EK-OTS11-PS-001

TS11

POCKET SERVICE GUIDE

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1 INTRODUCTION

1.1 GENERAL

This document is designed for use by someone trained to service a TS11 Subsystem. Procedures are brief, concise, and support the maintenance philosophy of module replacement.

The first two chapters present product overview and installation information for quick review. Chapter 3 is troubleshooting information. Use of diagnostics and maintenance panel features allow quick location of malfunctions. Chapter 4 describes removal and replacement procedures and Chapter 5 explains how to check and adjust the TS11.

Programming information is not provided but register summaries and definitions are found in Appendix A and a Troubleshooting Flowchart in Appendix B.

This chapter is a compilation of information and reference material needed to service the TS11 Subsystem. It is intended to provide a quick overview of the product.

Figure 1-1 TS11 Subsystem Block Diagram

1.2 SUBSYSTEM OVERVIEW

The TS11 Subsystem Block Diagram is shown in Figure 1-1.

1.3 TS11 ASSEMBLIES

Major TS11 assemblies are shown in Figures 1-2, 1-3, and 1-4.

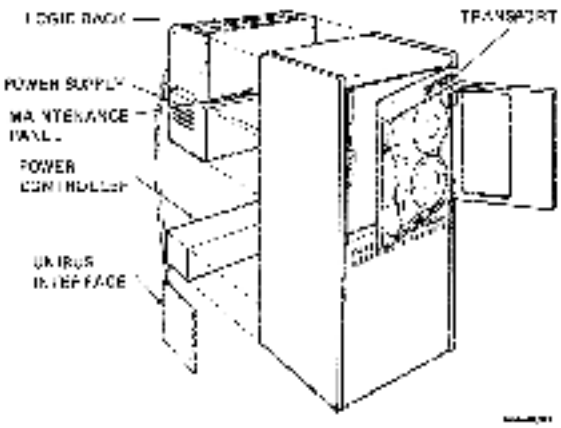

Figure 1-2 TS11 Subsystem Major Assemblies

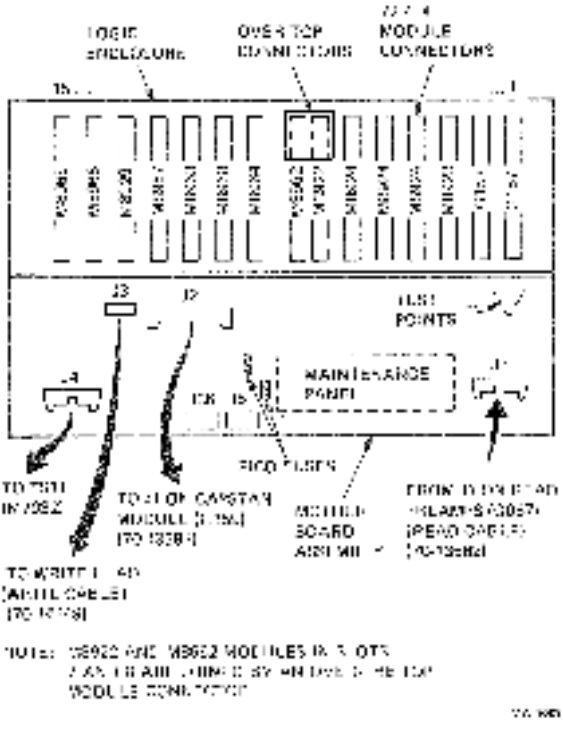

Figure 1-3 Logic Rack

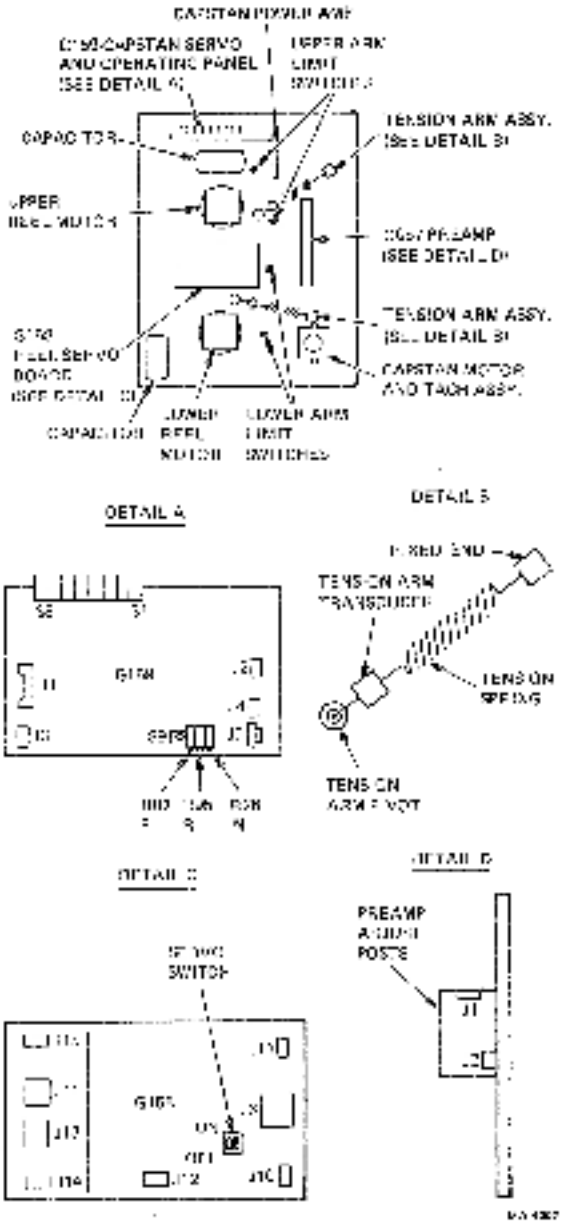

Figure 1-4 Transport Assemblies (Rear View)

1.4 CONTROLS AND INDICATORS

The following three sections offer a brief explanation of TS11 Subsystem controls and indicators.

1.4.1 Operator Panel (Normal Mode)

Refer to Figure 1-5 while reading the following text.

Control Functions

LOD (load)	Used to load, unload, or rewind tape

NOTE
Tape will not rewind if M7982 is not powered up.

ONL (on-line)	Used to place unit on-line or off-line

Indicator Functions

LOD (load)	Tape loaded and reel motors energized when on
ONL (on-line)	TS11 ready for system commands when on
LOK (microprocessor okay)	Correct microprocessor operation when on
VCK (volume check error)	Tape reel status change occurred when on
DCK (density check)	Incorrect tape density being read when on
WLK (write locked)	No reel mounted or no write-ring in mounted reel when on
BOT (beginning of tape)	BOT marker is over sensor when on
EOT (end of tape)	EOT marker is over or passed sensor when on

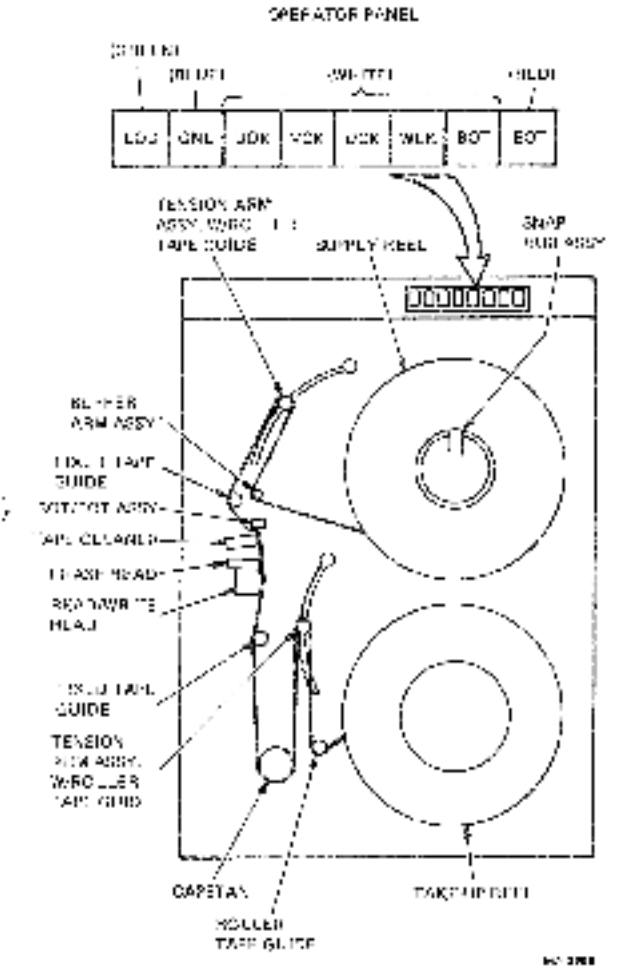

Figure 1-3 Transport Assemblies (Front View)

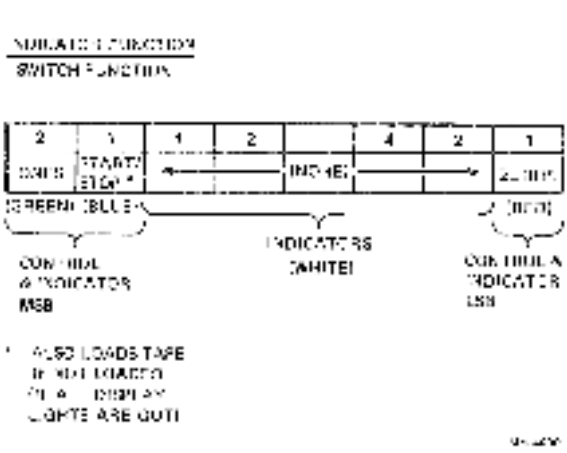

Figure 1-6 Operator Panel (Maintenance Mode)

1.4.2 Operator Panel (Maintenance Mode)

Refer to Figure 1-6 while reading the following text.

Control Functions

ONES	Enters one into LSB position and shifts entire register contents left when pressed
START/STOP	Loads tape if not loaded and causes selected test to run when pressed and halt when released
ZEROS	Enters zero into LSB position and shifts entire register contents left when pressed

Indicator Functions

All indicators are used to display in octal notation (377 max.) the number of the test entered by means of the ones and zeros controls. A test failure causes an error code to be displayed.

