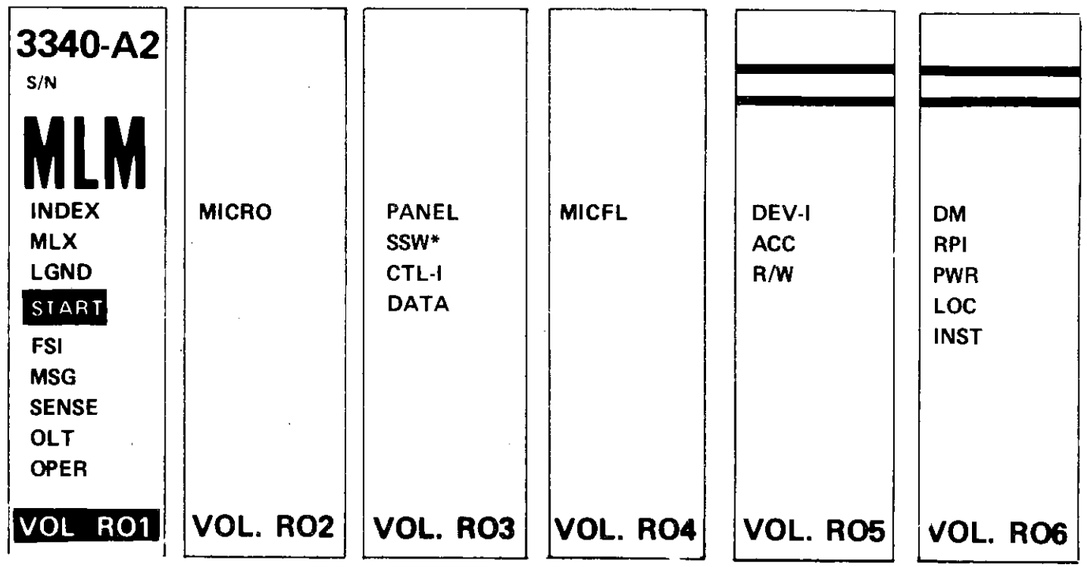
IBM Maintenance Library

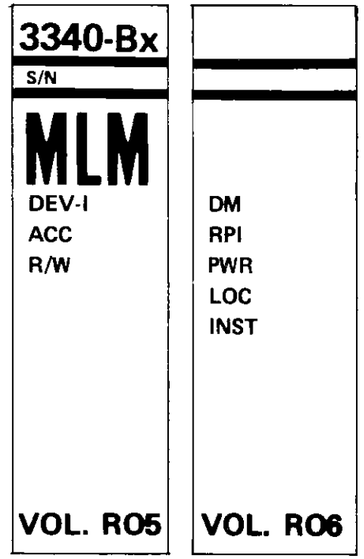
CONTROL MODULE



Volumes RO1, 2, 3, and 4 accompany only Control Modules (A2).

** This section is only with Control Modules that have the string switch feature installed.*

SATELLITE MODULE



Volumes RO5 and RO6 accompany every Control Module (A2) and every Satellite Module (B1 or B2). (One set per serial numbered frame.) To ensure proper documentation level, use the volume that goes with the module you are working on.

3340 Disk Storage

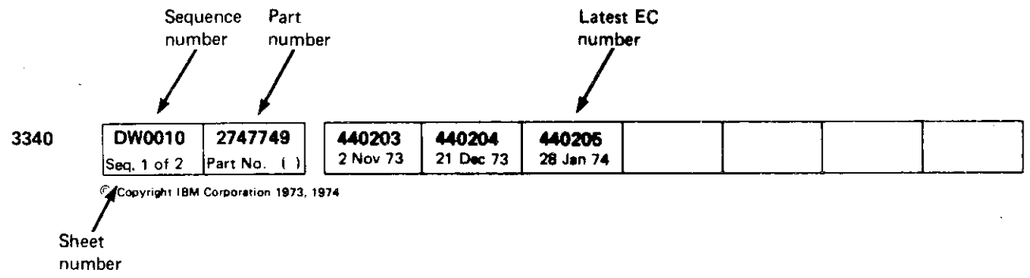
AA000A	2747753	440203	440218	440224				
Seq. 1 of 2	Part No. ( )	2 Nov 73	5 Aug 74	15 Dec 75				

PREFACE

MAINTENANCE LIBRARY ORDERING PROCEDURE (IBM Internal)

Individual pages of the 3340 Maintenance Library can be ordered from the San Jose plant by using the *Wiring Diagram/Logic Page Request* (Order No. 120-1679). In the columns headed "Logic Page", enter the page identifier information: sequence number, sheet number, part number, and EC number. Groups of pages can be ordered by including a description (section, volume, etc.) and the machine serial number.

Example:



This manual was prepared by the IBM General Products Division, Product Publications, Department G24, San Jose, California 95193.

CE SAFETY PRACTICES

All Customer Engineers are expected to take every safety precaution possible and observe the following safety practices while maintaining IBM equipment:

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if you MUST work alone.
2. Remove all power, ac and dc, when removing or assembling major components, working in immediate areas of power supplies, performing mechanical inspection of power supplies, or installing changes in machine circuitry.
3. After turning off wall box power switch, lock it in the Off position or tag it with a "Do Not Operate" tag, Form 229-1266. Pull power supply cord whenever possible.
4. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, observe the following precautions:
   a. Another person familiar with power off controls must be in immediate vicinity.
   b. Do not wear rings, wrist watches, chains, bracelets, or metal cuff links.
   c. Use only insulated pliers and screwdrivers.
   d. Keep one hand in pocket.
   e. When using test instruments, be certain that controls are set correctly and that insulated probes of proper capacity are used.
   f. Avoid contacting ground potential (metal floor strips, machine frames, etc.). Use suitable rubber mats, purchased locally if necessary.
5. Wear safety glasses when:
   a. Using a hammer to drive pins, riveting, staking, etc.
   b. Power or hand drilling, reaming, grinding, etc.
   c. Using spring hooks, attaching springs.
   d. Soldering, wire cutting, removing steel bands.
   e. Cleaning parts with solvents, sprays, cleaners, chemicals, etc.
   f. Performing any other work that may be hazardous to your eyes. REMEMBER – THEY ARE YOUR EYES.
6. Follow special safety instructions when performing specialized tasks, such as handling cathode ray tubes and extremely high voltages. These instructions are outlined in CEMs and the safety portion of the maintenance manuals.
7. Do not use solvents, chemicals, greases, or oils that have not been approved by IBM.
8. Avoid using tools or test equipment that have not been approved by IBM.
9. Replace worn or broken tools and test equipment.
10. Lift by standing or pushing up with stronger leg muscles – this takes strain off back muscles. Do not lift any equipment or parts weighing over 60 pounds.
11. After maintenance, restore all safety devices, such as guards, shields, signs, and grounding wires.
12. Each Customer Engineer is responsible to be certain that no action on his part renders products unsafe or exposes customer personnel to hazards.
13. Place removed machine covers in a safe out-of-the-way place where no one can trip over them.
14. Ensure that all machine covers are in place before returning machine to customer.
15. Always place CE tool kit away from walk areas where no one can trip over it; for example, under desk or table.
16. Avoid touching moving mechanical parts when lubricating, checking for play, etc.
17. When using stroboscope, do not touch ANYTHING – it may be moving.
18. Avoid wearing loose clothing that may be caught in machinery. Shirt sleeves must be left buttoned or rolled above the elbow.
19. Ties must be tucked in shirt or have a tie clasp (preferably nonconductive) approximately 3 inches from end. Tie chains are not recommended.
20. Before starting equipment, make certain fellow CEs and customer personnel are not in a hazardous position.
21. Maintain good housekeeping in area of machine while performing and after completing maintenance.

Knowing safety rules is not enough.
An unsafe act will inevitably lead to an accident.
Use good judgment - eliminate unsafe acts.

ARTIFICIAL RESPIRATION

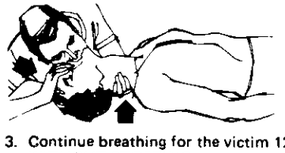
General Considerations

1. Start Immediately – Seconds Count
   Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing, warm the victim, or apply stimulants.
2. Check Mouth for Obstructions
   Remove foreign objects.
3. After victim is breathing by himself or when help is available:
   a. Loosen clothing.
   b. Place victim on his side.
   c. Keep victim warm.
4. Remain in Position
   After victim revives, be ready to resume respiration if necessary.
5. Call a Doctor
   Have someone summon medical aid.
6. Don't Give Up
   Continue without interruption until victim is breathing without help or is certainly dead.

Rescue Breathing for Adults

1. Place victim on back; lift neck and tilt head way back. (Quickly remove any noticeable food or objects from mouth.)

2. Pinch nose closed; make airtight seal around victim's mouth with your mouth; and forcefully breathe into victim until chest rises (expands).

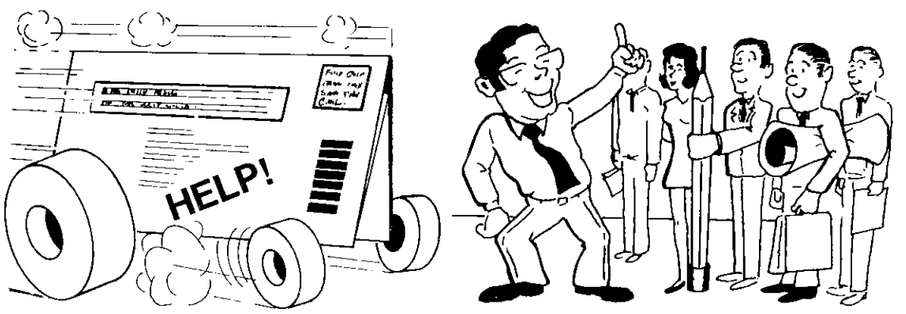


3. Continue breathing for the victim 12 times per minute WITHOUT STOPPING.
4. If chest does not rise (expand), roll victim onto side and pound firmly between shoulder blades to remove blocking material. Also, try lifting jaw higher with your fingers. Resume rescue breathing.

CE-MLM FEEDBACK

HELP us HELP you!

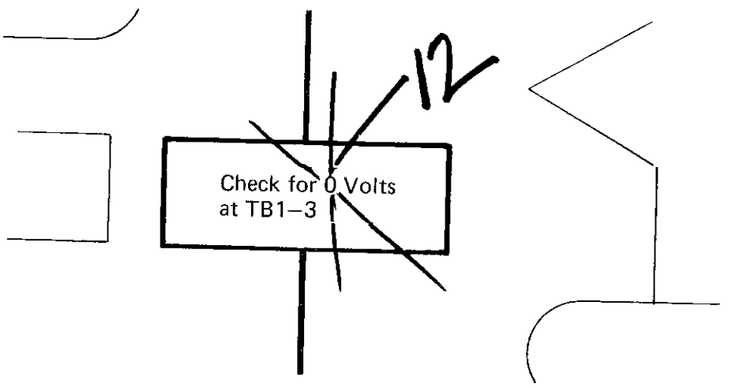
If you find a problem in this MLM, we would like to hear about it! Please put relevant information on the CE-MLM information feedback form, and send it to us.
WE WILL ACKNOWLEDGE YOUR EFFORT. We will, when appropriate, make needed improvements to the MLM and send RETAIN responses.



HELP us HELP you!

Your help will make trouble analysis easier next time and reduce the duration of the next call.

HELP us HELP you!



HELP us HELP you!

Let us hear from you!
When you write to us, include any error information that may help us analyze the MLM problem. The CE-MLM feedback form provides a direct pipeline for quick fixes to the MLM.

Typing errors or transpositions are not eligible for suggestion awards. However, if you have a better method or procedure for presenting the material, a suggestion form may also be submitted.

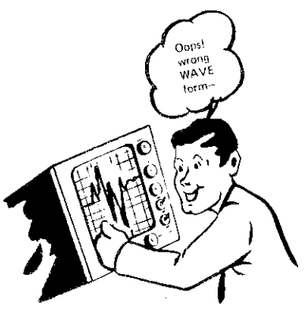
CE-MLM FEEDBACK

HELP us HELP you!

This is the kind of information we are looking for:

ERRORS IN MLM

Flowchart in error.
Indicated FRU did not fix the problem.
MICRO error not related to problem.
Scope picture wrong.
Timing diagram in error.
Reference incorrect.
Voltage wrong.
Other errors.



HELP us HELP you!

DOCUMENTATION AMBIGUITY/CLARITY

Hard to follow/not clear. (Please explain or draw picture showing problem area).
No continuity in the flow of information. (Tell us where).
Too complicated. (Is there an easier way to tell?).
Don't understand the meaning.
Something else?

HELP us HELP you!

SUGGESTED IMPROVEMENTS

New procedures.
Personal techniques.
Missing information.

HELP us HELP you!

MOST EFFECTIVE TOOL USED FOR PROBLEM ANALYSIS

Microdiagnostic.
Machine language diagnostics.
MAPs.
LOG OUT/LOG OUT analysis.
OLT.
Operating system.
Other.

—See Over—

F
L

HELP us HELP you!

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Mach Type/Mod	Serial Number	Storage Control/CPU	MLM Page ID	MLM Page EC No.
Symptom/Error Code			If no error or symptom code, check here ☐	

Describe trouble as it was reported to you, or as it appeared to you. (Machine problem).

Describe problem you encountered with documentation. See CE-MLM Feedback tab for helpful hints!
Have a solution?

HELP us HELP you!

All comments and suggestions become the property of IBM.

Want an acknowledgement?

Fill in your name and Branch Office Number:

Name _____

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Thanks for your help.

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HELP us HELP you!

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Symptom/Error Code			If no error or symptom code, check here ☐	

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Describe problem you encountered with documentation. See CE-MLM Feedback tab for helpful hints!
Have a solution?

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Z

Zero Velocity Detect ACC 461

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION

DC power must be off prior to changing cards. Unless procedures state otherwise, do not restore power with cards missing; this can result in circuit damage or a "system hang" condition. Remove power as follows:

POWER DOWN PROCEDURE

Control Module (A2)

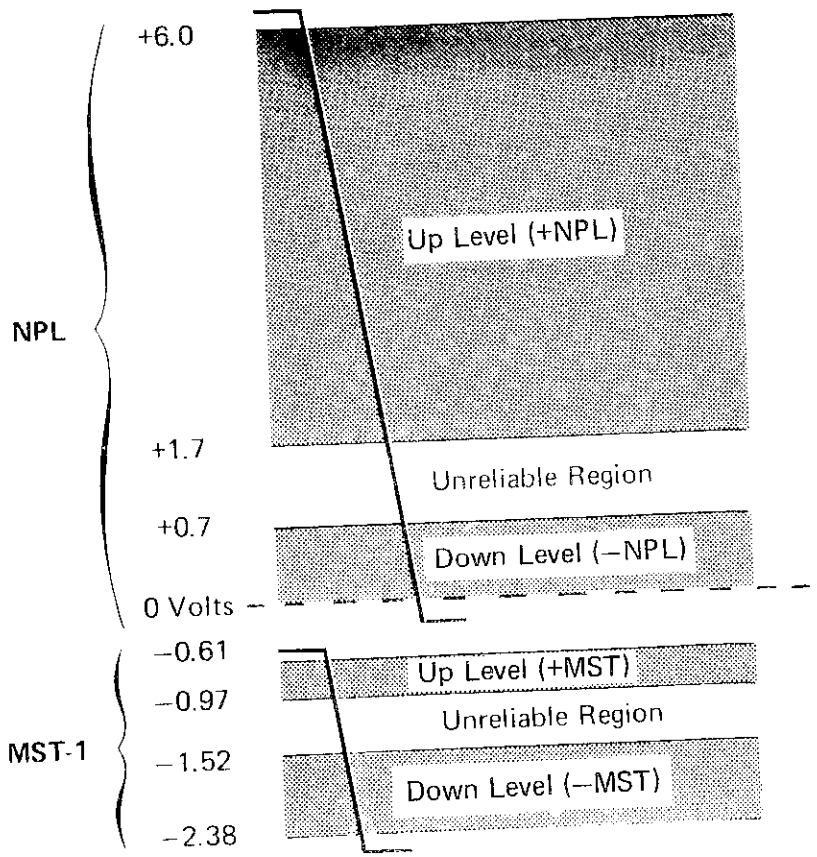
1. Turn the Start/Stop switch to STOP on every drive in the string.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Push the Power Off switch located on the Power Panel on the front of the 3340-A2. *Power is removed from the entire string: the 3340-A2 plus all attached 3340-B1s and B2s.*

Satellite Module (B1, B2)

1. Turn the Start/Stop switch to STOP on each drive in the satellite module to be powered down.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Turn off CP210 located on the AC compartment (accessible

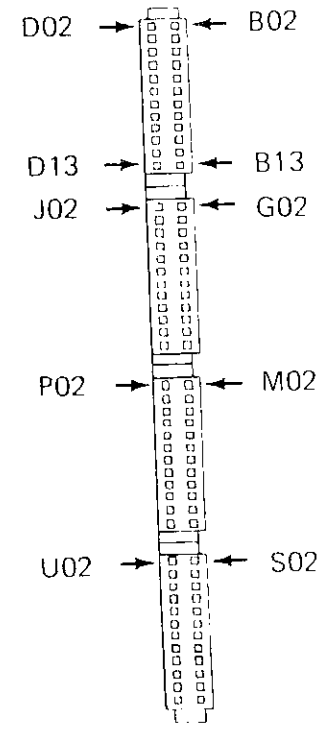
nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card

Voltage	*Card (Contact Tab)*
–4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

KV010, 020	(drives)
BV100	(controller)

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION
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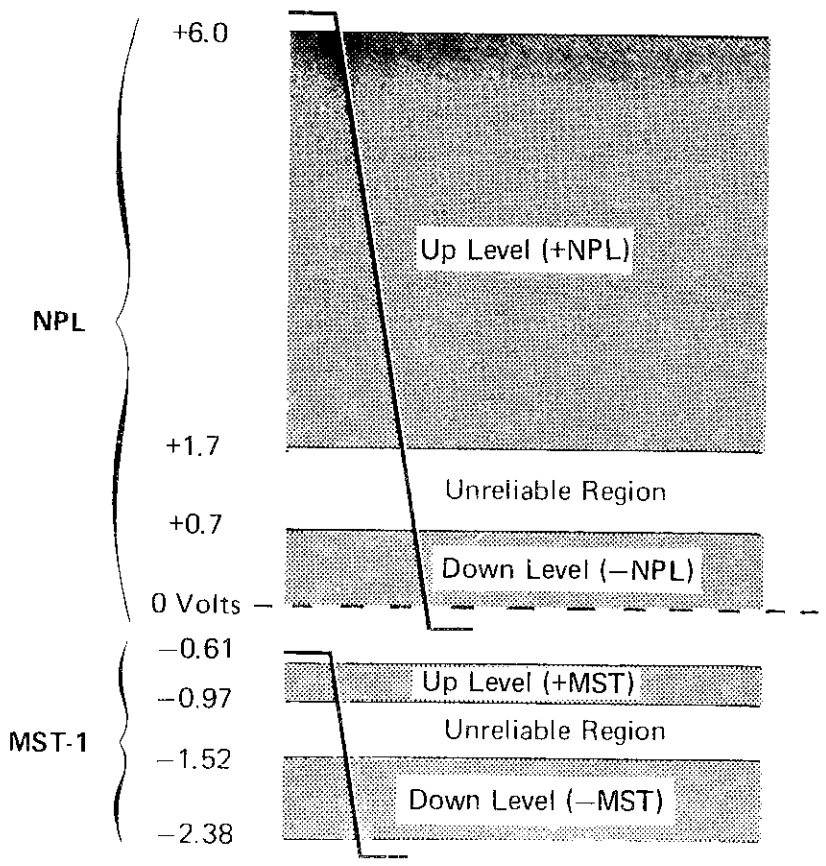
3. Turn off CP210 located on the AC compartment (accessible

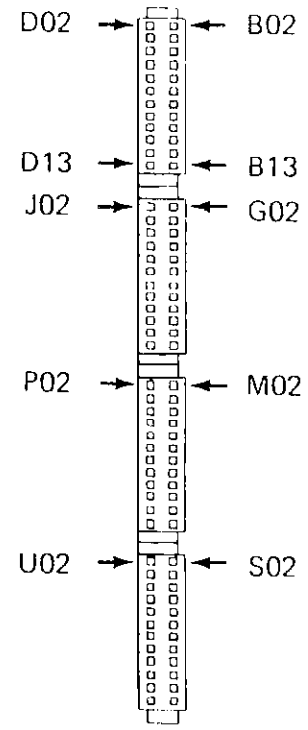
...nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card	
Voltage	*Card (Contact Tab)*
−4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

KV010, 020 (drives)
BV100 (controller)

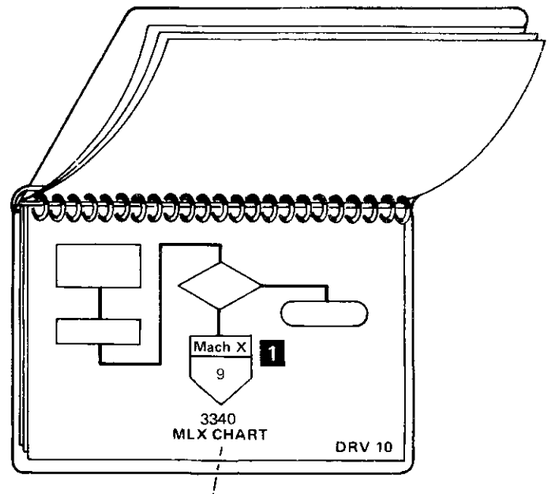
F
L

MAINTENANCE LIBRARY CROSS REFERENCE (MLX)

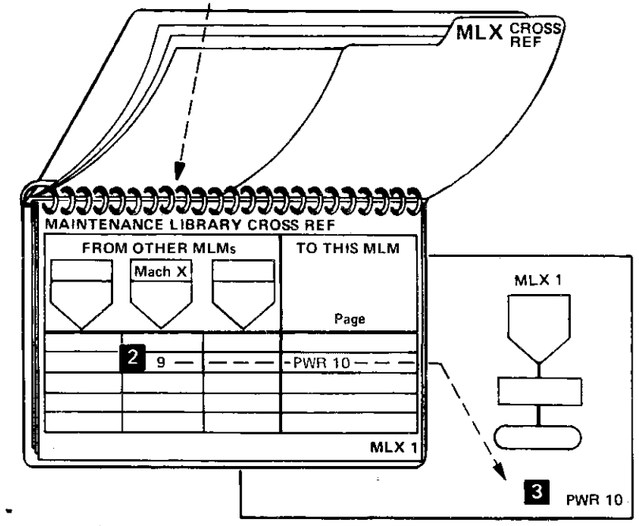
USE THIS PAGE WHEN ENTERING THIS MLM FROM ANOTHER MLM:

1. Note exit number on page of MLM you are leaving.
2. Find that exit number in the appropriate column of the chart on this page.
3. Proceed to referenced page in this MLM.

Machine X Maintenance Library



3340 Maintenance Library



FROM OTHER MLMs						TO THIS MLM
	370/115	370/125	370/135	ISC	3830	Page
			1	1, 3, 5	1, 3, 5	START 100, Entry B
			6	6	6	START 100, Entry A
				7, 12	7, 12	START 100, Entry D
				8	8	START 100, Entry C
				9, 15	9, 15	CTL-I 410, Entry C
	7	7		14, 17, 20	14, 17, 20	SENSE 100, Entry A
	1	1				OLT 1
	2	2				MSG 30
	3	3				FSI 50
	4	4				MICRO 10
	6	6				FSI 100
				10	10	RPI 110, Entry E
	8	8				OPER 100
	5	5				MICRO 90

MLM EXIT LISTING

USE THIS PAGE WHEN TRACING BACK FROM ANOTHER MLM TO LOCATE A LINE THAT EXITED FROM THIS MLM.

Exit	Page(s)
1	CTL-I 100
2	
3	
4	
5	START 100
6	
7	SENSE 104, START 100
8	
9	SENSE 100
10	MICRO 11, PANEL 151
11	PANEL 152
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION
DC power must be off prior to changing cards. Unless procedures state otherwise, do not restore power with cards missing; this can result in circuit damage or a "system hang" condition. Remove power as follows:

POWER DOWN PROCEDURE

Control Module (A2)

1. Turn the Start/Stop switch to STOP on every drive in the string.
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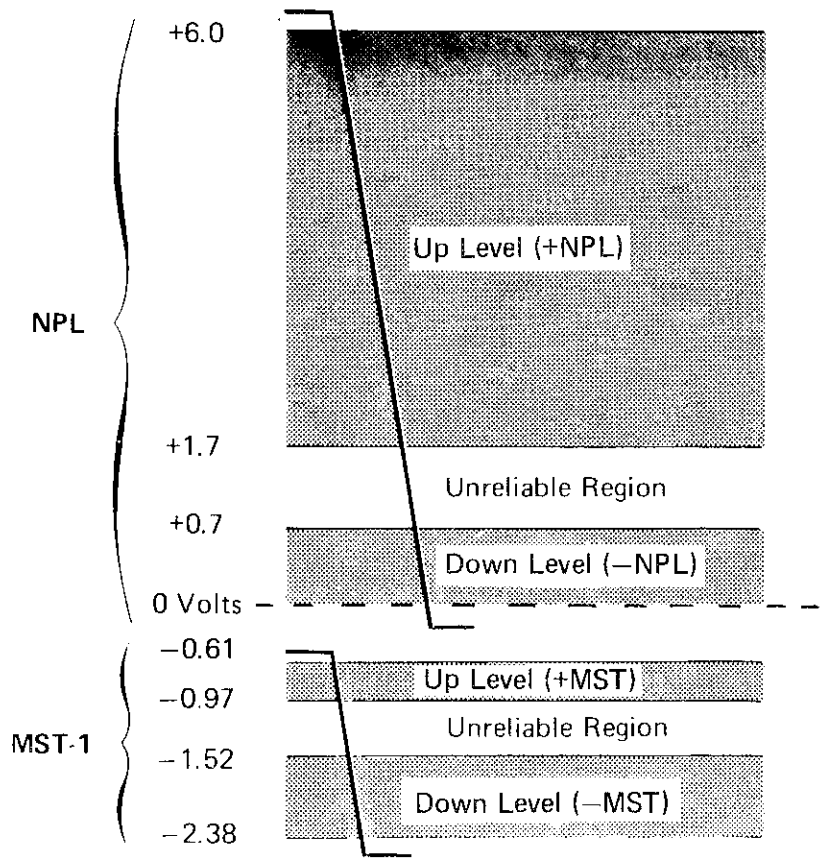
3. Turn off CP210 located on the AC compartment (accessible

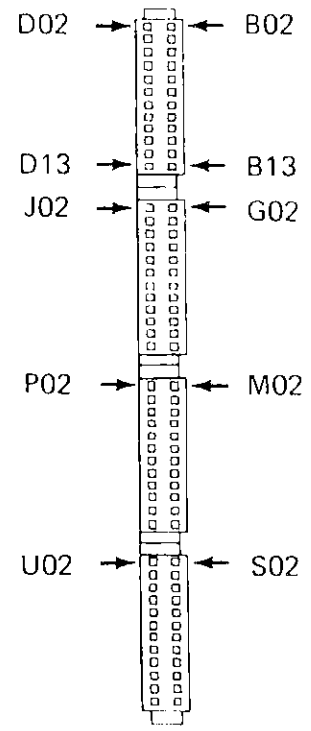
nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card	
Voltage	*Card (Contact Tab)*
–4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

KV010, 020 (drives)
BV100 (controller)

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LEGEND CONTENTS

MAINTENANCE ANALYSIS PROCEDURE (MAP) LEGEND

Flowchart Symbols – – – – – – – – – **LGND 4**

Description of blocks and symbols used on MAP flowcharts.

Other Symbols – – – – – – – – – – – **LGND 6**

Description of symbols used on MAP diagrams.

MAINTENANCE DIAGRAM DESCRIPTION – – – – – – – – – – **LGND 8**

Typical MAP diagram layout. Shows card boundaries, card locations, and ALD references.

AUTOMATED LOGIC – – – – – – – **LGND 10, 12, 14**

Definition of blocks and symbols used on ALDs and compressed FEALDs.

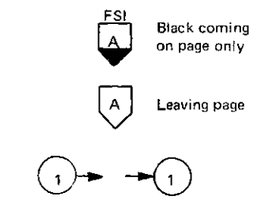
ABBREVIATIONS AND DEFINITIONS – **LGND 16, 18, 20**

Glossary of terms and abbreviations.

MICFL LEGEND – – – – – – – – – – **MICFL 5**

Description of special symbols for automated Microdiagnostic Flowcharts.

FLOWCHARTS

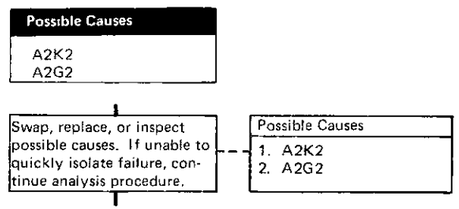


External Page Connector

Connection between flowcharts on separate pages. Letter keys are used to identify corresponding points. Below the symbol is the page number of the connecting point.

Internal Page Connector

Connection between several parts of the same flowchart. Line-of-sight arrows assist in locating other connector(s).

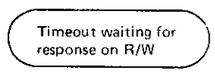


Possible Causes

Summary of possible failing units on MLM page. (See details on START 55)

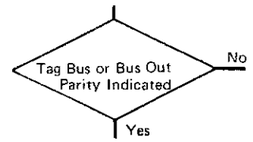
Possible failing units for a particular error.

Primary isolation method — Swap, replace, or inspect.
Alternate isolation method — Continue analysis procedure.



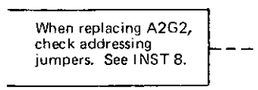
Terminal Block

Beginning or end of flow path.



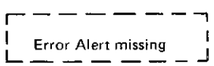
Decision Block

Branch to alternate paths.



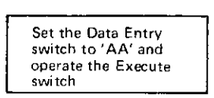
Annotation Block (Supplementary)

Descriptive comment or explanatory note.

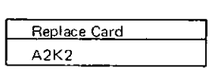


Annotation Block (In Line)

Descriptive comment or explanatory note.



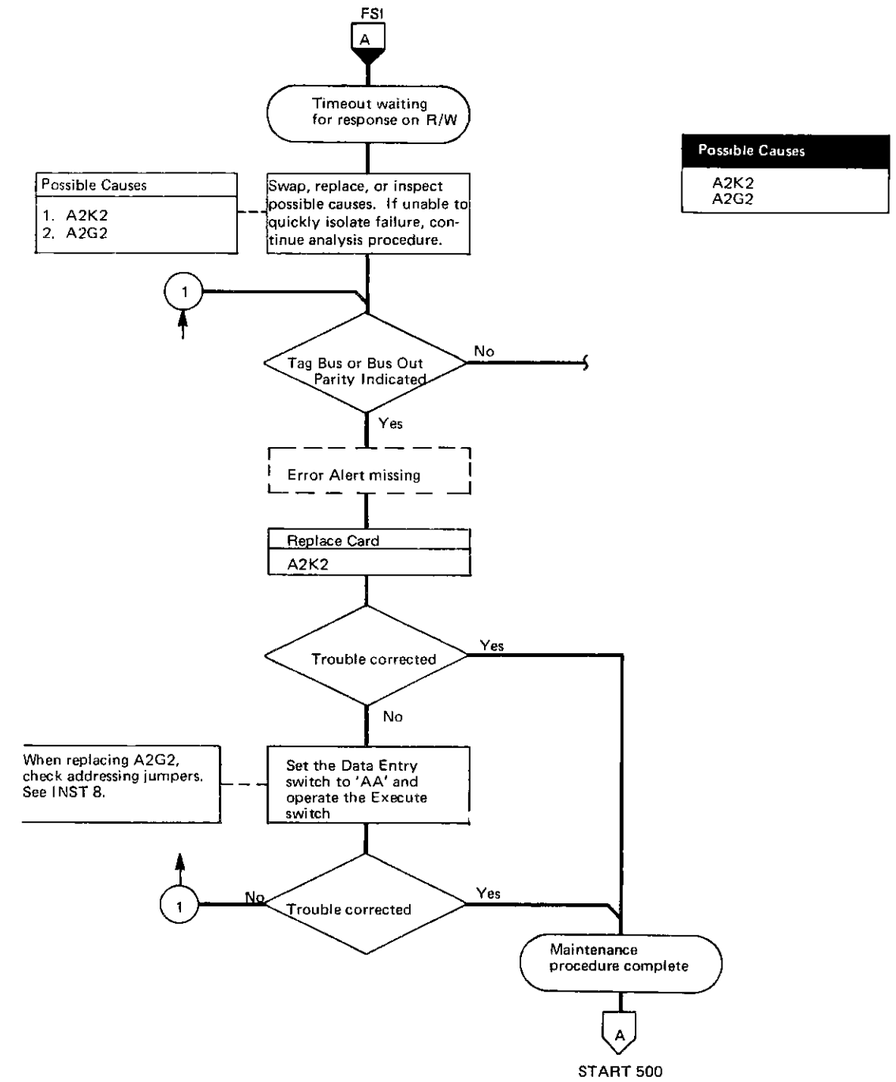
General Purpose Action Block



Specific Action Block

Denotes special CE actions: Scoping, Replacing or Swapping Cards, Checking, Running Microdiagnostics, Adjusting, or Installing.

EXAMPLE



3340

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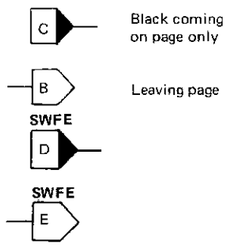
MAINTENANCE ANALYSIS PROCEDURE (MAP) LEGEND

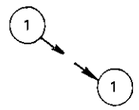
DIAGRAMS



External Page Connectors

Connection between diagrams on separate pages. Letter keys are used to identify corresponding points.

SWFE over the symbol indicates a connection if the String Switch feature is installed.



Internal Page Connectors

Connection between several parts of the same diagram. Line-of-sight arrows assist in locating other connector(s).

Test Points

Used on diagrams to indicate key test points or key circuit parts.

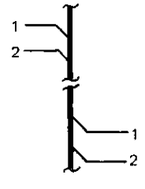
CHANNEL INTERFACE (CHL–I)
CONTROL INTERFACE (CTL–I)
DEVICE INTERFACE (DEV–I)

Interface Between Two Functional Units

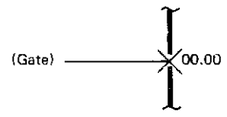
(For examples of their use, see OPER 5)

DEV BUS IN DEV BUS IN
CTL BUS OUT CTL BUS OUT
READ ⇔ WRITE ⇔ READ

Channel Buses and Read/Write Bus



Multiple Line Transfer



Gate

Numerals beside the gate symbol give page or diagram number of gating circuit.

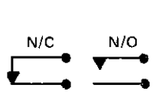
Solenoid

Identified by name, for example, Feed Clutch.

Relay or Contactor

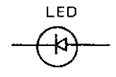
Type indicated by letter code.

P	=	Pick	H	=	Hold
PL	=	Pick Lower	LP	=	Latch Pick
PU	=	Pick Upper	LU	=	Latch Upper

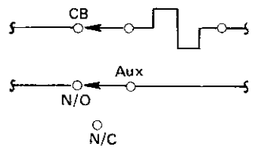


Relay Contacts

Shown in the deenergized position. N/C = Normally Closed (break). N/O = Normally Open (make).

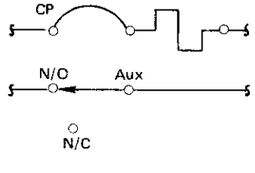


LED (Light Emitting Diode)



Circuit Breaker (CB) with Aux Points

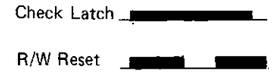
Electrically or manually tripped, handle generally higher current, and may have auxiliary points (aux). N/O points make contact when associate CB is positioned to conduct current.



Circuit Protector (CP) with Aux Points

Normally tripped electrically, handle lower current, and may have auxiliary points (aux). N/O points make contact when associate CP is positioned to conduct current.

TIMING CHARTS



For all signals (+ or –), the active state is indicated by the heavy part of the line.

FEATURE PAGE IDENTIFICATION

SWFE

Located in upper and lower right corners of pages that are unique to the string switch feature.

FHFE

Located in upper and lower right corners of pages that are unique to the fixed head feature.

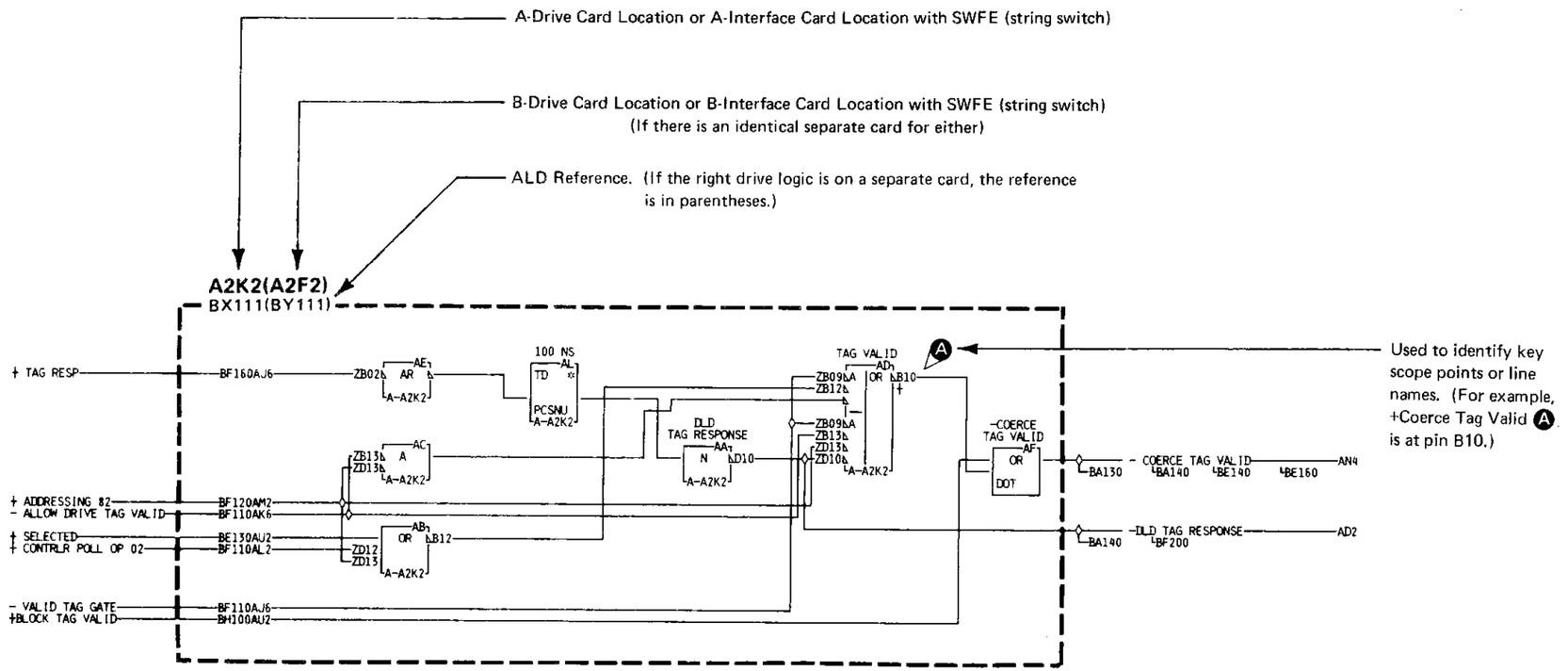
Basic Machine

The diagrams used with the Maintenance Analysis Procedure (MAP) throughout the MLM use the same format as shown in this example.

The dashed line defines the card boundaries. The card location and ALD reference page are identified in the upper left corner of the dashed block. If the logic on the card is shared by the A drive (left drive of the module, looking from the front) and the B drive (right drive), there is one location and one ALD reference. If the A drive and B drive have separate but identical cards for the same function, only the logic for the A drive is shown. The identifier in the upper left part of the dashed block gives both locations.

Machines With String Switch Feature

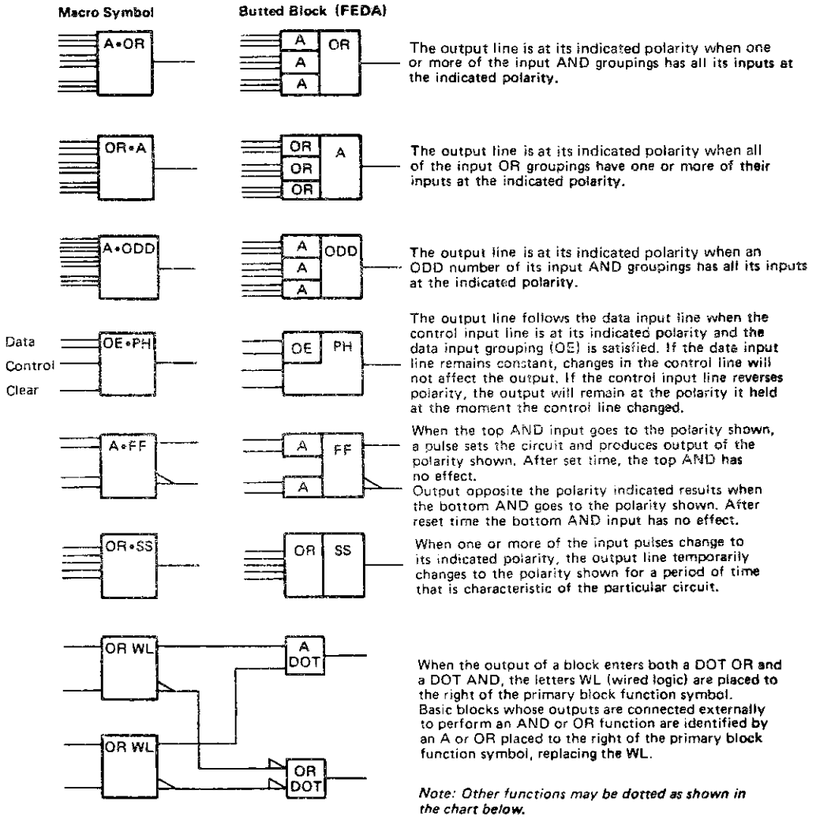
On pages with diagrams of string switch logic, where the A-interface and the B-interface have separate but identical cards for the same function, only the logic for the A-interface is shown. The identifier in the upper left part of the dashed block gives both locations.



AUTOMATED LOGIC DIAGRAMS

SOLID LOGIC DESIGN AUTOMATION

2 Level Symmetrical

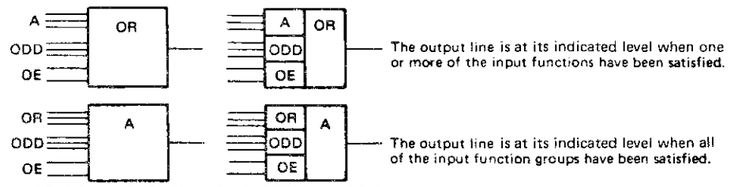


ADDITIONAL 2 LEVEL SYMMETRICAL

Input Level	Output Level	Symbol	Input Level	Output Level	Symbol
OE ODD OR	A	OE•A ODD•A OR•A	AND OE OR	PH	A•PH OE•PH OR•PH
AND OE	OR	A•OR OE•OR	AND OE OR	FF OR FL	A•FF A•FL OE•FF OE•FL OR•FF OR•FL
AND	ODD	A•ODD			
AND OR	OE	A•OE OR•OE	AND OE OR	SS	A•SS OE•SS OR•SS

Note: For additional information see IBM Maintenance Library, Logic Blocks, Automated Logic Diagrams SLT, SLD, ASLT, MST, order number SY22-2798.

2 Level Unsymmetrical



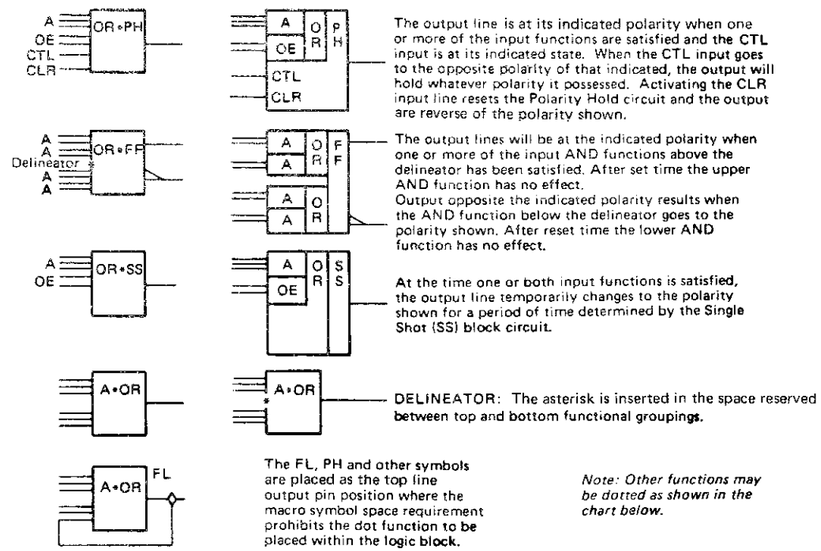
ADDITIONAL 2 LEVEL UNSYMMETRICAL LOGIC

Input Level	Output Level	Symbol	Input Level	Output Level	Symbol
•	AND	A	•	OE	OE
•	OR	OR	ODD	PH	PH
•	ODD	ODD	ODD	SS	SS

•Any of the following functions: A, OR, AR, OE or ODD

Note: For additional information, see IBM Maintenance Library, Logic Blocks, Automated Logic Diagrams SLT, SLD, ASLT, MST, order number SY22-2798

3 Level Logic



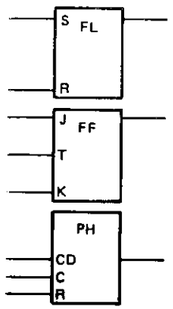
ADDITIONAL 3 LEVEL LOGIC

Input Level	Second Level	Output Level	Symbol	Input Level	Second Level	Output Level	Symbol
•	OR OE	A	OR•A OE•A	•	AND OR OE	FF or FL	A•FF A•FL OR•FF OR•FL OE•FF OE•FL
•	AND OE	OR	A•OR OE•OR	•	AND OR OE	SS	A•SS OR•SS OE•SS
•	OR AND OE	PH	OR•PH A•PH OE•PH				

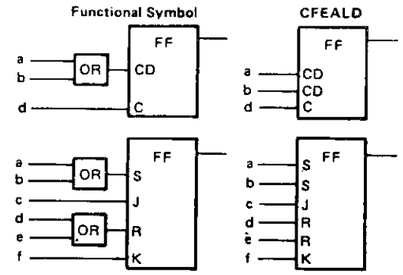
•Any of the following basic functions A, OR, AR, or OE.

CONDENSED FIELD ENGINEERING AUTOMATED LOGIC DIAGRAM SYMBOLS

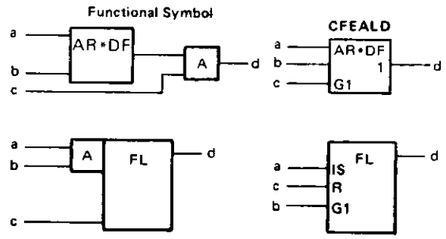
Descriptions



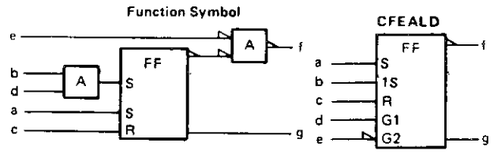
Basic Storage Symbols



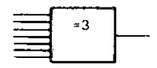
Inherent-OR In The FF



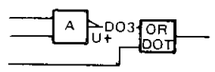
Single Function Application



Dependent Notation



An equal sign (=) followed by a number specifies the number of input lines of the polarity shown required to produce the indicated output.



A plus (+) or minus (▷) under an output line indicates the extreme potential that may be forced by an external source.

A loading character (L or U) under the output line indicates that the external load cannot be isolated from the driving circuit without affecting the output of the driver.

Special Notations

Note: For additional information, see IBM Maintenance Library Logic Blocks, Automated Logic Diagrams SLT, SLD, ASLT, MST, Order No. SY22-2798

CFEALD Logic Block Line Symbols

Symbol	Input Line	Input Lines: Ind Polarity	Input Lines: Rev. Polarity	Output Lines: Ind Polarity	Output Lines: Rev. Polarity	Output Lines: No Action	Storage Element: On	Storage Element: Off	Storage Element: Hold State	Storage Element: Compliment
S		X		X			X			
S'			X			X				
R		X			X			X		
R			X			X				
J		X		X			X			
J			X			X				
K		X			X			X		
K			X			X				
JK		X								X
T		X								X
CD		X		X			X			
CD			X		X			X		
C			X							X
*C		X								
G		X		X			X			
G			X			X				

COMMENTS

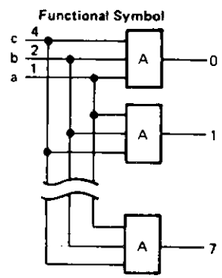
Example:

S input with indicated polarity produces the indicated output level of the block ("on" condition).

*Allows its associated "CD" entry to set or reset the storage element.

Note: Flip Flop = Any combination
Flip Latch = S, R, G.
Polarity Hold = C, CD, R, or G.

Decode

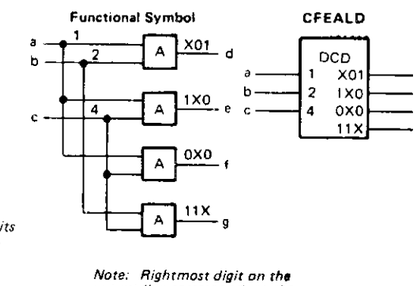


Note: INH line inhibits all output lines if it is positive (+).

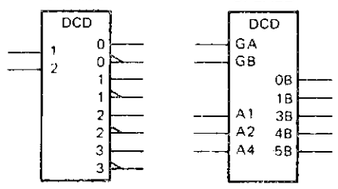
The decimal sum of the line values of those inputs which are at their active level equals the value of the active output line. If no input lines are active the 0 output line is active. If all input lines are active the 7 output line is active.

Note: The decimal sum value existing at the decoder inputs agrees with the decimal number shown at the output line labels. Only one output can be active at any given time.

Output Value	Input Line Condition
0	$\bar{A}\ \bar{B}\ \bar{C}$
1	$A\ \bar{B}\ \bar{C}$
2	$\bar{A}\ B\ \bar{C}$
3	$A\ B\ \bar{C}$
4	$\bar{A}\ \bar{B}\ C$
5	$A\ \bar{B}\ C$
6	$\bar{A}\ B\ C$
7	$A\ B\ C$



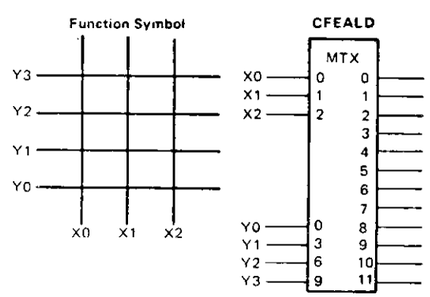
Note: Rightmost digit on the output line corresponds to the topmost digit on the input line ("X" in any position means that input line has no effect).



Multiple output lines can be associated with a given output (sum).

A decoder shown with gating lines.

Matrix

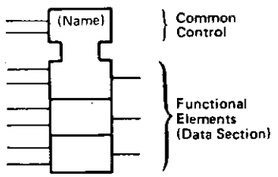


Active Input Lines: X0	X1	X2	Y0	Y1	Y2	Y3	Active Output
X			X				0
	X		X				1
		X	X				2
X				X			3
	X			X			4
		X		X			5
X					X		6
	X				X		7
		X			X		8
X						X	9
	X					X	10
		X				X	11

Note: The matrix (MTX) is a functional logic block with two or more groups of inputs. The decimal numbered output will be active when it equals the decimal sum of one active line from each input group (shown in Chart). If any input group does not have an active input, then there is no active output from the matrix block.

ELEMENTS WITH COMMON INPUTS/OUTPUTS

Element Description

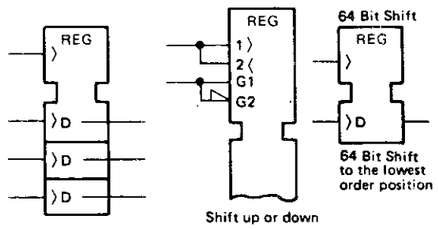


COMMON CONTROL SECTION: Used only for dependancy (gating) and/or common lines for the register. There are no outputs from the common section.

Name: May be any of the following, selector (SEL), register (REG), decoder (DCD), matrix (MTX), multiregister (MREG), and delay (DLY).

DATA SECTION: A group of vertically stacked functional elements. The number of stacked elements varies with the number of inputs.

Shift Register (REG)



CFEALD CFEALD

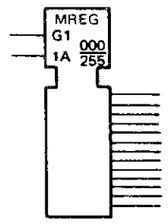
DEFINITION: The control input causes the data in each bit position to shift one position as indicated by one of the following designations.

" ⟩ " (greater than) When this line goes active the data content shifts from the top (uppermost) bit position. Similarly, the contents of each bit position shifts down the symbol.

" ⟨ " (less than) When this line goes active, the data content shifts from the bottom to the next bit position above and similarly for each bit position in the shift register symbol.

Note: A time difference in shifting is indicated by a trailing edge symbol (¬).

Multi-Register (MREG)



CFEALD

DEFINITION: The MREG functional logic block represents groups of associated storage elements in addressable word configuration. The MREG requires address inputs. All functional lines used for storage elements including the dependency notation are applicable.

Addresses are previously decoded and the resultant address line(s) are handled by a single flowline representing all addresses.

Address notation A, AR, or AW must prefix the data. This indicates the data is dependent on an address.

A = Read Only Storage (ROS) or when the read/write address is identical.
AW = Write address. AW must be shown as data input dependent; (for example, AWCD).
AR = Read address. AR must be shown as a dependency with the output.

The numeric address span is specified in the common section.

"G" replaces the C to control the data information in the MREG. The C is reserved for the condition that would place a zero in all storage cells not addressed.

DEPENDENCIES AND FUNCTIONAL NOTATIONS

Inputs – Dependency notation is read from right to left

Example:

AW2G1D – Data input dependent on control G1 further dependent on gate 2 and the write address.

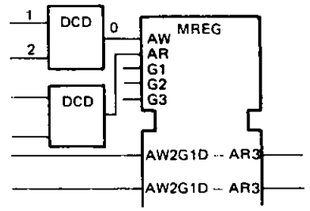
Outputs – Notation read from right to left.

Example:

AR3 – Storage data output dependent on Gate 3 and further dependent upon contents of the stored data at the selected address.

ORDER AND SELECTION OF FUNCTIONAL SYMBOLS HAVE THE FOLLOWING EFFECT

Note: No action takes place in the addressed storage cell unless G1 is active.



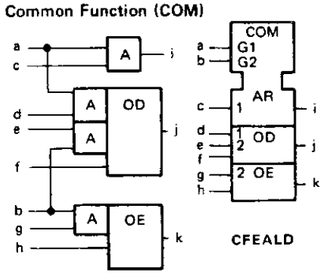
G1 Active At Its Indicated Polarity:

(a) Data and G2 active = write a one.

(b) Data and G2 inactive = write a zero

(c) The output is active if 1 had been stored in the storage element and G3 is active. If a 0 had been stored or G3 is inactive, the outputs are inactive.

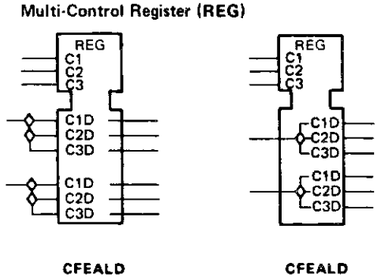
Common Function (COM)



Functional Symbol

DEFINITION: Common Function block may be associated with any group of basic logic elements functionally related by their dependent gating. Each functional element contains the proper letter(s) that makes it an approved logic symbol. The common section may contain the letters COM at the very top line.

Multi-Control Register (REG)



CFEALD CFEALD

The multiple control inputs is designated by sequential numbers shown entering the common section; for example, C1, C2.

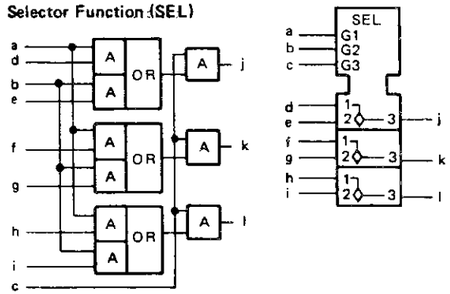
The control data enters the data section of the symbol and normally diagrammed as multiple outputs.

The "C" designator must be a suffix to differentiate it from a gate.

Example:

C1D = Storage Data controlled by C1.

Selector Function (SEL)

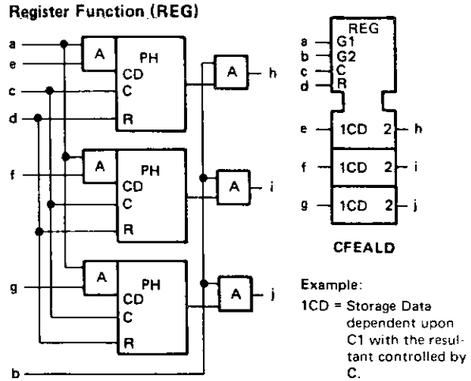


Functional Symbol CFEALD

DEFINITION: A selector is a functional logic block that consists of two or more OR blocks having input and/or output signals dependent upon common gates.

Note: The " ◇ " symbol represents the OR function connection in the data section.

Register Function (REG)



Functional Symbol

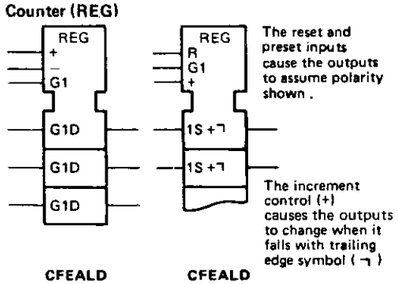
DEFINITION: A register logic block consisting of a group of associated storage elements with common input and/or output gating or other common input lines such as reset.

Note: Descriptive nomenclature such as bit 1, may be placed in each logic element.

Example:

1CD = Storage Data dependent upon C1 with the resultant controlled by C.

Counter (REG)



CFEALD CFEALD

DEFINITION: A Register to be incremented or decremented under control of input lines drawn to the common section of the symbol with the follow notations.

