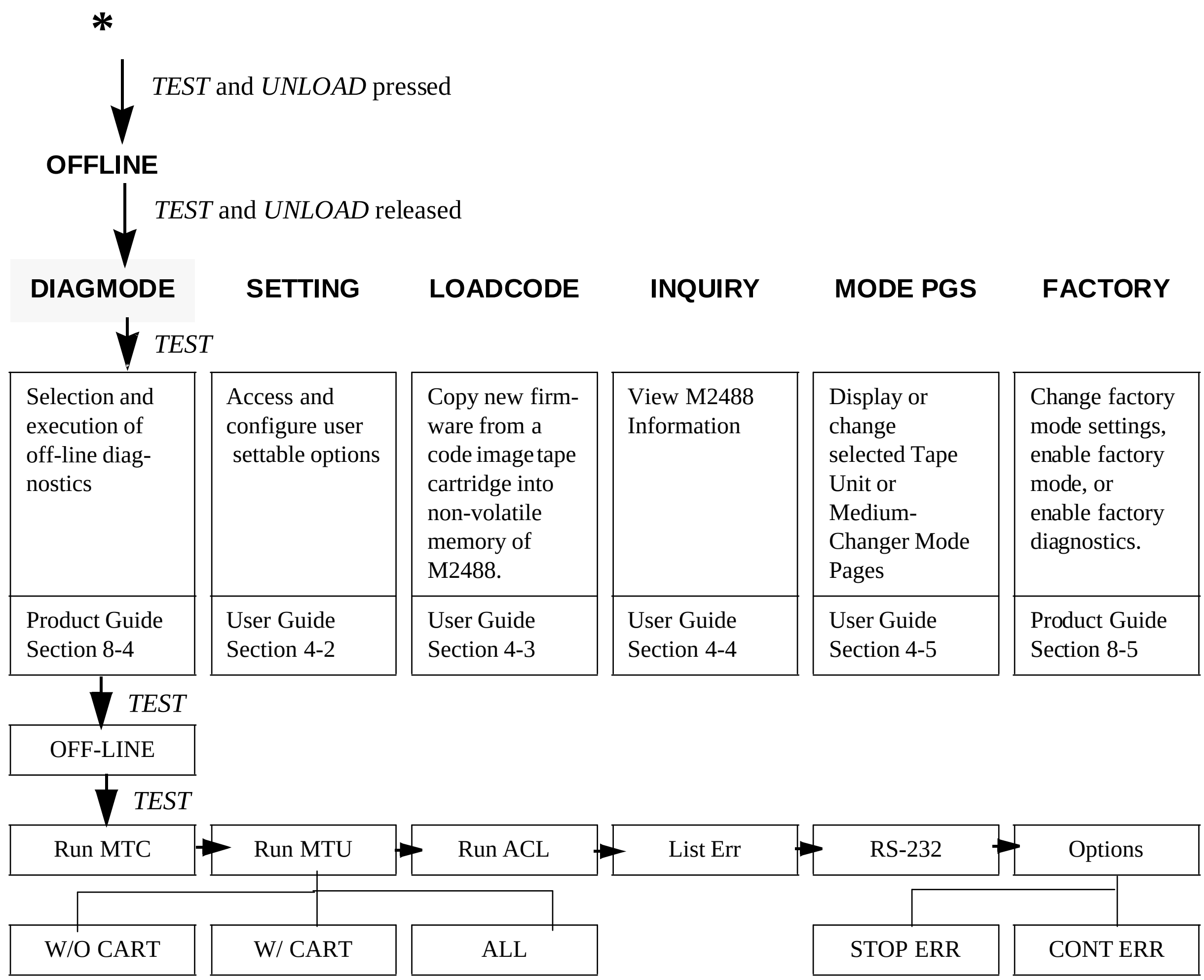
No pending SCSI operations.

Refer to the following drawing for instructions to invoke the off-line diagnostics via the operator panel menu:

8-4.3 MTU Diagnostics

The MTU Diagnostic Specifications are presented in APPENDIX H.

Table 8-16. Operator Panel Top Level Menus - Diagnostics Mode



Navigation keys:
To navigate through the options, settings, and to make changes from the Operator Panel:
Press *START* to move forward through the options or settings. It will also increment the settings numbers.
Press *SHIFT* and *START* to move backward through the options or settings. It will also decrement the settings numbers.
Press *RESET* to move from settings to option or to leave setting mode.
Press *TEST* to move from the option to settings.
Press *UNLOAD* to select a number field for multiple digit numbers.
Setting Procedure:

Step 1. At the ✳, press and hold the *TEST* and *UNLOAD* pushbuttons simultaneously until **DIAG-MODE** is displayed.

Step 2. Press the *TEST* pushbutton.

Step 3. The first option, **OFFLINE**, is displayed. Press *TEST* again to enter the Off-Line Diagnostic mode. The display will now indicate **RUN MTC.**

Step 4. Press the *TEST* push-button to select MTC (controller) diagnostics.

Step 5. The Operator Panel display indicates **CNT0001**. To accept the default run count of 1, press *TEST* once more. The controller diagnostics will execute one time. The *START* or *SHIFT* + *START* keys may be used to change the run count or select other diagnostic menu items as described in section 8-4.3.1.

8-4.3.1 Off-Line Diagnostic Menu on the Operator Panel

Table 8-17. Operator Panel Off-Line Diagnostics

COMMAND	SELECTION OR RESPONSE	DESCRIPTION
*Run Run MTC Run MTU Run ACL	R:######	This command begins execution of all diagnostic tests in the current test list. The display will indicate which test is currently being executed. In the following example, routine 0x06, test 0x03, is executing loop 0x0A. Example: R:06030A R : 0 6 0 3 0 A Loop count Test Number Routine Number "Running" Run MTC - runs tests on the controller Run MTU - runs tests on the drive Run ACL - runs tests on the ACL
List Err	########	Lists up to the first 16 errors generated during the last Run/Continue of the current diagnostic test list. The following example shows an error which occurred while running routine 0x03, test 0x02 which happened to be the 5th test (node) in the current test list: Example: 05030102 0 5 0 3 0 1 0 2 Error Code Test Number Routine Number Node Number
*Continue	R:######	Continue running the list of test(s) previously selected. The display is the same as for the Run command.
RS-232	RS-232?	When RS-232 is selected, all diagnostic tests are run from the Remote Maintenance (RS-232) interface. Typing "quit<enter>" or pressing the RESET switch on the Operator Control Panel will exit this mode.
*List Reg	LR: ####	Lists all of the tests that can be selected from the registry of diagnostic tests for a particular diagnostic mode. The following example shows how to display the first test of every routine in the Diagnostic Test Registry: Example: LR: 0001 L R : 0 0 0 1 Test Number Routine Number "List Registry"

Table 8-17. Operator Panel Off-Line Diagnostics (Continued)

COMMAND	SELECTION OR RESPONSE	DESCRIPTION
*Add	A: ####	Add a test to the end of the test list. The following example shows how to add Routine 0x09, Test 0x02: Example: A: 0902 A : 0 9 0 2 Test Number Routine Number “Add”
Options	STOP ERR CONT ERR	Select STOP ERR for stop on error or CONT ERR for continue on error.
*Delete	D: ####	Delete the test at node number n in the current test list. The following example shows how to delete node 8 through the end of the current test list: Example: D: 0800 D : 0 8 0 0 Ending node Beginning node “Delete”
*List	L: ####	List the tests in the current test list. The following example shows how to list nodes 5 through 10 of the current test list: Example: L: 050A L : 0 5 0 A Ending node Beginning node “List”

* This command is available only if FACTORY MODE is enabled.

8-4.3.2 Off-Line Diagnostic Menu through the Remote Maintenance (RS-232) Interface

Off-Line diagnostic tests may be invoked and run through the RS-232 interface as well as the Operator Control Panel interface. Diagnostic tests are selected and executed in the same manner regardless of which interface is used, however the RS-232 interface is easier to use, more flexible, and provides more detailed error information.

The RS-232 user interface is a command-set driven architecture. A basic set of commands is provided to facilitate the selection and execution of diagnostic tests. The Diagnostic Microcode architecture is a list processing architecture. The RS-232 user interface command set enables the creation, modification, and deletion of tests to build a test list. The command set also includes the capability to begin test execution, provide user help information, and exit the Off-Line diagnostic mode. Multiple commands may be entered on the same line using a semicolon “;” as a separator.

The usual sequence of operations would be to first create a list of tests to be executed. Then, modify any test options as desired. Finally, begin test execution. A description of the commands to accomplish these steps are outlined in section .

RS-232 User Interface Commands

Upon entering the Off-Line diagnostic mode, the command prompt

OFF-LINE DIAGNOSTIC COMMAND:

will appear. At the command prompt, the following commands are available.

a) Conventions used in this session:

All commands are case insensitive and may be abbreviated by entering only the first letter of the command. The lower case letters immediately following the first letter are optional.

Bold	Commands, options, variables, arguments, and user input appear in bold typeface.
Italic	Names of variables to which values must be assigned are in italics.
< >	Input typed in a command line that does not appear on the screen (for example, the return key) is shown within angle brackets.
[ ]	Optional input, such as command options, variables, and arguments, are enclosed in square brackets.

b) RS-232 command set:

COMMAND	DESCRIPTION	VARIABLES/ARGUMENTS
Add *r t* [*l*]	Add a new test to the end of the test list.	***r*** -Routine number to be added. This number must be a valid routine number from the routines listed in the test registry (see List command for more details). ***t*** -Test number of the routine to be added. If an asterisk "*" is entered, all tests for the given routine will be added. ***l*** -Loop count, number of times to repeat this test. This number must be in the range between 1 and 254. If 0 is entered, the test will loop forever.
Delete *n* [*x*]	Delete a test from the list of tests.	***n*** -Delete node number *n* from list. The node number must be a number in the range of node numbers in the current list. If an asterisk "*" is entered, then the entire list is deleted. ***x*** - Delete to this end node. (Default is "*"; to the end of the list.)
Help (or ?) **Help notes** **Help macros**	Display RS-232 user interface command help. Entering this command displays the help information shown in Figure 8-1.	
Insert *n r t* [*l*]	Insert a new test in the test list.	**n** -Node number to insert. This number must be in the range of node numbers in the current list. ***r*** -Routine number to be added. This number must be a valid routine number from the routines listed in the test registry (see List command for more details). ***t*** -Test number of the routine to be added. If an asterisk "*" is entered, all tests for the given routine will be added. ***l*** -Loop count, number of times to repeat this test. This number must be in the range between 1 and 254. If 0 is entered, the test will loop forever.

COMMAND	DESCRIPTION	VARIABLES/ARGUMENTS
List **List [*n*] [*e*]** **List [Regis-try] [*r*] [*t*]**	List current tests in test list or list test registry. Entering "List" will display all of the tests in the current test list. Entering "List Registry" will display the registry of all of the tests available for use in the current diagnostic mode. The list command may be aborted by pressing <RETURN> before all tests are displayed.	List arguments: ***n*** -Node number in current test list to list, or being listing from. If *n* is not specified or is an asterisk "*", then the entire test list will be displayed. If only *n* is specified, then only the test at that node number will be displayed. ***e*** -End node number in current list to stop listing at. If an asterisk "*" is entered, all tests beginning with *n* will be displayed. List Registry arguments: ***r*** -Routine number in test registry to be displayed. If an asterisk "*" is entered, then all routines in the current diagnostic mode will be displayed. ***t*** -Test number of routine r in test registry to be displayed. If an asterisk "*" is entered, all tests for routine *r* will be displayed.
Options *o*: [+/-] [*c:e:s*]	Set test options for all tests in the current test list.	***o*** -Options byte for this list of tests. The options byte is arranged into bit fields as illustrated in the Table 8-18.
Quit	Quit Off-Line diagnostics mode. (Entering this command will cause a return to the previous operating mode.)	
Run [macro] [#]	Run tests in current test list. This command is used to begin test execution. Tests are executed in sequential order beginning with the first node. The test options byte for each test may modify execution behavior. At any point during test list execution, the operator may abort execution of the test list at the conclusion of the current test.	# - The number of times to execute the entire list of tests. By default, the list will only execute one time. To loop forever, enter 0. **macro** - One of several predetermined test lists. Macro names are listed when entering "help macros" at the command line prompt.
Node n l	Set loop count for test at node # n in the current test list	n - Node number to change loop count for. This number must be in the range of node numbers in the current list. l - Loop count, the number of times to repeat the test at the specified mode.

```
Off-Line diagnostic command: help
- Diagnostic Help: Overview ---------------------------------------------------------------
COMMANDS:
  Add r t [l] ---------------->  Add to test list
  Continue ------------------>  Continue running the current test list
  Delete n [x] -------------->  Delete a test, n="*" clears the entire list
  Help|? [notes|macros] ->  Diagnostic help information
  Insert n r t [l] ----------->  Insert test at node 'n' in list
  List [n] [x] -------------->  List tests in Test List
  List Registry [r] [t] --->   List tests in Test Registry
  List Errors -------------->  List Error history
  Node [n] [l] ------------->  Set loop count to ‘l’ at ‘n’
  Options [o]|[+|-][c|e|s]--->Options for all tests, or loop count at node 'n'
  Quit ---------------------->  Quit Diagnostics
  Run [#] ------------------>  Run entire test list # times [1=default, 0=forever]
 KEY:
  r = routine number (HEX)     t = test number (HEX)
  l = loop count byte, 1 (default) to 254 times, or 0 to loop test forever
  n = node number                   x = end node number
 +c = continue on error           -c = stop on error
 +e = display errors                -e = suppress error display
 +s = display status                -s = suppress status
------------------------------------------------------------------------------------------------
Off-Line diagnostic command: help macros
- Diagnostic Help: Macros -------------------------------------------------------------------
 Macros are an easy way to build and run a list of diagnostics routines and
 tests. Macros are executed by entering "RUN" [macro name] [run count]
VALID MACRO NAMES:
  ACL = ACL/FACL test without magazine
  ACL_MAG = ACL/FACL test with magazine
  ACL_ALL = ACL/FACL test list - both with and without magazine
  COMB = All LWR “In-line” tests
  MTC = Controller test list
  MTU = Drive test without cartridge
  MTU_CART = Drive test with cartridge
  MTU_ALL = Drive test list - both with and without cartridge
  LOAD = Load cartridge
  UNLOAD = Unload cartridge
------------------------------------------------------------------------------------------------
Off-Line diagnostic command: help notes
- Diagnostic Help: Notes ---------------------------------------------------------------------
 NOTES:
  1. Only the first letter (case insensitive) of each command is required
  2. Routine, Test, and Options numbers are always entered in hexadecimal
  3. Loop counts and Node numbers are decimal by default (prefix '0x' for Hex)
  4. The wildcard "*" may be used to select all routines, tests, etc.
  5. Multiple commands per line may be entered using a semicolon (;) separator
  6. To abort running tests, enter [RETURN] or press and hold the RESET button
  7. The test list Options may also be entered as a hexadecimal number:
     Options [o]
     where, o = options byte (HEX):  bit 0 = 0x01 -> continue on error
    (NOTE: These settings are bit      bit 5 =0x20 -> suppress errors
     significant)                        bit 6 = 0x40 -> suppress status
```

Figure 8-1. Help Information Display

DIAGNOSTICS

Table 8-18. Options Byte Field Descriptions

BINARY	HEX	DESCRIPTION
00000001	0x01	Continue on error If an error occurs, the next test in the test list is executed.
00000010	0x02	Reserved Not used at this time.
00000100	0x04	Reserved Not used at this time.
00001000	0x08	Loop all Tests Forever Loop all tests in the current test list until the operator aborts test execution.
00010000	0x10	Reserved Not used at this time.
00100000	0x20	Suppress Errors Do not display errors when they occur.
01000000	0x40	Suppress Status Do not display status as tests are executing.
10000000	0x80	Reserved Not used at this time.

8-4.4 Types of Diagnostic Procedures

The Diagnostic Microcode architecture is a list based architecture. Therefore, the basic sequence of operations for any diagnostic procedure is as follows:

1. Create or modify a test list - (optional, FACTORY MODE only)

Building a list of diagnostic tests to execute is an optional task because every mode of diagnostic operation includes a default list of tests to be executed. Therefore this step is not required.

2. Execute the test list

Through the use of the “RUN” command, individual nodes in a test list are sequentially executed until the end of the list is encountered. Options are available to allow the ability to loop individual nodes of a test list or loop the entire list.

3. Examine the results

At the end of each test list execution, the number of times the test list was executed is displayed along with the number of errors encountered. Errors are displayed at the time they occur, and the first 16 errors that occur are captured in an error log. Based on the results obtained from executing a test list, the test list may be modified and executed again to obtain additional information.

Although these steps apply mainly to the Off-Line diagnostic mode, the same sequence of operations is performed for every mode.

8-4.4.1 Tasked Go/No-Go Diagnostics

Diagnostics executed in this mode are done automatically at M2488 power on. The nodes in the default test list are executed in sequence until the end of the test list is encountered. If an error occurs in this mode of operation, an error message will be scrolled on the operator control panel and the SCSI interface to the M2488 Tape Drive ***will not*** be enabled. However, controller firmware will attempt to continue in order to provide the ability to invoke the Off-Line diagnostics to allow further trouble-shooting of the problem.

Tests may be aborted in this mode if the <ENTER> key is pressed while the test list is executing. The current test list node will continue executing to completion (or until an error is encountered) and the test list will be aborted prior to execution of the next node.

8-4.4.2 Off-Line Diagnostics

Off-Line diagnostics may be invoked through the RS-232 user interface by simultaneously pressing the START and UNLOAD keys on the operator control panel. Then select the main menu item DIAGMODE by pressing START. The next level of menus begin with run. Press the UNLOAD key once. The operator control panel should now display RS-232. Press the START key to select the RS-232 menu item. At this point, the Operator Control Panel will flash the message “RS-232?” and input will only be accepted from the RS-232 port by entering commands at the Off-Line diagnostic command prompt. All of the commands discussed in section will be available. Entering the “Quit” command will return control to the Operator Control Panel keys.

8-4.4.3 In-line Diagnostics

The types of tests performed are determined by the Selftest bit of the SEND DIAGNOSTICS command. A selftest bit of 1 performs the default selftest, as described in paragraph a. A selftest bit of 0 directs the target to perform tests defined by the bytes in the parameter list, as described in paragraph b.

a. Selftest

The default selftest consists of the tests described in Table 8-19.

Table 8-19. Selftest Description.

TEST	DESCRIPTION
PCC Timers Timer 0-2 Tests	Test each timer in PCC Function and verify that it operates at 5% of normal value.
CP Bus Tests	Parity checking: Force parity errors on the CP bus and verify that an interrupt is generated
	Invalid Address Detection: Attempt to access an address beyond the known address space and verify that an interrupt is generated.
PCC Tests	External Register Tests: Write/verify to all writable registers and read all readable registers. Verify RSVP counters and microcode timers in the PCC chip.
SDDP Tests	External Register Tests: Write/verify to all writable registers and read all readable registers.
	Data buffer DRAM Verification: Write/verify entire SDDP data buffer DRAM (256 bytes at a time).
	Host Packet Processor: Verify that packet headers are built correctly for EDRC write and read operations.
EDRC Tests	Verify data compression capability with “canned” data patterns
Formatter Tests	Registers for RSVP Interface, Read, Write and Test Jump. Verify formatter counters and interrupts.
Loop Write/Read LVL1 - Digital Tests	Data is written into the data buffer and passed from the data buffer to the MTU. The MTU returns the data to the formatter through both the analog and digital check circuitry. No tape motion is required.
Loop Write/Read LVL2 - Analog Tests	Data is written into the data buffer and passed from the data buffer through the formatter.

b. Page Code 80h Tests

Table 8-20. Page Code 80h Test Description

TEST	ONLINE ROUTINE	DESCRIPTION	OPERATOR INTERVENTION
Self Test	01h	The same tests as described in Table 8-19. The self test is also SCSI Routine 01h.	
Loop Write/ Read LVL1 - Digital Tests	50h	Data is written into the data buffer and passed from the data buffer to the MTU. The MTU returns the data to the formatter through both the analog and digital check circuitry. No tape motion is required.	
Loop Write/ Read LVL2 - Analog Tests	51h	Data is written into the data buffer and passed from the data buffer through the formatter. No tape motion is required.	
Write Data Tests	52h	Tape is positioned at Load Point and 4 tones are written. They are each 4 meters in length and written with the order of Erase Tone, IBG Tone, Tape Mark (TM) Tone, and Density ID (DID) Tone.	A scratch tape must be loaded prior to running this Online routine.
Read Date Tests	53h	Tape is positioned at Load Point and 4 meters of Erase Tone, IBG Tone, TM Tone and DID Tone are written. The tones are read back in reverse direction and a rewind is performed.	A scratch tape must be loaded prior to running this Online routine.
Combination Tests 1	54h	Tape is positioned at Load Point and 4 tones of 4 meters each is written. The tones are; Erase Tone, IBG Tone, TM Tone and DID Tone. The tape is then rewound. At Load Point, another 4 tones are written (same as above), but this time instead of just rewinding, the tones are read in the reverse direction.	A scratch tape must be loaded prior to running this Online routine.
Combination Tests 2	57h	An ‘all zeroes’ data pattern is replicated in the data buffer and blocks are written to tape until Logical EOM is detected. The first block written is 255 bytes in length. Each succeeding block length is incremented by one. All data is read in both the forward and reverse directions.	A scratch tape must be loaded prior to running this Online routine.
Medium Changer - No Cartridge Present	C0h	Tests the drive logic, photo sensors, loader mechanism, and the tachometer pulse generation.	Before running this diagnostic, the xCL magazine must be removed.
Medium Changer - No Magazine Set	C2h	Tests the ACL/FACL loader mechanism and photo sensors.	Before running this diagnostic, the xCL magazine must be removed. For a FACL, after this diagnostic has been requested, the TEST button on the FACL operator panel must be pressed for this diagnostic to begin.

8-4.5 Diagnostic Test Registry

Refer to Appendix F, Table F-2 for a list of all of the diagnostic tests in the Diagnostic Test Registry for the Tasked Go/No-Go mode, the OnLine mode, and the Off-Line mode.

8-4.6 Diagnostic Microcode Specifications

Table 8-21 lists some Diagnostic Microcode specifications:

Table 8-21. Diagnostic Microcode Specifications

PARAMETER	LIMIT
Maximum number of tests in Diagnostic Test Registry	255
Maximum number of tests (TLN's) in test list	254
Maximum number of characters per command line	255
Maximum extended error message length (characters)	1024

8-5 FACTORY SETTINGS

The factory menu is used to set options during manufacturing and can be used to view M2488 information such as serial number, tape motion time, and power-on time. This menu is also used to enable factory mode. The factory settings can only be changed when in factory mode. Entry and use of the factory menu is described in the following paragraphs.

Table 8-22. Operator Panel Top Level Menus - Factory Option

TEST and *UNLOAD* pressed → *TEST* and *UNLOAD* released

* → **OFFLINE** → **DIAGMODE**

Menu	Key	Description	Reference
DIAGMODE		Selection and execution of off-line diagnostics	Product Guide Section 8-4
↓ *START*			
SETTING		Access and configure user settable options	User Guide Section 4-2
↓ *START*			
LOADCODE		Copy new firmware from a code image tape cartridge into non-volatile memory of M2488.	User Guide Section 4-3
↓ *START*			
INQUIRY		View M2488 Information	User Guide Section 4-4
↓ *START*			
MODE PGS		Display or change selected Tape Unit or Medium-Changer Mode Pages	User Guide Section 4-5
↓ *START*			
FACTORY	*TEST* →	Change factory mode settings, enable factory mode, or enable factory diagnostics.	Product Guide Section 8-5

Navigation keys:
To navigate through the options, settings, and to make changes from the Operator Panel:
Press *START* to move forward through the options or settings. It will also increment the setting numbers.
Press *SHIFT* and *START* to move backward through the options or settings. It will also decrement the setting numbers.
Press *RESET* to move from settings to option or to leave setting mode.
Press *TEST* to move from the option to settings.
Press *UNLOAD* to select a number field for multiple digit numbers.
Setting Procedure:

Step 1. At the ❋, press and hold the *TEST* and *UNLOAD* push-button simultaneously until **DIAG-MODE** is displayed.

Step 2. Press the *START* push-button until **FACTORY** is displayed. Note: *SHIFT* + *START* may be pushed one time.

Step 2. Press the *TEST* pushbutton.

Step 3. The first option, **F0:FACT0**, is displayed. Press *TEST* will allow changing this setting if the unit is in factory mode.

Step 4. Press the *START* push-button or *SHIFT+START* keys to select other factory options described as follows:.

Table 8-23 describes the factory menu options and settings.

Table 8-23. Factory Menu Options and Settings Description

OPTION	SETTINGS	DESCRIPTION	DEFAULT/ INITIAL SETTINGS
F0:FMODE0	N/A	Factory mode setting 0 - presently not used.	00h
F1:FMODE1	N/A	Factory mode setting 1 - presently not used.	00h
F2:FMODE2	N/A	Factory mode setting 2 - presently not used.	00h
F3:FMODE3	N/A	Factory mode setting 3 - presently not used.	00h
F4:MTIME	MTIME	Tape motion time in seconds. Eight digit hexadecimal number.	00h
F5:PTIME	PTIME	Number of minutes the M2488 has been powered on. Eight digit hexadecimal number.	00h
F6:SRNUM	SRNUM	Serial number of M2488 represented by 16 ASCII character string.	SRNUM
F7:*****	N/A	Unused factory setting menu item.	
G8:FMODE	DISABLE ENABLE	Factory mode is disabled. Press *START* key to move to ENABLE. Press *TEST*, **PW="?????" <-?** is displayed.	N/A
G9: xxxxx	N/A	Unused factory setting menu item.	N/A
G10:WTROM	N/A	Write to NVRAM the settings as changed. This menu item only appears when Factory mode is enabled.	N/A

8-6 ERROR RECOVERY PROCEDURES

The IDENTIFY message is used by the initiator or target to establish the physical path between the initiator and target for a specific logical unit. Bit 6 of the IDENTIFY message is defined as follows:

Bit 6: When the initiator sets this bit to a one, the initiator allows disconnect. If the initiator sets this bit to a zero, the initiator does not allow disconnect. When the target performs a disconnect/reconnect sequence, an implied RESTORE POINTERS operation is performed by the initiator. This results in all data for the command being retransmitted from the initiator unless the target has issued a SAVE DATA POINTER message prior to disconnection.

The target always sets bit 6 to zero during reconnection.

If an error occurs during data transfer, the target is automatically restored to the beginning of data.

8-6.1 EDRC Error Recovery

Certain errors during EDRC operation are recoverable. This category of errors occurs during data transfer and requires the data to be re-transmitted in order to record the data on tape. Included in this category are the following related errors:

Initiator record expands past 451 KB during compaction process.

Initiator record expanded past the available buffer space.

Hardware error occurred. (e.g. timeouts, compression/decompression errors, etc.)

8-6.2 Retry Methods

There are four retry methods the target is capable of using to recover the above errors:

1. Automatic retry from the internal retry buffer for blocks up to 64 kB (65,536 bytes)
2. Explicit Restore Pointers
3. Disconnect/reconnect with an implied Restore Pointers
4. Aborted Command

The above methods are tried in order as determined by the initiator (MESSAGE REJECT message or IDENTIFY message).

The error recovery for the first method is performed internally within the target. This retry method can be disabled via feature mode 1, bit 0 (0x01), using the CHANGE DEFINITION command, or from the operator panel SETTING menu, option 77:S.FT1 (refer to the User’s Guide, Chapter 4).

The error recovery for the second and third methods is completed when the host restores the data pointers and retransmits the data.

The error recovery following an aborted command is completed when the host reissues the WRITE command for the failing data.

For all four retry methods, the target performs the first retry in the same data compression mode as the original data transfer. For any additional retries, the target automatically switches to reblocking in non-compacted mode. The target automatically switches back to the mode defined prior to the error after the retry is successful or after the third retry has failed and a permanent error has been reported to the initiator.

If the initiator does not support the restore pointers mechanism for error recovery, the initiator must reject the RESTORE POINTERS message with the MESSAGE REJECT message.

If the initiator does not support the disconnect/reconnect mechanism for error recovery, the initiator must not allow the target to disconnect via the IDENTIFY message.

If the initiator does not support both the RESTORE POINTERS message and disconnect/reconnect, the target can be configured to not perform these retry methods. The target is configured by setting feature mode 1, bit 1 (0x02) to one via the CHANGE DEFINITION command (VPD page C1h, fm1 field) or by the operator panel, SETTING menu, option 77:S.FT1 (see Chapter 4 of User's Guide).

It is important to note that when bits 0 and 1 of feature mode 1 are both set to one, only the fourth retry method (Aborted Command) is supported.

The following EDRC retry method may be used by the initiator to determine if the EDRC error is retryable. Refer to Figure 8-2:

a. SENSE KEY byte 2 has a value of 0Bh,

b. Additional Sense Code byte 12 and Additional Sense Code Qualifier byte 13 have a value of 44h and 00h respectively,

c. Host ERPA byte 19 has a value of 4Ch.

After the initiator has verified bytes 2, 12, 13, and 19 are of the correct value, the initiator can reissue the WRITE command.

**** NOTE ****

It is possible for the target to generate SENSE KEY 0Bh (Aborted Command) with sense data bytes 12, 13, and 19 containing values other than those shown in Figure 8-2. This indicates that more specific data transfer errors occurred (e.g. SPC Parity error on data received) and the initiator can still reissue the WRITE command.

ERROR RECOVERY

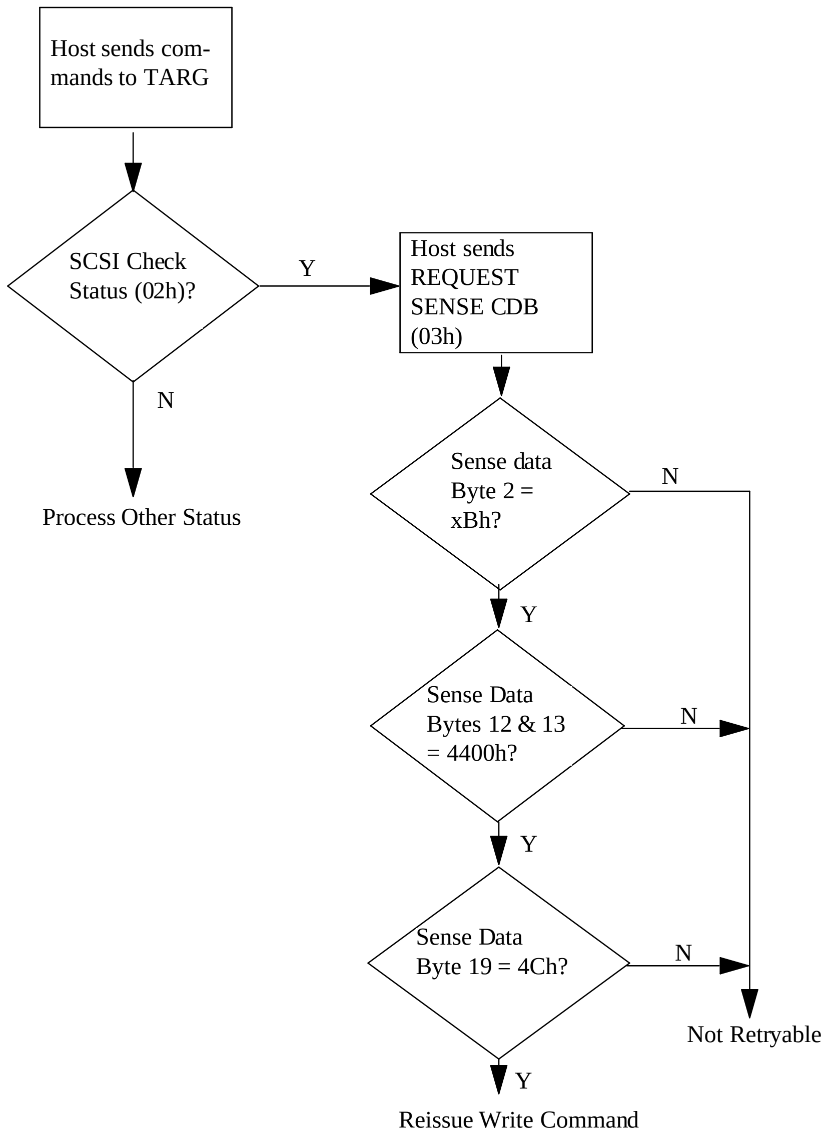


Figure 8-2. EDRC Retry

8-7 MAINTENANCE TERMINAL

The maintenance terminal is attached to the rear of the M2488 via the 9-pin DIN connector. It has two functions, use as a terminal to run diagnostics using keyboard input and as a debug port for use with special tools that can be accessed by remote attach with a modem.

8-7.1 Maintenance Interface

A 9-pin (DB-9) maintenance interface (DTE device) is provided on the rear panel of the tape drive which is used for maintenance and diagnostic operation. Nearly all maintenance and all diagnostic capabilities are accessible through this interface. The maintenance interface connector is shown in Figure 8-3 and the pin assignments are indicated in Table 8-24.

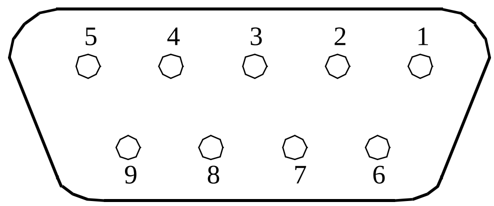


Figure 8-3. Maintenance Connector (M2488)

Table 8-24. Maintenance Interface Connector Pin Assignments

M2488				PC	
CONNECTOR CONTACT NUMBER	SIGNAL NAME	ABBREVIATION	DIRECTION	25-PIN	SIGNAL
1	DATA CARRIER DETECT	DCD	IN	2	TX
2	RECEIVE DATA	RX	IN	3	RX
3	TRANSMIT DATA	TX	OUT	6	DSR
4	DATA TERMINAL READY	DTR	OUT	7	GND
5	SIGNAL GROUND	GND		20	DTR
6	DATA SET READY	DSR	IN	5	CTS
7	REQUEST TO SEND	RTS	OUT	4	RTS
8	CLEAR TO SEND	CTS	IN		
9	RING INDICATOR	RI	IN		

To establish communications with this interface, host configuration settings for maintenance operations are provided in Table 8-25.

Table 8-25. Maintenance Interface Communications Settings

COMMUNICATIONS SETTING	VALUE
BAUD rate	19200
Parity	None
Data bits	8
Stop bits	1
Duplex	FULL

8-7.2 Remote Debug for JDB

These procedures describe how to establish a debug session between a local workstation and a remote M2488.

8-7.2.1 M2488 Side (Remote)

8-7.2.1.1 Equipment Required

1 US Robotics Sportster 28,800 FAX Modem

1 RS-232 cable, 9-pin female to 25-pin male

1 M2488 Cartridge Tape Drive

8-7.2.1.2 Procedure

STEP	ACTION
1	Switch M2488 power on. Wait for self-test diagnostics to complete. (The M2488 may already be powered-on in which case you don't need to perform this step.)
2	Prepare modem DIP switch settings. Important settings are: 1 down (DTR override) 2 up (verbal results code) 3 up (suppress result codes) 4 up (echo off-line commands) 5 up (auto answer) 6 up (carrier detect normal) 7 down (load factory defaults) 8 down (smart modem)
3	Attach phone line to modem (telephone wall socket to modem connection.)
4	Attach line between phone and modem if desired.
5	Connect power cord to modem.
6	Connect RS-232 cable between modem and M2488.
7	Switch modem power on.
8	Press *SHIFT* and *TEST* keys at same time. Hold keys for 5 seconds. (If the modem has a Receive Data (RD) lamp, this lamp will blink a few times.)

8-8 PREVENTIVE MAINTENANCE

Refer to the User's Manual, Chapter 6, for a description of preventive maintenance procedures.

8-9 TAPE PATH CLEANING PROCEDURE

If the media created excessive debris buildup on the head or head guide, then manually wet clean the head or head guide as follows:

STEP	ACTION
1	Turn the tape drive power switch to off. Disconnect SCSI cables and power cord.
2	See Figure 8-1. Remove the two screws from the fan cover. Open the fan cover.
3	Without allowing hands to contact the head or guides, clean the tape path (head) and head guides using a cotton swab and 98% isopropyl alcohol. Do NOT use Freon solvent.

NOTE: Under normal conditions, this procedure is unnecessary. Only service personnel should perform this procedure.