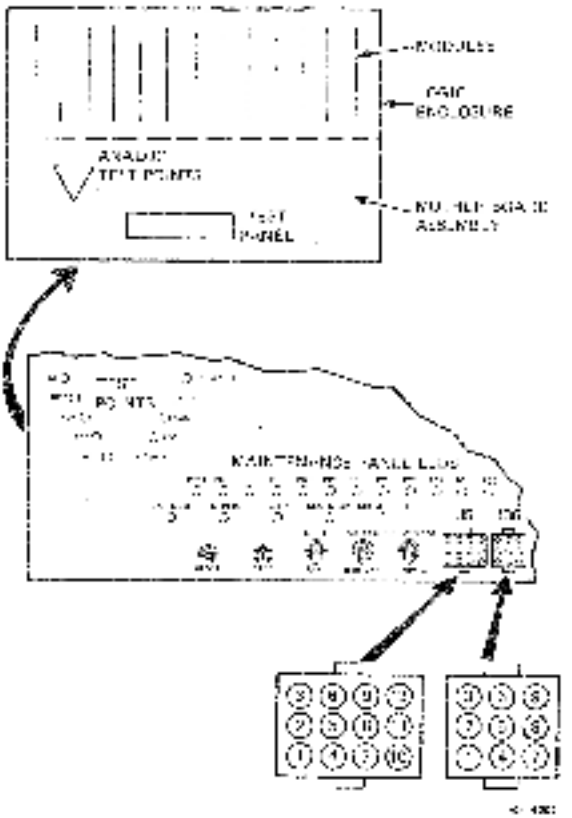

Figure 1-7 Maintenance Panel

1.4.3 Maintenance Panel (Test Panel)

Refer to Figure 1-7 while reading the following text.

Test Points	Function
RD0 – RD7, RDP	Read channel analog test points, these signals are preamplifier outputs for data and parity channels
SKEW OUT	Analog output of internal skew meter, signal is overall skew as function of voltage

Indicators	Function
PC11 – PC0	Displays contents of microprocessor program counter, PC0 is LSB
EXT MEM	Indicates which of two 2K memory banks is accessed when PC displays an address larger than 3777(8); i.e., 0—3777 always accesses same ROMs on M8964 but 4000 - 7777 access one of two banks of ROMs on M8965 depending on state of EXT MEM bit
STK PERR	Indicates stack parity error has occurred when on
AC LO	Indicates ac line voltage went below acceptable limits when on
CLK STOP	Indicates microprocessor clock not running when on
CROM PERR	Indicates control ROM parity error occurred when on

Controls	Function
RESET SW	Resets microprocessor to PC=0 for a reinit and clears registers when pushed
STEP SW	Causes microprocessor to do one instruction when pushed
HALT/RUN SW	Disables or enables microprocessor
DIS ERR/ENB ERR SW	Disables or enables halt-on-error function
MAINT MODE/ NORMAL SW	Places transport into maintenance or normal mode
NORMAL SW	mode

1.5 TOOLS

In addition to the standard DIGITAL tool kit the following tools are required to service the TS11.

Description	DEC Part Number
Oscilloscope with probes (2×10)	
Standard amplitude tape	29-11696
Master skew tape (600 ft) (1200 ft)	 29-22020 29-19224
BOT/EOT markers	90-09177
Hub spanner wrench	29-22999
Double height extender	W984
1-3/8 in. socket (1/4 in drive)	—
Tension gauge (0—500 gram)	—
Hub height gauge	96-07951
Roller height gauge	96-07952

1.6 SPARES KIT LIST

DEC Part Number	Description
Preamplifier module	G057
Read/write module	G157
Reel servo module	G158
Capstan servo module	G159
UNIBUS interface	M7982
PE control	M8922
Read control	M8923
PE format	M8924
Write control	M8929
Microprocessor	M8962
Stack	M8963
ROM board	M8964
I/O shift reg	M8965
I/O mix	M8966

DEC Part Number	Description
I/O control	M8967
ROM extension	M8968
Two fuses 5A	12-09747
Switch toggle	12-09550
Switch push button	12-11079
BOT/EOT assembly	12-13720
Bulbs (GE 47)	12-12716-01
Snap lock hub assembly	12-13119
Fixed roller assembly	12-16080
CD kit case	29-23083
Capstan driver	54-13692
Sonod extender	
Tension arm	70-14014
Limit switch	70-15666
Capstan wheel	74-18010
Capstan wheel clamp	74-18021
Lens caps	
Color Logo	
Green LOD	12-14343-20
Blue ONL	12-14343-21
White VOK	12-14343-22
White VCK	12-14343-23
White DCK	12-14343-24
White WLK	12-14343-25
White BOT	12-14343-26
Red EOT	12-14343-27

1.7 APPLICABLE DOCUMENTATION

The following documentation is available if more information on the TS11 Subsystem is required.

Field Maintenance Print Set	MP00848 MP00849	TS04-A-1 TS11-A
TS11 Subsystem Technical Manual (User Manual plus theory of operation and servicing)	EK-OTS11-TM	
TS11 Subsystem User's Guide (installation, microdiagnostic operation, customer care and operating information)	EK-OTS11-UG	

All TS11 options are covered by the following Illustrated Parts Breakdowns (IPBs).

872 Power Controller	EK-00872-IP
861 Power Controller	EK-00861-IP
TS11 A (standalone)	EK-TS11A-IP
TS11 B (TS11 A and H9502 cabinet)	EK-TS11B-IP
TS11 C (TS11 A and H9546 cabinet)	EK-TS11C-IP
TS11 D (TS11 A and H950 cabinet)	EK-TS11D-IP

1.8 SYSTEM DIAGNOSTICS

Section 3.8 provides operational details for the following tests.

Transport Control Logic Test (CZTSI)

This test causes data-wraparounds through the TS11, the serial bus, the I/O side, and the formatter. The output of this test calls out a failing module when an error occurs.

Transport Data Reliability Test (CZTSH)

This test simulates a worst case operating environment for the transport by executing commands in random order, with random record lengths and data. This test is mainly a confidence test.

2 INSTALLATION

2.1 M7982 INSTALLATION

M7982 vector and address settings are listed in Table 2-1. An example of these settings is given in Table 2-2 and Figure 2-1 indicates switch locations on the TS11 interface module. Figure 2-2 shows a typical subsystem configuration.

2.2 INSTALLATION CHECKLIST

1. Unpack and place.
2. Inspect for the following things.
   a. Shorted pins
   b. Broken components
   c. Proper card seating
   d. Complete plug seating
3. Set M7982 address and vector switches
4. Remove the bus grant card (G727, G7270).
5. Cut CA1 to CB1 (NPG) jumper on the SPC backplane slot.
6. Insert the M7982 module, and connect the serial bus interface cable attached (TS11-J1 to motherboard J4).

   NOTE
   The M7982 LED lights up if the interface cable is reversed.

7. Verify correct voltage and frequency at the rear of the transport.

Table 2-6 Interrupt Vector and Address Assignments

TSU	Interrupt Vector	UNIBUS Address	Register
1	524	772 520 772 522	TSBA/TSDB TSSR
2	Floating rank 37	772 524 772 526	TSBA/TSDB TSSR
3	Floating rank 37	772 530 772 532	TSBA/TSDB TSSR
4	Floating rank 37	772 534 772 536	TSBA/TSDB TSSR

Table 2-7 Address and Vector Examples

ADDRESS																
17		13		12		11		10		9		8		7		6
X	X	1	1	1	1	1	0	1	1	0	1	1	0	1	0	X
		LSI						P20								
X	X	X	X	1	1	0	9	8	7	6	5	4	3	2	X	X
X	X	X	off	on	off	on	off	on	off	on	off	on	on	on	on	X

on = 0; off = 1

VECTOR																
15		14		13		12		11		10		9		8		7
X	X	X	X	X	X	1	1	1	0	1	0	1	0	0	X	X
										LSI						
X	X	X	X	X	X	8	7	6	5	4	3	2	X	X	X	X
X	X	X	X	X	X	on	off	on	on	off	on	off	on	on	X	X

on = 0; off = 1

NOTE
When 50 Hz power is used, both switches on the G159 board must be in the open or off position. (At 60 Hz both must be closed or on.) Also, verify that the ac input box (VS04 Power Supply) is correct. It is necessary to check the tension arm adjustment when changing from 60 Hz to 50 Hz power.

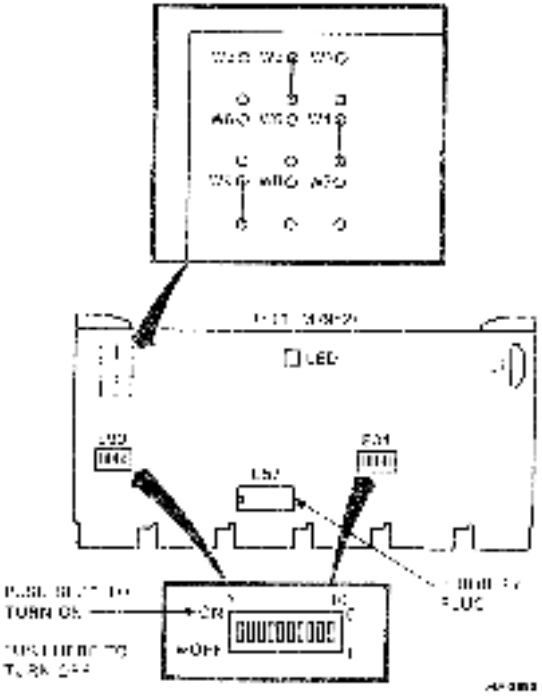

Figure 2-1 M79X2 Interface Module

5. Power up the transport and verify all voltages. (Refer to Paragraph 5.1).
9. Place the transport in maintenance mode and view the PC lights. Check for errors.

10. Load a tape (tape will not be positioned at BOT).
11. Run internal diagnostics, the control logic test, then the data reliability test. (Test 47 fails in autosequence mode if the TS11 is not powered up.)

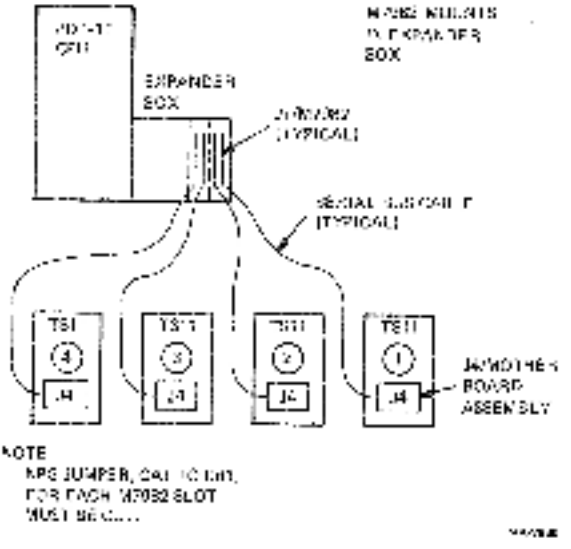

Figure 2-2 Typical Subsystem Configurations

3 TROUBLESHOOTING

3.1 GENERAL

Sections 3.2, 3.3, and 3.4 describe microdiagnostics; Section 3.5 details error codes and error tables. Section 3.6 describes microdiagnostic operation; Section 3.7 describes the customer confidence check. Section 3.8 describes PDP-11 based diagnostic operation and Section 3.9 lists special troubleshooting aids.