"+n" When this line goes to its indicated polarity the decimal quantity n is added to the binary count contained in the register. The n need not appear when it is a one.

"–n" When this line goes to its indicated polarity, the decimal quantity n is subtracted from the binary count contained in the register, The n need not appear when it is a one.

ABBREVIATIONS AND DEFINITIONS (Part 1 of 2)

A

A-2	control module, controller
AC, ac	alternating current
ACC	access
act	active
adj	adjust, adjustment
ALD	automated logic diagram
alt	alternate
AM	address marker
amp	amplifier
asgd	assigned
asgn	assign
asm	assembly

B

B1, B2	satellite module, drive
BSDA	bit significant device (drive) address
bus	signal or power conductor
bus in	bus entering a functional unit
bus out	bus leaving a functional unit
byte	eight bits plus a parity bit

C

CAR	cylinder address register
CB	circuit breaker
CCB	command control block
ccw	counterclockwise
CCW	channel command word
CDS	configuration data set
chan	channel
chg	change
chk(s)	check(s)
cnt	count
conn	connector
CP	circuit protector
CR	diode, rectifier
CSW	channel status word
ctl	control
CTL-I	control interface
ctlr	controller
ctr	counter
CU	control unit
CUA	channel/unit address
cw	clockwise

D

DAC	digital-to-analog converter
data module	contains the disks, spindle, read/write heads, and access arms
DC, dc	direct current
DCB	detection code byte
def	defective
dev	device
DEV-I	device interface
diag	diagnostic
DIFF	difference counter
DIO	device input/output
DM	data module
DOS	disk operating system
dr, drv	drive
drive A	left drive in a module
drive B	right drive in a module
drive	mechanical assembly to mount and control one data module

E

EC	edge connector, engineering change
ECC	error correction code
EL	error log
EPO	emergency power off
ERP	error recovery procedure
EREP	error recovery program
err	error
EXIO	execute input/output
exptd	expected

F

FHFE	fixed head feature
FM	format message
FPM	file protect mode
FRIEND	fast running interpreter enabling natural diagnosis
FRU	field replaceable unit
FSC	fault symptom code
FSI	fault symptom index

G

gen	generator, general
gnd	ground
G1, G2, G3	gaps in record format

H

HA	home address
HAR	head address register
hd	head
hex	hexidecimal
Hz	Hertz, cycles per second

I

IFA	integrated file adapter
ILT	inline test
IMPL	initial microprogram load
intf, ifc	interface
intlk	interlock
I/O	input/output
IPL	initial program load
ISC	integrated storage control

J

JCL	job control language

K

K	relay (contactor)

L

LED	light emitting diode
ld	load
loc	location

M

MAP	maintenance analysis procedure
MB	megabyte
MICFL	microdiagnsotic flowchart
MICRO	microdiagnostic
MLM	maintenance library manual
MLX	maintenance library cross reference index
module	serial numbered frame containing one or two drives (module A1, B1, or B2)
modulo	base number system other than ten
MSG	message
MST	monolithic system technology
MST 1	voltage level
mtr	motor
mult	multiple
MVT	multiprogramming with a variable number of tasks

N

N	inverter logic block
n/c	normally closed point
n/o	normally open point
No-Op, NOP	no operation
NPL	voltage level

O

OBR	outboard recording
OD	odd (number)
OE	exclusive OR function
offline	isolated control of a unit from a primary function
OLT	online test
OLTEP	online test executive program
OLTSEP or OLT(S)EP	online test standalone executive program
online	unit is available to a primary function
op	operation
opt	option
OR	OR function
OS	operating system
outbus	same as bus out
ovrn	overrun

P

P	plug
parameter	constant value for a given purpose
par, P	parity
P Bit	parity bit
PC	parity check, pack change
PG	parity generate
pgm	program
PH	polarity hold
PLO	phase locked oscillator
P/N	part number
P/P	peak-to-peak
PS	power supply
PSW	program status word
pwr, pwrd	power, powered

Q

Q	Transistor

R

raw data	data as it is read from the storage medium
rcvr	receiver
Rd	read
RDCKD	read checked
RDHA	read home address
rdr	reader
reg	register, regulator
R0	record zero
RPS	rotational position sensing
rst	reset
rtn	routine
RW, R/W	read/write

ABBREVIATIONS AND DEFINITIONS (Part 2 of 2)

S	sc, scu	storage control
	sectr, sec	sector
	sel, seHd	select, selected
	SEL	selector logic block
	seq	sequence
	ser	serial
	SERDES	serializer/deserializer
	serv	service
	SERVOUT	service out
	SFM	set file mask
	SIO,SI/O	start input/output
	SIP	seek in progress
	SK	seek
	SL	system library
	SLT	solid logic technology
	sol	solenoid
	SOSP	standalone/online support program that is transparent to user
	sp, spec	special
	spindle	contained in the data module
	SS	single-shot logic block
	SSW	string switch
	stor, stg	storage
	SVP	service processor
	sw, s	switch
	SWFE	string switch feature
	sync	synchronize
T	T	transformer
	TB	terminal board
	TP	test point
	TRK	track
U	UC	unit check
	unsupp	unsuppressible
V	VCM	voice coil motor
	VFO	variable frequency oscillator
W	WCKD	write checked
	WINSEPCO	diagnostic test used under OLTSEP.
	word	four bytes
	wr, wrt	write
	wraparound	advance according to some sequence with automatic restart provisions
X	XEQ	execute
	XFER	transfer
	XIO	execute input/output
	XOR	exclusive-OR function

ABBREVIATIONS AND DEFINITIONS (Part 2 of 2) LGND 18

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION
DC power must be off prior to changing cards. Unless procedures state otherwise, do not restore power with cards missing; this can result in circuit damage or a "system hang" condition. Remove power as follows:

POWER DOWN PROCEDURE

Control Module (A2)

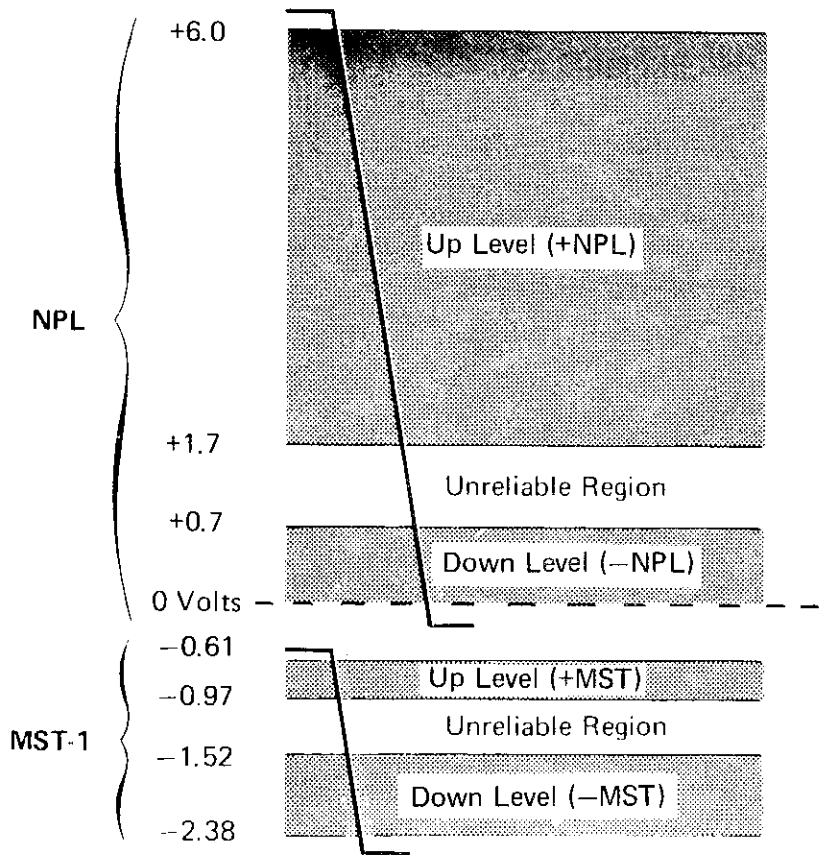
1. Turn the Start/Stop switch to STOP on every drive in the string.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Push the Power Off switch located on the Power Panel on the front of the 3340-A2. *Power is removed from the entire string: the 3340-A2 plus all attached 3340-B1s and B2s.*

Satellite Module (B1, B2)

1. Turn the Start/Stop switch to STOP on each drive in the satellite module to be powered down.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Turn off CP210 located on the AC compartment (accessible

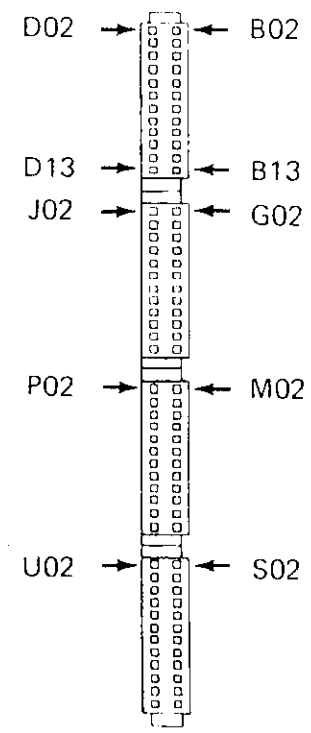
nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card	
Voltage	*Card (Contact Tab)*
–4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

KV010, 020 (drives)
BV100 (controller)

START CONTENTS

Note: Certain 3340 subsystems may have a 3344 drive attached. If a 3344 drive is attached and the problem is in the 3344, go to the START section in Volume R07 of the 3344 MLM. (3344 documentation will be available in May 1976).

Document Description – – – – – – – START 20

Table of contents of the MLM with a short description of each section.

Maintenance Philosophy – – – – – – START 50-90

Describes the 3340 maintenance philosophy and the MLM.

Problem Analysis – – – – – – – – START 100

Primary start page for maintenance procedures within the MLM. Using customer symptoms, sense data from EREP, console messages or visual indications, it points to the correct maintenance analysis procedure. (See Note.)

3340 Checkout Procedure from Control Module CE Panel – – – – – – START 110

Describes how to use the CE Panel to check the 3340 subsystem.

Intervention Required – – – – – – – START 130

Intermittent Errors – – – – – – – – START 400

Assists in trying to duplicate intermittent failures, and if that cannot be done, to provide some guidance to possible corrective actions.

MAP Fallthrough – – – – – – – – – START 410

Designed to help the CE to further isolate and correct a problem when the MAPs fail.

FSC/Micro Reference Table – – – – – START 420

Fault Symptom Codes listed in their order of importance. Microdiagnostic routine(s) most likely to duplicate the failure are listed along with the significant sense bytes for each Fault Symptom Code and a reference to an MLM page that provides additional information.

Maintenance Complete – – – – – – – START 500

Common exit from every maintenance procedure. Used to verify the correct status and operation of the machine before returning it to the customer.

START CONTENTS START 1

DOCUMENTATION DESCRIPTION (By section)

These sections accompany each Control Module (one set per facility).

INDEX — Alphabetical subject index of the MLM.

MLX CROSS REFERENCE — Pages for cross-referencing other MLMs (3830-2, I8C, IFAs, etc.).

LGND — Glossary of technical terms, Abbreviations. Legend of symbols used in MLM, including FEALD circuit symbology.

START — MLM starting point:
Documentation description.
How to use MLM.
Maintenance Philosophy.
Entry point for trouble-shooting, exits to MAPs within functional area MLM sections.

FSI FAULT SYMPTOM — Fault Sympton code description, generation instructions, and index to tie symptom code to proper analysis procedures.

MSG SYSTEM MESSAGES — Presents and explains basic console error message format, EREP summaries (OS), OBR error record (OS) and logging mode error record.

SENSE DATA — Summary and detailed description of sense data.

OLT DIAGNOSTIC — Online and Inline tests. Contains error messages and operating procedures.

OPER ATIONS — Description of 3340 operations to tie functional units together. Provides high level description of complete subsystem operation, including some command descriptions allowing CE to obtain "big picture" without going to system documentation.

MICRO OPER. INST. — Microdiagnostic operating instructions and brief routine and test descriptions.

MICRO A0XX
MICRO A4XX
MICRO A7XX — Microdiagnostic error code dictionary. Defines error codes and ties codes to analysis procedures.
MICRO ADxx
MICRO AFXX

PANEL CE OPER — Description, operation, and maintenance of CE and Operators panels.

SSW STRING SWITCH FEATURE — Maintenance (MAPs) and theory for the String Switch feature and associated circuits.

CTL-I NTERFACE — Maintenance (MAPs) and theory for the control interface and associated circuits. (Tag decodes, addressing, bus assembly circuits, etc.)

DATA CONTROL — Maintenance (MAPs) and theory for the controller circuits involved with data transfer. Includes: Read/Write control, Error Detection and correction, SERDES, and PLO/VFO.

MICFL A0 000
MICFL A4 300
MICFL A7 600
MICFL AF 1100
MICFL B0 1230 — Microdiagnostic routine descriptions, flowcharts, and scoping procedures.

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These sections accompany every Control Module and Satellite module (one set per serial numbered frame).

DEV-I NTERFACE — Maintenance (MAPs) and theory for device interface, and associated circuits (Tag decodes, selection, bus assembly circuits, etc.)

ACC ESS — Maintenance (MAPs), adjustments, and theory fo servo circuits and head positioning mechanics.

R/W DRIVE READ/WRITE — Maintenance (MAPs) and theory for drive read/write circuits. Includes matrix circuits in each drive and analog circuits common to both drives.

DM DATA MODULE DRIVE MECHS — Maintenance (MAPs) and theory for Data Module, Data Module loading, drive motor, etc.

DM REMOVALS AND ADJUSTMENTS — Adjustments and removals for Data Module, Data Module loading, drive motor, etc.

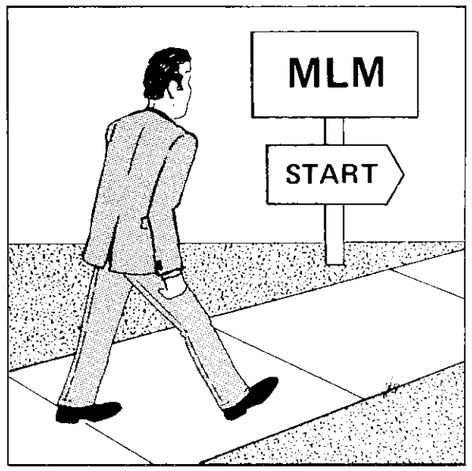
RPI ROTATIONAL POSITION INDEX — Maintenance (MAPs) and theory for the index detection and checking, and the rotational position sensing (feature) circuits.

POWER — Maintenance (MAPs), adjustments, and theory for power supplies, distribution, and sequencing.

LOC ATIONS — Shows structural and component locations.

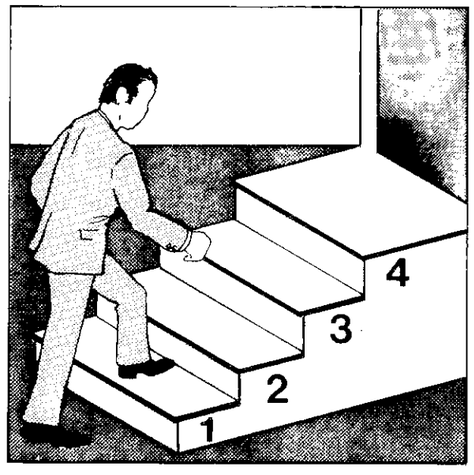
INST ALLATION — Installation instructions.

1 START



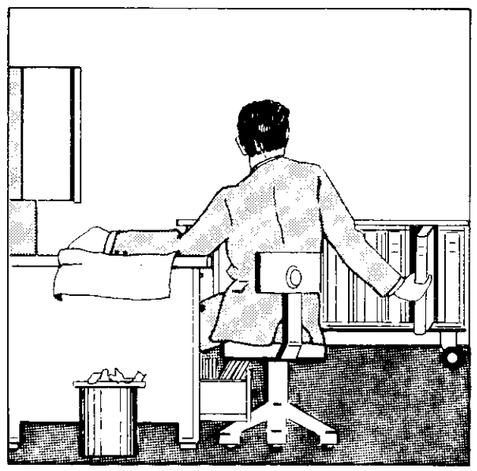
Start by gathering information about the failure and consulting the START pages in the MLM.

2 FOLLOW DIRECTIONS



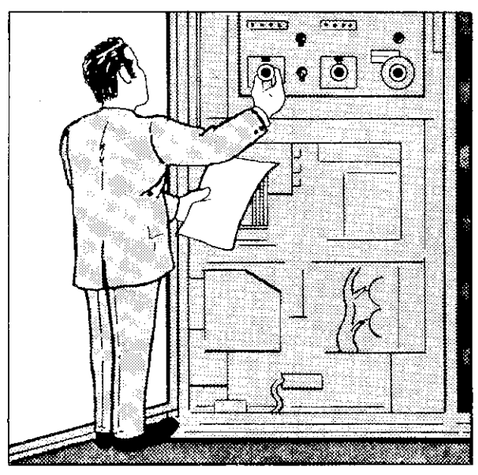
Perform each sequential step without skipping any steps or pages. Read **all** instructions and notes.

3 ANALYZE



Analyze available failure information with the aid of the maintenance analysis procedures (MAPs). These procedures begin in the START section. Follow the procedure to isolate the failing area.

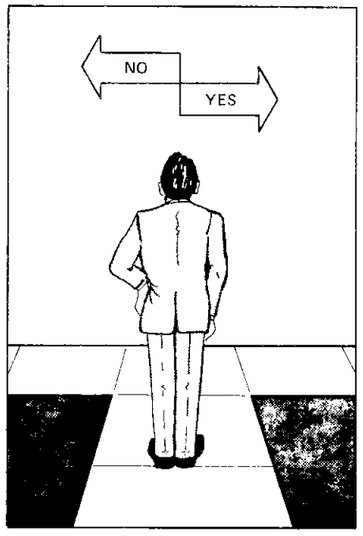
4 REPAIR



Follow the **MAP** to determine repair action. Use circuit diagrams, included with or referenced from MAP, to assist in analyzing failures. MAPs usually attempt to recreate failures by having you run microdiagnostics. **Return** to the MAP to analyze results. If the microdiagnostic detects a failure not covered by the MAP, consult the microdiagnostic error code dictionary.

TROUBLE NOT FOUND ?

LOST ?



The original error indications may have been misread or misleading. Return to the original failure indications and reconsider the problem. Consult associated circuit diagrams and theory of operation information to assist in diagnosing difficult problems. The OPERations section of the MLM contains a high-level description of facility operation.

NEED HELP ?

Obtain help whenever you experience difficulty in effecting a rapid repair. Local procedures dictate exactly how and when to do this.

F
L

3340 MAINTENANCE PHILOSOPHY

BASIC PHILOSOPHY

The 3340 maintenance philosophy and Maintenance Library Manual (MLM) are designed to help the customer engineer repair hardware malfunctions. Maintenance material is given prominence in the organization of the MLM and emphasis is on "how to fix" rather than "how it works" (theory of operation).

Although the maintenance philosophy is designed for the minimum level Product Trained CE, it is recognized that there are significant differences in skill levels, experience, and natural ability among CEs. Additional maintenance procedures and sections of the MLM are provided for more proficient Product Trained and Product Support CEs. This allows each individual CE to continue with the maintenance procedure until he has exhausted his resources, or until existing policies dictate that he request assistance.

Together, analysis flowcharts, functional diagrams, and descriptions make up the maintenance analysis procedures (MAPs). MAPs are provided to assist the CE in making decisions (based on sense data, microdiagnostic results, customer data, or visual indications) to isolate the failure to the smallest possible area. Flowcharts and functional diagrams reference other material in the MLM and ALDs to provide a more complete path to failure isolation. The descriptions are provided to help the CE understand the failing operation.

The normal card-isolation technique is to replace or swap the specified cards within a particular maintenance procedure until the failing one is located. At the CE's discretion, and/or depending on the customer's requirements, cards may be swapped between drives and/or modules to speed the isolation. In certain areas where it is not practical to rapidly swap or replace components, information is provided to allow isolation of the failing replaceable unit. (These areas include the Power, Data Module loading, and other mechanical or electro-mechanical sections.)

Scoping procedures are provided if components are not available for replacement or swapping. Keep in mind that swapping or replacing is the primary card-isolation technique and that scoping is the alternate method.

MAINTENANCE ANALYSIS PROCEDURES

The MAPs are made up of the following basic interacting parts:

(1) START, (2) Flowcharts, (3) Diagrams, (4) Support Theory, (5) Tests, (6) Support Material, and (7) Special Microdiagnostic Utility Programs.

Start

Problem-analysis entry to the MLM is made on START 100. This page uses symptoms from customer information, sense data from EREP (or equivalent error recording program), console messages, or visual indications to point to the correct analysis procedure.

Flowcharts

A. ENTRY
Entry into the flowcharts is made from START, Microdiagnsotic Error Code Dictionary, Fault Symptom Index, or another flowchart.

B. MICRODIAGNOSTICS
The microdiagnostic blocks in the flowcharts tell the CE when to run microdiagnostics. If the tests fail, a base or reference point is established (even on intermittent errors). The microdiagnostics are also run to verify repairs.

C. POSSIBLE CAUSES
Some flowcharts contain a block listing the possible causes for a failure. The possible causes are listed in the most probable order of failure or in order for ease of checking. The blocks are provided so that:

1. The CE may order the suspected parts beforehand (shopping list).
2. He may use the list as a reference or starting point for intermittent failures.
3. The CE may swap or replace parts to make a fix before he continues with the alternate method of isolating the failure. (See the last two paragraphs of the Basic Philosophy on this page and LGND 4.)

D. ISOLATION
Flowcharts do not attempt to provide detailed instructions for every possible cause of a malfunction. Instead, a functional diagram of the failing function is provided, and the CE's abilities are called upon to identify the specific failing unit. For example, the MAP has isolated the cause of a malfunction to the failure of a certain relay to pick. The relay is picked by a series of switches and cables through a number of connectors. A functional diagram (or in some instances, the ALDs) is used to identify the specific point of failure.

E. INTERACTION WITH OTHER MAP PARTS
The flowchart is the focal point of the Maintenance Analysis Procedure. Since the other MAP components are all integral parts of the procedure, they are tied to the flowcharts in some way, either directly or by reference.

Diagrams

The functional diagrams support the flowcharts. They give more detail, such as interconnections between cards, and show specific test points for each function. They include physical locations and ALD page references if more specific information is needed. (See LGND 8). Where necessary, detailed descriptions and scoping information are provided (scope set-up, waveform pictures, and timing diagrams).

Support Theory

A high-level theory of operation is presented in the OPER section of the MLM to provide a basic "big picture" understanding of 3340 operation. Detailed theory is presented in other sections for a better understanding of the particular function.

Tests

A. MICRODIAGNOSTICS
This is the CE's primary tool to help him duplicate a customer failure and isolate it to a particular functional failure. The microdiagnostic philosophy is provided on MICFL 3. MICRO 8 – MICRO 38 give operating instructions and routine summaries.

B. OLT (ONLINE TESTS)
Secondary tests that allow the CE to test the data module concurrently with customer programs. (See OLT 1 or the System/3 Diagnostic Users Guide if the storage control is a DSA or the 5998 CTM, MAP 1301, if the storage control is a System/7 for test information.)

Support Material And References

SPECIAL MLM SECTIONS
Special references and information, EREP summaries, locations, and sense data are provided in the following sections:

INDEX
MLX
LGND
MSG
SENSE
MICFL
LOC
INST

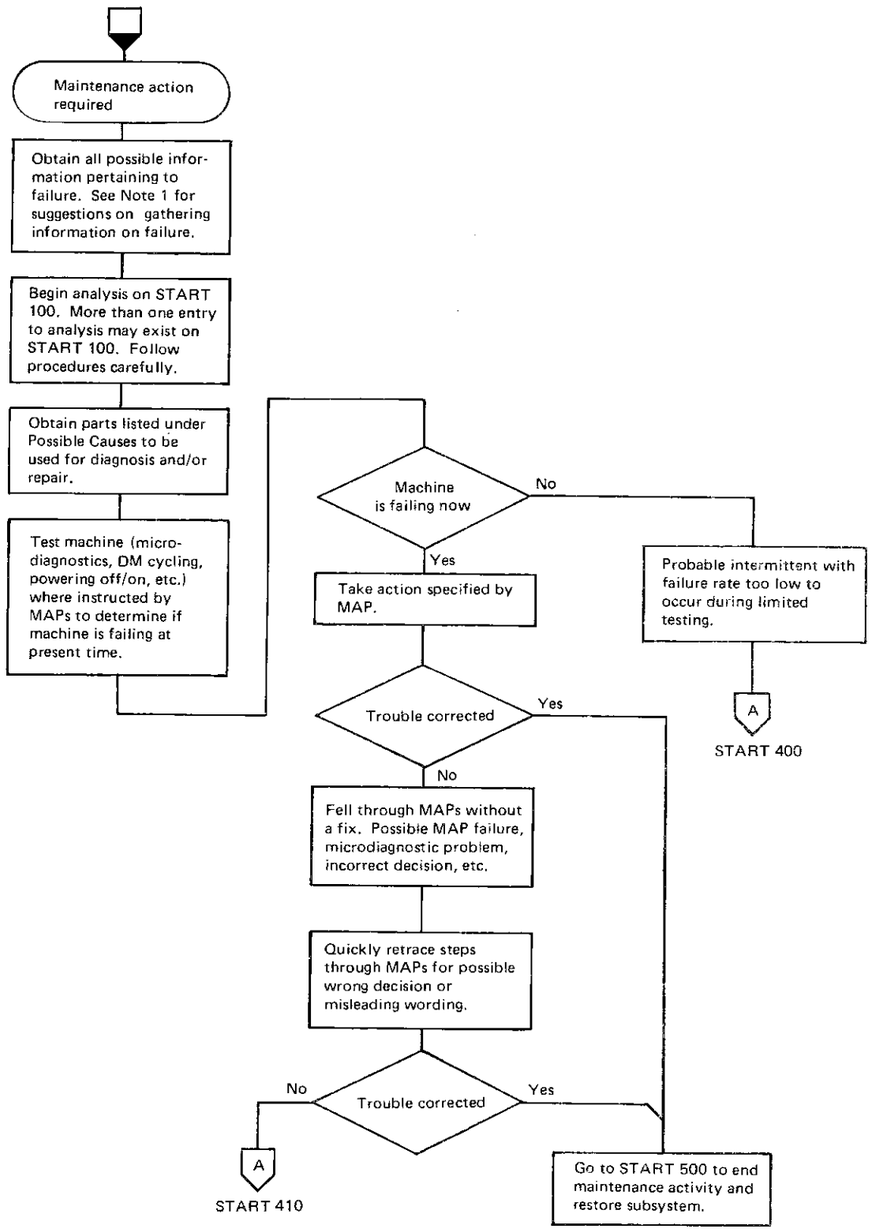
A summary of the contents of these sections is located on START 20.

Special Microdiagnostic Utility Programs

Special microdiagnostic programs available to the CE are:

- Dynamic Servo Adjustment
- Re-format CE Tracks Utility
- Tag Cycle Utility
- Carriage Go Home Scope Utility
- Control Interface Bringup Utility

Detailed test descriptions are given in the MICFL section; operating instructions and routine summaries are presented in MICRO. (See MICRO 1.)



Note 1: Information gathering.

Unless the type of 3340 failure is obvious, use system manuals, attachment manuals, programming manuals, etc., to determine how to obtain logged information from the specific system/programming configuration to which the 3340 is attached. See MSG section of the 3340 MLM for samples of typical OS/DOS outputs.

Obtain any available console error messages. Use operator manuals, system message manuals, etc., for specific formats, layouts, descriptions, and corrective actions. Also refer to the 3340 MLM MSG section. Determine from the logged information or messages if the failure is one drive, two drives in the same module, one data module, all drives in the 3340 subsystem, etc. Determine what is failing and what is not failing. Log summaries are usually most effective in this area. If data module failures are suspected, the failing address(es) should be determined from the detailed sense information.

A few soft (retryable/correctable) errors, especially Data Checks or Seek Checks, should not be cause for concern. Any significant increase in the error rates should be investigated.

Review IR history for the machine in question as well as for other 3340s in the account. It is possible the trouble could have been put on (transferred to) the machine while card swapping to isolate a problem in another machine.

The following visual indications require special consideration:

- Data module load or unload problems (DM 100, Entry A). The original indications for load or unload problems occurring when the cycle is initiated by the Start/Stop switch may be lost if Reset is pressed, the Start/Stop switch is operated a second time, the Attention pushbutton is operated, or the data module is mechanically cycled by hand. Try to duplicate the original failure and follow the MAPs to find the cause. For a failure too intermittent to duplicate, request that the customer leave the machine in a failing condition the next time it occurs until a CE can get there to determine the cause. No Resets, Attention pushbutton, or Start/Stop switch operations should be made until the failure conditions have been determined by microdiagnostic routines B3 or AC or by checking the mechanical position with the handcrank.

- Ready light fails to come on after loading a data module. Same as the data module load or unload problem.

- Ready light goes off and data module unloads. This indicates a sequence error occurred after proper loading. The system should provide an Intervention Required message. Bit 5, Byte 10 of the sense information indicates a DM sequence error. Latched conditions in Byte 9, bits 0, 2, and 3, indicate what caused the failure. Some system configurations do not provide the required sense bytes on Intervention Required messages. Microdiagnostic routine AC can be used to read latch status (DM 101, Entry C) unless the Start/Stop switch has been operated.

MLX A

A facility or single drive failure is suspected

3344 MLM
MSG 10
MSG 12
MLX
B

Yes — 3344 Attached — No

A
START 100
(Vol. R07, 3344 MLM)

Review START 50, 55, and 90, then return here. See Note 2.

Note 1: If multiple controllers are on one interface or switch unit and varied or confusing error information is received, see Multiple Controller Check Procedure on CTL-I 290.

Note 2: Standard MST probes may be used in place of an oscilloscope to measure MST up/down levels.

Visually check (or consult operator) to determine if any of the following **Failure Symptoms** exist:

Failure Symptom	Location/Notes	Analysis Procedure
AC and/or dc Power lamp off. CP407 or CP408 tripped.	Sequence board (on early controllers, lamps are on Power Panel.)	PWR 10, Entry A
Cover Locked lamp off (data module loaded).	Drive Operators Panel.	DM 100, Entry B
Data module load/unload problem or cover won't open or cover lamp stays on.		DM 100, Entry A
Ready lamp off, or drops Ready.	Drive Operators Panel.	DM 101, Entry D
Won't power-down.		PWR 10, Entry B
Read Only lamp does not come on or stays on.	Drive Operators Panel.	R/W 212, Entry A
Suspect data module damage.		DM 530

Gather failure information and determine which of the following **Symptoms/Conditions** best describes the suspected failure (or failure information). *More than one path may exist.* (See START 90).

Symptom/Condition	Notes	Analysis Procedure
Sense data is available.	Review Note 1	
Console message available.	Review system documentation for console message information.	OS – MSG 10 DOS – MSG 12 Sys/3 – MSG 1
No meaningful **sense data** is available and it is desired to check out the facility	Includes System "hangs" or timeouts.	START 110 (Checkout procedure)
Degraded performance. Error rates high	Requires analysis of history. Run EREP	MSG 30, Entry A
Intermittent or no trouble found.	Microdiagnostics do not fail or MAP did not fix problem.	START 90
Missing interrupts.	Usually reported by operator.	DEV-I 200, Entry A
Voltage problem suspected.	If logic problems are unresolved by other procedures, suspect possibility of voltage (power supply) problems.	PWR 10, Entry C
CE Panel doesn't function correctly.		PANEL 150, Entry A

Determine which bits are active in Sense Byte 0

Bit 0,1,5, or 6 Active (Hex 80, 40, 04 or 02)

Yes — Byte 0 = '40' — No

Byte 0
Bit 0=1 — Command Reject
Bit 5=1 — Overrun
Bit 6=1 — Trk. Cond. Chk.
These conditions usually indicate operator or programming error. However, hardware malfunctions can cause these indications. If hardware is suspected, check out the Storage Control maintenance documentation and/or the 3340 as outlined on START 110. If all failures are on one drive, use 3340 Checkout procedure (START 110).

START 130
Intervention Required

START 110
Checkout Procedure

Bit 2 Active (Hex 20)

Not a 3340 Failure, See Storage Control documentation

Bit 3, 4, 7 or none active (Hex 10, 08, 01, or 00)

MLX C

Byte 0
Bit 3=1 — Equipment Chk
Bit 4=1 — Data Check
Bit 7=1 — Seek Check

No — Byte 7 = '1X' or '4X' — Format 1 or 4 Yes

No — Byte 7 = '5X' — Format 5 Yes

No — Byte 7 = '6X' — Format 6 Yes

Formats not listed above

Other formats are used for system or attachment detected problems. Refer to their maintenance manual for proper entry into the problem analysis.

Format 6 does not indicate a 3340 error condition. This format is used for both device and system/attachment environmental data. See SENSE 104 and SENSE 109 for additional information. System or attachment manual may also provide additional information on Format 6.

3340 5
Storage Control MLX Chart

3340 7
Storage Control MLX Chart

MLX D

No — Bytes 22 and 23 both zero — Yes

Fault Symptom Code not included with sense data.

Go to FSI 50 and use the flowchart to develop the symptom code. Look up the code in the FSI section to determine the analysis procedure.

Go to FSI section. Starting on FSI 100, look through the sequential FSC numbers to find the one corresponding to the fault symptom code in bytes 22 and 23.

Proceed to page indicated in FSI.

A
R/W 300

FSI 10

FSI 50

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See EC History	440218 5 Aug 74	440219 26 Sept 74	440223 14 Mar 75	440224 15 Dec 75	440226 27 Feb 76	440227 14 Sept 76

3340 CHECKOUT PROCEDURE FROM CONTROL MODULE CE PANEL

WITHOUT STRING SWITCH FEATURE

1. The drive to be tested must be varied offline from the system if running under OS to run in inline mode (time sharing with an operating system such as OS or DOS).
2. Set the Power Mode switch at the drive to be tested to the CE (toggle up) position.
3. Load a data module on the drive to be tested.

   Note: Any size data module can be used, but an IBM 3348 data module is required for routine A7 (see MICRO 24 for routine A7 reference notes). For a complete check-out of the fixed head feature, a fixed head data module (70F) must be used.

   Check that the ac, dc, and Ready lamps are on. If the indicators are not on and all switches are in their correct position, go to START 100 and analyze the problem.
4. Load the correct 3340 microdiagnostic disk into the storage control reader. If the storage control is a System/3 DSA, refer to the System/3 Diagnostic Users Guide for instructions to load the diagnostic. If the storage control is a System/7, refer to the 5998 CTM, MAP 1302, to call out the microdiagnostics. (If the fixed head feature is installed on the drive to be tested, the FHFE microdiagnostic disk must be used.) See MICRO 10 for complete details concerning operation of the 3340 CE Panel, loading and running microdiagnostics.
5. Enter routine number A1 to run the microdiagnostics listed below (see MICRO 8). These routines are linked together and the complete sequence runs without intervention. If the routine cannot be loaded successfully, go to PANEL 150 to analyze the problem. Refer to the MICFL section for detailed test descriptions.

   A1 Control Interface and Logic tests*
   A2 Device Interface and Logic test*
   A3 DM Control Logic tests
   A5 Index/Sector tests
   AD Gap Counter tests
   AF Format Read/Write tests
   A4 Servo 1 tests
   AE ECC tests

   If errors occur, refer to the error code dictionary (in MICRO section of the MLM) and follow instructions for the error(s) encountered. After obtaining all information from the first error, it is recommended that the tests be restarted to see if the same error stop occurs a second time. Intermittent errors do not always occur on the best error stop to provide easy analysis. It is usually best to use the lowest-order error stop obtainable (that is, the error number in the earliest test routine in the sequence). Record all information from all error stops and look for some common element that might be helpful. For example: if the same bit position in the received information is always incorrect, it might indicate a Bus In problem.
6. To complete the checkout procedure, the following microdiagnostics should be run. These are not linked. Enter routine and any required parameter(s) as defined in the description in the MICRO section of the MLM (start on MICRO 23). Run the routine to completion.

   A7 Servo Adjustment Program (Verification Mode)
   AB Random Seek test
   B1 Read test
   B2 Write test
7. Refer to START 400 to assist in duplicating an intermittent error.

These two routines can be run without a data module loaded.

ADDITIONAL DATA MODULE OR FEATURE TESTING

Fixed Head Feature

1. Fixed head data module (Model 70F) must be loaded.
2. Reload routine B1 from a FHFE microdiagnostic disk to test all of the fixed heads.
3. Enter parameters: 10, FF, FF, 00, 00.

RPS Feature

1. Verify that the RPS feature is installed. Continue with step 2 if:
   a. RPS feature is listed on the machine history for this machine.
   b. Card A1G2 is installed in the drive.

   Note: If the feature is listed on the machine history, this card must be installed.
2. Load routine A5.
   Enter parameters: 10, 05, 00.

Data Module Checkout From the System

If it is desired to test a Data Module, the following online test programs are available. Refer to OLT 5 for running instructions.

T3340 – PSA Pack Scan A (OLT 22)
T3340 – PSB Pack Scan B (OLT 24)

If other tests are desired, use FRIEND. See OLT 26 for a summary of FRIEND operation.

If the storage control is a System/7, refer to the 5998 CTM for test description.

WITH STRING SWITCH FEATURE

Facility Checkout

- For drive problems, see the Single Drive Checkout below.
- The primary objective of this checkout procedure on a facility with the String Switch Feature is to determine as soon as possible whether the fault is in:

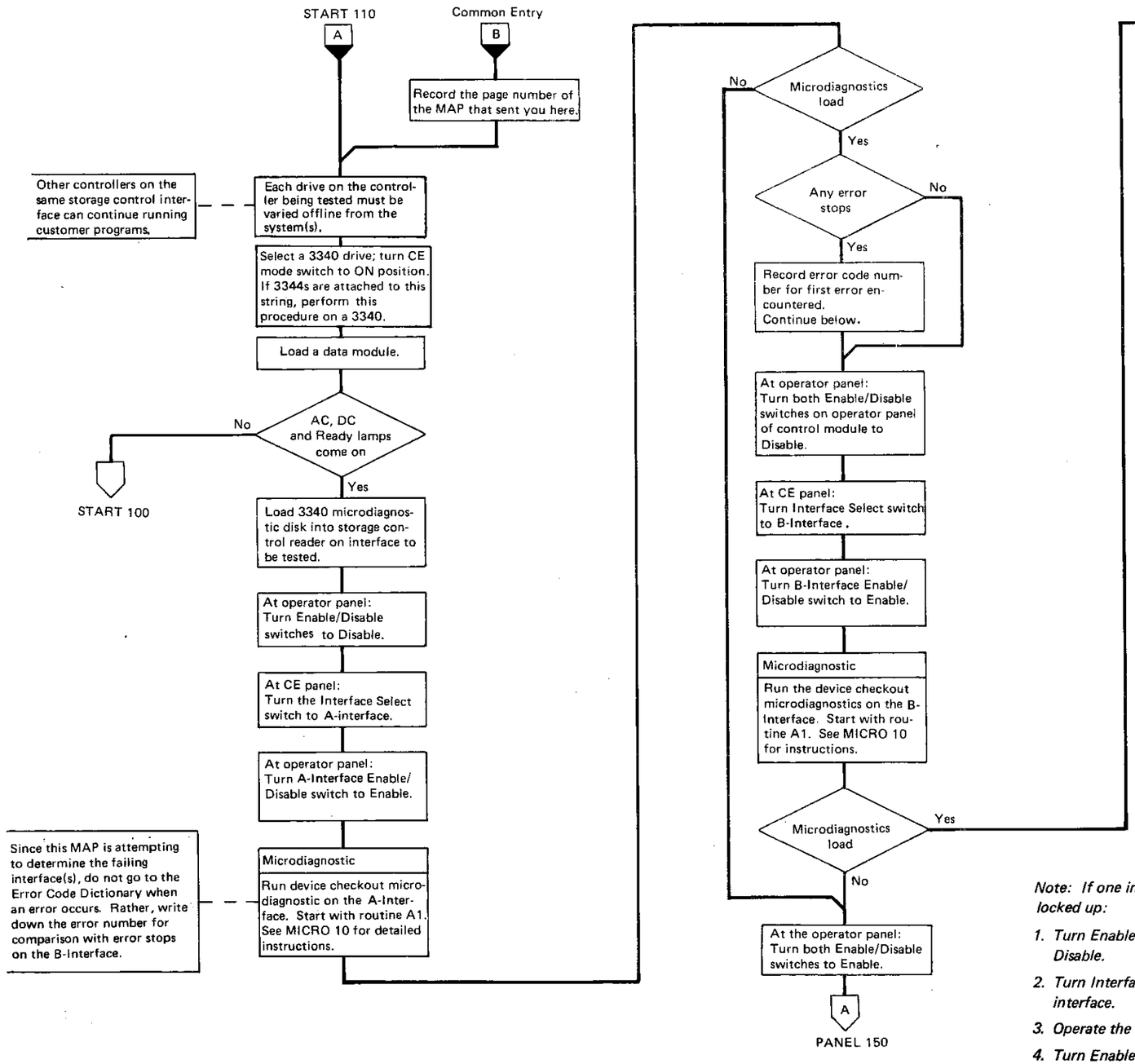
  Interface A
  Interface B
  String Switch common electronics
  The controller
  The drive(s) and/or the device interface
- Check out the entire facility:

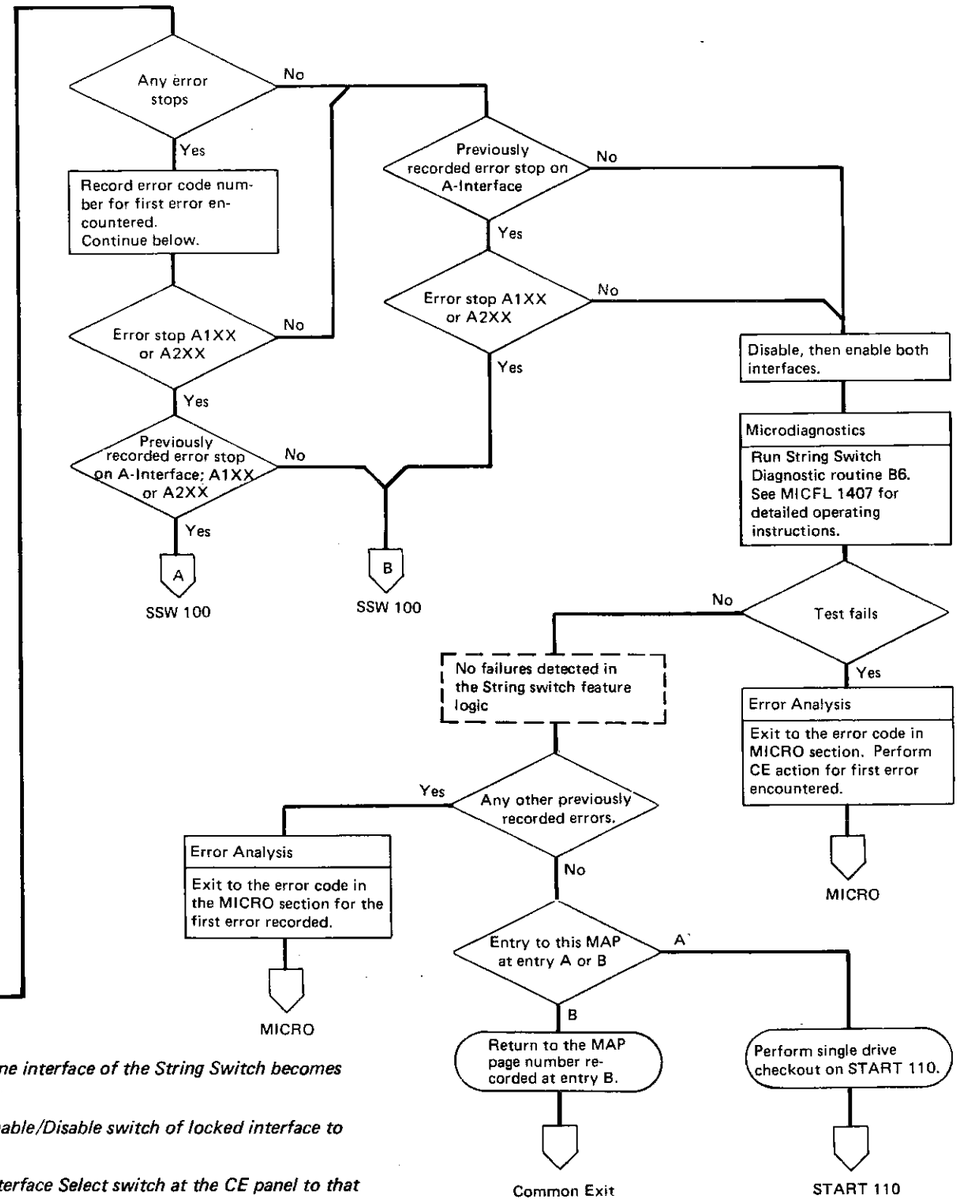
  For undefined failures.
  After installation.
  To verify repair actions.
- To perform the facility checkout, go to START 120, Entry A.

Single Drive Checkout

1. The drive to be tested must be varied offline from the system to run in inline mode (time sharing with an operating system such as OS or DOS).
2. At the drive to be tested, turn the Power switch to the ON position (toggle up) at the CE panel and turn the Interface Select switch to the interface being used.
3. Load a data module on the drive to be tested. Check that the ac, dc, and Ready lamps are on. If the indicators are not on and all switches are in their correct position, go to START 100 and analyze the problem.
4. Load the 3340 microdiagnostic disk into the Storage Control reader of the interface being used. See MICRO 10 for complete details concerning operation of the 3340 CE panel, loading and running microdiagnostics.
5. Continue with Step 5 under Without String Switch Feature.

FACILITY CHECKOUT WITH STRING SWITCH





Note: If one interface of the String Switch becomes locked up:

1. *Turn Enable/Disable switch of locked interface to Disable.*
2. *Turn Interface Select switch at the CE panel to that interface.*
3. *Operate the Execute switch at the CE panel.*
4. *Turn Enable/Disable switch to Enable.*

INTERVENTION REQUIRED

An Intervention Required message is used to indicate to the operator that his intervention is required to make the machine ready for use. It is possible for certain hardware malfunctions to give this indication. This MAP is designed to guide you to the proper area of the MLM when these malfunctions occur.

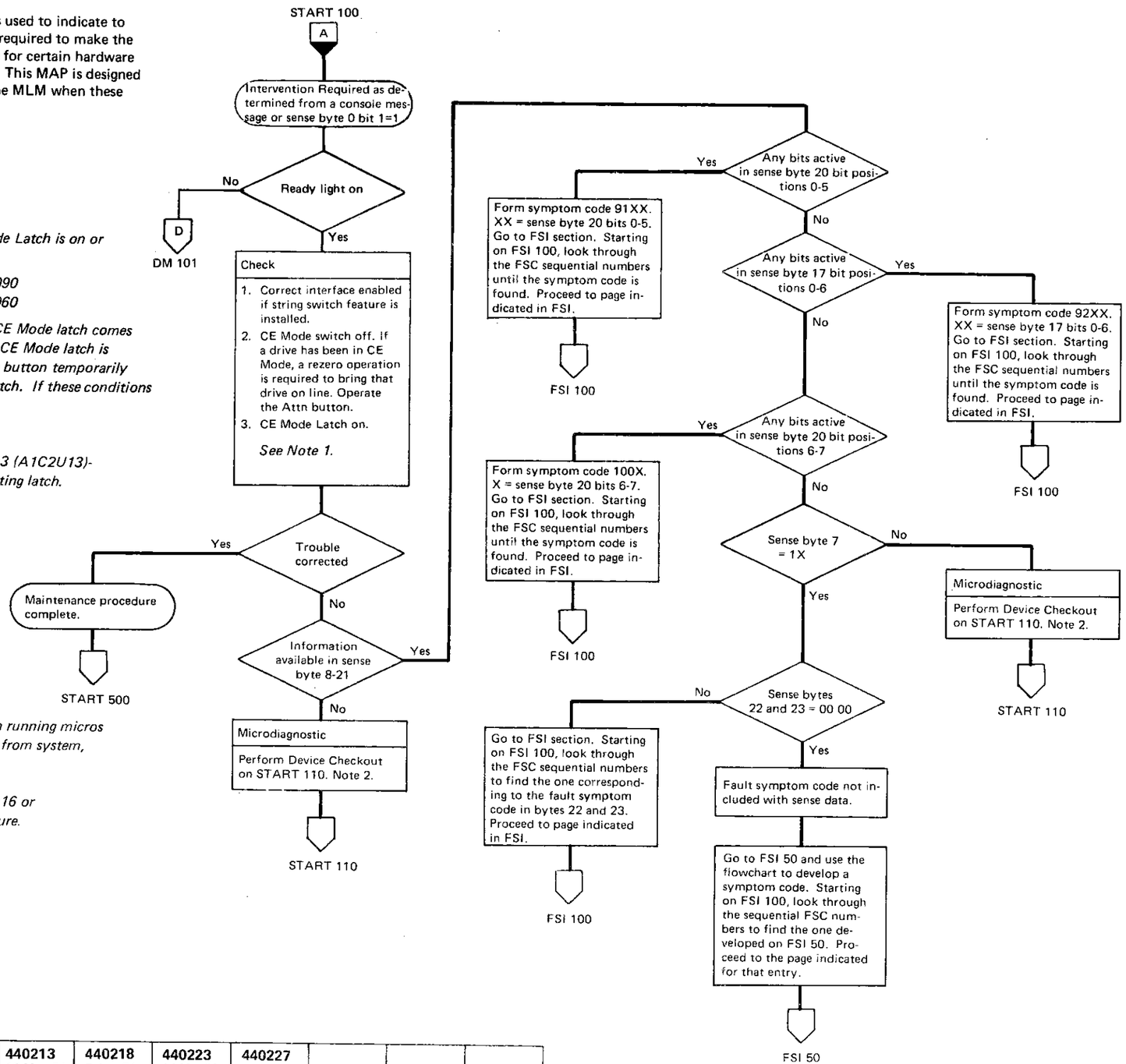
Note 1: To determine if the CE Mode Latch is on or does not reset, check:

—CE Mode A A1C2S12 KA090
—CE Mode B A1C2U11 KA060

Intervention Required results if the CE Mode latch comes on due to a malfunction. Unless the CE Mode latch is "stuck on", depressing the Attention button temporarily clears the problem by resetting the latch. If these conditions exist:

1. *Replace A1C2.*
2. *Monitor CE switch A (B) A1C2S13 (A1C2U13)-KA090 for possibility of noise setting latch.*

Note 2: *If drive selects properly when running micros (drive in CE Mode) but will not select from system, check items under Note 1. If OK:*
1. *Replace A1D2*
2. *Refer to selection logic on DEV-I 116 or KK040 and determine cause of failure.*



INTERMITTENT ERRORS

Some action should be taken to correct an intermittent problem whenever possible, even if the failure cannot be duplicated. The purpose of this page is to assist in trying to duplicate the failure, and if that cannot be done, to provide some guidance as to possible corrective actions which can be taken.

If failures are predominantly one sysmptom code or several related codes, refer to START 420. Symptom codes are listed in their order of priority (most significant first). Loop the microdiagnostic routine(s) indicated for the symptom code available from the error information. If a failure occurs, determine which test is failing from the Error Code Dictionary. Looping the failing test within the routine increases the testing frequency. Follow the procedures indicated by the error stop in the Error Code Dictionary.

If the microdiagnostics do not produce a failure, use the Fault Symptom Code occurring most frequently and find the possible cause lists in the FSI section and/or MAP. Replace, swap, or check the items listed. Maintain a list of what has been done. This information may be valuable if additional action is required. A Check of the customer's operation has to be made to determine if the problem has been corrected. If mass card replacement was used, every attempt should be made to determine which one caused the error by putting removed cards back in one or two at a time.

Other forms of stress testing, such as marginal voltages, raising and lowering temperature, and vibration may be tried but have not proven too effective. A folded tab card raked across the cards while in a micro loop sometimes helps find a bad card connection or a vibration sensitive card. Moving cables and connectors under the same conditions also occasionally locates a problem.

It is essential to have *all* the information possible regarding failures. Use full log dumps and analyze them fully. Understand how much of the 3340 subsystem is working correctly as well as what is failing. Use SENSE, OPER, and individiual MAPs in the MLM to understand functions which are failing.

Determine if a failure is with one or multiple data modules. With single data module failures, determine the failing addresses. Determine if one or more or many tracks common to one head are failing. Use the R/W section starting at R/W 300 to help understand addressing and what can cause various troubles. OPER 30 provides a summary of programs available to assign alternate tracks on the data module.

For access failures, card swapping between two drives is effective in isolating card failures. Use microdiagnostic routine A7 in adjust mode (see MICRO section) to adjust the velocity gain. This is required if cards A1R2 or A1Q2 are replaced or swapped. Power amplifiers can be swapped between drives. Check the interconnecting cables and connectors. Check the voltages.

For intermittent data module load and unload problems and for dropping ready (Intervention Required), it is sometimes necessary to request that the customer leave the machine in the failing condition until the CE arrives. Microdiagnostic utilities B3 or AC can then be used to determine what caused the failure. Pressing Reset or Attention or operating the Start/Stop switch frequently changes or resets the original failure indication.

Use a digital voltmeter to check voltage levels and an oscillocope to check voltage ripple on the power supplies.

Check the time when errors occur when possible. It is possible some external noise source is present only at certain times.

Question the customer about other possible environmental problems such as room temperature, static discharges possibly from low humidity, or other unusual occurrences.

INTERMITTENT ERRORS START 400

MAP FALLTHROUGH

The machine is failing now and the MAPs have not corrected the problem. The following is designed to help the CE to further isolate and correct the problem when the MAPs failed to do so.

Return to your original MAP entry and replace, swap, and check items listed as Possible Causes. Test the machine in the original manner to determine if the trouble is corrected. If it is, go to START 500, Entry A.

CAUTION
When replacing or swapping components, keep a list of what has been done. This is very valuable if the error is being propagated due to components being damaged.

At this point, understanding the failure becomes essential. A methodical approach must be developed and followed. Analyze all failure information; sense, microdiagnostic error stops, message bytes or anything else pertaining to the failure. Know what is failing and what is not. If you can duplicate the failure and obtain the same failure information, you should be close to understanding the problem. If sense information resulted in a Fault Symptom Code, use FSI 50 to be sure the FSC was generated correctly. Use the SENSE and OPER sections of the MLM to help understand the failure.

If a fairly solid error condition exists with a microdiagnostic routine or test, loop the routine or test and scope the inputs that set the error latch or line. Try to determine the input at fault or if it is the output. Use the MICFL section of the MLM to determine what the microdiagnostic is doing. Many MAPs have diagrams and scoping information which can be helpful. At this point you may be looking for an open or short on the board or in a cable rather than a card problem.

If the problem is with the data module loading or unloading, use microdiagnostic routines B3 or AC to determine what is failing. Keep in mind that pushing Reset, Attention, or operating the Start/Stop switch after a failure may reset the original conditions which caused the failure.

Access cards can be easily swapped between drives to help isolate access problems. This includes the power amplifier. Run microdiagnostic routine A7 in adjust mode to be sure the velocity gain is correct. This is also necessary if A1R2 (A1Q2) is replaced or swapped. Check the cabling and voltage.

If the problem is Data Checks, the problem must be isolated to the smallest element possible (one drive, one data module, all drives, etc.). Swap data modules between drives, use different data modules, or whatever is necessary. Review the R/W section of the MLM starting with R/W 300 for possible causes and information on R/W functions. Also see the OPER section of the MLM. Aleternate track flagging information is on OPER 30.

If one data module fails, run OLTs PSA and PSB. Microdiagnostic routine B1 can also be used with parameters to read-verify customer tracks. See the MICRO section for details. Any HA or R0 failures identified with a data module must be corrected. Advise the customer to rewrite the data or assign an alternate track if data cannot be rewritten due to a surface defect. If several defects appear, check the head addresses. If the problem is common to one head, the head may be defective or the connector may be bad. See the R/W section starting on R/W 340.

If one drive only is failing, regardless of the data module being used, see R/W 302.

If more than one drive module (2 drive box) fails or there is only one drive module in the subsystem, see R/W 304.

If all drives in the subsystem fail (3 or more drives attached), see R/W 306.

If the failures are random or the failure still has not been found, monitor the voltages with a digital voltmeter to be sure they are within specification. Pay particular attention to the +6 Vdc and −4 Vdc supply. Check the power supplies for noise or high frequency ripple with an oscilloscope. Check grounding, cables, and connectors for bad crimps, shorts, or poor connections. Check other environmental conditions that may cause machine problems such as temperature, static, primary power, external noise, etc.

FSC/MICRO REFERENCE TABLE

This table lists FSCs in their order of importance. For example, when multiple symptom codes appear, the first one on the chart should be looked at first. The microdiagnostic routine(s) most likely to duplicate the failure are listed in the column labeled Micro Routine. The linked series of microdiagnostics starting with A1 should always be run first. Individual routines can then be looped to provide increased testing of specific functions or areas.

Note: Certain 3340 subsystems may have a 3344 drive attached. If a 3344 drive is attached and the problem is in the 3344, go to the FSI section in Volume R07 of the 3344 MLM. (3344 documentation will be available in May 1976).