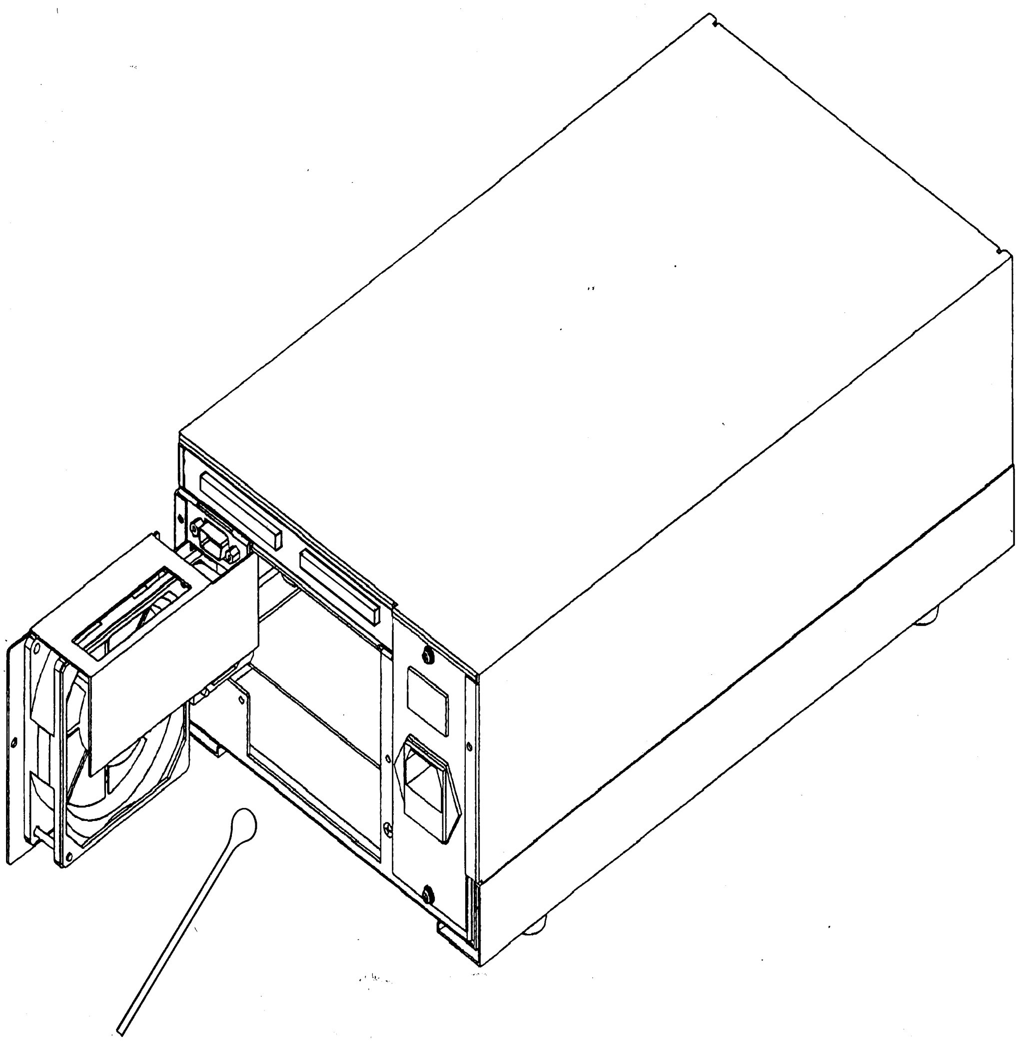


Figure 8-1. Tape Path Cleaning

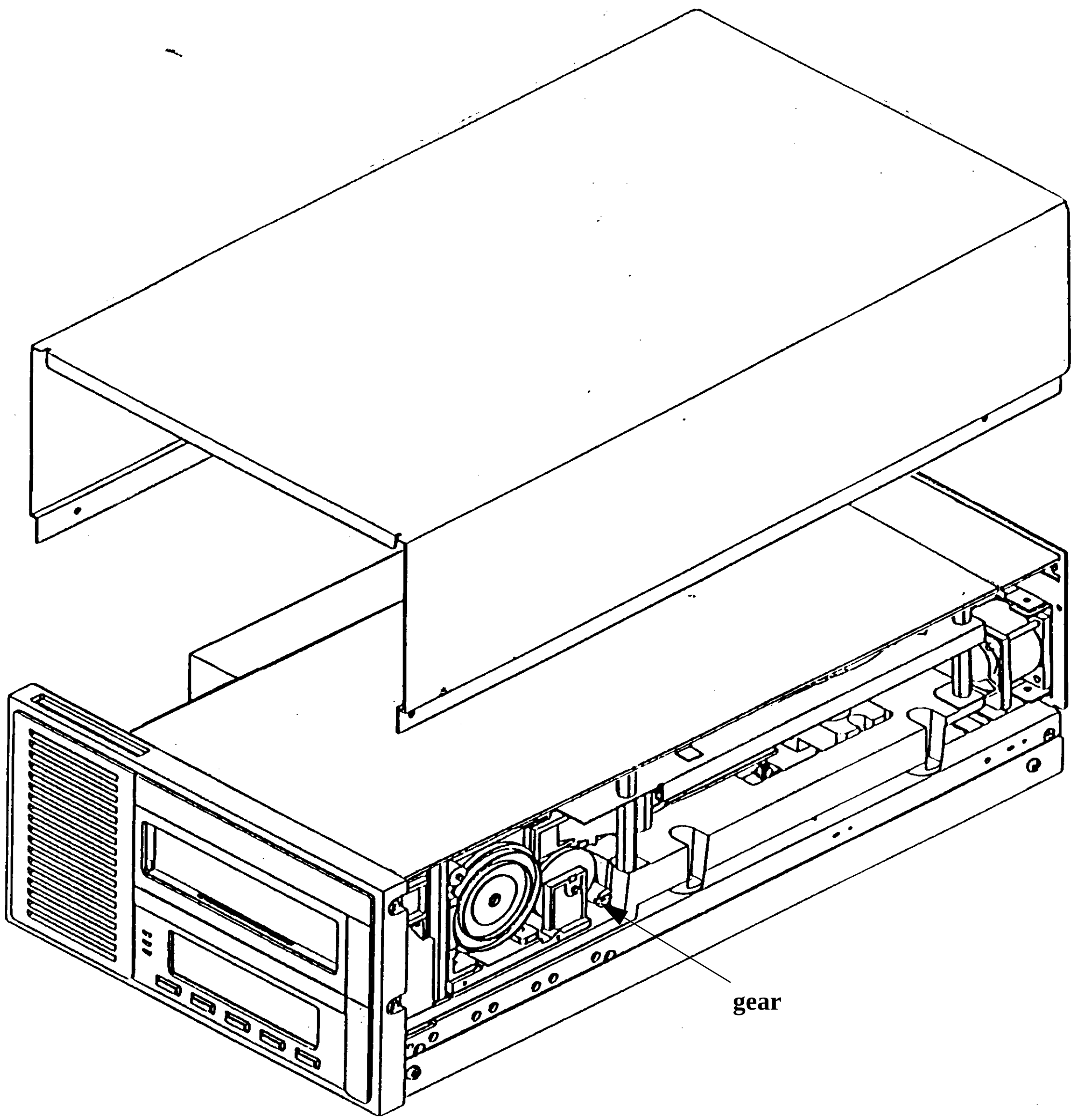
MANUAL TAPE REMOVAL

8-10 MANUAL TAPE REMOVAL PROCEDURE

When the cartridge tape cannot be ejected automatically, use the procedure that applies to your situation.

8-10.1 Cartridge Tape Stopped During Loading

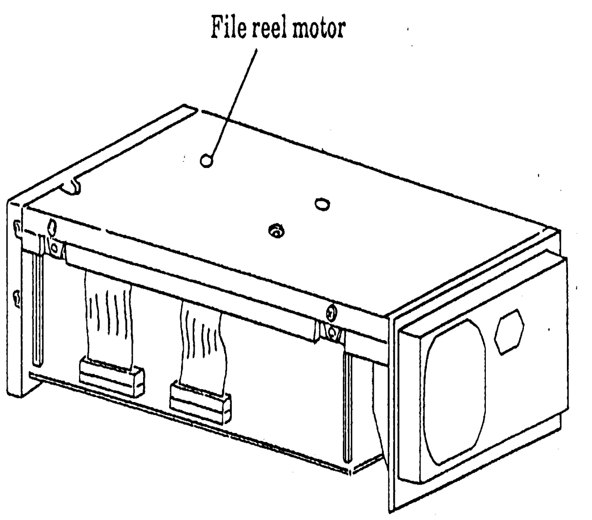
STEP	ACTION
1	Remove the top cover as described in paragraph 8-11.4.
2	Confirm that the tape is completely wound into the cartridge.
3	On the Loader Assembly (shown below), turn the gear counterclockwise with a phillips screwdriver.



8-10.2 Tape Stopped During Threading

<u>STEP</u> <u>ACTION</u>

1. Remove the DTC as described in paragraph 8-11.6.
2. Confirm that the tape is not wound into the machine reel.
3. Remove the Threader Assembly as described in paragraph 8-11.7
4. Remove the leader block from the threader pin.
5. Lay the drive on its left side (when viewed from front).
6. Store the leader block into the cartridge by turning the file reel motor (on bottom as shown below) with a phillips screwdriver.



8-10.3 Tape Wound on Take-up Reel

<u>STEP</u> <u>ACTION</u>

1. Remove the DTC as described in paragraph 8-11.6.
2. Lay the drive on its left side (when viewed from front).
3. Turn the file reel motor (on bottom as shown above) counterclockwise with a phillips screwdriver.
4. Do **not** exceed 1.25 kg-cm torque equal to 250 g for tape). Rewind the tape slowly and carefully until the leader block is exposed on the take-up reel.
5. Move back threader by pushing bearing, following the groove until the leader block comes out of the take-up reel.
6. Rewind the tape by turning the file reel motor counterclockwise with a phillips screwdriver.
7. Push the threader bearing so that the leader block seats in the tape cartridge.

REMOVE & REPLACE

8-11 REMOVE AND REPLACE PROCEDURES

NOTICE

SERVICE
PERSONNEL
ONLY

****
* CAUTION *
****

Prior to performing the repair and replace procedures, power off the drive. Disconnect the power cord by pulling on the plug to remove from the electrical outlet. Disconnect all cables from the M2488 Tape Drive.

The M2488 cable and connector interconnects are listed in Table 8-1. See the PCBAs in Chapter 9 for actual connector locations.

The procedures listed in Table 8-2 describe the removal and replacement of Field Replacement Units (FRUs). Follow each procedure in the order presented to insure proper disassembly and reassembly. Remove the drive from its rack-mount or desktop support base, if applicable, prior to performing the removal procedures.

After replacements are complete, install the drive in the rack-mount or support base, if applicable. Then connect all cables and power cords. See the Installation Instructions in CHAPTER 1. Power on drive.

Table 8-1. M2488 Interconnects

FROM		TO		CABLE/ CONNECTOR TYPE	DESCRIPTION
DTC	CNJ21	DVL	CNP21	120 pin, direct connect	DTC-DVL I/F
DTC	CNJ03	RDL	CNJ14	68 pin, FPC	DTC-RDL I/F #2
DTC	CNJ02	RDL	CNJ13	68 pin, FPC	DTC-RDL I/F #1
DTC	CNP05	PSU	CNP92	6 pin	power
DTC	CNJ07	IPM	CNP07	direct connect	DTC-IPM I/F
DTC	CN6				DTC-Seismic I/F (optional connection)
DTC	CNP04	RS232C		10 pin	RS-232 I/F
IPM	CNP07	DVL	CNJ07	direct connect	DTC-IPM I/F
IPM	IN/OUT	SCSI			
DVL	CNP29	Fan Assembly	CNP62	8 pin	
DVL	CNP41	Machine Reel Sensor		4 pin	

Table 8-1. M2488 Interconnects (Continued)

FROM		TO		CABLE/ CONNECTOR TYPE	DESCRIPTION
DVL	CNP42	File Reel Sensor		4 pin	
DVL	CNJ43	Threader Sensor		7 pin FPC	
DVL	CNJ44	Loader Sensor 1 and 2		12 pin FPC	
DVL	CNP21	DTC	CNJ21	120 pin, direct connect	
DVL	CNP22	RDL	CNJ15	20 pin FPC	
DVL	CNP23	WTL	CNJ31	30 pin x2 FPC	
DVL	CNP28	ACL/FACL		34 pin	optional medium changer connect
DVL	CNP27	not used		8 pin	
DVL	CNP24	OP	CNP41	10 pin	
DVL	CNJ51	SVL	CNP51	48 pin, direct connect	
OP	CNP41	DVL	CNP24	10 pin	
Fan Assembly	CNP62	DVL	CNP29	8 pin	
SVL	CNP52	File Reel Motor		8 pin	
SVL	CNP53	Machine Reel Motor		8 pin	
SVL	CNP54	Loader Motor	CNJ61	2 pin	
SVL	CNP55	Threader Motor		2 pin	
SVL	CNP51	DVL	CNJ51	48 pin	
SVL	CNP50	PSU	CNP91	12 pin	
Loader Motor	CNJ61	SVL	CNP54	2 pin	
PSU	CNP94	RDL	CNP16	5 pin	
PSU	CNP93	WTL	CNP30	4 pin	
PSU	CNP92	DTC	CNP05	6 pin	
PSU	CNP91	PSU	CNP91	12 pin	
PSU		AC Input			
RDL	CNP16	PSU	CNP94	5 pin	
RDL	CNJ13	DTC	CNJ02	68 pin	
RDL	CNJ14	DTC	CNJ03	68 pin	
RDL	CHK01	not used		50 pin	
RDL	CNJ12A	Head	CNJ90A	40 pin FPC	

Table 8-1. M2488 Interconnects (Continued)

FROM		TO		CABLE/ CONNECTOR TYPE	DESCRIPTION
RDL	CNJ12B	Head	CNJ90B	40 pin FPC	
RDL	CNJ15	DVL	CNJ22	20 pin FPC	
WTL	CNP30	PSU	CNP93	4 pin	
WTL	CNJ31	DVL	CNP23	30 pin x2 FPC	
WTL	CNJ32A	Head	CNJ91A	40 pin FPC	
WTL	CNJ32B	Head	CNJ91B	40 pin FPC	
Head	CNJ90A	RDL	CNJ12A	40 pin FPC	
Head	CNJ90B	RDL	CNJ12B	40 pin FPC	
Head	CNJ91A	WTL	CNJ32A	40 pin FPC	
Head	CNJ91B	WTL	CNJ32B	40 pin FPC	

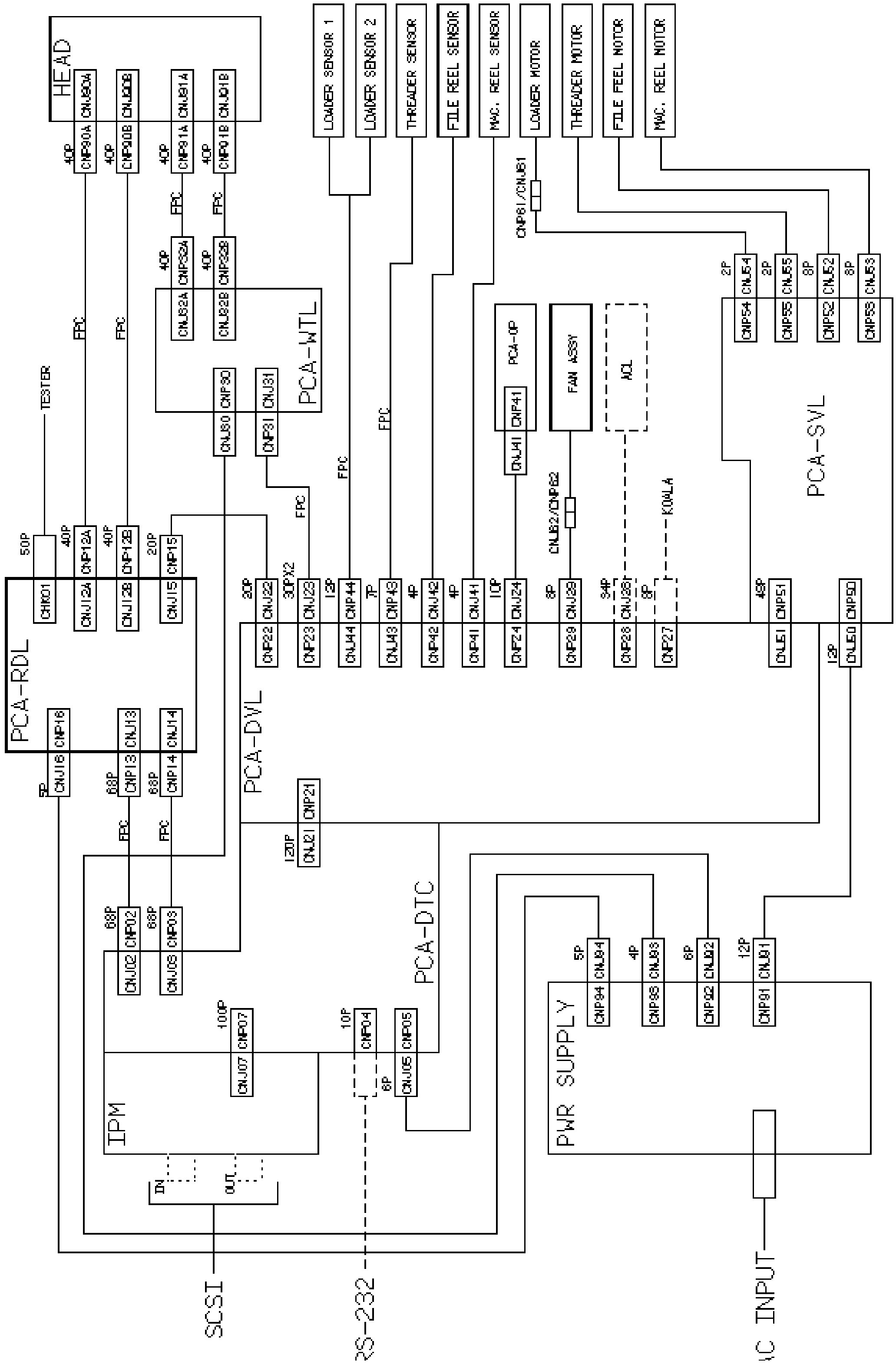


Figure 8-2. Interconnect Diagram

Table 8-2. FRUs Remove and Replace Procedures

FRU	TOOLS	PARAGRAPH
Air Filter	screwdriver	8-11.1 on page 8-43
Fan Assembly	#2 phillips screwdriver	8-11.2 on page 8-44
IPM (all types)	#2 phillips screwdriver	8-11.3 on page 8-45
DTC PCBA	#2 phillips screwdriver	8-11.6 on page 8-48
Threader Assembly	#2 phillips screwdriver 9/32” nut driver	8-11.7 on page 8-50
Loader Assembly	#2 phillips screwdriver 9/32” nut driver	8-11.8 on page 8-51
OP PCBA	#2 phillips screwdriver	8-11.9 on page 8-52
Power Supply (PSU)	#2 phillips screwdriver	8-11.10 on page 8-53
SVL PCBA	#2 phillips screwdriver	8-11.11 on page 8-54
RDL PCBA	#2 phillips screwdriver	8-11.12 on page 8-54
WTL PCBA	#2 phillips screwdriver	8-11.13 on page 8-55

8-11.1 Air Filter Remove and Replace Procedures

Refer to Figure 8-3 for location of the air filter.

8-11.1.1 Air Filter Removal

This procedure takes approximately five minutes to perform.

STEP	ACTION
1	Insert a screwdriver into the bottom left of the front panel under the air filter.
2	Push up with screwdriver, then remove air filter from top of front panel.

8-11.1.2 Air Filter Replacement

STEP	ACTION
1	Insert clean air filter though the top left of the front panel.

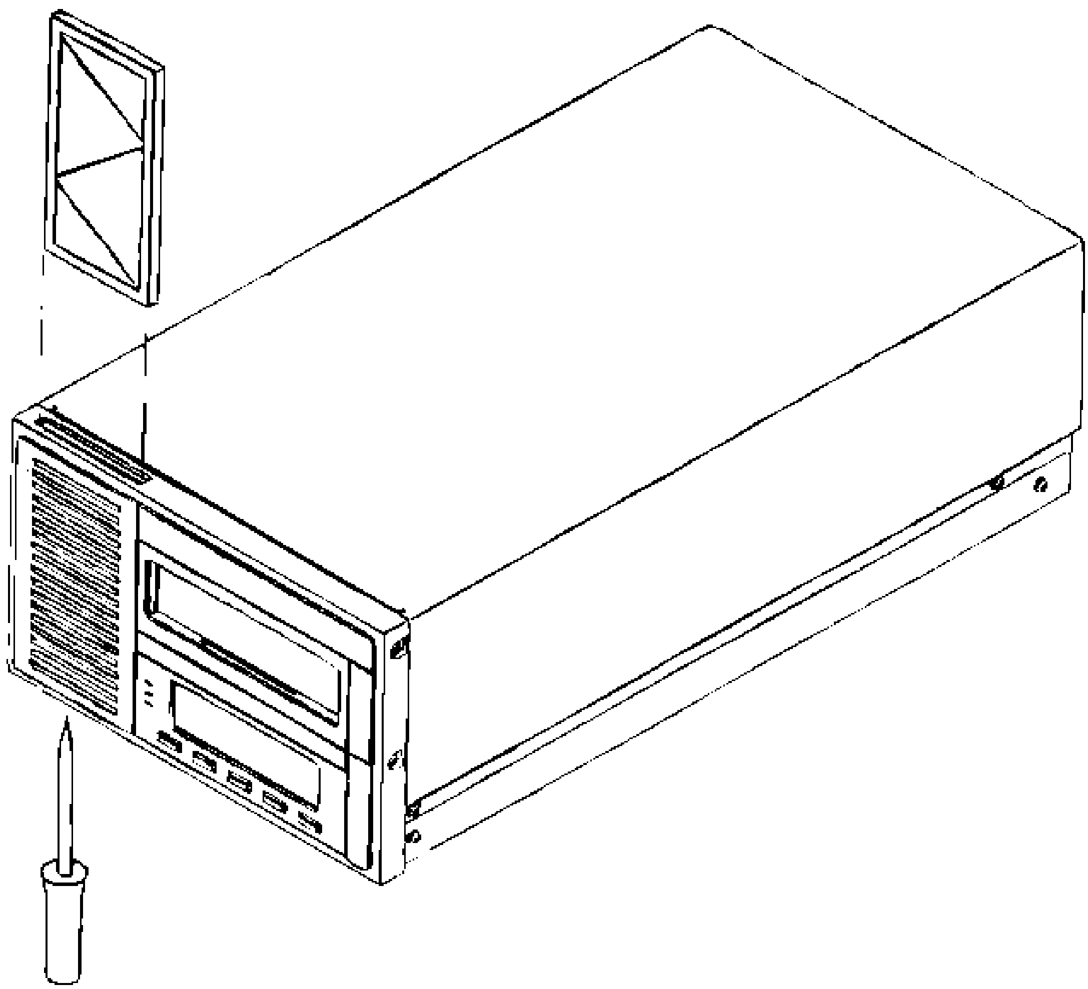


Figure 8-3. Air Filter Removal

FAN ASSEMBLY R & R

8-11.2 Fan Assembly Remove and Replace Procedures

Refer to Figure 8-4 for location of the fan assembly.

****
* CAUTION *
****

Ensure that the power has been turned off and that the fan is no longer rotating prior to removing the fan assembly.

8-11.2.1 Fan Assembly Removal

STEP	ACTION
1	Remove the two exterior screws from the fan cover.
2	Swing out the fan cover plate to the left.
3	Disconnect CNP62.
4	Remove the four screws from the fan assembly.
5	Remove the fans.

8-11.2.2 Fan Assembly Replacement

STEP	ACTION
1	Replace the fans.
2	Insert the four screws into fan corners.
3	Connect CNP62 to CNJ62.
4	Close the fan cover.
5	Insert the two fan cover screws and tighten.

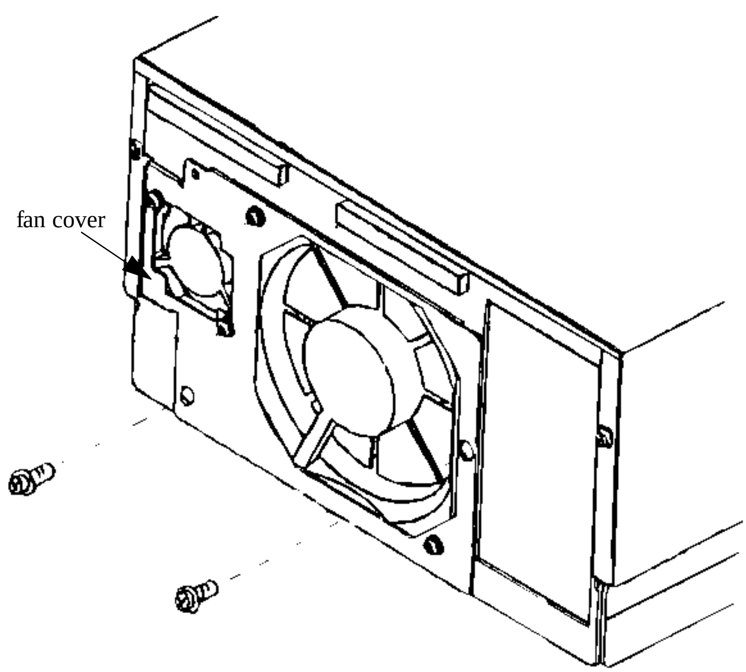


Figure 8-4. Fan Assembly

8-11.3 IPM Remove and Replace Procedures

Refer to Figure 8-5 for location of the PCA-IPM.

8-11.3.1 IPM Removal

STEP	ACTION
1	Disconnect cables and, if applicable, terminator from the two connectors on the IPM.
2	Remove the two screws from the IPM.
3	Pull out the IPM.

8-11.3.2 IPM Replacement

STEP	ACTION
1	Insert the IPM into the rear of the drive.
2	Tighten two screws on the IPM.
3	Connect cables and, if applicable, terminator to the connectors.

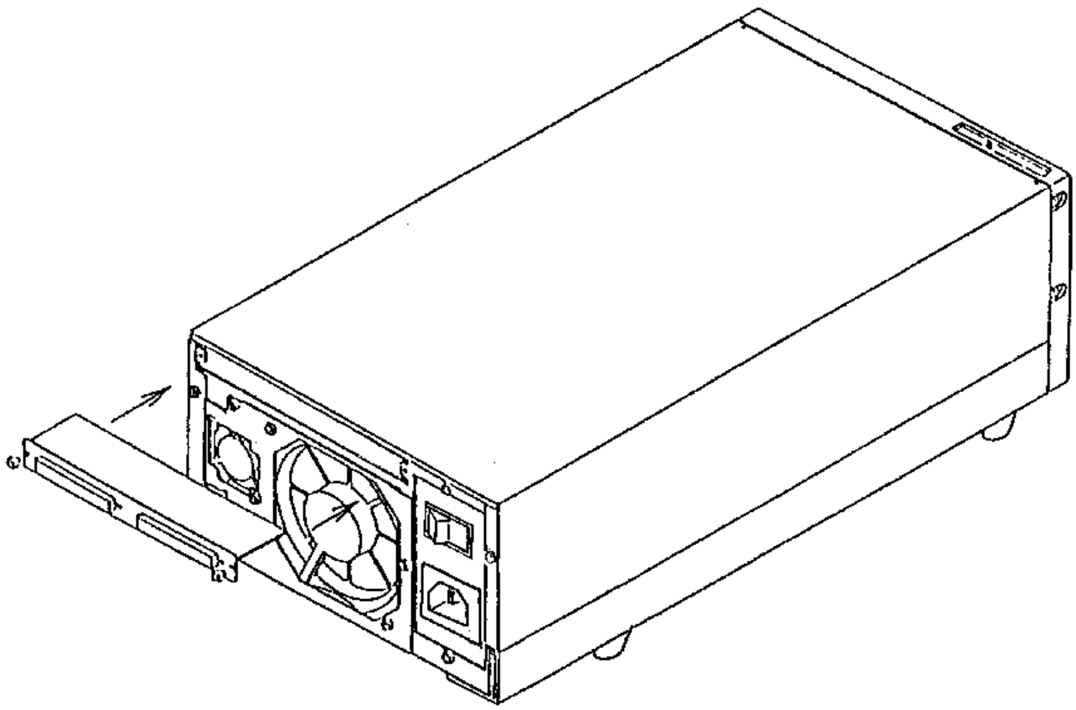


Figure 8-5. IPM

8-11.4 Top Cover Remove and Replace Procedures

Refer to Figure 8-6 for location of the top cover. Remove the IPM, if installed, prior to removing the top cover.

8-11.4.1 Top Cover Removal

STEP	ACTION
1	Remove four screws from foot rails, if attached, and remove.
2	Remove six screws from sides and back of top cover.
3	Lift off top cover.

8-11.4.2 Top Cover Replacement

STEP	ACTION
1	Replace top cover on drive.
2	Screw in the six screws on the cover's sides and back.
3	Attach foot rails with the four screws.

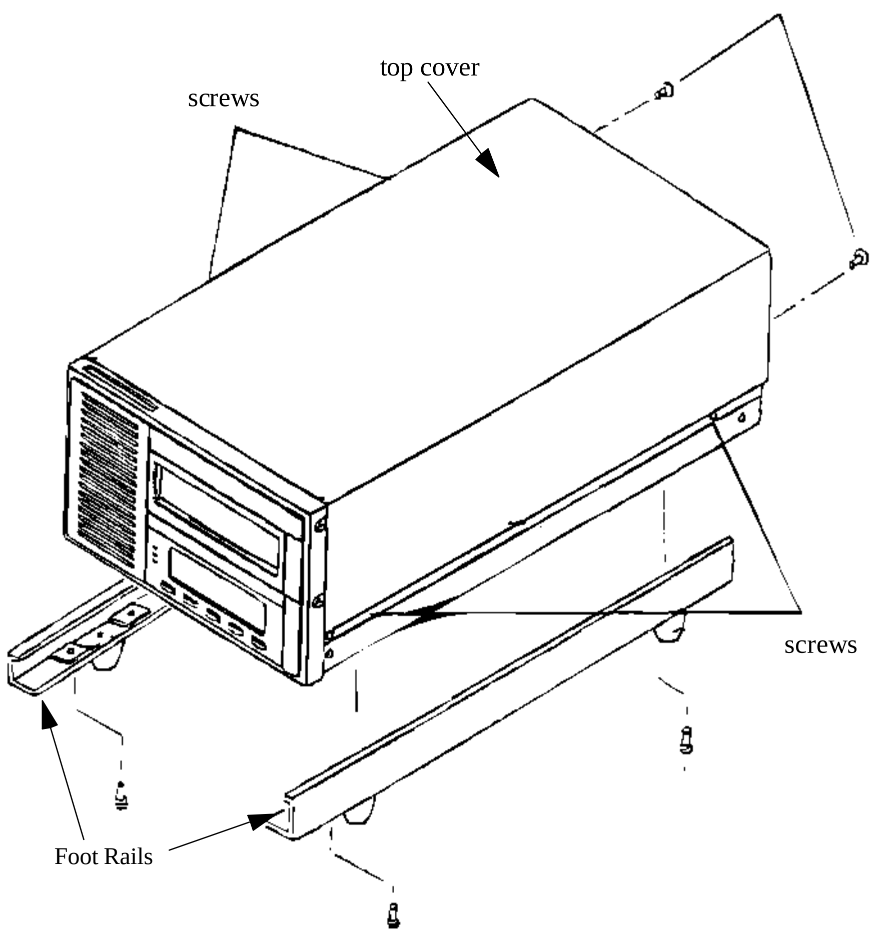


Figure 8-6. Top Cover

8-11.5 Bottom Cover Remove and Replace Procedures

Refer to Figure 8-7 for location of the bottom cover.

8-11.5.1 Bottom Cover Removal

STEP	ACTION
1	Lay drive on its top cover.
2	Remove four screws from foot rails, if attached, and remove.
3	Remove four screws from bottom cover.
4	Lift off cover.

8-11.5.2 Bottom Cover Replacement

STEP	ACTION
1	Replace bottom cover on drive.
2	Screw in the four screws on the cover.
3	Attach foot rails with the four screws.

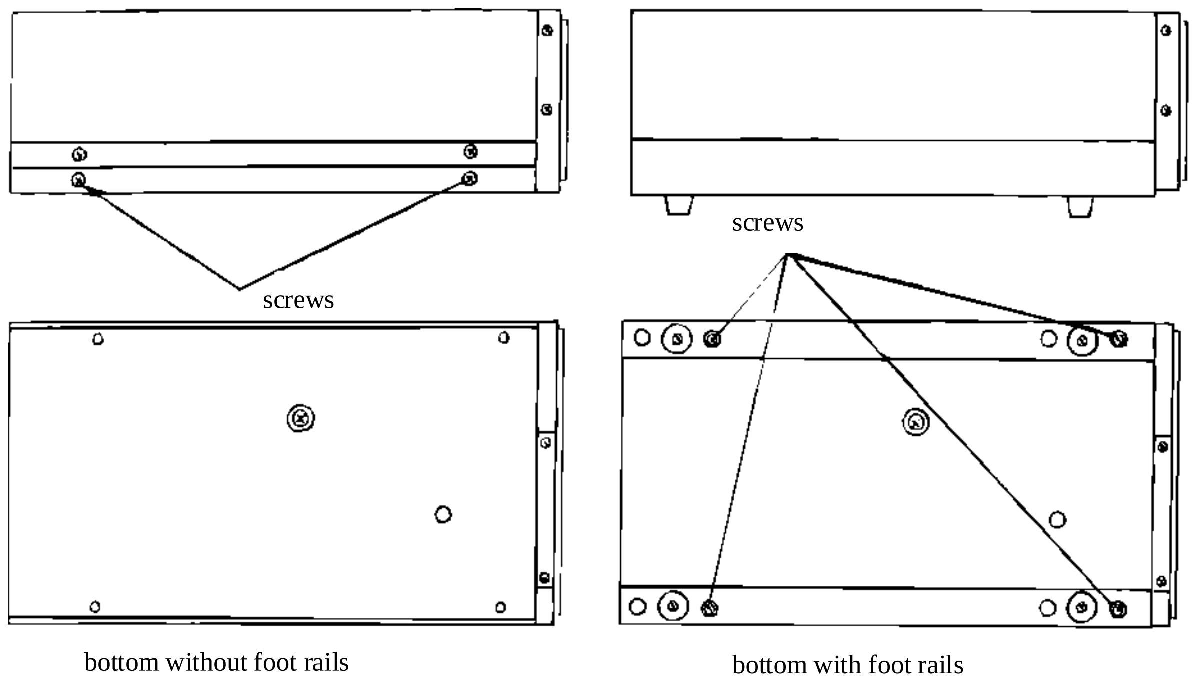


Figure 8-7. Bottom Cover

8-11.6 DTC PCBA Remove and Replace Procedures

Refer to Figure 8-8 for location of the DTC PCBA.

****
* CAUTION *
****

Do not exchange the lithium battery on the DTC PCBA.

8-11.6.1 DTC PCBA Removal

STEP	ACTION
1	Remove the IPM as described in paragraph 8-11.3.1 on page 8-45.
2	Remove the top cover as described in paragraph 8-11.4.1 on page 8-46.
3	Remove the five screws from the controller.
4	Disconnect the connectors CNP05, CNJ02, and CNJ03 on the DTC PCBA. CNJ02 and CNJ03 are on the underside of the board.
5	Remove the DTC board.

8-11.6.2 DTC PCBA Replacement

STEP	ACTION
1	Place the DTC PCBA component side down on the drive.
2	Connect the connectors CNP05, CNJ02, and CNJ03 on the DTC PCBA. CNJ02 and CNJ03 are on the underside of the board and should be gently pushed onto the mating plugs.
3	Place the five screws into the board, aligning the board with all screw holes. Tighten the five screws into the board. Be careful not to bow the board while tightening the screws.
4	Replace top cover as described in paragraph 8-11.4.2 on page 8-46.
5	Replace the IPM as described in paragraph 8-11.3.2 on page 8-45.

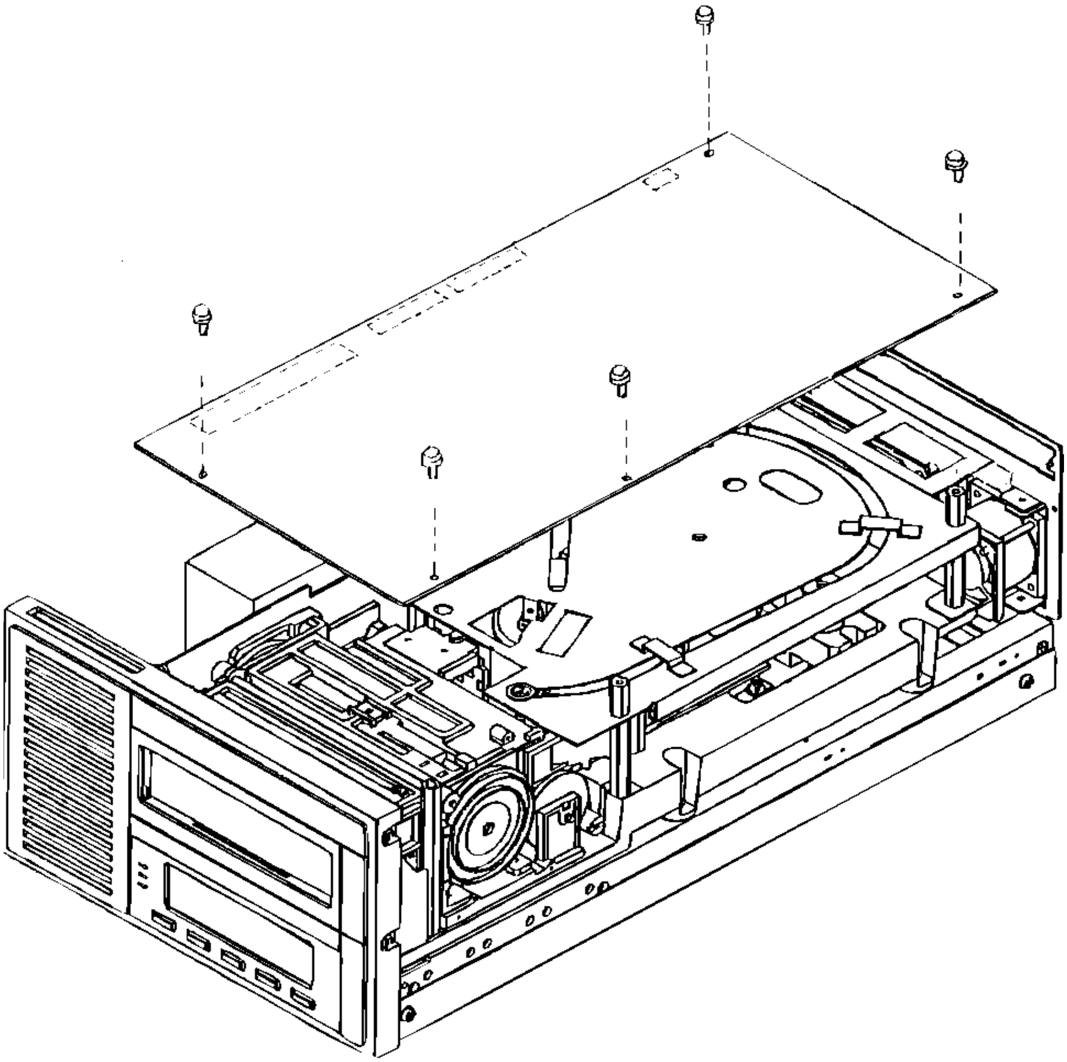


Figure 8-8. DTC PCBA

8-11.7 Threader Assembly Remove and Replace Procedures

Refer to Figure 8-9 for location of the Threader Assembly.

8-11.7.1 Threader Assembly Removal

STEP	ACTION
1	Perform the DTC PCBA removal procedure in paragraph 8-11.6.1 on page 8-48.
2	Disconnect ribbon cable CNP43 from the PCBA DVL CNJ43. Lift up on connector top to remove.
3	Remove one stud and three screws from the Threader Assembly.
4	Lift up on Threader Assembly to remove.

8-11.7.2 Threader Assembly Replacement

STEP	ACTION
1	Position the Threader Assembly.
2	Replace one stud and three screws on the Threader Assembly.
3	Connect connector CNP43 to the PCBA DVL CNJ43. Push down on connector top to hold ribbon cable in place.
4	Perform the DTC PCBA replacement procedure in paragraph 8-11.6.2 on page 8-48.