3.2 INTERNAL MICRODIAGNOSTICS (IN-LINE)

These five tests verify basic microprocessor operation. They run anytime the transport is powered up and has not executed a subsystem command for approximately 900 milliseconds. Brief test descriptions follow.

3.2.1 LSTM

This tests M8962, M8964, and M8968 boards and checks all transport instructions, the input bus, and the output bus.

3.2.2 STAKM

This tests 64 byte push/pop RAM on the M8963 board and communications with the G159 board. Also, STAKM tests parity, overflow detection, attention branch logic, and the attention register of the stack. It performs a data wraparound on the capstan bus and checks the CBUS and branch logic.

3.2.3 IOTSM

This tests functionality on the M8965, M8966, and M8967 boards and attention logic on M8963. IOTSM performs a simple handshake over the TSTI bus.

3.2.4 CATSM

This tests functionality of the G159 and the remainder of M8963 not checked by STAKM and IOTSM. CATSM checks the 1KHz clock, simulated capstan motion, and the logic part of the digital servo system.

3.2.5 PETSM

This tests some functionality of M8933, G157, M8929, M8926, and M8930. It checks M8929 clock logic and silo interface to the M8966, G157, and M8923 pulse generators. Also checked is the center frequency of VCO on M8922 and M8924 window logic. PETSM checks data through the G157, M8923-24-22 boards. Performs XORs and checksums for the formatter table lookup ROMs on the M8922 board.

3.3 INITIALIZATION MICRODIAGNOSTICS

These tests are internal (inline) diagnostics but run under special conditions to check more hardware. They alter registers in the transport and reset them to a specific initial value. If a customer operation was taking place when these were invoked, data could be altered. These diagnostics are invoked by power-up, maintenance panel reset, subsystem initialize, or the UNIBUS initialize.

3.4 OFF-LINE MICRODIAGNOSTICS (Customer Confidence and Maintenance Tests)

These tests check transport functionality including tape motion, read data, and write data. A standard amplitude tape must be loaded on the transport to run the off-line tests. Each test is briefly described in Table 3-1.

Table 3-1 Test Descriptions

Test No.	Description
1	Field Service PM Test (Test 0 is illegal) – Causes tests 2 through 47 to run sequence to completion or error
2	Capstan Board Clock Test – Tests capstan 1 ms clock, TAC sync flop, and TAC attention logic
3	Capstan Simulated Motion Forward Test – Sets capstan maintenance signal to prevent motion and simulates acceleration and deceleration in forward, capstan should not move, reel motors may shift position slightly
4	Capstan Simulated Motion Reverse Test – Same as Test 3, but in reverse

Table 3-1 Test Descriptions (Cont.)

Test No.	Description
5	Reel Motors Off Test – Turns reel motors off and checks G159 board for negation of reel motor on signal
6	Reel Motors On Test – Same as Test 5, but turns motors on and looks for assertion of signal
7	Tach Phase Forward Test – Checks tach phase duty cycle and relationship between tach phases 1 and 2 in forward
	NOTE If a tach "flat" is bent, it may not be seen on the scope (because of 50% or so others) but the test will detect it.
10	Tach Phase Reverse Test – Same as Test 7, but in reverse
11	Forward Speed Test – Checks forward capstan speed
12	Reverse Speed Test – Checks reverse capstan speed
13	Capstan Deceleration Test – Checks capstan stop time in number of ticks
14	I/O Micro Basic Test – Checks I/O micro attention logic and data path
15	I/O Micro Flag and Frame Counter Test – Rechecks data path, sets and resets I/O flag bits, clocks and rotates a pattern through frame counter
16	I/O Silo Good Parity Data Test – Writes I/O silo with good parity and returns it to main micro with silo parity error register to check for errors
17	I/O Silo Bad Parity Data Test – Same functionality as Test 16 but causes bad parity and looks for error in silo parity error register

Table 3-1 Test Descriptions (Cont)

Test No.	Description
20	I/O Loop-around zeroes Test – Writes into I/O extended address, OP code, and shift registers, then shifts eight times and looks for error
21	I/O Loop-around ones Test Wraparound – Same as test 20 but with ones to test for bits that cannot be set to one
22	I/O Loop around MUX Test – Checks I/O's ability to multiplex shifting sequence from 5-bit to 21-bit, to 23-bit shift, checks I/O STWORD and STBYT instructions
23	Write Board Clock Test – Fills I/O silo with data and checks M8929's ability to empty silo at three selectable data rates
24	Formatter Flag and Sync-up Test – Sets and clears formatter flag control bit, and tests write board formatter and silo for sync-up time by writing special pattern into I/O silo and timing formatter's time to fill up formatter's silos (done in formatter wraparound mode)
25	Formatter Peak Shift and FWD/REV MUX Test Checks formatter's ability (M8924 boards) to shift data and phase window to follow peak shift and FWD/REV MUX (M8923 and G159)
26	Formatter Table Look-up ROM Checksum Test Checks M8922 ROMs by checksum testing all ROM locations
27	Not Used
30	Not Used
31	Skew Meter Calibration Test – Checks skew meter circuit with microprocessor generated data
32	Data Head Test – Writes data at 40 percent threshold and verifies each head; five out of eight 64 byte bursts can be read without error

Table 3-1 Test Descriptions (Cont)

Test No.	Description
33	Erase Head Test – Checks that erase head can reduce residual tape signal to less than 7 percent
34	Minimum Amplitude Test – Checks capability to read most 3200 FCI data written at 80 percent threshold
35	Maximum Amplitude Test – Checks capability to prevent reading most 3200 FCI data transitions when written at 120 percent threshold
36	Secondary Pulse Test – Checks for excess characters in record after write head current
37	Feedthrough Test – Checks for noise when reading during write at 7 percent threshold
40	Tracking Test – Checks that tape path across head is same in forward and reverse
41	PE Data Test – Writes 72 records at normal thresholds; sets errors for more than four bad records
42	PE Data Test – Writes 72 records, reads reverse without checking errors, and reads forward at 70 percent threshold; sets error for more than 30 bad records
43	PE Data Test – Writes 72 records and reads reverse at 60 percent threshold; sets error for more than 30 bad records
44	PE Signal Sag (RD FWD) – Writes 64 records and positions back and forth over data 10 times, checks to read 32 or more records at 70 percent threshold on final read forward
45	PE Signal Sag (RD REV) Test – Same as Test 44 but read reverse is final operation
46	Rewind Test – Checks that rewind stops at BOT and no limit switch error

Table 3-1 Test Descriptions (Cont)

Test No.	Description
	NOTE **This test may be used to rewind tape if M7982 is not powered up.**
47	I/O Serial Bus Wraparound Test – Checks basic serial bus operation, also, sends out bad serial bus parity to the UNIBUS interface to set SPE bit in TSSR after this test
	NOTE **This test fails if M7982 is not powered up.**
Auto Sequence Stops here. Tests 50 through 57 run manually only	
50	Forward/Reverse Skew Test – Checks head skew in forward and reverse
	NOTE **A skew tape must be mounted for proper operation.**
51	Forward Read Test – Causes normal PE read cycle, forward at BOT, reverse at EOT
52	Reverse Read Test – Causes normal PE read cycle, forward at BOT, reverse at EOT
53	Write Zeros Test – Causes 256 character, all zero records to be written on tape, rewinds when EOT is hit
54	Write Alternating Ones Test – Same as Test 53 with alternating ones pattern (Parity track will always be a one though)
55	Stuck Test – Causes stuck verify test to loop with good and bad parity; if error, will halt at 1772–1774
56	CBUS Test – Causes CBUS communication test to loop; if error, will halt at 1772–1777
57	Manual Switch and Light Test – Scans test motions on, operator panel switches, limit switches, write lock switch, and BOT/EOT sensors, these are then displayed in operator panel indicators

3.5 ERROR CODES

This section describes the three error code classes and defines the error codes.

3.5.1 *Fatal Errors*

These errors are caused by a failure in the main micro and are identified by all operator panel lights out and the CLK STP and CROM PERR lights on. The PC lights indicate the fatal error. Accepted range is from 1750—,777. Values outside this range indicate CROM parity errors. Table 3-2 lists the fatal error, error description, and the module that probably failed.

NOTES

1. **The display in the operator lights and switches at this point may not apply to the error.**

2. **To loop microdiagnostics on error halt, raise the override switch. Set the HALT/RUN switch to halt (for single step). Set the HALT/RUN switch to run to loop continuously. Press the step switch to recycle.**

Table 3-2 Fatal Microprocessor Errors

Error (PC counter)	Test Error Description	Probable Module
1750	Main micro detected CROM parity error in I/O during operational code OPEND entry called at wrong time: microcode bug halt IOM rate vectored data from I/O at end of data operation when expecting record-length flags, probably means I/O microproblem Start I/O operation called at wrong time, probably microcode bug	M8967

Table 1-2 Fatal Microprocessor Errors (Cont)

Error (PC counter)		Test Error Description	Probable Module
1751	DISPM	Spurious ATTN (Noise on .NATTN line?)	M8963
1752	DISPM MUCTM	Fatal stack parity error or overflow error occurred, may be hardware failure of stack board or microcode stack bug (bad)	M8963
1753	DISPM	Stack not empty and nothing more to do could be hardware stack pointer problem or microcode bug (too many pushes or pops)	
	MTTTM	Maintenance mode fatal microcode bug halt	
1754	UINTM	Stack pointer will not hold data	M8962 M8963 M8964
1755	UTSTM	Failure of one of branch tests	M8964 M8966 M8967
1756	UTSTM	Failure of Z bit test – Z bit says result of last arithmetic operation was zero)	M8962 M8964
1757	UTSTM	Failure of N bit test – (N bit says result of last arithmetic operation was negative or OBUS bit 7 was a one during last instruction)	M8962 M8964
1760	UTSTM	Failure of C bit test (C bit says result of last arithmetic operation should have caused carry out of high order stage of ALU)	M8962 M8964

Table 3-2 Fatal Microprocessor Errors (Cont)