FSC	Type of Failure	Micro Routine	MLM Reference	Significant Sense Byte(s)
9104	I Write Fail	AF	DATA 124	8
91x8	CTL-I or DEV-I Bus In Parity Check	A1, A2	9118-DEV-I 180, others CTL-I 390	13, 15, and 20
9110	DEV-I Bus In Parity Check	A2	DEV-I 180	13, 15, and 20
9120	One-of-Eight Check	A1, A2	DEV-I 110	4 and 20
9140	CTL-I Bus Out Parity	A1	CTL-I 370	20
9180	CTL-I Tag Bus Parity	A1	CTL-I 380	20
91FC	CTL-I Bus In Assembly Failure	A1	CTL-I 445	8 through 12 and 20
9200	False CTL Error	A1	CTL-I 400 and OPER 260	8
9202 9206	ECC Hardware Error with Monitor Check	AE, AD	DATA 200 and OPER 242	17
9204	Monitor Check	A1, A2, AD	DATA 220	17
9208 920C	Write Data with Monitor Check	AD, AE, AF	DATA 230	17
921x	Gap Counter	AD, AE	DATA 240 and OPER 46	17
922x	Shift Register	A3, AD, AF	DATA 250	17
9240	No PLO	A3, AF	DATA 260	17
928x	PLO error	A3, AD, AF	DATA 270	17
92C0	No PLO - PLO error	A3, AD, AF	DATA 270	17
9001	No Tag Valid, R/W Operation	A4	CTL-I 250	18
9002	Normal or Check End missing following R/W or ECC operation.	A1, A2	CTL-I 260	18
9003	No response from Controller on control operation	A1	CTL-I 270	18
9004	Timeout for Index	A5	RPI 110, 100, and OPER 125	18 and 20
9005	ECC Hardware Check	A1, AE	DATA 214 and OPER 242	18
9006	Multiple Controllers selected	A1	CTL-I 300	13, 14, and 18
9007	Preselection Check	A1	CTL-I 320	18
9008	Head Switch timer expired	AF	DATA 90	18
9009	Busy missing after Seek Start	A3, A4, A6, A7* A8, AA, AB	ACC 210	8 and 18
900A	Physical Address Check	A2	DEV-I 110	4 and 18
900F	Attention Check	A2, A3, A4, A5	DEV-I 202	18
10xx	Device Interface Check	A1, A2	DEV-I 120, 126, 300	8 and 20
11xx	DM Sequence Check	B3*, AC*	DM 100, and 640 through 657	9, 10, and 11
12xx	Access Timeout	A3, A4, A6, A7*, A8 AA, AB, AD, AF	OPER 113 through 148	16
15xx	Overshoot Check	A3, A4, A6, A7* A8, AA, AB	OPER 113 through 148	16
16xx	Servo Off Track	A3, A4, A6, A7* A8, AA, AB	OPER 113 through 148	16
1301	Sector Compare Check (RPS)	A5	RPI 500	9
	Chart is continued on START 421			

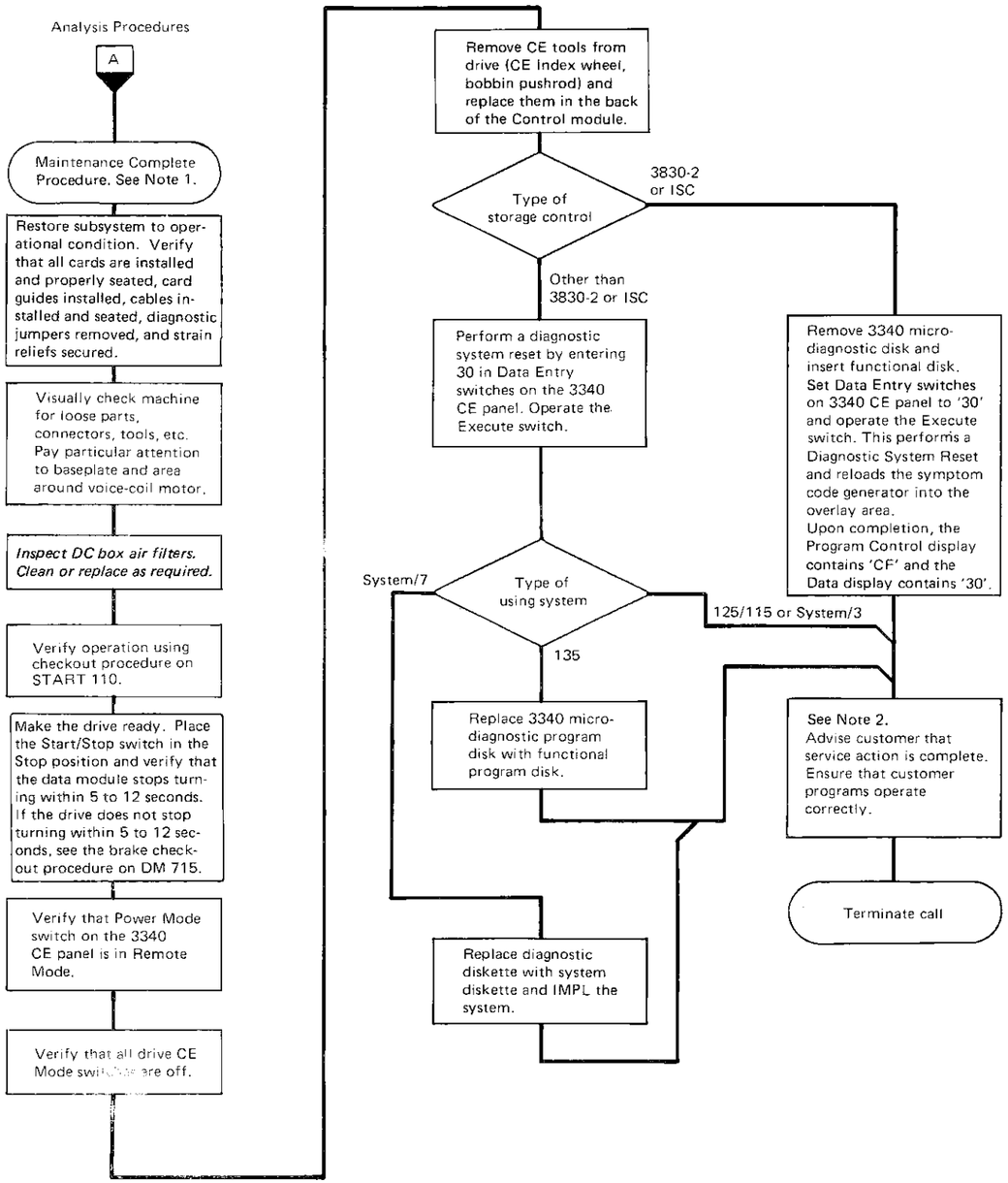
**Utility or adjustment programs. Do not loop to exercise machine. See the microdiagnostic descriptions starting on MICRO 20 for details.*

FSC/MICRO REFERENCE TABLE

FSC	Type of Failure	Micro Routine	MLM Reference	Significant Sense Byte(s)
1310	False Drive Check	A3, A5, AA	DEV-I 240	8
14xx	Read/Write Safety	A3, A5, AD, AF, B2	R/W 280, R/W 100, OPER 225	12
1910	Error Alert (not defined)	A1	CTL-I 402, OPER 260	7
1911	Transmit Target Errors (RPS)	A5	RPI 600	7
1913	Transmit Fixed Head Error	A3	DEV-I 160	7
1914	Sync Out Timing Error	A1, A4, A6, A8 AD, AF	DATA 110	7
1916	Transmit CAR Error	A2	DEV-I 170, OPER 105	7
1917	Transmit Head	A2, A3	DEV-I 150, OPER 105	7
1918	Difference Error	A2, A3	DEV-I 150, OPER 105	7
49xx	Data Check, No Sync byte found	AF, B1	R/W 300, 315, OPER 230 through 233	7

* *Utility or adjustment programs. Do not loop to exercise machine. See the microdiagnostic descriptions starting on MICRO 20 for details.*

MAINTENANCE COMPLETE PROCEDURE



Note 1:

Refer to START 90 for additional information if no trouble was found or no action was taken to correct trouble.

Note 2:

When a 3340 drive is switched to CE Mode, a latch is set in the drive to allow selection with the CE address and to prevent interrupts to the system. Turning the CE Mode switch off prevents CE addressing but does not reset the latch. (With the latch set, the customer cannot address the drive.) A Rezero operation must take place to reset the latch. A Rezero operation can be initiated by:

- *Operating the Attention switch on the operators panel.*
- *Performing a data module load cycle.*

Either of these operations generate an interrupt to the system, so they are usually performed by the customer when he is placing the device back online following maintenance activity.

Either of these operations also resets the cylinder address to zero to correspond to the access position.

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION

DC power must be off prior to changing cards. Unless procedures state otherwise, do not restore power with cards missing; this can result in circuit damage or a "system hang" condition. Remove power as follows:

POWER DOWN PROCEDURE

Control Module (A2)

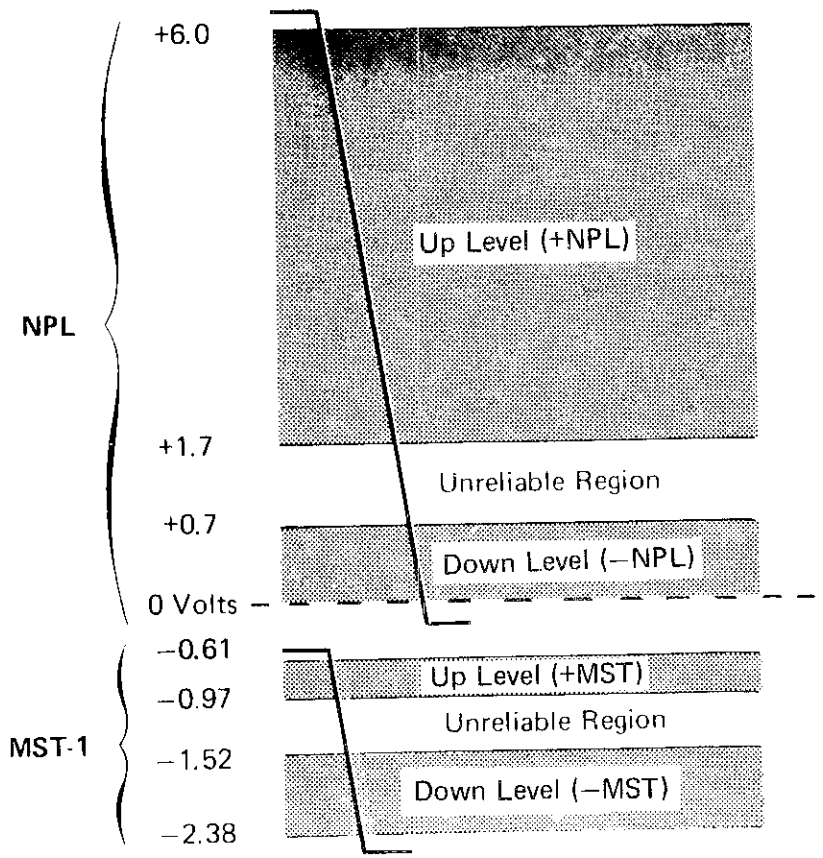
1. Turn the Start/Stop switch to STOP on every drive in the string.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Push the Power Off switch located on the Power Panel on the front of the 3340-A2. *Power is removed from the entire string: the 3340-A2 plus all attached 3340-B1s and B2s.*

Satellite Module (B1, B2)

1. Turn the Start/Stop switch to STOP on each drive in the satellite module to be powered down.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Turn off CP210 located on the AC compartment (accessible

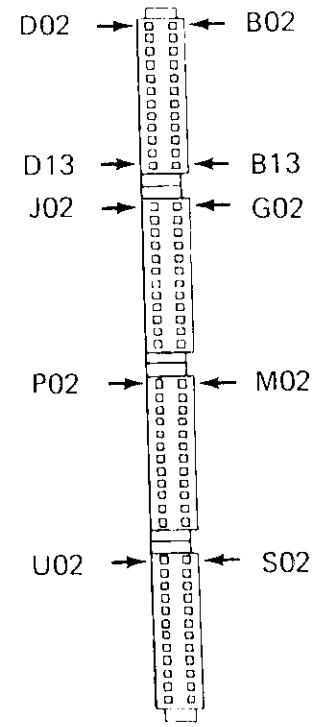
- Always go to [illegible] when [illegible]
nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card	
Voltage	*Card (Contact Tab)*
−4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

KV010, 020 (drives)
BV100 (controller)

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FAULT SYMPTOM INDEX CONTENTS

Fault Symptom Code Generation – – – – – – **FSI 50**

Describes how the microprogram generates a four character hexadecimal code from sense information; can be used to manually develop a code if the microprogram generator is not available.

B3 Microdiagnostic Fault Symptom Code Generation – – – – – – **FSI 60, 65**

Describes how a code is generated from B3 microdiagnostic message bytes. Includes B3 message byte description.

Fault Symptom Index – – – – – – – – – – – **FSI 100-9XX**

Ties Fault Symptom Codes to analysis procedures.

Note: Certain 3340 subsystems may have a 3344 drive attached. If a 3344 drive is attached and the problem is in the 3344, go to the FSI section in Volume R07 of the 3344 MLM. (3344 documentation will be available in May, 1976.)

FSI MAINTENANCE PHILOSOPHY

1. Locate the Fault Sympton Code (FSC) starting on FSI 100 and note the error description.

2. Follow the instructions under the microdiagnostics column.

3. If unable to reproduce the failure with the microdiagnostics, replace the items listed under Possible Causes column. If the failure is on a single drive, replace the cards listed under the A1 Board column first. If more than one drive fails, replace the cards listed under the A2 Board column first.

4. If the above steps fail to correct the problem, go to the MAP Entry indicated for the FSC. Also read START 90, START 400, and START 410 to assist in isolating the failure.

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FAULT SYMPTOM CODE GENERATION

This chart demonstrates how the Storage Control microprogram develops a Fault Symptom Code from Sense information. The 4-character hexidecimal code is presented in Sense Bytes 22 and 23. The chart can be used to manually develop a symptom code if the generator microprogram code is not available in the Storage Control.

For 3830-2 and ISCs only, to reload the Fault Symptom Code Generator after running microdiagnostics:

1. Insert the functional disk.
2. Set the Data Entry switches on the 3340 CE panel to '30'.
3. Operate the Execute switch.

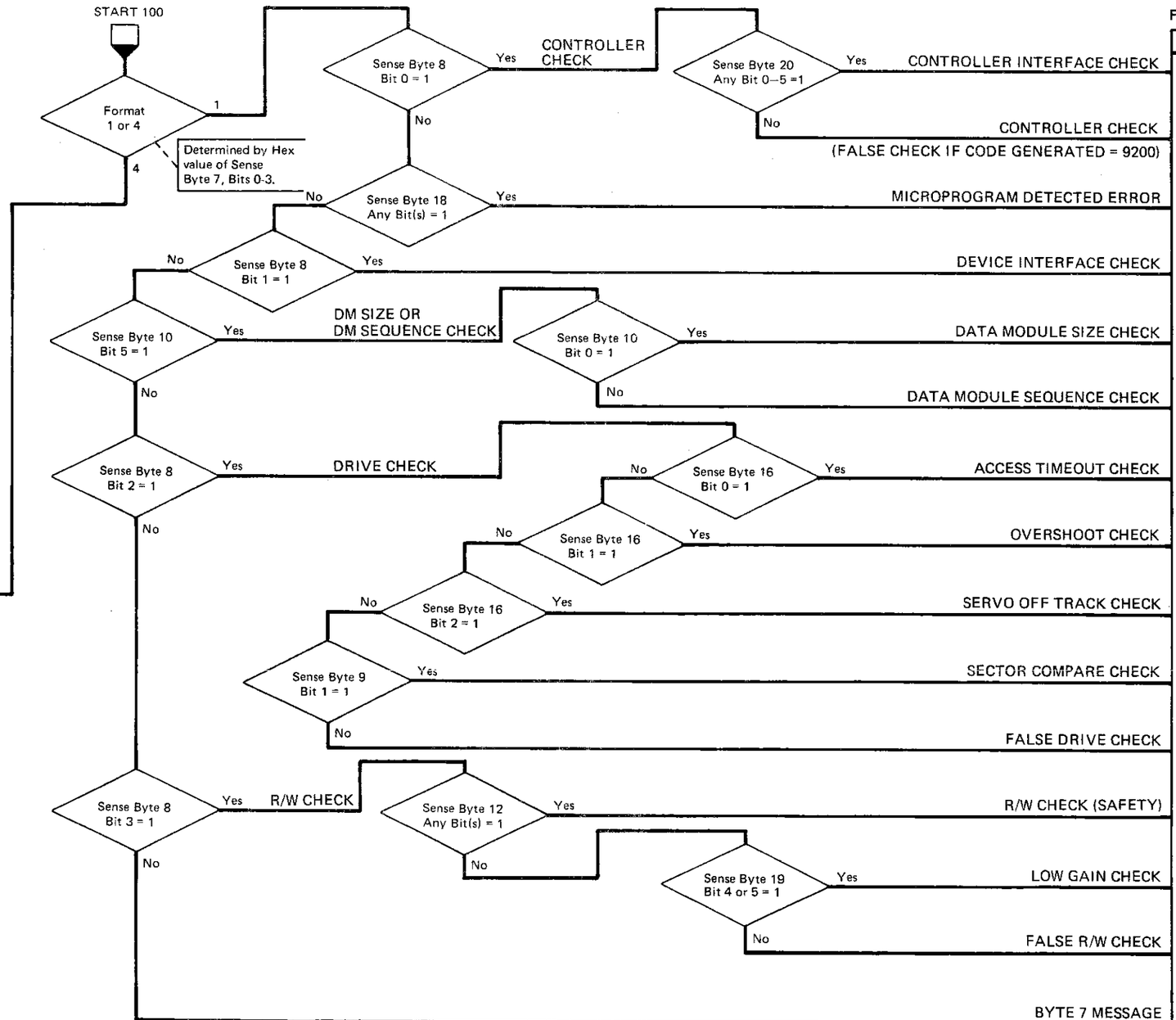
This performs a Diagnostic System Reset and reloads the Symptom Code Generator into the overlay area.

Upon completion, the Program Control display contains 'CF' and the Data display contains '30'.

Other control storages do not require any special action to reload the Fault Symptom Code Generator.

FORMAT 4 FAULT SYMPTOM CODE

Byte 22		Byte 23	
4	9	4	Byte 7 Bits 4–7

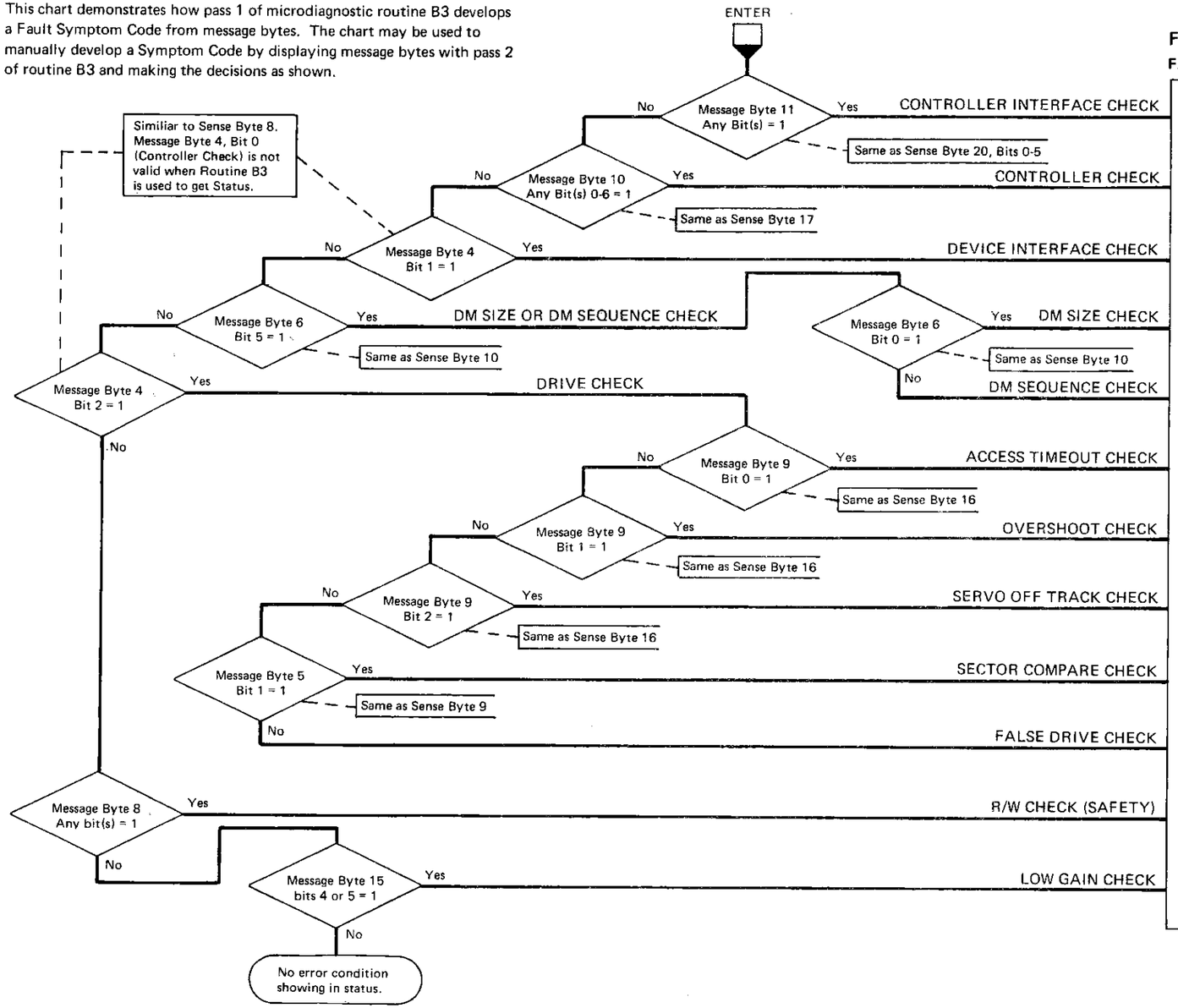


FORMAT 1 FAULT SYMPTOM CODE

	Byte 22		Byte 23	
CONTROLLER INTERFACE CHECK	9	1	Byte 20 Bits 0–3	Byte 20 Bit 4 & 5
CONTROLLER CHECK (FALSE CHECK IF CODE GENERATED = 9200)	9	2	Byte 17 Bits 0–3	Byte 17 Bits 4–6
MICROPROGRAM DETECTED ERROR	9	0	Byte 18 Bits 0–3	Byte 18 Bits 4–7
DEVICE INTERFACE CHECK	1	0	0	Byte 20 Bits 6,7
DATA MODULE SIZE CHECK	1	1	F	F
DATA MODULE SEQUENCE CHECK	1	1	Byte 10 Bits 1–3	0
ACCESS TIMEOUT CHECK	1	2	0	Byte 16 Bits 4–7
OVERSHOOT CHECK	1	5	0	Byte 16 Bits 4–7
SERVO OFF TRACK CHECK	1	6	0	Byte 16 Bits 4–7
SECTOR COMPARE CHECK	1	3	0	1
FALSE DRIVE CHECK	1	3	1	0
R/W CHECK (SAFETY)	1	4	Byte 12 Bits 0–3	Byte 12 Bits 4–7
LOW GAIN CHECK	1	4	F	Byte 19 Bits 4 & 5
FALSE R/W CHECK	1	4	0	0
BYTE 7 MESSAGE	1	9	Byte 7 Bits 0–3	Byte 7 Bits 4–7

B3 PASS 1 MICRODIAGNOSTIC SYMPTOM CODE GENERATION

This chart demonstrates how pass 1 of microdiagnostic routine B3 develops a Fault Symptom Code from message bytes. The chart may be used to manually develop a Symptom Code by displaying message bytes with pass 2 of routine B3 and making the decisions as shown.



FORMAT 1

FAULT SYSTEM INDEX NUMBER

CONTROLLER INTERFACE CHECK	9	1	Message Byte 11 Bits 0-3	Message Byte 11 Bit 4 & 5 Only
CONTROLLER CHECK	9	2	Message Byte 10 Bits 0-6	
DEVICE INTERFACE CHECK	1	0	0	Message Byte 12 Bits 6,7
DM SIZE CHECK	1	1	F	F
DM SEQUENCE CHECK	1	1	Message Byte 6 Bits 1-3 (set bit 0 = 0)	0
ACCESS TIMEOUT CHECK	1	2	0	Message Byte 9 Bits 4-7
OVERSHOOT CHECK	1	5	0	Message Byte 9 Bits 4-7
SERVO OFF TRACK CHECK	1	6	0	Message Byte 9 Bits 4-7
SECTOR COMPARE CHECK	1	3	0	1
FALSE DRIVE CHECK	1	3	1	0
R/W CHECK (SAFETY)	1	4	Message Byte 8 Bits 0-3	Message Byte 8 Bits 4-7
LOW GAIN CHECK	1	4	F	Message Byte 15 Bit 4 & 5

B3 MESSAGE BYTE TO SENSE BYTE CONVERSION CHART

(Message Bytes Displayed on Pass 2 of B3)

Message Byte No.	Message Byte Name	Equiv. Sense Byte	Detailed Descript.
1	Physical Drive Identification	4	SENSE 106
2	Sense Head Address Register	None	—
3	Sense Difference Counter	None	—
4	Drive Status	8	SENSE 106, 107
5	Check/Status (Sense Status 1)	9	SENSE 107
6	DM Sequence Control	10	SENSE 107
7	Load Switch Status (Sense Status 3)	11	SENSE 107
8	R/W Safety (Sense Read/Write)	12	SENSE 107
9	Access Status (Sense Status 4)	16	SENSE 107, 108
10	Controller Checks (Controller Error 2)	17	SENSE 108
11	CTL-I Checks (Controller Error 1)	20 Bits 0-5	SENSE 108
12	DEV-I Checks (Sense Interface)	20 Bits 6,7	SENSE 108
13	Target Address Register – RPS Feature	None	—
14	Cylinder Address Register (Switch Feature)	None	—
15	STATUS (Sense Status 0)	19	SENSE 108
Last Display	Routine ID – B3	None	—

** See table on FSI 65 for additional breakdown of message information.*

B3 MESSAGE DISPLAY – PASS 2

PROGRAM CONTROL DISPLAY HEX VALUE	MESSAGE B3 BYTE	DATA DISPLAY	0	1	2	3	4	5	6	7	DETAILED DESCRIPTION
E1	1	Physical Drive Identification	A	B	C	D	E	F	G	H	SENSE 106 Byte 4
E2	2	Sense HAR	Basic Dir In = 1 / Not used FHFE	Basic Diff 256 / Fixed Heads = 1 FHFE	Basic Not used / 32 FHFE	16	8	4	2	1	
E3	3	Sense Difference Counter	128	64	32	16	8	4	2	1	
E4	4	Drive Status		Device ** Interface Check	Drive ** Check	Read/Write ** Check	Online *	Data Module Attention	Busy	Seek/Sector Complete	SENSE 106, 107 Byte 8
E5	5	Checks/ Status	Data Module ** Loaded Switch Latched	Sector ** Compare Check	Air/ ** Motor at Speed Latched	Belt ** Switch Latched	Write Enable	Data Module Size 3 bit (70 F)	Data Module Size 2 Bit (70 Mb)	Data Module Size 1 Bit (35 Mb)	SENSE 107 Byte 9
E6	6	Data Module Sequence Control	Data Module ** Size Check	Data Module * Latch 4	Data Module * Latch 2	Data Module Latch 1	Check ** Latch	Data Module ** Sequence Check Latched	Bias Disable Switch	Odd Track	SENSE 107 Byte 10
E7	7	Load Switch Status	Drive Start * Switch	Data Module * Present Switch	Cover Locked * Switch	Data Module Unloaded Switch	Data Module * Loaded Switch	Belt * Switch	Carriage Home	Air/* Motor at Speed Switch	SENSE 107 Byte 11
E8	8	R/W Safety	Multiple ** Head Select Check	Capable/ ** Enable Check	Write ** Overrun	Index ** Check	R/W ** Interlock Check	Control ** Check	Transition ** Check	Write ** Current Check	SENSE 107 Byte 12
E9	9	Access Status	Access ** Timeout Check	Overshoot ** Check	Servo Off ** Track Check	Track * Crossing	Servo * Latch	Linear * Mode Latch	Control * Latch	Wait Latch	SENSE 108 Byte 16
EA	10	Controller Checks	PLO ** Check	No PLO ** Input	SERDES ** Check	Gap ** Counter Check	Write ** Data Check	Monitor ** Check	ECC ** Check	ECC* Zeros Detected	SENSE 108 Byte 17
EB	11	Control Interface Checks	Control Interface Tag Bus Parity Check **	Control Interface Bus Out Parity Check **	Device ** Selection Check	Device Bus In Parity Check **	Control Interface Bus In Parity Check **	I Write ** Fail			SENSE 108 Byte 20, Bits 0–5
EC	12	Device Interface Checks							Device Bus Out Parity Check **	Device Tag Parity Check **	SENSE 108 Byte 20, Bits 6, 7
ED	13	Target Address Register (RPS Feature)	(Bit 0 = 1 if RPS Installed)	64	32	16	8	4	2	1	
EE	14	Sense Cylinder Address Register (Switch Feature)	256	128	64	32	16	8	4	2	
EF	15	Status (FHFE Only)	Direction Bit 1 = IN		Difference 256			Low Gain Error**		Fixed Head Feature Installed	SENSE 108 Byte 19
CE		Routine Number	1	0	1	1	0	0	1	1	MICRO 36

* *Indicators which are normally on with no error condition, Ready lamp on, and DM sequence at State 6.*

** *Error or check condition.*

} This byte for FHFE Only

Symptom Codes 1000–1003

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
0000	S/115 and S/125 display an error count for FSC 0000. These are usually Format 5 Data Checks. The 3830-2 and ISC do not generate an FSC after running micro-diagnostics unless the Symptom Code Generator has been reloaded. Refer to START 500 for reload instructions. Check sense byte 7 for format and take action as outlined on START 100.	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Cause and MAP Entry column.	A1M2 (L2)	A2G2* A2F2 A2S2	Cable group 8. See FSI 930.		
1000	Invalid Device Interface Check.		A1C2	A2L2		DEV-I 120	A
1001	Device Interface Check – Tag Bus Parity Error.		A1C2	A2L2, A2G2*	Cable group 1 and 0. See FSI 930.	DEV-I 120	B
1002	Device Interface Check – Bus Out Parity Error.		A1C2	A2F2, A2Q2, A2G2*, A2L2		DEV-I 120	C
1003	Device Interface Check – Tag Bus and Bus Out Parity Error.		A1C2	A2G2*, A2L2		DEV-I 120	D

Note 1: Use the microdiagnostic routines to reproduce the failure and verify the fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**When replacing A2G2, check the addressing jumpers. See INST 8.*

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FAULT SYMPTOM INDEX – FORMAT 1

Symptom Codes 1100-11FF

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
1100	DM Sequence Check at State 0 with Stop Recycle Latch On.	*Note: If the Ready lamp is on, run the linked series starting with routine A1. If the Ready lamp is off and the machine is in a failing condition, run routine AC. If the machine is not in a failing condition, load and unload the DM several times to reproduce the failure. When it fails (do not operate Start/Stop switch or CE Reset after failure occurs), run routine B3.* Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.	A1M2 (L2), A1T4 (S4)			DM 100	C
1110	DM Sequence Check at State 1 with Stop Recycle Latch On.		A1M2 (L2), A1T4 (S4)		DM Loaded switch, Belt switch.	DM 100	C
1120	DM Sequence Check at State 2 with Stop Recycle Latch On.		A1M2 (L2), A1T4 (S4), A1P2 (N2)			DM 100	C
1130	DM Sequence Check at State 3 with Stop Recycle Latch On.		A1M2 (L2), A1T4 (S4)		Air switch, Motor-At-Speed switch.	DM 100	C
1140	DM Sequence Check at State 4 with Stop Recycle Latch On.		A1M2 (L2), A1T4 (S4)		DM Unloaded switch. Cable group 4. See FSI 930.	DM 100	C
1150	DM Sequence Check at State 5 with Stop Recycle Latch On.		A1M2 (L2), A1T4 (S4)		Air switch, Motor-At-Speed switch. Cable group 4. See FSI 930.	DM 100	C
1160	DM Sequence Check at State 6 with Stop Recycle Latch On.		A1M2 (L2)			DM 100	C
1170	DM Sequence Check at State 7 with Stop Recycle Latch On.		A1M2 (L2), A1T4 (S4)		Home Photo Cell.	DM 100	C
11FF	Data Module Size Check and DM Sequence Error.		A1M2 (L2), A1T4 (S4), A1C2, A1F2 (E2)		DM Size Jumper, DM Interface Connector. Cable group 5. See FSI 930.	DM 100	C

Symptom Codes 1200-120F

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
1200	Access Timeout Error during Recalibrate State 0 – Move Out.	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.	A1P2 (N2), A1T2 (S2), A1R4 (Q4), A1R2 (Q2),* A1D2, A1G2, A1F2 (E2)	A2G2**	Power Amp, velocity gain adjustment.* Interconnecting cables and connectors. Try a different data module unless machine is known to be failing with more than one.	DM 311 (FSC 1200)	A
1201	Access Timeout Error during Recalibrate State 1 – Reset.					ACC 300 (FSC 1201)	B
1202	Access Timeout Error during Recalibrate State 2 – Move In.					ACC 300 (FSC 1202)	B
1203	Access Timeout Error with an Invalid Control State.					ACC 230 (FSC 1203)	A
1204	Access Timeout Error with an Invalid Control State.					ACC 230 (FSC 1204)	A
1205	Access Timeout Error with an Invalid Control State.					ACC 230 (FSC 1205)	A
1206	Access Timeout Error during Recalibrate State 6 – Linear Mode.					ACC 300 (FSC 1206)	B
1207	Access Timeout Error with an Invalid Control State.					ACC 230 (FSC 1207)	A
1208	Access Timeout during Seek State 8 – Decelerate.					ACC 560 (FSC 1208)	A
1209	Access Timeout Error with an Invalid Control State.					ACC 230 (FSC 1209)	A
120A	Access Timeout Error during Seek State A – Accelerate.					ACC 540 (FSC 120A)	A
120B	Access Timeout Error with an Invalid Control State.					ACC 230 (FSC 120B)	A
120C	Access Timeout Error during Seek State C – Linear Mode to On Track.					ACC 580 (FSC 120C)	A
120D	Access Timeout Error with an Invalid Control State.					ACC 230 (FSC 120D)	A
120E	Invalid Timeout Error posted during Access Control State E – On Track.					ACC 100 (FSC 120E)	C
120F	Access Timeout Error with an Invalid Control State.					ACC 230 (FSC 120F)	A

Note 1: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**Use microdiagnostic routine A7 to make velocity gain adjustment. This adjustment is required if either A1R2 or A1Q2 are replaced.*

***When replacing A2G2, check the addressing jumpers. See INST 8.*

****Adjustment program. Do not loop to exercise machine. See the microdiagnostic descriptions starting on MICRO 20 for details.*

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FAULT SYMPTOM INDEX – FORMAT 1

Symptom Codes 1301-1310

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
1301	Drive Check – Sector Compare.	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.	A1G2			RPI 500	A
1310	Drive Check (false): Sense bytes 9 and 16 do not show error bits (B3 message bytes 5 and 9).		A1P2 (N2), A1M2 (L2), A1G2	A2G2* A2L2		DEV-I 240	A

Note 1: Use the microdiagnostic routines to reproduce the failure and verify the fix. Always run the link series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**When replacing A2G2, check the addressing jumpers. See INST 8.*

Symptom Codes 1400-14xx

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
1400 through 14xx	Read/Write Safety Checks: Fault Symptom Code is 14xx where xx = sense byte 12 (B3 message byte 8). Sense Byte 12 or B3 Message Byte 8: Bit 4 on = R/W Interlock Check	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Cause and MAP Entry column.	A1J2,* A1H2**		Matrix card, Cable groups 5 and 6. See FSI 930.	R/W 280	A
	Bit 3 on = Index Check		A1F2 (E2), A1T2 (S2), A1H2,** A1C2		Data module, DM connector, power, spindle ground.		
	Bit 5 on = Control Check		A1H2,** A1C2	A2F2, A2Q2	Voltage.		
	Bit 2 on = Write Overrun Check		A1H2,** A1C2 A1F2 (E2)	A2Q2, A2F2	Voltage.		
	Bit 0 on = Multi Head Select Check		A1F2 (E2), A1H2**		Data module, matrix card, matrix connector, DM cable group 6. See FSI 930.		
	Bit 7 on = Write Current Check		A1H2**		Matrix card, matrix connectors, cable group 6. See FSI 930.		
	Bit 6 on = Write Transition Check		A1H2,** A1J2,* A1F2 (E2)	A2T2, A2Q2	Data module, DM connector or cable, matrix card, cable group 2 and 6. See FSI 930.		
	Bit 1 on = Capable Enable Check		A1M2 (L2), A1H2,** A1C2, A1F2 (E2), A1P2 (N2), A1T4 (S4)		Read Only Switch, data module defective. Cable group 4. See FSI 930.		
14FA	Sense Byte 19 or B3 Message Byte 15, bit 5 Low Gain Check.		A1H2,** A1F2, (E2)		R/W matrix card, cable group 6 (See FSI 930), and power supplies.		

Note 1: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**If a 3344 is installed in this string, also check A1J2 (M2) in the 3344.*

***If a 3344 is installed in this string, also check A1H2 (N2) in the 3344.*

FAULT SYMPTOM INDEX – FORMAT 1

Symptom Codes 1500-150F

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
1500	Invalid Overshoot Check.	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.	A1P2 (N2), A1T2 (S2), A1R4 (Q4), A1R2 (Q2)*, A1D2, A1F2 (E2), A1M2 (L2)	A2L2	Power amp, velocity gain adjustment,* cable group 4. See FSI 930. Try a different data module unless machine is known to fail with more than one.	ACC 120 (FSC 1500)	B
1501	Invalid Overshoot Check.					ACC 120 (FSC 1501)	B
1502	Invalid Overshoot Check.					ACC 120 (FSC 1502)	B
1503	Overshoot Check – Invalid Control State.					ACC 230 (FSC 1503)	A
1504	Overshoot Check – Invalid Control State.					ACC 230 (FSC 1504)	A
1505	Overshoot Check – Invalid Control State.					ACC 230 (FSC 1505)	A
1506	Recalibrate – Track 0 Overshoot Check.					ACC 300 (FSC 1506)	C
1507	Overshoot Check – Invalid Control State.					ACC 230 (FSC 1507)	A
1508	Access Mode Seek – Overshoot Check during Control State 8 Decelerate.					ACC 560 (FSC 1508)	B
1509	Overshoot Check – Invalid Control State.					ACC 230 (FSC 1509)	A
150A	Access Mode Seek – Overshoot Check during Control State A Accelerate.					ACC 540 (FSC 150A)	A
150B	Overshoot Check – Invalid Control State.					ACC 230 (FSC 150B)	A
150C	Access Mode Seek – Overshoot Check posted during Control State C Linear Mode.					ACC 580 (FSC 150C)	B
150D	Overshoot Check – Invalid Control State.					ACC 230 (FSC 150D)	A
150E	Overshoot Check – Lost Servo Track Following.					ACC 700 (FSC 150E)	D
150F	Overshoot Check – Invalid Control State.					ACC 230 (FSC 150F)	A

Note 1: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**Use microdiagnostic routine A7 to make velocity gain adjustment. This adjustment is required if either A1R2 or A1Q2 are replaced.*

***Utility or adjustment program. Do not loop to exercise machine. See the microdiagnostic descriptions starting on MICRO 20 for details.*

Symptom Codes 1600-160F

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
1600	Servo Off Track Error – Set R/W on during Access operation.	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.	A1P2 (N2), A1T2 (S2), A1R4 (Q4), A1R2 (Q2),* A1D2, A1C2	A2G2,** A2F2, A2L2	Power Amp, velocity gain adjustment,* interconnecting cables and connectors. Try a different data module unless machine is known to be failing with more than one.	ACC 130 (FSC 1600)	E
1601	Servo Off Track Error – Set R/W on during Access operation.					ACC 130 (FSC 1601)	E
1602	Servo Off Track Error – Set R/W On during Access operation.					ACC 130 (FSC 1602)	E
1603	Servo Off Track Error – Invalid Access Control State indicated.					ACC 130 (FSC 1603)	E
1604	Servo Off Track Error – Invalid Access Control State indicated.					ACC 130 (FSC 1604)	E
1605	Servo Off Track Error – Invalid Access Control State indicated.					ACC 130 (FSC 1605)	E
1606	Servo Off Track Error – Set R/W On during Access operation.					ACC 130 (FSC 1606)	E
1607	Servo Off Track Error – Invalid Access Control State indicated.					ACC 130 (FSC 1607)	E
1608	Servo Off Track Error – Set R/W On during Access operation.					ACC 130 (FSC 1608)	E
1609	Servo Off Track Error – Invalid Access Control State indicated.					ACC 130 (FSC 1609)	E
160A	Servo Off Track Error – Set R/W on during Access operation.					ACC 130 (FSC 160A)	E
160B	Servo Off Track Error – Invalid Access Control State indicated.					ACC 130 (FSC 160B)	E
160C	Servo Off Track Error – Set R/W on during Access operation.					ACC 130 (FSC 160C)	E
160D	Servo Off Track Error – Invalid Access Control State indicated.					ACC 130 (FSC 160D)	E
160E	Servo Off Track Error – Access Control in On Track State.					ACC 130 (FSC 160E)	A
160F	Servo Off Track Error – Invalid Access Control State indicated.					ACC 130 (FSC 160F)	E

Note 1: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**Use microdiagnostic routine A7 to make the velocity gain adjustment. This adjustment is required if either A1R2 or A1Q2 are replaced.*

***When replacing A2G2, check the addressing jumpers. See INST 8.*

****Utility or adjustment programs. Do not loop to exercise machine. See the microdiagnostic descriptions starting on MICRO 20 for details.*

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FAULT SYMPTOM INDEX — FORMAT 1

Symptom Codes 1910-191F

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
1910	Error Alert — not further defined.	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.		A2K2,A2F2, A2L2, A2Q2, A2G2*		CTL-I 402	
1911	Transmit Target Error (RPS Feature).		A1G2, A1C2, A1D2, A1P2 (N2)			RPI 600	F
1912	Microprogram Detected Error (detailed information in byte 18).				See FSI codes 9001 through 9008.	FSI 900	
1913	Transmit Fixed Head Error.		A1C2, A1F2 (E2) A1G2, A1P2 (N2)			DEV-I 160	B
1914	Sync Out Timing Error.			A2S2, A2K2, A2P2, A2G2,* A2M2(SWFE)	Sync in/Sync out Drivers in storage control.		B
1915	Unexpected File Status at initial selection.		A1C2, A1D2, A1M2 (L2) A1T4 (S4) A1A3 (Term.)** A1P2 (N2)	A2G2* A2L2, A2F2, A2K2	Cable groups 0 and 1. See FSI 930.	DEV-I 140	
1916	Transmit CAR Error (SWFE only).		A1J4, A1C2			DEV-I 170	A
1917	Transmit Head Error.		A1F2 (E2), A1D2, A1C2, A1P2 (N2)	A2F2, A2L2, A2G2*		DEV-I 150	A
1918	Transmit Difference Error.		A1F2 (E2), A1D2, A1C2, A1P2 (N2)	A2F2		DEV-I 150	B
1919	Unexpected File Status during Read IPL.				Run checkout procedure.	START 110	
191A	Seek Verification Check on Physical Address (Home Address read).		A1F2 (E2), A1P2 (N2), A1R4 (Q4)	A2L2, A2Q2, A2S2, A2F2		ACC 500	B
191B	Byte 9, bit on. Sector Non-Compare (B3 message byte 5, bit 1) — FSI 130, code 1301. Byte 16, bit 0 on. Access time out (B3 message byte 9, bit 0). See Note 2 — FSI 120, code 12xx. Byte 16, bit 1 on. Access Overshoot (B3 message byte 9, bit 1). See Note 2 — FSI 150, code 15xx.					FSI 130, Code 1301 FSI 120, Code 12xx FSI 150, Code 15xx	
191C	No interrupt from drive (missing Device Attention).		A1R4 (Q4)	A2F2		DEV-I 200	A
191D	Defect Skipping Reorientation Error.					DATA 170	
191E	DM Incompatibility Error on Invalid DM size.		A1M2 (L2)	A2F2, A2G2*		DEV-I 290	E
191F	Unused.						

Note 1: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

Note 2: Use Fault Symptom Code as indicated (xx=Byte 16 from System Sense or B3, byte 9).

**When replacing A2G2, check the addressing jumpers. See INST 8.*

***If a 3344 is attached, refer to INST 8 in the 3344 MLM for terminator locations.*

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FAULT SYMPTOM INDEX – FORMAT 1

Symptom Codes 4940-4947

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
4940	Home Address Field Data Check.	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.		A2P2, A2Q2, A2R4, A2S2, A2T2		R/W 300	A
4941	Count Field Data Check.			A2T2		R/W 300	A
4942	Key Field Data Check.					R/W 300	A
4943	Data Field ECC Uncorrectable Data Check.			A2F2, A2G2,* A2P2		R/W 300	A
4944	Home Address Field – No Sync Byte Found.		A1C2	A2F2, A2G2,* A2P2, A2Q2, A2S2, A2T2		R/W 300	A
4945	Count Field – No Sync Byte Found.			A2K2, A2P2, A2Q2, A2S2, A2T2		R/W 300	A
4946	Key Field – No Sync Byte Found.					R/W 300	A
4947	Data Field – No Sync Byte Found.					R/W 300	A

Note 1: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routine listed after the FSC to attempt to reproduce the failure.

**When replacing A2G2, check the addressing jumpers. See INST 8.*

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See EC History	440223 14 Mar 75	440224 15 Dec 75	440227 14 Sept 76	

Symptom Codes 9000-900F

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
9001	No Tag Valid on Read/Write Macro (Time Out).	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 1. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Cause and MAP Entry column.		A2K2,A2G2,* A2F2, A2Q2, A2S2, A2T2		CTL-I 250	A
9002	Normal or Check End missing following Read/Write Operation or ECC operation.		A1H2 A1C2	A2K2, A2P2, A2Q2, A2G2,* A2F2, A2L2, A2S2		CTL-I 260	A
9003	No response from Controller on Control operation.		A1C2, A1D2	A2K2, A2G2,* A2Q2, A2L2, A2D2 (E2)*(SWFE), A2M2 (SWFE), A2F2		CTL-I 270	A
9004	Timeout waiting for Index/Active track.		Drive A or B fails: A1J2, A1F2 (E2), A1P2 (N2), A1H2	All drives fail: A2K2, A2Q2, A2F2, A2S2, A2P2		RPI 110	D
9005	ECC Hardware Check			A2P2, A2Q2, A2K2		DATA 214	A
9006	Multiple Controllers selected.		A1D2	A2G2,* A2D2 (E2)*(SWFE), A2F2, A2K2, A2L2		CTL-I 300	A
9007	Preselection Check.			A2K2, A2Q2, A2G2*, A2P2		CTL-I 320	A
9008	Head Switch Timer Expired Check.			A2Q2, A2P2, A2S2, A2K2		DATA 090	C
9009	Busy missing after Seek Start is issued.		A1C2, A1P2 (N2), A1F2 (E2), A1D2	A2F2 A2L2		ACC 210	A
900A	Physical Address Check – Incorrect Physical Address returned after drive selection.		A1D2, A1C2, A1G2	A2K2, A2G2,* A2L2, A2F2	Cable group 0. See FSI 930.	DEV-I 110	C
900F	Attention Check – Device Attention failed to reset.		A1D2, A1C2, A1F2 (E2), A1G2, A1M2 (L2), A1P2 (N2), A1H2, A1J4 (SWFE)	A2F2, A2G2*	Cable group 0. See FSI 930.	DEV-I 202	A

Note 1: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**When replacing A2G2, A2D2, or A2E2 check the addressing jumpers. See INST 8.*

***Utility or adjustment programs. Do not loop to exercise machine. See the microdiagnostic descriptions starting on MICRO 20 for details.*

FAULT SYMPTOM INDEX – FORMAT 1

Symptom Codes 9100-91FC (See Note 1.)

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
9104	I Write Fail.	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 2. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.	A1H2	A2K2, A2P2, A2Q2, A2F2		DATA 124	A
9108	Control Bus In Parity Check.		A1D2, Note 3	A2F2, A2K2, A2S2, A2R4, A2G2*, A2L2, A2P2		CTL-I 390	A
9110	Device Bus In Parity Check.		A1D2 Note 3	A2P2, A2K2, A2G2*, A2F2	Cable group 0. See FSI 930.	DEV-I 180	A
9118	Device Bus In Parity Check and Control Bus In Parity Check.		A1D2 Note 3	A2P2, A2K2, A2Q2, A2G2*, A2F2, A2L2	Cable group 0. See FSI 930.	DEV-I 180	A
9120	1-of-8 Drives Selected Check.		3340: A1D2, A1C2 3344: A1K2 (A1L2)** Note 3	A2G2*, A2K2, A2P2, A2L2	Cable group 0. See FSI 930.	DEV-I 110	A
9140	Control Interface Bus Out Parity Check.			A2G2*, A2D2 (E2)* (SWFE), A2K2, A2L2		CTL-I 370	C
9148	Control Bus Out and Control Bus In Parity Check.			A2F2, A2K2			
9180	Control Interface Tag Bus Parity Check.			A2G2*, A2D2 (E2)* (SWFE), A2F2, A2K2, A2L2	Cable group A. See FSI 930.	CTL-I 380	
9188	Control Interface Bus In Parity Check.			A2F2, A2K2, A2S2, A2R4, A2G2*, A2L2		CTL-I 390	A
91FC	Control Interface Bus In Assembly Failure.			A2Q2, A2P2, A2K2, A2F2, A2L2		CTL-I 445	–

Note 1: If Fault Symptom Code is not listed above, suspect that more than one circuit is failing.
1. *Select and pursue the first error indicated in byte 20.*
2. *Run microdiagnostic and pursue first error code.*

Note 2: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

Note 3: If a 3344 is attached, refer to the FSI section in the 3344 MLM for additional possible causes.

**When replacing A2G2, A2D2, or A2E2, check addressing jumpers. See INST 8.*

***When replacing A1K2(A1L2) in the 3344, check addressing jumpers. See INST 12 in the 3344 MLM.*

Symptom Codes 9200-920C (See Note 1.)

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
9200	Controller Error (not further defined -- false error).	Run Link Series starting with routine A1. See MICRO 10 for detailed instructions. See Note 2. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Causes and MAP Entry column.		A2K2, A2L2, A2F2, A2S2, A2T2, A2P2, A2G2*		CTL-I 400	B
9201	ECC Zero Compare. Indicator only, not an error. This indicates the normal completion of a Read or Write operation.						
9202	ECC hardware check.			A2R4, A2S2, A2Q2, A2M2 (SWFE), A2G2*, A2K2, A2P2		DATA 200	A
9204	Monitor Check.			A2L2, A2Q2, A2P2, A2S2, A2T2, A2G2*, A2K2		DATA 220	B
9206	Monitor Check and ECC Hardware Check.			A2R4, A2S2, A2Q2, A2M2 (SWFE)		DATA 200	A
9208	Write Data Check.			A2S2, A2P2, A2G2*, A2T2, A2Q2, A2K2		DATA 230	A
920A	Write Data Check and ECC Check.			A2P2, A2Q2, A2S2, A2G2*		DATA 230	A
920C	Write Data Check and Monitor Check.			A2S2, A2P2, A2G2*, A2T2, A2Q2		DATA 230	A

Note 1: If Fault Symptom Code is not listed above, suspect more than one circuit failure.
1. *Select and pursue the first error indicated in byte 17.*
2. *Run microdiagnostics and pursue first error code.*

Note 2: Use the microdiagnostic routines to reporduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent, refer to START 420 to locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**When replacing A2G2, check the addressing jumpers. See INST 8.*

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FAULT SYMPTOM INDEX – FORMAT 1

Symptom Codes 9210-92C4 (See Note 1.)

FAULT SYMPTOM CODE	ERROR DESCRIPTION	MICRODIAGNOSTICS	POSSIBLE CAUSES			MAP Entry	
			A1 Board Drive	A2 Board Controller	Additional Possible Causes and Actions		
9210	Gap Counter Check.	Run Link Series staring with routine A1. See MICRO 10 for detailed instructions. See Note 2. If the microdiagnostics fail to load, exit to PANEL 150, Entry A. Microdiagnostics fail? YES 1. Display and record the Error Message Bytes. See MICRO 12 for detailed instructions. 2. Exit to FSI 950. NO Follow the instructions under Possible Cause and MAP Entry Column.		A2P2, A2G2*, A2S2, A2Q2, A2T2, A2K2		DATA 240	B
9212	Gap Counter Check and ECC Hardware Check.			A2P2, A2G2*, A2S2, A2Q2, A2T2		DATA 240	B
9214	Gap Counter Check and Monitor Check.			A2P2, A2G2*, A2S2, A2Q2, A2T2		DATA 240	B
9220	Shift Register Error.			A2S2, A2T2, A2K2, A2P2, A2Q2		DATA 250	A
9222	Shift Register Error and ECC Hardware Check.			A2S2, A2T2, A2P2		DATA 250	A
9240	No PLO Input.		A1T2, A1H2**	A2T2, A2S2, A2K2, A2G2*, A2L2, A2Q2		DATA 260	A
9244	No PLO Input and Monitor Check.			A2Q2		DATA 260	A
9254	No PLO Input, Gap Counter Check, and Monitor Check.			A2T2		DATA 260	A
9280	PLO Check.			A2T2, A2S2, A2K2, A2Q2		DATA 270	A
9282	PLO Check and ECC Hardware Check.			A2T2, A2S2, A2K2		DATA 270	A
92C0	PLO Check and No PLO Input.			A2T2, A2S2, A2K2		DATA 270	A
92C4	PLO Check, No PLO Input, and Monitor Check.			A2T2		DATA 270	A

Note 1: If Fault Symptom Code is not listed above, suspect more than one circuit failure.

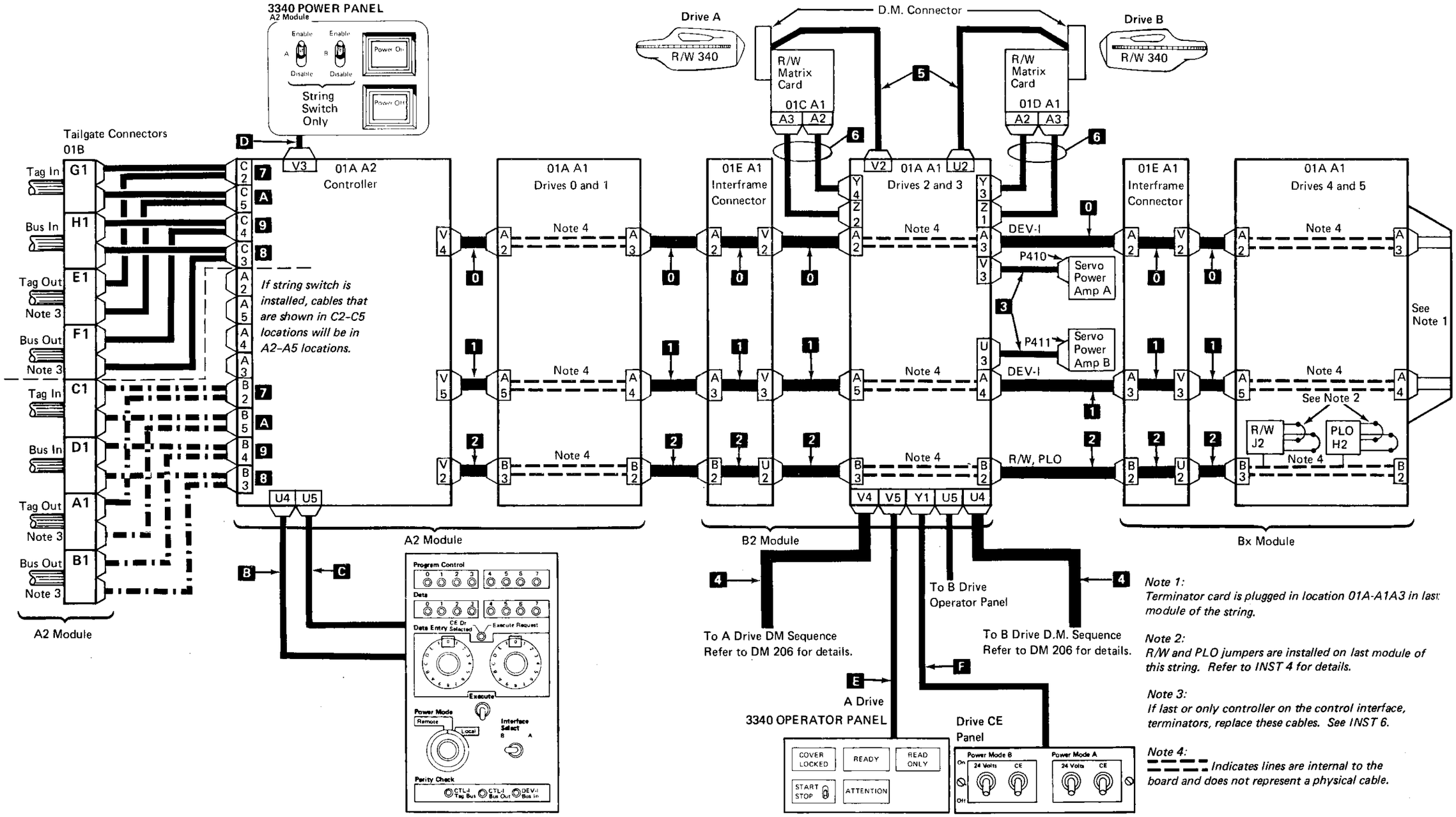
1. *Select and pursue the first error indicated in byte 17 bits 0 to 6.*
2. *Run microdiagnostics and pursue first error code.*

Note 2: Use the microdiagnostic routines to reproduce the failure and verify a fix. Always run the linked series first. If the problem is intermittent refer to START 420 and locate the FSC and loop the microdiagnostic routines listed after the FSC to attempt to reproduce the failure.

**When replacing A2G2, check the addressing jumpers. See INST 8.*

*** If a 3344 is attached, A1H2(N2) in the 3344 can also cause a failure in the 3340.*

3340 CABLING DIAGRAM FSI 930



Note 1:
Terminator card is plugged in location 01A-A1A3 in last module of the string.

Note 2:
R/W and PLO jumpers are installed on last module of this string. Refer to INST 4 for details.

Note 3:
If last or only controller on the control interface, terminators, replace these cables. See INST 6.

Note 4:
Indicates lines are internal to the board and does not represent a physical cable.

3340	AP0930 Side 2 of 2	2747534 Part No. (1)

See EC History	440223 14 Mar 75	440224 15 Dec 75	440227 14 Sept 76	

CABLE CHART

This cable chart shows the specified cables and connectors in the 3340. When directed to check cables, check every connector in the group.

See CTL-I 107 for cable checking hints.