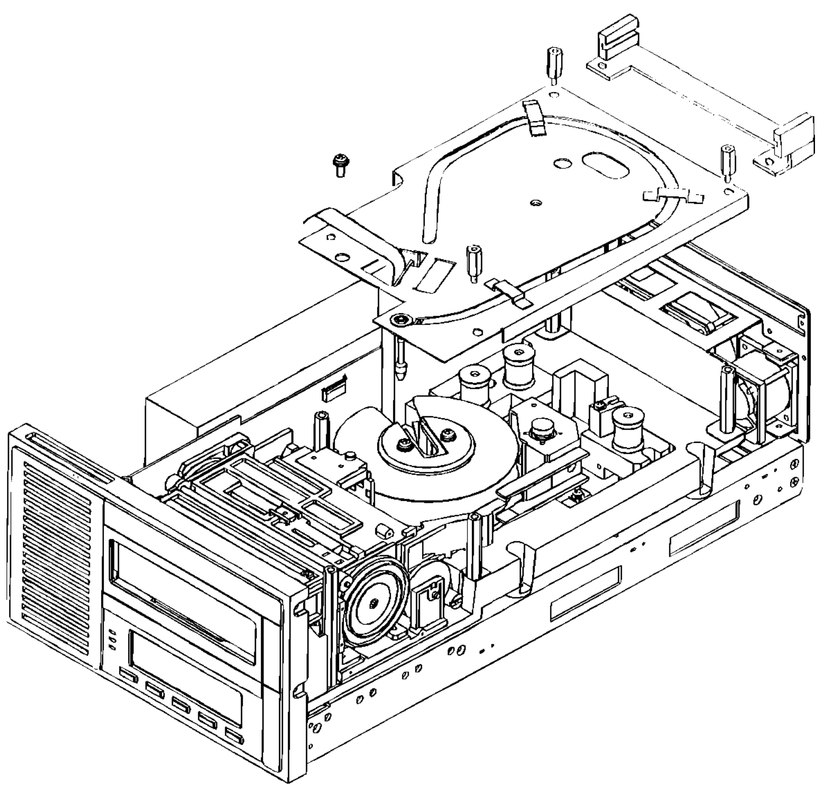


Figure 8-9. Threader Assembly

8-11.8 Loader Assembly Remove and Replace Procedures

Refer to Figure 8-10 for location of the Loader Assembly.

8-11.8.1 Loader Assembly Removal

STEP	ACTION
1	Perform the Threader Assembly removal procedure in paragraph 8-11.7.1 on page 8-50.
2	Disconnect ribbon cable CNP44 from the PCBA DVL CNJ44.
3	Remove one stud and three screws from the Loader Assembly.
4	Slowly lift up on Loader Assembly to remove.
5	Disconnect motor cable CNJ61.

8-11.8.2 Loader Assembly Replacement

STEP	ACTION
1	Connect motor cable CNJ61 to connector in casting panel.
2	Insert the Loader Assembly into position. Secure with one stud and three screws.
3	Connect ribbon cable CNP44 to the PCBA DVL CNJ44. Push down on the top of the connector to secure the connection.
4	Perform the Threader Assembly replacement procedure in paragraph 8-11.7.2 on page 8-50.

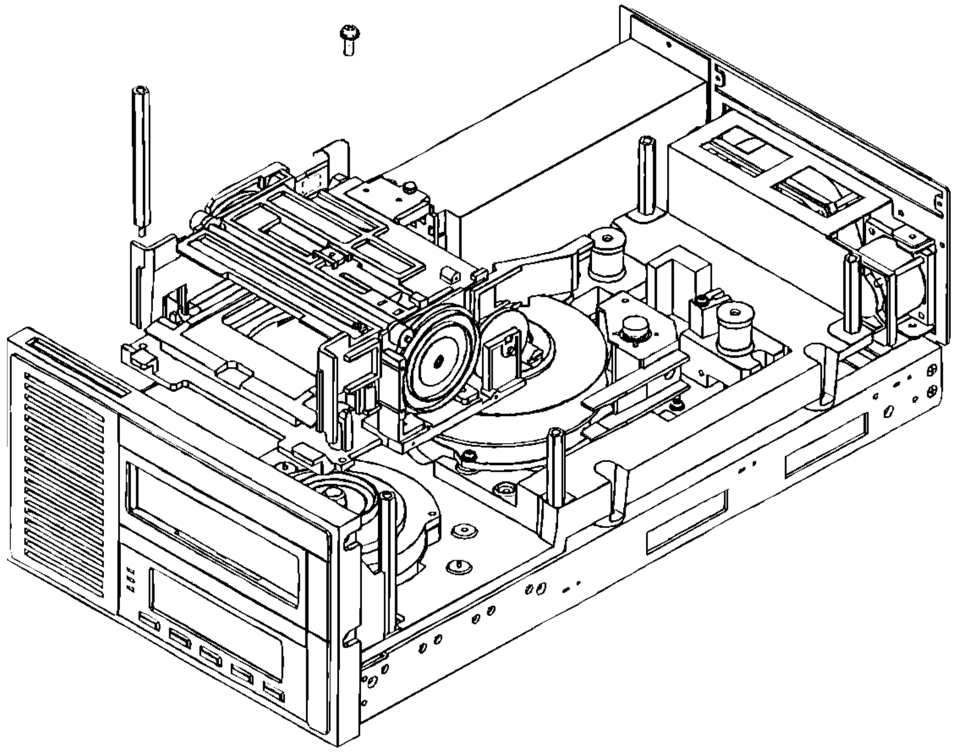


Figure 8-10. Loader Assembly

8-11.9 OP PCA Remove and Replace Procedures

Refer to Figure 8-11 for location of the OP PCBA.

8-11.9.1 OP PCA Removal

STEP	ACTION
1	Remove the four screws from the sides of the front panel.
2	Pull front panel forward and disconnect connector CNJ41.
3	Remove two screws from front panel.
4	Remove retaining plate and screw plate.
5	Remove two screws securing the OP PCA and remove the OP.
6	Remove the five switch buttons from the OP PCA.

8-11.9.2 OP PCA Replacement

STEP	ACTION
1	Insert the five switch buttons into the OP PCA.
2	Secure the OP PCA to the front panel with two screws.
3	Insert screw plate and retaining plate.
4	Insert two screws into bottom of front panel.
5	Connect CNJ41. Push front panel onto drive.
6	Insert four side screws to secure front panel to drive.

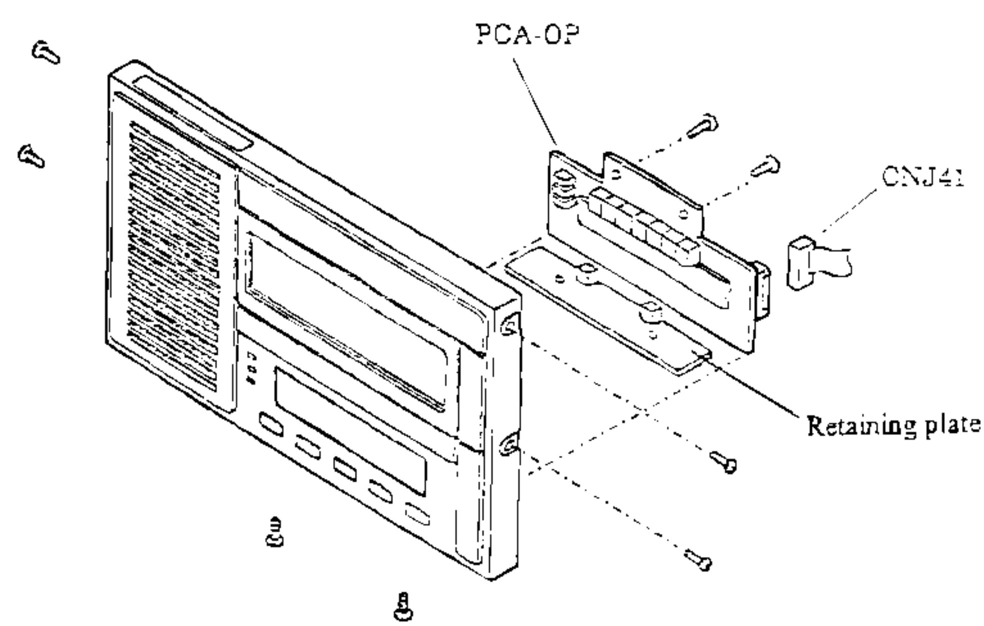


Figure 8-11. OP PCBA

8-11.10 Power Supply (PSU) Remove and Replace Procedures.

Refer to Figure 8-12 for location of the PSU.

8-11.10.1 Power Supply Removal

STEP	ACTION
1	Perform the DTC PCBA removal procedure in paragraph 8-11.6.1 on page 8-48.
2	Remove the three screws securing the power supply.
3	Disconnect connectors CNP91, CNP92, CNP93, and CNP94.
4	Lift out power supply to remove.

8-11.10.2 Power Supply Replacement

STEP	ACTION
1	Insert power supply into the tape drive.
2	Use the three screws to secure power supply.
3	Connect connectors CNP91, CNP92, CNP93, and CNP94.
4	Perform the DTC PCBA replacement procedure in paragraph 8-11.6.2 on page 8-48.

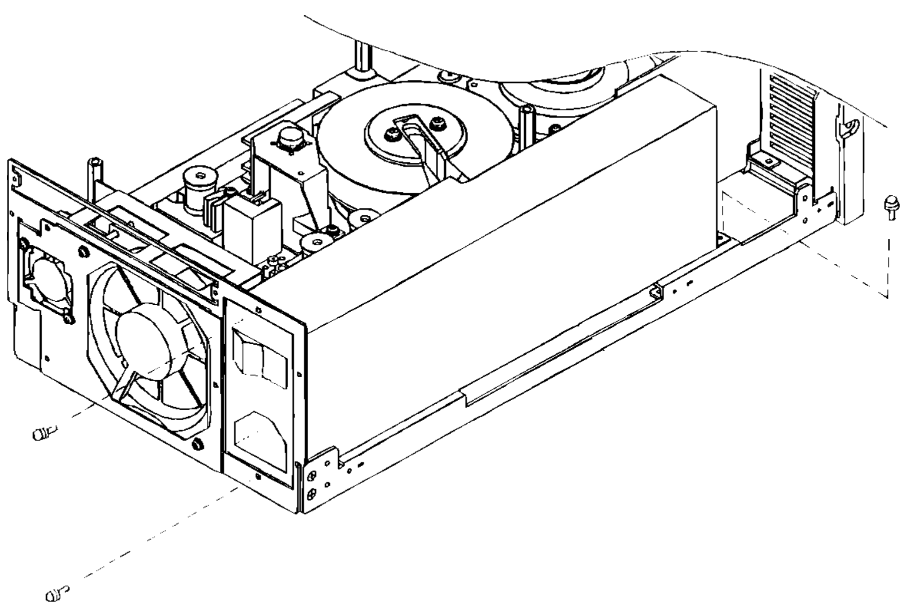


Figure 8-12. PSU

8-11.11 SVL PCBA Remove and Replace Procedures

8-11.11.1 SVL PCBA Removal

STEP	ACTION
1	Perform the top cover removal procedure in paragraph 8-11.4.1 on page 8-46.
2	Perform the bottom cover removal procedure in paragraph 8-11.5.1 on page 8-47.
3	Remove the four screws securing the SVL.
4	Lift up the SVL and disconnect connectors CNP50, CNP52, CNP53, CNP54, and CNP55.
5	Remove the SVL PCBA.

8-11.11.2 SVL PCBA Replacement

STEP	ACTION
1	Insert the SVL PCBA into the bottom of the drive.
2	Align connectors CNP50, CNP52, CNP53, CNP54, and CNP55, then gently press on each connector to mate.
3	Align screws holes, then insert four screws and tighten.
4	Perform the bottom cover replacement procedure in paragraph 8-11.5.2 on page 8-47.
5	Perform the top cover replacement procedure in paragraph 8-11.4.2 on page 8-46.

8-11.12 RDL PCBA Remove and Replace Procedures

8-11.12.1 RDL PCBA Removal

STEP	ACTION
1	Perform the top cover removal procedure in paragraph 8-11.4.1 on page 8-46.
2	Perform the bottom cover removal procedure in paragraph 8-11.5.1 on page 8-47.
3	Remove the four screws securing the RDL.
4	Lift up the RDL and disconnect connectors CNP12, CNP13, CNP14, CNP15, and CNP16.
5	Remove the RDL PCBA.

8-11.12.2 RDL PCBA Replacement

STEP	ACTION
1	Insert the RDL PCBA into the bottom of the drive.
2	Align connectors CNP12, CNP13, CNP14, CNP15, and CNP16, then gently press on each connector to mate.
3	Align screws holes, then insert four screws and tighten.
4	Perform the bottom cover replacement procedure in paragraph 8-11.5.2 on page 8-47.
5	Perform the top cover replacement procedure in paragraph 8-11.4.2 on page 8-46.

8-11.13 WTL PCBA Remove and Replace Procedures

Refer to Figure 8-13 for location of the WTL PCBA.

8-11.13.1 WTL PCBA Removal

STEP	ACTION
1	Perform the RDL PCBA removal procedure in paragraph 8-11.12.1 on page 8-54.
2	Remove the three screws securing the WTL.
3	Disconnect connectors CNJ30 and CNJ31.
4	Remove the WTL PCBA.

8-11.13.2 WTL PCBA Replacement

STEP	ACTION
1	Insert the WTL PCBA into the bottom of the drive.
2	Connect connectors CNJ30 and CNJ31.
3	Align screws holes, then insert three screws and tighten.
4	Perform the RDL PCBA replacement procedure in paragraph 8-11.12.2 on page 8-54.

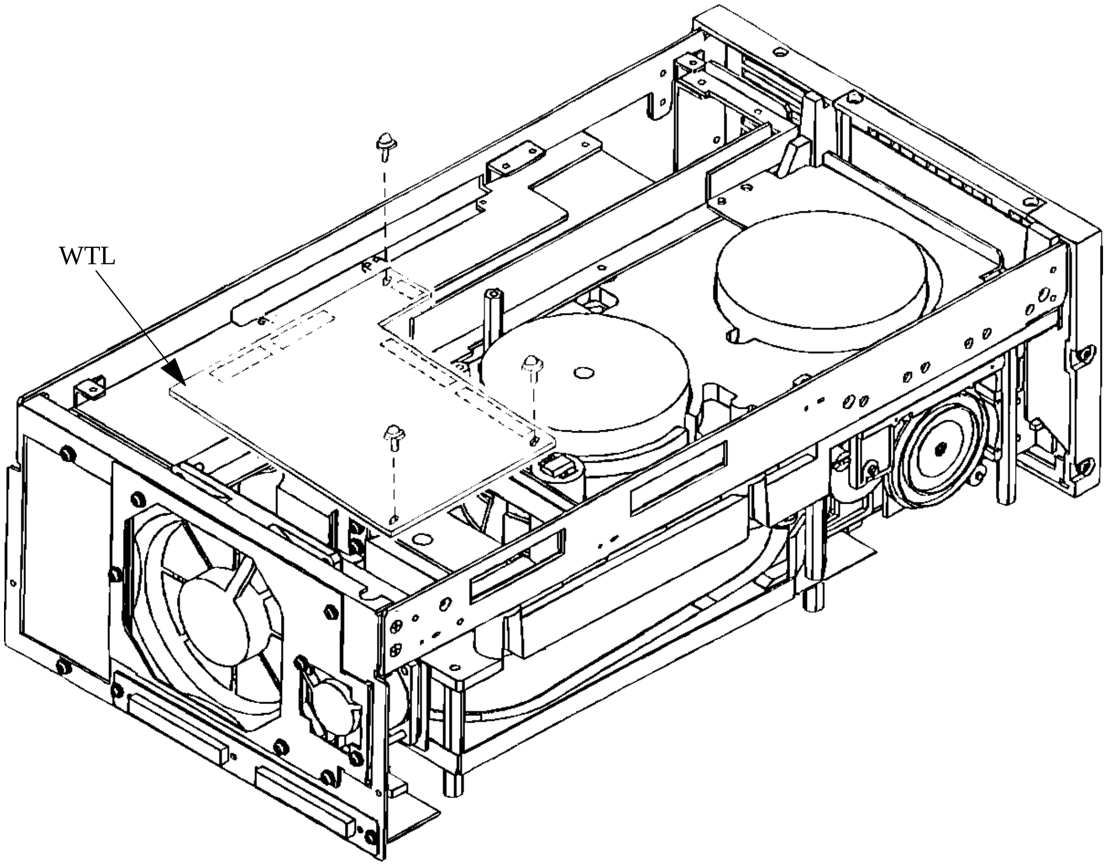


Figure 8-13. WTL PCBA

FRU

CHAPTER 9

PARTS REPLACEMENT CATALOG

9-1 INTRODUCTION

This chapter provides parts information on the M2488 Cartridge Tape Drive field replaceable units as described in the following paragraphs:

9-2 FIELD REPLACEABLE UNITS

9-2 FIELD REPLACEABLE UNITS

Table 9-1 describes the Field Replaceable Units (FRUs) for the M2488 Cartridge Tape Drive. For location of the FRUs, refer to the drawing figure(s) and index listed in the table.

Table 9-1. Field Replaceable Units

FIGURE & INDEX	NAME	PART NUMBER	DESCRIPTION
9-1, 5	Air Filter	B90L-1155-0021A	Air Filter
9-2, 4	Fan Assembly	CA01311-D016	Fan Assembly
Not Shown	AC Fuse		120 ACV, 15 Watts
9-1, 2 9-4	PCA - IPM	CA20312-B45X CA20312-B46X CA20312-B47X CA20312-B48X	Fast/Wide Single-ended SCSI Fast/Wide Differential SCSI Narrow Single-ended SCSI Narrow Differential SCSI
9-1, 4	Loader Assembly	CA01311-F200	Loader Assembly
9-1, 1 9-3	PCBA - DTC	CA20312-B44X	Controller Printed Circuit Board Assembly
9-2, 3	PCBA - OP	B17B-1540-0140A	Control Panel Printed Circuit Board Assembly
9-2, 2 9-6	PCBA -SVL	CA20116-B81X	Servo Printed Circuit Board Assembly
9-2, 1 9-5	PCBA - RDL	CA20116-B79X	Read Circuit Printed Circuit Board Assembly
9-2, 5 9-7	PCBA -WTL	CA20116-B82X	Write Circuit Printed Circuit Board Assembly
9-1, 6	Power Supply Unit	CA01311-D901	Power Supply
9-1, 3	Threader Assembly	CA01311-F300	Threader Assembly

FRU

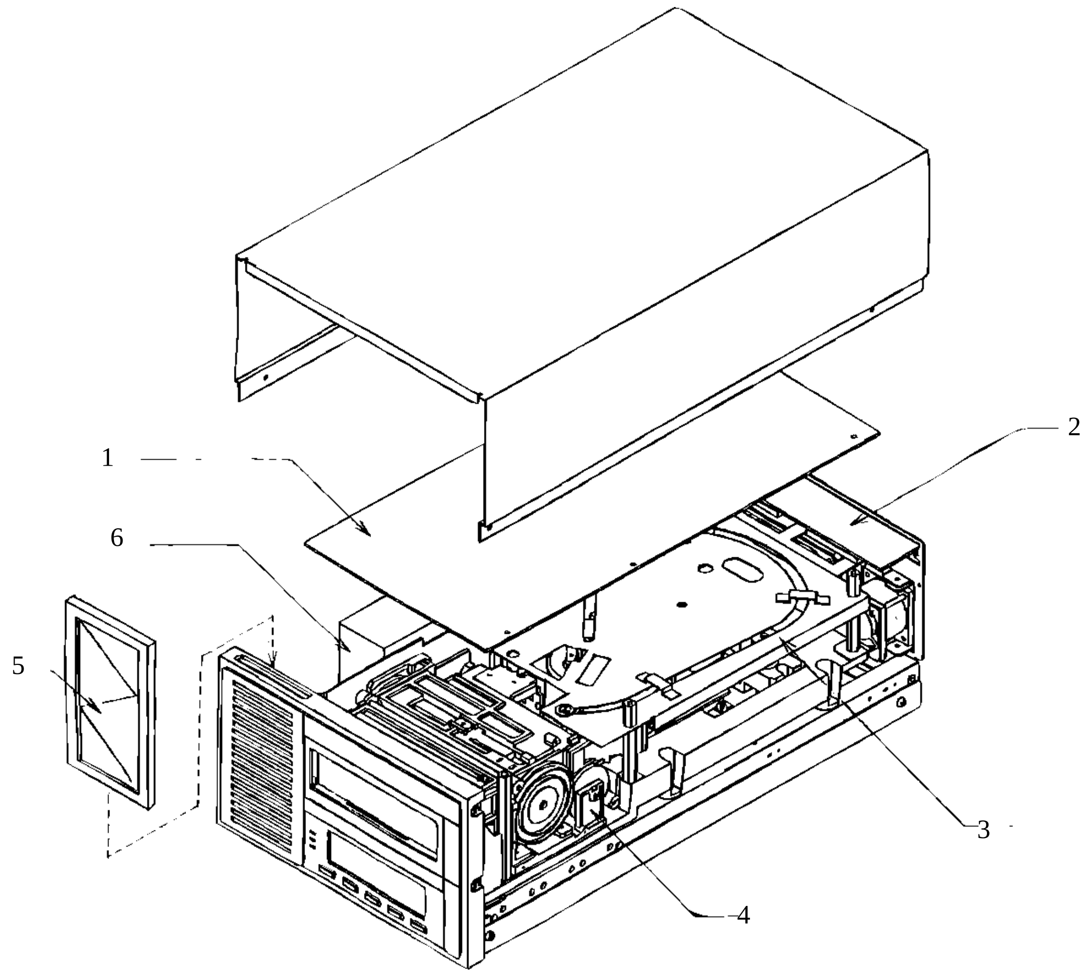


Figure 9-1. M2488 Tape Drive FRUs (Top Side)

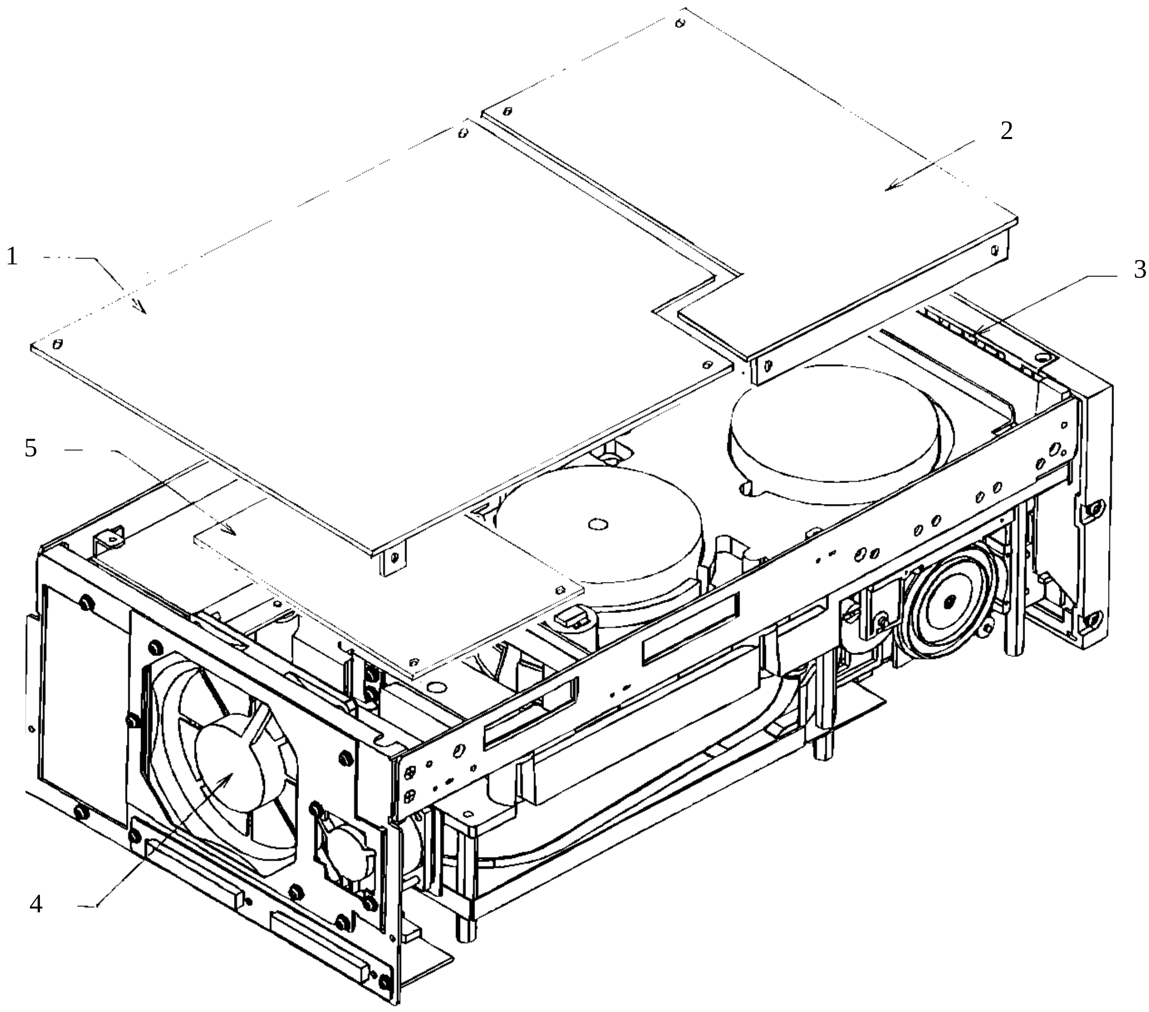


Figure 9-2. M2488 Tape Drive FRUs (Bottom Side)

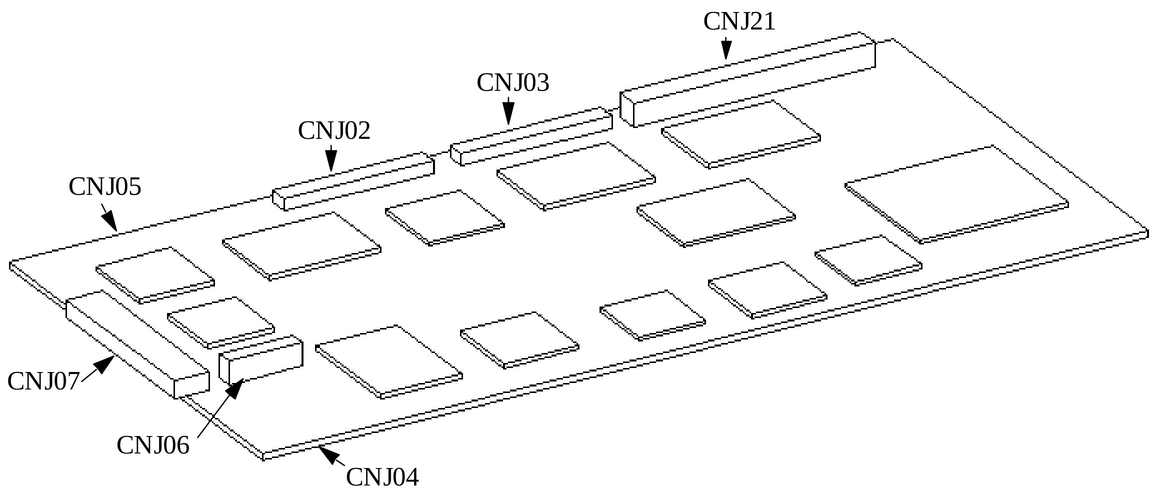


Figure 9-3. DTC PCBA

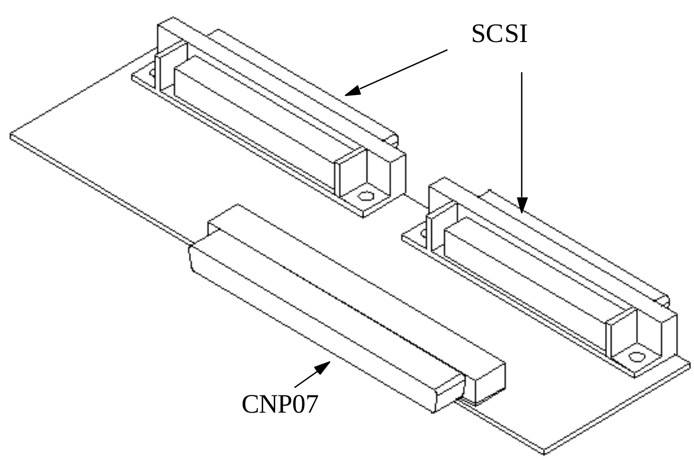


Figure 9-4. IPM PCBA

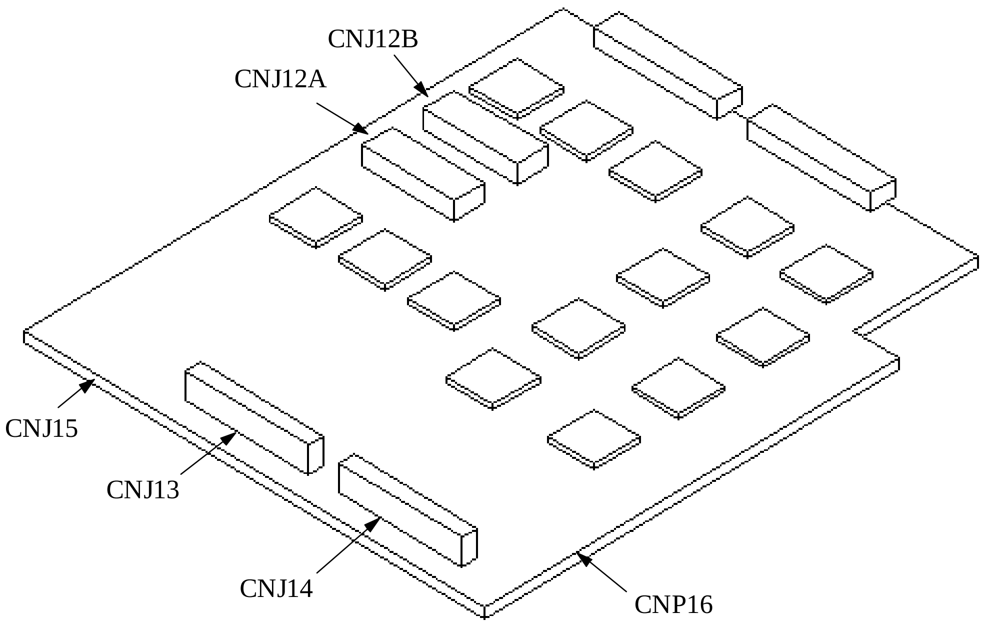


Figure 9-5. RDL PCBA

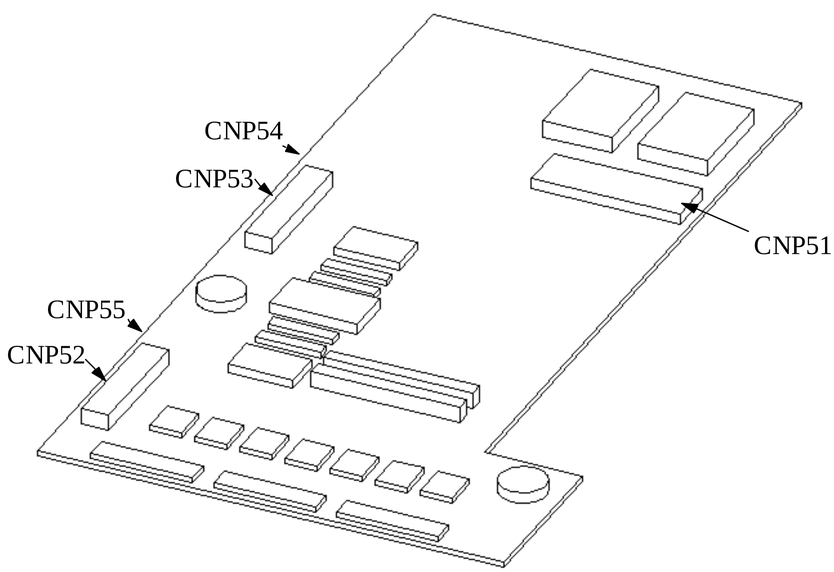


Figure 9-6. SVL PCBA

FRU

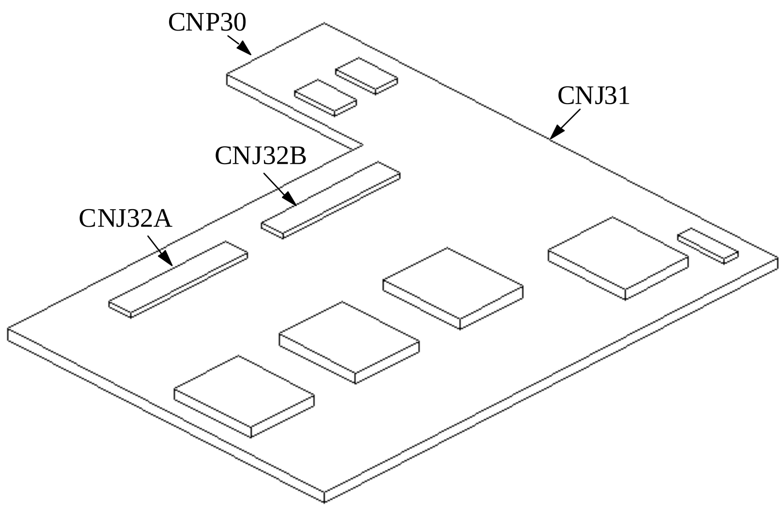


Figure 9-7. WTL PCBA

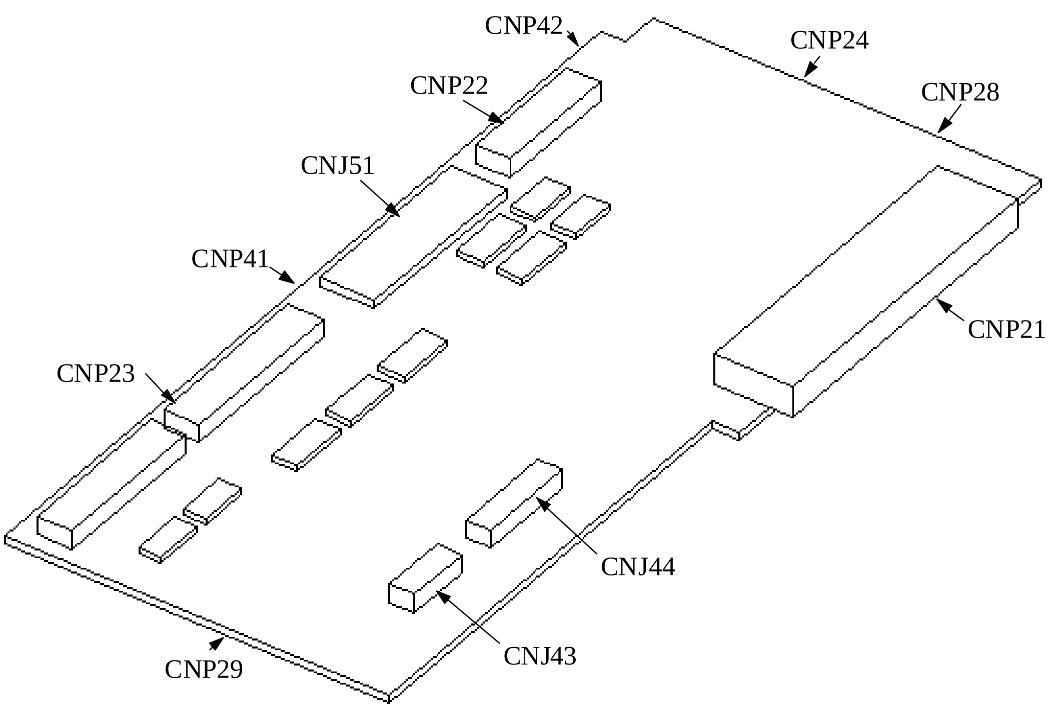


Figure 9-8. DVL PCBA (Reference Only)

APPENDIX A

SENSE KEYS

The Sense Keys are described in Table A-1. These are the sense keys returned in byte 2, bits 0-3 of the error code sense formats described in paragraph 8-3.1 on page 8-4.

Table A-1. Sense Key Descriptions

SENSE KEY	DESCRIPTION
0h	NO SENSE. Indicates there is no specific sense key information to be reported for the designated logical unit. This sense key indicates a successful command or a command that received a CHECK CONDITION status because a filemark, EOM, or ILI bits is set.
1h	RECOVERED ERROR. Indicates the last command completed successfully with some recovery action performed by the target. Details are obtained by examining the additional sense bytes and the information bytes.
2h	NOT READY. Indicates the logical unit addressed cannot be accessed. Operator intervention may be required to correct this condition.
3h	MEDIUM ERROR. Indicates the command terminated with a nonrecoverable error condition that was probably caused by a flaw in the medium or an error in the recorded data. This sense key may also be returned if the target is unable to distinguish between a flaw in the medium and a specific hardware failure.
4h	HARDWARE ERROR. Indicates the target detected a nonrecoverable hardware failure (for example, controller failure, device failure, parity error, etc.) while performing the command or during a self test.
5h	ILLEGAL REQUEST. Indicates there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands (FORMAT UNIT, SEARCH DATA, etc.). If the target detects an invalid parameter in the command descriptor block, the target terminates the command without altering the medium.
6h	UNIT ATTENTION. Indicates the removable medium may have been changed or the target has been reset.
7h	DATA PROTECT. Indicates a command that writes the medium was attempted on a device that is protected from this operation. The write operation is not performed.
8h	BLANK CHECK. Indicates the device encountered blank medium indication while reading.
Ah	COPY ABORTED. Indicates a COPY command was aborted due to an error condition on the source device, the destination device, or both.
Bh	ABORTED COMMAND. Indicates the target aborted the command. The initiator may be able to recover by trying the command again.
Dh	VOLUME OVERFLOW. Indicates EOM was reached and data remains in the buffer that has not been written to the medium. A RECOVER BUFFERED DATA command(s) may be issued to read the unwritten data from the buffer.

APPENDIX B

ASC/ASCQ

The Additional Sense Code (ASC) and the Additional Sense Code Qualifier (ASCQ) are described in Table B-1 by Sense Key and in Table B-3 by ASC/ASCQ. These are the ASC and ASCQs returned in bytes 12 and 13 of the error code sense formats described in paragraph 8-3.1 on page 8-4. The sense keys, which are mapped to the ASC/ASCQs, are described in Appendix A. The Advised Action column indicates action codes which are described in Table B-2.