Error (PC counter)		Test Error Description	Probable Modules
1761	UTSTM	Failure of miscellaneous test A – the Z bit was set even though result of last operation was non-zero	M8962 M8964
1762	UTSTM	Failure of write/read external test – unsuccessful attempt to write and read an external register (the PC buffer)	M8964 M8962
1763		Failure of register address/data test – each internal register written with its own number, but gave discrepancy when read back	M8962
1764	UTSTM	Failure of register test 2 – each register written with complement of its own number, but gave discrepancy when read back	M8962 M8964
1765	UTSTM	Failure of add arithmetic function	M8962 M8964
1766	UTSTM	Failure of ASUB test	M8962 M8964
1767	UTSTM	Failure of BSUB test	M8962 M8964
1770	UTSTM	Failure of shift test – unsuccessful attempt to shift (rotate) data left or right	M8962 M8964
1771	UTSTM	Failure of logical operands test (AND, OR, NAND, XOR, etc)	M8962 M8964
1772	STACM	Failure of stack parity test – bad parity written into the stack, but stack parity error not detected	M8963

Table 3-2 Patrol Microprocessor Errors (Cont)

Error (PC counter)		Test Error Description	Probable Module
1773	STAKM	Failure of stack underflow/overflow test – attempted to push data on stack past location 77 (overflow) or pop data off stack past location zero (underflow), and did not get error (or attention condition)	M8963
1774	STAKM	Failure of stack address data test – some location(s) of stack do not contain correct data after being written	M8963
1775	STAKM	Failure of esputa bus data-wrap test – data written into light register and different when read back	G159 M8963 CBUS cable
1776	STAKM	Failure of CBUS branch condition test	M8963
1777	STAKM	Failure of limit attention flag – limit error was enabled, and status of limit switch does not agree with corresponding position in situation register	M8963

3.5.2 Non-Fatal Errors

Errors are identified by CLR STP off and operator panel light values from 100-237 (octal). Table 3-3 lists error code, error description, the module that probably failed, and scope loop.

NOTES

1. This error table is valid when in-line or initialize microdiagnostics are running. If off-line tests were being run see Off-Line Test Errors.

2. To scope loop these tests, enter maintenance mode (on-line switch to off position, maintenance switch up, press RESET). Enter the off-line test number (see the scope loop column in Table 3-3) in the operator console lights, and press the on-line button. The test will loop until the on-line switch is returned to the off-line position and errors are displayed continuously.

Table 3-3 Non-Fatal Microprocessor Errors

Error Test (Operator panel)		Error Description	Probable Module	Scope Loop (Test number)
137	Operator Panel Clock	Capstan runaway error (.0159), capstan did not stop within acceptable window after last command		
100	IOTSM	Basic I/O error (a bus/parity error, IOATN, handshaking, and data window test between I/O and main micro NOTE: Can also be caused by the serial bus SHIN (shift in) stuck asserted	MA960	18

Table 3-3 Non-Fatal Microprocessor Errors (Cont)

Error Test (Operator panel)		Error Description	Probable Module	Scope Loop (Test Number)
101	IOTSM	Error in I/O status register test	M8966 M8967	15
102	IOTSM	Failure of frame counter test	M8965 M8967	15
103	IOTSM	Failure of I/O silo non-parity error data test or write flag	M8966 M8965 M8967	16
104	IOTSM	Failure of I/O silo parity error test or data late test	M8966 M8967	17
105	IOTSM	Failure of shift loop with zeros	M8965	17
106	IOTSM	Failure of shift loop with ones	M8965	21
107	IOTSM	Failure of shift length mux	M8965	22
110	IOTSM	Failure to receive correct operating code from TS11 when responding to data sent over SHUS cable another board the serial bus	M8965	47
111	CATSM	Failure of 1 kHz clock test, also test tach sync flop	G159 CBUS cable M8965	2
112	CATSM	Tach register changed when motion register cleared	G159	3,4
113	CATSM	FWD or REV bits wrong after 1 tick of simulated command, and tach pulses	G159	3,4

Table 2-3 Non-Fatal Microprocessor Errors (Cont)

Error Text (Operator panel)		Error Description	Probable Module	Scope Loop (Test Number)
114	CATSM	Failure of simulated capstan speed test. Speed counter was out of range when tape motion at speed was simulated	G159	3,4
115	CATSM	Failure of simulated slow capstan test. speed counter did not latch up with maximum count when slow tach rates were simulated	G159	3,4
116	CATSM	Failure of simulated capstan deceleration test, counter not zero for forward or 377 for reverse while decelerating, or MVG Bit NOT 1	G159	3,4
117	CATSM	Failure of moving flag to go to zero after stopping (direction reversal for one tach tick)	G159	3,4
120	PETSM	Failure of write buffer to run out and empty sole, or data late bit does not work	M8929 M8966	23
121	PETSM	Failure of write buffer to empty sole at correct speed	M8922	24
124	PETSM	Parameter flag does not work on M8922	M8922	24
125	PETSM	Formatter silo filling and data error	M8922	24

Table 3-3 Non-Fatal Microprocessor Errors (Cont)

Error Test (Operator panel)		Error Description	Probable Module	Scope Loop (Test Number)
126	PLUSM -	Peak shift test error	M8924 M8922 M8923 M8924	25
127	PLUSM	Formatter table lookup ROM checksum test error	M8922 M8923 M8924	26

3.5.3 Off-Line Test Errors

These errors occur only when running off-line tests. If running in auto-sequence mode the failing test is displayed first. This failing test can be entered to run in standalone mode. The resulting error code in the operator panel describes the failure and the module that probably failed. Section 3.5 explains how to run off-line tests. Table 3-4 lists the failing test, operator panel indication, error description, and probable cause. (The asterisks (*) indicate customer confidence tests.

Table 3-4 Customer Confidence or Maintenance Mode Test Errors

Test Number and Scope Loop	Operator Panel Error Indication (octal)	Error Description	Probable Cause
1	Various	Indicates failed test number	See Failed Test description
2	111	Formatter detailed clock off speed TACsync flop; or TACATTN signals not working	M8863, G159, Mother board
3-4	112	Operator panel affected by WRT CLR to MOT. REG	G159

Table 3-4 Customer Confidence or Maintenance Mode Test Errors (Cont)

Test Number and Scope Loop	Operator Panel Error Indication (octal)	Error Description	Probable Cause
3–4	113	MVG or FWD/REV flop not okay	G159
3–4	114	SPD REG out of tolerance (on speed)	G159
3–4	115	SPD REG wrong (slow speed)	G159
3–4	116	SPD wrong (deceleration)	G159
3–4	117	MVG not set during deceleration	G159
5*	1	With reel motors off, reel motors on signal was one	G158, G159 Reel Motor
6*	1	Reel motors on, reel motor signal was zero	G158, G159 Reel Motor
7-10*	4	Phase angles confused	G159, Capstan assembly motor
7-10*	3	Phase exceeded limit	G159, Capstan assembly or motor
11-12*	2	Capstan speed too fast	G158
11-12*	1	Capstan speed too slow	G159
13*	10	REV overshoot, too many ticks to stop REV	G159, G158
13*	4	REV under shoot, too few ticks or bounced back	G159, G158

Table 3-4 Customer Confidence or Maintenance Mode Test Errors (Cont)

Test Number and Scope Loop	Operator Panel Error Indication (octal)	Error Description	Probable Cause
13*	2	FWD over shoot, too many ticks to stop FWD	G159, G158
13*	1	FWD under shoot, too few ticks or bounded back	G159, G158
14	100	I/O Micro step, I/O	M8967, M8963
15	101	IOC NO register test	M8967
16	102	Frame counter test	M8966
16	103	Silo good parity data-flag	M8966, M8963
17	104	Silo bad parity, data late	M8966
20	105	I/O loop around, series	M8965
21	106	I/O loop around, gates	M8965
22	107	I/O loop around, shift length MUX	M8965
4*	110	Serial bus/TSII alive	M8965, M7982, Mother board
23	120	I/O silo not being clocked by write board	M8929, M8966
23	121	WRT BD silo CLK out of range	M8929
24	124	FMT FLG in FMT CNTL R/S test	M8922

Table 3-4 Customer Confidence or Maintenance Mode Test Errors (Cont)

Test Number and Scope Loop	Operator Panel Error Indication (octal)	Error Description	Probable Cause
24	125	PE FMT mode, data, silo	M8922, 23, 24, G157
25	126	PE FMT early/late bit skew test	M8922, 23, 24, G157
26	127	PE FMT initialize loop up ROM checksum test	M8922
27	1	Skew limit too loose, turn R49, M8923 CCW	M8923
31	1	Skew limit too tight, turn R49, M8923 CW	M8923
32*			Head, M8922, G057
32*	001	Track active data error	Erase-head
34, 35	100	Data timeout if data expected, TST 32, 34; noise when no data expected, TST 33, 35–40	G057, M8922
36*	20	Byte count error	Head
37*	17	Track number, bit 1s parity track	Head
40*			Head
41–42*	200	Fatal error. Error corrected/can data	Head threshold adj.
51–54	100	Data error. VCO lost sync	M8922, M8924, M8929 threshold adj.
	40	Tape mark seen	M8922, M8924, M8929 threshold adj.

Table 3-6 Customer Confidence or Maintenance Mode Test Errors (Cont)

Test Number and Stops Loop	Operator Panel Error Indication (octal)	Error Description	Probable Cause
	20	Data error VCO still synced	M8922, M8924, M8929 threshold adj.
50	2	Reverse skew error	Head, tape path
50	1	Forward skew error	Head, tape path
57	200	Reel motors on	Switches Sensors Reel Motor
57	100	Checkout switch in (lights ONLI)	
57	40	Limit switch exceeded, latch set (all limit switches light UOK)	
57	20	Load switch in (load switch lights VOK)	
57	10	Enter zero switch in (EOT switch lights DCK)	
57	4	Write lock over cut WRT Locked (Write lock lever lights WLK)	
57	2	BOT latch set (BOT sensor lights BOT)	
57	1	EOT latch set (EOT sensor lights EOT)	

NOTE
Test 57 loops on itself. The loop is broken by pressing the maintenance panel reset button.

3.6 HOW TO RUN MICRODIAGNOSTICS

3.6.1 Internal Microdiagnostics (Inline)

These tests run by themselves when the transport is idle for more than 200 milliseconds. They cause fatal and non-fatal errors.

3.6.2 Internal Microdiagnostics (Initialization)

These tests are a superset of inline diagnostics, and test more logic. They are initiated by a power-up, maintenance panel reset, subsystem and/or UNIBUS reset. They cause more fatal and non-fatal errors.