Cable Group No.	Cable Group Name		Cable Connector Locations					Reference Diagrams
0	Device Bus In		01A-A2V4	01A-A1A3	01A-A1A2	01E-A1V2	01E-A1A2	DEV-I 305
1	Device Bus Out		01A-A2V5	01A-A1A5	01A-A1A4	01E-A1V3	01E-A1A3	
2	Device R/W Data/PLO		01A-A2V2	01A-A1B3	01A-A1B2	01E-A1U2	01E-A1B2	R/W 306
3	Servo Power Amp.	Drive A	01A-A1V3	P410				ACC 402
		Drive B	01A-A1U3	P411				
4	DM Sequence Control	Drive A	01A-A1V4	Switches and Relays etc. (See Diagram)				DM 206
		Drive B	01A-A1U4					
5	DM Servo	Drive A	01A-A1V2	DM Connector				ACC 403
		Drive B	01A-A1U2					
6	R/W Matrix and HD Select	Drive A	01A-A1Y4 01A-A1Z2	01C-A1A2 01C-A1A3				R/W 350
		Drive B	01A-A1Y3 01A-A1Z1	01D-A1A2 01D-A1A3				
7	Control Interface Tag In	Basic	01A-A2C2	01B-A1G1	01B-A1E1			CTL-I 105 and 113
		SWFE A	01A-A2A2	01B-A1G1	01B-A1E1			
		SWFE B	01A-A2B2	01B-A1C1	01B-A1A1			
8	Control Interface Bus In	Basic	01A-A2C3	01B-A1H1	01B-A1F1			CTL-I 105 and 113
		SWFE A	01A-A2A3	01B-A1H1	01B-A1F1			
		SWFE B	01A-A2B3	01B-A1D1	01B-A1B1			
9	Control Interface Bus Out	Basic	01A-A2C4	01B-A1H1	01B-A1F1			CTL-I 105 and 113
		SWFE A	01A-A2A4	01B-A1H1	01B-A1F1			
		SWFE B	01A-A2B4	01B-A1D1	01B-A1B1			
A	Control Interface Tag Out	Basic	01A-A2C5	01B-A1G1	01B-A1E1			CTL-I 105 and 113
		SWFE A	01A-A2A5	01B-A1G1	01B-A1E1			
		SWFE B	01A-A2B5	01B-A1C1	01B-A1A1			
B	CE Panel Switch	Basic	01A-A2U4					PANEL 153
C	CE Panel Data		01A-A2U5					PANEL 155
D	SWFE Panel Switch	SWFE	01A-A2V3					
E	Operator Panel		01A-A1V5	Operator Panel				DM 206
F	Drive CE Panel		01A-A1Y1	Drive CE Panel				

Figure 1. Cable Chart for 3340

FSC/ERROR CODE MATRIX

DESCRIPTION

The chart that starts on FSI 952 contains combinations of Fault Symptom Codes and microdiagnostic Error Codes. The flowchart on this page shows how to use that chart.

LEGEND

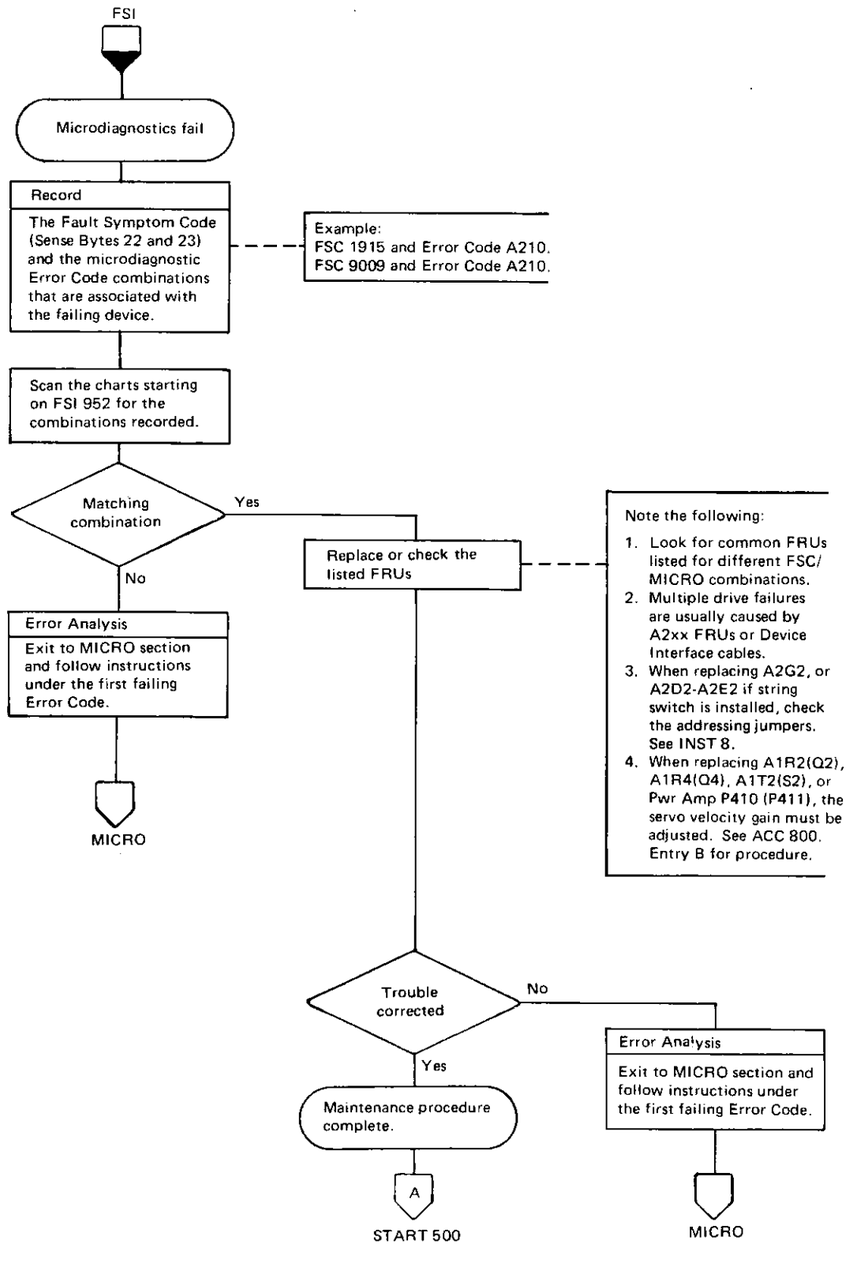
Cbl Grp X – This refers to one of the specific cable groups shown on FSI 940.

HANG – No FSC available but the CPU is in a hang condition.

NOLD – Microdiagnostics cannot be loaded.

TOUT – Functional microcode timed-out.

CMRJ – Command Reject – Sense Byte 0, Bit 0=1.



FSC/ERROR CODE MATRIX

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
HANG	A120	A2G2	A2F2		
HANG	A14D	A2L2	A2K2		
HANG	A152	A2K2	A2Q2	A2P2	
HANG	A157	A2Q2			
HANG	A158	A1D2	A2L2	CBL GRP 1	
HANG	A212	A2G2	A1D2	CBL GRP 0	
HANG	A221	A1D2	CBL GRP 0		
HANG	A227	A1C2			
HANG	A235	A1P2 (N2)	A1F2 (E2)	A1C2	
HANG	A240	A2G2	A2F2	A1D2	CBL GRP 0
HANG	A242	A1D2			
HANG	A258	A2K2	A2G2		
HANG	A311	A1P2 (N2)	A1C2		
HANG	A333	A1P2 (N2)			
HANG	A341	A1D2	A1P2 (N2)		
HANG	A342	A1P2 (N2)	A1D2		
HANG	A384	A1H2			
HANG	A385	A1F2(E2)			
HANG	A52A	A2F2	A2K2		
HANG	AF26	A2P2	A2K2	CBL GRP 7	
HANG	NOLD	A2F2	A2G2	CBL GRP 8	CBL GRP A
CMRJ	AD04	A1M2 (L2)	CBL GRP 4		
CMRJ	AD15	A1M2 (L2)	CBL GRP 4		
TOUT	A158	A1D2	A2F2	CBL GRP 0	
TOUT	A321	A1P2 (N2)	A1M2 (L2)		
0000	A117	A2K2	CBL GRP 8		
0000	A125	A2K2			
0000	A130	A2G2	CBL GRP A		
0000	A132	A2F2			
0000	A14D	A2P2	A2G2		
0000	A153	A2F2	CBL GRP 8		
0000	A157	A2F2	CBL GRP 8		
0000	A158	A1D2	A2F2	CBL GRP 0	
0000	A210	A2K2	A2G2	CBL GRP 1	
0000	A215	A2K2	A2G2		
0000	A216	A2F2	CBL GRP 1		
0000	A222	A1M2 (L2)	A1C2		
0000	A224	A2L2	CBL GRP 1		
0000	A232	A1F2 (E2)	A1C2		
0000	A235	A1P2 (N2)	A1M2 (L2)	A1C2	
0000	A240	A2G2	A2F2		
0000	A364	A2G2	CBL GRP A		
0000	AD04	A1C2	CBL GRP 4	CBL GRP 0	
0000	AD15	A2Q2			
0000	AD18	A2S2	A2P2	A2K2	A2G2
0000	AD1A	A2S2	A2F2	CBL GRP 8	
0000	AD25	A2K2	CBL GRP 7		
0000	AD27	A2S2			
0000	AD37	A2Q2			
0000	AD48	A2G2	A2P2	A2S2	CBL GRP A
0000	AD68	A2Q2			
0000	AE04	A1C2			
0000	AEF9	A2P2	A2S2		
0000	AF1A	A2S2	A2P2	A2F2	
0000	AF1B	A2S2			
0000	AF26	A2K2			
0000	AF9B	A2T2			
0000	NOLD	A2F2	A2P2	A2G2	CBL GRP 8
1000	A158	A1D2	A2F2	CBL GRP 0	
1000	A210	A2L2	A1C2	CBL GRP 1	
1000	A222	A1C2			
1000	NOLD	A2L2			
1001	A210	A1C2	A2L2	CBL GRP 1	
1001	A223	A2L2	A1C2	CBL GRP 1	
1001	A224	A2L2	A1C2	CBL GRP 1	
1001	A230	A1C2	A2L2	CBL GRP 1	
1001	NOLD	A2L2			
1002	A210	A2F2	A1C2	A2G2	CBL GRP 1
1002	A216	A2F2	A1C2	CBL GRP 1	
1002	A227	A2F2	A1C2	A2G2	CBL GRP 1
1002	A232	A2F2	A1C2	CBL GRP 1	
1002	NOLD	A2G2	CBL GRP 9	CBL GRP A	
1003	A210	A2L2	A2G2		
1003	A212	A2L2	CBL GRP 1		
1003	A222	A1C2	CBL GRP 1		
1003	NOLD	A2L2			
1110	AC14	A1T4 (S4)	CBL GRP 4		
1110	AC34	A1T4 (S4)	CBL GRP 4		
1140	A310	A1M2 (L2)			
1140	AC14	A1T4 (S4)	CBL GRP 4		
1140	AC34	A1T4 (S4)	CBL GRP 4		
1150	A310	A1M2 (L2)			
1150	AC34	A1T4 (S4)	A1M2 (L2)		
1150	AC98	A1M2 (L2)	A1T4 (S4)		
1150	AC99	A1T4 (S4)	CBL GRP 4		
11FF	A232	A1F2 (E2)	A1C2		
11FF	A234	A1C2			
11FF	AC9B	A1M2 (L2)	CBL GRP 5		
1200	A135	A2G2			
1200	A235	A1F2 (E2)			
1200	A242	A1D2			
1200	A337	A1F2 (E2)	A1T2 (S2)	A1P2 (N2)	A1R2 (Q2)
1200	AD0A	A1P2 (N2)	A1R4 (Q4)		

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
1201	A281	A1P2 (N2)			
1201	A283	A1P2 (N2)			
1201	A292	A1P2 (N2)			
1201	A294	A1P2 (N2)			
1201	A311	A1R4 (Q4)	A1P2 (N2)		
1201	A321	A1P2 (N2)			
1201	A331	A1P2 (N2)			
1201	A336	A1P2 (N2)			
1201	A337	A1R4 (Q4)	A1P2 (N2)	A1R2 (Q2)	A1F2 (E2)
1202	A321	A1P2 (N2)			
1202	A337	A1R4 (Q4)	A1P2 (N2)	A1R2 (Q2)	A1F2 (E2)
1206	A327	A1R4 (Q4)			
1206	A337	A1P2 (N2)	A1R4 (Q4)	A1F2 (E2)	A1T2 (S2)
1208	A431	A1R4 (Q4)			
1208	A432	A1R4 (Q4)			
120A	AD09	A1P2 (N2)			
1310	A135	A2L2	A2G2		
1310	A311	A1P2 (N2)	A1M2 (L2)		
1310	A369	A1P2 (N2)			
1310	NOLD	A2G2	A2L2		
1400	A275	A1H2			
1400	A369	A1H2	A1F2 (E2)		
1401	A369	A1H2	CBL GRP 6		
1401	A386	A1H2			
1402	A369	A1H2	CBL GRP 6		
1402	AD15	A2T2	A1J2	A1H2	CBL GRP 6
1402	AF1D	A2P2	A2Q2		
1402	AFAA	A2P2	A2Q2		
1403	A234	A1C2			
1403	AD15	A1H2	A2F2	A2Q2	CBL GRP 6
1403	AD86	A1H2			
1403	AF9B	A2Q2	A2F2		
1404	A386	A1H2			
1404	AD15	A1H2			
1408	A294	A1F2 (E2)			
1408	A369	A1H2	CBL GRP 6		
1410	A158	A2F2	A1D2	CBL GRP 0	
1410	A223	A1F2 (E2)			
1410	A369	A1F2 (E2)			

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
1440	A223	A1H2			
1440	A366	A1H2			
1440	A369	A1H2	A1P2 (N2)		
1440	A384	A1H2			
1440	AD15	A1H2	A1M2 (L2)	A1J2	A1F2 (E2)
1441	A223	A1H2			
1458	A223	A1C2			
1480	A294	A1F2 (E2)			
1480	A363	A2P2	A2Q2		
1480	A366	A2P2			
1480	A369	A1F2 (E2)	A1H2	CBL GRP 6	
14F4	A275	A1H2			
14F4	A369	A1H2			
14F4	AF1B	A1H2	CBL GRP 6		
1500	A326	A1R4 (Q4)			
1500	A337	A1R4 (Q4)			
1506	A321	A1P2 (N2)			
1506	A337	A1R4 (Q4)	A1R2 (Q2)	A1P2 (N2)	A1T2 (S2)
1506	AC34	A1T4 (S4)			
1506	AC99	A1T4 (S4)	CBL GRP 4		
1506	AD0A	A1R4 (Q4)	A1P2 (N2)		
1506	AF0A	A1R2 (Q2)			
1508	A292	A1F2 (E2)			
1508	A434	A1P2 (N2)	A1F2 (E2)		
1508	A43C	A1F2 (E2)	A1P2 (N2)		
1508	AD0B	A1F2 (E2)	A1R2 (Q2)	A1R4 (Q4)	
1508	AF0A	A1P2 (N2)	A1R4 (Q4)		
150A	AD0B	A1P2 (N2)	A1R4 (Q4)		
150A	AF0A	A1P2 (N2)	A1R4 (Q4)		
150C	A43C	A1P2 (N2)			
150C	A533	A1F2 (E2)			
150C	AD0B	A1R4 (Q4)	A1P2 (N2)		
150C	AD0E	A1F2 (E2)			
150E	A337	A1R4 (Q4)			
150E	AC8A	A1M2 (L2)			
1580	A369	A1F2 (E2)			
1580	AD0B	A1R2 (Q2)	A1F2 (E2)		
1600	A135	A2L2	A2F2		
1600	A158	A1C2	A1D2		
1600	A240	A1C2	A1D2		
1600	NOLD	A2F2			

FSC/ERROR CODE MATRIX

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
1601	A311	A1P2 (N2)			
1601	A320	A1P2 (N2)			
1609	A223	A1C2			
160E	A158	A2F2	A1D2	CBL GRP 0	
160E	A369	A1F2 (E2)			
160E	AD09	A1R4 (Q4)	A1P2 (N2)		
1910	A127	A2L2	A2G2	A2F2	A2Q2
1910	A136	A2G2	A2F2		
1910	A150	A2F2			
1910	A1A1	A2G2	CBL GRP 9		
1910	A235	A2G2	A2F2		
1910	NOLD	A2G2	A2F2	CBL GRP 9	CBL GRP A
1911	A234	A1C2			
1911	A236	A1C2			
1913	A233	A1C2			
1913	A234	A1C2			
1913	A331	A1P2 (N2)			
1914	A152	A2K2			
1914	A210	A2G2			
1914	A363	A2P2			
1914	AD17	A2G2	A2P2	CBL GRP A	
1914	AD18	A2S2	A2K2	A2G2	CBL GRP 9
1914	AD48	A2S2	A2P2		
1914	AF16	A2P2	A2S2		
1914	AF1A	A2P2	A2S2		
1914	AF1B	A2S2	A2P2		
1915	A130	A2G2	CBL GRP A		
1915	A132	A2F2	CBL GRP 1		
1915	A140	A2K2	A2G2		
1915	A141	A2L2	A2G2		
1915	A150	A2F2	CBL GRP 8		
1915	A157	A2G2			
1915	A158	A2F2	A1D2	CBL GRP 0	
1915	A1A1	A2G2			
1915	A210	A1C2	A2L2	A2F2	CBL GRP 1
1915	A216	A1C2	A2F2	CBL GRP 1	
1915	A220	A1C2			
1915	A227	A2F2	A1C2	CBL GRP 1	
1915	A232	A2F2			
1915	A234	A1C2			
1915	A235	A1C2	A1D2	A2F2	CBL GRP 0
1915	A236	A1C2			
1915	A240	A1D2			
1915	A242	A1D2	A1C2		
1915	A310	A1C2			
1915	A311	A1C2	A1P2 (N2)		
1915	A320	A1P2 (N2)			
1915	A322	A1P2 (N2)	A1C2		
1915	A325	A1P2 (N2)	A1M2 (L2)		
1915	A368	A1C2			
1915	A402	A1P2 (N2)			
1915	AC08	A1T4 (S4)	A1M2 (L2)		
1915	AC8A	A1M2 (L2)			
1915	AD02	A1P2 (N2)			
1915	NOLD	A2G2	A2L2	A2F2	
1917	A150	A2F2			
1917	A220	A1D2			
1917	A223	A1F2 (E2)			
1917	A233	A1P2 (N2)	A1C2		
1917	A234	A1F2 (E2)	A1C2		
1917	A235	A1F2 (E2)	A1D2	A2F2	A2G2
1917	A282	A1C2	A1F2 (E2)		
1917	A283	A1F2 (E2)	A1C2		
1917	A325	A1P2 (N2)			
1917	A335	A1P2 (N2)			
1917	A381	A2L2	A2G2		
1917	NOLD	A2G2	CBL GRP A		
1918	A210	A1D2			
1918	A220	A1D2			
1918	A234	A1F2 (E2)			
1918	A235	A1F2 (E2)	A1C2	A1D2	
1918	A292	A1F2 (E2)	A1C2		
1918	A293	A1F2 (E2)	A1C2		
191A	A152	A2F2			
191A	A235	A1F2 (E2)			
191A	A337	A1T2 (S2)	A1R2 (Q2)	A1R4 (Q4)	A1P2 (N2)
191A	A382	A1P2 (N2)	A1R4 (Q4)		
191A	A473	A1R2 (Q2)			
191A	AD09	A1P2 (N2)	A1R4 (Q4)	A1F2 (E2)	
191A	AD0B	A1R4 (Q4)	A1P2 (N2)	A1T2 (S2)	
191A	AD15	A2Q2			
191A	AD37	A2Q2			
191A	AF19	A2Q2	A2L2		
191A	AF1A	A2P2	A2S2		
191A	AF1B	A1P2 (N2)	A2S2	A2P2	
191A	AF53	A2Q2	A2L2		
191A	NOLD	A2L2			
191C	A221	A1D2	A2F2	CBL GRP 0	
191C	A320	A1P2 (N2)			
191C	A321	A1P2 (N2)	A1M2 (L2)		
191C	A327	A1R4 (Q4)			
191C	A333	A1P2 (N2)			

FSC/ERROR CODE MATRIX

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
191E	A210	A2G2	A1C2	A2K2	CBL GRP 1
191E	A221	A2F2	CBL GRP 0		
191E	A235	A1C2			
191E	A310	A1M2 (L2)			
191E	AD04	A1C2			
191E	AE04	A1C2			
4940	A152	A2Q2	A2K2		
4940	AD18	A2P2			
4940	AD78	A2P2	A2S2		
4940	AF1B	A2Q2	A2P2	A2R4	A2S2
4941	AD1A	A2S2			
4941	AF9B	A2T2			
4941	AFDB	A2T2			
4944	A157	A2Q2			
4944	A210	A1C2	A2F2	CBL GRP 1	
4944	A216	A2F2	CBL GRP 1		
4944	A232	A2F2	A1C2	CBL GRP 1	
4944	A235	A1C2			
4944	A362	A2P2			
4944	A382	A1R4 (Q4)	A1P2 (N2)		
4944	A530	A1F2 (E2)	A1H2		
4944	AD0E	A2P2			
4944	AD0F	A2Q2			
4944	AD15	A2T2	A2S2	A2P2	A1J2
4944	AD17	A2P2			
4944	AD18	A2S2			
4944	AD1A	A2S2	A2T2	A2Q2	A2P2
4944	AD1B	A2S2			
4944	AD67	A2P2			
4944	AD78	A2S2			
4944	AF1A	A2S2			
4944	AF1B	A2S2	A2P2	A2Q2	A1H2
4944	NOLD	A2Q2	A2P2		
4945	AF15	A2S2	A2T2		
4945	AF1B	A2S2	A2T2		
4945	AF9B	A2T2			
9001	A140	A2Q2			
9001	A14D	A2Q2			
9001	A152	A2S2	A2Q2		
9001	A254	A2Q2	A2F2		
9001	A255	A2L2	A2G2		
9001	AD15	A2T2			
9001	AF19	A2L2	A2Q2		
9001	AF53	A2L2	A2Q2		

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
9002	A123	A2P2	A2K2	A2Q2	
9002	A124	A2Q2	A2S2	A2P2	
9002	A126	A2Q2	A2S2	A2K2	
9002	A131	A2Q2			
9002	A13C	A2L2	A2K2	A2G2	
9002	A140	A2Q2			
9002	A141	A2K2	CBL GRP 7		
9002	A14C	A2L2			
9002	A14D	A2P2	A2G2		
9002	A152	A2Q2	A2K2		
9002	A157	A2Q2	A2G2		
9002	A254	A2L2	A2F2		
9002	A255	A2L2	A2G2		
9002	A362	A2P2	A2K2	A2G2	CBL GRP 9
9002	A363	A2Q2	A2P2	A2G2	A2L2
9002	A364	A2G2	CBL GRP A		
9002	A368	A2Q2	A1C2		
9002	A369	A2P2			
9002	A384	A1H2			
9002	A385	A2Q2	A1F2 (E2)	A2L2	
9002	A387	A2Q2	A2P2		
9002	A520	A1H2			
9002	A521	A1H2			
9002	A52A	A2F2			
9002	AD15	A2Q2	A2S2	A2P2	A2F2
9002	AD17	A2P2			
9002	AD28	A2P2	A2K2	A2Q2	
9002	AD57	A2Q2	A2P2		
9002	AD67	A2P2	A2Q2		
9002	AD68	A2Q2			
9002	AF1D	A2P2	A2Q2		
9002	AFCA	A2Q2			
9002	NOLD	A2L2	A1C2	A2G2	CBL GRP 1
9002	NOLD	A2L2	A2G2	A1C2	CBL GRP 1
9003	A13C	A2L2			
9003	A140	A2K2	A2G2	CBL GRP 7	
9003	A141	A2K2	A2L2	CBL GRP 7	
9003	A14D	A2Q2			
9003	A152	A2S2	A2Q2		
9003	A210	A1C2	A2K2	A2G2	CBL GRP 1
9003	A227	A2G2	A2F2		
9003	A232	A2F2	A1C2	CBL GRP 1	
9003	A250	A2L2			
9003	A254	A2F2	A2Q2	A2L2	
9003	A52A	A2F2			
9003	AD28	A2P2	A2Q2		
9003	NOLD	A2L2	A2G2		

FSC/ERROR CODE MATRIX

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
9004	A123	A2P2	A2Q2		
9004	A124	A2Q2	A2S2	A2P2	
9004	A152	A2Q2	A2K2		
9004	A157	A2L2			
9004	A362	A2G2	CBL GRP 9		
9004	A384	A1H2			
9004	A385	A2Q2	A2P2	A2L2	
9004	A520	A1H2			
9004	A521	A1H2			
9004	A52A	A2F2			
9004	AD15	A2Q2	A2S2	A2P2	A2F2
9004	AD25	A2K2	CBL GRP 7		
9005	AE20	A2K2	A2Q2		
9005	AF26	A2Q2			
9005	AF34	A2Q2			
9006	A120	A2F2	A2G2	CBL GRP 8	
9006	A131	A2G2			
9006	A140	A2K2	CBL GRP 7		
9006	A240	A2F2	A2G2		
9006	NOLD	A2F2	A2L2	A2G2	CBL GRP 8
9007	A111	A2K2	CBL GRP 7		
9007	A112	A2K2	CBL GRP 7		
9007	A113	A2K2	CBL GRP 7		
9007	A114	A2K2	CBL GRP 7		
9007	A115	A2L2	CBL GRP 7		
9007	A116	A2K2	CBL GRP 7		
9007	A117	A2K2	CBL GRP 8		
9007	A122	A2G2	A2K2	CBL GRP A	
9007	A123	A2P2	A2K2		
9007	A126	A2Q2	A2K2	A2S2	
9007	A127	A2L2			
9007	A135	A2L2	A2G2	A2F2	
9007	A152	A2Q2			
9007	AD15	A2S2			
9007	AD18	A2K2	CBL GRP 8		
9007	AD28	A2K2	CBL GRP 7		
9007	NOLD	A2G2	CBL GRP A		
9008	A131	A2L2	A2K2		
9008	A152	A2Q2	A2K2		
9008	A157	A2Q2			
9008	A366	A2Q2			
9008	AD15	A2Q2			
9008	AD67	A2P2			
9008	AF15	A2Q2	A2K2		
9008	AF1D	A2Q2			
9008	NOLD	A2K2			

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
9009	A120	A2F2	CBL GRP 8		
9009	A158	A1C2	CBL GRP 1		
9009	A210	A1C2	A2L2	A2G2	CBL GRP 1
9009	A212	A2L2	CBL GRP 1		
9009	A216	A2G2	A2L2	A2F2	
9009	A217	A2L2	CBL GRP 1		
9009	A223	A2L2	CBL GRP 1		
9009	A225	A1D2	A2F2	CBL GRP 0	
9009	A227	A1C2	A2G2	A2F2	CBL GRP 1
9009	A230	A1C2	A2L2	CBL GRP 1	
9009	A232	A1C2	CBL GRP 1		
9009	A234	A1C2			
9009	A235	A1C2			
9009	A240	A1C2	CBL GRP 1		
9009	A320	A1P2 (N2)			
9009	A321	A1P2 (N2)	A1C2		
9009	A325	A1P2 (N2)	A1C2		
9009	A384	A1C2			
9009	NOLD	A2L2	A2G2	CBL GRP 9	
900A	A13C	A2G2			
900A	A234	A1C2			
900A	NOLD	A2F2	A2L2	A2G2	CBL GRP 8
900B	A214	A2G2	A2F2		
900B	NOLD	A2L2	A2G2		
900F	A158	A2F2	A1D2	CBL GRP 0	
900F	A210	A1C2	CBL GRP 1		
900F	A222	A1C2	A1M2 (L2)	CBL GRP 1	
900F	A223	A1H2	A1C2	CBL GRP 1	
900F	A232	A1C2	CBL GRP 1		
900F	A233	A1P2 (N2)	A1C2		
900F	A234	A1C2			
900F	A235	A1C2	A1M2 (L2)	A1P2 (N2)	
900F	A292	A1C2	A1F2 (E2)		
900F	A293	A1C2	A1F2 (E2)		
900F	A335	A1C2			
900F	AC98	A1T4 (S4)	A1M2 (L2)		
900F	AD12	A1P2 (N2)			
900F	AD8A	A1H2			
900F	NOLD	A2Q2	A2P2	A2F2	CBL GRP 8
9104	A157	A2Q2			
9104	AD15	A2Q2	A2F2	A1H2	
9104	AD38	A2Q2	A2P2		
9104	AF1A	A2P2			
9104	AF6A	A2F2	A2P2		
9104	AF9A	A2Q2			
9104	AFCA	A2Q2			

FSC/ERROR CODE MATRIX

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
9108	A122	A2K2	A2G2		
9108	A125	A2S2	A2P2		
9108	A127	A2K2	A2F2	A2S2	
9108	A132	A2F2	A2K2		
9108	A13C	A2F2	A2L2		
9108	A140	A2Q2			
9108	A14D	A2K2	A2F2	A2S2	
9108	A153	A2F2			
9108	A157	A2K2	A2S2	A2F2	A2P2
9108	A233	A2F2			
9108	A240	A2F2	A2G2		
9108	A254	A2S2			
9108	A281	A2G2	A1D2	CBL GRP 1	
9108	A367	A2F2			
9108	AD0F	A2G2	A2F2		
9108	AD15	A2S2			
9108	AD1A	A2S2			
9108	AD78	A2S2			
9108	AE10	A2F2	A2K2		
9108	AF1A	A2K2	A2P2	A2F2	
9108	NOLD	A2F2	A2K2	A2G2	A2S2
910C	NOLD	A2K2	A2F2		
9110	A127	A2K2	A2F2		
9110	A158	A2F2	A1D2	CBL GRP 0	
9110	A220	A1D2	A2F2	CBL GRP 0	
9110	A225	A2F2	A1D2	CBL GRP 0	
9110	A234	A2F2	A1D2	CBL GRP 0	
9110	A235	A1D2	A2F2	CBL GRP 0	
9110	A281	A2K2	A1D2	A2F2	CBL GRP 0
9110	NOLD	A2G2			
9118	A136	A2L2	A2F2		
9118	A13C	A2L2	A2F2		
9118	A233	A2F2			
9118	A281	A2K2	A2G2	A1C1	CBL GRP 1
9118	NOLD	A2K2	A2F2		
9120	A127	A2K2	A2G2		
9120	A157	A2G2			
9120	A158	A1D2	A2L2	A1C2	CBL GRP 1
9120	A210	A2L2	A2G2		
9120	A211	A1D2	A2G2	CBL GRP 0	
9120	A212	A2G2	A1D2	A1C2	CBL GRP 0
9120	A216	A2L2			
9120	A240	A2L2	A1D2	A1C2	CBL GRP 1
9120	A242	A1D2	CBL GRP 0		
9120	NOLD	A2G2	CBL GRP A		
9128	NOLD	A2F2	A2K2		

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
9140	A127	A2G2	A2K2	CBL GRP 9	
9140	A1A1	A2G2	CBL GRP 9		
9140	AD15	A2Q2			
9140	NOLD	A2G2	CBL GRP 9		
9148	NOLD	A2K2	A2F2		
9180	A127	A2G2			
9180	NOLD	A2L2	A2G2	CBL GRP 8	CBL GRP A
9188	NOLD	A2F2	A2K2		
91E8	A122	A2G2	CBL GRP A		
91FC	A131	A2L2	A2K2		
91FC	NOLD	A2K2			
9200	A127	A2K2	A2F2		
9200	A13C	A2P2	A2L2	A2K2	
9200	A150	A2K2	A2F2		
9200	NOLD	A2G2	CBL GRP A		
9201	AD78	A2S2			
9201	AF6A	A2S2			
9202	A123	A2P2			
9202	A127	A2S2	A2P2	A2K2	
9202	A150	A2K2	A2F2		
9202	A1FB	A2P2			
9202	A366	A2P2			
9202	AD17	A2P2	A2G2	CBL GRP A	
9202	AD1A	A2S2	A2P2		
9202	AD57	A2Q2	A2P2		
9202	AD78	A2S2	A2R4	A2Q2	
9202	AF1A	A2R4	A2P2	A2S2	
9202	AF9A	A2Q2	A2P2		
9203	A366	A2P2			
9203	AD1A	A2P2			
9204	A123	A2S2	A2P2		
9204	A127	A2P2	A2L2	A2S2	A2Q2
9204	A14D	A2Q2			
9204	A210	A2L2			
9204	A342	A2G2	CBL GRP 0		
9204	A366	A2S2	A2P2		
9204	AD17	A2P2			
9204	AD1A	A2S2			
9204	AD27	A2S2			
9204	AF1A	A2S2	A2P2	A2Q2	A2T2
9204	AFBA	A2P2	A2Q2	A2T2	
9204	AFCA	A2P2			
9204	NOLD	A2L2			

FSC/ERROR CODE MATRIX

Fault Symptom Code	Micro Error Code	FRU 1	FRU 2	FRU 3	FRU 4
9206	AF1A	A2P2	A2S2	A2Q2	A2T2
9208	A127	A2S2	A2K2		
9208	A157	A2S2	A2P2		
9208	A366	A2P2			
9208	AD17	A2P2			
9208	AD1A	A2S2	A2G2	A2P2	
9208	AD78	A2S2	A2P2	A2G2	
920A	AD1A	A2S2	A2G2		
920A	AD78	A2S2	A2G2	A2P2	
9210	A127	A2P2	A2S2	A2K2	
9210	A366	A2P2	A2Q2		
9210	AD0F	A2Q2			
9210	AD15	A2S2			
9210	AD18	A2P2	A2G2		
9210	AD1A	A2P2			
9210	AD38	A2Q2	A2P2		
9210	AD48	A2P2			
9210	AD78	A2P2			
9210	AF16	A2P2			
9210	AF1A	A2P2			
9210	AF1B	A2S2			
9210	AF6A	A2P2	A2G2		
9210	AF8A	A2P2			
9210	AFBB	A2S2			
9212	A366	A2Q2			
9212	AD15	A2Q2			
9212	AD18	A2P2	A2G2		
9212	AD48	A2P2			
9212	AD78	A2P2			
9212	AF16	A2P2	A2S2		
9212	AF1A	A2P2			
9212	AF6A	A2G2	A2P2		
9212	AF9A	A2Q2			
9214	A127	A2S2	A2P2	A2T2	
9220	A127	A2S2	A2K2		
9220	A157	A2S2			
9220	A1FB	A2P2			
9220	A366	A2P2			
9220	AD15	A2S2			
9220	AD1A	A2S2			
9220	AD48	A2Q2			
9220	AD78	A2S2			
9220	AF1A	A2S2			
9220	AF1B	A2P2			
9220	AF27	A2S2			
9220	AF6A	A2P2	A2S2		
9222	AD15	A2S2			
9222	AD1A	A2S2			
9222	AD78	A2S2			
9222	AF6A	A2P2			
9228	AF27	A2S2			
9240	A127	A2T2	A2S2	A2Q2	A2K2
9240	A14D	A2T2	A2L2		
9240	A363	A2Q2			
9240	A366	A1H2	A1T2 (S2)	A2T2	CBL GRP 2
9240	A371	A2T2			
9244	A127	A2Q2			
9244	A127	A2Q2			
9280	A127	A2T2	A2Q2	A2K2	
9280	A14D	A2T2			
9280	A233	A2T2			
9305	NOLD	A2L2			

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION

DC power must be off prior to changing cards. Unless procedures state otherwise, do not restore power with cards missing; this can result in circuit damage or a "system hang" condition. Remove power as follows:

POWER DOWN PROCEDURE

Control Module (A2)

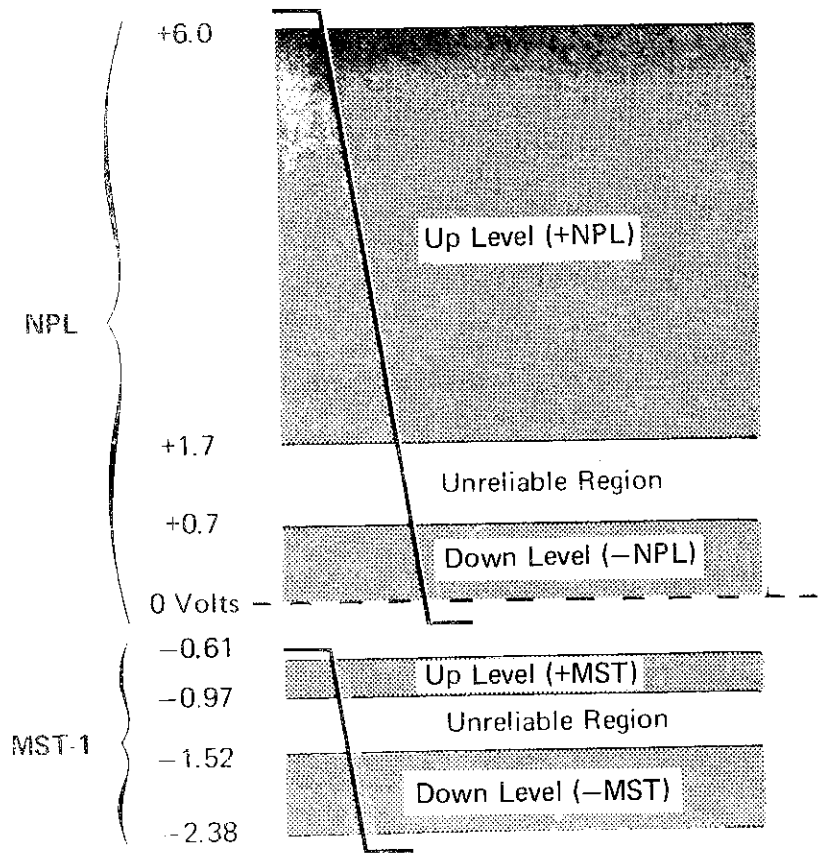
1. Turn the Start/Stop switch to STOP on every drive in the string.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Push the Power Off switch located on the Power Panel on the front of the 3340-A2. *Power is removed from the entire string: the 3340-A2 plus all attached 3340-B1s and B2s.*

Satellite Module (B1, B2)

1. Turn the Start/Stop switch to STOP on each drive in the satellite module to be powered down.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Turn off CP210 located on the AC compartment (accessible

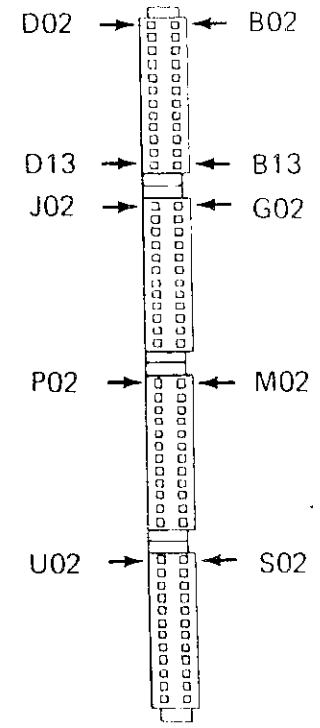
nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card	
Voltage	*Card (Contact Tab)*
−4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

KV010, 020 (drives)
BV100 (controller)

MESSAGE CONTENTS

CONSOLE MESSAGES

Resulting from error detection by the operating system. If the storage control is a System/3, Model 15, refer to ERAP in the System/3 Diagnostic Users Guide.

OS Console Error Message Analysis — — MSG 9, 10

Definition and Interpretation of each field. Directions to other MLM pages for aid in correcting the problem. (See Note.)

DOS Console Error Message Analysis — MSG 12

Definition and Interpretation of each field. Directions to other MLM pages for aid in correcting the problem. (See Note.)

EREP MESSAGES (Environmental Recording, and Printing)

Types of information produced and how it is used.

Performance Data — — — — — — — MSG 20

Data Types
Data Collection
Data Retrieval

Data Content — — — — — — — — — MSG 22

Statistical Data Format and Collection.
Error Data Format and Collection.

Using EREP — — — — — — — — — — MSG 30

How to find a detailed error record from the EREP Summary.

EREP Summaries — — — — — — — — MSG 32 (OS)
MSG 40 (DOS)

I/O Record types found.
Usage and Error data from System Log.

OS Unit Check Records — — — — — MSG 34

Location and Description of the information available.

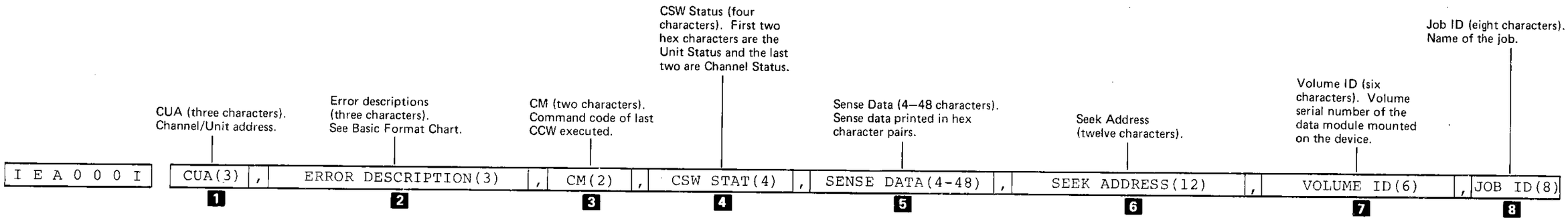
DOS Unit Check Records — — — — MSG 42

Location and Description of the information available.

Sys/3 ERAP — — — — — — — — — — MSG 44

Note: Certain 3340 subsystems may have a 3344 drive attached. If a 3344 drive is attached and the problem is in the 3344, go to the MSG section in Volume R07 of the 3344 MLM for 3344 MSG information. (3344 documentation will be available in May 1976).

BASIC CONSOLE ERROR MESSAGE FORMAT



The end of each field (except the last) is marked by a comma.

More than one comma in sequence indicates that one or more fields have been omitted.

The Basic message may consist of one or two lines. Each line uses the basic format but prints different fields. See Basic Format Chart.

* *Error number and CUA are repeated on line 2 with sense data.*

Basic Format Chart

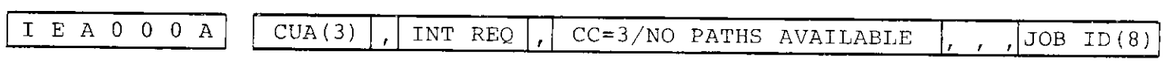
Condition	Number of Lines	CUA	Error Description	Command	CSW Status	Sense Data	Seek Address	Volume ID	Job ID
Channel Data Check	1	Yes	CDC	Yes	Yes	N/A	Yes	Yes	Yes
Interface Control Check	1	Yes	ICC	Yes	Yes	N/A	Yes	Yes	Yes
Channel Control Check	1	Yes	CCC	Yes	Yes	N/A	Yes	Yes	Yes
Overrun	2	Yes	OVR	Yes	Yes	0–8* (Line 2)	Yes	Yes	Yes
Bus Out Parity Check	2	Yes	BOC	Yes	Yes	0–7* (Line 2)	Yes	Yes	Yes
Chaining Check	1	Yes	CHC	Yes	Yes	N/A	Yes	Yes	Yes
Data Check	2	Yes	DCK	Yes	Yes	0–23* (Line 2)	N/A	Yes	Yes
Command Reject	2	Yes	CMD	Yes	Yes	0–8* (Line 2)	Yes Line 2	Yes	Yes
Equipment Check	2	Yes	EQC	Yes	Yes	0–23* (Line 2)	N/A	Yes	Yes
Seek Check	2	Yes	SKC	Yes	Yes	0–23* (Line 2)	Yes	Yes	Yes
Write Inhibit	2	Yes	WRI	Yes	Yes	0–8* (Line 2)	Yes	Yes	Yes

See Storage Control Unit MLM for Problem Analysis

MESSAGE FORMAT FOR INTERVENTION REQUIRED

Device Intervention Required

Controller Not Available



START 100
MLX 1

A

An error message has been printed on the console. The customer has directed your attention to it with a request for repair action.

Read field 1 on MSG 9 to verify that it contains the 3340 unit address. (See Note.)

Note: Certain 3340 subsystems may have a 3344 drive attached. If a 3344 drive is attached, and the unit address is a 3344, go to the MSG section in Volume R07 of the 3344 MLM. (3344 documentation will be available in May 1976).

Read the error description from field 2 on MSG 9 and follow the corresponding directions.

Seek Check	Intv Reqd	Cmd Reject	Equip Check	Data Check	ABEND	Write Inhbted
The access mechanism has failed to position properly or HA Compare fails after auto head switching on a multitrack operation. The symptom code is the 4 hex digits of sense bytes 22 and 23 of the end of field 5, line 2 on MSG 9. If Sense bytes 22 and 23 are 0000, proceed to FSI 50 and manually generate the Fault Symptom Code. Otherwise, proceed to the Fault Symptom Index.	The device requiring intervention is specified in CUA field 9 on MSG 9. CC = 1 indicates device intervention required.	This is normally a programming problem. However, if 3340 disk storage failure is suspected, perform the 3340 facility checkout procedure on START 110.	The symptom code is the 4 hex digits of Sense bytes 22 and 23 at the end of field 5, line 2 on MSG 9. If Sense bytes 22 and 23 are 0000, proceed to FSI 50 and manually generate the Fault Symptom Code. Otherwise, proceed to the Fault Symptom Index.	Data check is written for permanent, ECC-uncorrectable read errors described under Format 4; see SENSE 102. Check the EREP history printouts. Move the failing data module to another physical drive to verify that the error is not due to a disk surface defect. If a surface defect is suspected, the operator can use utility programs to attempt data recovery and assign an alternate surface for the defective track. The symptom code is the 4 hex digits of Sense bytes 22 and 23 at the end of field 5, line 2 on MSG 9. If Sense bytes 22 and 23 are 0000, proceed to FSI 50 and manually generate the Fault Symptom Code. Otherwise, proceed to the Fault Symptom Index.	This is normally a programming problem. However, if 3340 disk storage failure is suspected because of no record found, perform the 3340 disk storage facility checkout procedure on START 110. See OPER 234 for description of No Record Found.	Check to ensure that the Read Only interlock is rotated to Write position.
FSI 100	A START 130	START 110	FSI 100	FSI 100	START 110	C R/W 210

BASIC CONSOLE ERROR MESSAGE FORMAT

Partition Identifier. Indicates the partition from which the message was issued.

Error Message Code. XX represents a specific error number with a range of 00 to 99. Y represents the action indicator and specifies the type of operator action required, for example:

D – the operator must make a decision between two or more courses of action.

Possible Operator Response. For example:
R – indicates Retry.

Error Description. See flowchart.

System Assignment and CUA (Channel/Unit Address) where the error occurred.

Line 1

xx	OPxxy	x	Error Description	SYSxxx ; xxx=CUA
			1	2

See system manuals for 370/125 and 370/115 displays.

The message normally consists of three lines.

When the error is Intr Reqd (Intervention Required) and sense byte 10, bits 1, 2, and 3 are 0, only the fields on line one are printed. All fields are printed for other conditions.

START 100
MLX 1

An error message has been printed on the console. The customer has directed your attention to it with a request for repair action.

Read field **2** to verify that the system number and CUA are for type 3340 disk storage installed on system. (See Note.)

Read error description from field **1** and follow the corresponding directions.

Channel Command and Channel Status Word. The first byte represents the command code of the last CCW executed. The remaining 8 bytes represent the CCW.

Address of user CCB (Command Control Block).

Seek address = BBCCHH. Represents the address of the track where the error occurred.

Line 2

CCSW = Command code and CSW (9 bytes)	CCB = Address of user CCB (3 bytes)	SK = Seek address

Sense Bytes. Obtained from the device-in-error.

Line 3

SNS = Sense bytes (See Caution)
3

CAUTION
If less than 24 Sense bytes are contained in the console message, the remaining sense bytes are zero, as sense bytes are printed only to the last significant byte. If all sense bytes are zero, only the first byte of zeros is printed.

Note: Certain 3340 subsystems may have a 3344 drive attached. If a 3344 drive is attached, and the unit address is a 3344, go to the MSG section in Volume R07 in the 3344 MLM. (3344 documentation will be available in May 1976).

Seek Check	Intr Reqd	Cmd Reject	Equip Check	Data Check	Write Inhibit
Access mechanism has failed to position properly or HA Compare fails after auto-head switching on a multitrack operation. The symptom code is the 4 hex digits of Sense bytes 22 and 23 at the n end of field **3**, line 3. If bytes 22 and 23 are 0, proceed to FSI 50 and manually generate the Fault Symptom Code. Otherwise, proceed to the Fault Symptom Index.	Device requiring intervention is specified in CUA field **2**.	Normally a programming problem; however, if 3340 disk storage is suspected, perform the 3340 disk storage Checkout Procedure on START 110.	This symptom code is the 4 hex digits of Sense bytes 22 and 23 at the end of field **3**, line 3. If bytes 22 and 23 are 0, proceed to FSI 50 and manually generate the Fault Symptom Code. Otherwise, proceed to the Fault Symptom Index.	Data Check is written for permanent, ECC uncorrectable Read errors described under Format 4; see SENSE 100. Check EREP history printouts. Verify that the error is not due to a surface defect by moving the failing data module to another physical drive. If a surface defect is suspected, the operator can use utilities to attempt data recovery and assign an alternate surface for the defective track. The symptom code is the 4 hex digits of Sense bytes 22 and 23 at the end of field **3**, line 3. If bytes 22 and 23 are 0, proceed to FSI 50 and manually generate the Fault Symptom Code. Otherwise, proceed to the Fault Sumptom Index.	Check to ensure that the Read Only interlock is rotated to the Write position.
FSI 100	A START 130	START 110	FSI 100	FSI 100	C R/W 210

ERROR RECOVERY PROCEDURE

The handling of errors usually involves storage control and system-invoking recovery actions. These recovery actions can vary depending on how and to what system the 3340 is attached.

The following topics are associated with recovery actions involving the 3830 Model 2, ISC (storage controls), and the 3340.

- Error Correction Function
- Error Condition Table
- Error Recovery Action

ERROR CORRECTION FUNCTION

The Error Correction Function (ECF) is part of the recovery action procedure. The ECF algorithms and the related procedure are fully described in the 3830 Model 2 and ISC reference manuals.

ERROR CONDITION TABLE

The error condition table identifies unique configurations of sense bits in sense bytes 0, 1, and 2 set by the storage control. In addition, it refers to each of these configurations in a specific recovery action to be invoked by the system.

ERROR RECOVERY ACTION

The error recovery action table (MSG 16, 18) specifies actions to be taken for error conditions listed in the error condition table. A necessary part of the recovery action is the construction of Restart CCWs 1 and 2.

Construction of Restart CCWs

If operation incomplete (byte 1, bit 7) is set in the sense information, it indicates that an error or unusual condition occurred during a logical operation after data transfer had been initiated. By constructing Restart Channel Command Words, the error recovery procedures can correct the unusual condition and continue the operation in progress from the point of interruption to the normal ending point.

RESTART CCW 1

Restart CCW 1 is constructed as follows:

1. The command code byte is provided in sense byte 3.
2. The data address is that of the interrupted CCW, plus the count of that CCW, minus the residual count in the channel status word (CSW).
3. The flags (except Program Controlled Interrupt – PCI) are those of the interrupted CCW.
4. The count is the residual count in the CSW. If the residual count is zero, a count of one must be used. If a Write command is in progress, the data address should specify a byte containing '00'. If a Read command is in progress, the skip bit should be on.

RESTART CCW 2

Restart CCW 2 is constructed as follows:

1. The command code is provided in sense byte 3.
2. The count is constructed as follows:
   a. Fetch the count of the CCW designated by CSW –8 and set a pointer to this CCW.
   b. Subtract the restart displacement from the count obtained in step a. If this result is positive, go to step f; otherwise go to step c.
   c. Check the chain data flag of the CCW designated by the pointer. If the flag is not set, go to step e; otherwise go to step d.
   d. Advance the pointer to the next non-Transfer in Channel (non-TIC) CCW in the data chain and add the countr of this CCW to the counts of all preceding non-TIC CCWs in the data chain. Return to step b.
   e. Truncation occurs. Set the restart CCW 2 count equal to 1. Go to Step 3 and include the skip bit in the Restart CCW flags.
   f. Set the Restart CCW 2 count equal to the result of the subtraction in step b. Go to Step 3.
3. The flags (except PCI) are those of the CCW designated by the pointer in Step 2. The skip bit is also set if Step 2e was previously executed.
4. The data address is that of the CCW designated by the pointer in Step 2, plus the count of that CCW, minus the Restart CCW count generated in Step 2.

If another Operation Incomplete occurs while executing the Restart CCW, a new Restart CCW may be generated from the old Restart CCW.

3340 ERROR CONDITION TABLE

Byte	Bit	Name	General Description	Action	Logged
0	0	Command Reject	Programming error.	1	No
0	1	Intervention Required	Drive offline, Not Ready, CE Mode, or data module incompatability such as a 3348-70F installed on a drive that does not have the fixed-head feature.	1	Yes
0	2	Bus Out Parity	Bus Out parity error.	3	Yes
0	3	Equipment Check	Equipment malfunction.	4	Yes
0	4	Data Check	Data check in home address, count area, or key area; or uncorrectable data check in data area.	4	Yes
0	5	Overrun	Service overrun or command overrun.	4	Yes
0	6	Track Condition Check	Non-home address or record 0 commands for a defective track or any multitrack commands switching from a known alternate or defective track.	5	No
0 1	6 7	Track Condition Check Operation Incomplete	Switching from alternate track during overflow record processing or switching to a defective track during overflow record processing.	9	No
0	7	Seek Check	Seek incomplete or incorrect physical address when reading home address or count area.	6	Yes
0 2	4 1	Data Check Correctable	Correctable data check in data area of overflow segment which is not the last segment.	7	Yes
0 2 1	4 1 7	Data Check Correctable Operation Incomplete	Correctable data check in data area of overflow segment which is not the last segment.	8	Yes
0 2 1 0	4 1 7 6	Data Check Correctable Operation Incomplete Track Condition Check	Correctable data check in any data area, or data area of last overflow segment. This is not the last segment on an alternate track.	8A	Yes
0 1	0 6	Command Reject Write Inhibit	A Write command received with the selected drive in the write inhibit state.	1	No
1	1	Invalid Track Format	Track capacity exceeded.	2	No
1	2	End of Cylinder	Cylinder boundary detected during a basic multitrack operation.	10	No
1 1	2 7	End of Cylinder Operation Incomplete	Cylinder boundary detected during a basic overflow operation.	11	No
1	4	No Record Found	Programming error or expected programming error condition. The searched data does not exist on that track.	2	No
1	5	File Protected	The Seek command or Read/Search multitrack operation violated file mask.	12	No
1 1	5 7	File Protected Operation Incomplete	A Read or Write Overflow operation violated file mask	13	No
2	3	Environmental Data Present	Statistical usage/error log information is present.	3	Yes

3340 ERROR RECOVERY ACTION TABLE

Action	Explanation
1	Print message* for operator and/or customer engineer notification.
2	Exit with programming error or unusual condition indication.
3	a. Repeat the operation one time. b. If the error condition persists, perform Action 1.
4	a. Repeat the operation. b. If the error condition persists after ten retries, perform Action 1.
5	a. If this is a defective track, perform Action 5A. b. Use address of defective track plus 1 in a Seek command. The defective track address can be found in the ID area of the record 0 count area. c. Resume operation after searching to desired track position.
5A	a. Use address of alternate track in a Seek command. The alternate track address can be found in the ID area of the record 0 area. b. Resume operation after searching to desired track position.
6	a. Issue a Recalibrate command. b. Seek to the original address. c. Perform Action 4.
7	a. Perform error correction function. b. Examine bit 7 of the file mask. If this bit is off, go to step c. If this bit is on, return to user with indication that data has been corrected. (User is operating in PCI fetch mode and must, therefore, supply restart recovery action.) *Note: Only applies with OS/360.* c. If the user's chain has not been completed, examine the next non-TIC command in the user's chain. If bit 3 of this command is on (count area), go to step d. If bit is off, perform Action 7A. *Note: If data chaining is indicated in the interrupted CCW, the preceding test must be executed on the first non-TIC CSW after the last CCW in the data chain.* d. Continue the user's chain by executing the following CCW chain: Seek (same as original)† Set File Mask (same as original) Read Home Address (skip bit on) Search ID Equal (CCHHR provided in sense bytes 8-12) TIC* –8 TIC (channel status word)
7A	Continue the user's chain by executing the following command chain: Seek (same as original)† Set File Mask (same as original) Read Home Address (skip bit on) Search ID Equal (CCHHR provided in sense bytes 8-12 TIC* –8 Read Count (skip bit on) TIC (channel status word)
8	a. Perform error correction function. b. Examine bit 7 of the file mask. If this bit is off, go to step c. If this bit is on, return to user with indication that data has been corrected. (User is operating in PCI fetch mode and must supply restart recovery action.) *Note: Only applies with OS/360.* c. Increment the seek argument by one. Cylinder bytes and the high-order head byte are obtained from the user. The lower-order head byte is obtained from bits 3 through 7 of sense byte 6. d. Construct Restart CCW 2. e. Complete the interrupted operation and continue the user's chain (if appropriate) by executing the following command chain. Seek (argument from step c)† Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* –8 Restart CCW 2 TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
8A	a. Perform error correction function. b. Examine bit 7 of the file mask. If this bit is off, go to step c. If this bit is on, return to user with indication that data has been corrected. (User is operating in PCI fetch mode and must supply restart recovery action). *Note: Only applies with OS/360.* c. Use address of the defective track plus 1 in the Seek command. d. Construct Restart CCW 2. e. Complete the interrupted operation and continue the user's chain (if appropriate) by executing the following command chain. Seek (argument from step c)† Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* –8 Restart CCW 2 TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*

† *Cylinder bytes and the high-order head byte are obtained from the user. The low-order head byte is obtained from bits 3 through 7 of sense byte 6.*

* *Message (should be printed on all permanent errors).*
- *a. Message Code.*
- *b. Error type (read, write, or control).*
- *c. Module designation, cylinder number, and head number (that is, device address and seek address).*
- *d. Channel designation.*
- *e. Status and sense bytes sent to CPU.*

3340 ERROR RECOVERY ACTION TABLE (continued)

Action	Explanation
9	a. If this is a defective track, perform Action 9A. b. Use address of defective track plus 1 in a Seek command and use the following CCW chain to resume operation. Seek Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* –8 Restart CCW 1 TIC (channel status word) *Note: If the modifier seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
9A	a. Use address of alternate track in Seek command in the following CCW chain. Seek Set File Mask (inhibit seeks) Set Sector (argument 0) Search ID Equal (record 1) TIC* –8 Restart CCW 1 TIC (channel status word)
10	a. Increment the cylinder address of the user's seek argument by one. Reset the head address. b. Continue the operation by executing the following command chain: Seek (argument from step a) Set File Mask (same as original) Set Sector (argument 0) Read Home Address (skip bit On) TIC (channel status work –8) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
11	a. Increment the cylinder address of the user's seek argument by one. Reset the head address. b. Construct Restart CCW 1. c. Complete the interrupted operation and continue the user's chain (if appropriate) by executing the following command chain. Seek (argument from step a) Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* –8 Restart CCW 1 TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
12	a. Determine if the interrupted command is a Seek. If yes, go to step b. If no, perform Action 12A. b. Continue the operation by executing the following command chain: Seek (same as original)† Set File Mask (same as original) Set Sector (argument 0) Read Home Address (skip bit on) TIC (channel status word) *Note: If the seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
12A	a. This is a multitrack operation. Increment the user's seek argument by one. b. Continue the operation by executing the following command chain: Seek (argument from step a) Set File Mask (same as original) Set Sector (argument 0) Read Home Address (skip bit on) TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
13	a. Increment the user's seek argument by one. b. Construct Restart CCW 1. c. Complete the interrupted operation and continue the user's chain (if appropriate) by executing the following command chain: Seek (argument from step a) Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* –8 Restart CCW 1 TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*

† Cylinder bytes and the high-order head byte are obtained from the user. The low-order head byte is obtained from bits 3 through 7 of sense byte 6.