Table B-1. ASC and ASCQ Description (by Sense Key)

SENSE KEY	ASC/ASCQ		DESCRIPTION	ADVISED ACTION
0	00	00	No additional sense available	7
	00	01	Filemark detected	7
	00	02	End-of-Medium detected	7
	00	04	Beginning-of-Medium detected	7
	A0	xx	Internal Software Error: Unsupported ERPA code xx encountered by error processing software. Report ERPA code to Product Support Engineer.	9
1	00	17	Clean Requested. NOTE: This ASC/ASCQ can only be generated when feature mode FT5, bit 5 (0x20) is set to one as described in the configuration settings in the M2488 User's Guide.	3
	0C	00	Recovered write error	3
	17	01	Recovered read data with retries	3
	44	00	Recovered internal hardware error	3
	5B	02	Log counter at maximum	6,3
	A0	xx	Internal Software Error: Unsupported ERPA code xx encountered by error processing software. Report ERPA code to Product Support Engineer.	9
2	04	00	Logical unit not ready, cause not reportable	5,4
	04	01	Not ready, in process of becoming ready. NOTE: This ASC/ASCQ can only be generated when feature mode FT4, bit 5 (0x20) is set to one as described in the configuration settings in the M2488 User's Guide.	4
	04	03	Load assistance required	5
	3A	00	Not ready, medium not present. NOTE: This ASC/ASCQ can only be generated when feature mode FT5, bit 4 (0x10) is set to one as described in the configuration settings in the M2488 User's Guide.	5
	53	00	Unload failure	5
	53	01	Unload failure	5
3	00	00	No additional information	7
	00	02	End-of-Medium detected	1
	04	00	Manual unload and buffered write data exists	5,2
	04	03	Load assistance required and buffered write data exists	5,2
	0C	00	Write error	2
	11	00	Unrecovered read error	2
	14	04	Block sequence error	2
	30	00	Incompatible medium installed - attempting 36-track writes over 18-track data away from BOT	1
	30	02	Incompatible format	1
	33	00	Tape length error	1
	53	00	Load failure occurred and buffered write data exists	5,2
	53	01	Manual unload failure occurred and buffered write data exists	5,2

Table B-1. ASC and ASCQ Description (by Sense Key) (Continued)

SENSE KEY	ASC/ASCQ		DESCRIPTION	ADVISED ACTION
4	44	00	Hardware error	1
5	1A	00	Parameter list length error	1
	20	00	Invalid command operation code	1
	21	01	Invalid medium changer element address	1
	24	00	Invalid field in CDB	1
	25	00	Logical unit not supported	1
	26	00	Invalid field in parameter list	1
	30	02	Incompatible format	8
	3B	0D	Destination medium changer element full	1
	3B	0E	No cartridge or magazine at specified medium changer source element position	1
	3B	8F	First destination medium changer element empty	1
	3B	90	Second destination medium changer element full	1
	3B	91	Second destination medium changer element empty	1
	3B	92	Medium changer transport element full	1
	3B	93	Medium changer element is not accessible	1
	3B	94	Drive is full, operation cannot be performed	1
	3D	00	Invalid bits in IDENTIFY message	1
6	28	00	Not ready to ready transition (Priority 2)	7
	29	00	Power on, reset, or BUS DEVICE RESET occurred (Priority 1)	7
	2A	01	Mode parameters changed (Priority 5)	7
	33	00	Tape length error (Priority 3)	7
	3F	01	Microcode has been changed (Priority 4)	7
7	27	00	Write protected	5,4
8	00	05	Tape void	1
	30	01	Cannot read medium - unknown format	1
B	43	00	Message reject error	1
	44	00	Internal target failure	4
	45	00	No initiator response to reselection	1
	47	00	SCSI parity error	1
	48	00	Active SCSI command aborted due to an Initiator detected error message being received	1
	49	00	Invalid message error	1
	4B	00	SPC transfer offset error or transfer period error	4
	4E	00	Overlapped commands attempted	1
D	00	02	End-of-Medium detected	1

Table B-2. Action Advised Codes

ADVISED ACTION CODE	DESCRIPTION
1	Treat the error as a permanent error.
2	Execute Dynamic Device Reconfiguration (DDR).
3	Continue processing.

Table B-2. Action Advised Codes (Continued)

ADVISED ACTION CODE	DESCRIPTION
4	Reissue the same command.
5	Request manual assistance.
6	Issue log sense commands to read counter pages. Refer to Chapter 4 for information on the log sense commands.
7	The Host operating system must analyze the condition to see if it is acceptable for the processing currently being performed. If acceptable, additional action is required prior to continuing processing, e.g.; cause a new tape to be mounted for multi-volume operation.
8	In the event of a READ REVERSE command, issue a READ command to read forward, then issue a SPACE command to space back one block. Otherwise treat as a permanent error.
9	Report all 44 bytes of SCSI sense data to the Product Support Engineer.

Table B-3. ASC and ASCQ Description (by ASC/ASCQ)

ASC/ASCQ		SENSE KEY	DESCRIPTION
00	00	0	No additional sense available
		3	No additional information
00	01	0	Filemark detected
00	17	1	Clean Requested. NOTE: This ASC/ASCQ can only be generated when feature mode FT5, bit 5 (0x20) is set to one as described in the configuration settings in the M2488 User's Guide.
00	02	0	End-of-Medium detected
		3	End-of-Medium detected
		D	End-of-Medium detected
00	04	0	Beginning-of-Medium detected
00	05	8	Tape void
04	00	2	Logical unit not ready, cause not reportable
		3	Manual unload and buffered write data exists
04	01	2	Not ready, in process of becoming ready. NOTE: This ASC/ASCQ can only be generated when feature mode FT4, bit 5 (0x20) is set to one as described in the configuration settings in the M2488 User's Guide.
04	03	2	Load assistance required
		3	Load assistance required and buffered write data exists
0C	00	1	Recovered write error
		3	Write error
11	00	3	Unrecovered read error
14	04	3	Block sequence error
17	01	1	Recovered read data with retries
1A	00	5	Parameter list length error
20	00	5	Invalid command operation code
21	01	5	Invalid medium changer element address
24	00	5	Invalid field in CDB
25	00	5	Logical unit not supported
26	00	5	Invalid field in parameter list
27	00	7	Write protected

Table B-3. ASC and ASCQ Description (by ASC/ASCQ) (Continued)

ASC/ASCQ		SENSE KEY	DESCRIPTION
28	00	6	Not ready to ready transition (Priority 2)
29	00	6	Power on, reset, or BUS DEVICE RESET occurred (Priority 1)
2A	01	6	Mode parameters changed (Priority 5)
30	00	3	Incompatible medium installed - attempting 36-track writes over 18-track data away from BOT
30	01	8	Cannot read medium - unknown format
30	02	3	Incompatible format
		5	Incompatible format
33	00	3	Tape length error
		6	Tape length error (Priority 3)
3A	00	2	Not ready, medium not present. NOTE: This ASC/ASCQ can only be generated when feature mode FT5, bit 4 (0x10) is set to one as described in the configuration settings in the M2488 User's Guide.
3B	0D	5	Destination medium changer element full
3B	0E	5	No cartridge or magazine at specified medium changer source element position
3B	8F	5	First destination medium changer element empty
3B	90	5	Second destination medium changer element full
3B	91	5	Second destination medium changer element empty
3B	92	5	Medium changer transport element full
3B	93	5	Medium changer element is not accessible
3B	94	5	Drive is full, operation cannot be performed
3D	00	5	Invalid bits in IDENTIFY message
3F	01	6	Microcode has been changed (Priority 4)
43	00	B	Message reject error
44	00	1	Recovered internal hardware error
		4	Hardware error
		B	Internal target failure
45	00	B	No initiator response to reselection
47	00	B	SCSI parity error
48	00	B	Active SCSI command aborted due to an Initiator detected error message being received
49	00	B	Invalid message error
4B	00	B	SPC transfer offset error or transfer period error
4E	00	B	Overlapped commands attempted
53	00	2	Unload failure
		3	Load failure occurred and buffered write data exists
53	01	2	Unload failure
		3	Manual unload failure occurred and buffered write data exists
5B	02	1	Log counter at maximum
A0	xx	0	Internal Software Error: Unsupported ERPA code xx encountered by error processing software. Report ERPA code to Product Support Engineer.
	xx	1	Internal Software Error: Unsupported ERPA code xx encountered by error processing software. Report ERPA code to Product Support Engineer.

APPENDIX C

ERPA CODES

The ERPA codes are described in Table C-1. These are the ERPA codes returned in byte 19 of the error code sense formats or described in paragraph 8-3.1 on page 8-4.

Table C-1. ERPA Codes

ERPA CODE	DESCRIPTION	ERROR
22	Path Equipment Check	Drive adapter error occurred. Could not recover from a buffer error on the lower interface. Could not recover from an error detected during a cartridge index/load cycle on the Automatic Cartridge Loader. The cartridge is manually retrievable by the operator.
23	Read Data Check	A permanent read error has occurred.
24	Display Check	A Display command was received while a drive check message is displayed.
25	Write Data Check	Buffered data could not be written on the tape successfully. ERP has tried to erase gaps and rewrites but could not complete the write operation. A permanent error occurred when trying to write data, an IBG or a tape mark on the tape. All attempts to retry the operation have been completed, but unsuccessfully.
26	Attempt to read backward an EDRC packet	Host recovery should perform a read forward followed by a backspace block command.
27	Command Reject	An undefined command op code has been issued. Control information is improper.
28	Write ID Mark Check	The ID mark could not be written successfully at the BOT. Any data to be written to the drive is still in the buffer.
2A	Buffered Log Data Present	The statistical counters have overflowed and a Request log command should be issued
2C	Permanent Equipment Check	Either the control unit cannot recover because an error occurred in the subsystem hardware or microprogram, or the control unit recovery action was unsuccessful.
2D	Data Security Erase Command Failure	The drive became not ready after the command was issued, or an error occurred while the command was processing.
2E	Not Capable (BOT error)	Either a density mark could not be read correctly or the Block ID read by the control unit is invalid (Bit 0 or bits 8-11 are not zero). If a density mark could not be read correctly, likely causes are: 1. a void occurred at BOT, or 2. a timeout occurred before the density separator was detected.
30	File Protected	A write type operation was attempted on a tape cartridge that is file protected.
31	Tape Void	No patterns or data were found on the tape during a read operation. The tape could be positioned after the last data block or tape mark that was written on the tape.
32	Load Assistance	An error caused the drive to lose tape tension.
33	Load/Unload Failure	The cartridge is not inserted or threaded correctly.
34	Manual Unloaded	The drive cannot maintain tape tension and control tape movement during an unload operation.

ERPA CODES

Table C-1. ERPA Codes (Continued)

ERPA CODE	DESCRIPTION	ERROR
35	Drive Equipment Check	One of the following has occurred: 1. The control unit cannot recover from a drive-detected error. 2. A check code message is displayed on the drive message display. 3. The automatic cartridge loader does not respond across the interconnection to the tape drive. 4. A failure occurred during an index/load or unload cycle. The tape cartridge is not manually retrievable by the operator.
36	End-of-Data Detected on Read	An End-of-Data (EOD) mark was detected on the tape during a read operation.
37	Tape Length Error	The tape length in the cartridge is too short. The error could occur when the leader block is replaced (the length of tape ahead of the BOT has been trimmed).
38	Physical End of Tape	A read or write operation was in process when the physical end-of-tape was reached. The drive does not pull the tape out of the cartridge.
39	Backward at BOT	While the tape was moving backwards, the beginning of tape was reached.
3B	Volume Removed by Operator	The Rewind Unload switch on the drive has been activated and the cartridge is unloaded.
41	Block ID Sequence Error	The control unit detected an incorrect Block ID sequence.
43	Intervention Required	A CDB was issued to a drive that is not ready.
44	Locate Block Unsuccessful	The control unit cannot find the block preceding the desired block.
47	Control Unit Error	The SCSI error processing microcode received an unrecognized ERPA code. Processing continues.
49	Bus Out Parity	The bus out parity error was detected on the command or parameter transfer.
4A	Control Unit ERP Failed	The control unit could not recover from a data handling failure.
4C	Recovered Hardware Error	The control unit recovered from a hardware error.
5B	Tape Extension Error	An attempt was made to write 36-Track format data on 18-Track formatted medium.
5C	Medium Changer Command	A Medium Changer command was given to a device that does not have the Medium Changer feature.
5D	Tape Length Error	The tape length in the cartridge is too long.
5E	Compaction Algorithm Incompatible	An attempt was made to read an unsupported data compaction algorithm.
6F	No Cartridge	No cartridge at selected location; or selected location not within the magazine size; or no magazine was present when an attempt was made to load a cartridge from the magazine.
77	Reel Diameter Greater than ECCST	Reel Diameter Greater than ECCST

FSC

APPENDIX D

FAULT SYMPTOM CODES

The Fault Symptom Codes (FSCs) are described in Table D-1 and Table D-2. Refer to Table 8-14 on page 8-15 for the FSCs listed in Table D-1. The FSCs listed in Table D-2 are the FSCs returned in bytes 22-27 of the Format 01h Sense Information described in paragraph 8-3.2 on page 8-9.

Table D-1. Error Recovery

F.S.C #	DESCRIPTION
3C80	Diagnostic Test Failure
3CA0	SCSI DMA XFER poll timeout
3CA1	SPC DMA data send (e.g. Read) parity error reported to SCSI manager
3CA2	SPC DMA data receive (e.g. Write) parity error reported to SCSI manager
3CA3	SPC manager reported to SCSI manager that an initiator detected error message was received on DMA transfer
3CA4	SPC manager reported to SCSI manager that a data xfer error occurred during DMA data transfer
3CA5	SPC manager reported to SCSI manager that a REQ/ACK timeout occurred during DMA data transfer
3CA6	SPC manager reported to SCSI manager that an SPC command timed-out during DMA data transfer
3CAE	SPC manager reported to SCSI manager that an unknown SPC error occurred during DMA data transfer
3CAF	SCSI manager encountered an unknown error occurred during DMA data transfer
3CB0	Write buffer copy to flash failed
3CB1	NVRAM read failure
3CB2	NVRAM write failure
3CB3	NVRAM allocate failure
3CB4	RM and SPC residual mismatch on read long
3CC0	Sense built after retries done for IDE message
3CC1	Initiator’s message reject message didn’t make sense
3CC2	Initiator’s message didn’t make sense
3CC3	Overlapped commands were attempted
3CC4	REQ/ACK timed-out in MSGIN, retries failed
3CC5	Parity error in MSGOUT, retries failed
3CC6	REQ/ACK timed-out in MSGOUT, retries failed
3CC7	REQ/ACK timed-out in CMD, retries failed
3CC8	Parity error in CMD phase, retries failed
3CC9	Parity error in DATA phase, retries failed

FSC

Table D-1. Error Recovery (Continued)

F.S.C #	DESCRIPTION
3CCA	REQ/ACK error in DATA phase, retries failed
3CCB	REQ/ACK timed-out in DATA, retries failed
3CE0	Buffer error reported
3CE1	Compression error reported
3CE2	ADT timeout
3CE3	Packet Processor error
3CE4	Packet expanded greater than maximum
3CE5	Bid not found in packet group
3CE6	Unable to read packet header
3CE7	Unable to read block forward
3CE8	Unable to rewrite packet header
3CF0	ADT error
3CF1	Buffer detected error
3CF2	Compression error

Table D-2. Formatter Error Recovery

F.S.C. #	DESCRIPTION	E.R.P.A.	BYTES 29-39 GROUP
8004	Unknown cause write trap	47	03
8170	Byte count not zero	47	03
83xx	Write FMT error reg (WER not zero), xx bit 0 - Don’t care bit 1 - Customer data CRC error bit 2 - CRC write error bit 3 - DRC write error bit 4 - VRC write error bit 5 - Write formatter path error bit 6 - Write trigger VRC error bit 7 - Don’t care	22	03
8400	Can’t reset RBE	25	01
8420	Can’t detect RDEND	25	01
8440	Can’t reset WER register	25	03
8600	Can’t reset RDE, CRS or WES register	25	01
8700	PHOK time-out after DBOB (WRITE)	25	04

Table D-2. Formatter Error Recovery (Continued)

F.S.C. #	DESCRIPTION	E.R.P.A.	BYTES 29-39 GROUP
8710	PHOK not reset after RDEND	25	04
8720	Invalid TM, WRAP or ERS RSVP reports unexpected mark	25	04
8730	ERASE error recovery failure	25	04
8780	PHOK time-out after DBOB	23	01
8810	Block not found (error block)	44	08
8820	Backward search Retry Count expired	44	08
8830	Forward search Retry Count expired	44	08
8841	Wrap signal lost on Read	23	04
8842	No continuous found on Read wrap	23	04
8843	Not enough total wrap mark detected on Read	23	04
8900	Can’t reset timer carry signal	25	03
8910	Can’t reset WBEND	25	03
8920	Can’t reset WCNE	25	03
8940	WBEND not on before prescribed time at WIDS	25	03
8950	WBEND time-out	25	03
8A30	Back into BOT	39	08
8A40	Invalid command	2E	08
8E00	End of Data Mark	36	04
8E2F	Slow or no GAP OUT acknowledge	47	03
8E30	GAP OUT up before setting	47	03
8E31	GAP OUT did not reset	47	03
8E80	Locate Parm error	44	08
9000	Slow begin	25	04
9001	Slow end before DPOST (WRITE)	25	04
9002	Slow end before IBG	25	04
9004	Can’t detect DBOB at IDS write	25	04
9005	Can’t detect DIBG at IDS write	25	04
9006	4 Meter Tones - Erase Gap tone dropout	23/25	04
9007	4 Meter Tones - IBG tone dropout	23/25	04
9008	4 Meter Tones - Tape Mark tone dropout	23/25	04

FSC

FSC

Table D-2. Formatter Error Recovery (Continued)

F.S.C. #	DESCRIPTION	E.R.P.A.	BYTES 29-39 GROUP
9009	4 Meter Tones - 18 Track DID tone dropout	23/25	04
900A	4 Meter Tones - Too many total tone dropouts	23/25	04
900B	4 Meter Tones - Too many continuous tone dropouts	23/25	04
900C	4 Meter Tones - Continuous ERG tone not met	23/25	04
900D	4 Meter Tones - Continuous IBG tone not met	23/25	04
900E	4 Meter Tones - Continuous TM tone not met	23/25	04
900F	4 Meter Tones - Continuous 18 Track DID tone not met	23/25	04
9010	4 Meter Tones - Total not met on Wrap Mark	23/25	04
9011	4 Meter Tones - Continues not met on Wrap Mark	23/25	04
9012	4 Meter Tones - Continues not met on 36 Track DID	23/25	04
9013	4 Meter Tones - Total not met on 36 Track DID	23/25	04
9061	Too many total drops on Read DID	23	01
9062	Continuous not met on Read DID	23	01
9063	Continuous not met on Read TM	23	01
9064	DID too long on Read	23	01
9180	Hardware error on readback at end of IBG	25	04
9181	DBOB off between HBOB and DPRE	25	04
9182	DPRE time-out after PHOK on	25	04
9183	DBOB off before DPOST is detected	25	04
9184	RDEND on before DPOST is detected	25	04
9185	RDEND time-out after DPOST is detected	25	04
9188	Long IBG detected	25	04
918A	RECA dropped at DID write	28	04
918B	Can’t set RECA at DID write	28	04
918C	Dropout detected at IDS write	28	04
918D	Dropout detected at IBG after IDS write	25	04
918E	Misposition by servo, started too late into IBG	23	04
918F	Misposition by servo, started over previous block or mark	23	04
9190	Can’t detect regular DTM length	25	04
9191	Can’t detect regular length IBG after DTM	25	04

Table D-2. Formatter Error Recovery (Continued)

F.S.C. #	DESCRIPTION	E.R.P.A.	BYTES 29-39 GROUP
9192	Drop-out length over after DTM and IBG	25	04
9194	Can't detect regular DERS length	25	04
9196	BOB or DTM length over after DERS and IBG ???	25	04
9198	DBOB off after BOB detected	25	04
919A	Abnormal TM format (No continuous)	25	04
919B	Abnormal ERS format	25	04
91B0	Can't detect regular WRAP length	25	04
91BA	Write Wrap Marks failed	25	04
92xx	Detect SRCK after DPRE : xx = Bit 0 - Uncorrectable error Bit 1 - Multiple track error Bit 2 - Skew error Bit 3 - Drop out error Bit 4 - CRC error Bit 5 - Postamble error Bit 6 - Start read check Bit 7 - End of data check (Bit 0 = MSB, Bit 7 = LSB)	25	01
9400	EFME and RSYE detected at RBE	25	01
9500	Can't start RSVP	47	04
9600	Can't detect (I-1) block at WR, WTM, and ERS	25	04
9610	Slow end after I-1 block	25	04
9620	BID Miscompare on write	25	07
9630	WRE and FWRE not equal at	25	01
9802	Tape Mark found on Space Block	C0	08
9803	File Protected Tape	30	01
9900	Out of data block sequence	23	07
9910	RDEND time-out after DPOST is detected	23	04
9921	Invalid WRAP Mark	25	04
9922	WRAP Mark detected on 18 track tape	2E	04
9930	Not capable	2E	04
9940	IBG not detected	25	01
9960	IBG not detected	41	01
9970	Data block not found	44	08

FSC

Table D-2. Formatter Error Recovery (Continued)

F.S.C. #	DESCRIPTION	E.R.P.A.	BYTES 29-39 GROUP
9Axx	RDE is not equal to 0 at RD operation in which xx = Bit 0 - Uncorrectable error Bit 1 - Multiple track error Bit 2 - Skew error Bit 3 - Drop out error Bit 4 - CRC error Bit 5 - Postamble error Bit 6 - Start read check Bit 7 - End of data check (Bit 0 = MSB, Bit 7 = LSB)	23	01
9C00	Detected RBE on READ	23	01
9D00	RSVP time-out waiting for block or mark	31	01
9D05	No IBG after good RDEND during readback	25	04
9D10	Time-out waiting for RSVP response	47	04
9D11	RSVP time-out during readback	25	04
9E00	DID detected while block read	23	04
9E10	BID Miscompare on read	41	07
BC1D	Invalid command sent to RSVP	47	03
E003	Read overflow detected in fdxs	47	03
E005	fdxs errors	47	03
E006	Formatter Packet Processor detected error at end of read transfer	23	02
E010	End of Transfer not detected	47	03
E100	Read sddp, fdxs err, crc, ovrn, par	47	03
ED00	Read clear block on 36trk edrc tape	23	02
ED02	Not a multiple of 32 bytes	2C	02

APPENDIX E

CHK XX ERROR CODES

E-1 CHK XX ERROR CODE DESCRIPTIONS

Table E-1 lists the error codes and a brief description of each one. Refer to Chapter 8 for a an explanation of this type of error message.

Table E-1. CHK xx Error Code Descriptions

CHK XX CODE	DESCRIPTION
00	MICRO PROCESSOR ERROR
01	RAM ERROR
02	REGISTER ERROR
03	TIMER ERROR
04	INTERRUPT ERROR (WRONG IRQ TO SERVO)
05	TOO MANY FTP INTERRUPTS
06	TOO FEW FTP INTERRUPTS
09	MACHINE REEL TACHOMETER PHASE ERROR
0A	MACHINE REEL ROTATION COUNTER OVERFLOW
0B	RRC COUNTER OVERFLOW
0C	GAP COUNTER PHASE ERROR
15	TOO SHORT LENGTH TAPE LOADED
17	BOT TIGHT UP ERROR
18	MACHINE REEL RUN AWAY IN LOADING
19	INVALID GAP OUT TIME
1B	WRITE VELOCITY CHECK
1C	OVER GAP IN POSITION
1D	GAP IN HARDWARE ERROR
1F	FILE OR MACHINE REEL TACHO METER ERROR
20	CARRIER MOVE UPWARD TIMEOUT ERROR
21	CARRIER MOVE DOWNWARD TIMEOUT ERROR
24	THREADER SENSORS COMBINATION ERROR
25	THREADER ARM IS NOT HOME WHEN LOADING STARTS
26	CARRIER POSITION SENSOR ALWAYS ON
28	CATCH ARM CLOSE TIMEOUT ERROR

Table E-1. CHK xx Error Code Descriptions (Continued)

CHK XX CODE	DESCRIPTION
29	CLEANING CARTRIDGE SENSOR FAILURE IN POWER UP
2A	CATCH ARM OPEN TIMEOUT ERROR
2B	CATCH ARM CLOSE RETRIES EXHAUSTED
2C	CATCH ARM OPEN RETRIES EXHAUSTED
2D	CATCH ARM OPEN AND CLOSE SENSOR BOTH ON
2F	UNDEFINED INTERNAL COMMAND
30	FEEDER MOVE FORWARD RETRIES EXHAUSTED
31	FEEDER MOVE BACKWARD RETRIES EXHAUSTED
32	CARTRIDGE POSITIONED ON CARRIER INCORRECTLY
33	MOTION COMMAND DURING SERVO OFF
34	TOO LONG LENGTH TAPE LOADED
36	CARRIER SENSORS: FRONT/REAR AND UNFEED ALL ON
37	OUT OF RANGE IN EOT LOCATION TABLE
38	CARRIER SENSORS: FRONT/UNFEED SENSORS BOTH ON
39	TOO LOOSE WRAP TAPE CTG IS LOADED OR ABNORMAL REEL CLUTCHING
3A	REAR CARRIER SENSOR ALWAYS ON
3B	UNFEED SENSOR ALWAYS ON
3D	WRITE TYPE COMMAND WITH FILEPROTECT
3E	FRONT CARRIER SENSOR ALWAYS ON
3F	UNFEED SENSOR NOT ON
40	LOADER MOTION TIME OUT
41	TAPE PATH SENSOR <CT> & <MR> BOTH ON
43	LEADER BLOCK CANNOT BE PULLED OUT FROM CART.
44	CARTRIDGE LOAD RETRY EXHAUSTED
45	TAPE THREAD RETRY EXHAUSTED
46	TAPE PATH HOME SENSOR ALWAYS ON ERROR
47	THREADER ARM CANNOT MOVE TO HOME POSITION AT POWER UP
48	CARTRIDGE NOT EJECTED
49	TOO LOOSE OR BROKEN TAPE IS LOADED
4A	THREADING TIMEOUT
4B	UNTHREAD TIME OUT

CHK XX

Table E-1. CHK xx Error Code Descriptions (Continued)

CHK XX CODE	DESCRIPTION
4C	CARTRIDGE UNLOAD TIME OUT
4D	TAPE UNLOAD TIME OUT
4E	THREADING TIME WAS TOO FAST
4F	UNTHREADING TIME WAS TOO FAST
50	THREADER ARM IS NOT HOME DURING CART. LOADING
51	FILE PROTECT SENSOR IS ALWAYS OFF (WRITE ENABLE)
52	FILE REEL DIRECTION ERROR DUE TO LOOSE TAPE WRAP
53	FILE REEL TURNS TOO FAST DUE TO LOOSE TAPE WRAP
54	TAPE PATH SENSOR <CT> IS NOT OFF DURING THREADING
55	FILE REEL DIRECTION ERROR DURING THREADING
56	FILE REEL TURNS TOO SLOW DURING UNTHREADING
57	FILE REEL DIRECTION ERROR DURING UNTHREADING
58	CARTRIDGE \ IN\ OR \ MOUNT\ SENSOR FAILURE
59	MACHINE REEL TACHOMETER FAILURE IN UNLOAD
5A	ABNORMAL REEL CLUTCHING DURING LOAD OR TOO LOOSE WRAP
5B	NO CARTRIDGE OR FILE PROTECT SENSOR ERROR (LD.)
5C	CARTRIDGE IS NOT LOADING POSITION AT START OF LOAD
5D	FILE REEL TURNS TOO FAST AFTER UNTHREADING
5E	MACHINE REEL TURNS TOO SLOW DURING CLEANING
5F	FILE REEL TURNS TOO FAST DURING CLEANING
60	MACHINE REEL TACHOMETER PHASE ERROR DURING THREAD/UNTHREAD
62	MACHINE REEL STOP LOCK ERROR DURING THREAD/UNTHREAD
63	FILE REEL DIRECTION ERROR WHEN CLEANING
64	MACHINE REEL DOES NOT TURN DURING POWER UP
65	MACHINE REEL TACHOMETER OR DIRECTION ERR
66	FILE REEL DOES NOT TURN IN POWER UP
67	FILE REEL TACHOMETER OR DIRECTION ERR
68	FRONT/REAR CARRIER SENSORS BOTH ON
6A	BACKWARD AT BOT DETECTED BY SERVO
6B	FORWARD AT EOT DETECTED BY SERVO
6C	STOP LOCK ERROR CAUSED BY LOOSE WRAP

Table E-1. CHK xx Error Code Descriptions (Continued)

CHK XX CODE	DESCRIPTION
6D	RRC CAN NOT BE DETERMINED
6E	FILE PROTECT SENSOR FAILURE DURING POWER UP
70	BACKWARD COMMAND AT BOT
71	FORWARD COMMAND AT PEOT
72	TIME OUT ERROR IN DECELERATION
73	NOT READY BY OPERATOR
74	TIME OUT ERROR IN FIRST MACHINE REEL WRAP
75	TIME OUT ERROR IN ACCELERATION
76	OVER SPEED IN ACCELERATION
77	REVERSE ROTATION IN CONSTANT SPEED SERVO
78	IN STOP LOCK SERVO FILE REEL TURNS TOO MUCH
79	IN STOP LOCK SERVO MACHINE REEL TURNS TOO MUCH
7A	RRC CHANGED BY TOO MANY COUNTS
7B	TOO MANY MACHINE REEL INTERRUPTS
7C	FILE REEL DIRECTION ERROR DURING UNLOADING
7D	FILE REEL TURNS TOO FAST DURING UNLOADING
7E	MACHINE REEL DIRECTION ERROR DURING UNLOADING
7F	MACHINE REEL TURNS TOO FAST DURING UNLOADING
82	MOUNT ARM MOVE FORWARD TIMEOUT ERROR DURING POWER UP
83	MOUNT ARM MOVE BACKWARD TIMEOUT ERROR DURING POWER UP
8E	MOUNT ARM MOVE FORWARD RETRY EXHAUSTED
8F	MOUNT ARM MOVE BACKWARD RETRY EXHAUSTED
90	MOUNT ARM HOME/DRIVE END & MAGAZINE END SENSORS ALL ON
92	MOUNT ARM HOME/DRIVE END SENSORS BOTH ON
93	MOUNT ARM HOME/MAGAZINE END SENSORS BOTH ON
94	MOUNT ARM HOME SENSOR ALWAYS ON
95	MOUNT ARM DRIVE END SENSOR ALWAYS ON
96	MOUNT ARM MAGAZINE END SENSOR ALWAYS ON
97	MOUNT ARM DRIVE & MAGAZINE END SENSORS BOT ON
99	DOOR SOLENOID LOCK TIMEOUT ERROR
9A	DOOR SOLENOID UNLOCK TIMEOUT ERROR

Table E-1. CHK xx Error Code Descriptions (Continued)

CHK XX CODE	DESCRIPTION
9B	DOOR SOLENOID LOCK SENSOR ALWAYS ON
9C	DOOR SOLENOID LOCK SENSOR OFF
9D	SERVO PROGRAM ERROR
9E	FACL OVER CURRENT DETECTED
A1	MISSING GAP IN INTERRUPT ON MOTION COMMAND
A2	SERVO COMMAND FAILED TO COMPLETE IN ALLOTTED TIME
A3	MOTION COMMAND TO NOT READY DEVICE
A4	WRITE OR D.S.E. COMMAND TO FILE PROTECTED DEVICE
A5	NO RESPONSE FROM SERVO MPU SENDING COMMAND
A9	WRITE FPC CABLE CHECK WRAP 1
AA	WRITE FPC CABLE CHECK WRAP 2
AE	PROGRAM DOWN LOAD FAILURE
AF	CANNOT EXECUTE PROGRAM DOWN LOAD
B0	TRANSFER DATA COUNT ERROR
B1	WRAP DIRECTION ERROR
B2	INVALID SECTOR
B3	UNEXPECTED COMMAND END INTERRUPT
B4	AUTOLOADER COMMAND RECEIVED TO NONEXISTENT DEVICE
B6	UNACCEPTABLE AUTOLOADER PARAMETER
B9	RESET KEY PRESSED BY OPERATOR
C0	LOAD MAGAZINE COMMAND CAN NOT EXECUTE
C1	MOVE MAGAZINE COMMAND PARAMETER ERROR
C2	MOVE MAGAZINE COMMAND CAN NOT EXECUTE
C3	NO MAGAZINE AT CTG UNLOAD
C4	ACL OVER CURRENT
C5	PINION PHASE ADJUST TIMEOUT
C6	BOTTOM STOPPER-ARM MOVING RETRIES EXHAUSTED
C7	BOTTOM STOPPER SENSOR <UP> & <DW> BOTH ON
C8	DOWNWARD MOVE MAGAZINE TIMEOUT
C9	UPWARD MOVE MAGAZINE TIMEOUT
CA	MAGAZINE POSITION MISCALCULATION

Table E-1. CHK xx Error Code Descriptions (Continued)

CHK XX CODE	DESCRIPTION
CB	MAGAZINE TOP DETECTED DURING MOVING UP OR UNLOADING
D0	ACL SENSOR CABLE CHECK
D1	MAGAZINE MISPOSITION CORRECTION ERROR
D2	FEEDER ARM SENSOR OP/CL BOTH ON
D3	MOUNT ARM HOME SENSOR FAILURE
D4	FEED IN TOO FAST
D5	FEED IN RETRIES EXHAUSTED
D6	CARTRIDGE IN MAGAZINE ALWAYS ON
D7	CARTRIDGE CATCH TIMEOUT
D8	MOUNT ARM DOES NOT RETURN BACK TO HOME
D9	MOUNT CARTRIDGE RETRIES EXHAUSTED
DA	UNFEED RETRIES EXHAUSTED
DB	UNFEED TOO FAST OR CTG IN MAG SENSOR ALWAYS ON
DC	INTERLOCK SW DETECT ERROR
DD	CARTRIDGE INSTALLED INCORRECTLY
DF	UNFEED SENSOR IS ON OR UNFEED COMPLETE
E0	FILE PROTECTED DURING WRITE OR DSE
E5	READ HEAD BIAS ERROR
E9	WRITE HEAD CIRCUIT HARDWARE ERROR
EC	NOVRAM DATA ERROR
ED	DOWN LOAD COMMAND CAN NOT EXECUTE
EE	EJECT CLEANING CELL SENSOR ON
EF	SERVO PROGRAM DOWN LOAD ERROR
F1	FAN ONE STOP OR SLOW ROTATION ERROR
F2	FAN TWO STOP OR SLOW ROTATION ERROR
F7	UNDEFINED SERVO OFFLINE ERROR
F8	NO CLEANING CARTRIDGE OR CANNOT EJECT CLEANING CARTRIDGE
F9	CLEANING CARTRIDGE IS NOT INSERTED IN CLEANING CELL
FA	CLEANING CARTRIDGE IS NOT KEPT IN CLEANING CELL
FB	DOOR OPEN ERROR DURING POWER UP
FC	DOOR OPEN ERROR

Table E-1. CHK xx Error Code Descriptions (Continued)

CHK XX CODE	DESCRIPTION
FD	LOADED CARTRIDGE IS NOT A CLEANING CARTRIDGE
FE	ABNORMAL CARTRIDGE IN CLEANING CELL
FF	POWER ON

E-2 CHK XX ERROR CODE REPLACEMENT ACTIONS

Table E-2 describes which items should be replaced when a particular CHK xx is displayed. The Replacement Action 1 column lists the item most likely to have caused the error, the next column lists less likely items, etc. If the error is not corrected by this item, replace or correct the item listed in the next column and so on. More than one item may be listed in the Replacement Action column, replace one of these items at a time.

Table E-3 on page E-13 describes the codes for the items listed in the Replacement Action columns.

Table E-2. CHK xx Error Code Replacement Actions

CHK XX CODE	REPLACEMENT ACTION 1	REPLACEMENT ACTION 2	REPLACEMENT ACTION 3
00	2,15	6	10
01	15		
02	15		
03	15		
04	15	13	
05	13	3,15	
06	13	3, 14, 15	16
09	14	3, 15	
0A	14	3, 15	
0B	14	3, 15	16
0C	13	3, 15	
15	16	13, 14	3, 15
17	3, 14	13, 15, 16	
18	3	13, 14, 16	15
19	3, 15	3, 14	16
1B	3	3,16	
1C	3, 15	13, 14	16
1D	15	13	3, 14

Table E-2. CHK xx Error Code Replacement Actions (Continued)

CHK XX CODE	REPLACEMENT ACTION 1	REPLACEMENT ACTION 2	REPLACEMENT ACTION 3
1F	13, 14	3, 15	
20	22		
21	22		
24	8	15	
25	8	15	19
26	22		
28	22		
29	7	15	
2A	22		
2B	22		
2C	22		
2D	22		
2F	15	2	
30	22		16
31	22		16
32	22		16
33	15	2	
34	16	13, 15	
36	22		
37	16	13, 15, 19	
38	22		
39	16	7, 13, 14	
3A	22		
3B	22		
3D		2	
3E	22		
3F	22		
40	7	15	
41	8	15	
43	16	8	
44	7	15	

Table E-2. CHK xx Error Code Replacement Actions (Continued)

CHK XX CODE	REPLACEMENT ACTION 1	REPLACEMENT ACTION 2	REPLACEMENT ACTION 3
45	8	15	
46	8	15	
47	8	3	15
48	7	15	
49	16	13	19
4A	8	3	15
4B	8	3	15
4C	7	3	
4D	13	3, 14	15
4E	8	3, 15	
4F	8	3, 15	
50	8	15	
51	7	15	
52	14	3, 15	
53	16	13	
54	8	15	
55	8	13	3, 15
56	8	13	3, 15
57	8	13	3, 15
58	7	15	16
59	14	3, 15	
5A	16	7, 13	
5B	7	15	
5C	7	15	19
5D	8, 16	13, 15	
5E	14	3, 13, 16	
5F	3	13, 16	
60	14	15	
62	14	3, 15	7
63	16	3, 13	15
64	14	3, 15	

CHK XX

Table E-2. CHK xx Error Code Replacement Actions (Continued)

CHK XX CODE	REPLACEMENT ACTION 1	REPLACEMENT ACTION 2	REPLACEMENT ACTION 3
65	14	3, 15	
66	14	3, 15	
67	14	3, 15	
68	22		
6A	2	13	15
6B	2	13	15
6C	16	3, 14, 15	
6D	15	14	
6E	7	15	
70	2		15
71	2		15
72		13	14, 15
73	2		15
74	13, 14		16
75	13, 14		
76	3	13, 14, 15	
77	13	15	16
78	3	13	
79	3	14	
7A	14	3, 13, 15	16
7B	14	3, 14	16
7C	13	3, 15, 16	
7D	13	2, 15	
7E	14	3, 15, 16	
7F	14	3, 15	
82	22		
83	22		
8E	22		
8F	22		
90	22		
92	22		

Table E-2. CHK xx Error Code Replacement Actions (Continued)

CHK XX CODE	REPLACEMENT ACTION 1	REPLACEMENT ACTION 2	REPLACEMENT ACTION 3
93	22		
94	22		
95	22		
96	22		
97	22		
99	22		
9A	22		
9B	22		
9C	22		
9D	15		
9E	22		
A1	15	2	
A2	15	2	
A3	2	20	
A4	20	2	
A5	15	2	
A9	4	2	
AA	4	2	
AE	2	15	
AF	2	15	
B0	2		
B1	2		
B2	2	15	
B3	15	2	
B4	20	2	
B6	20	2	
B9	19	6	
C0	2	15	
C1	2	15	
C2	2	15	
C3	22		

Table E-2. CHK xx Error Code Replacement Actions (Continued)

CHK XX CODE	REPLACEMENT ACTION 1	REPLACEMENT ACTION 2	REPLACEMENT ACTION 3
C4	22		
C5	22		
C6	22		
C7	22		
C8	22		
C9	22		
CA	22		
CB	22		19
D0	22		19
D1	22		
D2	22		
D3	22		
D4	22		19
D5	22		
D6	22		
D7	22		
D8	22		
D9	22	7	15
DA	22		7
DB	22		
DC	22		
DD	19	22	
DF	22		
E0	2	19	
E5	5, 22		
E9	4, 12		
EC	2		
ED	2	15	
EE	22		19
EF	15		
F1	10		

Table E-2. CHK xx Error Code Replacement Actions (Continued)

CHK XX CODE	REPLACEMENT ACTION 1	REPLACEMENT ACTION 2	REPLACEMENT ACTION 3
F2	10		
F7	15		
F8	22	19	
F9	22		
FA	22		
FB	22		
FC	22	19	
FD	22		19
FE	22	16	
FF			

Table E-3. Replacement Action Codes

CODE	DESCRIPTION
For codes 1 through 11, exchange the item indicated or replace the drive.	
1	PCA-IPM
2	PCA-DTC
3	PCA-SVL
4	PCA-WTL
5	PCA-RDL
6	PCA-OP
7	Loader Assembly
8	Threader Assembly
9	Fan Assembly
10	PSU
11	Air Filter
For codes 12 through 15, replace the drive.	
12	Head Assembly
13	File Motor

Table E-3. Replacement Action Codes (Continued)

CODE	DESCRIPTION
14	Machine Motor
15	PCA-DVL
For codes 16 through 21, exchange or correct the item indicated.	
16	Cartridge Tape
17	Dirty head and tape running surface
18	Setting error
19	Operation error
20	Interface cable/terminator
21	Servo code
22	FACL

APPENDIX F

DIAGNOSTIC TESTS AND ERROR CODES

Table F-1 lists all of the diagnostic tests in the Diagnostic Test Registry for the Tasked Go/No-Go mode, the On-Line mode, and the Off-Line mode. An 'x' indicates in which diagnostic modes the test may be run The 'MFG' column indicates tests available when FACTORY MODE is enabled. Table F-3 through Table F-25 list and describe the diagnostic error codes by the routine and test numbers.