3.6.3 Off-Line Microdiagnostics (Customer Confidence and Maintenance)

A write-enabled standard amplitude tape must be loaded on the transport. Set the maintenance mode/normal switch on the maintenance panel to maintenance mode. The operator panel now operates in maintenance mode with the on-line switch out. Enter the off-line test in the operator panel (in octal notation). (The left most switch puts a one in LSB and the right most switch puts a zero in LSB. The value shifts left after each entry.) Test 1 is auto sequence mode; tests 2 through 47 run consecutively. The on-line switch is now a start/stop switch. Press the switch to latch it in and the selected test will run; press it a second time to release it and the test will stop. A new test can be selected whenever the start/stop switch is in the stop position. Successful completion in auto-sequence mode is shown by a rotating pattern in the operator panel (only when connected to a TS11 with power applied). Exit to normal operation by placing the maintenance mode/normal switch in the normal position and replace the scratch tape.

3.7 CUSTOMER CONFIDENCE CHECK

The customer confidence test is a sub-set of off-line tests. It can run without going inside the cabinet and setting the maintenance switch. The test is designed to be run by the operator to verify the drive. A Field Service standard amplitude tape must be loaded (load light on), off-line, and write-enabled. Push both the LOD and UNLOAD recessed pushbuttons together. The display now shows 300 indicating the customer confidence tests will run as soon as you push the on-line switch on. If a test fails, the test number will flash in the lights. If all tests pass, the lights display a rotating pattern. To return the drive to normal operation at any time, push the on-line switch again so the switch is released.

3.8 OPERATING INSTRUCTIONS FOR PDP-11 BASED DIAGNOSTICS

1. Load XXDP+ monitor

   a. Enter date

2. Answer hard core questions

   a. SO HC? Y or N

   b. LSI? Y or N

      This is XXDP+. Type H or H/I for details (help file).

      [Receive XXDP+ prompt (dot)

      .

3. Enter R (space) program

   The program is CZTSI or CZTSH etc.

   The operator entry should look like this:

   [.R CZTSI]

4. Receive DR> prompt.

5. Enter the appropriate command. For example, DR> STA for start.

6. Change HW (L) ?

7. Change SW (L) ?

   NOTE
   Refer to the diagnostic listing for specific program problems.

3.8.1 Data Reliability Program Tests

Test 1	Basic functions
Test 2	Data reliability
Test 3	Write compatibility/write utility
Test 4	Read compatibility/read utility
Test 5	Operator selected sequence

3.8.2 Control Logic Program Tests

Test 1	PDP-11/TSI wrap test
Test 2	PDP-11/cassport wrap test
Test 3	Set character check

Test 4	Tract active/inactive test
Test 5	PE data test
Test 6	PE skew test
Test 7	Tread tracks test
Test 8	ROM look-up table test
Test 9	Inline microdiagnostic test
Test 10	JNIT microdiagnostic test

3.8.3 Program Control Flags

HOE	Halt on error, causing CMD mode to be entered when error
LOE	Loop on error, causing diagnostic to loop continuously within specified defined block of coding (segment, subtest, or test)
IbR	Inhibit error reporting
IBE	Inhibit basic error reports
IXE	Inhibit extended error reports
PRI	Direct all messages to line printer
PNT	Print number of test being executed
BOE	Bell on error
UAM	Run in unattended mode, bypassing manual intervention tests
ISR	Inhibit statistical reports
IDU	Inhibit dropping of units by diagnostic

3.8.4 Hardware Parameters

The following are base address and vector assignment default parameters.

TSSR ADDRESS (172522)?
VECTOR (224)?

Example of commands: STA/TES:2/T:LA:IDU:LOP

Example meaning: Start test 2, inhibit dropping unit and loop on error

3.8.5 Software Parameters (Data Reliability Program Only)

Refer to diagnostic listings.

3.9 SPECIAL TECHNIQUES

The special procedure explained here should be followed to bring up the system when it is "dead in the water".

When nothing else works (tape cannot be loaded or microdiagnostics run) and the power is okay. One of the modules that makes up the microprocessor or control read only memory (CROM) is not working, or a module that hangs on the microprocessor buses is hanging the bus.

Hardware and microcode are structured so that all modules except the main micro and main ROM board can be removed from the system and then added one by one until a failure occurs. The diagnostic serves the modules as they are added and expands the test loop to encompass the new boards functional. Perform the following initial set up procedures.

1. Power off.
2. Remove all PC cards in the logic rack except M8962 (microprocessor) and M8964 (PC and ROM 1).
3. Remove the cable from J 2 on backplane. This disconnects G139 (capstan servo board).
4. Remove the cable from J4 on backplane (disconnects TS11 UNIBUS Interface Card M7922).
5. Place the maintenance switch in the normal position, the enable error switch to enable and the halt switch to run.

Starting with only the M8962 and M8964 installed, perform the following test sequence procedure.

1. Power up.
2. Wait 30 seconds.
3. Press the reset button on the maintenance panel.
4. Table 3-5 lists the correct contents of the maintenance panel and operator panel displays. If the display differs, the last module added is bad.

Table 3-5 Bring-Up Procedure Errors

Add	Maintenance Panel CLK STOP	Maintenance Panel PROM PERR	Maintenance Panel PC (octal)	Front Panel Lights (octal)	Comment
M8962, M8964	off	off	377[illegible]	1	Loop basic micro test
M8963	off	off	377[illegible]	2	Loop [illegible] micro test
M8963	on	on	[illegible]777	3	Control bus test
G159 cable 19 on backplane	off	off	1037	100	Base IO test
M8967	off	off	1037	102	Frame control test
M8956	off	off	1037	105	I/O [illegible] test
M8965	off	off	1037	110	Serial bus wrap test
M8982	off	off	1037	120*	Write Load/[illegible] test
M8929	off	off	1037	12[illegible]	[illegible] test
M0922 and interconnect jumper	off	off	1037	135	PE [illegible] test
M8923, M8924, G157	off	off		Micro okay	System up (VCK OK) VCK light on

*116 if host CPU power off.

5. If all display indicators are correct,

   a. Power off

   b. Insert the next card listed in the add column of Table 3-5

   c. Go back to step 1 and continue testing

3.9.1 Dead Track Card Identifier

Table 3-6 shows which card is bad for each dead track.

Table 3-6 Dead Track/Module Locations

Dead Track	BH	Head US	Slot/Card
1	0	2	2 = G157
2	1	8	2 = G157
4	2	1	1 = G157
10	3	9	1 = G157
20	4	3	1 = G157
40	5	5	2 = G157
100	6	6	2 = G157
200	7	7	1 = G157
400	F	4	3 = M8923

4 REMOVAL AND REPLACEMENT

This chapter provides removal or replacement procedures for parts listed in the spares kit list. Complete procedures for all replaceable parts are found in the *TS11 Technical Manual*.

4.1 SPECIAL PROCEDURES

Several pieces of the spares kit require no special removal or replacement techniques. Except where noted, no adjustment is required after replacement. Normal safety precautions should be followed. One module (G158 Reel Servo board) has line voltage exposed on its surfaces. Always remove power when replacing parts on this unit. The following spares require no special procedures.

- Pico Fuses (DEC P/N 12-05747) – Refer to Figure 1-5.
- Maintenance Panel LED (DEC P/N 11-10326) – Refer to Figure 1-5.
- Maintenance Panel Switches

  Toggle (DEC P/N 12-09590) – Refer to Figure 1-5.

  Pushbutton (DEC P/N 12-11079) – Refer to Figure 1-5.

- Limit Switch (DEC P/N 70-15656) – Check tension and mechanical adjustment (Figure 4-1).
- Operator Panel Light (DEC P/N 12-12716-01) – General Electric #73 (Figure 1-3).
- Operator Panel Lights Covers – (Paragraph 1.6) Refer to Figure 1-3.

4.2 MODULE REPLACEMENT

Table 4-1 lists adjustments to be checked and performed, as needed, whenever a module is replaced. The adjustments are found in Chapter 5.

Table 4-1 Module and Adjustment Number

Replaced Module	Adjustment To Perform
M7985	See installation section Set address and vector switches
M8972	V.C.O.
M8933	Threshold, skew
M8934	*
M8920	*
M8962	*
M8963	*
M8964	*
M8965	*
M8966	*
M8967	*
M8968	*
G187	Preamplifier amplitude
G157	*
G158	Set S1 for appropriate frequency (check adjustment tension arm)
G159	Capstan null Capstan deceleration

*None

4.3 OPERATOR PANEL – (G159 BOARD)

This panel is an integral part of the G159 module. If necessary, replace G159 and perform the adjustments shown in Table 4-1. Test switches by using off-line test 57.

4.4 BOT/EOT SENSOR (DEC P/N 12-11720-00)

When replacing a new sensor ensure that its face is parallel with the tape path.

4.5 CAPSTAN WHEEL (DEC P/N 74-18010)

The following procedure describes capstan wheel removal and replacement. A capstan clamp (DEC P/N 74-18021) may be necessary to perform this procedure.

4.5.1 Capstan Wheel Removal

1. Use the Allen wrench to loosen the capstan clamp at the rear of the capstan wheel.
2. Once loose, pull forward until the wheel is free.

4.5.2 Capstan Wheel Replacement

1. Carefully place the new wheel over the capstan motor shaft. Align the wheel flush with the capstan motor shaft.
2. Holding the wheel firmly in place, tighten the capstan clamp with the Allen wrench. Check tape path alignment and tape tracking.

4.6 FIXED REEL ASSEMBLY

The following procedure describes fixed reel assembly removal and replacement.

> **NOTE**
> **The fixed reel assembly (four pieces: rear flange, inner hub, front flange, and trim piece) fits against a hub adapter. This adapter should not be removed for normal servicing. A special gauge is provided in the spares kit to check the hub adapter height.**

4.6.1 Fixed Reel Assembly Removal

1. Remove three Phillips head screws and carefully slide all four assembly pieces forward.

4.6.2 Fixed Reel Assembly Replacement

1. Assemble all four pieces on the hub adapter individually, and align the screw holes as you go.
2. Insert screws and tighten progressively in a clockwise sequence.

4.7 SNAP LOCK HUB ASSEMBLY (DEC P/N 12-03149)

The following procedure describes snap lock hub assembly removal and replacement.

> **NOTE**
> This assembly fits against a hub adapter. The hub should not be disturbed to remove or replace the snap lock hub assembly or bezel. A special gauge (hub height tool DEC P/N 96-07951) is provided in the spares kit to check hub adapter height.

4.7.1 Snap Lock Hub Assembly Removal

1. Lift the locking tab and remove the index screw.
2. Rotate the outer hub counterclockwise to unscrew the hub from the hub adapter.

4.7.2 Snap Lock Hub Assembly Replacement

1. Carefully thread the snap lock hub clockwise onto the hub adapter until fully seated with the snap lock open.
2. Back off the hub counterclockwise until the snap lock closes smoothly.
3. Use several reels of tape to check for smooth and firm snap lock action.
4. Locate the nearest index screw hole through the hub and reinstall the index screw.