INTRODUCTION

The 3340 disk storage is connected to an operating system that has programs to collect, record, and retrieve two types of data describing the 3340 performance (statistical and error). Periodically, this data is retrieved and analyzed to form the basis for maintenance activity and intermittent problem resolution. Operating System (OS) and Disk Operating System (DOS) terminology is used in describing the host system functions. Other IBM systems that support the 3340 disk storage use similar functions and terms.

Data Types

Two types of data, statistical and error, are collected during normal operation:

- **STATISTICAL** data gives a summary of the 3340 performance record, based on usage counter overflows of number of bytes Read and/or number of Seek operations.
- **ERROR** data shows the condition of all 3340 indicators at the time an error occurs, whether temporary or permanent. These "hard" errors create an error message at the operators console (see MSG 10, 12). A detailed description of the data content and its collection is shown on MSG 22 and MSG 30.

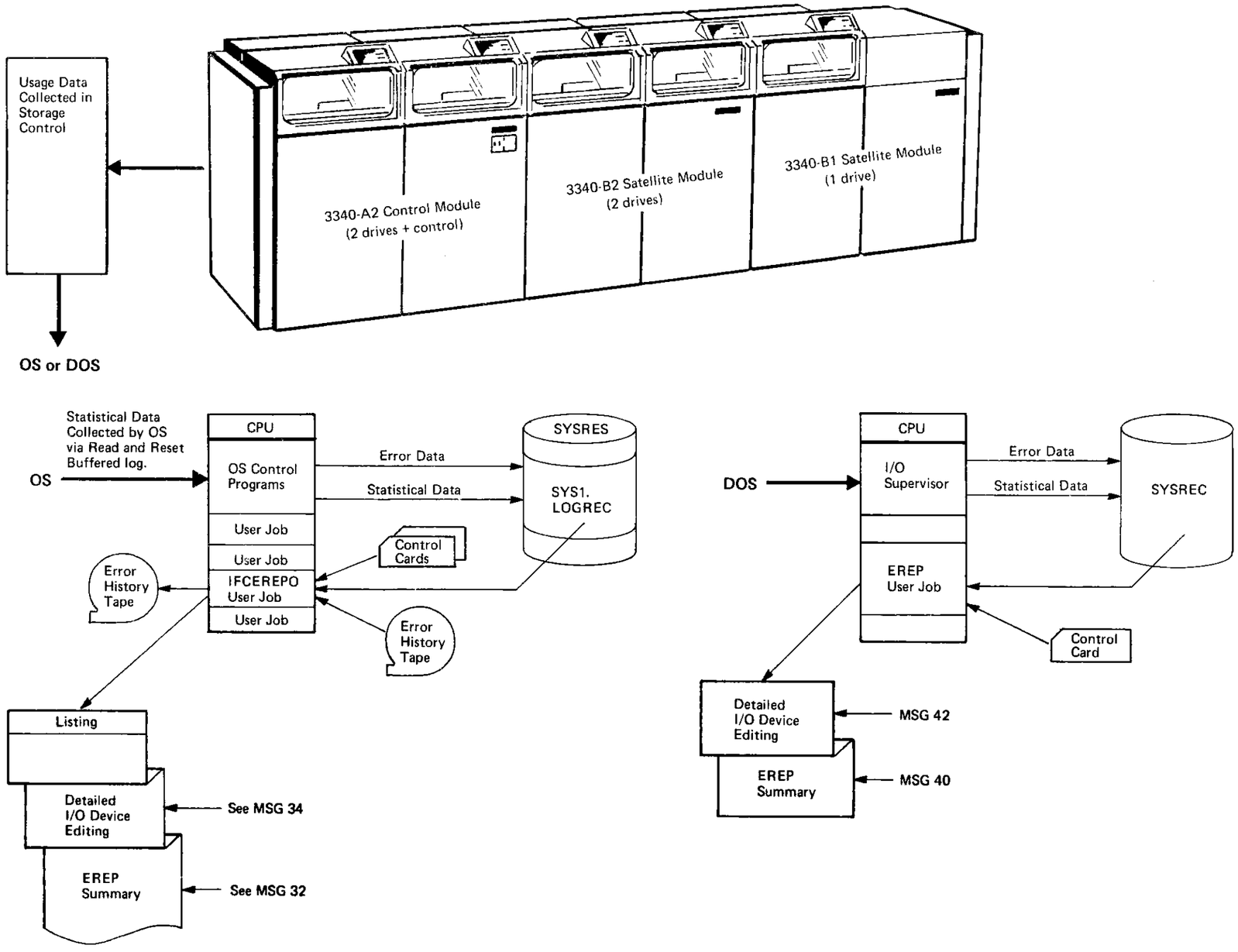
Data Collection

The data collected by the operating system is stored on a data set named SYS1.LOGREC (OS), SYSREC (DOS). This data set is usually located on a specified direct-address device and contains information for every device used by the operating system.

Data Retrieval

The data is retrieved, edited, and printed by the IFCEREP0 (OS) and EREP (DOS).

OVERALL VIEW OF PERFORMANCE DATA



F
L

STATISTICAL DATA

Format

Twenty-four bytes of Format-6 data are collected by the Operating System; see SENSE 104. Additional information is added as follows:

Date and Time
Device Type (3340)
Channel/Unit Address
Physical Controller/Drive Address
Volume ID (Data Module label)

This data is formatted and recorded by the operating system.

Collection Initiation

Statistical data is gathered under three conditions:

- Buffered log overflow.
- Pack change.
- End of day operation.

Collection Method

The Read and Reset Buffered Log is initiated by the storage control as follows:

1. The next Start I/O command that addresses the drive is not executed. Instead, a Unit Check status is sent to the operating system.
2. The operating system issues a Sense command and passes the sense data to its 3340 Error Recovery Procedures (ERPs) for analysis. The Sense command reads and resets the log in storage control.
3. The ERPs determine that the sense data is usage statistics (Byte 2, Bit 3, Format 6); see SENSE 104.
4. The operating system reissues the Start I/O command.
5. The operating system records the statistical record.

ERROR DATA

Format

Twenty-four sense bytes are collected by the operating system which adds additional information as follows:

Date and Time
Device Type (3340)
Program ID (Name of the OS Job)
Channel/Unit Address
Physical Controller/Drive Address
Volume ID (Data Module label)
Failing CCW
CSW
Last Seek Address

This data is formatted and recorded by the operating system.

Collection Method

When the operating system detects an I/O interrupt with Unit Check status, sense data is collected and analyzed by ERPs. An Outboard Recorder record is written to SYS1. LOGREC following any occurrence of:

1. Equipment Check (soft, hard, or permanent)
2. Data Checks
3. Seek Checks
4. Bus Out Parity and overruns.

When DOS initially detects a Unit Check, an entry is made to the SYSREC volume. If after a given number of retries have been exhausted and the problem persists, the error becomes permanent and another entry is made.

HOW EREP WORKS

Refer to MSG 34 (OS) or MSG 42 (DOS) for a description of the operation of EREP.

HOW TO RUN EREP

Most installations have an established procedure for processing error information. This procedure should not only include JCL statements for the execution of the EREP program, but should also define the operating proctices necessary to periodically print accumulated error records via EREP. Examples of the JCL required to execute EREP with a minimumsubset of options is described below.

EXAMPLES (May Vary with User's System)

OS

JCL cards to execute EREP and obtain printout of all records on SYS1 LOGREC:

```
//JOBA      JOB
//          EXEC    PGM=IFCEREPO
//SERLOG    DD      DSN=SYS1.LOGREC,DISP=(OLD,KEEP)
//EREPPT    DD      SYSOUT=A
```

JCL cards to execute EREP and obtain printout of 3340 records only:

Replace the card

```
//          EXEC    PGM=IFCEREPO
```

with

```
//          EXEC    PGM=IFCEREPO,PARM='TYPE=OTS,DEV=3340'
```

DOS

JCL cards to execute EREP and obtain printout of all records:

```
//    EXEC    EREP
```

When the system comes back to the console with:

```
3E11D ENTER OPTION SOURCE C=CARD, S=CONSOLE, N=NONE
```

Type N or EOB

JCL to print 3340 records only:

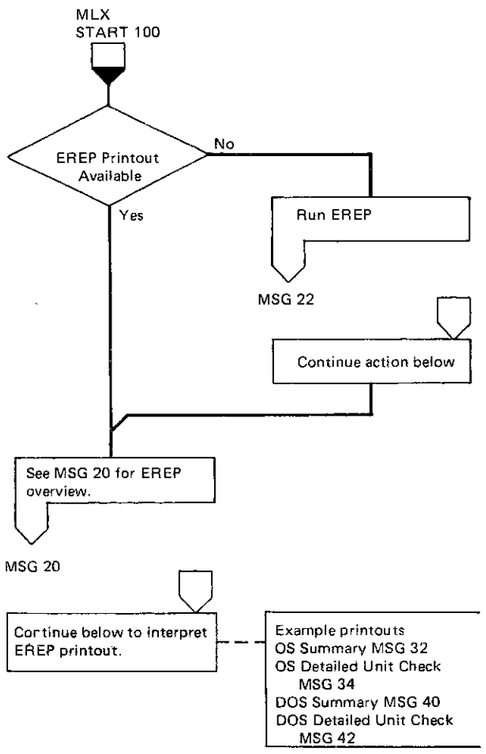
```
//              JOB
//              EXEC    EREP
¢OPTION         SELECT
¢DEVICE=3340
/*
/&
```

When the system comes back to the console with:

```
3E11D ENTER OPTION SOURCE C=CARD, S=CONSOLE, N=NONE
```

Type C

USING EREP (Environmental Recording, Editing, and Printing)



EREP provides the CE with a summary of statistical data and detailed unit check records in a readable format.

Statistical Summary

The Statistical Summary (shown on MSG 32 for OS and MSG 40 for DOS) allows the CE to quickly determine the condition of the 3340 subsystem. The summary is in two parts. The top part of the summary shows how many records of each indicated type were found in the SYS.LOGREC (OS) or SYSREC (DOS) data sets. The bottom part of the summary is a breakdown of the data from the top, but divided into the various data modules used on the drive during the period of service. It is an accumulation of the usage information collected by the control storage log and error information compiled by EREP.

This information can be used in three ways:

1. Assist in deciding the action to be taken for Preventive Maintenance.
2. Separate data module and drive problems.
3. Indicate detailed unit check records.

Unit Check Records

The detailed unit check records (shown on MSG 34 for OS and MSG 42 for DOS) describe the subsystem condition at the time of the request and list the Fault (Error) Symptom Code. The Fault (Error) Symptom Codes point to a Maintenance Analysis Procedure (MAP) and are listed in the Fault Symptom Index starting on FSI 100.

The unit check printout is requested after analyzing the keywords found in the summary.

How to Find a Unit Check Record (OS)

For a DOS system, go to MSG 40.

The example of a summary printout shown on MSG 32 may be analyzed as follows:

SUMMARY OF I/O RECORDS (A)

1. The number of logs by error type for Channel/Unit Address 1C4 is listed for the time period day 173.
2. To locate the unit check record description for each log, match the CUA and error type (in this case, equipment check for drive 1C4) with the proper unit check record description page from the detailed system error printout. See example on MSG 34.

SUMMARY OF I/O STATISTICAL AND OBR RECORDS BY VOLUME (B)

The summary sheet further identifies data checks (read retry errors) and seek checks by Volume ID. It also lists logs caused by pack change, EOD (End of Day) and overflow of counters. See MSG 22 for Statistical Data Collection Initiation.

Other errors shown in summary on MSG 32 are:

- Volume ID SJTC01 has one seek error and one read error corrected by retry logged.
  (These are also indicated in summary (A).

Action to be Taken

Using the procedure described in How To Find a Unit Check Record, examine the detailed error records corresponding to Equipment Check, Data Check (permanent), or Seek Checks. Error rates can vary considerably and still be considered normal due to various combinations of data modules (Vol. IDs) and drives.

- To establish a basic error rate for a drive, combine the number of unit check records on each VOL. ID used on a drive and compare them to the total usage (Total Accesses 7 MSG 32 and Total Megabytes Read 9 MSG 32 for each VOL. ID).
- Later EREP summaries can be compared with the established basic error rate to determine if error rates show an increasing trend.
- If maintenance action is required, due to an increasing trend in error rates, determine if Equipment, Data or Seek checks have caused the increase. Is one VOL. ID responsible for the error increase or have all VOL. IDs on a particular drive caused the increase?
- Find symptom codes in EREP printout 7 on MSG 34, and exit to FSI 100 to gather more information on the Unit Checks.

If overrun errors cause system degradation treat them as unit checks (permanent) and follow 3340 checkout procedure on START 110.

OBR Summary

There may be two adjacent summary pages in the EREP output with the same Physical Channel Unit Address. In this case, one of the summary pages contains valid statistical summary information and the other summary page contains valid OBR error summary information. The page that shows a non-zero number of statistical records (right-hand column at the top of the summary (A) on MSG 32) contains the valid statistical data for the device shown at the bottom of the summary (B) on MSG 32. The other page contains valid OBR error summary data. Disregard the bottom of this summary page.

Shared Devices

If two systems share the same DASD device, EREP must be run on both systems and combined to get the total number of errors on the shared device.

EREP SUMMARIES (OS)

The EREP program gathers performance data for each device attached to the operating system. The 3340 subsystem information is printed in the format shown to the right.

DEVICE ID

The low-order digit of the PHYSICAL CHANNEL UNIT ADDRESS **1** (top) and the PHYSICAL DRIVE **6** (bottom) are equivalent; see the following table.

Units Position of Address	Physical Drive
0 or 8	A
1 or 9	B
2 or A	C
3 or B	D
4 or C	E
5 or D	F
6 or E	G
7 or F	H

UNIT CHECKS

See MSG 30, How To Find a Unit Check Record.

STATISTICAL INFORMATION

These are the total usage and error figures for this PHYSICAL DRIVE listed by Data Module Volume ID up to a maximum of ten data modules.

Definitions

3 EQUIPMENT CHECKS

Attachment: those equipment checks detected in the storage control unit.

- Sense Byte 0 bit 3 = 1
- Sense Byte 7 bits 0–3 = 2 (Format 2)
- See the Storage Control MLM for a further discussion of Format 2 checks.

Drive: those equipment checks detected in the controller and drive.

- Sense Byte 0 bit 3 = 1
- Sense Byte 7 bits 0–3 = 1 (Format 1)

4 DATA CHECKS

Permanent–errors which could not be corrected by ECC or retry. Correctable–errors which were corrected by using the ECC information. Retry–errors corrected by a retry operation.

5 SEEK CHECKS

Permanent–errors that could not by a retry operation be corrected. Retry–errors corrected by a retry operation.

7 TOTAL ACCESSES

A count of the total number of accesses issued to the data module, by 1000.

8 SEEK ERRORS

A count of the number of Seek Incomplete errors detected plus the number of Seek Verification errors detected by the storage control. Recorded as Format 1 Unit Checks. See EREP edited printouts on MSG 34.

9 TOTAL MEGABYTES READ

A count of the bytes read in million-byte units.

10 RETRY READ ERRORS

The number of soft, ECC uncorrectable errors detected in the HA, Count, and Data fields recorded as Format 4 errors. See EREP edited printouts on MSG 34.

11 CORRECTABLE READ ERRORS

The number of correctable errors found in the data fields. Recorded as Format 5 Unit Checks. See EREP edited printouts on MSG 34.

Sample OS EREP Summary (May vary with user system)

A

```
SUMMARY OF I/O RECORDS  TYPE OBR/MDR SOURCE - OUTBOARD DEVICE TYPE  3340  MODEL- 0145   SERIAL NO. 012345

                 DAY YEAR    DAY YEAR
DATE RANGE - 173   74 TO 173   74

      [1] PHYSICAL CHANNEL UNIT ADDRESS 0001C4  TOTAL NUMBER OF RECORDS 0018 UNIT CHECK RECORDS
[2] ERROR RECORD(OBR) SUMMARY

    BUS OUT PARITY        0001

[3] EQUIPMENT CHECKS
        ATTACH            0002
        DRIVE             0001

[4] DATA CHECKS
        PERMANENT         0000
        CORRECTABLE       0001
        RETRY             0001

[5] SEEK CHECKS
        PERMANENT         0000
        RETRY             0001

    OVERRUN               0001            STATISTICAL      0010

    TOTAL                 0008            TOTAL            0010

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

B

```
SUMMARY OF I/O STATISTICAL AND OBR RECORDS BY VOLUME ID        DEVICE TYPE        3340

      [6] PHYSICAL DRIVE        E                    TOTAL NUMBER OF RECORDS 0018
```

VOLUME ID	**7** TOTAL ACCESSES (1000)	**8** SEEK ERRORS	**9** TOTAL MEGABYTES READ	**10** RETRY READ ERRORS	MEGABYTES READ/RETRY ERROR	**11** CORRECTABLE READ ERRORS	MEGABYTES READ/CORR ERRORS
SJTC01	00009	00001	00009	00001	00009	00001	00009
SJTC02	00000	00000	00001	N/A		N/A	
SJTC03	00001	00000	00002	N/A		N/A	
SJTC04	00001	00000	00004	N/A		N/A	
SJTC05	00005	00000	00019	N/A		N/A	
SJTC06	00004	00000	00014	N/A		N/A	
SJTC07	00002	00000	00006	N/A		N/A	
SJTC08	00019	00000	00061	N/A		N/A	
SJTC09	00003	00000	00008	N/A		N/A	
SJTC10	00002	00000	00013	N/A		N/A	
SJTC11	00025	00000	00047	N/A		N/A	
TOTALS	00046	00001	00137	00001	00137	00001	00137

```
TOTAL OVERRUNS CHAN A        TOTAL OVERRUNS CHAN B        TOTAL OVERRUNS CHAN C        TOTAL OVERRUNS CHAN D
      COMMAND  00001               COMMAND  00000               COMMAND  00000               COMMAND  00000
      DATA     00000               DATA     00000               DATA     00000               DATA     00000

00000    00000
```

OS EREP UNIT CHECK RECORD DESCRIPTION

1 ENVIRONMENTAL INFORMATION
System-supplied information is provided at the top of each page of the EREP printout of a 3340 unit check record. The information describes the operating environment at the time of the failure.

Note: The job identity, which indicates a means of recreating the failure, may contain zeros if a system task was in operation.

2 PHYSICAL CHANNEL UNIT ADDRESS
The primary physical address of the device and is equivalent to the physical channel unit address or physical drive shown on the summary page, MSG 32.

3 LOGICAL CHANNEL UNIT ADDRESS
The actual logical address path over which the error occurred. If the high-order (channel) digit is zero, as shown in this example, disregard the channel digit. If it is not zero, it indicates the channel where the error occurred.

4 NUMBER OF I/O RETRIES
The number of retries made by the system ERPs before the error was recorded.

5 VOLUME LABEL
The Volume Label of the data module being used at the time of the failure. This information is provided as an aid in determining whether the error was caused by a hardware failure or by a data module problem. The volume label or SYSRES data module will be 000000 or blank.

6 KEYWORDS
The keyword error description corresponds to that given in the summary; see MSG 32.

7 FAULT (ERROR) SYMPTOM CODE
Using the Fault (Error) Symptom Code, refer to the Fault Symptom Index starting on FSI 100. If the Fault (Error) Symptom Code is set to 0000 (Sense Bytes 22 and 23), go to FSI 50 and manually generate the code.

8 FAILING CCW, CSW, LAST SEEK ADDRESS
Information that defines conditions at the time of the failure.

9 SENSE BYTE FORMAT
The field that defines the sense byte format.

10 SENSE BYTES
See SENSE 100–104 for a description by format. See SENSE 109 for a detailed description.

11 HEX DUMP OF RECORD
The unformatted data for the Unit Check printout.

Sample OS Detailed Unit Check Record (May vary with user system)

```
---RECORD ENTRY TYPE - UNIT CHECK     SOURCE - OUTBOARD              MODEL- 0145      SERIAL NO.   012345
   VS1  REL.   03
                          DAY YEAR                        HH MM SS.TH                  JOB IDENTITY EREP3340
                 DATE- 173   74                TIME 00 00 00 31                                 C5D9C5D7F3F3F4F0

DEVICE TYPE                          3340
PHYSICAL  CHANNEL UNIT ADDRESS       0001C4
LOGICAL   CHANNEL UNIT ADDRESS       0001C4
PHYSICAL DRIVE                       E
NUMBER OF I/O RETRIES                0001
VOLUME LABEL                         SJTC01

EQUIPMENT CHECK  DRIVE-TEMPORARY
ERROR SYMPTOM CODE- 1917                                                 K    CA   US CS  CT
                    CC   CA   FL     CT                                 
FAILING CCW         07 001F00 40 00 0006            CSW     00 004340 0E 00 0006

                    M  B B  C C  H H  R
LAST SEEK ADDRESS- 00 0000 0000 0000 00

SENSE BYTE DATA-  FORMAT 1

 BYTE 0   10    BYTE 1   00    BYTE 2   82    BYTE 3   00    BYTE 4   08    BYTE 5   00    BYTE 6   00    BYTE 7   17
----------UNIT CHECK DESCRIPTION----------  RESTART CMWD  PHYSICAL ID    LOW CYLINDER   HI CYL/LOG TRK FORMAT/MSG

COMMAND REJ 0  PERM ERROR  0  RPS PRESENT 1   00000000      DRIVE A     0  CYL 128     0                 0  FORMAT  8  0
INTERVN REQ 0  INV TRK FMT 0  CORRECTABLE 0                 DRIVE B     0  CYL  64     0  CYL   512     0  FORMAT  4  0
BUS OUT PAR 0  END OF CYL  0              0                 DRIVE C     0  CYL  32     0  CYL   256     0  FORMAT  2  0
EQUIPMNT CK 1              0  ENV DATA PR 0                 DRIVE D     0  CYL  16     0                 0  FORMAT  1  1
DATA CHECK  0  NO REC FND  0              0                 DRIVE E     1  CYL   8     0  LOG TRK 8      0  MESSAGE 8  0
OVERRUN     0  FILE PROTCT 0  DATA MOD SZ 0                 DRIVE F     0  CYL   4     0  LOG TRK 4      0  MESSAGE 4  1
TRK COND CK 0  WRT INHIBIT 0  DATA MOD SZ 1                 DRIVE G     0  CYL   2     0  LOG TRK 2      0  MESSAGE 2  1
SEEK CHECK  0  OP INCOMPLT 0  DATA MOD SZ 0                 DRIVE H     0  CYL   1     0  LOG TRK 1      0  MESSAGE 1  1

  BYTE 8   08    BYTE 9   0A    BYTE 10  60    BYTE 11  ED    BYTE 12  00    BYTE 13  80    BYTE 14  05    BYTE 15  8F
DRIVE STATUS    DRIVE CK/STAT  SEQUENCE CNTRL LOAD SW STATUS R/W SAFETY      CTL INT B OUT  CTL INT B IN   CTL INT TAG B

CNTRLR CK   0  DM LD SW L  0  DM SIZE CK  0  DR START SW 1  MULTI-HD CK 0  BIT 0       1  BIT 0       0              1
INTRFACE CK 0  SECT COM CK 0  MOD LATCH 4 1  DM PRES  SW 1  CAP/ENAB CK 0  BIT 1       0  BIT 1       0              0
DRIVE CHECK 0  MOT SP AIR  0  MOD LATCH 2 1  COVER LK SW 1  WRITE OVRUN 0  BIT 2       0  BIT 2       0              0
R/W CHECK   0  BELT SW L   0  MOD LATCH 1 0  DM UNLD  SW 0  INDEX CHECK 0  BIT 3       0  BIT 3       0              0
ON LINE     1  WRT ENABLE  1  CHECK LATCH 0  DM LOAD  SW 1  R/W INTR CK 0  BIT 4       0  BIT 4       0              1
MOD ATTENTN 0  MODULE SZ 3 0  SEQUENCE CK 0  BELT SW      1  CONTROL CK  0  BIT 5       1  BIT 5       1              1
BUSY        0  MODULE SZ 2 1  BIAS DSB SW 0  CARR HOME   0  TRANSINT CK 0  BIT 6       0  BIT 6       0              1
SK/SCTR COM 0  MODULE SZ 1 0  ODD TRACK   0  MT SP AR SW 1  WRT CURT CK 0  BIT 7       0  BIT 7       1              1

  BYTE 16  1E    BYTE 17  01    BYTE 18  00    BYTE 19  00    BYTE 20  00    BYTE 21  00    BYTE 22  19    BYTE 23  17
ACCESS STATUS   CNTRLR CHKS    MICRO DETCD ER STATUS          INTERFACE CKS                 -----ERROR SYMPTOM CODE-----

TIME-OUT CK 0  PLO CHECK   0              0  SET R/W     0  CTL TAG CK  0  00000000       00011001       00010111
OVRSHOOT CK 0  NO PLO INPT 0              0              0  CTL B/O CK  0
ACC OFF TRK 0  SER/DES ck  0              0              0  DEV SEL CK  0
TRK CROSSNG 1  GAP CNTR CK 0              0              0  DEV B/I CK  0
SERVO LATCH 1  WRT DATA CK 0  MESSAGE 8   0              0  CTL B/I CK  0
LIN MOD LAT 1  MONITOR CK  0  MESSAGE 4   0              0  I WRT FAIL  0
CONTROL LAT 1  ECC CHECK   0  MESSAGE 2   0              0  DEV B/O CK  0
WAIT LATCH  0  ECC ZEROS   1  MESSAGE 1   0              0  DEV TAG CK  0

HEX DUMP OF RECORD
HEADER    30438800    00000100    0073173F    00000031        00012345    01450000

0000  C5D9C5D7    F3F3F4F0    07001F00    40000006        00004340    0E000006    030001C4    3050200A
0020  000001C4    00000018    E2D1E3C3    F0F10000        00000000    00000000    00000000    00000000
0040  10008200    80000017    080A60ED    0080058F        1E010000    00001917
```

HOW TO FIND A UNIT CHECK RECORD (DOS)

1. EREP Summary A – Gives a statistical summary and usage.
2. EREP Summary B – Shows a unit check record summary by device giving sense byte 7 summary.

   Up to 10 VOL IDs can be listed. (More than 10 are combined.) 4

   Total unit check records are indicated. 6

   Example: DEV = 1C8. 3

   Sense byte 7 value 10, count 001. 7

   - Search through EREP Dump.
   - Separate edited printouts (see MSG 42) for device 1C8. There could be more than 10 VOL ID unit error records.
   - Look for sense byte 7 = 10 in these edited records. A (See MSG 42.)
   - VOL ID 5 MSG 42 and type of error 6 MSG 42 found in edited printouts.

Action To Be Taken

Using the search through EREP Dump procedure, examine the detailed error records corresponding to Equipment check, Data check (permanent), or Seek checks noted in the Error Record Summary. Error rates can vary considerably and still be considered normal due to various combinations of data modules (VOL IDs) and drives.

- To establish a basic error rate for a drive, combine the number of unit check records on each VOL ID used on a drive and compare to the total usage (total accesses 1 and total megabytes read 2 for each VOL ID).
- Later EREP summaries can be compared with the established basic error rate to determine if error rates show an increasing trend.
- If maintenance action is required, due to an increasing trend in error rates, determine if Equipment, Data, or Seek checks have caused the increase. Is one VOL ID responsible for the error increase or have all VOL IDs on a particular drive caused the increase?
- Use symptom code 7 on MSG 42, go to FSI 100 and search for correct symptom code. Go to MAP indicated to gather more information about error (MSG 42).

A SAMPLE OF DOS EREP TOTAL STATISTICAL SUMMARY (May vary with user system)

```
                                    --EREP SUMMARY--

                        FILE DATE RANGE   FIRST   00/000   LAST   00/000

DEVICE TYPE   3340      CUA   ICA                TOTAL RECORDS   00002

TOTAL OVERRUNS  CHNL A                           TOTAL OVERRUNS  CHNL B
                COMMAND   000000                                 COMMAND   000000
                DATA      000000                                 DATA      000000

          1 TOTAL          ACCESS    2 TOTAL        RETRY        MEGABYTES     CORRECTABLE   MEGABYTES
            ACCESSES       ERRORS      MEGABYTES    READ         READ/RETRY    READ          READ/CORR
            (X1000)                    READ         ERRORS        ERROR        ERRORS         ERROR

TOTALS        000000       000000      000000       000002        000000       000000        000000

VOLUME ID                                                  <-- Data Checks
```

B SAMPLE OF DOS UNIT CHECK SUMMARY

```
                                    --EREP SUMMARY--
                                        3
DEVICE TYPE - 3340   NORMALIZED CUA - ICB   FILE DATE RANGE  --  FIRST - 00/000   LAST - 00/000

        VOLUME LABELS ENCOUNTERED - MAXIMUM OF 10 -
                      VOLUME   COUNT
                    4 DOSR28     003 5
                      XXX        XXX

                TOTAL RECORDS - 00003 6  <-- (Total of temporary/permanent Unit Check Records)
```

See SENSE 100 → SENSE BYTE 7 SUMMARY

VALUE/COUNT		VALUE/COUNT		VALUE/COUNT		VALUE/COUNT	
00	000	00	000	18	000	40	000
01	000	0D	000	19	000	41	000
02	000	0E	000	1A	000	42	000
03	000	0F	000	1B	000	43	000
04	000	7 10	001	1C	000	44	000
05	000	11	000	1D	000	45	000
06	000	12	000	20	000	46	000
07	000	13	000	21	000	47	000
08	000	14	000	22	000	50	000
09	000	15	000	23	000	51	000
0A	000	16	000	24	000	52	000
0B	001	17	000	30	000	53	000

DOS EREP UNIT CHECK RECORD DESCRIPTION

The information supplied by DOS systems in the EREP printout is similar to that supplied by OS. The DOS output varies from the OS only in the content of the failing Channel/Unit Address. Information supplied by DOS running on S/370-125/115 is similar, but the format differs; see system and attachment manuals for details.

1 ENVIRONMENTAL INFORMATION
System-supplied information is provided at the top of each EREP page. The information describes the operating environment when the failure occurred.

2 PHYSICAL DRIVE
The physical drive field describes the Physical Address. See Device ID chart on MSG 32.

3 FAILING CHANNEL/UNIT ADDRESS
In the DOS output the failing Channel/Unit Address is the logical address of the drive and not the Physical Address.

4 NUMBER OF I/O RETRIES
This is the number of retries made by the System ERPs before the error was recorded.

5 VOLUME LABEL
The identification printed on the Volume Label of the data module in use when the failure was recorded. This information aids to determine whether the error is a hardware failure or a Data Module problem.

6 KEYWORDS
Indicates type of unit check.

7 FAULT (ERROR) SYMPTOM CODE
Using the Fault (Error) Symptom Code, refer to the Fault Symptom Index starting on FSI 100. If this field is set to 0000 (Sense Bytes 22 and 23), go to FSI 50 and manually generate the code.

8 FAILING CCW, CSW, LAST SEEK ADDRESS
This defines conditions at the time of the failure. Note that three separate page locations are used.

9 SENSE BYTE FORMAT
This field defines the Sense Byte Format used.

10 SENSE BYTES
See SENSE 100–104 for a description by format type.
See SENSE 109 for detailed description of error.

If an error becomes permanent, two entries are present in the history for the error.

SAMPLE OF DOS ENVIRONMENTAL INFORMATION (May vary with user system)

```
                                --- I/O DEVICE EDITING ---

                        TASK IDENTITY - ERPRUN                          DAY  YEAR          HH MM SS
1   RECORD TYPE - UNIT CHECK                                    DATE - 194   73     TIME - 08 28 28

    CPU MODEL 0145    SERIAL 010613
    DOS RELEASE LEVEL 29

3   FAILING CHANNEL/UNIT ADDRESS  01C4      DEVICE TYPE  3340

                 CC    DA    FL    CT                                        K    CA    US CS  CT
8   FAILING CCW  07 007CE8  40 00 0006                              8 CSW    10 0078F0  0E 00 0006

4   NUMBER OF I/O RETRIES - 00001
2   PHYSICAL DRIVE A
5   VOLUME LABEL - SJTC01
6   EQUIPMENT CHECK-DRIVE-TEMPORARY
7   ERROR SYMPTOM CODE - 1917

9   SENSE BYTE DATA FORMAT 1              8 LAST SEEK ADDRESS   M B B C C H H R
                                                                00 0000 0000 0000 00                  A

  BYTE 0   10    BYTE 1   00    BYTE 2   82    BYTE 3   00    BYTE 4   08    BYTE 5   00    BYTE 6   00    BYTE 7   10
 --------UNIT CHECK DESCRIPTION----------  RESTART CMWD  PHYSICAL ID    LOW CYLINDER   HI CYL/LOG TRK FORMAT/MSG

 COMMAND REJ 0  PERM ERROR  0  RPS PRESENT 1   00000000   DRIVE A    0  CYL 128    0                0  FORMAT  8   0
 INTERVN REQ 0  INV TRK FMT 0  CORRECTABLE 0              DRIVE B    0  CYL  64    0  CYL   512     0  FORMAT  4   0
 BUS OUT PAR 0  END OF CYL  0              0              DRIVE C    0  CYL  32    0  CYL   256     0  FORMAT  2   0
 EQUIPMNT CK 1                ENV DATA PR 0              DRIVE D    0  CYL  16    0                0  FORMAT  1   1
 DATA CHECK  0  NO REC FND  0              0              DRIVE E    1  CYL   8    0  LOG TRK 8     0  MESSAGE 8   0
 OVERRUN     0  FILE PROTCT 0  DATA MOD SZ 0              DRIVE F    0  CYL   4    0  LOG TRK 4     0  MESSAGE 4   1
 TRK COND CK 0  WRT INHIBIT 0  DATA MOD SZ 1              DRIVE G    0  CYL   2    0  LOG TRK 2     0  MESSAGE 2   1
 SEEK CHECK  0  OP INCOMPLT 0  DATA MOD SZ 0              DRIVE H    0  CYL   1    0  LOG TRK 1     0  MESSAGE 1   1

  BYTE 8   08    BYTE 9   0A    BYTE 10  60    BYTE 11  ED    BYTE 12  00    BYTE 13  80    BYTE 14  05    BYTE 15  8F
 DRIVE STATUS   DRIVE CK/STAT  SEQUENCE CNTRL LOAD SW STATUS  R/W SAFETY     CTL INT B OUT  CTL INT B IN   CTL INT TAG B

 CNTRLR CK   0  DM LD SW L  0  DM SIZE CK  0  DR START SW 1  MULTI-HD CK 0  BIT 0      1   BIT 0      0              1
 INTRFACE CK 0  SECT COM CK 0  MOD LATCH 4 1  DM PRES  SW 1  CAP/ENAB CK 0  BIT 1      0   BIT 1      0              0
 DRIVE CHECK 0  MOT SP AIR  0  MOD LATCH 2 1  COVER LK SW 1  WRITE OVRUN 0  BIT 2      0   BIT 2      0              0
 R/W CHECK   0  BELT SW L   0  MOD LATCH 1 0  DM UNLD  SW 0  INDEX CHECK 0  BIT 3      0   BIT 3      0              0
 ON LINE     1  WRT ENABLE 1  CHECK LATCH 0  DM LOAD  SW 1  R/W INTR CK 0  BIT 4      0   BIT 4      0              1
 MOD ATTENTN 0  DM SIZE   3 0  SEQUENCE CK 0  BELT SW     1  CONTROL CK  0  BIT 5      0   BIT 5      1              1
 BUSY        0  MODULE SZ 2 1  BIAS DSB SW 0  CARR HOME    0  TRANSINT CK 0  BIT 6      0   BIT 6      0              1
 SK/SCTR COM 0  MODULE SZ 1 0  ODD TRACK    0  MT SP AR SW 1  WRT CURT CK 0  BIT 7      0   BIT 7      1              1
10

  BYTE 16  1E    BYTE 17  01    BYTE 18  00    BYTE 19  00    BYTE 20  00    BYTE 21  00    BYTE 22  19    BYTE 23  17
 ACCESS STATUS  CNTRLR CKS     MICRO DETCD ER STATUS          INTERFACE CKS                 -----ERROR SYMPTOM CODE-----