Table F-1. Diagnostic Test Registry for all Diagnostic Modes

ROUTINE	TEST	DIAGNOSTIC MODES				TITLE
		OFF-LINE	ON-LINE	GO/NO-GO	MFG	
01	01			x		Control store data bus test
01	02			x		Control store byte boundary test
01	03			x		Control store half word boundary test
01	04			x		Control store address bus test
01	05			x		Control store incrementing pattern test
01	06			x		Control store data pattern 0xAA test
01	07			x		Control store data pattern 0x55 test
01	08			x		Control store walking 0xFFs test
02	01			x		IRC initialization
02	02			x		IRC to PCC interrupt test
02	03			x		Timer 0 interrupt test
02	04			x		Timer 1 interrupt test
02	05			x		Check 1 interrupt test
02	06			x		IRC test cleanup/exit
03	01	x	x	x	x	CP Bus parity - Control Store
03	02	x	x	x	x	CP Bus parity - SDDP
03	03	x		x	x	CP Bus parity - SPC
04	01	x	x	x	x	RSVP Internal registers test
04	02	x	x	x	x	RSVP External registers test
04	03	x	x	x	x	RSVP Counters test - 2 frame
04	04	x	x	x	x	RSVP Counters test - 4 frame
04	05	x	x	x	x	RSVP Counters test - 8 frame
04	06	x	x	x	x	RSVP Counters test - 16 frame
04	07	x	x	x	x	RSVP Counters test - single byte mode

Table F-1. Diagnostic Test Registry for all Diagnostic Modes (Continued)

ROUTINE	TEST	DIAGNOSTIC MODES				TITLE
		OFF-LINE	ON-LINE	GO/NO-GO	MFG	
04	08	x	x	x	x	RSVP Counters test - 2 byte mode
04	09	x	x	x	x	RSVP DBOB interrupt test
05	01	x	x	x	x	SDDP Host I/F Buffer Page Xreg test
05	02	x	x	x	x	SDDP Host I/F Buffer Refresh Xreg test
05	03	x	x	x	x	SDDP Host I/F Packet Header Xregs test
06	01	x	x	x	x	Buffer RAM data bus bit test
06	02	x	x	x	x	Buffer byte, half, word boundary test
06	03	x	x	x	x	Buffer paging test
06	04	x	x	x	x	Buffer RAM address bus bit test
06	05	x	x	x	x	Buffer RAM 0xAA data pattern test
06	06	x	x	x	x	Buffer RAM 0x55 data pattern test
06	07	x	x	x	x	Buffer RAM walking one’s test
06	08	x	x	x	x	Buffer RAM incremental pattern test
07	01	x		x	x	SPC CP Bus Bit test
07	02	x		x	x	SPC User Program Memory test
07	03	x		x	x	SPC MCS Buffer test
07	04	x		x	x	SPC to Data Buffer DMA test
07	05	x		x	x	SPC MPU bus parity test
08	01	x	x	x	x	Formatter Counter 0 test
08	02	x	x	x	x	Formatter Counter 1 test
08	03	x	x	x	x	Formatter Counter 2 test
09	01	x	x	x	x	PCC Timers Timer 0 test
09	02	x	x	x	x	PCC Timers Timer 1 test
09	03	x	x	x	x	PCC Timers Timer 2 test
10	01	x		x	x	Write clear 3 bytes 00, mode 1Eh
10	02	x		x	x	Read clear 3 bytes 00, mode 0Eh
10	03	x		x	x	Write EDRC-NC 3 bytes 00, mode 18h
10	04	x		x	x	Read EDRC-NC 3 bytes 00, mode 08h
10	05	x		x	x	Write clear 3 bytes 00, mode 1Ah
10	06	x		x	x	Read clear 3 bytes 00, mode 0Ah

Table F-1. Diagnostic Test Registry for all Diagnostic Modes (Continued)

ROUTINE	TEST	DIAGNOSTIC MODES				TITLE
		OFF-LINE	ON-LINE	GO/NO-GO	MFG	
10	07	x		x	x	Write EDRC-NC 3 bytes 00, mode 14h
10	08	x		x	x	Read EDRC-NC 3 bytes 00, mode 04h
10	09	x		x	x	Read EDRC 3 bytes 00, mode 00h
10	0A	x		x	x	Write EDRC 3 bytes 00, mode 10h
11	01	x		x	x	Write clear 32 bytes walk 1, mode 1Eh
11	02	x		x	x	Read clear 32 bytes walk 0, mode 0Eh
11	03	x		x	x	Write EDRC-NC 32 bytes walk 1, mode 18h
11	04	x		x	x	Read EDRC-NC 32 bytes walk 0, mode 08h
11	05	x		x	x	Write clear 32 bytes walk 1, mode 1Ah
11	06	x		x	x	Read clear 32 bytes walk 0, mode 0Ah
11	07	x		x	x	Write EDRC-NC 32 bytes walk 1, mode 14h
11	08	x		x	x	Read EDRC-NC 32 bytes walk 0, mode 04h
11	09	x		x	x	Read EDRC 32 bytes walk 0, mode 00h
11	0A	x		x	x	Write EDRC 32 bytes walk 1, mode 10h
12	01	x		x	x	SDDP-R20 buffer flush signal test, 14h
12	02	x		x	x	SDDP-R20 testing 64k sgc-i-mem, 14h
12	03	x		x	x	SDDP-R20 testing 16k sgd-i-mem, 04h
12	04	x		x	x	SDDP-R20 testing sgd-de controls, 00h
12	05	x		x	x	SDDP-R20 testing sgc-ce controls, 10h
12	06	x		x	x	SDDP-R20 testing expansion sgd-de, 00h
12	07	x		x	x	SDDP-R20 testing expansion sgc-ce, 10h
12	08	x		x	x	SDDP-R20 read flush test, 00h
13	01	x		x	x	Write Hi_data parity error check
13	02	x		x	x	Read Hi_data parity error check
13	03	x		x	x	Read Sync host crc error check
13	04	x		x	x	Write Buffer overflow error check
13	05	x		x	x	Read Crc-b error check
13	06	x		x	x	Read Header crc error check
13	07	x		x	x	Write PPh host crc error check
13	08	x		x	x	Write PPh host count error check

DIAGNOSTIC TESTS AND ERROR CODES

Table F-1. Diagnostic Test Registry for all Diagnostic Modes (Continued)

ROUTINE	TEST	DIAGNOSTIC MODES				TITLE
		OFF-LINE	ON-LINE	GO/NO-GO	MFG	
13	09	x		x	x	Read Compression err/sgd crc-a errors
13	0A	x		x	x	Read Sync h_cnt/comp/sgd h_cnt-h errs
13	0B	x		x	x	Read Sync h_cnt/comp/sgd h_cnt-l errs
13	0C	x		x	x	Read Sync h_crc/comp/sgd h_crc errors
20	01	x	x	x	x	Loop write to read 0 test - 36 Track
20	02	x	x	x	x	Loop write to read 0 test - 18 Track
20	03	x	x	x	x	LWR0 - EDRC Data - 36 Track
20	04	x	x	x	x	Loop write to read 2 test - 36 Track
20	05	x	x	x	x	LWR2 - ETPs - Skew Error - 36 Track
20	06	x	x	x	x	LWR2 - ETPs - Skew Error - 18 Track
20	07	x	x	x	x	LWR2 - ETPs - Invalid Error - 18 Track
20	08	x	x	x	x	LWR2 - ETPs - Disorder Error - 36 Trk
20	09	x	x	x	x	LWR2 - ETPs - Format Control Error -36
20	0A	x	x	x	x	LWR2 - ETPs - Unknown Error - 36 Track
20	0B	x	x	x	x	LWR2 - ETPs - Unknown Error - 18 Track
20	0C	x	x	x	x	LWR2 - Ignore Invalid ETP - 4 good fms
20	0D	x	x	x	x	LWR2 - Reset Invalid ETP - 8 good frms
20	0E	x	x	x	x	LWR2 - Reset Invalid ETP at Resync
20	0F	x	x	x	x	LWR2 - Reset Persistence ETP at Resync
20	10	x	x	x	x	LWR2 - Multi-Track Error - 36 Track
20	11	x	x	x	x	LWR2 - Multi-Track Error - 18 Track
20	12	x	x	x	x	LWR2 - Uncorrectable Error - 36 Track
20	13	x	x	x	x	LWR2 - Detect Hard Error - 36 Track
20	14	x	x	x	x	No Signal Test
20	15	x	x		x	LWR3 - External Loop Write to Read
20	16	x	x	x	x	LWR0 - Seismic CRCA Error Detection
20	17				x	LWR2 - Seismic SDFT Data Pattern
20	18	x	x	x	x	LWR2 - Seismic CRCA EDRC Transfer
50	01		x	x	x	Write 4M tones test
50	02		x	x	x	Read-backward 4M tones test

Table F-1. Diagnostic Test Registry for all Diagnostic Modes (Continued)

ROUTINE	TEST	DIAGNOSTIC MODES				TITLE
		OFF-LINE	ON-LINE	GO/NO-GO	MFG	
50	03		x	x	x	Read 4M tones test
51	01		x	x	x	Write incrementing block lengths
51	02		x	x	x	Rewind
51	03		x	x	x	Read incrementing block lengths
80	01	x	x		x	Servo Diag: Logic test
80	02	x	x		x	Servo Diag: Photo sensors test
80	03	x	x		x	Servo Diag: Loader test
80	04	x	x		x	Servo Diag: Threader test
80	05	x	x		x	Servo Diag: Tachometer test
80	06	x	x		x	Servo Diag: ACL/FACL test
80	07	x			x	Servo Diag: Manual Sensor test
80	08	x			x	Servo Diag: Manual ACL test
81	01		x		x	MFG diagnostic load execute table
81	02		x		x	MFG diagnostic display execute table
81	03		x		x	Clear Log Counters
81	04		x		x	Write BOT - EOT test
81	05		x		x	Read BOT - EOT test
81	06		x		x	Rewinding tape
81	07		x		x	Locate Block
81	08		x		x	Space Block
81	09		x		x	Write Filemarks
81	0A		x		x	Space File
81	0B		x		x	MFG diagnostic display results table
82	01		x		x	MTU diagnostic load execute table
82	02		x		x	MTU diagnostic send execute table
82	03		x		x	MTU diagnostic run
82	04		x		x	MTU diagnostic retrieve results table
83	01				x	Operator Control Panel keys test
83	02				x	Operator Control Panel display test
83	03				x	Operator Control Panel tape LED test

Table F-1. Diagnostic Test Registry for all Diagnostic Modes (Continued)

ROUTINE	TEST	DIAGNOSTIC MODES				TITLE
		OFF-LINE	ON-LINE	GO/NO-GO	MFG	
83	04				x	Operator Control Panel drive LED test
84	01				x	Library I/F Port output test
84	02				x	Library I/F Port input test
90	01	x	x		x	Drive Diag: LOAD test
90	02	x	x		x	Drive Diag: AC/PS, MODCH tests
90	03	x	x		x	Drive Diag: TPPFM test
90	04	x	x		x	Drive Diag: LOCAT test
90	05	x	x		x	Drive Diag: D.S.E. test
90	06	x	x		x	Drive Diag: REWND test
90	07	x	x		x	Drive Diag: UNLOD test
90	08	x	x		x	Drive Diag: ACL LDUL test

Refer to Chapter 8 for Diagnostics information and displays. Table F-3 through Table F-25 lists and describes the Diagnostic Error Codes. Refer to Table F-1 for the Diagnostic Test Registry.

Table F-2. Error Codes Common to all Routines/Tests

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
*	*	Error Codes common to all tests of routines greater than 0x02.	0xFA	A Check 1 condition was left pending, which was able to be cleared.
			0xFE	A Check 1 condition was left pending, which could not be cleared.
			0xFC	The RSVP code download to the PCC LSI failed.
			0xFD	Real Time Clock initialization in the PCC LSI failed.

Table F-3. Routine 1 - Control Store Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x01	0x01	Control store data bus test	0x01	Data miscompare clearing control store address 0
			0x02	Data bus bit miscompare
0x01	0x02	Control store byte boundary test	0x01	Control store address 0 not set to 0xFFFFFFFF
			0x02	Control store address 0x04 couldn't be set to 0
			0x03	Read/verify of control store byte write failed
			0x04	Read/verify of control store data word failed
0x01	0x03	Control store half word boundary test	0x01	Data miscompare clearing control store address 0
			0x02	Control store address 0x04 couldn’t be set to 0xFFFFFFFF
			0x03	Read/verify of control store half-word write failed
			0x04	Read/verify of control store data word failed
0x01	0x04	Control store address bus test	0x01	Read/verify of control store address bus bit failed
0x01	0x05	Control store incrementing pattern test	0x01	Read/verify of control store incrementing pattern failed
0x01	0x06	Control store data pattern AA test	0x01	Control store data word miscompare
0x01	0x07	Control store data pattern 55 test	0x01	Control store data word miscompare
0x01	0x08	Control store walking FFs test	0x01	Control store data miscompare

Table F-4. Routine 2 - Interrupt Request Controller Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x02	0x01	IRC initialization	0x01	Processor in invalid register window
			0x02	Pending interrupt detected at IRC input
			0x03	Pending interrupt latched in IRC
0x02	0x02	IRC to PCC interrupt test	0x01	Expected interrupt(s) not detected in IRC
			0x02	No interrupt detected by processor
			0x03	Expected interrupt not detected in processor
0x02	0x03	Timer 0 interrupt test	0x01	Timer 0 interrupt not detected
			0x02	Incorrect interrupt detected
0x02	0x04	Timer 1 interrupt test	0x01	Timer 1 interrupt not detected
			0x02	Incorrect interrupt detected
0x02	0x05	Check 1 interrupt test	0x01	Pending interrupt detected
			0x02	CP bus timeout not detected
			0x03	Check 1 interrupt not detected
			0x04	Incorrect interrupt detected
			0x05	Interrupt(s) could not be cleared

Table F-5. Routine 3 - CP Bus Parity Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x03	0x01	CP Bus parity - Control Store	0x01	An unexpected Check 1 condition was prematurely detected at the beginning of this test
			0x02	CP Bus parity error was not set as expected after attempting a read a Control Store location previously written with bad parity
			0x03	An unexpected Check 1 condition was pending after it should have been cleared
			0x04	A CP bus parity error was not detected as expected after a write/read operation on a word of control store with forced bad parity
			0x05	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x06	A CP bus parity error was not detected as expected after reading a word previously written with bad parity
			0x07	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x10	A CP bus parity error was not detected after writing byte 0 of a word with bad parity
			0x11	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x12	A CP bus parity error was not detected after reading byte 0 of a word which was previously written with bad parity
			0x13	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x20	A CP bus parity error was not detected after writing byte 1 of a word with bad parity
			0x21	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x22	A CP bus parity error was not detected after reading byte 1 of a word which was previously written with bad parity
			0x23	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x30	A CP bus parity error was not detected after writing byte2 of a word with bad parity
			0x31	An unexpected Check 1 condition was pending after an attempt to clear it was made

Table F-5. Routine 3 - CP Bus Parity Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x03	0x01	CP Bus parity - Control Store	0x32	A CP bus parity error was not detected after reading byte2 of a word which was previously written with bad parity
			0x33	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x40	A CP bus parity error was not detected after writing byte 3 of a word with bad parity
			0x41	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x42	A CP bus parity error was not detected after reading byte 3 of a word which was previously written with bad parity
			0x43	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x50	An unexpected Check 1 condition was detected after attempting to write a word with good parity to control store
0x03	0x02	CP Bus parity - SDDP	0x01	An unexpected Check 1 condition was prematurely detected at the beginning of this test
			0x02	An unexpected Check 1 condition was detected after reading the HDXC register in the SDDP
			0x03	A CP bus parity error was not detected as expected after a SDDP register write operation with forced bad parity
			0x04	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x05	A data miscompare was detected reading an SDDP register previously written with bad parity
			0x06	An unexpected Check 1 condition was detected after reading an SDDP register
			0x07	An unexpected Check 1 condition was detected after attempting to restore the contents of the HDXC register
			0x08	A data miscompare was detected when verifying the contents of the HDXC register previously restored
			0x09	An unexpected Check 1 condition was pending after read verification of the HDXC register was completed

Table F-5. Routine 3 - CP Bus Parity Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x03	0x02	CP Bus parity - SDDP	0x0A	An unexpected Check 1 condition was detected after setting a bit to force bad parity on writes to the SDDP
			0x0B	A Check 1 condition was not detected after reading a register in the SDDP with the SDDP set to cause bad parity
			0x0C	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x10	A CP bus parity error was not detected after writing byte 0 of an SDDP register word with force bad parity set
			0x11	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x12	A CP bus parity error was not detected after writing byte 1 of an SDDP register word with force bad parity set
			0x13	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x14	A CP bus parity error was not detected after writing byte 2 of an SDDP register word with force bad parity set
			0x15	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x16	A CP bus parity error was not detected after writing byte 3 of an SDDP register word with force bad parity set
			0x17	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x18	A data miscompare was detected during a read verify of the SDDP register used to test parity error detection
			0x19	An unexpected Check 1 condition was detected after completing a successful read verify of an SDDP register
0x03	0x03	CP Bus parity - SPC	0x01	An expected CP Bus parity error was not detected
			0x02	An unexpected Check 1 condition was detected after an attempt was made to clear it
			0x03	An expected CP bus parity error was not detected after attempting to force bad SPC parity

Table F-5. Routine 3 - CP Bus Parity Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x03	0x03	CP Bus parity - SPC	0x04	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x05	An expected CP bus parity was not detected after attempting to read an SPC register with SPC parity inverted
			0x06	An unexpected Check 1 condition was pending after an attempt to clear it was made
			0x07	An unexpected Check 1 condition was detected
			0x10	Initialization of the SPC chip failed
			0x20	SPC interrupt request was not generated during SPC Diagnostic initialization
			0x21	An SPC interrupt was not detected in the Interrupt Request Controller (IRC) during SPC Diagnostic initialization
			0x22	The SPC interrupt was inadvertently cleared when the Interrupt Request Controller was cleared
			0x23	The SPC interrupt/step code did not report command complete as expected
			0x24	The SPC interrupt request could not be cleared
			0x30	An SPC interrupt request was not generated by the SPC during diagnostic test
			0x31	An SPC interrupt was not detected in the Interrupt Request Controller (IRC) during SPC Diagnostic initialization
			0x32	The SPC interrupt was inadvertently cleared when the Interrupt Request Controller was cleared
			0x33	The SPC interrupt/step code did not report a Register Parity error as expected
			0x34	The SPC interrupt request could not be cleared
			0x40	An SPC interrupt request was not generated by the SPC during diagnostic test
			0x41	An expected SPC interrupt was not detected in the Interrupt Request Controller (IRC)
			0x42	The SPC interrupt was inadvertently cleared when the Interrupt Request Controller was cleared

Table F-5. Routine 3 - CP Bus Parity Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x03	0x03	CP Bus parity - SPC	0x43	The SPC interrupt/step code did not report a Register Parity error as expected after changing the SPC parity from odd to even
			0x44	The SPC interrupt request could not be cleared
			0x50	An SPC interrupt request was not generated by the SPC during diagnostic test
			0x51	An expected SPC interrupt was not detected in the Interrupt Request Controller (IRC)
			0x52	The SPC interrupt was inadvertently cleared when the Interrupt Request Controller was cleared
			0x53	The SPC interrupt/step code did not report a Register Parity error as expected after changing the SPC parity from odd to even
			0x54	The SPC interrupt request could not be cleared
			0x60	An expected SPC interrupt request was not generated by the SPC
			0x61	An expected SPC interrupt was not detected in the Interrupt Request Controller (IRC)
			0x62	The SPC interrupt was inadvertently cleared when the Interrupt Request Controller was cleared
			0x63	The SPC interrupt/step code did not report a Command Complete as expected
			0x64	The SPC interrupt request could not be cleared
			0x80	An SPC interrupt request was not generated by the SPC during SPC setup restoration
			0x81	An expected SPC interrupt was not detected in the Interrupt Request Controller (IRC)
			0x82	The SPC interrupt was inadvertently cleared when the Interrupt Request Controller was cleared
			0x83	The SPC interrupt/step code did not report a Command Complete as expected after restoring SPC setup
			0x84	The SPC interrupt request could not be cleared

Table F-6. Routine 4 - Read Signal Verification Processor Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x04	*	RSVP Routine Initialization	0xE0	Initialization timeout waiting for RSVP to reach the RSVP idle loop
			0xE1	RSVP reported incorrect status after being reset
			0xE2	RSVP failed to clear Response Available in the allocated time
			0xE3	RSVP failed to set Response Available in the allocated time
			0xE4	RSVP Alert Interrupt not set as expected
			0xE5	RSVP failed to set data transfer or timer registers as expected
0x04	0x01	RSVP Internal Registers test	0x01	RSVP failed to set control register RCTL as expected
			0x02	RSVP failed to clear control register RCTL as expected
			0x03	Data miscompare attempting to set RSVP register RDME
			0x04	Data miscompare attempting to clear RSVP register RDME
			0x05	Data miscompare attempting to set RSVP register SNDA to 0x55
			0x06	Data miscompare attempting to set RSVP register SNDA to 0xAA
			0x07	Data miscompare attempting to clear RSVP register SNDA
			0x08	Data miscompare attempting to set RSVP register SNDB to 0x55
			0x09	Data miscompare attempting to set RSVP register SNDB to 0xAA
			0x0A	Data miscompare attempting to clear RSVP register SNDB
			0x0B	Data miscompare attempting to set RSVP register SNDC to 0x55
			0x0C	Data miscompare attempting to set RSVP register SNDC to 0xAA
			0x0D	Data miscompare attempting to clear RSVP register SNDC

Table F-6. Routine 4 - Read Signal Verification Processor Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x04	0x01	RSVP Internal Registers test	0x0E	Data miscompare attempting to set RSVP register TIMR to 0x55
			0x01	Timeout waiting for RSVP Response Available after setting DSG0 Order Available
			0x02	RSVP Alert Interrupt not set as expected after setting DSG0 Order Available
			0x03	Timeout waiting for RSVP Response Available after setting DSG1 Order Available
			0x04	RSVP Alert Interrupt not set as expected after setting DSG1 Order Available
0x04	0x02	RSVP External Registers test	0x05	Timeout waiting for RSVP Response Available after setting RDOP Order Available
			0x06	RSVP Alert Interrupt not set as expected after setting RDOP Order Available
			0x07	Timeout waiting for RSVP Response Available after setting FCNT Order Available
			0x08	RSVP Alert Interrupt not set as expected after setting FCNT Order Available
			0x09	Timeout waiting for RSVP Response Available after setting FCNT.B Order Available
			0x0A	RSVP Alert Interrupt not set as expected after setting FCNT.B Order Available
			0x0B	Unable to reset all register FCNT bits
			0x0C	Timeout waiting for RSVP Response Available after setting CECC Order Available
			0x0D	RSVP Alert Interrupt not set as expected after setting CECC Order Available
0x04	0x03	RSVP Counters test -2 frame	0x01	Carry counter error
			0x02	Timeout waiting for Response Available after setting CECC Order Available
			0x03	RSVP Interrupts not set as expected
			0x04	Register CECC data miscompare after clearing Response Available
0x04	0x04	RSVP Counters test -4 frame	0x01	Carry counter error
			0x02	Timeout waiting for Response Available after setting CECC Order Available
			0x03	RSVP Interrupts not set as expected

Table F-6. Routine 4 - Read Signal Verification Processor Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x04	0x04	RSVP Counters test -4 frame	0x04	Register CECC data miscompare after clearing Response Available
0x04	0x05	RSVP Counters test -8 frame	0x01	Carry counter error
			0x02	Timeout waiting for Response Available after setting CECC Order Available
			0x03	RSVP Interrupts not set as expected
			0x04	Register CECC data miscompare after clearing Response Available
0x04	0x06	RSVP Counters test - 16 frame	0x01	Carry counter error
			0x02	Timeout waiting for Response Available after setting CECC Order Available
			0x03	RSVP Interrupts not set as expected
			0x04	Register CECC data miscompare after clearing Response Available
0x04	0x07	RSVP Counters test - single byte mode	0x01	Timeout waiting for Response Available after setting CECC Order Available testing counter 2, low byte carry out
			0x02	RSVP Interrupts not set as expected testing counter 2, low byte carry out
			0x03	Register CECC data miscompare after resetting Response Available testing counter 2, low byte carry out
			0x04	Timeout waiting for Response Available after setting CECC Order Available testing counter 1, low byte carry out
			0x05	RSVP Interrupts not set as expected testing counter 1, low byte carry out
			0x06	Register CECC data miscompare after resetting Response Available testing counter 1, low byte carry out
			0x07	Timeout waiting for Response Available after setting CECC Order Available testing counter 0, low byte carry out
			0x08	RSVP Interrupts not set as expected testing counter 0, low byte carry out
			0x09	Register CECC data miscompare after resetting Response Available testing counter 0, low byte carry out

Table F-6. Routine 4 - Read Signal Verification Processor Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x04	0x07	RSVP Counters test - single byte mode	0x0A	Timeout waiting for Response Available after setting CECC Order Available testing counter 2, high byte carry out
			0x0B	RSVP Interrupts not set as expected testing counter 2, high byte carry out
			0x0C	Register CECC data miscompare after resetting Response Available testing counter 2, high byte carry out
			0x0D	Timeout waiting for Response Available after setting CECC Order Available testing counter 1, high byte carry out
			0x0E	RSVP Interrupts not set as expected testing counter 1, high byte carry out
			0x0F	Register CECC data miscompare after resetting Response Available testing counter 1, high byte carry out
			0x10	Timeout waiting for Response Available after setting CECC Order Available testing counter 0, high byte carry out
			0x11	RSVP Interrupts not set as expected testing counter 0, high byte carry out
			0x12	Register CECC data miscompare after resetting Response Available testing counter 0, high byte carry out
0x04	0x08	RSVP Counters test - 2 byte mode	0x01	Timeout waiting for Response Available after setting CECC Order Available testing counter 2
			0x02	RSVP Interrupts not set as expected testing counter 2
			0x03	Register CECC data miscompare after resetting Response Available testing counter 2
			0x04	Timeout waiting for Response Available after setting CECC Order Available testing counter 1
			0x05	RSVP Interrupts not set as expected testing counter 1
			0x06	Register CECC data miscompare after resetting Response Available testing counter 1
			0x07	Timeout waiting for Response Available after setting CECC Order Available testing counter 0

Table F-6. Routine 4 - Read Signal Verification Processor Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x04	0x08	RSVP Counters test - 2 byte mode	0x08	RSVP Interrupts not set as expected testing counter 0
			0x09	Register CECC data miscompare after resetting Response Available testing counter 0
0x04	0x09	RSVP DBOB Interrupt test	0x01	Timeout waiting for Response Available after setting DBOB Order Available
			0x02	DBOB and RSVP Interrupt not set as expected

Table F-7. Routine 5 - SDDP External Register Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x05	0x01	SDDP Host I/F Buffer Page Xreg test	0x01	Buffer page register data miscompare
0x05	0x02	SDDP Host I/F Buffer Refresh Xreg test	0x01	Buffer refresh register data miscompare
			0x02	Error restoring buffer refresh register to initial state
0x05	0x03	SDDP Host I/F Packet Header Xregs test	0x01	Packet header register data miscompare
			0x02	Error restoring packet header registers to initial state

Table F-8. Routine 6 - Data Buffer Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x06	0x01	Buffer RAM data bus bit test	0x01	Data bus bit miscompare
0x06	0x02	Buffer byte, half, word boundary test	0x01	Full word read data miscompare
			0x02	Half word read data miscompare
			0x03	Byte read data miscompare
0x06	0x03	Buffer paging test	0x01	Buffer page data miscompare

Table F-8. Routine 6 - Data Buffer Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x06	0x04	Buffer RAM address bus bit test	0x01	Address bus bit miscompare, possible open address bit(s)
			0x02	Address bus bit miscompare, possible short/ tied address bit(s)
0x06	0x05	Buffer RAM 0xAA data pattern test	0x01	Data miscompare error
0x06	0x06	Buffer RAM 0x55 data pattern test	0x01	Data miscompare error
0x06	0x07	Buffer RAM walking one's test	0x01	Data miscompare error
0x06	0x08	Buffer RAM incremental pattern test	0x01	Data miscompare error

Table F-9. Routine 7 - SCSI Protocol Controller Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x07	*	SPC Routine Initialization	0xD0	SPC register initialization failed
			0xE0	SPC did not generate an interrupt request
			0xE1	SPC interrupt was not detected at the Interrupt Request Controller
			0xE2	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE3	SPC interrupt/step code did not report Command Complete
			0xE4	The SPC interrupt request could not be cleared
			0xE5	SPC did not generate an interrupt request
			0xE6	SPC interrupt was not detected at the Interrupt Request Controller
			0xE7	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE8	SPC interrupt/step code did not report Diagnostic Self-Test passed
			0xE9	The SPC interrupt request could not be cleared
			0xEF	SPC interrupt request or interrupt/step register could not be cleared at the end of the test

Table F-9. Routine 7 - SCSI Protocol Controller Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x07	0x01	SPC CP Bus Bit test	0x01	SPC data bus bit test failed, data miscompare in walking one's test
0x07	0x02	SPC User Program Memory test	0x01	SPC data miscompare during incremental data pattern test of User Program Memory
			0x02	SPC data miscompare during address bus bit test in SPC User Program Memory
			0x03	SPC data miscompare during read of SPC User Program Memory after all bits were inverted
0x07	0x03	SPC MCS Buffer test	0x01	Incorrect SPC status detected after issuing a diagnostic n-byte message command
			0x02	Incorrect SCSI bus status during diagnostic data transfer while expecting REQ assertion
			0x03	Incorrect SCSI bus status during diagnostic data transfer while expecting REQ de-assertion
			0x04	SPC reported an incorrect data transfer length
			0x05	Data miscompare detected in SPC low MCS buffer after diagnostic message transfer
			0x06	Data miscompare error detected in SPC high MCS buffer after diagnostic message transfer
0x07	0x04	SPC to Data Buffer DMA test	0x01	Incorrect SPC status detected after issuing a diagnostic data transfer to buffer command
			0x02	Bad SCSI bus status detected waiting for REQ assertion during diagnostic data transfer
			0x03	Bad SCSI bus status detected waiting for REQ de-assertion during diagnostic data transfer
			0x04	SPC reported an incorrect transfer length after completion of a diagnostic data transfer command
			0x05	Error reported by Record/Buffer manager in attempting to setup SDDP for a DMA transfer
			0x06	Unexpected status returned by Record/Buffer manager after DMA transfer
			0x07	Data miscompare detected in SPC MCS buffer
			0x08	Bad SCSI bus status detected waiting for REQ assertion during diagnostic data transfer

Table F-9. Routine 7 - SCSI Protocol Controller Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x07	0x04	SPC to Data Buffer DMA test	0x09	Incorrect SCSI bus status during diagnostic data transfer while expecting REQ de-assertion
			0x0A	SPC reported an incorrect data transfer length
			0x0B	Record/Buffer manager did not report successful completion for the DMA transfer
			0x0C	Data miscompare detected in SPC MSC buffer after DMA data transfer completed
			0x10	SPC did not generate an interrupt request
			0x11	SPC interrupt was not detected at the Interrupt Request Controller
			0x12	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0x13	An incorrect SPC interrupt/step code was reported
			0x14	The SPC interrupt request could not be cleared
			0x20	SPC did not generate an interrupt request
			0x21	SPC interrupt was not detected at the Interrupt Request Controller
			0x22	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0x23	SPC interrupt/step code did not report Command Complete
			0x24	The SPC interrupt request could not be cleared
0x07	0x05	SPC MPU bus parity test	0x01	SPC reported incorrect status
			0x02	Bad SCSI bus status detected waiting for REQ assertion during diagnostic data transfer
			0x03	Incorrect SCSI bus status during diagnostic data transfer while expecting REQ de-assertion
			0x04	SPC did not generate an interrupt request
			0x05	SPC interrupt was not detected at the Interrupt Request Controller
			0x06	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0x07	SPC interrupt/step code did not report MPU Parity Error as expected

Table F-9. Routine 7 - SCSI Protocol Controller Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x07	0x05	SPC MPU bus parity test	0x08	The SPC interrupt request could not be cleared
			0x09	CP bus parity error was not reported as expected
			0x0A	Unexpected Check 1 condition was reported after attempting to clear the Check 1 CP bus parity error

Table F-10. Routine 8 - Formatter Counters Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x08	0x01	Formatter Counter 0 test	0x01	The Formatter Counter 0 count enable register could not be cleared
			0x02	A data miscompare occurred walking a one through the Formatter Counter 0 high byte count register
			0x03	A data miscompare occurred walking a one through the Formatter Counter 0 low byte count register
			0x04	Test Jump Carry Out bit for the high byte count of Formatter Counter 0 was set prematurely before counter was started
			0x05	An unexpected value was read in the count enable register for Formatter Counter 0 after the high byte counter finished running
			0x06	The high byte count for Formatter Counter 0 did not contain the expected value after the counter finished running
			0x07	Test Jump Carry Out bit for the high byte count of Formatter Counter 0 was not set as expected after the counter finished running
			0x08	Test Jump Carry Out bit for the low byte count of Formatter Counter 0 was set prematurely before counter was started
			0x09	An unexpected value was read in the count enable register for Formatter Counter 0 after the low byte counter finished running

Table F-10. Routine 8 - Formatter Counters Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x08	0x01	Formatter Counter 0 test	0x0A	The low byte count for Formatter Counter 0 did not contain the expected value after the counter finished running
			0x0B	Test Jump Carry Out bit for the low byte count of Formatter Counter 0 was not set as expected after the counter finished running
			0x0C	WBEND_CNEH0 Interrupt not set as expected
0x08	0x02	Formatter Counter 1 test	0x01	The Formatter Counter 1 count enable register could not be cleared
			0x02	A data miscompare occurred walking a one through the Formatter Counter 1 high byte count register
			0x03	A data miscompare occurred walking a one through the Formatter Counter 1 low byte count register
			0x04	Test Jump Carry Out bit for the high byte count of Formatter Counter 1 was set prematurely before counter was started
			0x05	An unexpected value was read in the count enable register for Formatter Counter 1 after the high byte counter finished running
			0x06	The high byte count for Formatter Counter 1 did not contain the expected value after the counter finished running
			0x07	Test Jump Carry Out bit for the high byte count of Formatter Counter 1 was not set as expected after the counter finished running
			0x08	Test Jump Carry Out bit for the low byte count of Formatter Counter 1 was set prematurely before counter was started
			0x09	An unexpected value was read in the count enable register for Formatter Counter 1 after the low byte counter finished running
			0x0A	The low byte count for Formatter Counter 1 did not contain the expected value after the counter finished running
			0x0B	Test Jump Carry Out bit for the low byte count of Formatter Counter 1 was not set as expected after the counter finished running
0x08	0x03	Formatter Counter 2 test	0x01	The Formatter Counter 2 count enable register could not be cleared

Table F-10. Routine 8 - Formatter Counters Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x08	0x03	Formatter Counter 2 test	0x02	A data miscompare occurred walking a one through the Formatter Counter 2 high byte count register
			0x03	A data miscompare occurred walking a one through the Formatter Counter 2 low byte count register
			0x04	Test Jump Carry Out bit for the high byte count of Formatter Counter 2 was set prematurely before counter was started
			0x05	An unexpected value was read in the count enable register for Formatter Counter 2 after the high byte counter finished running
			0x06	The high byte count for Formatter Counter 2 did not contain the expected value after the counter finished running
			0x07	Test Jump Carry Out bit for the high byte count of Formatter Counter 2 was not set as expected after the counter finished running
			0x08	Test Jump Carry Out bit for the low byte count of Formatter Counter 2 was set prematurely before counter was started
			0x09	An unexpected value was read in the count enable register for Formatter Counter 2 after the low byte counter finished running
			0x0A	The low byte count for Formatter Counter 2 did not contain the expected value after the counter finished running
			0x0B	Test Jump Carry Out bit for the low byte count of Formatter Counter 2 was not set as expected after the counter finished running

Table F-11. Routine 9 - PCC Timers Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x09	0x01	PCC Timers Timer 0 test	0x01	10ms Timer (timer 0) interrupt was not detected
0x09	0x02	PCC Timers Timer 1 test	0x01	Deadman Timer (timer 1) interrupt was not detected
0x09	0x03	PCC Timers Timer 2 test	0x01	Real Time Clock (timer 2) not incrementing

Table F-11. Routine 9 - PCC Timers Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x09	0x03	PCC Timers Timer 2 test	0x02	FMT counter 2 low count carry-out bit not set
			0x03	Timer 2 running too FAST compared against FMT counter 2.
			0x04	Timer 2 running too SLOW compared against FMT counter 2.