4.8 LOWER ROLLER ASSEMBLY (FIXED ROLLER, DEC P/N 12-16060)

The following procedure describes lower roller assembly removal and replacement.

4.8.1 Lower Roller Assembly Removal

1. Remove capstan wheel (Paragraph 4.5.1).
2. Remove fixed reel assembly (Paragraph 4.6.1).
3. Remove snap lock hub assembly (Paragraph 4.7.1).
4. Remove bezel covering the casting by removing seven screws from the rear of the casting (Figure 4-1).

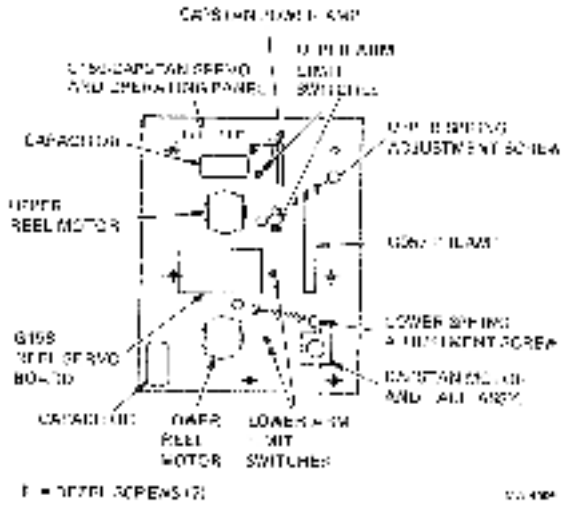

Figure 4-1 Deck Plate Assembly (Rear View)

5. Remove two screws from the roller assembly in front.
6. Lift out roller assembly.

4.8.2 Lower Roller Assembly Replacement

1. Screw new roller assembly in place with two screws.
2. Replace bezel by fastening seven screws in the rear of the casting (Figure 4-1).
3. Replace snap lock hub (Paragraph 4.7.2).
4. Replace fixed reel assembly (Paragraph 4.6.2)
5. Replace capstan wheel (Paragraph 4.5.2).
6. Verify tape tracking and tape path alignment (Chapter 5)

4.9 UPPER ROLLER ASSEMBLY

This roller is part of the head assembly DEC P/N 70-13514. If it fails, the head assembly must be replaced. These procedures are found in the *TS11 Technical Manual*.

4.10 TENSION ARM ASSEMBLY (DEC P/N 17-10014)

The following procedure describes tension arm assembly removal and replacement.

4.10.1 Tension Arm Assembly Removal (upper or lower)

1. Remove capstan wheel (Paragraph 4.5.1).
2. Remove fixed reel assembly (Paragraph 4.6.1).
3. Remove snap lock hub assembly (Paragraph 4.7.1).
4. Remove bezel by unfastening seven screws from the rear of the deck plate (Figure 4-1).
5. While holding the tension arm spring loosen and remove the tension block screw. Remove the tension spring from the transducer cable (Figure 4-11).
6. Unhook the transducer cable from the pin in the pivot arm housing.
7. Unscrew the three holding screws from the front of the deck plate and remove the arm assembly through the back of the deck plate.

4.10.2 Tension Arm Assembly Replacement

1. Insert the new arm assembly into place through the rear of the deck plate. Ensure the opening in the pivot arm housing points to the tension block assembly for the transducer cable). Then secure with three screws.
2. Place the unit in a vertical position and attach the transducer cable to the pin in the pivot arm housing.
3. Prepare the tension block assembly by having the adjusting screw in place and ready to attach when spring tension is applied.
4. Attach the spring and adjust the tension screw several turns.
5. Adjust coarse spring tension using the procedure in Chapter 5.
6. Replace the bezel by fastening seven screws in the rear of the deck plate (Figure 4-1).
7. Replace snap lock hub, fixed reel assembly, and capstan wheel (Paragraphs 4.7.2, 4.6.2, and 4.5.2).

8. Perform line tension arm adjustment.
9. Check tape path alignment and tape tracking.

4.4 AC INPUT/LINE FILTER BOX

Special techniques to remove or replace the ac input/line filter box are needed. This is the only change for ac input voltage modification. Use Table 4-2 to select the proper parts.

Table 4-2 120V/240V AC Input Part Numbers

Voltage	Line Filter	Cord
120 V	DEC P/N 70-15283-00	DEC P/N 70-16295-01
240 V	DEC P/N 70-16983-01	DEC P/N 08-16295-01

5 ADJUSTMENTS

5.1 QUICK REFERENCE ADJUSTMENT SPECIFICATION

Table 5-1 provides a quick reference to the various TS21 adjustment specifications.

Table 5-1 Adjustment Specifications

Parameter	Specified Value	Test Points
SUPPLY VOLTAGE	(At motherboard)	
5 V Noise	5.0 to 5.2 Vdc <300 mV	J5-7 to ground (adjust ff744)
+15 V Noise	14.5 to 15.5 Vdc <300 mV	J5-3 to ground (adjust power line monitor/15 V regulator R24)
−15 V Noise	−14.0 to −16.0 Vdc <300 mV	J5-11 to ground No adjustment
Unregulated Supply Noise	+15 to +20 Vdc <300 mV	J2-2 (G159) +15 V J2-4 (G159) −15 V to ground
TACHOMETER Duty cycle (FWD) 01 02	 45% - 55% 45% - 55%	 G159 – Pin 5 to 29 G159 – Pin 3 to 29
Phase shift (FWD – REV)	81% - 99%	
CAPSTAN NULL	−0.1 to +0.1 V	Red lead of capstan motor to ground (R20 on G150)

Table 5-1 Adjustment Specifications (Cont)

Parameter	Specified Value	Test Points
TENSION (COURSE ADJUSTMENT)		
Lower arm Before fine adjustment	435 to 450 gm 385 to 415 gm	
Upper arm After fine adjustment	400 to 425 gm 400 to 425 gm	
HUB HEIGHT		
Upper Lower	(Use hub tool) (Use hub tool)	DEC P/N 90-09951
CAPSTAN POSITION ON SHAFT	Flush with end of motor shaft	
LIMIT SWITCHES	Open tension arm activate switch	
TENSION ARM CENTERING		
Upper	Approx. center of swing	Test 11 (forward)
Lower	Approx. center of swing	Test 12 (reverse)
Arm to limit switch distance	2 to 2.5 cm (0.75 to 1.0 in) running Test 30	Test 30
REEL/SDT SENSOR		
Sensor position	Parallel to tape	on U159
Marker voltage		
BOT off	>1 V	BOT, Pin 5 E1
BOT on	<3 V	
EOT off	>1 V	EOT, Pin 7 E1
EOT on	<3 V	
TAPE PATH ALIGNMENT	See procedure	
	Tape centered on spindle	
	No tape in and out position change with tape motion	

Table 5-1. Adjustment Specifications (Cont.)

Parameter	Specified Value	Test Points
	(forward and reverse) No tape puckering at roller	
FINAL TENSION ADJUSTMENT	See procedure	
SPEED TEST Forward Period Jitter	242.5 to 257.5 µs less than 5 µs	G159 Pin 3 E29 (Test 11)
Reverse Period Jitter	242.5 to 257.5 µs less than 5 µs	G159 Pin 3 E29 (Test 12)
CAPSTAN DECELERATION Forward	Operator panel lights flicker equally	Test 13 (R87-G159) Forward
Reverse	Operator panel lights flicker equally	(R93-G159) Reverse
SKEW METER CALIBRATION	No operator panel lights lit in Unl	Test 61 (R89-MK92.5) All lights out
PREAMP AMPLITUDE	See following	Maintenance board Analog
Read after write amplitude Preamble (3200 FCI)	9.75 to 11.25 VPP	RD0-RD7 (Test 54) With master output tape
Read after write amplitude Data (1600 FCI)	>16.7 VPP	
Read forward amplitude Data (1600 FCI)	within ±15% of above value	Test 51
Read reverse amplitude Data (1600 FCI)	within ±15% of above value	Test 52

Table 5-1 Adjustment Specifications (Cont)

Parameter	Specified Value	Test Points
THRESHOLD (DURING DATA)	0.9 to 1.1 V from ground	Channel 1 Pin A5A1 on backplane. Channel 2 Pin RDO on maintenance panel Test 54 with master output tape
VCO Level shift (ac) between data and no data	Minimal	Test 54 with master output tape VCO TP1 on MS322 and RDO
SKEW Forward Reverse	+2.5 V +2.0 V	Skew analog Test 51 Test 52 (use master skew tape)
COMPLETE MICRODIAG-NOSTICS	"Jackpot" in operator panel lights	Test 1 (auto sequence

5.2 ADJUSTMENT PROCEDURES

The following procedures describe the correct way to perform various TS11 adjustments.

5.2.1 Tension (Course Adjustment)

Refer to Figure 5-1 when performing this adjustment:

1. Power down the system.
2. Using a one-foot length of tape with loops at each end, attach a force gauge to the upper arm as shown. Place the tape between the upper fixed guide and the upper roller guide. Pull the arm in the direction shown to the approximate center of its swing. Take care that the force gauge has been zeroed. Adjust the upper spring adjustment screw on the back of the deckplate until the gauge reads 400 gm ±15 gm.
3. Using the same one-foot length of tape, attach the force gauge to the lower arm as shown. Place the tape between the capstan and the lower roller guide. Pull the arm in the direction shown to the approximate center of its swing. With the gauge properly zeroed, adjust the lower spring adjustment screw on the back of the deckplate until the gauge reads 450 gm ± 15 gm.

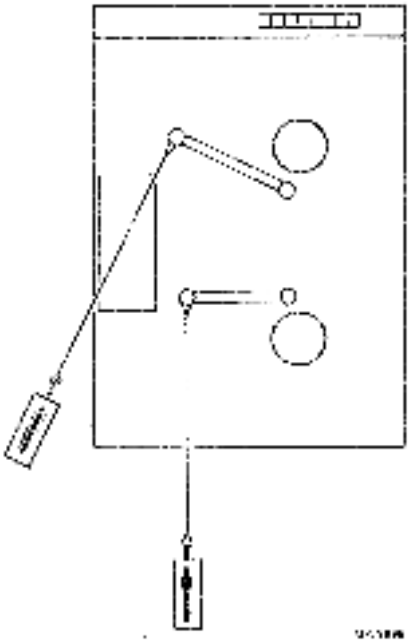

Figure 5-1 Tension Arm Adjustment

5.2.2 Tape Path Alignment Adjustment

Remove the upper and lower fixed guide reference edge capture washers, and press against the spring loaded washers (Figures 5-2 and 5-3).

1. Perform maintenance test 11, with a worn tape loaded that is known to be good. Ensure the tape has no edge damage.
2. Adjust gimbal screw no. 2 (Figure 5-2) until the tape rides in line with both the upper and lower fixed guide reference edge (Figure 5-3).
3. Perform maintenance test 50 and adjust gimbal screw no. 1 (Figure 5-2) until there is no visible difference in tape position on the capstan.
4. Run the maintenance test 50. Repeat adjustment of both gimbal screw no. 2 and no. 1 until the tape rides in line with the fixed guide reference edges and maintains a stable position on the capstan.

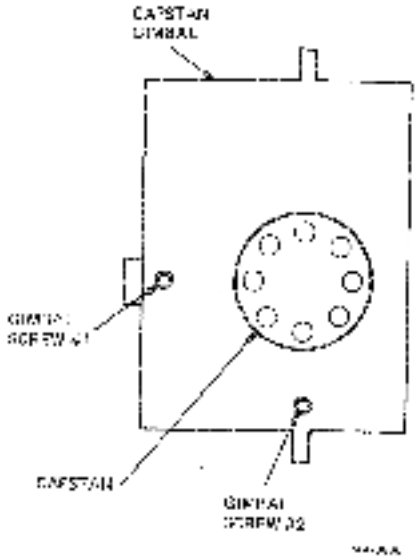

Figure 5-2 Capstan Gimbal Adjustment

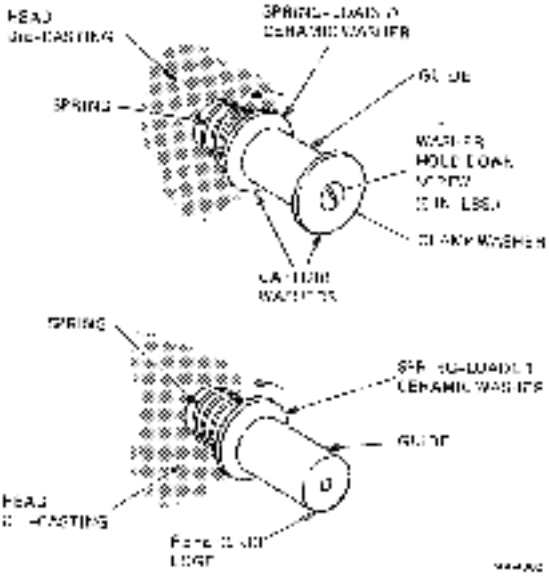

Figure 5-3 Tape Path Guides

5. Ensure no tape puckering occurs at the roller guides and that the tape is not rubbing against the reels.
6. Stop the maintenance test. Carefully replace the capstan washers, the beveled edge of the ceramic (white) washer facing the tape, and tighten to 5 in lbs. Release the spring loaded washers.
7. Perform maintenance test 50 again and check that the results have not changed, repeat all previous steps if necessary.

5.2.3 Final Tension Adjustment

1. Connect an ammeter in series with the capstan motor.
2. Adjust the tension spring so that the current is equal for forward and reverse tape motion (Figure 4-1).
3. For forward tape direction, adjust upper spring.
4. For reverse tape direction, adjust the bottom spring.

5.2.4 Speed Test

Measure speed in the maintenance mode with tape loaded. Monitor Pin 3 F 29 of G199 (each phase 01). Set the oscilloscope in the following manner.

Channel 1	10 v/cm
Vertical Coupling	dc
Horizontal	50 μs/cm
Trigger	Channel 1, Normal, Positive Slope

1. Run test 11 (forward) and verify there are no operator panel lights on. Otherwise, perform a tachometer adjustment.
2. Measure the period of the signal to be 250 μs ± 3 percent. Jitter, measured from the same edge from which the scope is triggered, should be less than 2 percent (Figure 5-4).
3. Run test 12 (reverse) and verify the same measurement.

5.2.5 Preamplifier Amplitude Adjustment

Perform maintenance test 54 with a master output tape loaded.

Figure 5-4 Capstan Speed Adjustment.

1. Remove the preamplifier board shield and attach a scope probe to TP0 (Figure 5-5).
2. Adjust the bit weight zero gain pot (Figure 5-5) for 10 Vp-p ± .25 V in the preamble portion of the analog signal on the scope (Figure 5-6).
3. Move the scope probe to the remaining test points and adjust the corresponding gain pots, including test point TP8 (Figure 5-6).
4. Ensure the data portion of signals TP0 through TP7 does not exceed 16.7 Vp-p (Figure 5-6).
5. Stop the maintenance test, remove the scope probe, replace and secure the board shield, and tighten to 6 in. lbs.

5.2.6 Threshold Adjustment

Measure in the maintenance mode with a master output tape loaded.

Set the oscilloscope in the following manner.

Channel 1	5 V/cm
Channel 2	1 V/cm
Vertical coupling	dc
Horizontal	2 ms/cm
Trigger	Channel 1, Normal, Positive Slope
Mode	Alternate

Channel 1 — monitor RD0 of the maintenance panel
Channel 2 — monitor Pin A3A1 of the backplane

1. Run test 54 and verify Pin A3A1 is 1 V ± .1 V during the data portion of the analog signal (Figure 5-7).
2. Adjust the top potentiometer (R46) of MS90A if needed.

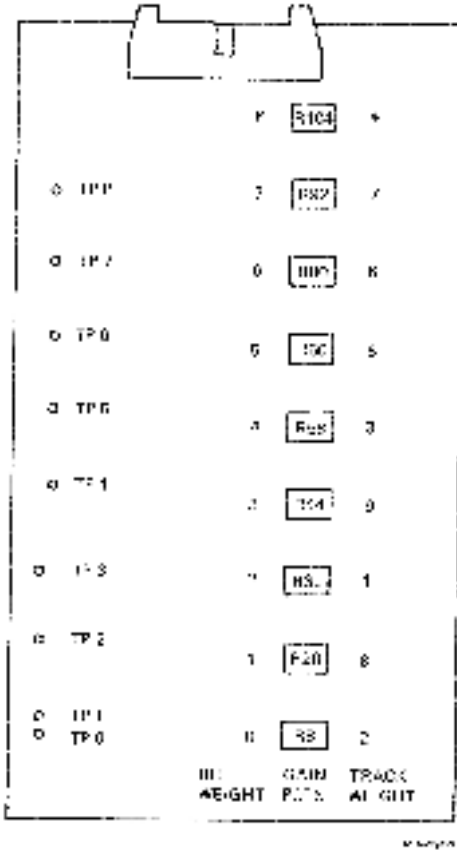

Figure 5-5 Read Preamp Locator

5.2.7 V.C.O. Adjustment

Measure V.C.O. in the maintenance mode with a master output tape loaded. Set the oscilloscope as shown at Paragraph 5.2.6.

Channel 1 — R00 on the maintenance panel
Channel 2 — V.C.O. T.P. on MS922

1. Run test 54. Adjust the potentiometer on MS922 for minimal level shift (dc) between data and no data portions of the signal on Channel 2 (Figure 5-7).

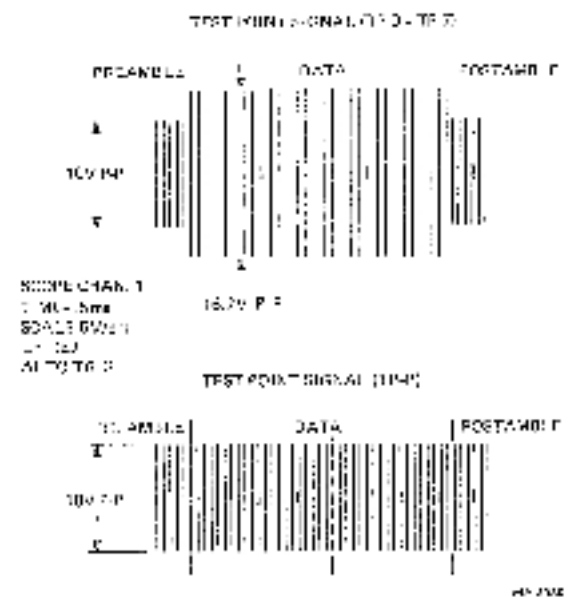

Figure 5-6 Read Preamp Adjustment

5.2.8 Skew Meter Calibration

To calibrate the skew meter run test 31 and adjust the lower potentiometer (R49) on the M8923 until operator panel lights 0 and 1 stay out.

NOTE

There is considerable lag between adjustment of the potentiometer and an updated display.

5.2.9 Head Skew Adjustment

Measure head skew in the maintenance mode with a master skew tape loaded. Set the oscilloscope in the following manner.

Channel 1	1 V/cm
Vertical Coupling	dc
Horizontal	.5 ms/cm
Trigger	Channel 1, normal, positive slope

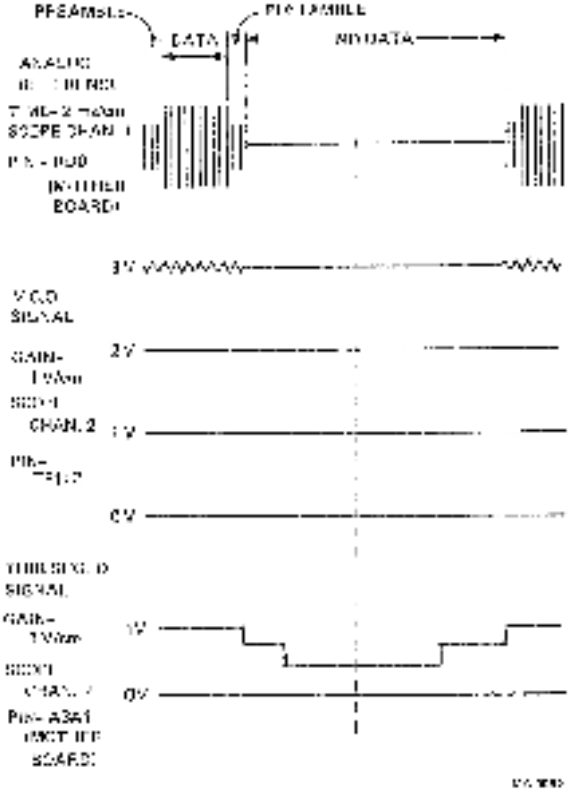

Figure 5-7 Threshold and VCO Adjustment.

Channel 1 — Skew out testpoint on maintenance panel.

1. Run test 51 (forward). Adjust the head azimuth (Figure 5-8) screw for minimum output. It must be 2.5 V or less in the forward direction.
2. Run test 52. Verify that the reverse skew signal is 3.0 V or less.