Table F-12. Routine 10 - EDRC Control Signals Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x10	*	All R20 Control Check Diagnostics	0xD0	SPC register initialization failed
			0xE0	SPC did not generate an interrupt request
			0xE1	SPC interrupt was not detected at the Interrupt Request Controller
			0xE2	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE3	SPC interrupt/step code did not report Command Complete
			0xE4	The SPC interrupt request could not be cleared
			0xE5	SPC did not generate an interrupt request
			0xE6	SPC interrupt was not detected at the Interrupt Request Controller
			0xE7	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE8	SPC interrupt/step code did not report Diagnostic Self-Test passed
			0xE9	The SPC interrupt request could not be cleared
			0x10	At end of test, SPC did not generate an interrupt request.
			0x11	At end of test, SPC interrupt was not detected at the Interrupt Request Controller.
			0x12	At end of test, the SPC interrupt was cleared while clearing the Interrupt Request Controller.

Table F-12. Routine 10 - EDRC Control Signals Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x10	*	All R20 Control Check Diagnostics	0x13	At end of test, SPC interrupt/step code did not report Command Complete.
			0x14	At end of test, the SPC interrupt request could not be cleared.
			0xEF	SPC interrupt request or interrupt/step register could not be cleared at the end of the test
0x10	0x01	Write clear 3 bytes 00, mode 1Eh	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x10	0x02	Read clear 3 bytes 00, mode 0Eh	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.

Table F-12. Routine 10 - EDRC Control Signals Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x10	0x02	Read clear 3 bytes 00, mode 0Eh	0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x10	0x03	Write EDRC-NC 3 bytes 00, mode 18h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x10	0x04	Read EDRC-NC 3 bytes 00, mode 08h	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.

Table F-12. Routine 10 - EDRC Control Signals Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x10	0x04	Read EDRC-NC 3 bytes 00, mode 08h	0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x10	0x05	Write clear 3 bytes 00, mode 1Ah	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x10	0x06	Read clear 3 bytes 00, mode 0Ah	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.

Table F-12. Routine 10 - EDRC Control Signals Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x10	0x06	Read clear 3 bytes 00, mode 0Ah	0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x10	0x07	Write EDRC-NC 3 bytes 00, mode 14h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x10	0x08	Read EDRC-NC 3 bytes 00, mode 04h	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.

Table F-12. Routine 10 - EDRC Control Signals Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x10	0x08	Read EDRC-NC 3 bytes 00, mode 04h	0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x10	0x09	Read EDRC 3 bytes 00, mode 00h	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x10	0x0A	Write EDRC 3 bytes 00, mode 10h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.

Table F-12. Routine 10 - EDRC Control Signals Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x10	0x0A	Write EDRC 3 bytes 00, mode 10h	0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.

Table F-13. Routine 11 - EDRC Data Buffers Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x11	*	All R20 Data Check Diagnostics	0xD0	SPC register initialization failed
			0xE0	SPC did not generate an interrupt request
			0xE1	SPC interrupt was not detected at the Interrupt Request Controller
			0xE2	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE3	SPC interrupt/step code did not report Command Complete
			0xE4	The SPC interrupt request could not be cleared
			0xE5	SPC did not generate an interrupt request
			0xE6	SPC interrupt was not detected at the Interrupt Request Controller
			0xE7	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE8	SPC interrupt/step code did not report Diagnostic Self-Test passed
			0xE9	The SPC interrupt request could not be cleared
			0x10	At end of test, SPC did not generate an interrupt request.
			0x11	At end of test, SPC interrupt was not detected at the Interrupt Request Controller.
			0x12	At end of test, the SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0x13	At end of test, SPC interrupt/step code did not report Command Complete.
			0x14	At end of test, the SPC interrupt request could not be cleared.
			0xEF	SPC interrupt request or interrupt/step register could not be cleared at the end of the test
0x11	0x01	Write clear 32 bytes walking 1, mode 1Eh	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.

Table F-13. Routine 11 - EDRC Data Buffers Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x11	0x01	Write clear 32 bytes walking 1, mode 1Eh	0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x11	0x02	Read clear 32 bytes walking 0, mode 0Eh	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x11	0x03	Write EDRC-NC 32 bytes walking 1, mode 18h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.

Table F-13. Routine 11 - EDRC Data Buffers Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x11	0x03	Write EDRC-NC 32 bytes walking 1, mode 18h	0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x11	0x04	Read EDRC-NC 32 bytes walking 0, mode 08h	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x11	0x05	Write clear 32 bytes walking 1, mode 1Ah	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.

Table F-13. Routine 11 - EDRC Data Buffers Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x11	0x05	Write clear 32 bytes walking 1, mode 1Ah	0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x11	0x06	Read clear 32 bytes walking 0, mode 0Ah	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x11	0x07	Write EDRC-NC 32 bytes walking 1, mode 14h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.

Table F-13. Routine 11 - EDRC Data Buffers Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x11	0x07	Write EDRC-NC 32 bytes walking 1, mode 14h	0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x11	0x08	Read, EDRC-NC 32 bytes walking 0, mode 04h	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x11	0x09	Read EDRC32 bytes walking 0, mode 00h	0x01	A host data path end of transfer was not detected in the allotted time.

Table F-13. Routine 11 - EDRC Data Buffers Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x11	0x09	Read EDRC32 bytes walking 0, mode 00h	0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x11	0x0A	Write EDRC32 bytes walking 1, mode 10h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.

Table F-14. Routine 12 - EDRC Address Bus Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x12	*	All R20 Address Check Diagnostics	0xD0	SPC register initialization failed
			0xE0	SPC did not generate an interrupt request
			0xE1	SPC interrupt was not detected at the Interrupt Request Controller
			0xE2	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE3	SPC interrupt/step code did not report Command Complete
			0xE4	The SPC interrupt request could not be cleared
			0xE5	SPC did not generate an interrupt request
			0xE6	SPC interrupt was not detected at the Interrupt Request Controller
			0xE7	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE8	SPC interrupt/step code did not report Diagnostic Self-Test passed
			0xE9	The SPC interrupt request could not be cleared
			0x10	At end of test, SPC did not generate an interrupt request.
			0x11	At end of test, SPC interrupt was not detected at the Interrupt Request Controller.
			0x12	At end of test, the SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0x13	At end of test, SPC interrupt/step code did not report Command Complete.
			0x14	At end of test, the SPC interrupt request could not be cleared.
			0xEF	SPC interrupt request or interrupt/step register could not be cleared at the end of the test
0x12	0x01	SDDP-R20 buffer flush signal test, mode 14h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.

Table F-14. Routine 12 - EDRC Address Bus Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x12	0x01	SDDP-R20 buffer flush signal test, mode 14h	0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x04	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x05	host data transfer end of transfer was received when not expected, check to see if flush is tied high to some other signal.
			0x06	host data transfer end of transfer was not received when expected, check to see if flush is tied low to some other signal.
			0x07	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
0x12	0x02	SDDP-R20 testing 64k sgc-i-mem, mode 14h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x04	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x05	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x06	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.

Table F-14. Routine 12 - EDRC Address Bus Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x12	0x02	SDDP-R20 testing 64k sgc-i-mem, mode 14h	0x07	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x08	host data transfer end of transfer was received when not expected, check to see if flush is tied high to some other signal.
			0x09	host data transfer end of transfer was not received when expected, check to see if flush is tied low to some other signal.
			0x0A	Host data transfer error detected on the retry mode of this test.
			0x0B	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x12	0x03	SDDP-R20 testing 16k sgd-i-mem, mode 04h	0x01	After start of read operation, SPC-status did not have SPC-busy and data_ready, possible sddp did not send data to spc.
			0x02	Once read operation had started, slow micro-code was able to pull data out of spc_data fifo faster then sddp could put into data fifo. Possible that the data pipe is broken.
			0x03	At end of read operation, the SPC-status should be not busy, not data_ready, and data_fifo empty.
			0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x12	0x04	SDDP-R20 testing sgd-de controls, mode 00h	0x01	After start of read operation, SPC-status did not have SPC-busy and data_ready, possible sddp did not send data to spc.
			0x02	Once read operation had started, slow micro-code was able to pull data out of spc_data fifo faster then sddp could put into data fifo. Possible that the data pipe is broken.
			0x03	At end of read operation, the SPC-status should be not busy, not data_ready, and data_fifo empty.

Table F-14. Routine 12 - EDRC Address Bus Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x12	0x04	SDDP-R20 testing sgd-de controls, mode 00h	0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x12	0x05	SDDP-R20 testing sgc-ce controls, mode 10h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x12	0x06	SDDP-R20 testing expansion sgd-de, mode 00h	0x01	After start of read operation, SPC-status did not have SPC-busy and data_ready, possible sddp did not send data to spc.
			0x02	Once read operation had started, slow microcode was able to pull data out of spc_data fifo faster then sddp could put into data fifo. Possible that the data pipe is broken.
			0x03	At end of read operation, the SPC-status should be not busy, not data_ready, and data_fifo empty.

DIAGNOSTIC TESTS AND ERROR CODES

Table F-14. Routine 12 - EDRC Address Bus Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x12	0x06	SDDP-R20 testing expansion sgd-de, mode 00h	0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the SPC receive buffer.
0x12	0x07	SDDP-R20 testing expansion sgc-ce, mode 10h	0x01	after a write diag operation was initialized in the spc chip, the SPC-status register did not have one of the following: SPC_data_trans_rdy, SPC_busy, or SPC_data_reg_empty.
			0x02	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC send buffer to the SPC data fifo, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.
			0x04	A non SUCCESS status was returned from the function call rm_request_wrtbuffer.
			0x05	All the data expected to be transferred out of the SPC data fifo was not transferred to the SDDP.
			0x06	A non SUCCESS status was returned from the function call rm_host_wrt_cmplt. A error was detected in the SDDP_HI-hdxs register.
			0x07	A byte for byte miscompare was detected on the data bytes stored in the data_buffer.
0x12	0x08	SDDP-R20 Read flush testing, mode 00h	0x01	A host data path end of transfer was not detected in the allotted time.
			0x02	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: SCSI_REQ, SCSI_BSY, xfer_phase.
			0x03	when transferring data from the SPC data_fifo to the SPC receive_buffer, the SPC-ssig register did not have the expected bits set: ~SCSI_REQ, SCSI_ACK, SCSI_BSY, xfer_phase.

Table F-14. Routine 12 - EDRC Address Bus Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x12	0x08	SDDP-R20 Read flush testing, mode 00h	0x04	All the data expected to be transferred from the SPC data_fifo to the SPC receive_buffer was not transferred.
			0x05	A non SUCCESS status was returned from the function call rm_host_rd_complt. A error was detected in the SDDP_HI-hdxs register.
			0x06	Incorrect residual data count in SDDP.

Table F-15. Routine 13 - EDRC Error Detection Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x13	*	All R20 Error Check Diagnostics	0xD0	SPC register initialization failed
			0xE0	SPC did not generate an interrupt request
			0xE1	SPC interrupt was not detected at the Interrupt Request Controller
			0xE2	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE3	SPC interrupt/step code did not report Command Complete
			0xE4	The SPC interrupt request could not be cleared
			0xE5	SPC did not generate an interrupt request
			0xE6	SPC interrupt was not detected at the Interrupt Request Controller
			0xE7	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xE8	SPC interrupt/step code did not report Diagnostic Self-Test passed
			0xE9	The SPC interrupt request could not be cleared
			0x10	At end of test, SPC did not generate an interrupt request.
			0x11	At end of test, SPC interrupt was not detected at the Interrupt Request Controller.
			0x12	At end of test, the SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0x13	At end of test, SPC interrupt/step code did not report Command Complete.
			0x14	At end of test, the SPC interrupt request could not be cleared.
			0xEF	SPC interrupt request or interrupt/step register could not be cleared at the end of the test
0x13	0x01	Write Hi_data parity error check	0xA0	SPC did not generate an interrupt request
			0xA1	SPC interrupt was not detected at the Interrupt Request Controller
			0xA2	The SPC interrupt was cleared while clearing the Interrupt Request Controller.

Table F-15. Routine 13 - EDRC Error Detection Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x13	0x01	Write Hi_data parity error check	0xA3	SPC interrupt/step code did not report Diagnostic Self-Test passed
			0xA4	The SPC interrupt request could not be cleared
			0x01	Bad SPC write initialization status.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Error reported by record manager attempting to request buffer for write clear SG-bypass.
			0x05	Data transfer length error reported by SPC.
			0x06	Expected data parity error on high byte of the DMA bus from SPC failed to be reported by SDDP.
			0xB0	SPC did not generate an interrupt request
			0xB1	SPC interrupt was not detected at the Interrupt Request Controller
			0xB2	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0xB3	SPC interrupt/step code did not report Diagnostic Self-Test passed
			0xB4	The SPC interrupt request could not be cleared
0x13	0x02	Read Hi_data parity error check	0x01	Failed to receive data end-of-transfer signal in SDDP hdxs register.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Data transfer length error reported by SPC
			0x05	SPC did not generate an interrupt request
			0x06	SPC interrupt was not detected at the Interrupt Request Controller
			0x07	The SPC interrupt was cleared while clearing the Interrupt Request Controller.
			0x08	SPC interrupt/step code did not report Diagnostic Self-Test passed

Table F-15. Routine 13 - EDRC Error Detection Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x13	0x02	Read Hi_data parity error check	0x09	The SPC interrupt request could not be cleared
0x13	0x03	Read Sync host crc error check	0x01	Failed to receive data end-of-transfer signal in SDDP hdxs register.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Data transfer length error reported by SPC
			0x05	SDDP failed to report expected CRC error.
0x13	0x04	Write Buffer overflow error check	0x01	Initial SPC write status is incorrect.
			0x02	Error reported by Record Manager Write Buffer function while attempting to write clear SG-bypass.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x04	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x05	Data transfer length error reported by SPC
			0x06	SDDP failed to report expected buffer overflow.
0x13	0x05	Read crc-b error check	0x01	Failed to receive data end-of-transfer signal in SDDP hdxs register.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Data transfer length error reported by SPC
			0x05	SDDP failed to report expected CRC-B error.
0x13	0x06	Read header crc error check	0x01	Failed to receive data end-of-transfer signal in SDDP hdxs register.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Data transfer length error reported by SPC
			0x05	SDDP failed to report expected header CRC error.

Table F-15. Routine 13 - EDRC Error Detection Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x13	0x07	Write PPh host crc error check	0x01	Initial SPC write status is incorrect.
			0x02	Error reported by Record Manager Write Buffer function while attempting to write EDRC non-compacted.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x04	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x05	Data transfer length error reported by SPC
			0x06	SDDP failed to report expected host Packet Processor CRC error.
0x13	0x08	Write PPh host count error check	0x01	Initial SPC write status is incorrect.
			0x02	Error reported by Record Manager Write Buffer function while attempting to write SG EDRC non-compacted.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x04	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x05	Data transfer length error reported by SPC
			0x06	SDDP failed to report expected host Packet Processor error count.
0x13	0x09	Read Compression error/sgd crc-a errors	0x01	Failed to receive data end-of-transfer signal in SDDP hdxs register.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Data transfer length error reported by SPC
			0x05	SDDP failed to report expected data compression error.
			0x06	SDDP failed to report expected data compression host count error.
			0x07	SDDP failed to report expected data compression host CRC error.
			0x08	SDDP failed to report expected CRCA error.

Table F-15. Routine 13 - EDRC Error Detection Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x13	0x0A	Read Sync host_count-high / compression error / sgd host_count-high errs	0x01	Failed to receive data end-of-transfer signal in SDDP hdxs register.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Data transfer length error reported by SPC
			0x05	SDDP failed to report expected data compression and sync host count error.
			0x06	SDDP failed to report expected data compression host count error.
			0x07	SDDP failed to report expected data compression host CRC error.
			0x08	SDDP failed to report expected CRCA error.
0x13	0x0B	Read Sync host_count-low / compression error / sgd host_count-low errs	0x01	Failed to receive data end-of-transfer signal in SDDP hdxs register.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Data transfer length error reported by SPC
			0x05	SDDP failed to report expected data compression and sync host count error.
			0x06	SDDP failed to report expected data compression host count error.
			0x07	SDDP failed to report expected data compression host CRC error.
			0x08	SDDP failed to report expected CRCA error.
0x13	0x0C	Read Sync host_crc / compression error / sgd host_crc errors	0x01	Failed to receive data end-of-transfer signal in SDDP hdxs register.
			0x02	Incorrect SPC SCSI control signal status waiting for REQ signal assertion.
			0x03	Incorrect SPC SCSI control signal status waiting for REQ signal deassertion.
			0x04	Data transfer length error reported by SPC
			0x05	SDDP failed to report expected data compression and sync host CRC error.

Table F-15. Routine 13 - EDRC Error Detection Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x13	0x0C	Read Sync host_crc / compression error / sgd host_crc errors	0x06	SDDP failed to report expected data compression host count error.
			0x07	SDDP failed to report expected data compression host CRC error.
			0x08	SDDP failed to report expected CRCA error.

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	*	All Loop Write to Read tests	0xA0	FDXS Xreg - expected data not equal to received data
			0xA1	FBPP Xreg - expected data not equal to received data
			0xA2	FBBC Xreg - expected data not equal to received data
			0xA3	WES Xreg - expected data not equal to received data
			0xA4	WER Xreg - expected data not equal to received data
			0xA5	RBE Xreg - expected data not equal to received data
			0xA6	RB0 Xreg - expected data not equal to received data
			0xA7	RB1 Xreg - expected data not equal to received data
			0xA8	RB2 Xreg - expected data not equal to received data
			0xA9	RB3 Xreg - expected data not equal to received data
			0xAA	RESI Xreg - expected data not equal to received data
			0xAB	RDE Xreg - expected data not equal to received data
			0xAC	CRS Xreg - expected data not equal to received data
			0xAD	ETPA Xreg - expected data not equal to received data
			0xAE	ETPB Xreg - expected data not equal to received data
			0xAF	VODA Xreg - expected data not equal to received data
			0xB0	VODB Xreg - expected data not equal to received data
			0xB1	TONE Xreg - expected data not equal to received data
			0xB2	TJ_HERR Xreg - expected data not equal to received data

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	*	All Loop Write to Read tests	0xB3	CRRZ Xreg - expected data not equal to received data
			0xE0	Initialization Error - FDXS Xreg not zero following Transfer Cycle
			0xE1	Initialization Error - TJ_WBEN Xreg not zero following Write Clear
			0xE2	Initialization Error - RBE Xreg not zero following Read Clear
			0xE3	Initialization Error - RDE Xreg not zero following Read Clear
			0xE4	Initialization Error - ETPA Xreg not zero following Read Clear
			0xE5	Initialization Error - ETPB Xreg not zero following Read Clear
			0xE6	Initialization Error - CRS Xreg not zero following Read Clear
			0xE7	Initialization Error - WER Xreg not zero following Write Clear
			0xE8	Initialization Error - TJ_PHOK Xreg not zero following Read Clear
			0xE9	Initialization Error -TJ_PRE Xreg not zero following Read Clear
			0xEA	Initialization Error -TJ_POST Xreg not zero following Read Clear
			0xEB	Initialization Error -TJ_REND Xreg not zero following Read Clear
0x20	0x01	Loop Write to Read 0 test - 36 track	0x01	Failed to Detect IBG - check INLWR or DBLK
			0x02	Failed to Detect DBOB - check DBLK
			0x03	Failed to Detect Phase OK
			0x04	Failed to Detect Preamble - check RDSTT
			0x05	Failed to Detect Postamble
			0x06	Failed to Detect Read End
			0x07	Phase OK not reset
			0x08	Failed to Detect Write Block End
0x20	0x02	Loop Write to Read 0 test - 18 track	0x01	Failed to Detect IBG - check INLWR or DBLK

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x02	Loop Write to Read 0 test - 18 track	0x02	Failed to Detect DBOB - check DBLK
			0x03	Failed to Detect Phase OK
			0x04	Failed to Detect Preamble - check RDSTT
			0x05	Failed to Detect Postamble
			0x06	Failed to Detect Read End
			0x07	Phase OK not reset
			0x08	Failed to Detect Write Block End
0x20	0x03	LWR0 - EDRC Data - 36 track	0x01	Failed to Detect IBG - check INLWR or DBLK
			0x02	Failed to Detect DBOB - check DBLK
			0x03	Failed to Detect Phase OK
			0x04	Failed to Detect Preamble - check RDSTT
			0x05	Failed to Detect Postamble
			0x06	Failed to Detect Read End
			0x07	Phase OK not reset
			0x08	Failed to Detect Write Block End
			0xB4	PF_BID Xreg - expected data not equal to received data
			0xB5	PF_PSCT Xreg - expected data not equal to received data
			0xB6	PFHD_ID Xreg - expected data not equal to received data
			0xB7	PFOFST Xreg - expected data not equal to received data
			0xB8	PFTRL_LN Xreg - expected data not equal to received data
			0xB9	PF_FLAG Xreg - expected data not equal to received data
			0xBA	PF_ALG Xreg - expected data not equal to received data
			0xBB	PF13 Xreg - expected data not equal to received data
			0xBC	PF14_15 Xreg - expected data not equal to received data

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x03	LWR0 - EDRC Data - 36 track	0xBD	PF_EOD Xreg - expected data not equal to received data
			0xBE	PF_EODSEC Xreg - expected data not equal to received data
			0xBF	PF_EOD_ID Xreg - expected data not equal to received data
			0xC0	PF22_25 Xreg - expected data not equal to received data
			0xC1	PF26_29 Xreg - expected data not equal to received data
			0xC2	MOD_32 Xreg - expected data not equal to received data
			0xC3	HRL Xreg - expected data not equal to received data
0x20	0x04	Loop Write to Read 2 test - 36 track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x04	Loop Write to Read 2 test - 36 track	0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x05	LWR2 - ETPs - Skew Error - 36 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x06	LWR2 - ETPs - Skew Error - 18 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x06	LWR2 - ETPs - Skew Error - 18 Track	0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x07	LWR2 - ETPs - Invalid Error - 18 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x07	LWR2 - ETPs - Invalid Error - 18 Track	0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x08	LWR2 - ETPs - Disorder Error - 36 Trk	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x09	LWR2 - ETPs - Format Control Error -36	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x09	LWR2 - ETPs - Format Control Error -36	0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x0A	LWR2 - ETPs - Unknown Error - 36 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x0A	LWR2 - ETPs - Unknown Error - 36 Track	0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x0B	LWR2 - ETPs - Unknown Error - 18 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x0C	LWR2 - Ignore Invalid ETP - 4 good fms	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x0C	LWR2 - Ignore Invalid ETP - 4 good fms	0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x0D	LWR2 - Reset Invalid ETP - 8 good frms	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x0D	LWR2 - Reset Invalid ETP - 8 good frms	0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x0E	LWR2 - Reset Invalid ETP at Resync	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x0F	LWR2 - Reset Persistence ETP at Resync	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x0F	LWR2 - Reset Persistence ETP at Resync	0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x10	LWR2 - Multi-Track Error - 36 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x10	LWR2 - Multi-Track Error - 36 Track	0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x11	LWR2 - Multi-Track Error - 18 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x12	LWR2 - Uncorrectable Error - 36 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x12	LWR2 - Uncorrectable Error - 36 Track	0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x13	LWR2 - Detect Hard Error - 36 Track	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x13	LWR2 - Detect Hard Error - 36 Track	0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x14	No Signal Test	0xC4	Failed to Detect No Sig TJ
			0xC5	Failed to Detect Write Error TJ
0x20	0x15	LWR3 - External Loop Write to Read	0x30	Wrap Mark not detected
			0x32	DBOB TJ not active
0x20	0x16	LWR0 - Seismic CRCA Error Detection	0x01	Failed to Detect IBG - check INLWR or DBLK
			0x02	Failed to Detect DBOB - check DBLK
			0x03	Failed to Detect Phase OK
			0x04	Failed to Detect Preamble - check RDSTT
			0x05	Failed to Detect Postamble
			0x06	Failed to Detect Read End
			0x07	Phase OK not reset
			0x08	Failed to Detect Write Block End
0x20	0x17	LWR2 - Seismic SDFT Data Pattern	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out

Table F-16. Routine 20 - Loop Write to Read Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x20	0x17	LWR2 - Seismic SDFT Data Pattern	0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.
0x20	0x18	LWR2 - Seismic Good EDRC Transfer	0x20	RSVP failed to Respond
			0x21	DATA Xreg Miscompare - RSVP not Ready
			0x22	DATB Xreg Miscompare - RSVP not Ready
			0x23	FHC1 time-out - DBOB not detected by RSVP
			0x24	FLC0 time-out - RSVP detected Long IBG
			0x25	FHC2 or FLC2 Time Out - Slow End of Data Block
			0x26	Lost DBOB prior to PHOK or while waiting for DPOST
			0x27	PHOK not seen in time
			0x28	Time-out waiting for DPRE
			0x29	Lost DBOB waiting for DPRE
			0x2A	Time-out waiting for DPOST
			0x2B	PHOK on after Read End
			0x2C	RSVP Dead Man time-out
			0x2D	Last Blk not Found
			0x2E	RSVP error - RSVP failed, cause unknown
			0x2F	IBG active, should not be - check INLWR pulled high.
			0x40	RSVP did not respond while looking for DBOB or IBG.

Table F-17. Routine 50 - 4M Tones Test Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x50	*	4M Tones Tests	0xE0	DVL card connection was not detected by the DTC.
			0xE1	A working tape was not loaded, or the tape drive was not READY when the test started.
			0xE2	The tape drive is not READY.
0x50	0x01	Write 4M tones test	0xE3	The tape (or magazine) is FILE PROTECTED.
			0x01	Formatter command not accepted error.
			0x02	Timeout waiting for Formatter Command Complete.
			0x03	Formatter error during command execution.
0x50	0x02	Read-backward 4M tones test	0x01	Formatter command not accepted error.
			0x02	Timeout waiting for Formatter Command Complete.
			0x03	Formatter error during command execution.
0x50	0x03	Read 4M tones test	0x01	Formatter command not accepted error.
			0x02	Timeout waiting for Formatter Command Complete.
			0x03	Formatter error during command execution.

Table F-18. Routine 51 - Incrementing Block Length Test Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x51	*	Incrementing block length tests	0xE0	DVL card connection was not detected by the DTC.
			0xE1	A working tape was not loaded, or the tape drive was not READY when the test started.
			0xE2	The tape drive is not READY.
0x51	0x01	Write incrementing blocks test	0xE3	The tape (or magazine) is FILE PROTECTED.
			0x01	Cartridge not installed or drive NOT READY error. A tape cartridge must be loaded before this test can be run.
			0x02	Cartridge WRITE PROTECT error. The cartridge must not be write protected for this test.
			0x03	Buffer space request not granted for data transfer.
			0x04	Data transfer timed out.
			0x05	Fatal error detected during data transfer.
			0x06	Bad status reported on data transfer complete.
			0x07	Logical EOT encountered during data transfer.
			0x08	Buffer flush timeout. Write from data buffer to tape was not completed in the allocated time.
			0x09	Write data in error reported at end of data transfer.
0x51	0x02	Rewind test	0x01	Cartridge not installed or drive NOT READY error. A tape cartridge must be loaded before this test can be run.
			0x02	Timeout waiting for Servo Command Complete during rewind operation.
			0x03	Timeout waiting for Formatter Action Complete during rewind operation.
			0x04	Record Manager or Servo error reported during rewind operation.
0x51	0x03	Read incrementing blocks test	0x01	Cartridge not installed or drive NOT READY error. A tape cartridge must be loaded before this test can be run.
			0x02	Error detected while requesting buffer space for data transfer.

Table F-18. Routine 51 - Incrementing Block Length Test Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x51	0x03	Read incrementing blocks test	0x03	Data transfer timeout error.
			0x04	Error reported during data transfer.
			0x05	Fatal error reported at completion of data transfer.
			0x06	Incorrect transfer length, retry required, or recovered error and incorrect length reported at end of data transfer.

Table F-19. Routine 80 - Servo Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x80	*	Servo Diagnostic Tests	0xE0	Test initialization error, the controller could not sense the presence of a DVL card. The DTC card must be connected to a DVL card in order to run this test.
			0xE1	Test initialization error, a servo unload command failed while attempting to eject a cartridge.
			0xE2	Servo reported error while attempting to unload a cartridge during test initialization.
0x80	0x01	Servo Diag: Logic test	0x41	Dummy signal of the file reel tachometer is wrong
			0x42	GAP counter is wrong
			0x43	RRC counter is wrong
			0x44	Forward direction of the file reel tachometer is wrong
			0x45	Backward direction of the file reel tachometer is wrong
			0x46	Dummy signal of the machine reel tachometer is wrong
			0x47	Forward direction of the machine reel tachometer is wrong
			0x48	Backward direction of the machine reel tachometer is wrong
			0xE3	Servo command was not accepted; sense information was built
			0xE4	Servo command was accepted but failed to complete within 60 seconds
			0xE5	Servo error occurred that was not reported as a diagnostic error.
0x80	0x02	Servo Diag: Photo sensors test	0x02	The tape path home sensor is off
			0x03	The cartridge in sensor is on
			0x04	The tape path “CT” sensor is off
			0x05	The tape path “MR” sensor is on
			0x06	The cartridge in sensor in on
			0x07	The file protect sensor is off
			0x08	The cleaning cartridge sensor is on

Table F-19. Routine 80 - Servo Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x80	0x02	Servo Diag: Photo sensors test	0x09	The cartridge mount sensor is on
			0xE3	Servo command was not accepted; sense information was built
			0xE4	Servo command was accepted but failed to complete within 60 seconds
			0xE5	Servo error occurred that was not reported as a diagnostic error.
0x80	0x03	Servo Diag: Loader test	0x01	Loader downward motion is too slow
			0x02	Loader downward motion is too fast
			0x03	Loader upward motion is too slow
			0x04	Loader upward motion is too fast
			0xE3	Servo command was not accepted; sense information was built
			0xE4	Servo command was accepted but failed to complete within 60 seconds
			0xE5	Servo error occurred that was not reported as a diagnostic error.
0x80	0x04	Servo Diag: Threader test	0x01	Threader forward motion is too slow
			0x02	Threader forward motion is too fast
			0x03	Threader backward motion is too slow
			0x04	Threader backward motion is too fast
			0xE3	Servo command was not accepted; sense information was built
			0xE4	Servo command was accepted but failed to complete within 60 seconds
			0xE5	Servo error occurred that was not reported as a diagnostic error.
0x80	0x05	Servo Diag: Tachometer test	0x01	The machine reel tachometer “A” is always “1”
			0x02	The machine reel tachometer “A” is always “0”
			0x03	The machine reel tachometer “B” is always “1”
			0x04	The machine reel tachometer “B” is always “0”
			0x05	The machine reel tachometer “A” and “B” changed at the same time

Table F-19. Routine 80 - Servo Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x80	0x05	Servo Diag: Tachometer test	0x06	The machine reel turns too slow
			0x08	File reel tachometer phase error in forward direction
			0x0A	File reel tachometer phase error in backward direction
			0x0D	File reel turns too slow
			0xE3	Servo command was not accepted; sense information was built
			0xE4	Servo command was accepted but failed to complete within 60 seconds
			0xE5	Servo error occurred that was not reported as a diagnostic error.
0x80	0x06	Servo Diag: ACL/FACL test	0x01	The servo command completed in error and valid sense information was built. Byte 19 of the sense information, which can be found in Table (ACL) or Table (FACL), gives a more detailed description of the error.
			0xE3	Medium changer not detected; this test cannot be run without a medium changer attached.
			0xE4	Magazine eject failed.
			0xE5	Servo reported error occurred during ACL/ FACL test initialization.
0x80	0x07	Servo Diag: Manual Sensor test	0x80	Servo error reported during Manual Sensor test execution.
			0xE3	Medium changer not detected; this test cannot be run without a medium changer attached.
0x80	0x08	Servo Diag: Manual ACL test	0x01	Servo error reported during Manual ACL test execution.
			0xE3	Medium changer not detected; this test cannot be run without a medium changer attached.

Table F-20. Routine 80 Test 06 - Servo ACL Error Codes in Sense Byte 19

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x80	0x06	Sense Byte 19 for ACL	0x01	Bottom stopper up and down sensors both on
			0x02	Bottom stopper up too fast
			0x03	Bottom stopper up too slow (or not move)
			0x04	Bottom stopper down too fast
			0x05	Bottom stopper down too slow (or not move)
			0x10	Pinion phase sensor always on
			0x11	Magazine motor move up too fast
			0x12	Magazine motor move up too slow (or not move)
			0x13	Magazine motor move down too fast
			0x14	Magazine motor move down too slow (or not move)
			0x20	Feeder arm open and close sensors both on
			0x21	Catcher open too fast
			0x22	Catcher open too slow (or not move)
			0x23	Catcher close too fast
			0x24	Catcher close too slow (or not move)
			0x30	Mount arm home sensor always on
			0x31	Mount arm move forward too slow
			0x40	Magazine is detected
			0x50	Cartridge inverse check
			0x60	Pushed interlock check
			0x70	Cartridge is detected

Table F-21. Routine 80 Test 06 - Servo FACL Error Codes in Sense Byte 19

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x80	0x06	Sense byte 19 for FACL	0x01	Door close sensor or door solenoid lock sensor off error
			0x02	Door solenoid lock timeout error
			0x03	Door solenoid unlock timeout error
			0x10	Carrier move up timeout error
			0x11	Carrier move down timeout error
			0x12	Carrier position sensor on too fast error
			0x13	Carrier position sensor off too fast error
			0x14	Carrier stopped at fault position
			0x20	Catch arm open timeout error
			0x21	Catch arm open sensor on too fast error
			0x22	Catch arm close timeout error
			0x23	Catch arm close sensor on too fast error
			0x24	Catch arm open and close sensors both on error
			0x30	Mount arm move drive side timeout error
			0x31	Mount arm drive end sensor on too fast error
			0x32	Mount arm move magazine side timeout error
			0x33	Mount arm magazine end sensor on too fast error
			0x34	Mount arm home and drive end sensors both on error
			0x35	Mount arm home and magazine sensors both on error
			0x40	No cleaning cartridge or not out of cleaning cell

Table F-22. Routine 81 - Manufacturing Test Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x81	*	MFG tests	0xE0	DVL card not detected. This test cannot be run without a DVL card connected to the DTC card
			0xE1	Drive NOT READY error. A working tape must be loaded to run this test.
0x81	0x01	Get MFG Parameters	-	No error codes specific to this test
0x81	0x02	Display MFG Parameters	-	No error codes specific to this test
0x81	0x03	Clear Log Counters	-	No error codes specific to this test
0x81	0x04	Write BOT - EOT test	0x01	Cartridge not installed or drive NOT READY error. A tape cartridge must be loaded before this test can be run.
			0x02	Cartridge WRITE PROTECT error. The cartridge must not be write protected for this test.
			0x03	Buffer space request not granted for data transfer.
			0x04	Data transfer timed out.
			0x05	Fatal error detected during data transfer.
			0x06	Bad status reported on data transfer complete.
			0x07	Logical EOT encountered during data transfer.
			0x08	Buffer flush timeout. Write from data buffer to tape was not completed in the allocated time.
			0x09	Write data in error reported at end of data transfer.
0x81	0x05	Read BOT - EOT test	0x01	Cartridge not installed or drive NOT READY error. A tape cartridge must be loaded before this test can be run.
			0x02	Error detected while requesting buffer space for data transfer.
			0x03	Data transfer timeout error.
			0x04	Error reported during data transfer.
			0x05	Fatal error reported at completion of data transfer.
			0x06	Incorrect transfer length, retry required, or recovered error and incorrect length reported at end of data transfer.

Table F-22. Routine 81 - Manufacturing Test Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x81	0x06	Rewind	0x01	Cartridge not installed or drive NOT READY error. A tape cartridge must be loaded before this test can be run.
			0x02	Timeout waiting for Servo Command Complete during rewind operation.
			0x03	Timeout waiting for Formatter Action Complete during rewind operation.
			0x04	Record Manager or Servo error reported during rewind operation.
0x81	0x07	Locate Block	0x01	Error while attempting to locate block.
0x81	0x08	Space Block	0x01	Error while attempting to space block.
0x81	0x09	Write Filemarks	0x01	Cartridge not installed or drive NOT READY error. A tape cartridge must be loaded before this test can be run.
			0x02	Cartridge WRITE PROTECT error. The cartridge must not be write protected for this test.
			0x03	Buffer space request not granted for data transfer.
			0x04	Logical EOT encountered before all filemarks had been written.
			0x05	Timeout during write filemarks.
			0x06	Error reported at completion of write filemarks.
0x81	0x0A	Space File	0x01	Error while attempting to space file.
0x81	0x0B	Display MFG Results	-	(No error codes specific to this test)

Table F-23. Routine 82 - Magnetic Tape Unit Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x82	*	MTU diagnostics routine	0xE0	A DVL card was not detected. This routine requires that the DTC card be properly connected to a DVL card.
0x82	0x01	MTU diagnostic load execute table	-	(No error codes specific to this test)
0x82	0x02	MTU diagnostic send execute table	0x01	The MTU diagnostic parameters were not successfully downloaded through the Servo Shared RAM Interface.
0x82	0x03	MTU diagnostic run	0x01	Servo Interface indicated that a servo command was not accepted
			0x02	Servo Interface indicated that an error occurred while processing the current Servo Command. Sense information was built.
			0x03	The current servo command failed to complete in the allocated time.
			0x04	An error occurred during execution of the current servo command. Sense information was built.
			0x05	No valid test groups were found.
0x82	0x04	MTU diagnostic retrieve results table	0x01	An error occurred attempting to retrieve the MTU diagnostic results through the Servo Shared RAM Interface.

Table F-24. Routine 83 - Operator Control Panel Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x83	*	All Operator Control Panel tests	0xE0	Operator Control Panel interface to the DTC card not detected.
0x83	0x01	Operator Control Panel keys test	0x01	RESET switch press not detected in allotted time.
			0x02	RESET switch release not detected in allotted time.
			0x03	UNLOAD switch press not detected in allotted time.
			0x04	UNLOAD switch release not detected in allotted time.
			0x05	START switch press not detected in allotted time.

Table F-24. Routine 83 - Operator Control Panel Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x83	0x01	Operator Control Panel keys test	0x06	START switch release not detected in allotted time.
			0x07	TEST switch press not detected in allotted time.
			0x08	TEST switch release not detected in allotted time.
			0x09	SHIFT switch press not detected in allotted time.
			0x0A	SHIFT switch release not detected in allotted time.
0x83	0x02	Operator Control Panel display test	0x01	Scrolling message not acknowledged within allotted time.
			0x02	General message, first half not acknowledged within allotted time.
			0x03	General message, flash first half not acknowledged within allotted time.
			0x04	General message, last half not acknowledged within allotted time.
			0x05	General message, flash last half not acknowledged within allotted time.
			0x06	General message, alternating first/last half not acknowledged within allotted time.
			0x07	Blinking character message not acknowledged within allotted time.
0x83	0x03	Operator Control Panel tape LED test	0x01	Correct tape position LED sequence not acknowledged within allotted time.
0x83	0x04	Operator Control Panel drive LED test	0x01	Correct operation of SELECT LED not acknowledged within allotted time.
			0x02	Correct operation of COMPRESSION LED not acknowledged within allotted time.