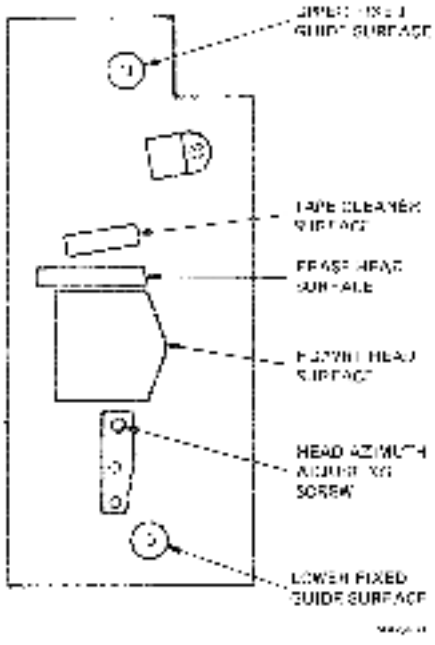

Figure 5-8 Head Skew Adjustment

APPENDIX A
REGISTER SUMMARY

Figure A-1 TX11 Register Summary

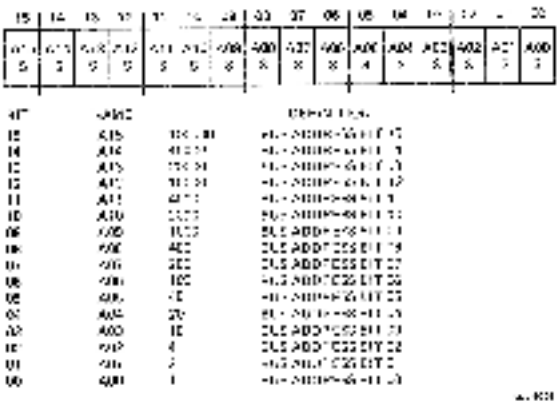

Figure A-2 Bus Address Register

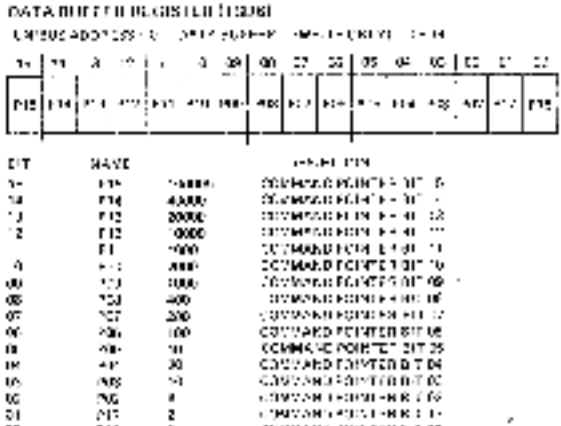

Figure A-3 Data Buffer Register

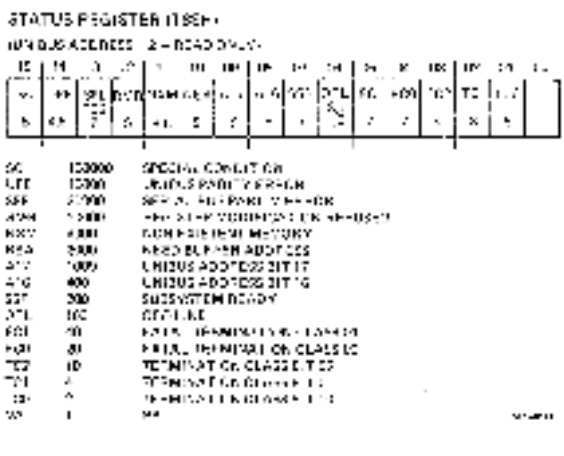

Figure A-4 STATUS Register

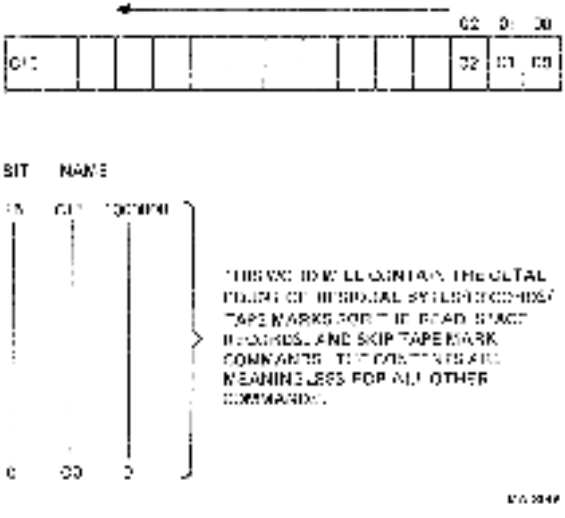

Figure A-5 Residual Frame Count Register

Figure A-6 Extended STATUS Register 0

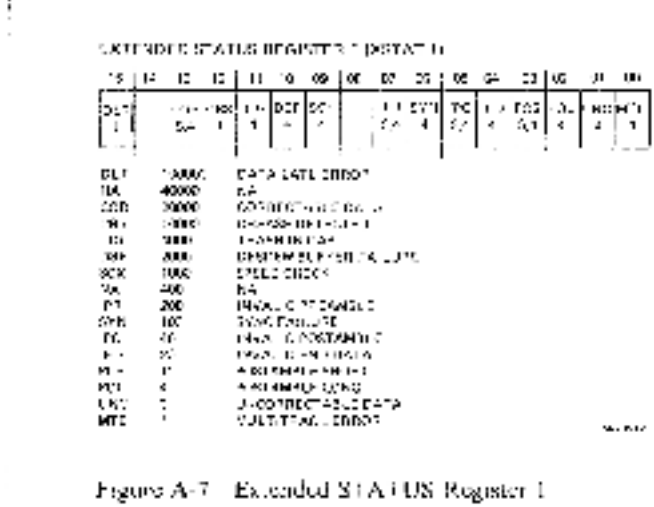

Figure A-7 Extended STATUS Register 1

Figure A-8 Extended STATUS Register 2

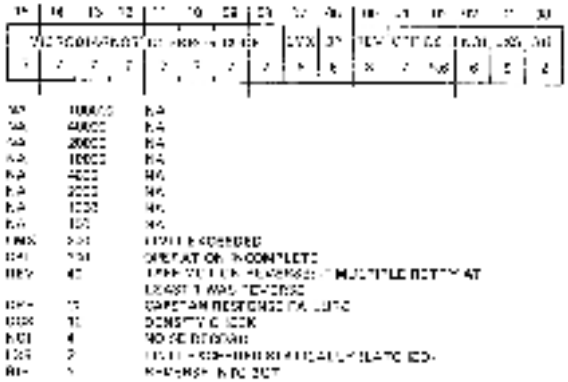

Figure A-9 Extended STATUS Register 3

APPENDIX B
TROUBLESHOOTING FLOWCHART

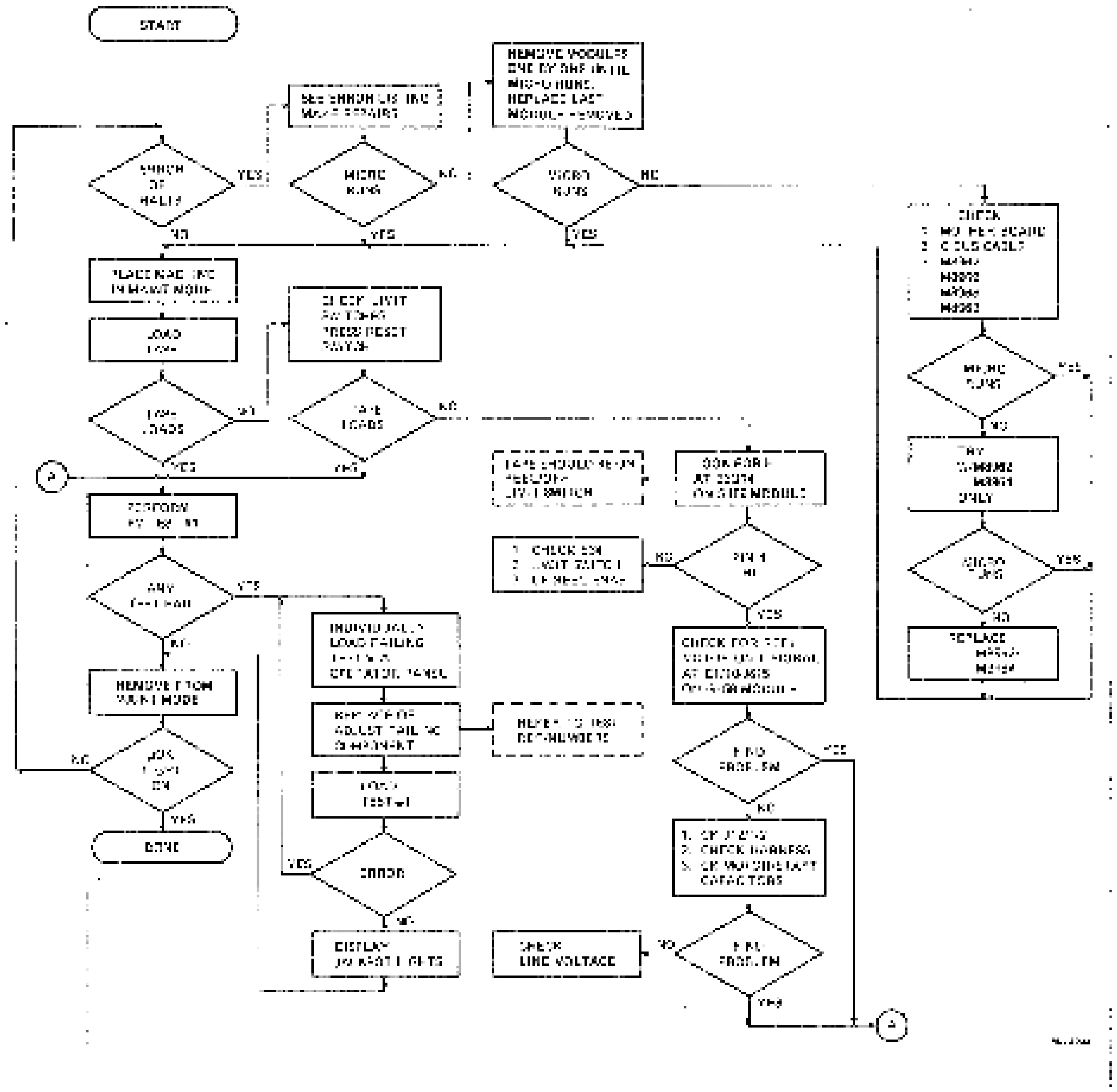

Figure B-1 Troubleshooting Flowchart