Table F-25. Routine 90 - Tape Drive Diagnostic Error Codes

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x90	*	All Drive Diag tests	0xE0	A DVL card was not detected. This routine requires that the DTC card be properly connected to a DVL card.
			0x01	Error transferring diagnostic parameters through the Shared RAM interface.
			0x05	Error receiving diagnostic results through the Shared RAM interface. (MFG mode only)
x90	0x01	Drive Diag: LOAD test	0x02	Servo error reported during drive diagnostic cartridge load test.
0x90	0x02	Drive Diag: AC/PS, MODCH tests	0x02	Servo error reported during drive diagnostic access/positioning test or mode change test.
0x90	0x03	Drive Diag: TPPFM test	0x02	Servo error reported during drive diagnostic tape acceleration/decleration test.
0x90	0x04	Drive Diag: LOCAT test	0x02	Servo error reported during drive diagnostic tape locate test.
0x90	0x05	Drive Diag: D.S.E test	0x02	Servo error reported during drive diagnostic Data Security Erase test.
0x90	0x06	Drive Diag: REWND test	0x02	Servo error reported during drive diagnostic rewind test.
0x90	0x07	Drive Diag: UNLOD test	0x02	Servo error reported during drive diagnostic cartridge unload test.
0x90	0x08	Drive Diag: ACL LDUL test	0xE0	A DVL card was not detected. This routine requires that the DTC card be properly connected to a DVL card.
			0xE1	Autoloader not detected. Must have an autoloader attached to run this test.
			0xE2	Servo error reported during tape removal.
			0xE3	Servo error reported during magazine removal.
			0xE4	Servo error reported during magazine insertion.
			0xE5	Servo error reported while waiting for FACL door to be closed.
			0xE6	Servo error reported while waiting for START switch to be pressed to load a tape.
			0xE7	Servo error reported during magazine load.
			0xE8	Servo error detected during magazine operation.

Table F-25. Routine 90 - Tape Drive Diagnostic Error Codes (Continued)

ROUTINE	TEST	TITLE	ERROR CODE	DESCRIPTION
0x90	0x08	Drive Diag: ACL LDUL test	0xE9	Magazine or magazine type not detected.
			0xEA	No cartridges detected in magazine. Must have at least one working cartridge installed in a magazine to run this test.
			0x02	Error reported during Autoloader load/unload test.

APPENDIX G

SUPPORTED SCSI TRANSFER RATES

The SCSI transfer rates that will be supported are determined by the available oscillator frequency, 20 MHz.

Table G-1. SCSI Transfer Rates for 20 MHz

XFR REG VALUE (DEC)	TRANSFER RATE (MB/S) FAST/NARROW DATA PHASE (ROUNDED TO 2 POSITIONS)	TRANSFER RATE (MB/S) FAST/WIDE DATA PHASE (ROUNDED TO 2 POSITIONS)
2	10.0	20.0
3	6.67	13.33
4	5.0	10.0
5	4.0	8.0
6	3.33	6.67
7	2.86	5.71
8	2.5	5.0
9	2.22	4.44
10	2.0	4.0
11	1.82	3.64
12	1.67	3.33
13	1.54	3.08
14	1.43	2.86
15	1.33	2.67
16	1.25	2.5
17	1.18	2.35
18	1.11	2.22
19	1.05	2.1
20	1.0	2.0
21	0.95	1.90
22	0.91	1.82
23	0.87	1.74
24	0.83	1.67
25	0.80	1.60
26	0.77	1.54

SCSI TRANSFER RATES

Table G-1. SCSI Transfer Rates for 20 MHz (Continued)

XFR REG VALUE (DEC)	TRANSFER RATE (MB/S) FAST/NARROW DATA PHASE (ROUNDED TO 2 POSITIONS)	TRANSFER RATE (MB/S) FAST/WIDE DATA PHASE (ROUNDED TO 2 POSITIONS)
27	0.74	1.48
28	0.71	1.43
29	0.69	1.38
30	0.67	1.33
31	0.65	1.29
00	0.62	1.25

APPENDIX H

MTU DIAGNOSTIC SPECIFICATIONS

This appendix contains the Magnetic Tape Unit (MTU) DIAG Specifications (SCSI/RS-232C).

H-1 OUTLINE

For the M2488 test routines, such as DIAGs for the life test and evaluation, are provided in the servo microcode. Some routines that are used for factory automatic testing are provided as DIAGs.

This specifications describes how to activate the routines through SCSI or RS-232C interfaces, and how to output the execution result.

H-2 HOW TO EXECUTE THE DIAG

H-2.1 SCSI interface

Activate the MTU DIAG from the SCSI interface using the SEND DIAGNOSTIC command. Output the DIAG execution result data using the RECEIVE DIAGNOSTIC RESULTS command. The parameter for activating the MTU DIAG requires 480 bytes. When the DIAG has been completed, 512 bytes of data are transferred as the execution result.

H-2.2 RS-232C interface

The MTU DIAG is activated from the RS-232C interface using an exclusive command. The DIAG execution result data is also output to the RS-232C using the exclusive command. The MTU DIAG activation parameter requires 480 bytes. After the DIAG has been completed, 512 bytes of data is transferred with the results.

H-2.3 How to execute the DIAG for the MTU

The CP executes the DIAG for the MTU as follows:

1) Transfers the DIAG parameter to the servo microprocessor unit. (480 byte)
2) Activates the MTU DIAG.
3) Receives the DIAG result data.(512 byte)

For these commands, refer to the Drive Controller-Drive Firmware Interface Specification.

H-3 M2488 DIAG STRUCTURE

The M2488 diagnostic tests can be classified into five types:

1. RD/WRT: Ten diagnostic tests to check read and write
2. LD/UNLD: Two diagnostic tests to check loading and unloading
3. ACL TEST: Two diagnostic tests to check the autoloader
4. TESTMODE: Diagnostic test to measure operations
5. COMBINATION: Running test by combining up to ten commands

These tests are presented in the following tables.

READ/WRITE test			
Read/write test	FWD READ	Forward read test	CMD CD : 0x11
	BWD READ	Backward read test	CMD CD : 0x12
	WRITE	Write test	CMD CD : 0x13
	FRD/BRD	FRD<->BRD test	CMD CD : 0x14
	L.W.R.	loop write to read test	CMD CD : 0x15
	FEED THR	feed through test	CMD CD : 0x16
	D.S.E.	D.S.E	CMD CD : 0x17
	WRP1 BOT	goto Wrap 1 BOT(Rewind)	CMD CD : 0x18
	WRP1 EOT	goto Wrap 1 EOT(Locate)	CMD CD : 0x19
	LOCATE	locate	CMD CD : 0x1A
	TP PATH	tape path test	CMD CD : 0x1B

LOAD/UNLOAD test			
Load/Unload test	NO CTG	LOADER/THREADER test	CMD CD : 0x20
	WITH CTG	load/unload test	CMD CD : 0x21

ACL test			
Auto loader test	ACL LDUL	Load/unload test	CMD CD : 0x90
	MAG UPDW	Magazine Up/Down test	CMD CD : 0x91

TESTMODE			
measure diag	M1:LOAD	Measure the cartridge loading time.	CMD CD : 0x41
	M2:TPPFM	Measure the tape acceleration/ deceleration time.	CMD CD : 0x42
	M3:AC/PS	Measure the tape access/positioning time.	CMD CD : 0x43
	M4:MODCH	Measure the mode change time.	CMD CD : 0x44
	M5:LOCAT.	Measure the tape locating time.	CMD CD : 0x45
	M6:REWND	Measure the tape rewinding time.	CMD CD : 0x46
	M7:D.S.E	Measure the DSE time.	CMD CD : 0x47
	M8:UNLD	Measure the cartridge unloading time.	CMD CD : 0x48
	M9:CLEAN	Measure the cleaning time.	CMD CD : 0x49

COMBINATION test			
Combination test	FWD READ	Forward read test	CMD CD : 0x01
	BWD READ	BACKWARD READ test.	CMD CD : 0x02
	WRITE	Write test.	CMD CD : 0x03
	D.S.E	D.S.E.test	CMD CD : 0x04
	LOCATE	Locating	CMD CD : 0x05
	REWIND	Rewinding to wrap1-BOT	CMD CD : 0x06
	LOAD	Load	CMD CD : 0x07
	UNLOAD	Unload	CMD CD : 0x08
	EJECT	Eject	CMD CD : 0x80
	TP PATH	tape path test	CMD CD : 0x0B
	REPEAT	Set next execution group and repeat counter.	CMD CD : 0x0A
	RUNNING	END TEST.	CMD CD : 0x0C or 0xFF
	ERROR RESET		CMD CD : 0x70 or 0xF0

H-4 MTU DIAG PARAMETER

H-4.1 DIAG activation parameter

The total data requirement for the MTU DIAG activation is 480 bytes.

H-4.2 Explanation

The parameter for the DIAG activation is composed of 16 groups. Each group requires 30 bytes. After the DIAG test of group 1 has been completed, the test of group 2 is executed and so on. If data 0xff or 0x0C is specified for the DIAG command code, the DIAGs of subsequent groups are not executed and all DIAGs are terminated. If an error is detected during a DIAG execution, that test is terminated.

```
struct diag parm {
                    unsigned char diag command;
                    unsigned char diag parameter [9];
                    unsigned long execute time;
                    unsigned long stop time;
                    unsigned long execute count;
                    unsigned char reserve [8]
               } diag input parm [16];
```

`DIAG command code`:

Specifies the command code of the DIAG to be executed.

`DIAG parameter 1 to 9`:

Selects the mode according to the DIAG to be executed.

diag_parameter 1	------	For the read/write DIAG, set the operation mode.
	------	For the locate DIAG, specify a sector.
diag_parameter 2	------	For the read/write DIAG, specify a test wrap.
	------	For the load/unload DIAG, specify “LOADER“ or “THREADER”.

**--->		------	For user diag flag
	diag_parameter 3	------	For the load/unload DIAG, specify a loading start position.
		------	For the ACL DIAG, specify a magazine up start position.
**--->		------	no eject magazine mode (after diagnostic test for user diag)
	diag_parameter 4	------	For the write DIAG, select a write data pattern.
		------	For the load/unload DIAG, Specify a unloading end position.
		------	For the ACL DIAG, specify a magazine down start position.
	diag_parameter 5	------	Select a path for the Loop Write To Read command.
	diag_parameter 6	------	Set a level of the Loop Write To Read command.
		------	Specify a repeat start position.
	diag_parameter 7	------	reserve
	diag_parameter 8	------	reserve
	diag_parameter 9	------	reserve

`execution time`:

For the read/write DIAG, specifies the execution time of the read/write.

For the path test, specifies start position.

For the ACL DIAG, specifies a cleaning count (FACL only).

`stop time`:

For the read/write DIAG, specifies the stop time of the read/write.

For the path test, specifies end position.

`execute count`:

Specifies the number of DIAG executions.

`DIAG reserve 1 to 8`:

diag_reserve 1 ------ For drive local flag

diag_reserve 2 ------ For 232C/SCSI mode flag

Details of each parameter are specified elsewhere.

H-4.3 DIAG

H-4.3.1 READ/WRITE: Ten diagnostic tests to check read and write

(Set the tests in detail using the given parameters.)

1)	FWD READ:	Forward read	-------	CMD CD : 0x11
2)	BWD READ:	Backward read	-------	CMD CD : 0x12
3)	WRITE:	Write	-------	CMD CD : 0x13
4)	FRD/BRD:	Forward and backward read alternately	-------	CMD CD : 0x14
5)	L.W.R.:	Loop write to read	-------	CMD CD : 0x15
6)	FEED THR:	Feedthrough write	-------	CMD CD : 0x16
7)	D.S.E.:	DSE operation	-------	CMD CD : 0x17
8)	WRP1 BOT:	High-speed tape run to wrap-1 BOT (Rewinding)	-------	CMD CD : 0x18
9)	WRP1 EOT:	High-speed tape run to wrap-1 EOT	-------	CMD CD : 0x19
10)	LOCATE:	High-speed tape run to specified sector (Locating)	-------	CMD CD : 0x1A
11)	TAPE PATH:	Tape run between the specified start position and end position.	-------	CMD CD : 0x1B

The tests can be set using the following parameters:

DIAG parameter 1: For "FRD READ", "BWD READ" or "WRITE", set the operation mode.

0x00 -	STREAMING	:	Set a continuous read (or write) operation.
0x01 -	START/STOP	:	Set the start/stop operation.

: For "LOCATE", specify a sector. Specify a location sector from 1 to 99.

DIAG parameter 2: For "FWD READ", "BWD READ", "WRITE", "FRD/BRD", "L.W.R." and "FEED THR", specify a test wrap.

0x00 -	WRAP 1	:	Wrap-1 test
0x01 -	WRAP 2	:	Wrap-2 test

DIAG parameter 4: For "WRITE", select a write data pattern from the following:

0x00 -	D.S.E. PT	:	D.S.E. pattern
0x01 -	2 F PT	:	2F pattern
0x02 -	1/6 F PT	:	1/6F pattern
0x03 -	1/5 F PT	:	1/5F pattern
0x04 -	1/4 F PT	:	1/4F pattern
0x05 -	1/3 F PT	:	1/3F pattern
0x06 -	1/2 F PT	:	1/2F pattern
0x07 -	1 F PT	:	1F pattern
0x08 -	1/12 F PT	:	1/12F pattern
0x09 -	1.5 F PT	:	1.5F pattern

DIAG parameter 5: For "L.W.R.", select a path of the Loop Write To Read command from the following:

0x00 -	PATH:A	:	Path A
0x01 -	PATH:B	:	Path B

DIAG parameter 6: For "L.W.R.", set a level of the Loop Write To Read command from the following:

0x00 -	LEVEL LO	:	Low level
0x01 -	LEVEL HI	:	High level

execution time: When diag parameter 1 is START/STOP, set the GO ON time (time when the tape is running).1 count is 10msec.
If this parameter is set to "0," the GO ON time becomes 10 ms.

: For the path test, specifies start position by the machine reel counter.

stop time: When diag parameter 1 is START/STOP, set the GO OFF time (time when the tape is not running). 1 count is 10msec.
If this parameter is set to "0," the GO OFF time becomes 0 ms.

: For the path test, specifies end position by the machine reel counter.

execute count: Specify an execution count. Specify a command execution count from 1 to 99,999.
When 0 is set, the command execution continues with no stop.

H-4.3.2 LOAD/UNLOAD: Two diagnostic tests to check loading and unloading

(Set the tests in detail using the given parameters.)

1) `NO CTG`: Loader and Threader test not using cartridge ------- CMD CD : 0x20
2) `WITH CTG`: Loader and Threader test using cartridge. ------- CMD CD : 0x21

The tests can be set using the following parameters:

DIAG parameter 2: For NO CTG, select a test type from the following:

0x00 -	LOADER	:	Loader test
0x01 -	THREADER	:	Threader test.

DIAG parameter 3: For WITH CTG, select a loading position from the following:

0x00 -	S:LD HM	:	Start loading from the loader home position.
0x01 -	S:CTG IN	:	Start loading from the cartridge-in position.
0x02 -	S:CAR DW	:	Start loading from the carrier-down position.

DIAG parameter 4: For WITH CTG only, select an unloading position from the following:

0x00 -	E:TH END	:	Start unloading from the thread end.
0x01 -	E:CAR DW	:	Start unloading from the carrier-down position.
0x02 -	1/6 F PT	:	Start unloading from the cartridge-in position.

execute count: Specify an execution count. Specify a command execution count from 1 to 99,999. When 0 is set, the command execution continues with no stop.

H-4.3.3 ACL TEST: Two diagnostic tests to check the autoloader

(Set the tests in detail using the given parameters.)

1) ACL LDUL: Load and unload cartridges sequentially from the top position of the magazine. ------- CMD CD : 0x90
2) MAG UPDW: Move the magazine between two position. ------- CMD CD : 0x91

The tests can be set using the following parameters:

DIAG parameter 3: For MAGAZINE UP/DOWN test, set the following:

0xXX- STRT Position : Magazine up-down start position

ACL type:	0x00 - 0x09 (10 slot type)
	0x00 - 0x04 (5 slot type)
FACL type:	0x00 - 0x06

DIAG parameter 4: For MAGAZINE UP/DOWN test, set the following:

0xXX- END Position : Magazine up-down end position.

ACL type:	0x00 - 0x09 (10 slot type)
	0x00 - 0x04 (5 slot type)
FACL type:	0x00 - 0x06

execution time: For ACL LOAD/UNLOAD test, set the frequency in use of cleaning cartridge. Cleaning cartridge in cleaning cell is loaded every setting counter. (from 1 to 99,999) Only FACL. If DIAG command code is set “0x90” and execution time is set “999”, cleaning cartridge is loaded one time.

execute count: Specify an execution count. Specify a command execution count from 1 to 99,999. When 0 is set, the command execution continues with no stop.

H-4.3.4 TESTMODE: Diagnostic test to measure operations

(This test has no parameter.)

1) M1:LOAD: Measure the cartridge loading time ------- CMD CD : 0x41
2) M2:TPPFM: Measure the tape acceleration/deceleration time. ------- CMD CD : 0x42
3) M3:AC/PS: Measure the tape access/positioning time. ------- CMD CD : 0x43
4) M4:MODCH: Measure the mode change time. ------- CMD CD : 0x44
5) M5:LOCAT: Measure the tape locating time. ------- CMD CD : 0x45
6) M6:REWND: Measure the tape rewinding time. ------- CMD CD : 0x46
7) M7:D.S.E: Measure the DSE time. ------- CMD CD : 0x47
8) M8:UNLD: Measure the cartridge unloading time. ------- CMD CD : 0x48
9) M9:CLEAN: Measure the cleaning time. ------- CMD CD : 0x49

H-4.3.4.1 M1:LOAD: Cartridge loading time measurement

Load a cartridge and measure the following operation time during loading. The cartridge type may be normal or E.

Loading time	Measure the time from when the loader starts moving and reaches the down position. (Unit: 1/10 sec)
Clutch winding time	Measure the time from when the loader reaches the down position until clutch winding finishes. (Unit: 1/10 sec)
Threading time	Measure the time from when the threader starts working until the leader block enters the machine reel. (Unit: 1/10 sec)
BOT shaking time	Measure the time from when the leader block enters the machine reel until the tape stops at wrap-1 EOT after shaking. (Unit: 1/10 sec) Depending on the loaded cartridge, measured data is stored in either of two areas reserved for normal and E cartridges.

H-4.3.4.2 M2:TPPFM: Measure the tape acceleration/deceleration time.

Tape acceleration or deceleration time

Measure the tape acceleration or deceleration time in a read-write operation.

- Measuring command: Forward Read, Back Read, or Write
- Measuring tape position: Wrap-1 sector 5 (A sector is able to be changed by “CHK SECT”)
- Unit of measurement: 1 msec

H-4.3.4.3 M3:AC/PS: Measure the tape access/positioning time.

Access time

Measure the time from a run command starts until gap-in is output.

- Measuring command: Forward Read, Back Read, or Write
- Measuring tape position: Wrap-1 sector 5 (A sector is changed by “CHK SECT”)
- Unit of measurement: 1 msec

Positioning time

Measure the positioning time.

- Measuring command: Forward Read, Back Read, or Write
- Measuring tape position: Wrap-1 sector 5 (A sector is changed by “CHK SECT”)
- Unit of measurement: 1 msec

H-4.3.4.4 M4:MODCH: Mode change time measurement

Measure the mode change time in the following command combinations:

Wrap 1 FRD -> Wrap 1 BRD
Wrap 1 FRD -> Wrap 1 WRT
Wrap 1 BRD -> Wrap 1 FRD
Wrap 1 BRD -> Wrap 1 WRT
Wrap 1 WRT -> Wrap 1 BRD
Wrap 2 FRD -> Wrap 2 BRD
Wrap 2 FRD -> Wrap 2 WRT
Wrap 2 BRD -> Wrap 2 FRD
Wrap 2 BRD -> Wrap 2 WRT
Wrap 2 WRT -> Wrap 2 BRD

- Measuring tape position: Wrap-1 sector 5 (A sector is changed by “CHK SECT”)
- Unit of measurement: 1 msec

H-4.3.4.5 M5:LOCAT: Tape locating time measurement

Measure the time required for tape locating from the wrap-1 BOT position to the wrap-1 PEOT position. (Unit: 1/10 sec)
The measured data is stored in either of two areas for normal and E cartridges.
After rewinding the tape to the wrap-1 BOT, servo MPU measures the Locating execution time from wrap-1 BOT to sector 95.

H-4.3.4.6 M6:REWND: Tape rewinding time measurement

Measure the time required for tape rewinding from the wrap-1PEOT position to the wrap-1 BOT position. (Unit: 1/10 sec)
The measured data is stored in either of two areas for normal and E cartridges.
After locating sector 95, servo MPU measures the Rewinding execution time from sector 95 to wrap-1 BOT.

H-4.3.4.7 M7:D.S.E: DSE time measurement

Measure the time required for DSE from the wrap-1 BOT position to the wrap-2 PEOT position. (Unit: 1/10 sec)
After rewinding the tape to the wrap-1 BOT, measure the DSE command execution time necessary to reach the wrap-2 PEOT position.

H-4.3.4.8 M8:UNLD: Cartridge unloading time measurement

If the tape is not at the wrap-1 BOT position, rewind the tape.
Unload the cartridge and measure the following operation times during unloading. Both normal and E-cartridge are able to be measured.

Tape winding time (from wrap-1 BOT to immediately before unthreading)
Measure the time from when the start of rewinding from the wrap-1 BOT position begins until immediately before unthreading. (Unit: 1/10 sec)
Unthreading time
Measure the time from the start of unthreading until the end of threading. (Unit: 1/10 sec)
Loader operation time
Measure the time from when the loader starts rising until it ejects the cartridge (by the ejection arm). (Unit: 1/10 sec)

H-4.3.4.9 M9:CLEAN: Cleaning time measurement

Load a cleaning cartridge and measure the time from when loader starts loading the cartridge until its ejects the cartridge after cleaning. (Unit: 1/10 sec)

The tests can be set using the following parameters:

DIAG parameter 1: For “M2:TPPFM”, “M3:AC/PS” and “M4:MODCH”, specify a location sector from 1 to 75.
The minimum value is 5.
The maximum value for a normal length cartridge is 60.
The maximum value for an external length cartridge is 75.

H-4.4 COMBINATION : Running test by combining up to ten commands

1)	#:F-READ (Forward read):	Forward read run It is same “FWD READ” test of READ/WRITE test.	-------	CMD CD : 0x01
2)	#:B-READ (Backward read):	Backward read run It is same “BWD READ” test of READ/WRITE test.	-------	CMD CD : 0x02
3)	#:WRITE (Write):	Write operation It is same “WRITE” test of READ/WRITE test.	-------	CMD CD : 0x03
4)	#:D.S.E. (DSE):	DSE operation It is same “D.S.E.”test of READ/WRITE test.	-------	CMD CD : 0x04
5)	#:LOCATE (Locate):	High-speed tape run to a specified sector It is same “LOCATE” test of READ/WRITE test.	-------	CMD CD : 0x05
6)	#:REWIND (Rewind):	High-speed tape run to the wrap-1 BOT position It is same “WRAP1 BOT” test of READ/WRITE test.	-------	CMD CD : 0x06
7)	#:UNLOAD (Unload):	Unloading	-------	CMD CD : 0x07
8)	#:LOAD (Load):	Loading next tape from a magazine. (only ACL/FACL)	-------	CMD CD : 0x08
9)	#:EJECT (Eject):	Ejection (only ACL/FACL)	-------	CMD CD : 0x80
10)	TAPE PATH:	Tape run between the specified start position and end position. It is same “TAPE PATH” test of READ/WRITE test.	-------	CMD CD : 0x0B
11)	#:REPEAT (Running repeat):	Repetition of run This diagnostic test repeats execution of diagnostic test from a specified test.	-------	CMD CD : 0x0A

The tests can be set using the following parameters:

DIAG parameter 6: Specify a repeat start position.

execute count: Specify an execution count. Specify a command execution count from 1 to 99,999. (When 0 is set, not repeat)

For example:

After end of 5th group, command code is set following:

DIAG command code is set “0x0A”
diag_parameter 6 is set “2”
execute count is set “3”

This diagnostic test repeats execution of diagnostic test

3 times from group 2 to group 5.

12)	#:END (Running end):	End of run This is end of diagnostic test.	-------	CMD CD : 0x0C or 0xFF

H-4.5 Error reset command ------- CMD CD : 0x70 or 0xF0

If A error is reported by the MTU during diagnostic test, it is necessary to issue this command.

H-5 PARAMETER LIST

FORWARD READ test		
	: name	: code
DIAG command code	: FORWARD READ test	: 0x11 or 0x01
DIAG parameter 1	: Set the operation mode	: 0x00 or 0x01
DIAG parameter 2	: Specify a test wrap	: 0x00 or 0x01
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	: Specify a execution time of test	: 0 - 99,999
stop time	: Specify a stop time of test	: 0 - 99,999
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

BACKWARD READ test		
	: name	: code
DIAG command code	: BACKWARD READ test	: 0x12 or 0x02
DIAG parameter 1	: Set the operation mode	: 0x00 or 0x01
DIAG parameter 2	: Specify a test wrap	: 0x00 or 0x01
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	: Specify a execution time of test	: 0 - 99,999
stop time	: Specify a stop time of test	: 0 - 99,999
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

WRITE test		
	: name	: code
DIAG command code	: WRITE test	: 0x13 or 0x03
DIAG parameter 1	: Set the operation mode	: 0x00 or 0x01
DIAG parameter 2	: Specify a test wrap	: 0x00 or 0x01
DIAG parameter 3	:	:
DIAG parameter 4	: Select a write data pattern	: 0x00 - 0x09
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:

WRITE test		
	: name	: code
DIAG parameter 9	:	:
execute time	: Specify a execution time of test	: 0 - 99,999
stop time	: Specify a stop time of test	: 0 - 99,999
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

FORWARD READ / BACKWARD READ test		
	: name	: code
DIAG command code	: FORWARD READ BACKWARD READ test	: 0x14
DIAG parameter 1	:	:
DIAG parameter 2	: Specify a test wrap	: 0x00 or 0x01
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	: Specify a execution time of test	: 0 - 99,999
stop time	: Specify a stop time of test	: 0 - 99,999
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

LOOP WRITE TO READ test		
	: name	: code
DIAG command code	: L.W.R test	: 0x15
DIAG parameter 1	:	:
DIAG parameter 2	: Specify a test wrap	: 0x00 or 0x01
DIAG parameter 3	:	:
DIAG parameter 4	: Select a write data pattern	: 0x00 - 0x09
DIAG parameter 5	: Select a PATH of L.W.R	: 0x00 or 0x01
DIAG parameter 6	: Select a Level of L.W.R	: 0x00 or 0x01
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	: Specify a execution time of test	: 0 - 99,999
stop time	: Specify a stop time of test	: 0 - 99,999
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

FEED THROUGH test		
	: name	: code
DIAG command code	: FEED THROUGH test	: 0x16
DIAG parameter 1	:	:
DIAG parameter 2	: Specify a test wrap	: 0x00 or 0x01

FEED THROUGH test		
	: name	: code
DIAG parameter 3	:	:
DIAG parameter 4	: Select a write data pattern	: 0x00 - 0x09
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	: Specify a execution time of test	: 0 - 99,999
stop time	: Specify a stop time of test	: 0 - 99,999
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

D.S.E test		
	: name	: code
DIAG command code	: D.S.E. test	: 0x17 or 0x04
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

WRAP 1 BOT test		
	: name	: code
DIAG command code	: WRAP 1 BOT test	: 0x18 or 0x06
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

WRAP 1 EOT test		
	: name	: code
DIAG command code	: WRAP 1 EOT test	: 0x19
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

LOCATE test		
	: name	: code
DIAG command code	: LOCATE test	: 0x1A or 0x05
DIAG parameter 1	: Specify a sector	: 0 - 99
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

TAPE PATH test		
	: name	: code
DIAG command code	: TAPE PATH test	: 0x1B or 0x0B
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:

TAPE PATH test		
	: name	: code
execute time	: Specify a execution time of test	: 0 - 99,999
stop time	: Specify a stop time of test	: 0 - 99,999
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

NO CARTRIDGE (LOAD/UNLOAD)test		
	: name	: code
DIAG command code	: NO CARTRIDGE	: 0x20
DIAG parameter 1	:	:
**----->		
DIAG parameter 2	: specifies “LOADER” or “THREADER”	: 0x00 or 0x01
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

WITH CARTRIDGE (LOAD/UNLOAD)test		
	: name	: code
DIAG command code	: WITH CARTRIDGE	: 0x21
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	: specifies loading start position	: 0x00 - 0x02
DIAG parameter 4	: specifies unloading start position	: 0x00 - 0x02
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

ACL LOAD/UNLOAD test		
	: name	: code
DIAG command code	: ACL LOAD/UNLOAD test	: 0x90
DIAG parameter 1	:	:
DIAG parameter 2	:	:

ACL LOAD/UNLOAD test		
	: name	: code
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	: frequency in use of cleaning CTG (only FACL)	: 0 - 99,999
stop time	:	:
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

ACL MAGAZINE UP/DOWN test		
	: name	: code
DIAG command code	: ACL MAGAZINE UP/DOWN test	: 0x91
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	: start position for MAGAZINE UP	: 0x00 - 0x02
DIAG parameter 4	: end position for MAGAZINE UP	: 0x00 - 0x02
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	: the number of DIAG executions	: 0 - 99,999
reserve	:	:

M1:LOAD		
	: name	: code
DIAG command code	: M1:LOAD	: 0x41
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

M2:TPPFM		
	: name	: code
DIAG command code	: M2:TPPFM	: 0x42
**---->		
DIAG parameter 1	: Specify a sector	: 5 - 75
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

M3:AC/PS		
	: name	: code
DIAG command code	: M3:AC/PS	: 0x43
**---->		
DIAG parameter 1	: Specify a sector	: 5 - 75
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

M4:MODCH		
	: name	: code
DIAG command code	: M4:MODCH	: 0x44
**---->		
DIAG parameter 1	: Specify a sector	: 5 - 75
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:

M4:MODCH		
	: name	: code
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

M5:LOCAT		
	: name	: code
DIAG command code	: M5:LOCAT	: 0x45
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

M6:REWND		
	: name	: code
DIAG command code	: M6:REWND	: 0x46
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

M7:D.S.E.		
	: name	: code
DIAG command code	: M7:D.S.E.	: 0x47
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

M8:UNLD		
	: name	: code
DIAG command code	: M8:UNLD	: 0x48
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

M9:CLEAN		
	: name	: code
DIAG command code	: M9:CLEAN	: 0x49
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:

M9:CLEAN		
	: name	: code
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

LOAD test		
	: name	: code
DIAG command code	: LOAD	: 0x07
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

UNLOAD test		
	: name	: code
DIAG command code	: UNLOAD	: 0x08
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

EJECT test		
	: name	: code
DIAG command code	: EJECT	: 0x80
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:

EJECT test		
	: name	: code
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

REPEAT		
	: name	: code
DIAG command code	: REPEAT	: 0x0A
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	: repeat start position	: 0x00 - 0x0F
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	: repeat counter	: 0 - 99,999
reserve	:	:

END		
	: name	: code
DIAG command code	: END	: 0x0C or 0xFF
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

ERROR RESET		
	: name	: code
DIAG command code	: ERROR RESET command	: 0x70 or 0xF0
DIAG parameter 1	:	:
DIAG parameter 2	:	:
DIAG parameter 3	:	:
DIAG parameter 4	:	:
DIAG parameter 5	:	:
DIAG parameter 6	:	:
DIAG parameter 7	:	:
DIAG parameter 8	:	:
DIAG parameter 9	:	:
execute time	:	:
stop time	:	:
execute count	:	:
reserve	:	:

H-6 DIAG RESULT DATA

The MTU DIAG execution result takes up 512 bytes.

Explanation

The DIAG execution result data is divided into groups. Each group requires 32 bytes. The result data is stored in an area corresponding to the DIAG group executed under the SEND DIAGNOSTIC command.

```
struct diag result {
                         unsigned short error code;
                         unsigned short diag result data[15];
                    } diag output parm [16];
        error code : 0x0000 ------ Normal end
        error code : 0xFF00 ------ Break end
        error code : 0x00XX ------ Error end  ( XX : Error code )
```

The DIAG result data format is shown as follows:

DIAG result format

Result of Loading time (“M1:LOAD”)			
		: measurement result	: unit
0- 1	error code	:	:
2- 3	result data 1	: Loading time	: 1/10 sec
4- 5	result data 2	: Clutch winding time	: 1/10 sec
6- 7	result data 3	: Threading time	: 1/10 sec
8- 9	result data 4	: BOT shaking time for normal CTG	: 1/10 sec
10- 11	result data 5	: BOT shaking time for E-CTG	: 1/10 sec
12- 13	result data 6	:	:
14- 15	result data 7	:	:

Result of Loading time ("M1:LOAD")			
		: measurement result	: unit
16- 17	result data 8	:	:
18- 19	result data 9	:	:
20- 21	result data 10	:	:
22- 23	result data 11	:	:
24- 25	result data 12	:	:
26- 27	result data 13	:	:
28- 29	result data 14	:	:
30- 31	result data 15	:	:

Result of Tape acceleration/deceleration time ("M2:TPPFM")			
		: measurement result	: unit
0- 1	error code	:	:
2- 3	result data 1	: Access time (wrap1 FRD)	: 1 msec
4- 5	result data 2	: Positioning time (wrap1 FRD)	: 1 msec
6- 7	result data 3	: Access time (wrap1 BRD)	: 1 msec
8- 9	result data 4	: Positioning time (wrap1 BRD)	: 1 msec
10- 11	result data 5	: Access time (wrap1 WRT)	: 1 msec
12- 13	result data 6	: Positioning time (wrap1 WRT)	: 1 msec
14- 15	result data 7	: Access time (wrap 2 FRD)	: 1 msec
16- 17	result data 8	: Positioning time (wrap 2 FRD)	: 1 msec
18- 19	result data 9	: Access time (wrap 2 BRD)	: 1 msec
20- 21	result data 10	: Positioning time (wrap 2 BRD)	: 1 msec
22- 23	result data 11	: Access time (wrap 2 WRT)	: 1 msec
24- 25	result data 12	: Positioning time (wrap 2 WRT)	: 1 msec
26- 27	result data 13	:	:
28- 29	result data 14	:	:
30- 31	result data 15	:	:

Result of Mode change time ("M4:MODCH")			
		: measurement result	: unit
0- 1	error code	:	:
2- 3	result data 1	: Wrap 1 FRD -> Wrap 1 BRD	: 1 msec
4- 5	result data 2	: Wrap 1 FRD -> Wrap 1 WRT	: 1 msec
6- 7	result data 3	: Wrap 1 BRD -> Wrap 1 FRD	: 1 msec
8- 9	result data 4	: Wrap 1 BRD -> Wrap 1 WRT	: 1 msec
10- 11	result data 5	: Wrap 1 WRT -> Wrap 1 BRD	: 1 msec
12- 13	result data 6	: Wrap 2 FRD -> Wrap 2 BRD	: 1 msec
14- 15	result data 7	: Wrap 2 FRD -> Wrap 2 WRT	: 1 msec
16- 17	result data 8	: Wrap 2 BRD -> Wrap 2 FRD	: 1 msec
18- 19	result data 9	: Wrap 2 BRD -> Wrap 2 WRT	: 1 msec
20- 21	result data 10	: Wrap 2 WRT -> Wrap 2 BRD	: 1 msec
22- 23	result data 11	:	:
24- 25	result data 12	:	:
26- 27	result data 13	:	:
28- 29	result data 14	:	:
30- 31	result data 15	:	:

Result of Locating time (“M5:LOCAT”)			
		: measurement result	: unit
0- 1	error code	:	:
2- 3	result data 1	: Locating time for normal CTG	: 1/10 sec
4- 5	result data 2	: Locating time for E-CTG	: 1/10 sec
6- 7	result data 3	:	:
8- 9	result data 4	:	:
10- 11	result data 5	:	:
12- 13	result data 6	:	:
14- 15	result data 7	:	:
16- 17	result data 8	:	:
18- 19	result data 9	:	:
20- 21	result data 10	:	:
22- 23	result data 11	:	:
24- 25	result data 12	:	:
26- 27	result data 13	:	:
28- 29	result data 14	:	:
30- 31	result data 15	:	:

Result of Rewinding time (“M6:REWND”)			
		: measurement result	: unit
0- 1	error code	:	:
2- 3	result data 1	: Rewinding time for normal CTG	: 1/10 sec
4- 5	result data 2	: Rewinding time for E-CTG	: 1/10 sec
6- 7	result data 3	:	:
8- 9	result data 4	:	:
10- 11	result data 5	:	:
12- 13	result data 6	:	:
14- 15	result data 7	:	:
16- 17	result data 8	:	:
18- 19	result data 9	:	:
20- 21	result data 10	:	:
22- 23	result data 11	:	:
24- 25	result data 12	:	:
26- 27	result data 13	:	:
28- 29	result data 14	:	:
30- 31	result data 15	:	:

Result of D.S.E. time (“M7:D.S.E”)			
		: measurement result	: unit
0- 1	error code	:	:
2- 3	result data 1	: D.S.E. time for normal CTG	: 1/10 sec
4- 5	result data 2	: D.S.E. time for E-CTG	: 1/10 sec
6- 7	result data 3	:	:
8- 9	result data 4	:	:
10- 11	result data 5	:	:
12- 13	result data 6	:	:
14- 15	result data 7	:	:
16- 17	result data 8	:	:
18- 19	result data 9	:	:

Result of D.S.E. time (“M7:D.S.E”)			
		: measurement result	: unit
20- 21	result data 10	:	:
22- 23	result data 11	:	:
24- 25	result data 12	:	:
26- 27	result data 13	:	:
28- 29	result data 14	:	:
30- 31	result data 15	:	:

Result of Unloading time (“M8:UNLD”)			
		: measurement result	: unit
0- 1	error code	:	:
2- 3	result data 1	: Tape winding time for normal CTG	: 1/10 sec
4- 5	result data 2	: Tape winding time for E-CTG	: 1/10 sec
6- 7	result data 3	: Unthreading time	: 1/10 sec
8- 9	result data 4	: Loader operation time	: 1/10 sec
10- 11	result data 5	:	:
12- 13	result data 6	:	:
14- 15	result data 7	:	:
16- 17	result data 8	:	:
18- 19	result data 9	:	:
20- 21	result data 10	:	:
22- 23	result data 11	:	:
24- 25	result data 12	:	:
26- 27	result data 13	:	:
28- 29	result data 14	:	:
30- 31	result data 15	:	:

Result of Cleaning time (“M9:CLEAN”)			
		: measurement result	: unit
0- 1	error code	:	:
2- 3	result data 1	: Cleaning time	: 1/10 sec
4- 5	result data 2	:	:
6- 7	result data 3	:	:
8- 9	result data 4	:	:
10- 11	result data 5	:	:
12- 13	result data 6	:	:
14- 15	result data 7	:	:
16- 17	result data 8	:	:
18- 19	result data 9	:	:
20- 21	result data 10	:	:
22- 23	result data 11	:	:
24- 25	result data 12	:	:
26- 27	result data 13	:	:
28- 29	result data 14	:	:
30- 31	result data 15	:	:

APPENDIX I

FLOWCHARTS

The Operator Panel flowcharts, provided in this appendix, show the flow through the menus available via the operator panel. Navigate the menus by pressing the pushbuttons indicated in the flowcharts. Begin with the flowchart in Figure I-1.

The flowcharts are arranged as follows:

Figure I-1 Operator Panel Flowchart on page I-2

Figure I-2 RUN COMB Flowchart on page I-3

Figure I-3 RUN ACL Flowchart on page I-3

Figure I-4 LIST ERROR Flowchart on page I-4

Figure I-5 RS-232 Flowchart on page I-4

Figure I-6 SETTING Flowchart on page I-5

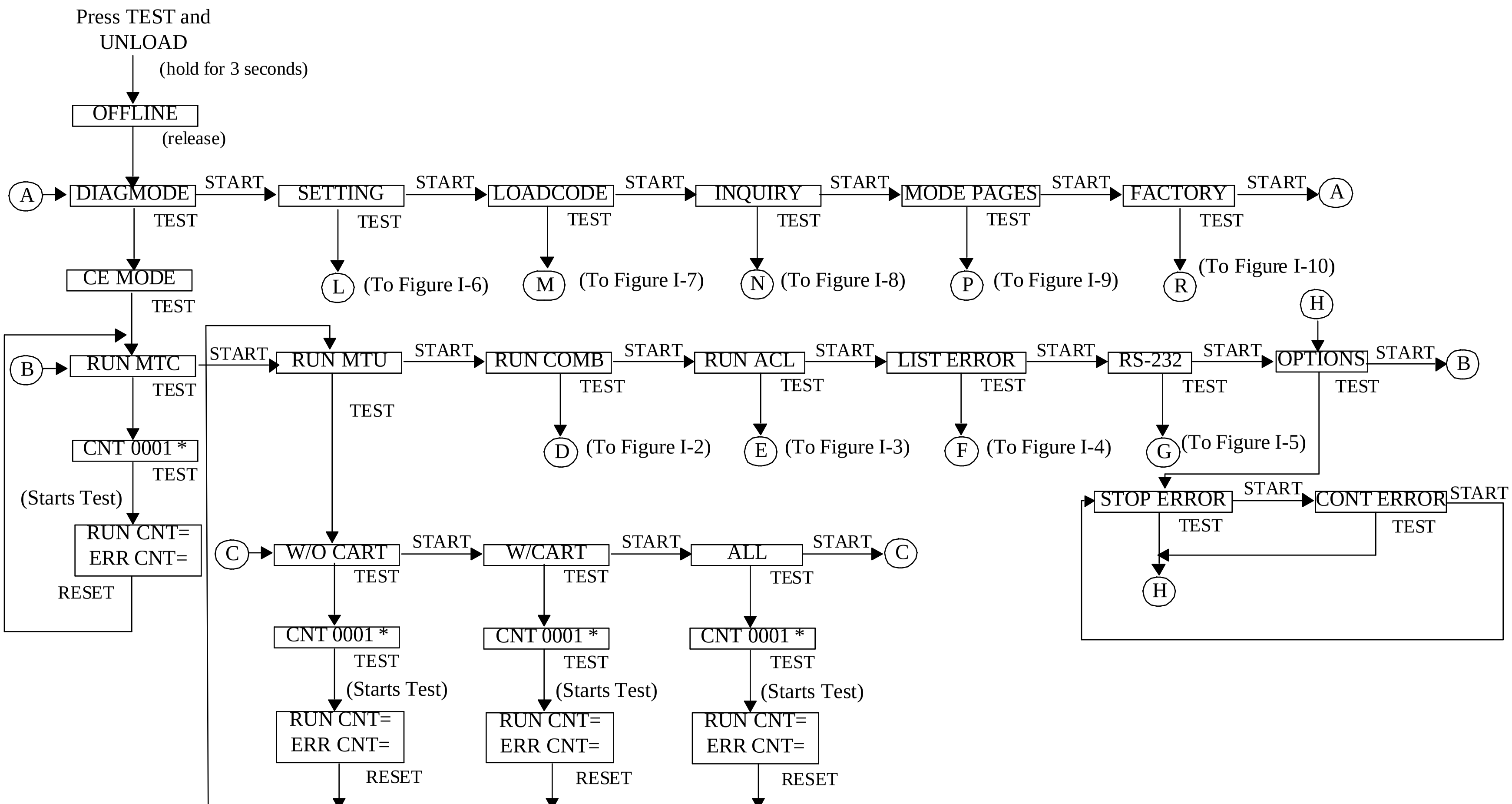
Figure I-7 LOAD CODE Flowchart on page I-6

Figure I-8 INQUIRY Flowchart on page I-6

Figure I-9 MODE PAGES Flowchart on page I-7

Figure I-10 FACTORY Flowchart on page I-8

Figure I-11 81:FSGRP Flowchart on page I-8



NOTES:
Use **TEST** to go DOWN one level EXECUTE function.
Use **RESET** to go UP one level.
Use **START** to go RIGHT to next selection.
Use **SHIFT** & **START** to go LEFT to previous selection.
* Flashing character moves to RIGHT with **UNLOAD**, to LEFT with **SHIFT** & **UNLOAD**
INCREMENT character with **START**, DECREMENT character with **SHIFT** & **START**.

Figure I-1. Operator Panel Flowchart

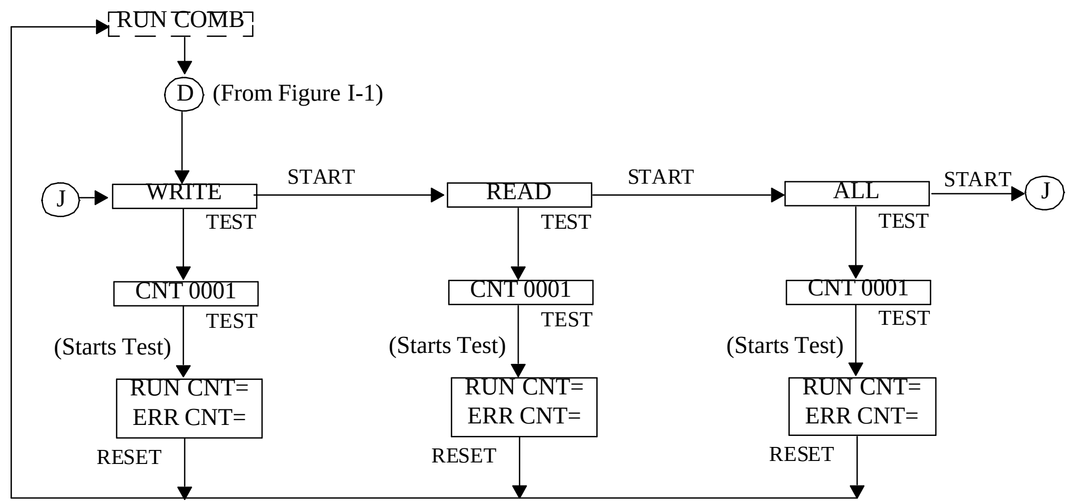


Figure I-2. RUN COMB Flowchart

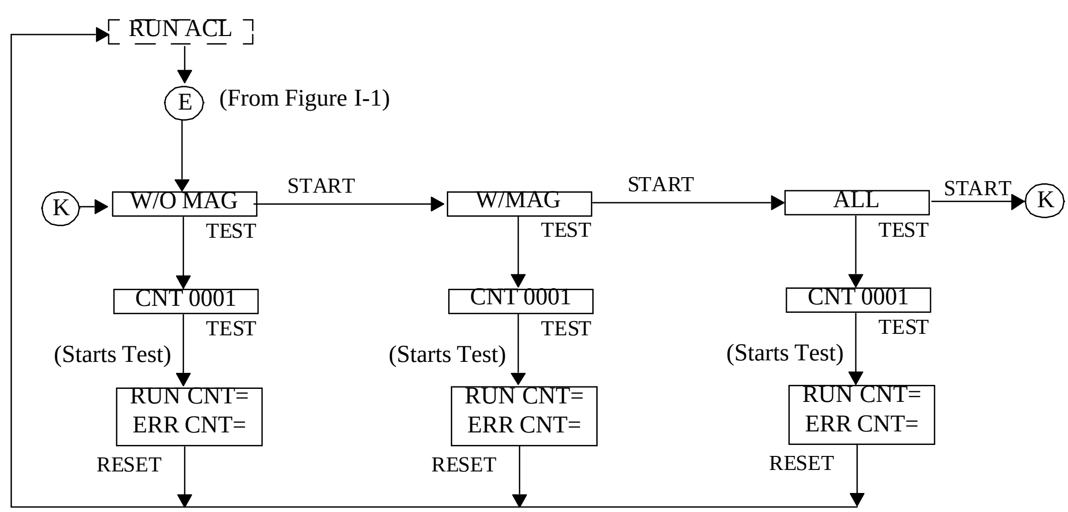


Figure I-3. RUN ACL Flowchart

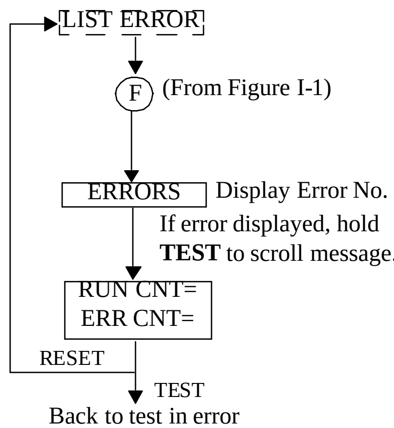


Figure I-4. LIST ERROR Flowchart

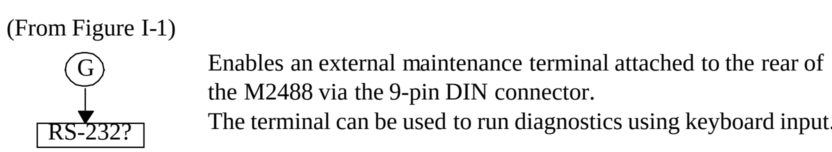


Figure I-5. RS-232 Flowchart

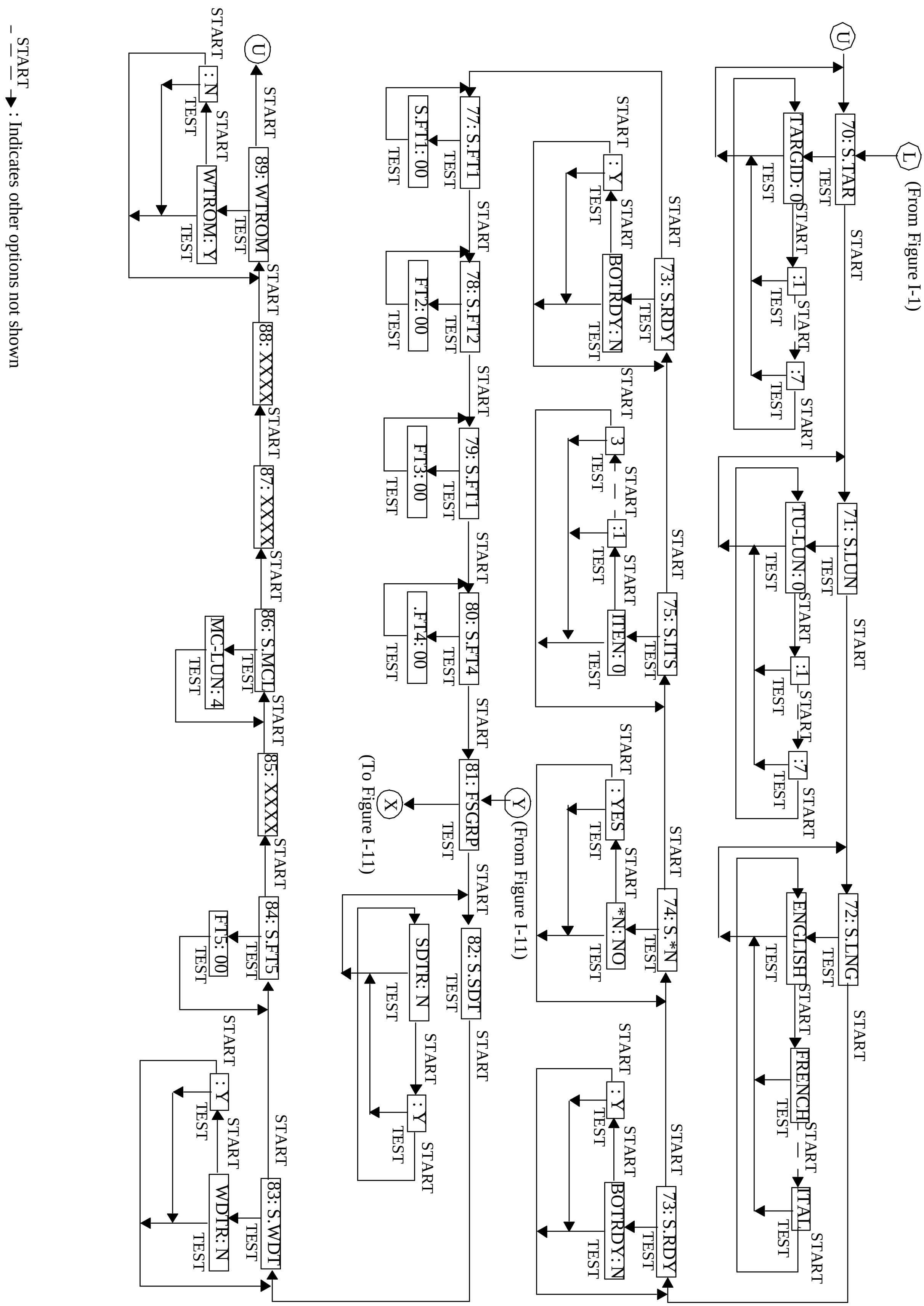


Figure I-6. SETTING Flowchart

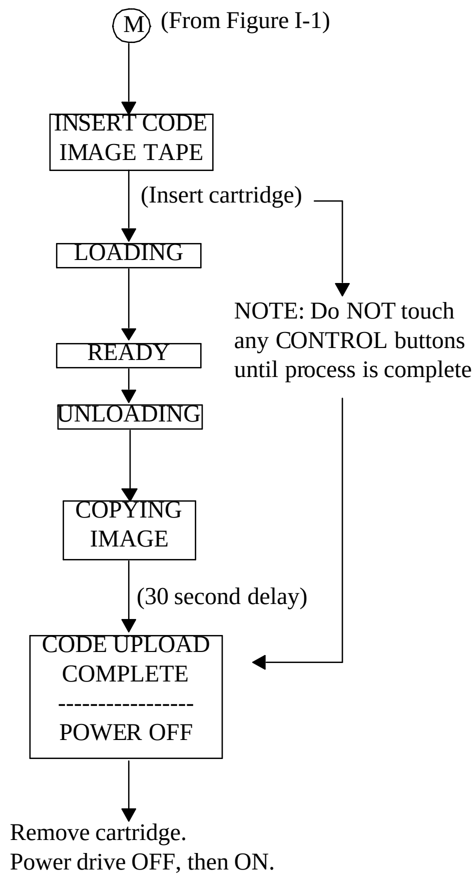
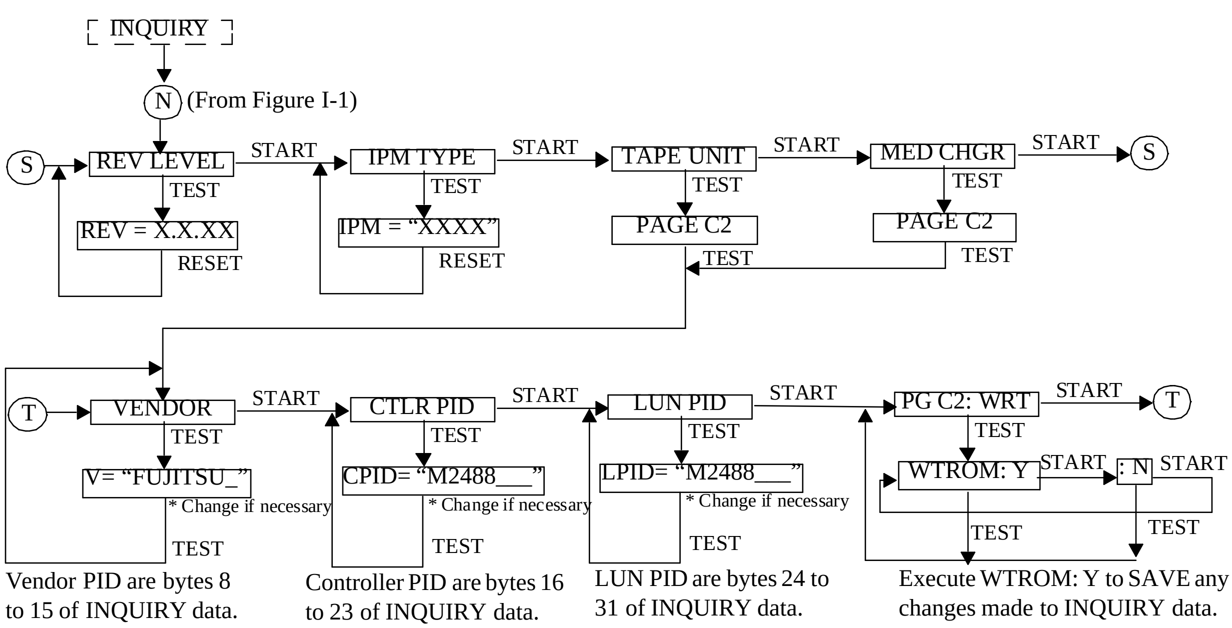
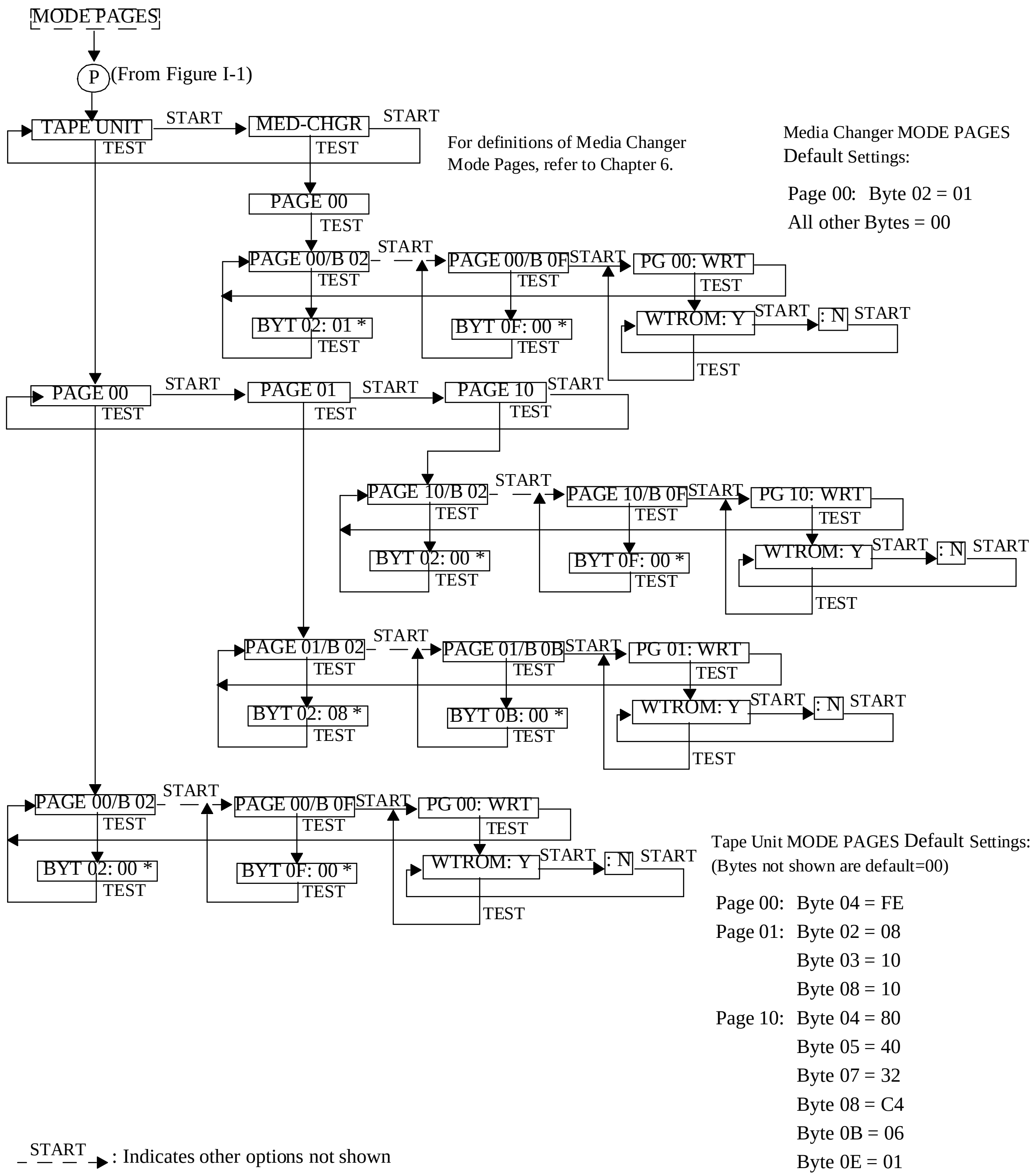


Figure I-7. LOAD CODE Flowchart



NOTE: If any PUD (Product ID) is changed, go to 'PGC2: WRT' to store in ROM.
* Flashing character moves to RIGHT with UNLOAD, to LEFT with SHIFT and UNLOAD.
Increment character with START, decrement with SHIFT and START.

Figure I-8. INQUIRY Flowchart



* To change MODE PAGE bytes:

1. Go to block identified with an asterisk.
2. The flashing hex digit moves to the right with UNLOAD, to the left with SHIFT and UNLOAD.
3. Increment digit with START, decrement with SHIFT and START.
4. After change is completed, move to PG XX: WRT and save by executing WTROM: Y.

For definitions of Tape Unit Mode Pages, refer to Chapter 5.

Figure I-9. MODE PAGES Flowchart

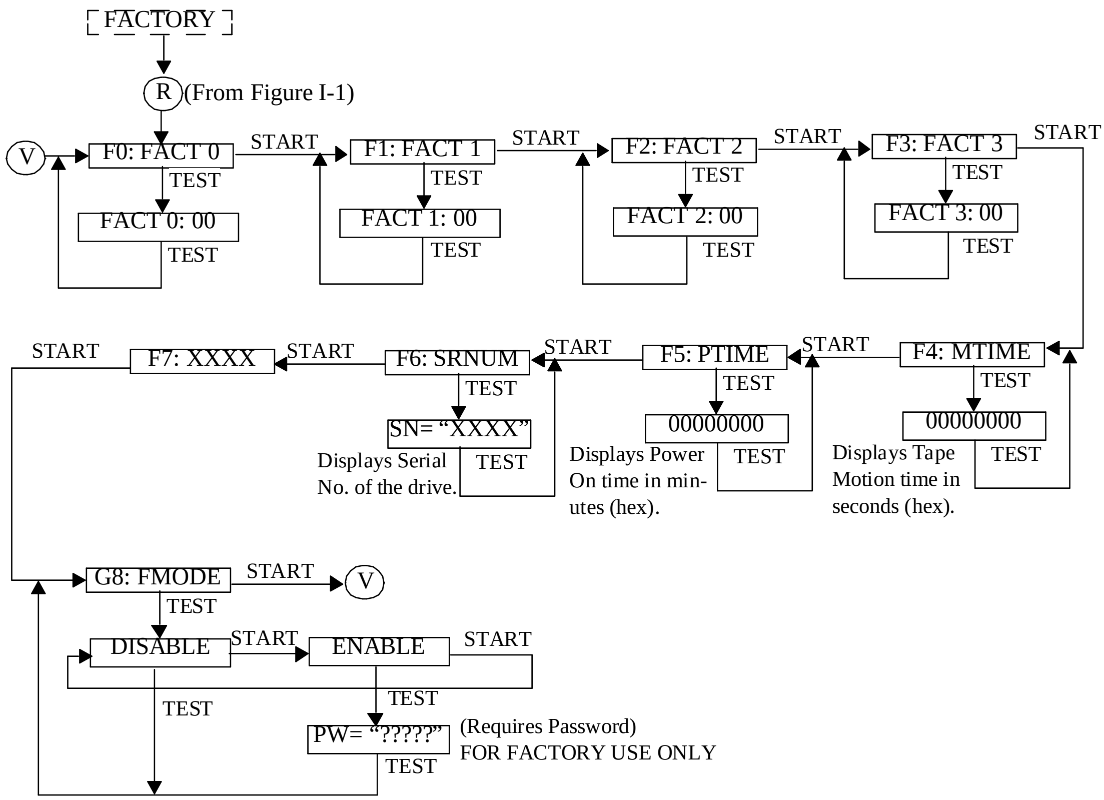


Figure I-10. FACTORY Flowchart

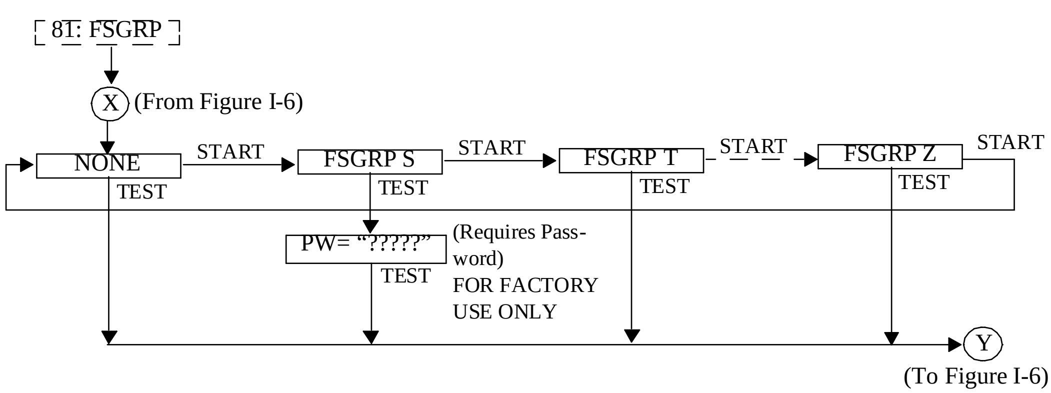


Figure I-11. 81:FSGRP Flowchart

INDEX

This is the index for theProduct Guide.

PAGE

A

ASC/ASCQ B-1
- Action Advised Codes B-2
- by ASC/ASCQ B-3
- by Sense Key B-1
- Description (by ASC/ASCQ) B-3
- Description (by Sense Key) B-1

ASSEMBLY INSTRUCTIONS 1-8
- Cable and Power Connections 1-10
- Desktop 1-11
  - Drive with ACL 1-11
  - Drive with ACL (10-cartridge) 1-12
  - Drive with FACL 1-15
  - Tape Drive 1-11
- General 1-9
- Interface Personality Module 1-9
- Rack-Mount 1-19

C

CHK xx
- Replacement Action Codes E-13

CHK xx Error Code
- replacement actions E-7

CHK XX ERROR CODES E-1

Codes
- CHK xx Error E-1, E-7
- ERPA C-1
- Fault Symptom D-1

Command Description Block Format 4-4

COMMAND DISCONNECTION 4-153

CONFIGURATIONS 1-1
- Desktop 1-3
- Rack-mount 1-2

D

DIAG H-1

DIAGNOSTIC
- ACL TEST H-6
- DIAG parameter H-3
- DIAG structure H-1
- How to execute the DIAG H-1
- LOAD/UNLOAD H-5
- M1LOAD H-7
- M2TPPFM H-7
- M3AC/PS H-7
- READ/WRITE H-4
- TESTMODE H-6

INDEX

Diagnostic Microcode Specifications 8-27
Diagnostic Page Codes (PF=1 in SEND DIAGNOSTIC command CDB) 4-85
Diagnostic Pages (PF=1) 4-119
Diagnostic Parameter List (PF=0 in SEND DIAGNOSTIC command CDB) . . . 4-87
Diagnostic Routine
  1 - Control Store F-7
  10 - EDRC Control Signals F-25
  11 - EDRC Data Buffers F-32
  12 - EDRC Address Bus F-38
  13 - EDRC Error Detection F-44
  2 - Interrupt Request Controller F-8
  20 - Loop Write to Read F-50
  3 - CP Bus Parity F-9
  4 - Read Signal Verification Processor F-14
  5 - SDDP External Register F-18
  50 - 4M Tones Test F-66
  51 - Incrementing Block Length Test F-67
  6 - Data Buffer F-18
  7 - SCSI Protocol Controller F-19
  8 - Formatter Counters F-22
  80 - Servo F-69
  80 Test 06 - Servo ACL Error Codes in Sense Byte 19 . . . . . F-72
  80 Test 06 - Servo FACL Error Codes in Sense Byte 19 . . . . . F-73
  81 - Manufacturing Test F-74
  82 - Magnetic Tape Unit F-76
  83 - Operator Control Panel F-76
  9 - PCC Timers F-24
  90 - Tape Drive F-78
DIAGNOSTIC SPECIFICATIONS H-1
Diagnostic Test Registry 8-27
Diagnostic Test Registry for all Diagnostic Modes F-1
DIAGNOSTIC TESTS AND ERROR CODES F-1
DIAGNOSTICS 8-16
  Go/No-Go 8-16
  MTU 8-16
  Off-Line Diagnostics 8-16
Diagnostics
  DIAG result data H-21
  Error reset command H-9
  How to execute the DIAG H-1
  M2488 DIAG structure H-1
  MTU DIAG parameter H-3
  Page Code 80h Tests 8-26
  Tests
    COMBINATION H-9
    LOAD/UNLOAD H-5
    M1LOAD H-7
    M2TPPFM H-7
    M3AC/PS H-7
    M4MODCH H-7
    M5LOCAT H-8
    M6REWND H-8
    M7D.S.E H-8
    M8UNLD H-8

M9CLEAN H-8
READ/WRITE H-4
TESTMODE H-6
Types of Procedures 8-24
In-line 8-25
Off-Line 8-25
Tasked Go/No-Go 8-24

E

EQUIPMENT INSPECTION 1-7
ERPA CODES C-1
ERROR MESSAGES
CHK XX 8-2
Diagnostic Error Codes 8-2
NVRAM Initialization 8-2
OZONE 8-1
ERROR RECOVERY
EDRC 8-30
Retry Methods 8-30
ERROR RECOVERY PROCEDURES 8-30

F

FACTORY SETTINGS 8-28
FAULT SYMPTOM CODES D-1
Error Recovery D-1
Formatter Error Recovery D-2
FIELD REPLACEABLE UNITS 9-1
DTC PCBA 9-4
DVL PCBA 9-6
IPM PCBA 9-4
RDL PCBA 9-5
SVL PCBA 9-5
WTL PCBA 9-6

I

INQUIRY/CHANGE DEFINITION VPD 5-17
ASCII Implemented Operating Definition Page 5-21
Configuration Page 5-23
General VPD Page Format 5-17
Implemented Operating Definition Page 5-20
Product Identification Page 5-24
Supported VPD Pages 5-19
Unit Serial Number Page 5-19
Unit Usage Page 5-22
INSPECTION
ACL 1-7
FACL 1-7
M2488 1-7
Installation 1-9
Automatic Cartridge Loader 1-26
Cable and Power 1-10
Desktop 1-11
Flush-mount Automatic Cartridge Loader 1-32

IPM 1-9
INSTALLATION INSTRUCTIONS 1-1
Interconnect Diagram 8-41

L

LOAD UNLOAD 4-25
Log Sense Pages 4-37
LUN 4-1

M

M2488 Interconnects 8-38
M2488 Tape Drive FRUs (Bottom Side 9-3
M2488 Tape Drive FRUs (Top Side) 9-2
MAINTENANCE AND SERVICING 8-1
MAINTENANCE TERMINAL 8-33
Interface 8-33
Interface Communications Settings 8-34
Interface Connector Pin Assignments 8-33
Remote Debug for JDB 8-34
MANUAL TAPE REMOVAL PROCEDURE 8-36
Media Changer LUN 4 4-1
Medium Changer
Additional Information
MODE SELECT AND MODE SENSE COMMANDS 6-32
COMMANDS 6-1
VPD
Inquiry/Change Definition 6-41
MODE SELECT/MODE SENSE COMMANDS
Additional Information 5-1
Common Device-Type Control Parameters 5-9
Density Code 28h 5-14
Device Configuration Parameters 5-11
Disconnect/Reconnect Control Parameters 5-7
Error Recovery and Reporting Parameters 5-4
Page Codes 5-1
Vendor Unique Parameter 5-2
ModeSense
Initiator Setup 4-60
MTU
Additional Information
MODE SELECT AND MODE SENSE COMMANDS 5-1
VPD
INQUIRY/CHANGE DEFINITION 5-17
MTU DIAGNOSTIC SPECIFICATIONS H-1

O

Off-Line Diagnostic 8-19
Help Information Display 8-23
Menu 8-19
Remote Maintenance (RS-232) Interface 8-20
OP PCA 8-52
Operation
M2488 2-1

MAGNETIC TAPE CONTROLLER . . . 2-2
Data Buffer . . . 2-2
Data Path . . . 2-2
ERDC Compression Feature . . . 2-2
Firmware . . . 2-4
Microprocessor Control . . . 2-3
MAGNETIC TAPE UNIT . . . 2-4
Airless Tape Path . . . 2-4
Read and Write Electronics . . . 2-5
OPERATOR PANEL DISPLAYED ERROR MESSAGES . . . 8-1

P

Parameter List . . . H-10
PARTS REPLACEMENT CATALOG . . . 9-1
PERMANENT ERROR HANDLING . . . 7-3
READ . . . 7-3
WRITE . . . 7-3
PREPARATION FOR USE . . . 1-37
PREPARING THE M2488 AND ITS OPTIONAL EQUIPMENT . . . 1-1
PREVENTIVE MAINTENANCE . . . 8-35
PSU . . . 8-53

R

RDL . . . 8-54
READ POSITION . . . 4-75
Description of Block ID Format . . . 4-78
Return Data . . . 4-76
READ/WRITE . . . H-4
RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) . . . 4-89
Remove & Replace
Air Filter . . . 8-43
DTC PCBA . . . 8-48
Fan Assembly . . . 8-44
IPM . . . 8-45
Loader Assembly . . . 8-51
OP PCA . . . 8-52
Power Supply . . . 8-53
RDL PCBA . . . 8-54
SVL PCBA . . . 8-54
Threader Assembly . . . 8-50
Top Cover . . . 8-46
WTL PCBA . . . 8-55
Replacement Action Codes . . . E-13
RESERVE UNIT Operation . . . 4-113

S

SCSI
BUS STATUS . . . 3-10
COMMANDS
drive . . . 4-2
Messages . . . 3-1
SCSI BUS STATUS
Busy . . . 3-10

Check Condition 3-10
Good 3-10
Intermediate 3-10
Reservation Conflict 3-11
SCSI COMMANDS
MEDIA CHANGER 6-1
EXCHANGE MEDIUM 6-2
MODE SELECT 6-6
MODE SENSE 6-11
MOVE MEDIUM 6-16
READ ELEMENT STATUS 6-19
TEST UNIT READY 6-30
Tape 4-1
CHANGE DEFINITION 4-5
DISPLAY 4-8
DISPLAY (10h) 4-12
DISPLAY (11h) 4-8
ERASE 4-15
INQUIRY 4-18
LOAD UNLOAD 4-25
LOCATE 4-28
LOG SELECT 4-32
LOG SENSE 4-33
LOOP WRITE TO READ 4-49
MODE SELECT 4-51
MODE SENSE 4-56
READ 4-63
READ BLOCK LIMITS 4-68
READ BUFFER 4-70
READ POSITION 4-75
READ REVERSE 4-80
RECEIVE DIAGNOSTIC RESULTS 4-83
RECEIVE DIAGNOSTIC RESULTS (FACTORY MODE) 4-89
RECOVER BUFFERED DATA 4-98
RELEASE UNIT 4-101
Report Density Support 4-105
REQUEST SENSE 4-103
RESERVE UNIT 4-112
REWIND 4-115
SEND DIAGNOSTIC 4-117
SEND DIAGNOSTIC (FACTORY MODE) 4-124
SPACE 4-135
TEST UNIT READY 4-138
WRITE 4-140
WRITE BUFFER 4-144
WRITE FILEMARKS 4-150
SCSI MESSAGES 3-1
ABORT 3-2
BUS DEVICE RESET 3-2
COMMAND COMPLETE 3-2
DISCONNECT 3-2
EXTENDED MESSAGE FORMAT 3-3
IDENTIFY 3-7
IGNORE WIDE RESIDUE 3-7

INITIATOR DETECTED ERROR 3-8
LINKED COMMAND COMPLETE 3-8
LINKED COMMAND COMPLETE (WITH FLAG) 3-8
MESSAGE PARITY ERROR 3-8
MESSAGE REJECT 3-8
NO OPERATION 3-9
RESTORE POINTERS 3-9
SAVE DATA POINTER 3-9
Synchronous Data Transfer Request 3-3
Wide Data Transfer Request 3-5
SCSI RESET 4-153
SCSI TRANSFER RATES G-1
Selftest 8-25
SENSE DATA 8-4
Error Code Sense Format 8-4
Sense Information Bytes 20-43 8-9
SENSE KEYS A-1
SVL 8-54

T

Tape LUN 0 4-1
Tape Path Cleaning Procedure 8-35
TAPE PROCESSING 7-1
CHANGING MODE PARAMETERS
Initiator Setup 7-1
TAPE UNIT PARAMETERS 5-1
Target ID 4-1
Top Cover 8-46

U

UNPACKING INSTRUCTIONS 1-4
Automatic Cartridge Loader 1-5
Flush-mounted Automatic Cartridge Loader 1-6
M2488 1-4

COMMENT FORM

We would appreciate your comments and suggestions regarding this manual.

Manual Code	C144-E019-03EN
Manual Name	M2488 CARTRIDGE TAPE DRIVE PRODUCT GUIDE

Please mark each item: E (Excellent), G (Good), F (Fair), P (Poor)

General appearance	( )	Illustrations	( )
Technical level	( )	Glossary	( )
Organization	( )	Acronyms and abbreviations	( )
Clarity	( )	Index	( )
Accuracy	( )		

Comments and Suggestions:

List any errors or suggestions for improvement.

Page	Line	Contents

Please send this form to the address below. We will use your comments in planning future editions.

Address: Engineering Information Systems Department
Information Systems Administration Division
Information Processing Administration Group
Fujitsu Limited
1-1, 4-Chome, Kamikodanaka
Nakahara-ku, Kawasaki 211-88, Japan
Fax: 81-44-754-2795

Organization:

Name: Fax:

M2488 CARTRIDGE TAPE DRIVE PRODUCT GUIDE C144-E019-03EN

M2488 CARTRIDGE TAPE DRIVE PRODUCT GUIDE C144-E019-03EN