 TIME-OUT CK 0  PLO CHECK   0              0  SET R/W     0  CTL TAG CK  0  00000000       00011001       00010111
 OVRSHOOT CK 0  NO PLO INPT 0              0              0  CTL B/O CK  0
 ACC OFF TRK 0  SER/DES CK  0              0              0  DEV SEL CK  0
 TRK CROSSNG 1  GAP CNTR CK 0              0              0  DEV B/I CK  0
 SERVO LATCH 1  WRT DATA CK 0  MESSAGE 8   0              0  CTL B/I CK  0
 LIN MOD LAT 1  MONITOR CK  0  MESSAGE 4   0              0  I WRT FAIL  0
 CONTROL LAT 1  ECC CHECK   0  MESSAGE 2   0              0  DEV B/O CK  0
 WAIT LATCH  0  ECC ZEROS   1  MESSAGE 1   0              0  DEV TAG CK  0
```

SYSTEM/3 ERAP TABLE DESCRIPTION

SYSTEM/3 ERAP TABLE DESCRIPTION

ERROR HISTORY TABLE

The history table provides for 63 entries and is recursive with no overflow or stop logic provided on recording. The 64th time an entry is made, it overlays the first entry. The 65th entry overlays the second, etc. Therefore, errors are printed in chronological order, oldest first.

Each entry in the error history table contains:

1. Q and R bytes of the SIO instruction issued at the time of the error.
2. Error byte W and X of the error condition.

For some devices, more data is recorded in the error history table than the Q, R, and error bytes W–X. This additional data is printed out and explained for each device.

Refer to ERAP in the System/3 Diagnostic Users Guide for additional information.

SYSTEM/3 ERAP TABLE DESCRIPTION

MSG 44

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION

DC power must be off prior to changing cards. Unless procedures state otherwise, do not restore power with cards missing; this can result in circuit damage or a "system hang" condition. Remove power as follows:

POWER DOWN PROCEDURE

Control Module (A2)

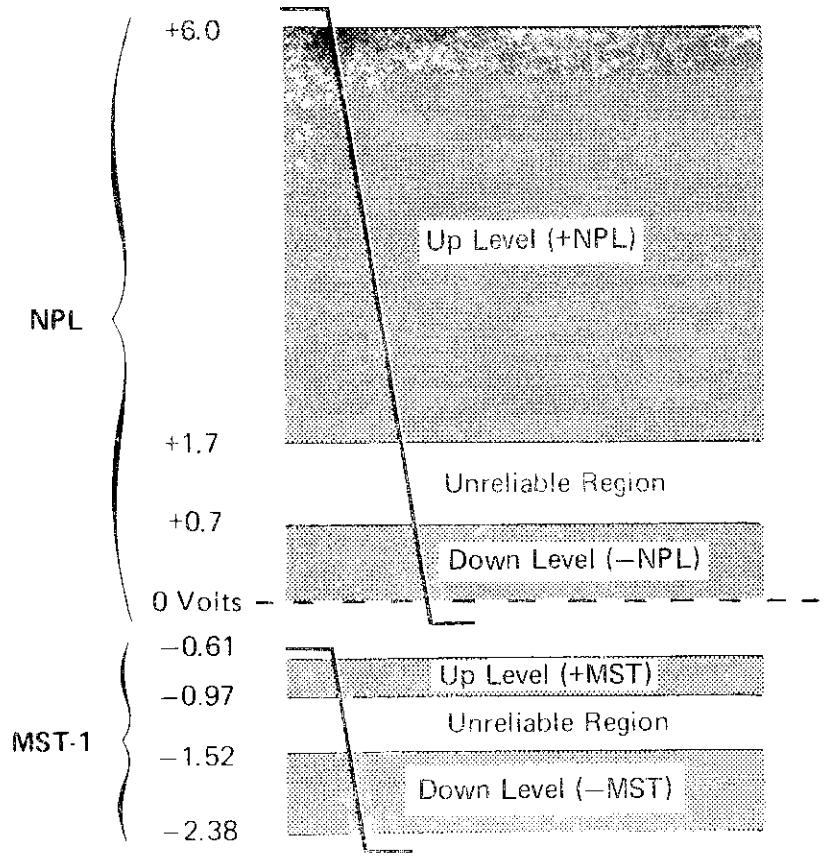
1. Turn the Start/Stop switch to STOP on every drive in the string.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Push the Power Off switch located on the Power Panel on the front of the 3340-A2. *Power is removed from the entire string: the 3340-A2 plus all attached 3340-B1s and B2s.*

Satellite Module (B1, B2)

1. Turn the Start/Stop switch to STOP on each drive in the satellite module to be powered down.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Turn off CP210 located on the AC compartment (accessible

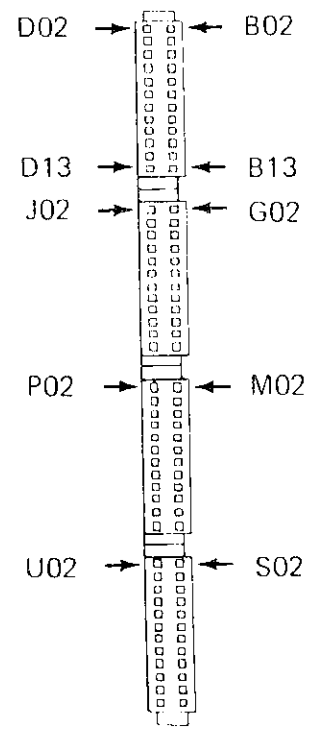
nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card	
Voltage	*Card (Contact Tab)*
−4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

KV010, 020 (drives)
BV100 (controller)

SENSE CONTENTS

Sense Data Summary

Bytes 0-7 and Messages – – – – – – – – – – – SENSE 100
Bytes 8-23 Format 1 – – – – – – – – – – – SENSE 101
Bytes 8-23 Format 4 – – – – – – – – – – – SENSE 102
Bytes 8-23 Format 5 – – – – – – – – – – – SENSE 103
Bytes 8-23 Format 6 – – – – – – – – – – – SENSE 104

Sense Data Description – – – – – – – – – – SENSE 105-110

Describes sense bytes, bits, and messages.

Fault Symptom Index – – – – – – – – – – – FSI Section

Describes how sense data is condensed into a Fault Symptom Code to assist in malfunction isolation.

Control and Device Interface Summary – – – – OPER 100, 101

Describes how sense and status information is collected by the various interface operations.

Note: Certain 3340 subsystems have a 3344 drive attached. If a 3344 drive is attached, go to the SENSE section in Volume R07 of the 3344 MLM for 3344 sense information. (3344 documentation will be available in May 1976).

SENSE CONTENTS SENSE 1

SENSE DATA SUMMARY (5 pages)

MLX A

BYTE / BIT

BYTE	0	1	2	3	4	5	6	7
0	Command Reject	Intervention Required	Chl Bus Out Parity	Equipment Check (Note 2)	Data Check (Note 2)	Overrun	Trk Condition Check	Seek Check (Note 2)
1	Permanent Error (Note 1)	Invalid Trk Format	End of Cylinder	Unused	No Record Found	File Protected (not used with System/3 DSA)	Write Inhibited	Operation Incomplete
2	RPS Feature Present	Correctable	Unused	Environmental Data Present	Unused	Data Module Size — 70F Fixed Head	Data Module Size — 70 Mb (Note 3)	Data Module Size — 35 Mb (Note 3)
3	RESTART COMMAND (Provided only when byte 1 bit 7, Operation Incomplete, is active) (System/3 = R Byte)							
4	PHYSICAL DRIVE IDENTIFICATION (System/3 = Q Byte) A	B	C	D	E	F	G	H
5	LOW ORDER LOGICAL CYLINDER ADDRESS 128	64	32	16	8	4	2	1
6	HIGH ORDER LOGICAL CYLINDER ADDRESS 512	256	and		Log. Trk. 8	Log. Trk. 4	Log. Trk. 2	Log. Trk. 1
7	FORMAT (bits 0-3 hex)				MESSAGE CODE (bits 4-7 hex)			

OR

0	1	2	3	4	5	6	7
*CURRENT SEEK ADDRESS							
128	64	32	16	8	4	2	1
*CURRENT SEEK ADDRESS							
512	256			8	4	2	1

If Seek Check active (byte 0, bit 7)

Current seek address is the last argument (address) issued to the device. Byte format remains the same as at right.

See Storage Control MLM for sense data and/or messages for Formats 0, 2, and 3. If the storage control is a System/3–3340 DSA, refer to the 3340 DSA T-MD manual for Formats 0 and 2.

3340 9 Storage Control MLX CHART

Notes:

1. *Set by ERPs.*
2. *Usually indicates a 3340 malfunction if byte 7, bits 0–3 equal '1', '4', or '5'.*
3. *If the storage control is a System/3–3340 DSA and a 12 Mb CE data module is installed, both bits 6 and 7 are zero.*

SENSE DATA SUMMARY **SENSE 100**

MESSAGES, determined by format and message code (byte 7)

MESSAGE CODE (Byte 7, bits 4-7 Hex)	FORMAT 1	FORMAT 4	FORMAT 5
0	No Message	HA field data check	Not used
1	Transmit target error	Count field data check	Not used
2	Microprogram detected error (defined by byte 18)	Key field data check	Not used
3	Transmit TSF Error	Data field uncorrectable data check	Data field correctable data check
4	Sync Out timing error	HA field no sync byte found	Not used
5	Unexpected drive status at initial selection	Count field no sync byte found	Not used
6	Transmit Cylinder Address Error (SWFE)	Key field no sync byte found	Not used
7	Transmit head error	Data field no sync byte found	Not used
8	Transmit difference error	Not used	Not used
9	Drive status not as expected during Read IPL	Not used	Not used
A	Seek verification check on physical address	Not used	Not used
B	Seek Incomplete or Sector Non-Compare	Not used	Not used
C	No interrupt from drive	Not used	Not used
D	Defect skipping re-orientation check	Not used	Not used
E	DM Incompatibility/ Invalid DM Size	Not used	Not used
F	Not used	Not used	Not used
	FORMAT 1	FORMAT 4	FORMAT 5

SENSE BYTES 8-23 — MESSAGES

To formats 1, 4, 5, 6

SENSE DATA SUMMARY **SENSE 100**

SENSE DATA SUMMARY (continued)

FORMAT 1

BYTE		BIT 0	1	2	3	4	5	6	7
Drive Status	8	Controller Check ✱	Device Interface Check ✱	Drive Check ✱	Read/Write Check ✱	On Line ✱✱	Data Module Attention	Busy	Seek Complete/ Search Sector
Checks, Status	9	Data Module Loaded Switch Latched ✱	Sector Compare Check ✱	Air/ Motor at Speed Latched ✱	Belt Switch Latched ✱	Write Enable	Data Module Size '3' Bit Fixed Head	Data Module Size '2' Bit —70 Mb	Data Module Size '1' Bit —35 Mb
DM Seq. Control	10	Data Module Size Check ✱	Data Module Latch 4 ✱✱	Data Module Latch 2 ✱✱	Data Module Latch 1	Check Latch ✱	Data Module Sequence Check Latched ✱	Bias Disable Switch	Odd Track
Load Sw Status	11	Drive Start Switch ✱✱	Data Module Present Switch ✱✱	Cover Locked Switch ✱✱	Data Module Unloaded Switch	Data Module Loaded Switch ✱✱	Belt Switch ✱✱	Carriage Home	Air/ Motor at Speed Switch ✱✱
R/W Safety	12	Multiple Head Select Check ✱	Capable/ Enable Check ✱	Write Overrun ✱	Index Check ✱	R/W Interlock Check ✱	Control Check ✱	Transition Check ✱	Write Current Check ✱
	13	CONTROL INTERFACE BUS OUT (For Message Code C) (For Message Code 2, See 1)				EXPECTED DRIVE STATUS/DATA (For Message Codes 1,3,5,6,7,8,&9)			
	14	CONTROL INTERFACE BUS IN (At the time an error was detected)							
	15	CONTROL INTERFACE TAG BUS (At the time an error was detected)							
Access Status	16	Access Time Out Check ✱	Overshoot Check ✱	Servo Off-Track Check ✱	Track Crossing ✱✱	Servo Latch ✱✱	Linear Mode Latch ✱✱	Control Latch ✱✱	Wait Latch
Controller Checks	17	PLO Check ✱	No PLO Input ✱	SERDES Check ✱	Gap Counter Check ✱	Write Data Check ✱	Monitor Check ✱	ECC Check ✱	ECC Zeros Detected ✱✱
Micro Detected Errors	18				CODED ERROR CONDITION (Bits 4-7 hex)				
Status	19	Set R/W on					Low Gain Error ✱		Fixed Head Feature
Interface Checks	20	Control Interface Tag Bus Parity Check ✱	Control Interface Bus Out Parity Check ✱	Drive Selection Check ✱	Device Bus In Parity Check ✱	Control Interface Bus In Parity Check ✱	I Write Fail ✱	Device Bus Out Parity Check ✱	Device Tag Parity Check ✱
	21								
	22	FAULT SYMPTOM CODE							
	23	FAULT SYMPTOM CODE							

OR

5	6	7
I Write Sense	Index Mark	Active Track

If Set R/W is active (byte 19, bit 0)

OR

0	1	2	3	4	5	6	7
***PREVIOUS SEEK ADDRESS							
Low Logical Cylinder Address							
128	64	32	16	8	4	2	1

OR

0	1	2	3	4	5	6	7
***PREVIOUS SEEK ADDRESS							
High Logical Cylinder Address				Logical Track Address			
512	256			8	4	2	1

If Seek Check is active (byte 0, bit 7)

***Previous seek address is the address at which the drive was located prior to the last issued seek argument (bytes 5 and 6).

OR

0	1	2	3	4	5	6	7
PRESENT ADDRESS (Read from disk)							
Low Logical Cylinder Address							
128	64	32	16	8	4	2	1

OR

0	1	2	3	4	5	6	7
PRESENT ADDRESS (Read from disk)							
High Logical Cylinder Address				Logical Track Address			
512	256			8	4	2	1

If Seek Check active (byte 0, bit 7)

CODED ERROR CONDITION (Bits 4-7 Hex)	Microprogram Error Messages, determined by Sense Byte 18, bits 4-7
0	Unused
1	No Tag Valid on R/W Op (A)
2	No Normal or Check End on R/W Op or on ECC Op
3	No response from controller (A) on Control Op
4	Time-out waiting for Index or Active Track
5	ECC Hardware Check (A)
6	Multiple or no controllers (A) selected
7	Preselection Check/Short Bus Time Expired
8	Head Switch Timer Expired check
9	Busy missing after Seek Start is issued
A	Incorrect drive selected
B–E	Unused
F	Attention Check

✱ Indicates an error condition detected.

✱✱ Indicates bits normally on with no error condition. Ready lamp on and DM sequence at State 6.

1 Bytes 13, 14, and 15 will be valid for microprogram error messages identified by (A)

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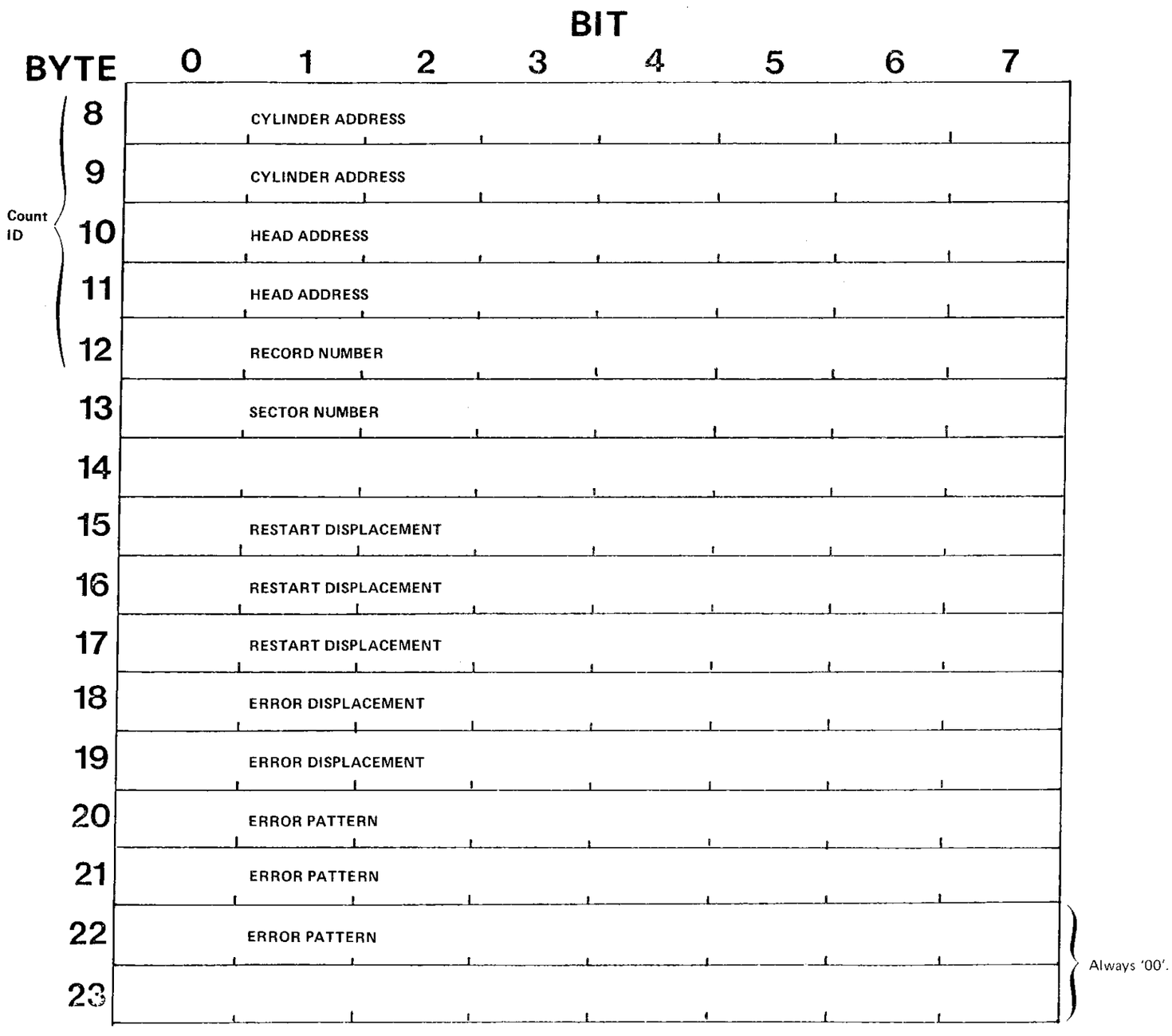
FORMAT 4

BYTE	BIT 0	1	2	3	4	5	6	7	
Count ID 8	CYLINDER ADDRESS								Last Count Field successfully read. (Previous Count Field read with error 4941 or 4945).
9	CYLINDER ADDRESS								
10	HEAD ADDRESS								
11	HEAD ADDRESS								
12	RECORD NUMBER								
13	SECTOR NUMBER								
14									
15									
16									
17									
18									
19									
20									
21									
22	FAULT SYMPTOM CODE (Always '49')								494X
23	FAULT SYMPTOM CODE (Always '4X')								

FORMAT 5



SENSE DATA SUMMARY (continued)

FORMAT 6

BYTE	BIT 0	1	2	3	4	5	6	7
8	NUMBER OF BYTES READ OR SEARCHED (Key and Data Fields Only)							
9	NUMBER OF BYTES READ OR SEARCHED (Key and Data Fields Only)							
10	NUMBER OF BYTES READ OR SEARCHED (Key and Data Fields Only)							
11	NUMBER OF BYTES READ OR SEARCHED (Key and Data Fields Only)							
12								
13								
14								
15								
16	NUMBER OF SEEK COMMANDS PROCESSED ('7F' maximum)							
17	NUMBER OF SEEK COMMANDS PROCESSED ('FF' maximum)							
18	Channel select for bytes 20-23							
19								
20	COMMAND OVERRUNS	CHANNEL A if byte 18 bit 0 is 0 CHANNEL C if byte 18 bit 0 is 1						
21	DATA OVERRUNS	CHANNEL A if byte 18 bit 0 is 0 CHANNEL C if byte 18 bit 0 is 1						
22	COMMAND OVERRUNS	CHANNEL B if byte 18 bit 0 is 0 CHANNEL D if byte 18 bit 0 is 1						
23	DATA OVERRUNS	CHANNEL B if byte 18 bit 0 is 0 CHANNEL D if byte 18 bit 0 is 1						

Not device-dependent information. See Storage Control maintenance documentation.

3340 7 Storage Control MLX CHART

If storage control is a System/3—DSA, this area is not used.

Sense Byte 0

Sense Bytes 0 through 2 are generated when a Unit Check is presented. These bytes describe the error condition and identify specific action to effect subsystem error recovery.

BIT 0—COMMAND REJECT

Sense Byte 7 identifies the error condition in more specific terms. Any one of the following conditions cause this bit to be generated:

a. Invalid command code or a command associated with an uninstalled feature has been issued.

b. Invalid command sequence.

c. Invalid or incomplete argument has been transferred by a control command.

d. Track formatted without a home address.

e. Write portion of the file mask is violated.

f. A Write command was issued to a drive that had a data module in place with its Write Enable latch removed. Byte 1, bit 6 (Write Inhibited) is also set.

BIT 1—INTERVENTION REQUIRED

This bit indicates that the addressed device is:

a. Not physically attached to the system.

b. Not online.

c. A Diagnostic Write or Load CCW is issued while an inline microdiagnostic is resident in the control storage.

d. 70F data module loaded on a basic 3340.

BIT 2—CHANNEL BUS OUT PARITY

The storage control has detected bad parity in data transferred from the channel. A parity error detected during command transfer is a Bus Out check and not a Command Reject.

BIT 3—EQUIPMENT CHECK

An unusual hardware condition originated in the channel, storage control, controller, or drive. (The conditions of this bit are defined in Sense Bytes 7 through 23).

BIT 4—DATA CHECK

a. A correctable data error has been detected in information received from the drive. (Byte 2, bit 1 on, correction information is provided in Sense Bytes 15 thru 21).

b. An uncorrectable data error has been detected in information received from the drive. (Condition further defined in Sense Byte 7.)

BIT 5—OVERRUN

a. A channel response to a data transfer request was not received in time by the storage control.

b. A command from the channel was received too late to be properly executed.

Detection of an overrun causes an immediate stop of data transfer. When writing, the remaining portion of the record area is padded out with zeros.

BIT 6—TRACK CONDITION CHECK

This bit is set whenever:

a. Any single track command other than Search HA, Read HA, or Read R0 is executed on a defective track.

b. Any multitrack command or overflow operation other than Search HA, Read HA, or Read R0 switches to a defective track.

c. Any multitrack command, including Search HA, Read HA, or Read R0, or Overflow Record operation that attempts to switch from an alternate or defective track is known by the storage control to be alternate or defective. The storage control knows if a track is an alternate or defective only if some single track Read or Search operation has been executed on the track in the current CCW chain, and no control command other than No-Op has been executed since the single track Read or Search command.

BIT 7—SEEK CHECK

The drive has been unable to successfully complete a Seek operation due to an equipment failure that prevented the access mechanism from positioning correctly. This condition is detected by the drive that presents a Seek Incomplete indication or by the storage control when it detects an incorrect physical address when reading Home Address or Count areas.

This bit is also posted when Capable/Enable Check (Format 1, Byte 12, bit 1) is on indicating the access mechanism is not track-following properly.

Sense Byte 1

BIT 0—PERMANENT ERROR

Set by ERPs when the specified number of retry actions is exhausted.

BIT 1—INVALID TRACK FORMAT

An attempt was made to write data exceeding track capacity. This bit is also posted during a Read or Search operation when the index point is detected in either the gap after a count or key field. This indicates a programming error or an expected programming condition has been detected.

BIT 2—END OF CYLINDER

One of the following conditions has occurred:

a. A multitrack Read or Search operation has attempted to continue beyond the addressable cylinder boundary.
b. An overflow operation has attempted to continue beyond the addressable cylinder boundary. Operation Incomplete (Byte 1, bit 7) is also included.

End of Cylinder indicates a programming error or an expected programming condition has been detected.

System/3—DSA:

Can only occur if adapter encounters the end of the last cylinder on the data module during a multitrack operation. This occurs on an attempted head switch from cylinder 209 head 7 to cylinder 209 head 8.

BIT 3—UNUSED

BIT 4—NO RECORD FOUND

One of the following has occurred:

a. The index point at the beginning of the selected logical track has been detected twice in the same command chain without an intervening Read operation in the home address area or in a data area.
b. The index point at the beginning of the selected logical track has been detected twice in the same command chain without an intervening Write, Sense, or Control command.

The storage control always verifies that the access mechanism is positioned properly before posting this bit. This bit indicates a programming error or an expected programming condition has occurred.
See OPER 234 for detailed description if no record found.

BIT 5—FILE PROTECTED

Note: If the storage control is a System/3—DSA, message does not apply.

One of the following has occurred:

a. A Seek command has violated the File Mask. Includes seek to a CE track when mask bit 5=0.

b. A multitrack Read or Search operation has violated the File Mask.

c. An overflow operation has violated the Seek portion of the File Mask. Operation Incomplete (Byte 1, bit 7) is also set.

File Protected indicates a programming error or expected programming condition has been detected.

BIT 6—WRITE INHIBITED

A Write command was received for a drive that had a data module installed with its Read Only Interlock set on in the data module. Command Reject is also set.

BIT 7—OPERATION INCOMPLETE

Note: If storage control is a System/3—DSA, only item d applies.

One of the following has occurred during the processing of an Overflow Record operation:

a. Overflow to a file-protected boundary. File Protected (Byte 1, bit 5) is also set.

b. Overflow past the cylinder boundary. End of Cylinder (Byte 0, bit 2) is also set.

c. A correctable Data Check was detected in the data field other than the last segment. Data Check (Byte 0, bit 4) and Correctable (Byte 2, bit 1) are also set.

d. A defective or alternate track condition is detected after initiation of data transfer. Track Condition Check (Byte 0, bit 6) is also set.

Sense Byte 3 provides the Restart Command.

Sense Byte 2

BIT 0—RPS FEATURE PRESENT

The Rotation Position Sensing (RPS) feature is installed in the selected drive.

SENSE DATA DESCRIPTION (Continued)

BIT 1—CORRECTABLE

Indicates the data field Data Check posted in byte 0, bit 4 is correctable. Sense Bytes 15 thru 22 identify the error pattern, error pattern displacement and restart displacement.

BIT 2—NOT USED

BIT 3—ENVIRONMENTAL DATA PRESENT

Indicates Sense bytes 8 through 23 have usage counter statistics under Format 6. Usage statistics include the number of bytes read/searched, number of overruns by channel, and number of access motion seeks.

BIT 4—NOT USED

BIT 5—DATA MODULE SIZE

This bit indicates that the fixed-head data module is installed (Model 70F).

BIT 6 AND 7—DATA MODULE SIZE

These two bits define the capacity of the selected data module. Bit 7 on equals 35 megabytes. Bit 6 on equals 70 megabytes.

Note: If the storage control is a System/3—DSA and the 12 Mb CE data module is installed, both bits 6 and 7 are zero.

Sense Byte 3

BITS 0 THRU 7—RESTART COMMAND

This byte is provided when Operation Incomplete (Byte 1, bit 7) is set. This byte identifies the operation in progress when the interrupt occurred. The system recovery program uses this command, along with CSW information, to construct a new CCW. The new CCW is issued to the storage control, after correcting the unusual conditions, to continue the operation following the point of interruption.

When Operation Incomplete is set, the Restart command is set to '06' to indicate a Read operation was in progress, or '05' to indicate a Write operation. Sense Byte 3 is zero when Operation Incomplete is not set.

Sense Byte 4

PHYSICAL DRIVE IDENTIFICATION

This byte identifies the physical drive that was selected when Unit Check was generated. The format of byte 4 is as follows:

Bit Number	Physical Address
Bit 0	Drive A
Bit 1	Drive B
Bit 2	Drive C
Bit 3	Drive D
Bit 4	Drive E
Bit 5	Drive F
Bit 6	Drive G
Bit 7	Drive H

Sense Byte 5

BITS 0 THRU 7—LOW LOGICAL CYLINDER

This byte identifies the low order eight bits of the cylinder address of the most current seek argument.

Sense Byte 6

BIT 0—NOT USED

BIT 1—LOGICAL CYLINDER HIGH

High-order bit (512) of cylinder address in sense byte 5.

BIT 2—LOGICAL CYLINDER HIGH

High-order bit (256) of cylinder address in sense byte 5.

BIT 3—NOT USED

BITS 4 THRU 7—LOGICAL TRACK

Identifies logical track of last seek (excluding retry seeks). Head address is updated during multitrack and overflow operations. (See OPER 12.)

If an alternate track condition is detected and Operation Incomplete is posted during an overflow operation, Byte 6 is set to the head address of the defective track plus 1. This information is used by the ERPs to construct the seek argument to continue the operation.

Sense Byte 7

BITS 0 THRU 3—FORMAT

Bits 0 thru 3 of Sense Byte 7 identifies the specific format of the remaining Sense Byte (8—23). See Storage Control MLM for sense data for Formats 0, 2, and 3.

If the storage control is a System/3—DSA, refer to the 3340 DSA T-MD manual for sense data for Formats 0 and 2.

BITS 4 THRU 7—MESSAGE CODE

Bits 4 thru 7 of Sense Byte 7 provide an encoded message which describes the specific nature of the error condition.

FORMAT 1—DRIVE EQUIPMENT CHECKS

This format is generated under the following conditions:

a. Detection of drive, Device Interface, or controller equipment checks. Byte 0, bit 3 (Equipment Check) is set.
b. No online indication in file status (Byte 8, bit 4). Byte 0, bit 1 (Intervention Required) is set.
c. Detection of seek errors. Byte 0, bit 7 (Seek Check) is set.

Sense Byte 8—Drive Status

BIT 0—CONTROLLER CHECK

One of the following errors has occurred:

a. No PLO Input. (See Format 1, Byte 17, bit 1). Three successive PLO pulses were missing.
b. Bus Out Parity Check
c. Device Bus In Parity Check
d. Shift Register error
e. Write Data Check
f. ECC Hardware Check
g. Tag Bus Parity Check
h. Check 1 of 8 (Drive Select Check)
i. Gap Counter Check
j. PLO Check (See Format 1, Byte 17, bit 0).
k. Monitor Check (See Format 1, Byte 17, bit 5).

BIT 1—DEVICE INTERFACE CHECK

A Device Tag Bus or Device Bus Out parity error has been detected. Details can be determined using the Sense Interface Tag.

BIT 2—DRIVE CHECK

One or more of the following check conditions has occurred in the drive:

a. Data module sequence error.
b. Access error.
c. Sector non-compare check (RPS only).

The conditions causing Drive Check are reset by Check Reset and CE Reset.

BIT 3—READ/WRITE CHECK

Read/Write Safety circuits have detected a condition that could endanger data integrity. These conditions are:

Multiple heads selected
Write current while reading
No write current while writing
No transitions while writing data
Overrun while writing
Set Read/Write while not read/write capable (Not track following)
Write Gate on while Write Enable is off
Write Gate on while Active Track is off
Read Gate and Write Gate on together
Write Gate and Unsquelch on together
Address Mark Control on without Read Gate
Read/Write Interlock not present
Index Check.
Low Gain controls incorrect while reading (FHFE only).

BIT 4—ONLINE

The drive switch is on, a data module is in the drive in Ready State 6, and the initial Rezero was successful. Online is active until the data module leaves Ready State 6.

BIT 5—DATA MODULE ATTENTION

If Byte 19 bit 0 = 0:
A Data Module has been brought to the ready condition following a Sequence Start signal, the drive Start/Stop switch being turned on, or an actuation of the Attention pushbutton. The Read/Write heads are positioned over track 0 with the Diff Counter, HAR, and CAR (when present) reset when this signal is present.

If Byte 19 bit 0 = 1:
The drive in Read/Write Mode has sensed that Write Current is present at the Read/Write Head.

BIT 6–BUSY

If Byte 19 bit 0 = 0:
The drive is performing a Rezero, Seek, or Search Sector operation. Busy is turned off by Seek Complete Sector Complete. For a Search Sector operation, Busy is present again after Sector Compare has dropped if no Attention Reset is given. Bit 6 in combination with bit 7 indicates the following:

- Bits 6 and 7 off – Seek or Search Sector is not active.
- Bit 6 off and bit 7 on – Seek or Sector Compare Complete generates an interrupt.
- Bit 6 on and bit 7 off – Busy – Seek in progress.
- Bits 6 and 7 on – Busy – Search Sector in progress.

If Byte 19, bit 0 = 1:
The drive in Read/Write Mode has detected an Index Mark.

BIT 7–SEEK COMPLETE/SEARCH SECTOR

If Byte 19, bit 0 = 0:
A Seek or Rezero operation initiated by the controlling system has been completed or a Search Sector operation is in progress. It is a result of one of the following conditions. For information on bit 7 in combination with bit 6, see bit 6 – Busy.

SEEK COMPLETE: This is the normal end of a Seek or Rezero operation initiated by the controlling system; the specified track has been reached and Drive Check is off.

SEEK INCOMPLETE: This is the abnormal end of a Seek or Rezero operation and is indicated by Drive Check (Byte 8, bit 2) appearing with Seek/Sector Complete. The access mechanism is in an undefined state.

If Byte 19, bit 0 = 1:
The drive in Read/Write Mode has sensed that Active Track is present. Active Track is present if Head Address Register Bit 7 is off during the even half track or that Head Address Register bit 7 is on during the odd half track.

Sense Byte 9–Checks/Status

BIT 0–DATA MODULE LOADED SWITCH LATCHED

Indicates that the switch has failed while the drive was in ready state.

BIT 1–SECTOR COMPARE CHECK

This check is used only when RPS is installed. It indicates that two index marks have been detected without an intervening Sector Compare while performing a Search Sector operation.

BIT 2–AIR/MOTOR-AT-SPEED SWITCH LATCHED

Indicates that the switch has failed while the drive was in a Ready state.

BIT 3–BELT SWITCH LATCHED

Indicates that the switch has failed while the drive was in a Ready state.

BIT 4–WRITE ENABLE

Indicates that the Read Only Lock on the data module is in the condition to allow writing.

BIT 5–DATA MODULE SIZE 3 BIT

Indicates that fixed-head DM is installed (Model 70F).

BITS 6 AND 7–DATA MODULE SIZE 2 AND 1 BITS

These two bits define the capacity of the selected data module. Bit 6 on indicates a 70 megabyte data module. Bit 7 on indicates a 35 megabyte data module.

Sense Byte 10–DM Sequence Control

BIT 0–DATA MODULE SIZE CHECK

Indicates that a parity error has occurred in the data module size bit code. This bit is generated if a DM connector or a DM size jumper failure occurs.

BITS 1 THRU 3 –DATA MODULE SEQUENCE LATCHES 1, 2, AND 4

The condition of these latches indicates the state of the data module sequencer.

BIT 4–CHECK LATCH

Indicates that more than 10 seconds has elapsed between DM Sequencer Control States during loading or unloading sequences.

BIT 5–DATA MODULE SEQUENCE CHECK LATCH

An error condition of this bit (on/off) along with bits 1-3 indicates the load/unload state of the data module.

BIT 6–BIAS DISABLE SWITCH

Voice Coil Motor bobbin bias is missing during a data module load/unload operation.

BIT 7–ODD TRACK

If on, the current physical cylinder address is odd. If off, the current physical cylinder address is even. This bit also represents the low order bit of the cylinder address.

Sense Byte 11–Loaded Switch Status

BITS 0 THRU 7–SWITCH STATUS

Indicates the state of the interlock switches for all states of the data module sequencer. The condition of each switch is latch stored for read out whenever an interlock fails when the drive is Ready or whenever a Data Module Sequence Check occurs during data module load/unload sequencing. Refer to SENSE 101 for the names of the switches.

Sense Byte 12–Read/Write Safety

BIT 0–MULTIPLE HEAD SELECT CHECK

More than one head has been selected in the selected drive.

BIT 1–CAPABLE/ENABLE CHECK

One of the following conditions has occurred:

a. Set Read/Write was present while the drive was not read/write capable (track following).
b. Writing was attempted on a data module which was in the Read Only condition.
c. Writing was attempted on a data module while Active Track was not present.

BIT 2–WRITE OVERRUN

Writing through an index mark has been attempted. It is permissible to write into or out of an index mark, but not both.

BIT 3–INDEX CHECK

An invalid index mark was detected while Set Read/Write was present.

BIT 4–R/W INTERLOCK CHECK

Indicates that read/write cards or cables may be loose or missing.

BIT 5–CONTROL CHECK

One of the following conditions has occurred:

a. The Write Gate signal has been present with the Unsquelch or Read Gate signals.
b. Address Mark Control has been present without Read Gate.

BIT 6–TRANSITION CHECK

One of the following conditions has occurred:

a. Write transitions were not detected 4 microseconds (nominally) after Write Gate was turned on.
b. Write transitions were not present when Write Gate was turned off.
c. Write transitions were detected while reading.

BIT 7–WRITE CURRENT CHECK

One of the following conditions has occurred:

a. No Write Current was detected during a Write operation.
b. Write Current was detected while not writing.

Sense Byte 13–Control Interface Tag Bus

This byte identifies the contents of CTL Bus Out at the time the error is detected for message code C and for message code 2 when byte 18 equals 1, 3, 5, or 6. It also identifies the expected drive status/data for message codes 1, 3, 5, 6, 7, 8, and 9. If Seek Check (Byte 0, bit 7) and message codes A or B occur, this byte contains the seek argument (low order logical cylinder) issued prior to the current argument (Byte 5).

Sense Byte 14–Control Interface Bus In

This byte identifies the contents of CTL Bus In at the time the error is detected. If Seek Check (Byte 0, bit 7) and message A or B occur, this byte contains the seek argument (high order/logical cylinder/logical track) issued prior to the current argument (Byte 6).

Sense Byte 15–Control Interface Tag Bus

Identifies the contents of the CTL Tag Bus at the time the error is detected.

Sense Byte 16–Access Status

BIT 0–ACCESS TIMEOUT CHECK

An access operation (Seek or Rezero) was not completed within 250 milliseconds and has therefore been terminated, or Seek Start was issued to the drive while the servo was not track following.

SENSE DATA DESCRIPTION (Continued)

BIT 1—OVERSHOOT

During a Seek or Rezero operation, one of the following events caused a Drive Check:

a. Three track crossings have been detected after the Difference Counter decremented to zero.
b. Three track crossings have been detected after the Access Control advanced to Linear Mode.
c. A Seek operation moved the carriage into the rezero pattern area.
d. A Seek operation moved the carriage into the Home photo cell area.

BIT 2—SERVO OFF-TRACK CHECK

The Servo has moved off-track during a Read or Write operation. A Rezero operation is required to reset this bit.

BIT 3—TRACK CROSSING

The access mechanism has crossed a track. This bit is used by the microdiagnostics to count track crossings during Seek or Rezero operations.

BITS 4 THRU 7—ACCESS CONTROL

These bits indicate the current state of the access control. Depending on which latch is on, the Access Control may be in any one of nine states. Refer to OPER 117 for a more detailed explanation of these bits.

Sense Byte 17—Controller Checks

BIT 0—PLO CHECK

One of the following errors has occurred:

a. Two successive PLO pulses were out of phase with the VFO Oscillator on a Write operation.
b. Three successive PLO pulses were missing on a Write operation.
c. A phase error was detected in the PLO.

BIT 1—NO PLO INPUT

Three successive PLO pulses were missing on a Write operation. This also causes a PLO check.

BIT 2—SERDES CHECK

SERDES Shift Register Parity did not match its predicted parity.

BIT 3—GAP COUNTER CHECK

Incorrect parity was detected in the Gap Counter.

BIT 4—WRITE DATA CHECK

A parity error was detected at the output of the SERDES Shift Register.

BIT 5—MONITOR CHECK

An error has occurred in the Bit Ring and associated hardware for a period of three servo pulses.

BIT 6—ECC CHECK

One of the following errors occurred:

a. An odd number of ECC Shift Register bits at B time.
b. Missing C pulse to the Shift Register.
c. Missing B pulse to the Shift Register.

BIT 7—ECC ZEROS DETECTED

Used to validate the control function during the ECC Control operation.

Sense Byte 18—Microprogram Detected Errors

BITS 0 THRU 3—NOT USED

BITS 4 THRU 7

Contain the error condition in hex code. The error conditions are as follows:

HEX 1 — Tag Valid missing on Read/Write operation. Indicates Tag Valid was not received from the controller in response to the issuance of a Read/Write operation. Bytes 13-15 are valid.

HEX 2 — No Normal or Check End on R/W ECC Operation. Indicates that neither Normal End nor Check End was received from the controller at the end of a Read, Write, or ECC operation. Bytes 13-15 are zero.

HEX 3 — No Response from Controller on Control Operation. Indicates that neither Tag Valid, Normal End, nor Check End was received from the controller in response to the issuance of an operation other than a Read/Write operation. Bytes 13-15 are valid.

HEX 4 — Time Out Waiting for Index or Active Track (40 ms time-out). Indicates that Index was not received from the controller, that it failed to drop, or that Active Track failed to occur. Bytes 13-15 are zero.

HEX 5 — ECC Hardware Check. Indicates one of the following:

a. Ending status was presented by no ECC Zeros detected.
b. Both ECC pattern bytes are equal to zero.
c. Bus In bit 4 under Check End was on without Bus In bit 3 to indicate an ECC Data Check.

Bytes 13—15 are valid.

HEX 6 — Multiple or no controllers selected. Indicates that a controller or drive selection command was issued and it was found that more than one controller was selected, or no controllers were selected. Bytes 13-15 are valid.

HEX 7 — Preselection Check or Short Busy timer expired. Indicates one of the following lines was active prior to selection:

a. Selected Alert 1 (Error Alert)
b. Select Active
c. Index Alert
d. Sync In
e. Normal End
f. Check End
g. Tag Valid

Bytes 13—15 are zero.
Shor Busy timer expired.

On machines with string switch feature, a busy response (index alert) was received for successive select tags for more than 1 millisecond.

HEX 8 — Head Switch Timer Expired Check. Indicates that an unexpected Check End was detected during a Read G1 Head Switch operation before Home Address data transfer was initiated. Bytes 13-15 are zero.

HEX 9 — Busy Missing After Seek Start is issued. Indicates that the drive failed to go Busy when Seek Start was issued for a non-zero cylinder difference seek. Bytes 13-15 are zero.

HEX A — Incorrect Drive Selected. Indicates that the physical address returned after the drive selection was incorrect. Bytes 13-15 are zero.

HEX B THRU E — Not used.

HEX F — Attention Check. An Attention failed to reset following an Attention Reset operation. Bytes 13-15 are zero.

Sense Byte 19—Status

BIT 0—SET READ/WRITE

Indicates that storage control has issued a Set Read/Write (Tag '85').

BITS 1 THRU 4—NOT USED

BIT 5—LOW GAIN ERROR
Indicates the low gain controls aren't correct while reading.

BIT 6—NOT USED

BIT 7—FIXED HEAD
Indicates that fixed-head feature is installed on this machine.

Sense Byte 20—Interface Checks

BIT 0—CONTROL INTERFACE TAG BUS PARITY CHECK

A parity error was detected on the Control Interface Tag Bus while Tag Gate was active.

BIT 1—CONTROL INTERFACE BUS OUT PARITY CHECK

A parity error was detected on the Control Interface Bus Out while Tag Gate was active.

BIT 2—DRIVE SELECTION CHECK

Indicates that more than one drive has been selected.

BIT 3—DEVICE BUS IN PARITY CHECK

A parity error was detected on Device Bus In.

BIT 4—CONTROL INTERFACE BUS IN PARITY CHECK

The controller detected bad parity on the control Interface Bus In.

BIT 5—I WRITE FAIL

The controller failed to detect I Write Sense from the device within approximately 9 microseconds after the rise of Write Gate.

BIT 6—DEVICE BUS OUT PARITY CHECK

A parity error has been detected on the Device Bus Out.

BIT 7—DEVICE TAG BUS PARITY CHECK

A parity error has been detected on the Device Tag Bus.

Sense Byte 21—Used Only on Seek Check

If Seek Check (Byte 0, bit 7) and Message A (Seek Verification on Physical Address) occur, this byte contains the high-order logical cylinder/logical track of the track selected.

SENSE DATA DESCRIPTION (Continued)

Bytes 22 and 23—Fault Symptom Code

These bytes contain a hex code that provides entry to the Fault Symptom Index (FSI). The FSI lists possible failures and references MAPs. The symptom code is a number generated from sense data by the storage control. The storage control places the code in Sense bytes 22 and 23 in sense data Formats 1 and 4. FSI 50 shows how a Fault Symptom Code is generated by analyzing sense information.

FORMAT 1—MESSAGES

Message 0—Not Used

Message 1 —Transmit Target Error

Generated after a Read Back check of the drive Target register detects that the Target register was improperly loaded on a Set Sector operation. Applies only if the RPS feature is installed.

Message 2—Microprogram Detected Errors

Generated by the microprogram as defined in Sense Byte 18.

Message 3—Transmit TSF Error (FHFE only)

Generated after a read back check of Sense Status 0 detects that the Detection bit and the Difference Count 256 were improperly loaded on a Set TSF command.

Message 4—Sync Out Timing Error

Generated when the controller posts data overrun (bit 1 on Bus In when Check End is posted during a read operation).

Message 5—Unexpected Drive Status at Initial Selection

Generated whenever the subsystem receives status that is not expected from the drive during initial selection.

Message 6—Transmit Cylinder Address Error

Generated after a Read Back check of the drive cylinder address register (CAR) detects that CAR was improperly loaded. CAR is installed only in machines with the String Switch feature.

Message 7—Transmit Head Error

Generated after a Read Back check of the drive Head Address Register (HAR) detects that HAR was improperly loaded on a Seek operation.

Message 8—Transmit Difference Error

Generated after a Read Back check of the Difference Register detected that the register was improperly loaded on a Seek operation.

Message 9—Drive Status Not as Expected During Read IPL

Note: If the storage control is a System/3 DSA, message is not used.

Generated whenever the storage control does not receive expected file status during the execution of a Read IPL command. The drive status which is checked after the internal recalibrate should be Online and Seek Complete.

Message A—Seek Verification Check on Physical Address

Generated whenever the storage control detects a difference between the current seek address and the physical address read drom the Home Address and Count areas of the data module.

Message B—Seek Incomplete/Sector Non-compare

SEEK INCOMPLETE

Generated when the drive has been unable to successfully complete a seek operation. An equipment failure occurred which prevented the access mechanism from positioning correctly. Seek Check (byte 0, bit 7) is set.

SECTOR NON-COMPARE

Note: If the storage control is a System/3 DSA, this description does not apply.

Generated if the drive failed to detect a sector compare between two index marks. Equipment Check (Byte 0, bit 3) is set.

Message C—No Interrupt From Drive

Generated whenever the storage control does not receive an interrupt from the drive within a specified time. This condition can only occur on an internal recalibrate associated with a Read IPL command.

If the storage control is a System/3 DSA, this message is posted if a time-out occurs during a Seek (including a hidden seek). A hidden seek occurs during a multiple record operation, and a seek to the next higher cylinder is required.

Message D—Defect Skipping/Reorientation Check

Note: If the storage control is a System/3 DSA, message is not used.

Generated by the storage control if Check End or Error Alert is received from the controller during the Re-orient operation.

Message E—Data Module Incompatability or Invalid DM Size.

Generated by the storage control for the following conditions:

- Detection of a fixed-head data module on a drive not equipped with the fixed-head feature. Intervention required is indicated in sense byte 0, bit 1.
- Detection of an invalid combination of data module size bits (sense status) bits 5 and 6. Equipment check is indicated in sense byte 0 bit 3.
- If the Storage Control is a System/3—3340 DSA: Detection of wrong data module size. Intervention Required is indicated in Sense Byte 0, Bit 1.
- If the Storage Control is a System/3—3340 DSA: Detection of invalid combination of Bits 5, 6, and 7 in Sense Byte 9, (all zeros). Equipment Check is indicated in Sense Byte 0, Bit 3.

Message F—Not Used

FORMAT 4—DATA CHECKS NOT PROVIDING DISPLACEMENT INFORMATION

This format is generated under the following conditions:

a. Detection of ECC uncorrectable errors in the data field.
b. Detection of ECC data errors in the Count, Key, or Home Address field. The message code in Byte 7 identifies the field that exhibits the error.

Bytes 8 Thru 12—Count ID

Bytes 8—12 contain the record ID (CCHHR) as obtained from the count field of the record in which the error occurs.

Byte 12, the record number (R), is set to zero if the error occurred in Home Address. This byte is unreliable after a space count.

The contents of these bytes are unreliable if the message code in byte 7 is either 0 or 4 (error occurred in HA), or 1 or 5 (error occurred in count field).

Byte 13—Sector Number

This byte contains the sector number of the record which was in error.

Byte 14 Thru 21

Set to zero.

Bytes 22 and 23—Fault Symptom Code

This code provides entry to the Fault Symptom Index (FSI). The FSI lists possible failures and references MAPs. The symptom code is a number generated from sense information by the storage control. The storage control places the code in Sense Bytes 22 and 23 in sense data formats 1 and 4

FORMAT 4—MESSAGES

Message 0—HA Field Data Check

Generated when a data error as detected by the ECC hardware occurs in the Home Address field.

Message 1—Count Field Data Check

Generated when a data error as detected by the ECC hardware occurs in the Count Field.

Message 2—Key Field Data Check

Generated when a data error as detected by the ECC hardware occurs in the Key Field.

Message 3—Data Field Uncorrectable Data Check

Generated if an error occurs in the data field that is uncorrectable by the ECC hardware.

Message 4—HA Field No Sync Byte Found

Generated if data synchronization on the Home Address field was unsuccessful.

Message 5—Count Field No Sync Byte Found

Generated if data synchronization on the count field was unsuccessful.

Message 6—Key Field No Sync Byte Found

Generated if data synchronization on the key field was unsuccessful.

Message 7—Data Field No Sync Byte Found

Generated if data synchronization on the data field was unsuccessful.

Messages 8 Thru F—Not Used

FORMAT 5—DATA CHECKS PROVIDING DISPLACEMENT INFORMATION

This format is generated if the data error in the data field is correctable. Data Check (Byte 0, bit 4) and Correctable (Byte 2, bit 1) are posted.

SENSE DATA DESCRIPTION (Continued)

Sense Byte 8 Thru 12—Count ID

These bytes contain the record ID (CCHHR) as obtained from the count field of the record in which the error occurred.

Byte 12, the record number (R), is set to zero if the error occurred in the Home Address. This byte is unreliable after a space count.

The contents of these bytes are unreliable if the message code in Byte 7 is either 0 or 4 (error occurred in HA), or 1 or 5 (error occurred in count field).

Sense Byte 13—Sector Number

This byte contains the sector number of the record which was in error.

Sense Byte 14—Not Used

Set to zero.

Sense Bytes 15 Thru 17—Restart Displacement

This parameter identifies the number of bytes processed by the storage control between the initiation of data transfer and the end of the data field in error. The restart displacement includes the first byte transferred but excludes all intermediate Home Addresses, Count, and Key areas that may have been clocked. Truncation within the operation does not affect the value of this parameter.

Sense Bytes 18 and 19—Error Displacement

These bytes specify the location of the first byte in error within the data field in relation to the end of that field.

Sense Bytes 20 thru 22—Error Pattern

These bytes identify the bits of a correctable data check that are in error. A logical 1 represents an incorrect bit. Byte 22 is always zero.

Sense Byte 23—Not Used

Set to zero.

FORMAT 5—MESSAGES

Messages 0 thru 2—Not Used

Set to zero.

Message 3—Data Field Correctable Data Check

Generated if the correctable error occurred in the data area.

Messages 4 thru F—Not Used

FORMAT 6—USAGE STATISTICS/OVERRUN ERRORS

This format is generated if the usage statistics or overrun errors require off-loading due to counter overflow condition or if a Read and Reset Buffered Log command is issued.

Sense Bytes 8 thru 11—Bytes Read/Searched

These bytes provide an accumulated count of the number of bytes processed by the subsystem in read or search operations. Only key and data field counts are accumulated.

Sense Bytes 12 thru 15—Not Used

Set to zero.

Sense Bytes 16 and 17—Number of Seek Commands Processed

These bytes provide a count of the number of Seek commands, excluding Head Seeks, processed by the subsystem.

Sense Byte 18—Channel Select

BIT 0—CHANNEL SELECT

Indicates to which pair (A and B or C and D) of interfaces the information in Sense Bytes 20—23 applies. If bit 0 equals 0, the information applies to interfaces A and B. If bit 0 equals 1, the information applies to interface C and D.

BITS 1 THRU 7—NOT USED

Sense Byte 19—Not Used

Sense Byte 20—Command Overrun A(C)

Indicates the number of channel A(C) command overruns that were detected by the storage control.

Sense Byte 21—Service Overrun A(C)

Indicates the number of channel A(C) service overruns that were detected by the storage control.

Sense Byte 22—Command Overrun B(D)

Indicates the number of channel B(D) command overruns that were detected by the storage control.

Sense Byte 23—Service Overrun B(D)

Indicates the number of channel B(D) service overruns that were detected by the storage control.

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION

DC power must be off prior to changing cards. Unless procedures state otherwise, do not restore power with cards missing; this can result in circuit damage or a "system hang" condition. Remove power as follows:

POWER DOWN PROCEDURE

Control Module (A2)

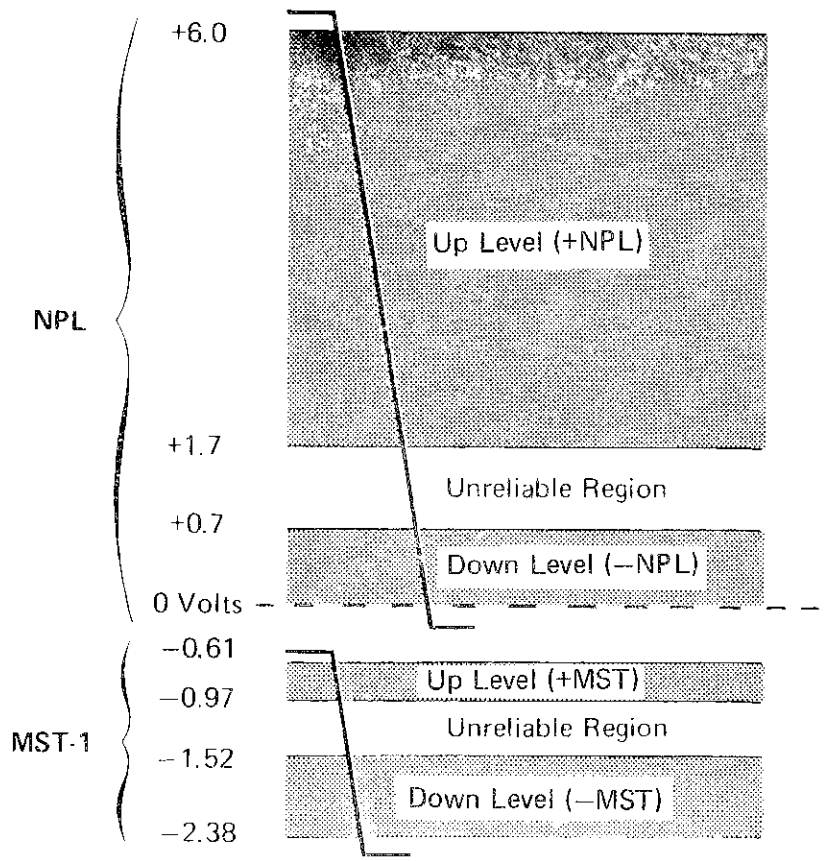
1. Turn the Start/Stop switch to STOP on every drive in the string.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Push the Power Off switch located on the Power Panel on the front of the 3340-A2. *Power is removed from the entire string: the 3340-A2 plus all attached 3340-B1s and B2s.*

Satellite Module (B1, B2)

1. Turn the Start/Stop switch to STOP on each drive in the satellite module to be powered down.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Turn off CP210 located on the AC compartment (accessible

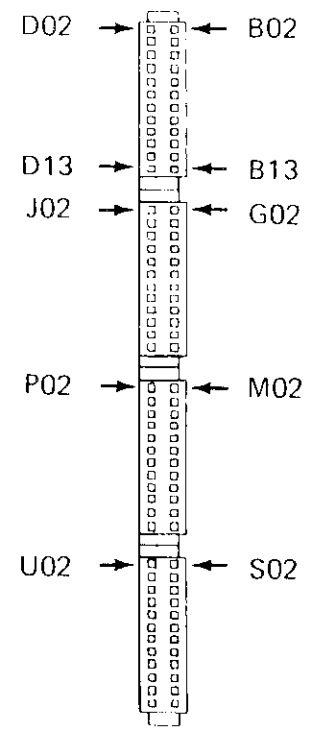
nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card	
Voltage	*Card (Contact Tab)*
–4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

KV010, 020 (drives)
BV100 (controller)

OLT CONTENTS

If the storage control is a S/3, Model 15, refer to the S/3 Diagnostic Users Guide for test information.

If the storage control is a S/7, 5998-T01, refer to the 5998 CTM, MAP 1301, for test information.

Running Refresher ..... **OLT 5 through 8**

Preparation, test and routine selection and run options for OLTSEP, OS/VS-OLTEP, DOS-OLTEP and WINSEPCO.

Requirements ..... **OLT 10**

Lists requirements for running online tests.

Test Descriptions ..... **OLT 20 through 25**

Presents general test usage, running details, and routine descriptions for format and data integrity checking and write/read test.

FRIEND ..... **OLT 26**

Gives a description and running details for using OLT(S)EP FRIEND as a diagnostic tool.

Alternate Track Assignment ..... **OLT 30**

Defines an alternate track and a defective track.
Describes the utility programs available and their use.

Error Messages ..... **OLT 40 through 280**

Lists all OLT errors and communications in sequence.

For additional information on OLTS and a bibliography, see the *System/370 Diagnostic Reference Summary* (Order No. SY25-0512). and the *OLT Users Guide* (Order No. D99-3340).

3340

AX0001	2747355
Seq. 1 of 2	Part No. (1)

440200	440203	440223	440224	440227
25 Jun 73	2 Nov 73	14 Mar 75	15 Dec 75	14 Sept 76

RUNNING REFRESHER — OLTSEP

For additional information, see System/370 Diagnostic Reference Summary (Order No. SY25-0512).

Preparation

Mount OLTSEP disk or tape and IPL.

Starting OLTSEP

OLTSEP prints:

```
    04 SEP188D ENTER DATE AND TIME IN THE FOLLOWING FORMAT 'MM/DD/YY,HH/MM/SS'
```

Reply:
`r 04,'MM/DD/YY'` or `r04,'MM/DD/YY,HH/MM/SS'` or `PSW RESTART`

OLTSEP prints:

```
        SEP102I OLTS RUNNING
        SEP107I OPTIONS ARE NTL,NEL,EP,CP,NPP,PR, FE,NMI,SI
    01  SEP105D ENTER DEV/TEST/OPT
```

If it is desired to run OLTs from card decks, the RDR device must be varied from its default of the IPL device to card. To do this, reply:

```
r 01,'VARY RDR=00C'
```

00C is the address of the card reader. Modify the address to conform to your system.

OLTSEP prints:

```
        SEP219I VARY COMPLETE
    01  SEP105D ENTER DEV/TEST/OPT
```

If the RDR device is to remain the IPL device, do not reply with the VARY command.

Make a Run Request

Make a run request to select the test you want to run.
Reply:

```
r 01,'160/3340PSA//'
```
(See OLT descriptions, OLT 20 through 26.)

This reply begins testing on device 160, runs OLTS section PSA and uses the default options. To select another sequence of testing, enter a reply of:

```
r 01,'160/3340PSA,2/NFE/'
```

This runs only routine 2 of the OLT section PSA, and causes all the default options to be selected except the option FE (first error communications), which will be altered to NFE.

See OS/VS-OLTEP Make a Run Request on OLT 6 for additional examples.

Options

OPTION	YES	NO	DEFAULT
TEST LOOP	TL (VALUE)	NTL	NTL
ERROR LOOP	EL		
	EL(I)		
	EL (VALUE)	NEL	NEL
ERROR PRINT	EP	NEP	EP
CONTROL PRINT	CP	NCP	CP
PARALLEL PRINT	PP (VALUE)	NPP	NPP
PRINT	PR	NPR	PR
FIRST ERROR COMM.	FE	NFE	FE
MANUAL INTERVENTION	*MI	NMI	NMI
SPURIOUS INTERRUPT	SI	NSI	SI
DATA ENTRY FIELD	EXT=(DATA)	---	---
REMOTE ENTRY	*RE	NRE	RE

**RE and MI are mutually exclusive (only one can be on).*

Halt OLTSEP

To halt OLTSEP at any time, press the Request key on the console.
OLTSEP prints:

```
        SEP107I OPTIONS ARE ---------
    01  SEP105D ENTER DEV/TEST/OPT
```

Reply:
`r 01,'(newDEVice/(newTEST)/(newOPTions)'` New instructions to OLTSEP

or to continue:

```
(EOB)
```

or to continue or restart the section under test:

```
r 01,'///'
```

or to terminate the section under test:

```
r 01,'CANCEL'
```

RUNNING REFRESHER — OS/VS-OLTEP

For additional information, see System/370 Diagnostic Reference Summary (Order No. SY25-0512).

Preparation

Units to be tested may be varied offline. This is accomplished through the console by using the Vary command.
Examples:

V 160,OFFLINE (Varies unit 160 offline.)
V(160,161,162),OFFLINE (Varies units 160,161, and 162 offline.)

(The System replies: 160,161,162 OFFLINE when the vary is completed.)

SYSRES cannot be varied offline.

3340 OLTS PSA and PSB can be run online and they will not destroy data on any disk. However, to perform maintenance on the drive, you must vary the drive offline before starting OLTEP. If FRIEND (OLT T0200A) is used to write, the drive must be varied offline.

Starting OS/VS-OLTEP

A. S – causes a job to be started if a reader procedure is incorporated in your system.
Examples:
S OLTEP (For an MVT or VS2 system.)
S OLTEP.PX (For an MFT or VS1 system, where X is the partition number OLTEP is to run in. If in doubt, ask an operator which partition to use.)
or
Use JCL on cards to execute program IFDOLT.

B. Once OLTEP is running, it generates various messages.
Examples:

IFD1021 OLTS RUNNING (To inform you that OLTEP is running.)

00 IFD104D REPLY ANY CHARACTER TO REQUEST COMMUNICATION.
(A reply of any character to the above request causes a communication interval.)

Make A Run Request

OLTEP waits for a reply after issuing the message.
01 IFD005D ENTER-DEVICE/TEST/OPTION (See OLT descriptions, OLT 20 through 26.)

Examples of DEVICE/TEST/OPTION replies: (The commands are given in this sequence.)

a) r 01,'160/3340PSA/EP/'
b) r 01,'/3340PSA//'
c) r 01,'161///'
d) r 01,'160,163,165/3340PSA,PSB/PP/'
e) r 01,'160-163/3340PSA//'
f) r 01,'260/3340PSA,2/NEP,MI/NRE/'

The commands carry forward until they are changed.

Examples	Devices (nine maximum)	Tests	Options
a)	160	3340PSA	EP,CP,PR,FE,SI
b)	160	3340PSA	EP,CP,PR,FE,SI
c)	161	3340PSA	EP,CP,PR,FE,SI
d)	160,163,165	3340PSA and PSB	PP,EP,CP,PR,FE,SI
e)	160,161,162,163	3340PSA	EL,EP,CP,PR,FE,SI
f)	260	3340PSA routine 2 only	PR,FE,MI,SI

Options

Use the OPTIONS list from OLTSEP, OLT 5.

Halt OS/VS-OLTEP

Reply to the outstanding request with any character to force communication.
OLTEP prints:

01 IFD005D ENTER--DEVICE/TEST/OPTION/

Reply:

r 01,'CANCEL' (This cancels OLTEP.)

For additional information, see System/370 Diagnostic Reference Summary (Order No. SY25-0512).

Preparation

Units to be tested must not be assigned to either of the Foreground Programs. The Background Program must be available for CE use.

Starting DOS-OLTEP

You may put Job Control Cards in the reader or you may enter JCL commands from the system console. The example shown is for the console. OLTs runs in a 20K region.

```
AR  START BG
BG  // JOB OLTEP
BG  // ASSGN SYS014, X'160'
BG  // EXEC IJZADOLT, REAL, SIZE=28K
BG  E102I OLTS RUNNING
BG  01E105D ENTER --DEV/TEST/OPT/
```

This is printed after the first error, after pressing the Interrupt switch, or at job completion.

Make a Run Request

Make a run request to select the test you want to run.
Reply:

`r 01,'160/3340PSA//'` (Test 160 with 3340PSA.)
`BG E158I S T3340PSA UNIT 0160` (Testing has begun.)

Option Field Entries

`/` (Run with default options on initial request only.)
`NTL,NEL,EP,CP,NAP/` (Run with default options.)
`AP/` (Run with default options but print on SYSLST.)

Halt DOS-OLTEP

To halt DOS-OLTEP at any time, operate the CP/Interrupt switch.
DOS-OLTEP prints:

```
BG 01E105D ENTER - DEV/TEST/OPT
```

Reply:

```
BG R 01, 'Cancel'
```

RUNNING REFRESHER (Continued)

WINSEPCO

WINSEPCO (3340 Online Test Standalone Executive Program – Card Only) is a 32K standalone OLT for use on System/370 Model 115 or 125 when testing 3340 DASD. It is for use only on disk-only Model 115s or 125s with no tape or multiplex devices attached.

Preparation

Place CDS cards in WINSEPCO deck (see WINSEPCO Users Guide for detailed instructions), load deck in card reader and IPL.

Starting WINSEPCO

WINSEPCO prints:

```
ISA188D ENTER DATE IN THE FOLLOWING
FORMAT MM/DD/YY
```

Your reply is:

```
08/25/73
```

WINSEPCO prints:

```
ISA1071 OPTIONS ARE EP, CP, NEL,
 NMI, NTL, NFE, PR,
NPP, NTR, SI.
ISA105D ENTER D/T/O
```

Make a Run Request

(Place OLTs to be run in the card reader prior to replying to the above request.)

Your reply is:

```
160/3340PSA//
```

This reply begins testing on device 160 by performing a Not Ready test and reading the security protect byte on the volume label. Test T3340PSA deck must be ready in the card reader. The above response uses default options described in the ISA107I message above.

To select another sequence of testing, enter:

```
160/3340PSA,2/FE/
```

This runs only routine 2 of test T3340PSA and alters the default option of NFE to FE (first error communication.)

To run both OLTs against a series of drives, use the following replies:
160/3340PSA–PSB/OPTIONS/
At the conclusion of testing on the first drive, put the OLT decks back in the card reader and enter:
161///
Continue in this maner until the last data module/drive has been tested.

Options

OPTION	YES	NO	DEFAULT
TEST LOOP	TL (VALUE)	NTL	NTL
ERROR LOOP	EL		
	EL (1)	32, 767	MAXIMUM
	EL (VALUE)	NEL	NEL
ERROR PRINT	EP	NEP	EP
CONTROL PRINT	CP	NCP	CP
PARALLEL PRINT	PP (VALUE)	NPP	NPP
PRINT	PR	NPR	PR
FIRST ERROR COMM.	FE	NFE	NFE
MANUAL INTERVENTION	MI	NMI	NMI
SPURIOUS INTERRUPT	SI	NSI	SI
DATA ENTRY FIELD	EXT=(DATA)	-	-
TRACE	TR	NTR	NTR

Halt WINSEPCO Test

At the communication interval (ISA105D message)
Reply: CANCEL to terminate a test section

3340 OLT Tests

PSA — HA and RO Format and Readability on 3340 or logical 3344 Volume.
PSB — Data Readability (burst check) on 3340 or logical 3344 Volume.
WT — Write test on any selected track.
T0200A — OLT(S)EP Friend

These tests are described on OLT 20 through 26.

Program Requirements

3340 OLTs run under DOS OLTEP REL 29, VS1 OLTEP release 3, VS2 OLTEP release 2, or OLTSEP release 5.0 or higher.

A. OLTEP requires a system or private library containing:

- Standalone Online Test Support Processor (SOSP)
- Configuration Data Set (CDS), see 3340 CDS description.
- 3340 OLT Sections.

B. OLTSEP requires a load tape or disk load file containing:

- IPL Loader.
- OLTSEP Nucleus.
- OLTSEP Transient Modules.
- Standalone Online Test Support Processor (SOSP).
- Configuration Data Set (CDS), see 3340 CDS description.
- 3340 OLT Sections.

For additional information, see *OLT Users Guide (D99-3340) and System/370 Diagnostic Reference Summary* (SY25-0512).

Equipment Requirements

3340 OLTs may be run on any 3340 or 3344 subsystem. There are no special equipment requirements.

3350 Configuration Data Set (CDS)

Configuration data must be correctly supplied in the OLTEP or OLTSEP libraries. CDS for the 3340 (one card per drive) or 3344 (one card per logical address) should appear as follows:

```
CC 01     Blank
CC 02–04CDS
CC 10–17Device Address (Example–
        0000 0160)
CC 18–19Blank
CC 20-21–Feature (02 if 3830 or ISC
         is storage control, blank if
         other attachment).
CC 22–23Device Class (20)
CC 24–25Device Type = (OA)
CC 26–29Blank
CC 30–31Flags  (04 = 2-channel switch or string
               switch installed)
              (40 = device shared via string
               switch or 2 channel switch)
              (44 = both of the above)
CC 32–35Blank
CC 36–37CUCDS suffix (see 3830 CDS
        requirements)
CC 38     /
```

These cards for other devices on the system must be included in CDS.

SOSP

The Standalone Online Test Support Processor (SOSP) may be used to create a master load tape or disk load file for OLTSEP.

SOSP also has facilities for the following:

- Add, replace, or delete OLTs from the master file.
- Duplicate master files (DUP).
- Print the contents of a master file (LIST).
- Generate and modify the Configuration Data Set (CONFIG).

The SOSP Operators Guide (D99-SOSPB) has details for selecting the options.

Error Messages

To locate the error message referenced by the error printout, use the section number and REFNUM from the first printout line as an index to OLT pages starting on OLT 40. Messages with REFNUMs ending in 91 through 99 are common to all sections and are found at the start of the error message listing under Common Error Messages (see OLT 40, 50, and 60).

USE OF OLTs

The Online Tests for the 3340 are designed to test the following:

- The readability and accuracy of the Home Address and Record Zero fields.
- The data integrity of data records.
- The ability of the 3340/3344 to write and read different bit patterns on selected tracks.
- The ability of drives with the RPS feature to run concurrently.

SECTIONS

T3340PSA–HA/R0 Scan (requires 8K)
T3340PSB–Burst Test (requires 8K)
T3340WT–Write Test (requires 8K, attempts to get 8K more core)

CE Cylinder

	Cylinder	Heads
35 Mb Data Module	349	0–11
70 Mb Data Module	698	0–11
	699	0–11
3344	2800-2804 (AF0-AF4)	0–11

T3340PSA HDA HA/R0 SCAN

This section tests the readability and accuracy of HA and R0 fields on the Volume..

Running Considerations

1. This section requires that a completely operational file subsystem be used. Hardware errors invalidate results and the internal retry capability of the storage control must present hard errors to the OLT.

   OLT recalibrate/retry is performed once then the error is printed and processing continues.

   Twelve hardware errors occurring on any one cylinder cause premature termination of the OLT (see OLT 210, REFNUM 0000A). Appropriate diagnostics should be run against the failing drive and/or corrective action completed before continuing to scan the Volume.
2. This OLT does not scan data on the CE cylinder. The CE cylinder is variable. See CE cylinder on this page.
3. If the 3830 Model 2 or ISC Mode switch is placed in Forced Error Logging mode while running this section, errors normally transparent to the system program (retried at the storage control level) are displayed on the test printout. This is most effective for intermittent/soft errors.

   Do not use the Forced Error Logging mode if the string is shared.

Routine Descriptions

Routine 1: This routine is run by default. It scans the entire Volume except the CE cylinder. Home Addresses and Record Zeros are scanned for readability and data accuracy. Invalid HA and/or R0 fields are printed in expected-received form. HA and up to 16 bytes of R0 (8-byte count field, 8-byte data field) are displayed when an error is found. Alternate and defective tracks are verified to point to a valid mate. If none is found, an appropriate error message is printed.

Routine 2: This routine must be selected. It allows specific tracks to be tested.

User options:

1. Select track or tracks to be scanned.
2. R0 data length to be tested (8 or any).

Running Details

This OLT requires 4 – 6 minutes to run or longer when run under VS-OLTEP.

1. In most cases the default mode of operation (routine 1 only) successfully tests a Volume.

   Enter:
   ```
   /3340PSA//
   ```
2. If some specific area of the Volume is suspected, the test time can be shortened by selecting the track(s) to be tested (routine 2).

   Enter:
   ```
   /3340PSA,2//
   ```
   Message:
   ```
   ENTER TRACKS(S),'ALL'OR'END'
   AS'CCHH–CCHH'OR'CCHH'
   ```
   Reply:
   ```
   'ALL',EOB
   ```
   or
   ```
   'END',EOB
   ```
   or
   ```
   'CCHH–CCHH',EOB
   ```
   or
   ```
   'CCHH',EOB
   ```
   or
   ```
   EOB(DEFAULT='ALL'TRACKS)
   ```
   Valid limits for CCHH are:
   35 Mb DM = '00000' through '15C0B'
   3344 or
   70 Mb Volume = '00000' through '2B90B'
3. If the R0 data is not 8 bytes long:

   Enter:
   ```
   /3340PSA,2//
   ```
   Message:
   ```
   ENTER TRACKS(S),'ALL'OR'END'
   AS 'CCHH–CCHH'OR 'CCHH'
   ```
   If specific tracks are required:

   Reply:
   ```
   'CCHH'or 'CCHH–CCHH'
   ```
   (the identity of the suspect track(s))
   or
   ```
   EOB(DEFAULT='ALL'TRACKS)
   ```
   ```
   Message:
   ENTER R0 DATA LENGTH
   Reply:
   'ANY',EOB
   or
   '8',EOB
   ```

See OLT 200 for example.

CCW Chains Used

1. Chain to fetch volume ID:

   SEEK (cyl=0, hd=0)
   SIDEQ (rcd no.=3)
   TIC (to SIDEQ)
   RDDATA (byte count=10)
2. Chain to Read HA/R0:

   SFM ('00')
   SEEK (cyl/hd incremented)
   RDHA
   RDR0 (byte count=16, DC)
   RDR0 (byte count=20000,SKIPSILI)

T3340PSB HDA BURST TEST

This section tests the readability of data records on the Volume.

Running Considerations

1. This section requires that the Home Addresses and Record 0s are valid and readable, therefore T3340PSA should be run before T3340PSB.
2. This section also requires that a completely operational file subsystem be used. Hardware errors invalidate results and the internal retry capability of the storage control must present hard errors to the OLT.

   OLT recalibrate/retry is performed once, then the error is printed and processing continues.

   Twelve hardware errors occurring on any one cylinder cause premature termination of the OLT (see OLT 250, REFNUM 0000A). Appropriate diagnostics should be run against the failing drive and/or corrective action completed before continuing to scan the Volume.
3. This OLT does not scan data on the CE cylinder. The CE cylinder is Variable. See CE cylinder on OLT 20.
4. If the 3830 Model 2 or ISC Mode switch is placed in Forced Error Logging mode while running this section, errors normally transparent to the system program (retried at the storage control level) are displayed on the test printout. This is most effective for intermittent/soft errors.

   Do not use Forced Error Logging mode if the string is shared.

Routine Descriptions

Routine 1: This routine is run by default. It scans the entire Volume for readability (burst check), all records, and all tracks (except CE tracks). A statistical summary is printed at the end of the OLT. All data records are read with the SILI and SKIP bits on. No data is transferred or printed.

Routine 2: This routine must be selected. It allows specific tracks to be tested.

Routine 3: This routine must be selected. It allows a track to be selected for a burst check on that part of the track containing valid data, then forms a tight scope loop.

Running Details

This OLT requires 5 to 30 minutes to run. Running time depends on storage control and Volume usage and density (for special cases, see routine 2 and 3 description).

1. In most cases, the default mode of operation (routine 1 only) successfully tests a Volume.

   Enter:
   ```
   /3340PSB//
   ```
2. If a specific area of the Volume is suspected, the test time can be shortened by selecting the track(s) to be tested (routine 2).

   Enter:
   ```
   /3340PSB,2//
   ```
   Message:
   ```
   ENTER TRACK(s), 'ALL' OR 'END'
   AS 'CCHH-CCHH' OR 'CCHH'
   ```
   Reply:
   ```
   'ALL',EOB
   ```
   or
   ```
   'END',EOB
   ```
   or
   ```
   'CCCHH-CCCHH',EOB
   ```
   or
   ```
   'CCCHH',EOB
   ```
   or
   ```
   EOB(DEFAULT='ALL' TRACKS)
   ```
   Valid limits for CCCHH are:

   35 Mb DM = '00000' through '15C0B'
   3344 or
   70 Mb Volume = '00000' through '2B90B'
3. If a hardware failure is causing a Data Check:

   Enter:
   ```
   /3340PSB,3//
   ```
   Message:
   ```
   ENTER TRACK FOR SCOPING
   ```
   Reply:
   CCCHH of the track to be looped.

   The OLT starts a tight loop of the track and continues until terminated by a normal console request or OLT(S)EP intervention.

   Command Chain may terminate when an abnormal condition occurs or the last data record has been read. Use OLT T0200A (FRIEND) or 3340 microdiagnostic routine B1 if a full track read of all gaps and fields is desired.

CCW Chains Used

1. Chain to fetch volume ID:

   SEEK (cyl=0,hd=0)
   SIDEQ(rcd no.=3)
   TIC (to SIDEQ)
   RDDATA (byte count=10)
2. Chain to burst check record n:

   SEEK (incremented)
   SFM ('18') inhibit head switching
   SIDEQ (rcd no.=n−1)
   TIC (to SIDEQ)
   MTRDCKD (byte count=8,DC)
   MTRDCKD (byte count=8500,SKIP,SILI)
3. Chain to bypass bad record n:

   SEEK (current track)
   SFM ('18') inhibit seeks and head switching
   SIDEQ (rcd no.=n−1)
   TIC (to SIDEQ)
   SPCNT (argument=000)
   MTRDCKD (byte count=8,DC)
   MTRDCKD (byte count=8500,SKIP,SILI)
4. Chain to scope loop track:

   SEEK (to CE selected track)
   SFM ('18')
   SPCNT
   MTRDCKD (byte count=8,DC)
   MTRDCKD (byte count=8500,SKIP,SILI)
   TIC (to first MTRDCKD)
5. Chain to burst check cylinder:

   SEEK (incremented)
   SET SECTOR (0)
   MTRDCKD (byte count=8500,SKIP,SILI)
   TIC (to MTRDCKD)

   A failure in this chain causes the cylinder to be scanned in detail, a record at a time (see Chain 2 above).

AX0022	2747357	See	440223	440224	440227	
Seq. 2 of 2	Part No. (1)	EC History	14 Mar 75	15 Dec 75	14 Sept 76	

T3340WT WRITE TEST

This section tests the write and read capability of any selected track. Routine 6 can be selected to test concurrent selection capability on drives with the RPS feature.

Running Considerations

Caution

- Before running this test, OLT T3340PSA must be run and errors acted upon.
- This OLT writes on any SELECTED TRACK of a 3344 Volume or a 3340 DM if the label = CE PACK. To test write and read capability, use only the CE track. The CE track is variable. See OLT 20 or message output asking for track to test.
- Always select a CE track first and test write/read. Resolve any errors detected on the CE track before selecting a non-CE track.

Note: *CE cylinder, track 01, is defect-free over its entire length.*

- Always make sure that there is backup for data on a non-CE track or that it has been dumped.
- If you are unsure about the status of data on the track to be tested, use the options to CHANGE the track selected or TERMINATE the test.
- Once the data can be considered scratch data, reply GO to begin testing.

Routine Descriptions

Routine 1: This routine writes and reads records that are alternately all zeros and all ones.

Data = 0000.....and FFFF.....

Running time is 20 seconds.

Routine 2: This routine writes and reads records with only one bit set per byte. The bit is then shifted right within the byte.

Data = 80808.....through 010101.....

Running time is 90 seconds.

Routine 3: This routine writes and reads records with the worst case pattern.

Running time is 10 seconds.

Routine 4: This is a dummy routine.

Routine 5: This routine only runs if selected.

Enter:

```
'/3340WT,5//'
```

It writes a single 2048 byte record on the track selected, then reads it 1024 times. This write/read routine is repeated ten times.

Data = worst case

Running time is 3 minutes.

Routine 6: This routine only runs if selected.

Enter:

```
'XXX,YYY/3340WT,6//'
```

Two drive addresses on the same string must be selected. Both drives must have the RPS feature. Running time is 5 seconds. This routine does not run under WINSEPCO.

Running Details

This OLT runs for 2 minutes on each track selected for testing, or longer when run under VS-OLTEP. Each tested track is restored with a standard R0 before another track can be selected. This OLT must be allowed to terminate or be cancelled. Routines 1 through 3 run by default for a thorough write/read test.

Enter:

```
'/T3340WT//'
```

However, any routine or combination of routines can be selected to reduce the run time or to extend the test to include 10,000 reads (see routine 5 description).

CCW Chains Used

1. Chain to read HA, SD and R0:

   SFM (C0 or C4)
   SEEK
   RDHA
   SNS (BC = 24)
   RDR0 (BC = 4,SILI)

2. Chain to read VOL ID:

   RECAL
   SRCIDEQ (R3)
   TIC (to SRCIDEQ)
   READ DATA (BC = 10,SILI)

3. Chain to write HA (if defective or alternate track is tested):

   SFM (C0 or C4)
   SEEK
   SRCHAEQ
   TIC (to SRCHAEQ)
   WRTHA (BC = 11 if type 0B,
   5 if type 09 or 0D)
   WRTR0 (BC = 16)
   NOP

4. Chain to write R0:

   SFM (C0 or C4)
   SEEK
   SRCHAEQ
   TIC (to SRCHAEQ)
   WRTR0 (BC = 8, DC)
   NOP (BC = 2048)
   NOP

5. Chain to write Rn:

   SFM (C0 or C4)
   SEEK
   SRCIDEQ (n−1)
   TIC (to SRCIDEQ)
   WRTCKD (BC = 8, DC)
   NOP (BC = 1 to 8192)
   NOP

6. Chain to read R0:

   SFM (C0 or C4)
   SEEK
   RDR0 (BC = 8500, SKIP, SILI)

7a. Chain to read R1 through Rn (if not a CE track):

   SEEK
   SFM (18)
   SRCIDEQ (R0)
   TIC (to SRCIDEQ)
   MTRDCKD (BC = 8500, SKIP, SILI)
   TIC (to MTRDCKD)

7b. Chain to read Rn (if CE track):

   SFM (C4)
   SEEK
   SRCIDEQ (Rn − 1)
   TIC (to SRCIDEQ)
   RDCKD (BC = 8500, SKIP, SILI)

T0200A FRIEND

The FRIEND OLT is a special diagnostic tool to support diagnosis of unique problems. Complete operation instructions are found in the Maintenance Diagnostic Program Users Guide For Friend (D99 – 0200).

Running Considerations

FRIEND truncates sense data to the rightmost non-zero byte.

FRIEND runs online under VS/OS/DOS OLTEP or OLTSEP. The Online Test Executive Program (OLTEP) or Online Test Standalone Execute Program (OLTSEP) schedules and controls the activity of FRIEND and provides communication with the operator. An I/O unit may be tested using FRIEND under OLTEP with minimum interference to the operation of other programs running in the system. This provides a method of testing I/O devices while customer programs are being processed by the system. Operation of FRIEND under OLTSEP eliminates the requirement for an operating system (OS) where an OS is not present.

FRIEND allows the user to construct man-readable S/360/370 channel programs.

FRIEND provides no data protection other than that of the OLT(S)EP.

Running Details

SELECTING FRIEND

Enter;

```
/T0200A//
```

OLTSEP options (MI, TL, etc.) have no effect when running FRIEND.

If the controller being tested is shared and FRIEND is running standalone under OLTSEP, use Block Multiplex mode (Control Reg 0, bit 0).

After FRIEND is loaded and in control, the following messages are printed:

```
04 SEP 1001   FRIEND running V/L=XX
04 SEP 1001   Data area in bytes=XXXXX
04 SEP 101D   Enter FRIEND command
```

COMMAND ENTRY

The program is now ready to receive user input in the form of CCW commands or interpreter commands. These may be entered singly or as a command string. String data must always end with a slash, for example:

```
SK/CYL=0/HD=0/SIDEQ/RCD NO.=3/TIC/
RDDATAINTO$A/NOP/GO/
```

This reads the volume label into a location known to FRIEND as $A. As each successive command or command string is entered, FRIEND processes each one and then prints 'ENTER CMND' when that command or string has been processed and it is ready to accept additional input. If more information is required, FRIEND asks for it. The FRIEND OLTSEP does not insert any CCW commands (such as SFM, TIC, or SET MODE).

TERMINATING FRIEND

Enter:

```
r 04, END
```

FRIEND Examples

To verify a possible bad track, enter:

```
SK/CYL=XXX/HD=XX/RDHAINTO$A
/RDR0INTO$B/KL=0/DL=8/GO/
```

To rewrite a bad track (standard R0), enter:

```
SFM/MASK=C0/SK/CYL=XX/HD=XX/
SRCHEQHA/TIC/WRR0/KEY=0/DATA=8X00/GO/
```

MASK=C4 must be entered to SK/WRITE on a CE track
See OLT 20 for CE cylinder addresses.

Command Summary

Primary	Alternate	(hex)	Explanation
No Operation	NOP	03	No Operation
Seek	SK	07	Control Seek
Recalibrate	RECAL	13	Recalibrate
Restore	RESTR	17	Restore
Set File Mask	SFM	1F	Set File Mask
Seek Cyl	SKCYL	0B	Seek Cylinder
Seek Hd	SKHD	1B	Seek Head
Release (see note 1)	REL	94	Release
Reserve (see note 1)	RSV	B4	Reserve
Space Count	SPCNT	0F	Space Count (Space Record)
Set Sector	SS NO	23	Set Sector
Diagnostic Ld	DL	53	Diagnostic Load
Sense	SNS	04	Read 24 bytes, Sense information.

In the following Search commands, SEARCH, SRCH, SCH, or S can be used. MT indicates multitrack and is entered preceding a Read or Search command. Example: MT SEARCH ID or MT READ CNT.

Primary	Alternate	(hex)	MT	Explanation
Sch HA Eq	SRCHEQHA	39	B9	Search Home Address Equal
Sch ID Eq	SRCHEQID	31	B1	Search Identifier Equal
Sch ID Hi	SCHHIID	51	D1	Search Identifier High
Sch ID Eq Hi	SEQHIID	71	F1	Search Identifier Equal or High
Sch Key Eq	SEQK	29	A9	Search Key Equal
Sch Key Hi	SHIK	49	C9	Search Key High
Sch Key Eq Hi	SEQHIK	69	E9	Search Key Equal or High
Read HA	RDHA or RH	1A	9A	Read Home Address
Read Count	RDCNT or RC	12	92	Read Count
Read R0	RDR0 or RR0	16	96	Read Record Zero
Read Data	RDDT or RDD	06	86	Read Data Field
Read Key Data	RDKDT or RKD	0E	8E	Read Key Data
Read Count Key Data	RDCKD or RCKD	1E	9E	Read Count Key Data
Read IPL	RDIPL READ RD	02		Read IPL (Initial Program Load)
Read and Reset Buffered Log	RDBL, 3330 RDLG, 3330	A4		Read and Reset Buffered Log
Read Diagnostic Status	RDDS	44		Read Diagnostic Status

Primary	Alternate	(hex)	Explanation
Read Sector	RDS	22	Read Sector
Write HA	WHA (Note 2) WRHA (Note 2) or WWHA WRWHA		Write Home Address (requires Set File Mask and SHAEQ command preceding, or the defective track bit on in the flag byte)
Write R0	WRTR0 WRR0	15	Write Record Zero (requires Set File Mask)
Write Count Key Data	WRTCKD WRCKD WCKD	1D	Write Count Key Data
Write Special Count Key Data	WRSPCKD	01	Write Special Count Key Data (optional feature)
Write Key Data	WRTKD WRKD WKD	0D	Write Key Data
Write Data	WRTDT WRD WD	05	Write Data
Erase	RS	11	Erase (WRCKD without address marker)
Diagnostic Write	DWRT DW	73	Diagnostic Write

Note 1: *Channel Attachment and 2 Channel Switch or String Switch feature are required for the Release and Reserve commands.*
Note 2: *If OLTSEP release 8.0 or higher.*

COMMON ACTION

PURPOSE OF THIS PAGE

This page is referenced by many of the Online Test pages. It contains instructions that are commonly used when OLT errors are found.

COMMON ACTION B

1. If a Fault Symptom Code (FSC) is not included in Sense Bytes 22 and 23, go to START 101 for sense byte analysis. If this step does not correct the problem, continue below.
2. The first error listed is probably the most valid error to investigate. Additional error data can be obtained by running all OLTs, and this additional information will reinforce or refute the original error.
3. Determine the failing CCW (marked by an *) and run microdiagnostics that verify the failing function. Select the appropriate microdiagnostic by checking the descriptions in the MICRO section of the MIM. The failing CCW may not reflect the test in process. An analysis of the chain printout will prevent misinterpretation of an invalid result. For example, the message HA READ=XXXXX is invalid if the Read HA command was not executed.
4. Was the OLT properly run? See Running section of OLT description (OLT 20 through 26).
5. Determine the failing CCW (marked by an *) and refer to the storage control maintenance documentation for the CCW description.

COMMON ACTION C

Use a utility program (see OLT 30) to correct tracks with unreadable or incorrect Home Addresses or ROs.

1. Control the DASDI program to flag the track as defective. If the Volume can be re-initialized (VTOC and all data destroyed) go to step 2. If not, go to step 3.
2. Rerun the DASDI program to format the Volume. All defective tracks are tested. If a track previously flagged is now usable, it is recovered and the Home Address and RO are corrected. More than one pass may be required to correct errors on a Volume. If the DASDI program ends prematurely due to errors or lack of alternate tracks, rerun it.
3. Always run OLT T3340PSA on the volume after correcting format errors.

See OLT 30 for additional information on rewriting Home Address and RO.

ALTERNATE TRACK ASSIGNMENT

DEFINITIONS

Alternate Track

An alternate track is used in place of a primary track. Alternate tracks are designated by the manufacturer and are logically addressed as follows:

35 Mb DM cylinder 348; heads 0 – 11
3344 or
70 Mb Volume cylinders 696; heads 0 – 11
697; heads 0 – 11

Unassigned alternate tracks contain their own logical track address in the CCHH bytes of the HA and R0 count field. Bit 7 of the flag byte in the HA field is set to identify the track as an alternate.

Defective Track

A defective track contains one or more surface defects that cause Read Data Checks. When the track is identified as defective, bit 6 of the flag byte in the HA field is set.

A defective alternate track will have both bits 6 and 7 of the flag byte set.

HOW TO REWRITE AN INCORRECT HA OR R0

To rewrite an unreadable or incorrect Home Address (HA) or Record 0 (R0), run IBCDASDI, ALTDK or IEHDASDR to flag the track as defective. Then run the DASDI program again to analyze, and if possible, reclaim the track.

HOW THE UTILITIES ASSIGN AN ALTERNATE TRACK

1. The R0 count field on the alternate track is written with CCHH bytes equal to the address of the defective track.
2. The R0 count field on the defective track is written with CCHH bytes equal to the address of the alternate track.
3. Bit 6 of the flag byte in the HA field on the defective track is set.

OS/VS UTILITIES

General utility programs are available with OS/VS operating systems to aid in alternate track assignment and Volume initialization. Because alternate track assignment is a customer responsibility, the following is for information only. For more detail, see *OS/VS Utilities* (Order No. GC35-0005).

IBCDASDI (standalone initializer)

A standalone utility used to initialize a Volume:

- Flags tracks defective and assigns alternate tracks.
- Writes volume label on track 0, record 3.
- Constructs and writes a volume table of contents (VTOC).
- Writes an IPL record on track 0.
- Allows tracks previously flagged defective to be analyzed and reclaimed if they are usable.
- Writes R0 on each track.

IEHDASDR (online initializer)

An online utility used to initialize a Volume:

- Performs the same functions as IBCDASDI.
- Can be used to dump or restore the contents or a portion of the contents of a Volume.

IEHATLAS (assign alternate track)

A system utility used to assign and write an alternate track:

- Attempts to rewrite defective record(s) with data supplied by the user.
- Flags a track defective if it cannot be rewritten successfully.
- Locates and assigns an alternate track.
- Retrieves and transfers usable data records from the defective track to the alternate track.
- Replaces bad records with data supplied by the user.

Alternate tracks cannot be assigned for defects in Home Address or R0 count fields. Tracks flagged defective cannot be reclaimed. Use IBCDASDI or IEHDASDR.

DOS/VS UTILITIES

General utility programs are available with DOS/VS operating systems to aid in alternate track assignment and Volume initialization. Because alternate track assignment is a customer responsibility, the following is for information only. For more detail, see *DOS/VS System Utilities* (Order No. GC33-5381).

INTDK (initialize disk)

A system utility used to initialize a Volume:

- Reads HA and R0 fields.
- Writes volume label on track 0, record 3.
- Constructs and writes a volume table of contents (VTOC) on cylinder 0, track 0.
- Allows tracks previously flagged defective to be analyzed and reclaimed if they are usable.

Alternate tracks are not assigned for tracks flagged defective. It is assumed that any track that is flagged defective has previously had an alternate assigned. To assign an alternate track, use ALTDK or standalone IBCDASDI.

ALTDK (assign alternate track)

A system utility used to assign and write an alternate track:

- Flags defective track.
- Locates and assigns an alternate track (requires a valid VTOC on the volume.)
- Retrieves and transfers usable data records from the defective track to the alternate track.
- Replaces bad record(s) with data supplied by the user.
- The condition of the defective track is not analyzed.

Alternate tracks cannot be assigned for defects in Home Address or R0 count fields. Tracks flagged defective cannot be reclaimed. Use standalone IBCDASDI or INTDK.

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340X	CECOM 038	INT REQ, R TO RETRY, T TO TERM	After replying, the Start I/O is retried or the OLT is terminated.	1. Determine the cause of Intervention Required Status, then reply. 2. Ensure that the drive is ready.
T3340X	CECOM 039	CC = X, R TO RETRY, T TO TERM	This message is sent to the console to warn of catastrophic failure (condition code = 2 or 3). Usually when the storage control is busy or not operational, further testing is invalid. Determine if the controller is 'hung' before continuing. If so, a Halt I/O failed to clear the condition. After replying, the Start I/O is retried or the OLT is terminated.	1. Determine if the subsystem is 'hung' before continuing. See if the storage control is in the normal idle loop. If normal, enter desired reply; if not, go to START 100. 2. Ensure that all cables and connectors are secure. 3. Ensure that the drive is ready. 4. Ensure that the interface is online.
T3340X	CECOM 041	DEV NOT 3340	CDS type code for the device under test is not '0A'.	Correct the CDS type code for the device to be tested or equate 'EQU' the device address to some existing CDS with the desired type code.

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340X	XX090	FPM MODE	File Protect mode was established. This section needs write space so it is not allowed to run.	1. Reply YES (Y) to the OLT message CAN VOL DATA ON XXX BE DESTROYED. 2. Then select the CE track (cylinder 1024, heads 0 through 29) to prevent destruction of valuable data.
Note:	*Nine (9) standard error numbers (REFNUM) have been reserved for errors encountered by the Start I/O used by OLT sections. These error numbers are XX091 through XX099, where XX is the routine number.*			
T3340X	XX091	ENVIRONMENTAL ERROR	An error occurred on a test CCW chain that established Error Logging mode or storage control was in Force Logging mode.	If a log overflow occurred, (Sense byte 7 = '60') ignore following action. 1. If the storage control is in Normal mode and this message appears intermittently, set the storage control to CE Normal mode. 2. If the storage control is in CE Normal mode and the error looks solid, anlayze errors as shown in Common Action B (OLT 28).
T3340X	XX092	CHANNEL CHECK	This error message is printed by the STARTIO subroutine when channel checks are found in the CSW status. The test is terminated when channel checks are found.	Channel checks are probably not due to subsystem failure. Run CPU channel tests.
T3340X	XX093	WAIT TIMED OUT	This error message is printed by the STARTIO subroutine when the test has timed-out while waiting for ending status. The test is terminated when it times out.	Ending status was not received from the CCW chain printed with this message. The subsystem may have gone busy or not operational, which invalidates further testing. Look for messages to this effect following REFNUM 93. If the control unit is 'hung', the storage e control must be reset before continuing the test.
T3340X	XX094	ERR ON SENSE	This error message is printed by the STARTIO subroutine. When the sense data is not posted, another STARTIO is tried.	1. If this failure persists 32 times, (see REFNUM XX095),continue running tests to determine if Sense I/O failure is intermittent or solid. 2. Run storage control tests. 3. Run CPU channel test for Sense I/O.
T3340X	XX095	32 RETRIES	This message is printed before terminating a section if either CU Busy or Invalid Sense was received on STARTIO and retried 32 times. See example on OLT 60.	1. Continue running tests to determine if Sense I/O failure is confined to this OLT. 2. Run storage control tests. 3. Run CPU channel test for Sense I/O.

COMMON ERROR MESSAGES

<table>
<tr><th>Sect ID</th><th>REFNUM</th><th>Error Messages and Console Communications</th><th>Diagnostic Information</th><th>CE Action</th></tr>
<tr><td>Example:</td><td></td><td>*T3340PSA-24 RTN 001 DEV/LN 02E1 ECA 0 REFNUM 00003
HDA HA/R0 SCAN
CCW01 1F 01796A 40 00 0001 CAW 00017918
CCW02 07 01796C 40 00 0006
*CCW03 1A 017981 40 00 0005
CCW04 16 017986 80 00 0010
CCW05 16 017938 30 00 2328
XPTD CC 0 RCVD CC 0
XPTD CSW1 00 017940 0C00 0000
*RCVD CSW1 00 017930 0E40 0005
*RCVD SNS 08 00 82 00 40 00 21 44 01 00 00 00 00 00 00 00 00
00 00 00 00 00 49 44
I/O ERRS READING HA/R0</td><td>This is an example of the error message output whenever a status error occurs. This message includes:
Symbol — Meaning
* — Error message
T3340PSA — OLT section identification
V/L 24 — OLT version and level
RTN001 — Routine number in OLT
DEV/LN — Device address against which OLT ran
REFNUM — Index into error dictionary (OLT section)
* on CCW03 — Failing CCW
* on RCVD CSW — Failing status
* on RCVD SNS — Failing sense data</td><td>1. Locate the REFNUM in the OLTs section (starting on OLT 200) and follow the diagnostic information and CE action.
2. Go to Common Action B (OLT 28)</td></tr>
<tr><td>T3340X</td><td>XX099</td><td>ABTERM, RET CODE - XX RCVD FROM YYYYYYYY
Module (YYYYYYYY) / Return Code (XX) / Termination Reason / Termination Code
ALLOCATE 04 Module not available D
08 Device not in device entry list
10 Space not available D
CECOM 04 Module not available C,D
08 Error executing module C,D
CONVERT 04 Module is not available D
08 Error from EH conversion O,D
DPRINT 04 Module not available D
08 Error while printing line of data H
0C Incomplete parameter list O
EXIO 04 Module not available D
08 Device not available C,D,T
Device not primary or data protected O,D
Device busy T
0C File protect violate. Respond with YES to CAN VOL DATA BE DESTROYED U
GRAB 04 Device Not in device entry list U
08 Entry list contains only one device U
0C Device descriptors not available C
PLINK 04 Module not available D
WAITIO 04 Module not available D
08 Timed out T
0C Error - Device not valid O,C</td><td>The OLT(S)EP module name YYYYYYYY returned to the OLT in use with an error (return code = 'XX', should be = '00').
Meaning of Termination Code:
Termination Code — Termination may be due to:
O — The OLT
D — The OLT(S)EP driver
T — Device under test, including channel and/or storage control
C — Configuration Data Set not correct
H — Hardware in use, including console printer
U — User error</td><td>1. Usually due to a failure in OLT(S)EP (unless EXIO or WAITIO is involved). Restart OLTEP or OLTSEP.
2. Check the Configuration Data Set (CDS) to make sure that it is correct for the system. Use SOSP LIST function or DISPLAY to obtain configuration data.
3. Module not available (return code '04') from any request for a module means that:
a. OLT and OLT(S)EP are not at compatible levels. This is not an error, but probably a down-level OLT(S)EP.
b. Module has been removed from OLT Library.
c. Device may be shared. This is not an error.</td></tr>
</table>

T3340PSA ERROR MESSAGES **OLT 200**

PACK SCAN A

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340PSA	CECOM 033	ENTER TRACK(S) FOR HA/R0 CHECK, 'ALL' OR 'END' AS CCCHH OR CCCHH-CCCHH (IN HEX)	Valid track entries are as follows: 35 Mb DM = '00000' through '15C0B' 3340 or 70 Mb Volume = '00000' through '2B90B'	Example: Enter one track ('00501', CYLINDER 5, HEAD 1) or some portion of the Volume ('00501 – 01008', CYLINDER 5, HEAD 1 through CYLINDER 16, HEAD 8) to be scanned. At the conclusion of scanning the last track selected, a statistical summary is printed and routine 2 is re-entered to allow selection of some other tracks or End. Default (EOB) is to check the entire logical Volume.
T3340PSA	CECOM 034	ENTER R0 DATA LENGTH AS '8', or 'ANY'		Enter R0 data length to be scanned; eight bytes if a standard OS/VS Volume is mounted, and any number of bytes if no data length test is required. The test defaults (EOB) to an 8-byte data length scan.

T3340PSA ERROR MESSAGES

PACK SCAN A

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340PSA	00001	VOL ID ON XXXX IS YYYYYYYYYY DM size is XX MB	This message is printed if the Volume under test is labeled, where XXXX is the drive address. If no label record (cyl 0, hd 0, R3) exists or it cannot be read, YYYYYYYYYY reads -NONE-. This message is preceded by error REFNUM 00002 if some hardware error other than No Record Found terminates the operation. The scan continues.	This is a normal message unless preceded by error REFNUM 00002.
T3340PSA	00002	I/O ERR READING VOL ID	This message warns of some hardware failure other than No Record Found while trying to read track 0, data Record 3. The Volume scan continues.	1. If the error is a Data Check and the drive has already been tested error-free using microdiagnostics, the problem is with the volume label. The operator must use the appropriate utility to restore the label. See OLT 30 for utility descriptions. 2. If the error is not a Data Check, use the printed status and sense data, then go to Common Action B (OLT 28).
T3340PSA	00003	I/O ERR READING HA/R0 CCW01 1F 01781E 40 00 0001 CAW 000177D0 CCW02 07 017820 40 00 0006 CCW03 1A 017835 40 00 0005 *CCW04 16 01783A 80 00 0010 CCW05 16 0177F0 30 00 2328 XPTD CC 0 RCVD CC 0 XPTD CSW1 00 0177F8 0C00 0000 *RCVD CSW1 00 0177F0 0E40 0008 *RCVD SNS 08 00 00 00 40 22 19 41 00 22 00 19 00 00 00 00 00 00 00 00 00 00 49 41 CCC HHRR KL DL \..SNS 0-6...\ FM \.....SNS 8-23.....\ 0022001900 00 0008 080000004022l9 41 00220019000000000000000000004941	This message warns of some error while trying to read HA and/or R0. The Volume scan continues. *This message may be followed by REFNUM 00007, which identifies an incorrect HA and/or R0 Read.*	1. If the error is followed by REFNUM 00007 or 00009, see action for that REFNUM. 2. If the error is not followed by REFNUM 00007 or 00009, use the status and sense data printed with REFNUM 00003, then go to Common Action B (OLT 28).
T3340PSA	00007	-HA AND/OR R0 COMPARE ERROR FOUND ....CYL#=0057 HD#=0F (HEX).... HOME ADDR- R0 COUNT-------- R0 DATA------- EXPD=040057000F 0057000F00000008 XXXXXXXXXXXXXXX RCVD=000017000F 0194000100000008 000000000000000	This message warns of HAs and/or R0s that are not as expected. XX---XX in EXPD field(s) indicates data insignificant. XX---XX in any RCVD field indicates significant data was not read into appropriate buffer (incomplete operation).	1. If the error was preceded by REFNUM 00003 and the error was not a Data Check or No Record Found, go to Common Action B (OLT 28). 2. Verify that all microdiagnostics run error-free on this drive. If there are no microdiagnostic errors, run OLT T3350WT on the CE track with the failing head selected. 3. If T3350WT runs error free, the problem is with the HA or R0 on this track. Restore the track with the appropriate utility. See OLT 30 for utility descriptions. *CAUTION* *Restoring the HA and R0 destroys the remaining data on the track.*
T3340PSA	00008	DEF TRK FOUND WITH INCORRECT -ALT-MATE ASSIGNED HOME ADDR- R0 COUNT-------- R0 DATA-------- DEF= 0201090001 010E0001 MATE= 01010E0001 010E0001 ....CYL= 0109 HD= 01 (HEX).... 3340 PSA HA/R0 SCAN HOME ADDR- R0 COUNT-------- R0 DATA-------- EPXD=0001090001 0109000100000008 XXXXXXXXXXXXXXX RCVD=0201090001 010E0001FA000008 01090001FAFFFFFF	This message warns of defective or alternate flagged tracks that point to mate tracks that are not correctly flagged, or if flagged, R0 does not point back to the ALT/DEF track (invalid assignment). Alternate tracks with incorrect mates do not have to be corrected.	If the track is defective, the operator must use the appropriate utility to restore the track. See OLT 30 for utility descriptions.

T3340PSA ERROR MESSAGES

PACK SCAN A

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340PSA	00009	DATA CHECK ON HA OR R0	This message is printed immediately to warn of a Data Check on the record indicated (see the failing CCW in REFNUM 00003, marked with an *, to determine the failing command). The sense data is reproduced in its entirety to allow absolute identification of the data error. See SENSE 100 for a sense byte breakdown. The most significant byte is Sense Byte 7, identified by FM in the message. Sense Byte 7 Description: Format / Msg / Field / Meaning 4 / 0 / HA / ECC Data Check 4 / 1 / Count / ECC Data Check 4 / 2 / Key / ECC Data Check 4 / 3 / Data / ECC Data Check 4 / 4 / HA / No Sync Byte Found 4 / 5 / Count / No Sync Byte Found 4 / 6 / Key / No Sync Byte Found 4 / 7 / Data / No Sync Byte Found 5 / 3 / Data / Data Check *Format 4 Data Checks are uncorrectable. Format 5 correctable Data Checks are caused by a failure while reading data and should be considered as HDA or data failures or intermittent hardware failures in the tested drive.*	The CE action to be taken when a Data Check is discovered depends upon the analysis of the 3340 HA/R0 Scan Error Statistics Table (REFNUM 0000B) and this detailed error message. Consistent Data Checks may indicate a defective head or drive read problems. Run OLT T3340WT and select the suspected heads on the CE cylinder (see CE cylinder on OLT 20). Run read/write microdiagnostics to verify that the drive and Volume are OK. If the drive has already been checked, the error is related to the Volume. The Volume may be corrected by the operator by using the appropriate utility. See OLT 30 for utility descriptions. Go to Common Action C (OLT 28).
T3340PSA	0000A	I/O ERRS READING HA/R0 ....CYL#=XXXX HD#=XX(HEX).... (EXCESSIVE HDWR ERRS ON CURRENT CYL, TEST TERMINATED)	This message is printed immediately to warn that some error other than a Data Check occurred in the chain displayed. Data integrity information for the record indicated is lost. If this was the 12th error on this cylinder, the message including TEST TERMINATED is added to the message, a statistical summary is printed, and the OLT terminates.	Use the printed status and sense data in REFNUM 00003, then proceed to Common Action B (OLT 28).

PACK SCAN A

<table>
<tr><th>Sect ID</th><th>REFNUM</th><th>Error Messages and Console Communications</th><th>Diagnostic Information</th><th>CE Action</th></tr>
<tr><td>T3340PSA</td><td>0000B</td><td>3340 PSA HA/RO SCAN ERROR STATISTICS TABLE
*** VOL ID ON 0160 IS .... -NONE-***
HD# -------ERR TYPE# (SENSE BYTE 07)--------
(HEX) 40 41 (42----49, 50------52) 53 XX TOTAL
00 000 000 ---------- 000 000 0000
01 000 000 ---------- 000 001 0001
SUMMARY INFORMATION FOR HEADS 2-11 WILL BE INCLUDED HERE
1B 000 000 ---------- 000 001 0001
TOTALS 00000000 ---------- 0000 0002 0002</td><td>This message follows abnormal termination or cancellation of the OLT. It also follows testing of the selected portions of the Volume, but the error statistics may not represent the condition of the entire Volume. ERR TYPES 40 through 53 are derived from the sense data provided on Data Checks. ERR TYPE XX is a catchall type to include all non-Data Check errors (hardware failures). Totals by head number (HD #) and by ERR TYPE number are shown, as well as an overall total.

The maximum value for any individual ERR#/HD# error counter is 255. If any additional errors occur, the error counter is locked at 255 until the error message is printed. A count of 255 may represent more than 255 errors.

Fixed Heads:
If the drive (Volume) being scanned has fixed heads, then the actual cylinder(s) on which the errors occurred determine if fixed or moveable head(s) are failing. See the detail message(s) corresponding to the errors in this table (REFNUMs 3, 7, or A) for identification of cylinder and addresses. Then convert logical to physical per the following:

Logical Cylinder — Head — Physical Fixed Heads
1 — 0 – 11 — 0 – 5
2 — 0 – 11 — 6 – 11
3 — 0 – 11 — 12 – 17
4 — 0 – 11 — 18 – 23
5 — 0 – 11 — 24 – 29
6 — 0 – 11 — 30 – 35
7 — 0 – 11 — 36 – 46
8 — 0 – 11 — 42 – 47
9 — 0 – 11 — 48 – 53
10 — 0 – 11 — 54 – 59</td><td>This output should be analyzed to determine if data errors or hardware failures follow any pattern. Many errors on one head, for instance, may indicate a defective head. Refer to the detailed error messages (REFNUM 00009) for more specific information on tracks/records in error. Follow the CE Action under REFNUM 00009.</td></tr>
<tr><td>T3340PSA</td><td>0000C</td><td>DEFECTIVE/ALTERNATE TRACK SUMMARY
CYL HD /CYL HD (HEX)
002B 05 /022B 00
002F 01 /022B 01
003C 01 /022B 02
0044 03 /022B 03
0059 01 /022B 04

005C 19 /-NO MATE
007E 00 /022B 05</td><td>This message follows the ERROR STATISTICS TABLE above. Defective and alternate tracks are summarized with NO MATE appearing beside those tracks flagged but not pointing to a valid or readable mate. Detailed information for these faulty ALT/DEF tracks is printed immediately and is found preceding this message (see REFNUM 00008).
All tracks in the alternate area are flagged and point to themselves until assigned to a defective track. These are not summarized here.</td><td>No action is necessary unless DEFECTIVE tracks with the NO MATE message appear. Then, the operator must use the appropriate utility to reflag those defective tracks or restore the Volume. See OLT 30 for utility descriptions.</td></tr>
</table>

PACK SCAN B

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340PSB	CECOM 033	ENTER TRACKS(S) FOR DATA CHECK 'ALL' or 'END' as CCCHH OR CCCHH-CCCHH (IN HEX)	Entering this track select mode of testing (routine 2) causes the OLT to go into a record-at-a-time test mode where selection of routine 1 (default) allows the faster cylinder-at-a-time mode. Do not use this routine 2 mode to check all tracks. Valid track entries are as follows: 35 Mb DM = '00000' through '15C0B' 3344 or 70 Mb Volume = '00000' through '2B90B'	Enter one track or some portion of the Volume to be checked. At the conclusion of the burst check of the last track selected, a statistical summary is printed and routine 2 is re-entered to allow selection of some other track(s) or End. Default (EOB) is to check all tracks.
T3340PSB	CECOM 035	ENTER TRACK TO LOOP AS CCCHH IN HEX		Enter one track address (in hex) to be burst checked in a tight loop. Default (EOB) is to cylinder 0, head 0.

T3340 PSB ERROR MESSAGES

PACK SCAN B

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340PSB	00001	VOL ID ON XXXX IS YYYYYYYYYY	This message is printed if the Volume under test is labeled and XXXX is the drive address. If no label record (cyl 0,hd 0,R3) exists or it cannot be read, YYYYYYYYYY is -NONE-. This message is preceded by error REFNUM 00002 if some hardware error other than No Record Found terminates the operation. The Volume scan continues.	This is a normal message unless preceded by error REFNUM 00002.
T3340PSB	00002	-I/O ERR READING VOLID	This message warns of some hardware failure other than No Record Found while trying to read track 0, data record 3. The Volume scan continues.	1. If the error is a Data Check and the drive has already been tested error-free using microdiagnostics, the problem is with the volume label. The operator must use the appropriate utility to restore the label. See OLT 30 for utility descriptions. 2. If the error is not a Data Check, use the printed status and sense data, then go to Common Action B (OLT 28).
T3340PSB	00004	SEARCH FAILED ON REC# XX ...CYL#=XXXX,HD#=XX(HEX)	This message indicates the search for record number XX failed after a prior read of record number XX was completed successfully. The test continues on next record.	1. If this failure first occurred on REC #00, then the R0 on this track is missing. Run OLT T3340PSA on this track. For any other REC #, see Steps 2 and 3. 2. If the storage control is not in Normal mode, this is printed as a result of reading/searching any count field with an intermittent uncorrectable error. In other than Normal mode, testing moves to the next track and leaves the remainder of this track untested. 3. If the storage control is in Normal mode, the problem is an intermittent read error. Follow the CE Action for REFNUM 00009.
T3340PSB	00006	UNCORRECTABLE DATA CHECK IN HA FIELD SKIP BURST CHECK ON THIS TRACK ....CYL#=XXXX, HD#=XX (HEX)	This message indicates the HA or CNT field on this track contains an uncorrectable Data Check, preventing burst check on subsequent records on this track. This message is followed by REFNUM 00009. Test continues on next track.	1. If the message reads HA FIELD, run T3340PSA on this track. 2. If the message reads CNT FIELD, do one of the following: a. Backup this track and then test it using OLT T3340WT. Use IEHATLAS to save the track. b. Have the customer perform the appropriate data recovery action for this track, record, data set, or volume.

PACK SCAN B

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340PSB	00009	DATA CHECK ON REC# 01 (HEX) CCC HHRR KL DL |..SNS 0-6...| FM |.....SNS 8-23.....| 0002000301 1811C4 08000000400203 43 00020003010200000000000000004943	This message is printed immediately to warn of a Data Check on the record indicated. The sense data is reproduced in its entirety to allow absolute identification of the data error. See SENSE 100 for a sense byte breakdown. The most significant byte is Sense Byte 7, identified by FM in the message at the left. Sense Byte 7 Description: Format / Msg / Field / Meaning 4 / 0 / HA / ECC Data Check 4 / 1 / Count / ECC Data Check 4 / 2 / Key / ECC Data Check 4 / 3 / Data / ECC Data Check 4 / 4 / HA / No Sync Byte Found 4 / 5 / Count / No Sync Byte Found 4 / 6 / Key / No Sync Byte Found 4 / 7 / Data / No Sync Byte Found 5 / 3 / Data / Data Check Format 4 is uncorrectable. Format 5 correctable Data Checks are caused by a failure while reading data and should be considered as HDA or data failures or hardware failures in the tested drive.	The CE action to be taken when a Data Check is discovered depends upon the analysis of the 3340 PSB Burst Test Error Statistics Table (REFNUM 0000B) and this detailed error message. Consistent Data Checks may indicate a defective head or drive read problem. Run T3340WT (using a CE track) or run read/write microdiagnostics to verify that this drive and Volume are OK. If the drive has already been checked, the error may be related to the Volume. The Volume can be tested using T3340WT (see OLT 25 for description). Write/read failures on a single track indicate that it should be flagged as defective. The Volume must be corrected by the operator using the appropriate utility. See OLT 30 for utility descriptions.
T3340PSB	0000A	I/O ERRS READING REC# XX (HEX) ....CYL#=XXXX HD#=XX (HEX).... (EXCESSIVE HDWR ERRS ON CURRENT CYL, TEST TERMINATED)	This message is printed immediately to warn that some error other than a Data Check occurred in the chain displayed. Data integrity information for the record indicated is lost. If this was the 30th error on this cylinder, the message including TEST TERMINATED is added to the message, a statistical summary is printed, and the OLT terminates.	Use the printed status and sense data, then go to Common Action B (OLT 28).
T3340PSB	0000B	3340 PSB BURST TEST *** VOL ID ON 0160 IS .... -NONE- *** HD# -------ERR TYPE# (SENSE BYTE 07)-------- (HEX 40 41 42----49, 50------52) 53 XX TOTAL 00 000 000 ---------- 000 000 0000 01 000 000 ---------- 000 001 0001 SUMMARY INFORMATION FOR HEADS 2-11 (HEX) WILL BE INCLUDED HERE 0B 000 000 ---------- 000 001 0001 TOTALS 00000000 ---------- 0000 0002 0002	This message is printed following testing on the portion of the Volume selected, following abnormal termination, or following cancellation of the OLT. ERR TYPES 40 through 53 are derived from the sense data provided on Data Checks. ERR TYPE XX is a catchall type to include all non-Data Check errors (hardware failures). Totals by head number (HD#) and by ERR TYPE number are shown as well as an overall total. The maximum value for any individual ERR#/HD# error counter is 255. If any additional errors occur, the error counter is locked at 255 until the error message is printed. A count of 255 may represent more than 255 errors. Fixed heads: See OLT 220, REFNUM 0000B.	This output should be analyzed to determine if data errors or hardware failures follow any pattern. Many errors on one head for instance, may indicate a defective head. Refer to the detailed error messages (REFNUM 00009) for more specific information on tracks/records in error. Follow the CE Action under REFNUM 00009.
T3340PSB	0000D	RECORD XX COUNT FIELD NOT 8 BYTES ....CYL#=XXXX HD#=XX(HEX)	This message warns of some record, XX, which does not have an 8-byte count field.	The operator must use the appropriate utility to restore the track. See OLT 30 for utility descriptions.

WRITE TEST

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340WT	CECOM 064	ENTER TRACK TO TEST AS CCCHH (DEC) OR XCCCHH (HEX) DUMP VALUABLE DATA BEFORE CONTINUING, ENTER 'T' TO TERM OR SELECT CE TRACK (CYL 349, HDS 1–11 ODD) OR (CYL 698, HDS 1–11 ODD) OR (CYL 2800, ENTER 'XAF0HH')		Enter the track address to be tested or terminate the test. If a head is to be tested, use a CE track. Enter 'XAF00A' to run the write/read test on the CE cylinder, head 10. If tests have been run successfully on the CE track and the data on the track to be tested is considered scratch, then a non–CE track can be tested. The track address can be entered in either decimal or hex. Enter 05201 or 'X03401' to test cylinder 52, head 1. Enter 00311 or 'X0030B' to test cylinder 3, head 11. Enter 'XAF40B' to test CE cylinder physical head 29. **3344 Note:** *One track on the CE cylinder is error free and suitable for running OLT T3340WT. A label on the rear of the HDA will identify the error free track. If no label is present, track 1 is error free. Use parameters 'XAF0HH', where HH is the track number in hex.* **3340 Note:** *A non-CE track on a data module can only be selected if the Volume label is 'CE PACK'. CE cylinder track 01 is defect free over its entire length.*
T3340WT	CECOM 065	**WARNING** TESTING ON TRACK XXX XX (CCC HH IN DEC) ALL DATA ON THIS TRACK WILL BE DESTROYED		Verify and double check that the track to be tested is the one that you desire.
T3340WT	CECOM 066	REPLY 'GO' TO PROCEED, 'C' TO CHANGE OR 'T' TO TERM		If you do not want to destroy data on the track described in CECOM 065, reply 'C' to return to the track select mode (CECOM 064) or; If you do not want to continue OLT T3340WT, reply 'T' to terminate the OLT. If it is OK to destroy the data on the track described in CECOM 065, reply 'GO' to start the write/read test.
T3340WT	CECOM 067	DEFECTIVE TRACK XXX XX (CCC HH IN DEC) TO BE UNFLAGGED OR ALTERNATE TRACK XXX XX (CCC HH IN DEC) TO BE UNFLAGGED	A defective or alternate track has been selected for the write/read test. Before testing can continue, the Home Address must be rewritten with bits 6 and 7 of the flag byte set to 00.	If this track is not to be tested, reply 'C' or 'T' to the CECOM 066 message that follows. If this track is to be tested, reply 'GO'. The track is re-flagged at the conclusion of testing.
T3340WT	CECOM 068	*WARNING*DEFECTIVE TRACK XXX XX(CCC HH IN DEC) NOT RE-FLAGGED OR *WARNING*ALTERNATE TRACK XXX XX(CCC HH IN DEC) NOT RE-FLAGGED	A defective or alternate flagged track was tested. At the conclusion of testing, the Write HA/R0 chain failed to re-flag this track.	Analyze the failure information presented with REFNUM 054 and: 1. Run T3340PSA, routine 2, and select this track (in hex) to determine the extent of the damage. 2. Run T3340PSA to scan the Volume for damage or erroneous HA or R0 fields. Restore HA and R0 on the track tested if necessary. 3. Go to Common Action C (OLT 28).
T3340WT	CECOM 069	CORE NOT AVAILABLE TO WRITE RECORDS>4K or >2K	The OLT attempts to get a Morecore Region of 4096 to 8192 bytes. If the message reads > 4K, only records 4096 bytes or shorter will be written. If the message reads > 2K only records 2048 bytes or shorter will be written. The test continues.	If the maximum test capability is desired, increase the region for OLTEP job. See the OLTEP system library manual for the region requirements for a 16K OLT.
T3340WT	CECOM 070	VOL ID ON XXX IS YYYYYYYYYY	If the VOL ID (YYYYYYYYYY) is blank, this volume is unlabeled.	Verify that the correct drive and volume were selected before continuing. If either is incorrect, reply 'T' to CECOM 064.

WRITE TEST

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340WT	CECOM 071	SELECT A CE TRACK	The test does not run unless a CE track is selected.	1. The 3344 Volume is in File Protect mode. Reply Yes to the message 'CAN VOL DATA BE DESTROYED'. 2. The 3340 data module does not have a label of 'CEPACK'. Have the volume owner relabel his pack to allow testing on non-CE tracks.
T3340WT	CECOM 073	RTN BYPASSED - 'NO SECONDARY ADDRESS' or 'RUN STANDALONE ONLY' or 'CONTROL MODE NOT AVAILABLE' or 'RPS NOT INSTALLED'	Routine 6 does not run if no secondary address is selected at DEV/TEST/OPTION time. See OLT 25 for running instructions. or OLTSEP (standalone) is not in control. or Control mode (standalone only) is not available. or The primary drive selected does not have the RPS feature installed.	

T3340WT ERROR MESSAGES

WRITE TEST

Sect ID	REFNUM	Error Messages and Console Communications	Diagnostic Information	CE Action
T3340WT	00020	TESTING BLOCK MULTIPLEX ERR DETECTED ON THE PRIMARY ADDRESS ENSURE TEST CHAN IN BLK-MPX MODE AND DEV ON UNSHARED UCW.	Prerequisites: 1. The Channel must be in Block Multiplex mode. 2. The device address must be on an unshared UCW. 3. The drive must have the RPS feature. 4. If an IFA is the SCU then the microprogram must include the Block Multiplex feature.	If all of the prerequisites have been met, go to Common Action B (OLT 28).
T3340WT	00021	TESTING BLOCK MULTIPLEX ERROR DETECTED ON THE SECONDARY ADDRESS ENSURE TEST CHAN IN BLK-MPX MODE AND DEV ON UNSHARED UCW.		
T3340WT	00022	TESTING BLOCK MULTIPLEX WAIT TIMED OUT - NO ENDING STATUS ENSURE TEST CHAN IN BLK-MPX MODE AND DEV ON UNSHARED UCW.		Ending status was not received from the CCW chain printed with this message. The subsystem may have gone busy or not operational, which invalidates further testing. Look for messages to this effect following REFNUM 93. If the control unit is hung, the storage control must be reset before continuing the test.
T3340WT	00050	ERROR ON READ HA CHAIN or WRITE HA CHAIN or SENSE I/O CHAIN	The OLT terminates on any of these three errors. An error on the Read HA command ('1A') can be caused by a bad Home Address or a drive failure. An error on the Write HA command ('19') can be caused by a storage control or drive failure. An error on the Sense I/O command ('04') can be caused by a channel, storage control, or drive failure.	Rerun the test and select a CE track. 1. If the test runs successfully, the original track is probably damaged. Restore the HA and R0 fields by using the procedure under Common Action C (OLT 28). 2. If the test fails on the CE tracks, go to Common Action B (OLT 28).
T3340WT	00051	ERROR ON READ ID CHAIN	An error occurred while attempting to Search and Read Record 3 on track 0. The test continues to test write/read on the selected track.	1. If the test runs successfully on the selected track, there is damage on the label record (track 0). Restore the label. See OLT 30. 2. If the test fails on the selected track, follow the CE Action under the REFNUMs produced by the test.
T3340WT	00052	ERROR ON WRITE R0 CHAIN or WRITE CKD CHAIN	These errors cause the current routine to terminate. See the first line of the error message for the routine number (RTN XX). The routines are described on OLT 25.	Rerun the test and select a CE track. 1. If the test runs successfully, the non-CE track that previously failed is probably damaged. Flag the track defective (See OLT 30). 2. If the test fails on the CE tracks, go to Common Action B (OLT 28). 3. Run OLT T3340PSA for final verification that the problem has been resolved.
T3340WT	00053	ERROR ON READ R0 CHAIN or READ CKD CHAIN		
T3340WT	00054	ERROR ON WRITE R0 CHAIN or WRITE HA	WRITE R0 CHAIN indicates an error terminated the chain to re-write a standard R0 on the track being tested. WRITE HA CHAIN indicates an error terminated the chain to re-write an alternate or defective HA and R0 following testing. If the Write HA chain failed, this defective or alternate track may not be flagged.	

CARD REPLACEMENT

The first attempt to correct problems should be to replace or swap cards listed in the "Possible Causes" block on each MAP.

CAUTION

DC power must be off prior to changing cards. Unless procedures state otherwise, do not restore power with cards missing; this can result in circuit damage or a "system hang" condition. Remove power as follows:

POWER DOWN PROCEDURE

Control Module (A2)

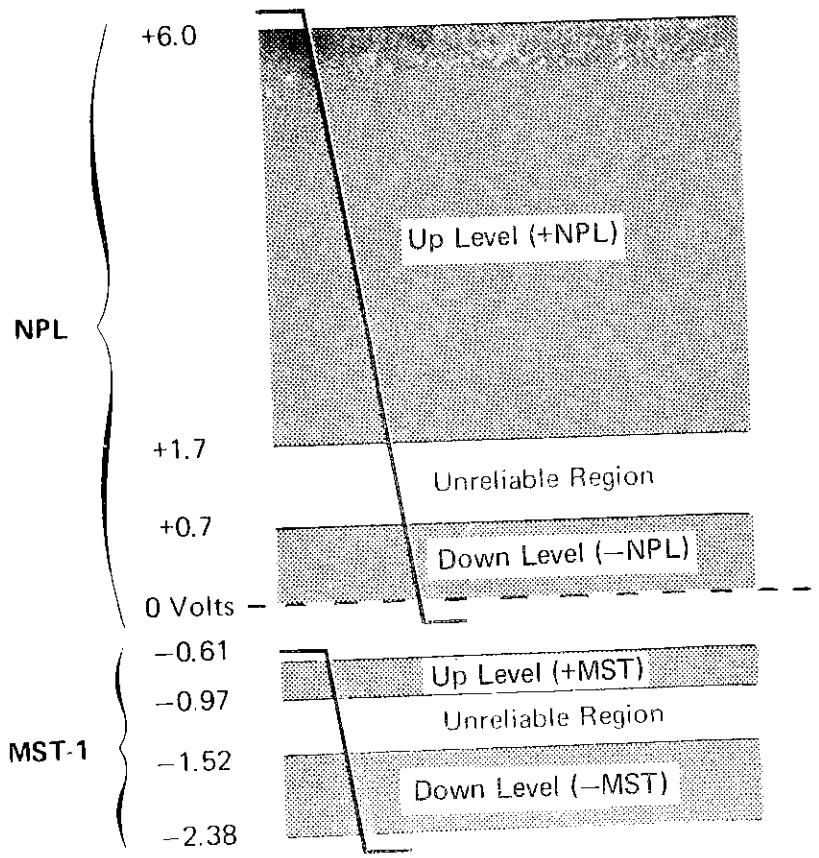
1. Turn the Start/Stop switch to STOP on every drive in the string.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Push the Power Off switch located on the Power Panel on the front of the 3340-A2. *Power is removed from the entire string: the 3340-A2 plus all attached 3340-B1s and B2s.*

Satellite Module (B1, B2)

1. Turn the Start/Stop switch to STOP on each drive in the satellite module to be powered down.
2. Wait until the data modules are completely unloaded (data modules need not be removed from the drives).
3. Turn off CP210 located on the AC compartment (accessible

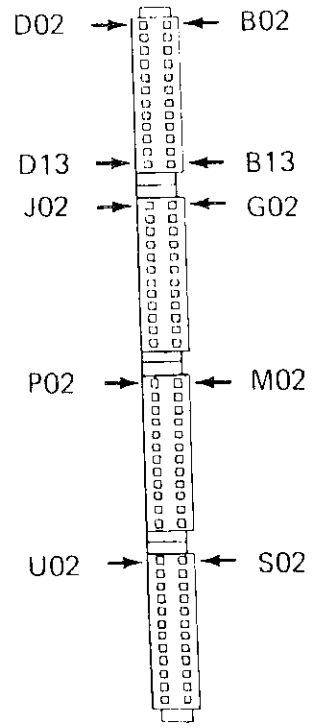
nance activity.

VOLTAGE LEVELS



SCOPE PIN LOCATIONS

Four-high card socket or pin side of MST board shown:



MST-1 Card	
Voltage	*Card (Contact Tab)*
–4	B06, G06, M06, and S06
Ground	D08, J08, P08, and U08

ALD pages showing voltage distribution:

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Select Operation – – – – – – – – OPER 110

String Switch Operation – – – – – OPER 111, 112

ACCESS

Seek Operation (System Level)– – – OPER 113–115

Access Operation - Block Diagram and Description by Card – – – – OPER 116, 117

Access Control Sequence – – – – – OPER 119, 120

Track Following - Functional Block Diagram and Description – – – – OPER 123–125

INDEX Detection – – – – – – – OPER 126

Rezero - Functional Block Diagram and Description – – – – – – – OPER 129, 130

Rezero Pattern Detection – – – – OPER 131

Access Operation (Rezero) – – – – OPER 136–138

Seek - Functional Block Diagram and Description – – – – – – – OPER 141, 142

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Search Commands – – – – – – – OPER 200

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Set and Reset Read/Write

R/W Control Overview – – – – – OPER 210

Description – – – – – – – – – OPER 213

Circuit Diagram – – – – – – – – OPER 214

Timing – – – – – – – – – – – – OPER 217, 218

R/W Control Logic Overview – – OPER 224

Write

Operation Description – – – – – OPER 225

Data Path – – – – – – – – – – OPER 226

Timing – – – – – – – – – – – – OPER 227

Read

Operation Description – – – – – OPER 230

Data Path – – – – – – – – – – OPER 231

Read Gap 1/Gap 2 – – – – – – OPER 232

Read Gap 3/Gap 4 – – – – – – OPER 233

No Record Found – – – – – – OPER 234

ECC Correct Op – – – – – – – OPER 240–242

RPS

Rotational Position Sensing – – – – OPER 250–251

ERROR ALERT

Description – – – – – – – – – – OPER 260

Check End Conditions – – – – – – OPER 270, 272

Note: Certain 3340 subsystems have a 3344 drive attached. If a 3344 drive is attached, go to the OPER section in Volume R07 of the 3344 MLM for all unique 3344 OPERations information. (3344 documentation will be available in May 1976).

DISK STORAGE AND ATTACHMENT FEATURES

IBM 3340 DISK STORAGE CONCEPT

Unique to the 3340 direct-access storage facility are the following basic features:

- A data module instead of a disk pack.
- Defect skipping.

The data module is a sealed cartridge that contains disks, spindle, read/write heads, and access arms. The data module concept offers the following advantages:

Drive capacity can be altered by changing the data module.

Preventive maintenance of the heads, disks, and spindle is eliminated by reducing the exposure to outside contamination.

Reliability is improved by read/write heads. Each head reads only the data it previously wrote.

Defect skipping allows data to be written before and after a surface defect. Thus, all of the track can be used except for that portion with the defect. This also eliminates the access time formerly required to move the read/write heads to an laternate track.
(See OPER 25 for details.)

FEATURES

Some system attachments do not support one or more of the following features. Refer to Functional Characteristics or Reference Manuals for system or attachment to determine which features are supported.

	For details see:
Fixed Head (FHFE)	R/W Section
Rotational Position Sensing (RPS)	OPER Section
String Switch (SWFE)	SSW Section

Note: *SSW section and microdiagnostic Routine B6 available only if feature is installed.*

DESCRIPTIONS AND IDENTIFICATIONS

Fixed Head

The Fixed Head feature permits attachment of the 3348 Model 70F. This 70-megabyte data module contains 30 additional fixed heads providing 500,000 bytes of storage with zero seek time.

The Fixed Head feature can be identified by two checks. First, the Read/Write Matrix card has two DM connector cables. Secondly, the DM connector between the matrix card assembly and the Data Module has a side connector attachment.
(See R/W 350 for cable details.)

Rotational Position Sensing

Rotational Position Sensing (RPS) is an optional feature for the 3340. This feature makes it possible to reduce the time needed to search for records after the cylinder and tracks are accessed.

The disk surface is divided into 64 sectors. RPS helps to locate the sector closest to the desired record. Although the sector location is not physically indicated on the track, the 3340 stores the sector number at the beginning of all Read, Write, and Search operations. The sector number can be transferred to main storage by chaining a Read Sector command after the operation. Subsequent operations with the same record can be facilitated by programming a Set Sector in the command chain. The Set Sector command fetches the sector number from main storage so it can be used to locate the desired record, provided that the access assembly is at the correct cylinder and track.
(See OPER 250–254 for details.)

The RPS feature can be identified by the added card in location A1G2 in the drive.

String Switch

The string switch feature (SWFE) allows an IBM 3340 Disk Storage and Control and its attached string of 3340 disk storage modules to be shared by various storage control attachments.

The 3340 can be dedicated to a single storage control with an Enable/Disable switch.
(See OPER 111–112 for details.)

The SSW feature can be identified by the cables in the A2 board locations A2–A5 and B2–B5. There should also be five cards in the A2 board at locations D2, E2, H2, J2, and M2 and a card in each drive at A1J4. *(See SSW 115 for cable details.)*

REFERENCE

- *Reference Manual for Integrated Storage Control,* Order No. GA26-1620.
- *Reference Manual for 3830 Model 2 Storage Control,* Order No. GA26-1617.
- *Functional Characteristics for 3115,* Order No. GA33-1510.
- *Functional Characteristics for 3125,* Order No. GA33-1506.

FEATURE IDENTIFICATION

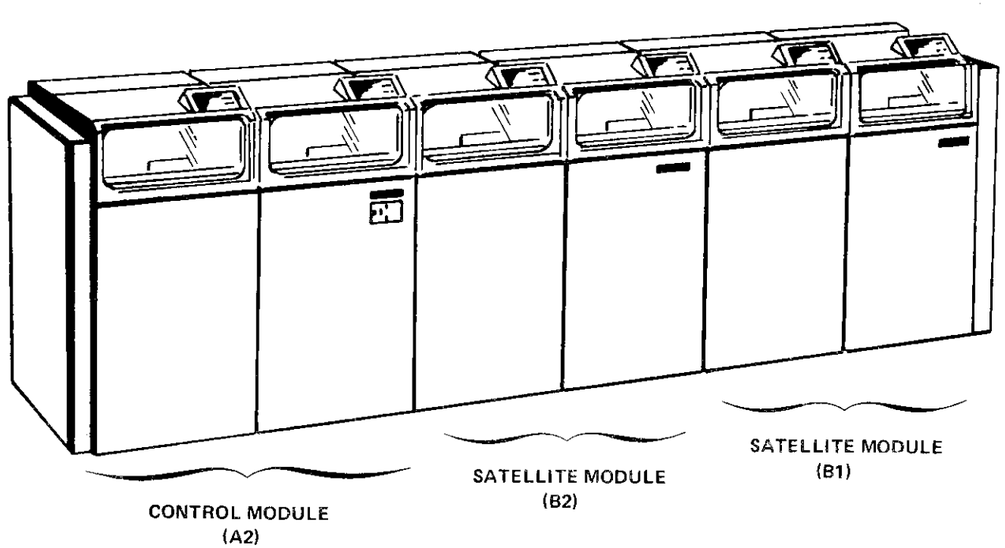
The machine history may be used to identify the features installed.

TESTING

For details on running the microdiagnostics for each feature, see START 110.

The following features use the following diagnostic tests:

FHFE – Routine B1
RPS – Routine A5
SWFE – Routine B6



CONCEPTUAL UNITS

CONTROLLER

(See OPER 40 for simplified data and control flow)

- Commands are sent from storage control to the controller
- The controller decodes each command to determine if it is for the controller only or must be forwarded to the drive.
- Contains data control circuitry and status information.
- Contains the following major functional units.

  SERDES, ECC, PLO/VFO, Error Assembler, CE Register/ Display/Data Switches, Gap/Data Counter and Read/Write Control, Op Decoder, and Status Assembler.

DRIVES

(See OPER 40 for simplified data and control flow)

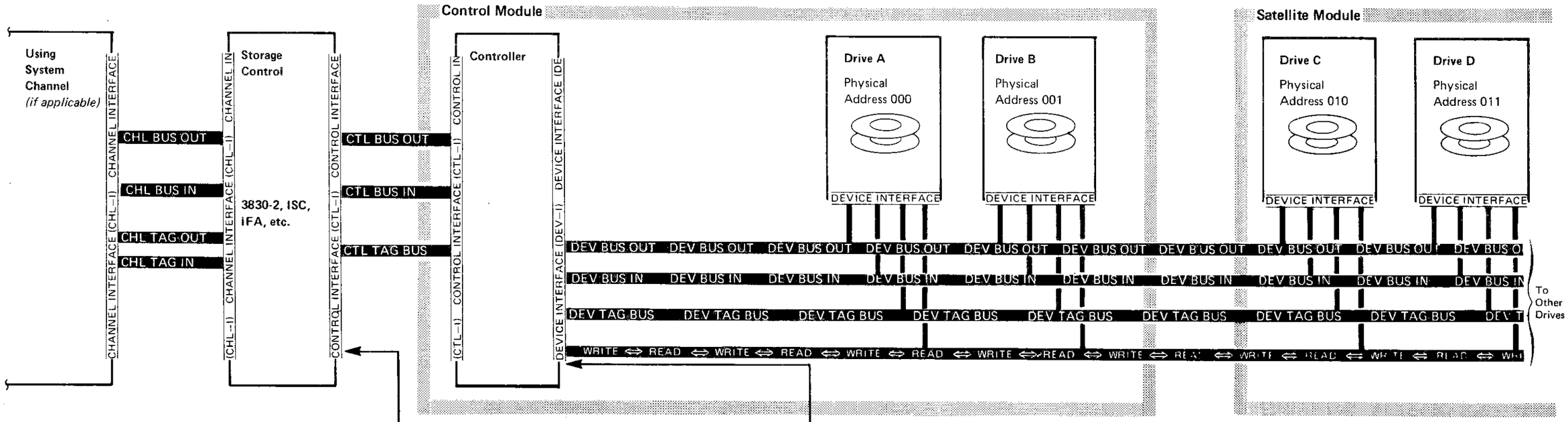
- Contain mechanical components that allow information to be stored on the data module.
- Position read/write heads over a selected cylinder to allow direct access to a data record.
- Provide circuits for drive selection and execution of commands issued by storage control.
- Provide read/write circuits to allow data recording on or retrieval from the disk pack.
- Provide Sector Counter if RPS feature is installed.
- Up to three 3340 satellite modules (B1 or B2) can be attached to a control module (A2).

DATA MODULES

(See OPER 10 for description)

- Heads and access mechanism are contained within the data modules.
- Contain information for head positioning, data timing, and rotational position sensing on one disk surface.
- Available in two models:

  35 Mb and 70 Mb capacity.



Control Interface

(See OPER 90 for description)

- Common connection between storage control and the controller.

Device Interface

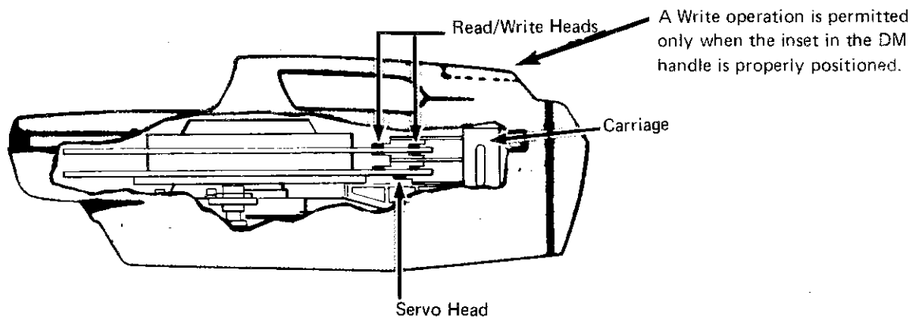
(See OPER 93 for description)

- Common connection between all drives and the controller.

1 DATA MODULE

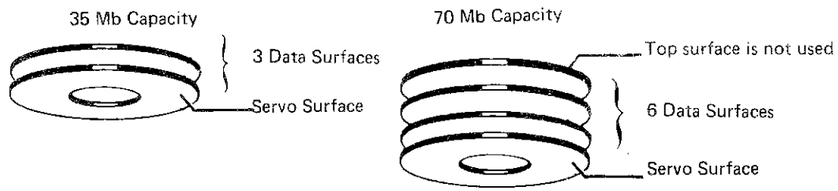
The 3348 data module contains either two or four disks, depending on the size used. It has a carriage in the module with two read/write heads per data surface and one servo head for the servo surface.

See DM 610 for the mechanical features.



2 DATA MODULE SIZE

There are two data module sizes:



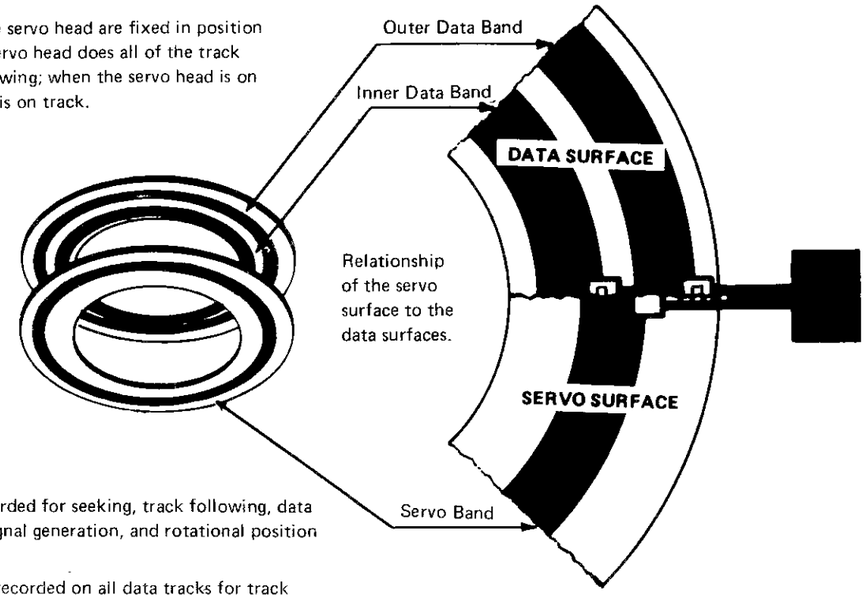
PHYSICAL DESCRIPTION	35 Mb	70 Mb
Total access Positions	350	350
Total physical cylinders*	350	350
Data surfaces	3	6
Heads per surface	2	2
Indexes	2	2
Tracks per physical cylinder	12	24

LOGICAL DESCRIPTION	35 Mb	70 Mb
Addressable data cylinders	348	696
Alternate data cylinders	1	2
CE cylinders	1	2

*Each access position consists of two physical cylinders: one cylinder on the outer data band and its corresponding cylinder on the inner data band.

3 POSITIONING OF HEADS

The data heads and the servo head are fixed in position on the carriage. The servo head does all of the track seeking and track following; when the servo head is on track, every data head is on track.

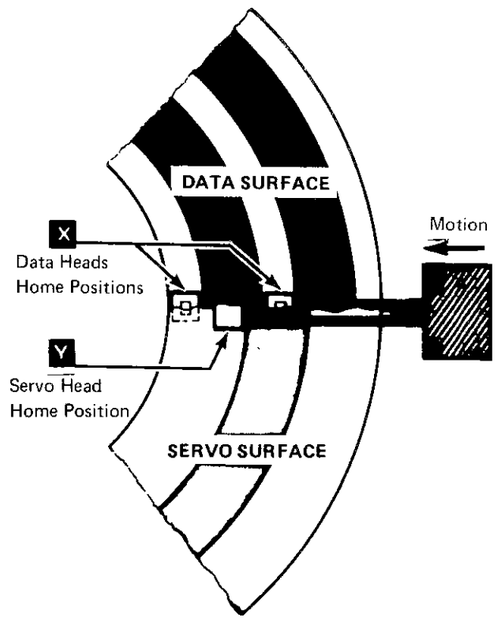


Servo tracks are prerecorded for seeking, track following, data clocking, index point signal generation, and rotational position signal generation.

Home addresses are prerecorded on all data tracks for track identification, seek verification, and skip displacement information.

4 HEAD HOME POSITION

When the data module is unloaded, the data heads come to rest in their home positions **X**, and the servo head comes to rest at its home position **Y**. This places the heads out of the recording area when the disk stops rotating.



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DATA SURFACE TRACK LAYOUT

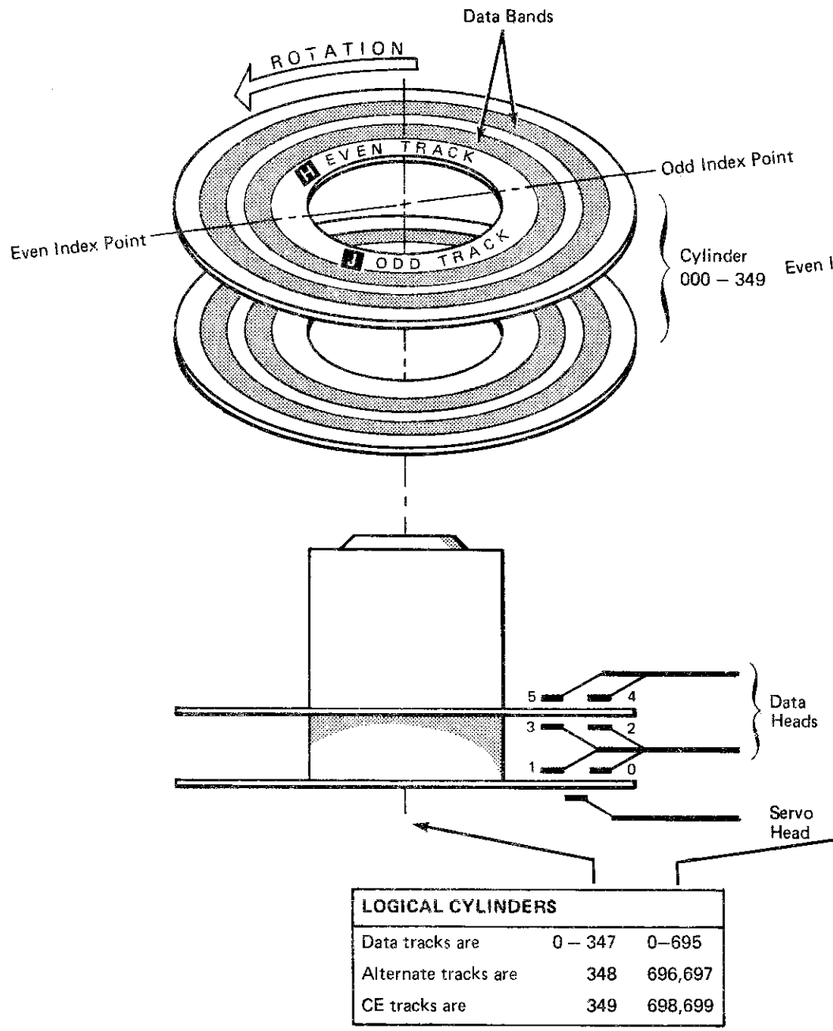
- Each data surface has two physical heads, each corresponding to a data band area.
- Each head records two tracks during a single revolution of the disk, an even track H after sensing the even index point and an odd track J after sensing the odd index point.
- Each physical head relates to the odd and even tracks as two separate logical heads.
- A logical head is selected by a logical track address.
- An entire cylinder is recorded by sequentially switching heads. One cylinder can be recorded on the 35 Mb data module and two cylinders on the 70 Mb data module before the carriage must be repositioned.

See R/W 343–346 for conversion of address to physical cylinder and head.

Example:

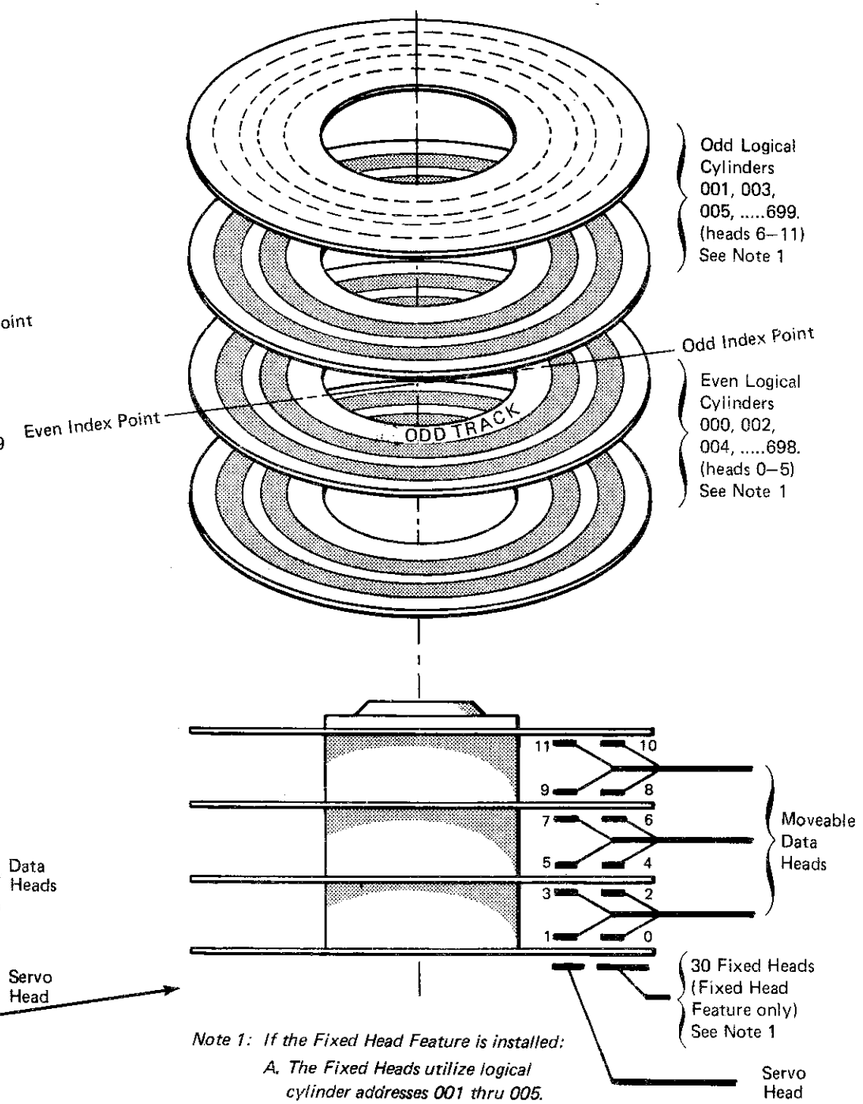
Logical Cylinder Address	Logical Track Address		Physical Head		Index
	35 Mb	70 Mb	35 Mb	70 Mb	
0	0	0	0	0	Even
	1	1	0	0	Odd
	2	2	1	1	Even
	3	3	1	1	Odd
	4	4	2	2	Even
	5	5	2	2	Odd
	6	6	3	3	Even
	7	7	3	3	Odd
	8	8	4	4	Even
	9	9	4	4	Odd
	A	A	5	5	Even
	B	B	5	5	Odd
1	0	0	0	6	Even
	1	1	0	6	Odd
	2	2	1	7	Even
	3	3	1	7	Odd
	4	4	2	8	Even
	5	5	2	8	Odd
	6	6	3	9	Even
	7	7	3	9	Odd
	8	8	4	10	Even
	9	9	4	10	Odd
	A	A	5	11	Even
	B	B	5	11	Odd

35 Megabytes



LOGICAL CYLINDERS		
Data tracks are	0 – 347	0–695
Alternate tracks are	348	696,697
CE tracks are	349	698,699

70 Megabytes

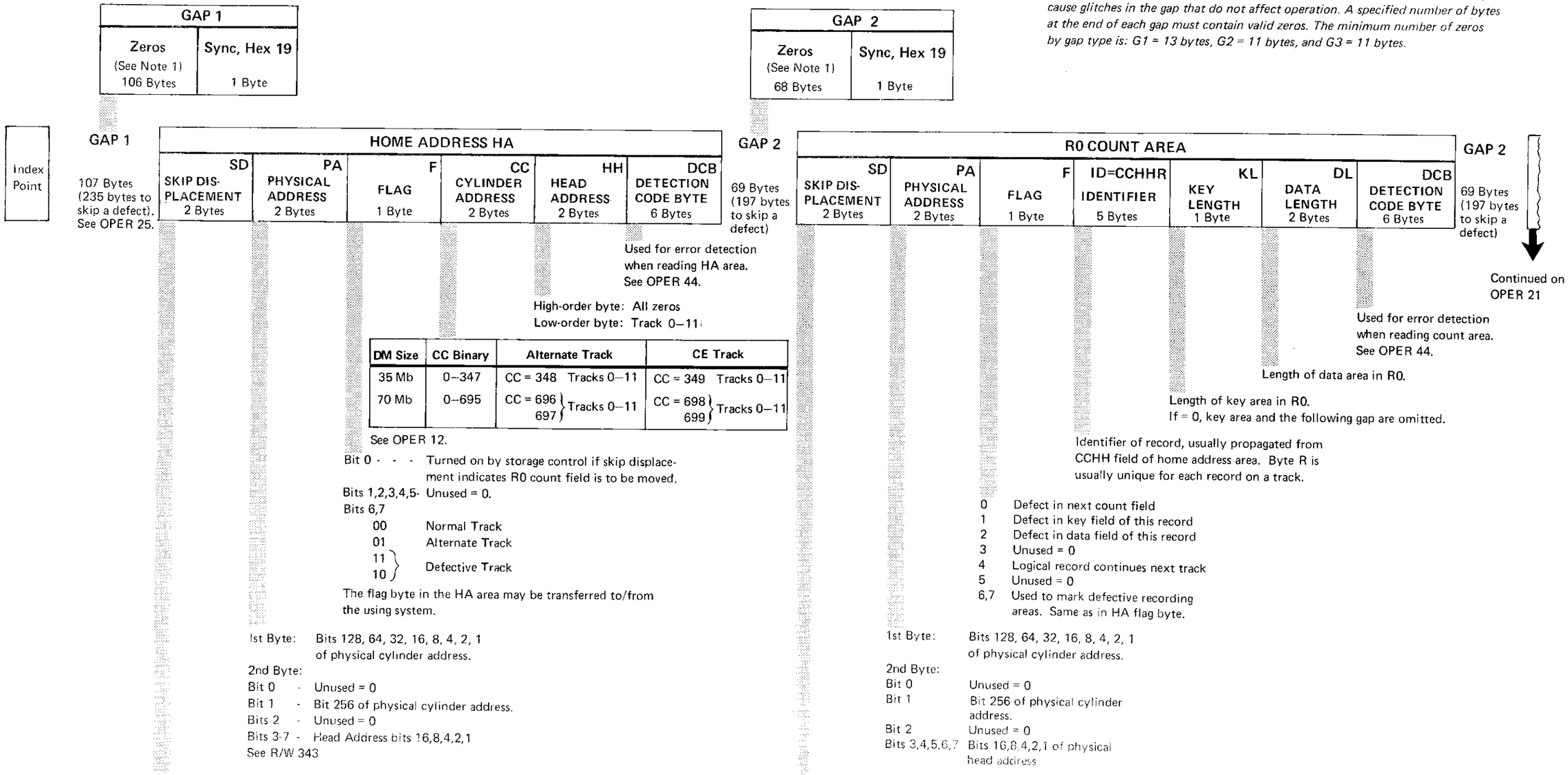


Note 1: If the Fixed Head Feature is installed:

A. The Fixed Heads utilize logical cylinder addresses 001 thru 005.

B. The system cannot use the moveable heads with logical cylinder addresses 001 thru 005.

Note 1: Gaps are usually written with zeros. Turning Write Gate on and off may cause glitches in the gap that do not affect operation. A specified number of bytes at the end of each gap must contain valid zeros. The minimum number of zeros by gap type is: G1 = 13 bytes, G2 = 11 bytes, and G3 = 11 bytes.



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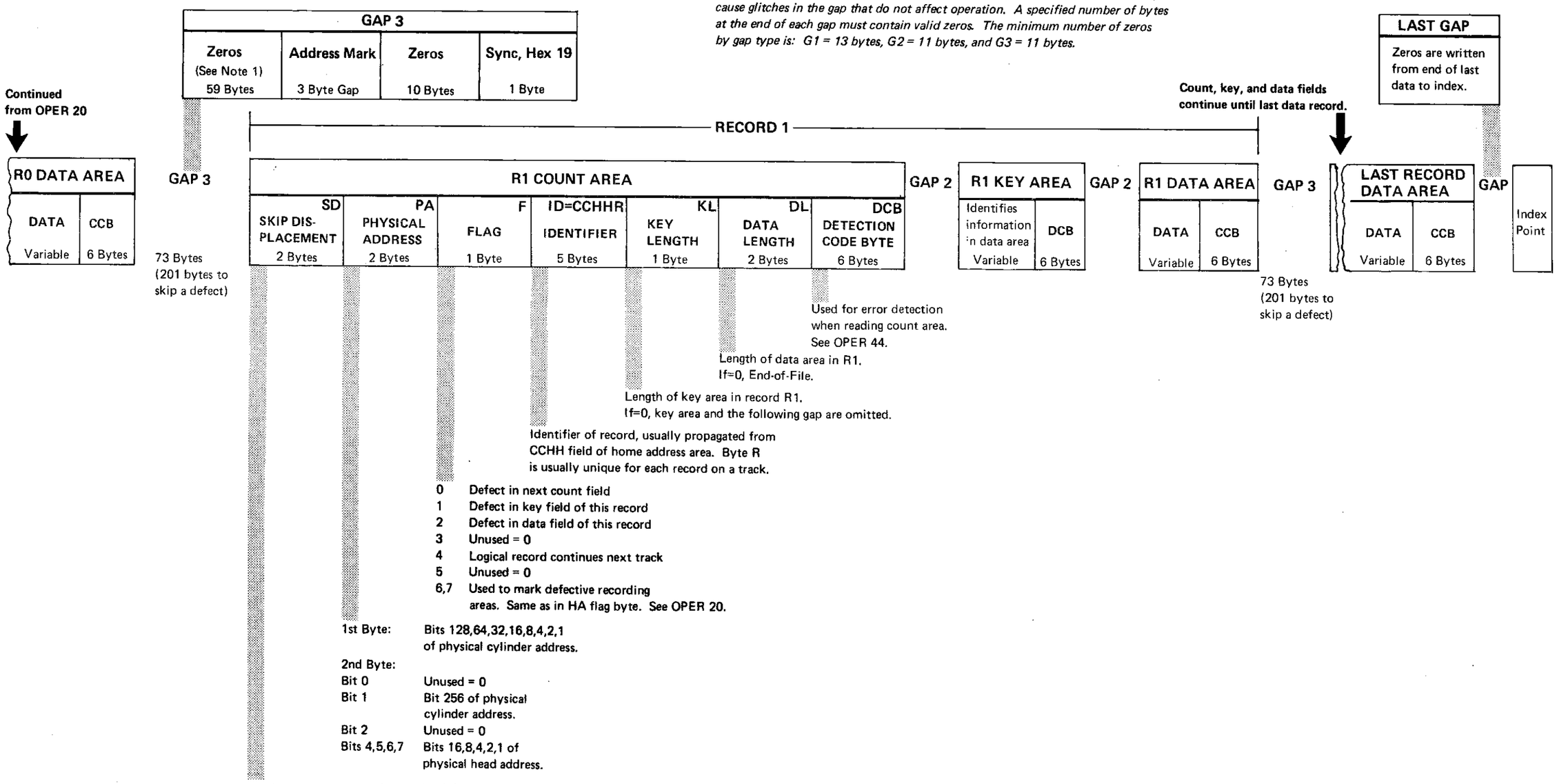
TRACK FORMAT (Continued)

Note 1: Gaps are usually written with zeros. Turning Write Gate on and off may cause glitches in the gap that do not affect operation. A specified number of bytes at the end of each gap must contain valid zeros. The minimum number of zeros by gap type is: G1 = 13 bytes, G2 = 11 bytes, and G3 = 11 bytes.



INTRODUCTION

Note: If the storage control is a System/3 DSA, this page should not be used. Refer to the INTRO section of the 3340 DSA MLM for information concerning surface defect skipping.

The 3340 automatically skips over surface defects on the 3348 data module disks.

When writing a track containing a defect, a special gap (128 bytes) is written over the defective area so no data can ever be recorded there.

If a defect is too large or if there is more than one defect on a track, the track is flagged as defective and an alternate assigned.

When formatting the tracks and a defect is detected, it is skipped by either:

- Moving a field and extending the preceding gap when the defect falls near or within the gap, or
- Splitting the field into two parts positioned on each side of the special gap that was written over the defective area.

Before a 3348 data module is shipped from the factory, a thorough surface analysis-initialization is performed. Home Address and a standard R0 (8-byte data length) are written. If a surface defect is found, its displacement from the Index Point is written in the HA field (SD = distance in bytes from Index Point to center of defect).

When the storage control becomes oriented on a Count field or Home Address during a Write operation, it stores the SD and Flag bytes and therefore knows the location of any defect. When the Count Field, SD, and Flag bytes are written during a WRCKD, the key length and data length have not been transferred from the system. The SD and Flag bytes for the Count field are then computed under the assumption that no defect exists. When the gap following the Count field is being written, the key and data length, transferred from the system, and the SD bytes are analyzed to see if the record extends to a track defect. If not, the assumption made while writing the Count field was correct and the SD value for the next Count field is computed.

If the record does extend to a defect, the Count field is not valid and must be rewritten with correct SD and Flag bytes. The necessary reorientation is accomplished by counting over almost a full track worth of bytes, padding to Index and clocking the remainder until a full revolution is completed. While this is happening, the record is being scanned and analyzed to determine whether it must be split or moved. Also, the system, after initially transferring the Count field, is ready to begin transferring the Key (data) field. The Count field is now rewritten from storage control with the newly computed SD and Flag bytes. The remainder of the record is then written, splitting or moving fields as appropriate.

Reading a record that has a surface defect is automatically controlled by microcode and no time is lost by seeking alternate tracks or from rotational delay.

HOW TO DETERMINE SKIP DISPLACEMENT

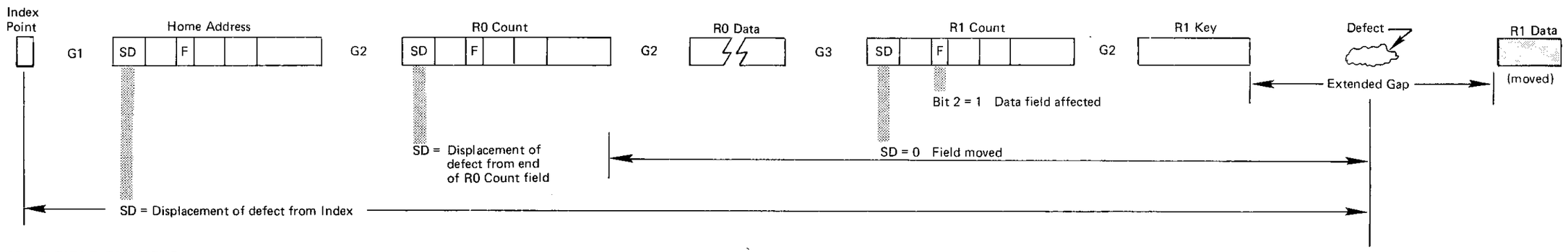
In normal operation, the Skip Displacement field in the Home Address is transparent to the user at the channel level. However, the HA SD field can be determined by executing the following CCW chain via the channel:

Read Home Address

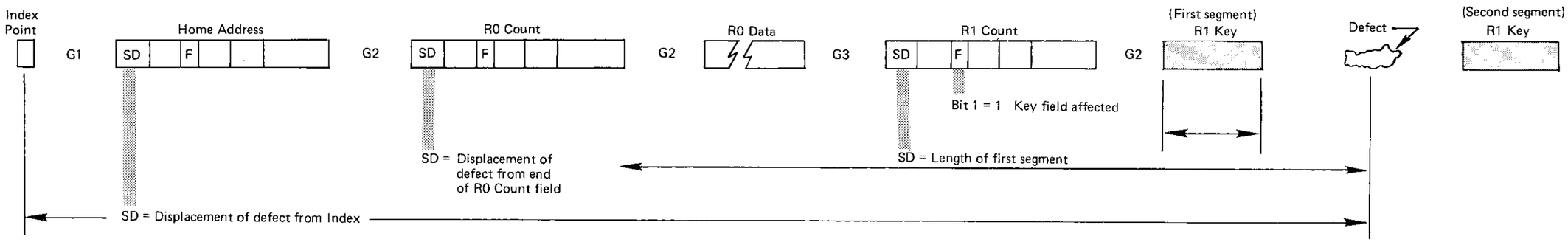
Sense I/O

If there is no outstanding Device End or Unit Check following the execution of this chain, the contents of the HA SD field appear in sense bytes 22–23.

EXTENDED GAP EXAMPLE



SPLIT FIELD EXAMPLE



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L

ALTERNATE TRACK ASSIGNMENT

DEFINITIONS

Alternate Track

An *alternate* track is an extra track that can be used in place of a *defective* track. The 35 Mb data module has 12 alternate tracks, and the 70 Mb data module has 24. These alternate tracks are designated at the plant and are logically addressed as follows:

35 Mb – Cyl 348, Hd 00-11 (Decimal)
70 Mb – Cyl 696-697, Hd 00-11 (Decimal)

Unassigned alternate tracks contain their own logical track address in the CCHH bytes of the HA and R0 count field. In addition, bit 7 of the Flag byte in the HA field is set to identify the track as an alternate.

Defective Track

A defective track is a track with one or more surface defects that cause Read Data checks. When the track is assigned as defective, bit 6 in the Flag byte of the HA field is set and the R0 count field is written with an address pointing to an alternate track.

ASSIGNMENT OF AN ALTERNATE TRACK

1. Bit 6 of the Flag byte in the HA field on the defective track is set.
2. The R0 count field on the defective track is written with the CCHH bytes equal to the address of the assigned alternate track.
3. The R0 count field on the *alternate* track to be assigned is written with the CCHH bytes equal to the address of the *defective* track (that is, it points back to the defective track).

OS/VS UTILITIES (Reference OS/VS Utilities, GC35-0005)

General utility programs are available with OS/VS operating systems to aid in alternate track assignment and data module initialization. Because alternate track assignment is a customer responsibility, the following is for information only.

IBC DASDI

An independent or standalone utility used for initializing a disk pack or data module:

- Assigns alternate tracks for all tracks flagged defective.
- Writes volume label on track 0, record 3.
- Constructs and writes a volume table of contents (VTOC) on cylinder 0, track 0.
- Writes an IPL record on track 0.
- Allows tracks flagged defective to be analyzed and reclaimed if they are good. (Release 7.77 and above.)
- Allows alternate track assignment for any track, whether it is defective or not. (Tracks with defects in HA or R0 are included.)

IEH DASDR

A system utility used to initialize a data module:

- Performs the same functions as IBC DASDI except that it runs under OS/VS.
- Can be used to dump or restore the contents or a portion of the contents of a 3340 data module (ERT ALT).

IEH ATLAS

A system utility used to assign and write an alternate track:

- When defective tracks are indicated.
- Attempts to rewrite defective record(s) with data supplied by user.
- Flags a track defective if it cannot be rewritten successfully.
- Locates and assigns an alternate track.
- Retrieves and transfers usable data records from the defective track to the alternate track.
- Replaces bad record(s) with data supplied by the user.

OTHER OS/VOS UTILITIES AVAILABLE FOR DIRECT-ACCESS DEVICES

- IBC DMPRS – an independent utility used to dump and restore data on a direct-access volume.
- IEB COPY – a data set utility used to copy or merge data sets.
- IEB UPDTE – a data set utility used to modify an existing partitioned or sequential data set. Logical records can be replaced, deleted, renumbered, rewritten or added to the member or data set.
- IEB ISAM – a data set utility used to copy an indexed sequential data set.

OS/VS SERVICE AIDS (Reference OS/VS Service Aids GC28-0633)

- SPZAP – a service aid program that operates a problem program.
- Can be used to replace, modify, or reconstruct direct-access data records that have been destroyed by an I/O error.

DOS/VS UTILITIES (Reference DOS/VS System Utilities, GC33-5381)

General utility programs are available with DOS/VS operating systems to aid in alternate track assignment and data module initialization. Because alternate track assignments is a customer responsibility, the following is for information only.

Initialize Disk (INTDK)

A system utility used to initialize a data module:

- Reads and verifies HA and R0 fields.
- Writes volume label on track 0, record 3 (after reading all HA and R0 fields and verifying they are correct).
- Constructs and writes a volume table of contents (VTOC) on cylinder 0, track 0.

Note: Alternate tracks are not assigned for tracks flagged defective. It is assumed that any track that is flagged defective has previously had an alternate assigned. To assign an alternate track, use ALTDK or standalone DASDI.

Assign Alternate Track Disk (ALTDK)

A system utility used to assign and write an alternate track:

- Flags defective track.
- Locates and assigns alternate track.
- Retrieves and transfers usable data records from the defective track to the alternate track.
- Replaces bad record(s) with data supplied by the user. Does not analyze the condition of the defective track.

Note: Alternate tracks cannot be assigned for defects in Home Address or R0 count fields (use standalone DASDI 7.77 or above).

Tracks flagged defective cannot be reclaimed (use standalone DASDI 7.77 or above).

OTHER DOS/VS UTILITIES AVAILABLE FOR DIRECT-ACCESS DEVICES

CLEAR DISK

- To establish pre-formated tracks on one, or more, extents on a 3348 disk.
- Create a file label in the VTOC.

COPY and RESTORE DISK

- Copy volume for file to disk, tape or card.

FAST COPY DISK VOLUME

- To copy entire contents of a 3348 volume to another 3348 or tape (multifiles).

DOS/DITTO

- A general purpose utility program can copy files from disk to disk or tape to print.

3340 OLTS (Reference OLT Section of MLM)

3340 Pack Scan A (T3340 PSA)

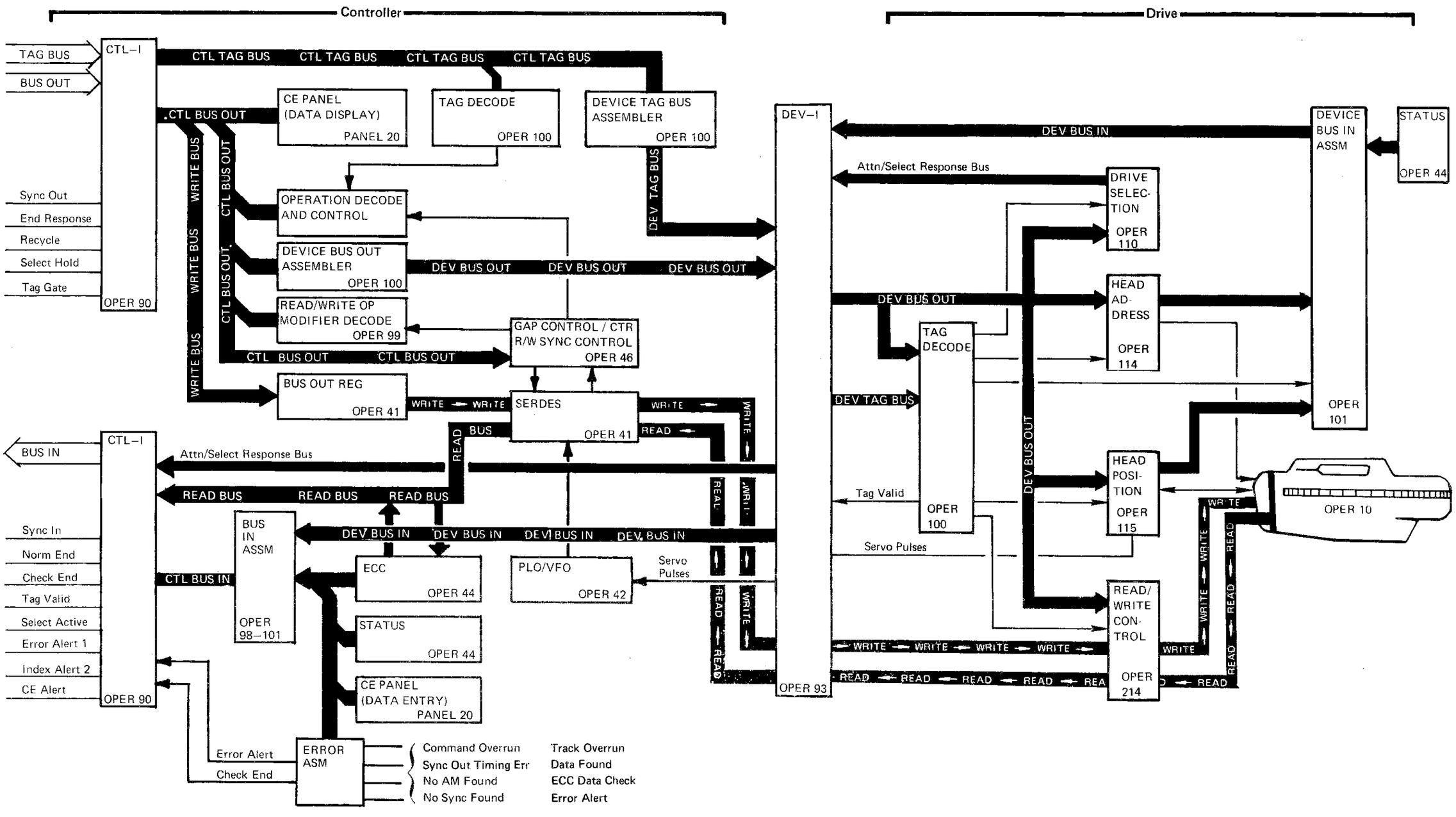
- Reads HA and R0 on all tracks except CE tracks.* CCHH bytes in the HA fields are compared against CCHH bytes in the respective R0 fields. An error summary is printed upon completion.
- Lists alternate tracks.
- Flags and lists defective tracks.
- Invalid alternate track mates are called errors.

3340 Pack Scan B (T3340 PSB)

- Reads all data on all tracks except CE tracks.* Prints an error summary upon completion. No data is transferred or destroyed.

**Checks to see that an ECC data check does not occur.*

DATA AND CONTROL FLOW



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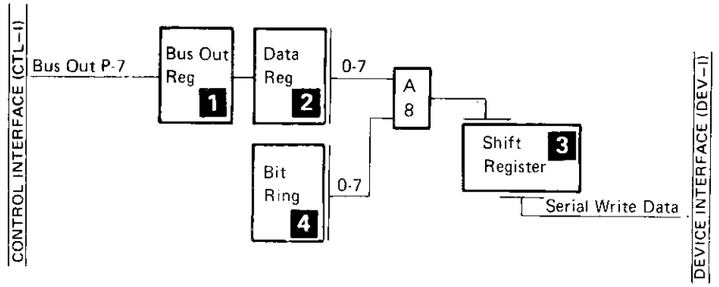
SERDES

SERDES consists of a Data Register, Shift Register, and Bit Ring.

- It receives 8-bit bytes from storage control and converts them to serial write data.
- It receives serial read data from the drive and deserializes it into an 8-bit byte to the storage control.
- It detects a 20-bit gap in serial data during Address Mark Search.
- It supplies clock pulses during Read and Write operations.

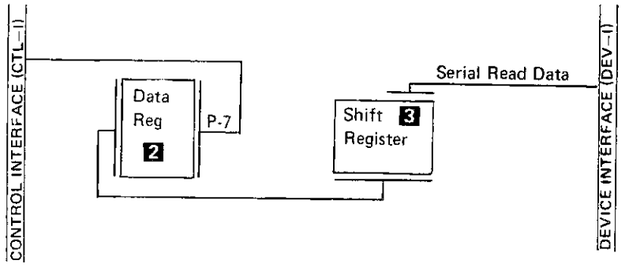
Write Data Serializer

During Write operations the serializer takes a byte of data from Bus Out (parallel-by-byte) and sends it to the drive one bit at a time (serial-by-bit). The serializer comprises the Bus Out Register, Data Register, Bit Ring, and the Shift Register.



Read Data Deserializer

During Read operations the deserializer takes data from the drive one bit at a time (serial-by-bit), assembles the data into a byte and places it on Bus In. The deserializer is composed of the Shift Register and the Data Register.



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1 BUS OUT REGISTER

During Write operations the Bus Out Register buffers data and gates it to SERDES.

2 DATA REGISTER

During Write operations the output of the Data Register is ANDed with the Bit Ring to serially gate data out.

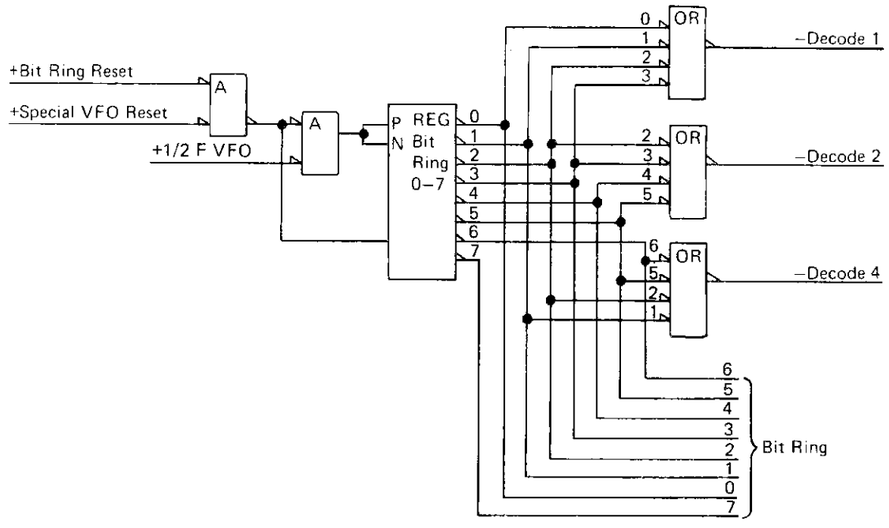
During Read operations the Data Register buffers the contents of the Shift Register.

3 SHIFT REGISTER

During Write operations the Shift Register serially shifts data. During Read operations the Shift Register assembles serial data into bytes.

4 BIT RING

The Bit Ring is driven by 1/2 F VFO. The Bit Ring is shifted at both the rise and fall of 1/2 F, stepping the Bit Ring at a rate of 1F. The outputs are decoded to give eight Bit Ring steps (0–7). Plus decodes of 1, 2, and 4 serialize write data. The outputs of the Bit Ring steps are used to gate the SERDES circuitry.



DATA AND CONTROL FLOW INTRODUCTION (Continued)

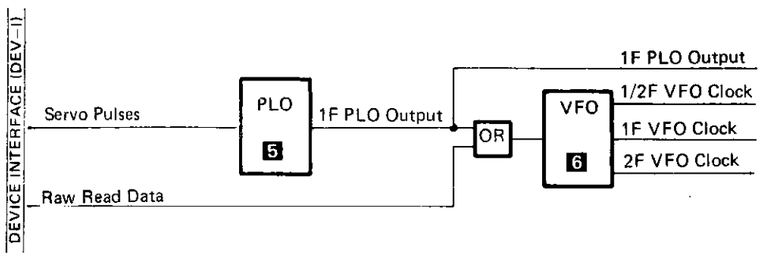
PLO/VFO

5 PHASE LOCKED OSCILLATOR (PLO)

The PLO circuits synchronize the write circuits to the disk speed during Write and Space operations. Servo Pulses are the input to the PLO from the disk servo track. Servo Pulses have a frequency of one pulse per two bytes. These Servo Pulses are used to synchronize a 7.08 MHz Voltage Controlled Oscillator(VCO) at 16 times the input frequency (8 pulses per byte). The PLO output synchronizes the Variable Frequency Oscillator (VFO), which generates the clock pulses that drive SERDES and control the write circuits.

6 VARIABLE FREQUENCY OSCILLATOR (VFO)

The VFO clocks the SERDES to the speed of the disk. The VFO synchronizes the the PLO output during Write and Gap Spacing operations and to Raw Read Data during Read operations. The VFO circuitry synchronizes to the disk speed, compensating for the varying speeds between drives.

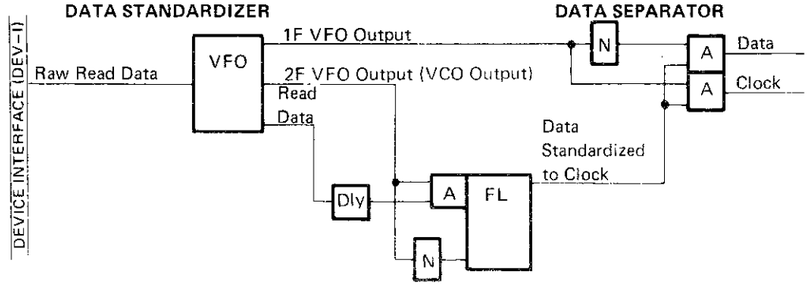


7 DATA STANDARDIZER

The data standardizer is part of the VFO circuitry and synchronizes the Raw Read Data from the drive with the VFO output. The read data is delayed and aligned with the next clock pulses to eliminate skew between bits.

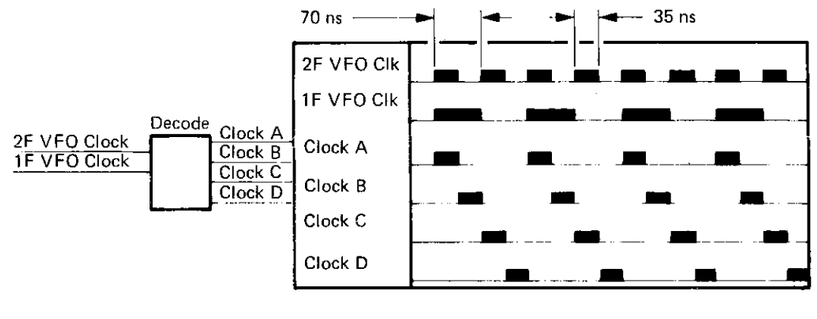
8 DATA SEPARATOR

The data separator takes data standardized to clock pulse during Read operations and separates the data and clock bits. The output data contains data bits with the clock bits removed.



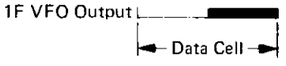
9 CLOCK PULSES

The 1F and 2F VFO outputs are decoded to generate Clock A, Clock B, Clock C, and Clock D pulses. The clock pulses drive SERDES and ECC circuitry.



DATA ENCODING

Data is encoded so that only one pulse (data or clock) is written during any data cell time (1F VFO clock) on the disk.



A data pulse is written for each 1 data bit.

A clock pulse is written only between two consecutive 0 data bits.

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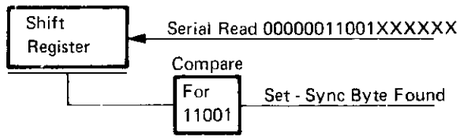
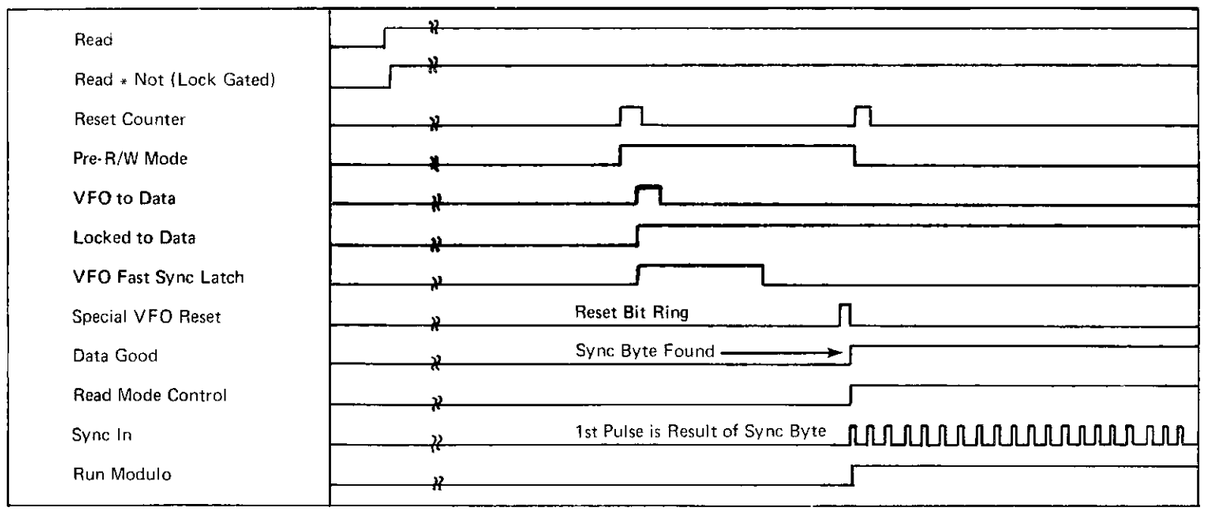
SYNC BYTE FOUND

A sync byte ('19') identifies the start of every field written on the disk. At the beginning of each Read operation, the controller searches for this pattern of 11001 in the Shift Register. The sync byte is preceded by several bytes of zeros. The Pre-R/W Mode latch is set approximately 12 bytes before the expected sync byte to indicate the area of search. The only bits read at this time are clock bits. As the sync byte shifts through the Shift Register, a Reset Bit Ring is generated and the Data Good latch is set. The Data Good latch sets the Read Mode latch and prevents any further Bit Ring resets. The Bit Ring is then in sync with data. The Read Mode latch allows the first Sync In to be generated, notifying storage control that the desired field has been found. The Read Mode latch also raises Run Modulo and resets the Pre-R/W Mode latch, preventing the No Sync Found latch from setting. If the sync byte is not found, the search continues for about ten byte-times before the No Sync Found latch is set.



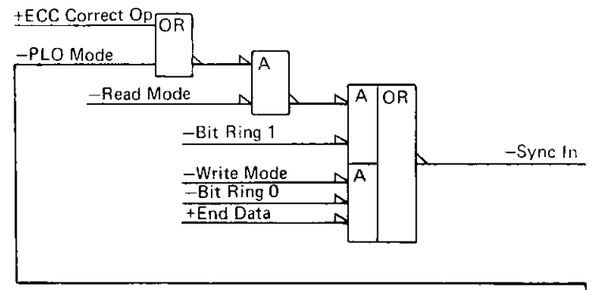
Read Operation with Sync Byte Found



SYNC IN

During the Write operations Sync In notifies the storage control that the Bus Out register is prepared to receive a byte of data.

During Read operations Sync In notifies the storage control that the Data register has placed a byte of data on Bus In via the Bus In Assembler.

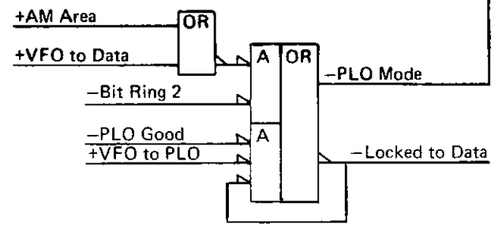


PLO/VFO Frequency Control

Lock PLO to Servo is raised a minimum of 200 μs to lock the PLO to the drive servo pulses. This is required after initially setting the read/write state.

Lock VFO to Data is raised a minimum of 8 μs to lock the VFO to the drive data.

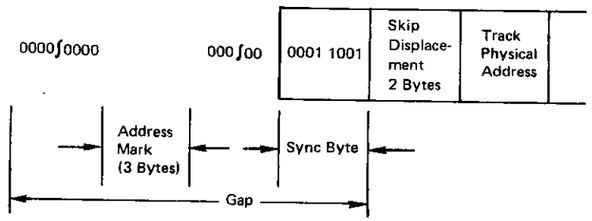
Lock VFO to PLO is raised for a minimum of 8 μs to lock the VFO to the PLO. This is required after Lock PLO to Servo and before a Write operation.



DATA AND CONTROL FLOW INTRODUCTION (Continued)

ADDRESS MARK

An address mark (AM) is contained in each Gap 3 and consists of three bytes of blanks (no data or clock bits). A Gap 3 precedes the count field of each record after R0. The address mark is separated from the sync byte at the end of the gap by 10 bytes of valid zeros and must be preceded by a minimum of 11 bytes of valid zeros. See OPER 20 and OPER 21 for gap sizes and configurations.



WRITE ADDRESS MARK (AM)

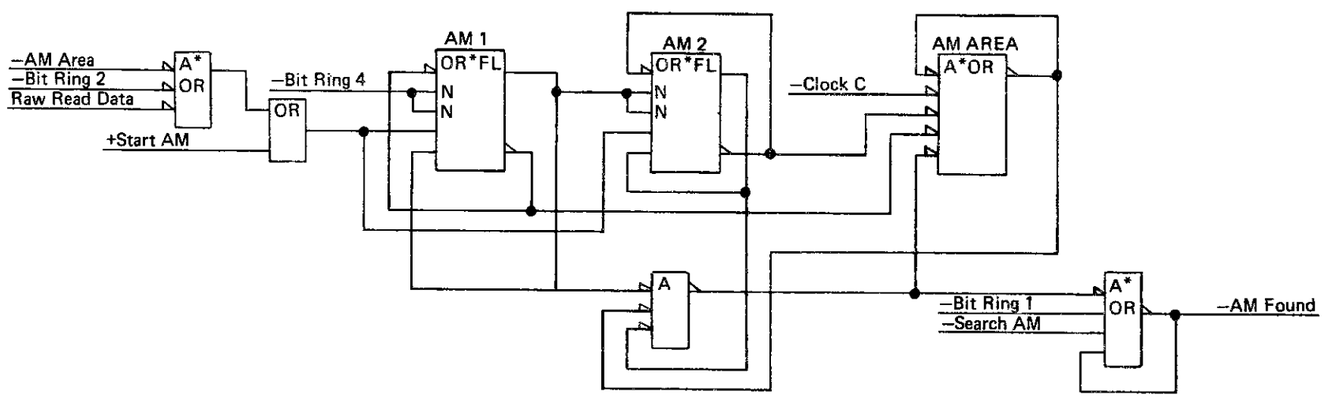
Write AM is accomplished by a Format G3 tag which causes the drive to write a complete Gap 3 (59 bytes of zeros, AM, 10 bytes of zeros, sync byte) prior to writing the count field.

ADDRESS MARK DETECTION

Address Mark Search is activated by a Read G3 Address Mark Search Tag. AM Detected rises after passing over 20 consecutive data cell periods without Raw Read Data (data or clock bits). It then conditions the controller hardware for subsequent data handling, provided the AM area is followed by Raw Read Data before Bit Ring 1.

The Address Mark Detection System consists of two flip latches that are connected as a two-bit binary counter. The latches are turned on at Bit Ring 4 time and reset by Raw Read Data pulses.

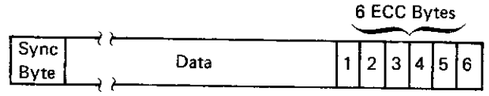
As a blank area is reached on the disk, the first FL (AM1) is set. It is not reset between Bit Ring 4 times, because no data is read. The second Bit Ring 4 time turns off AM1 and turns on AM2. Again the latches are not reset by Raw Read Data and the next Bit Ring 4 time sets AM1; AM2 stays on. Thus, three bytes of blanks have been counted. With both AM1 and AM2 on, the AM Area latch is set. At this point, it is not certain that an address mark has been found (three bytes of blanks must be followed by some read data). The first bit of Raw Read Data following an AM Area, resets AM1 and AM2. With these two latches Off and AM Area On, the AM Found latch is set at Bit Ring 1 time. If the blank area is not followed by Raw Read Data before Bit Ring 3 time following the AM area, AM area is reset and the search for another blank area on the disk is continued.



ECC (Error Correction Code)

See OPER 242 for additional ECC information.

Each block of information (Home Address, Count, Key, or Data) written on the data module has a 6-byte hardware-generated ECC burst appended to it.



ECC bytes are divided into two categories: Detection Code Bytes (DCB) and Correction Code Bytes (CCB). The ECC bytes for home address, count, and key fields are called Detection Code Bytes and are used for error detection only. The six bytes added to data areas provide error correction capability in addition to error detection. The DCB and CCB detect virtually all errors. The CCB also can correct errors of a 3-bit span or less.

When data is read, the ECC checks for errors. If an error exists, the result of the ECC check is analyzed by the controller to determine if the error is correctable.

STATUS

Controller Status

ABNORMAL CONDITIONS

Unit Check – Set when an unusual or error condition is detected in the subsystem.

NORMAL CONDITIONS

Control Unit End
Busy
Channel End
Device End
Unit Exception

Drive Status

ABNORMAL CONDITIONS

Interface Check – Device Tag Bus or Device Bus Out parity error.

Drive Check – One or more of the following conditions:
Data module sequence error.
Access error.
Sector noncompare (RPS only).

Read/Write Check – Read/Write safety circuits have detected a condition that could endanger data integrity.

Seek Incomplete – Abnormal end of a Seek or Rezero operation.

NORMAL CONDITIONS

Online
Data Module Attention
Busy
Seek/Sector Complete
Seek Complete
Sector Compare (RPS only).

GAP COUNTER

GAP COUNTER

The gap counter operates in two modes to time the 3340 operations. First, it is used to clock the events in the gaps. In this mode, the counter is reset to zero by conditions such as End Data Op, AM Found, or Index. The counter is then advanced at each Bit Ring 4 (BR 4) time. Count 2, Count 4, and Count 8 are fed to a decoder to develop lines D0 to D14. D0 is active for a count of 0 and 1. D2 is active for a count of 2 and 3 and so on.

A parity trigger is maintained in a state so that the parity check circuits always have an odd number of inactive (+) inputs.

In the second mode of operation, the counter functions as a Modulo 16 counter. During data transfer operations the counter is loaded with the ones complement of a Modulo 16 value from the storage control. A counter value of 15 in conjunction with a down Recycle line signals the End Data operation.

Parity is maintained in the same manner as before except that the parity trigger is initially set according to the parity of the Modulo 16 value from the storage control.

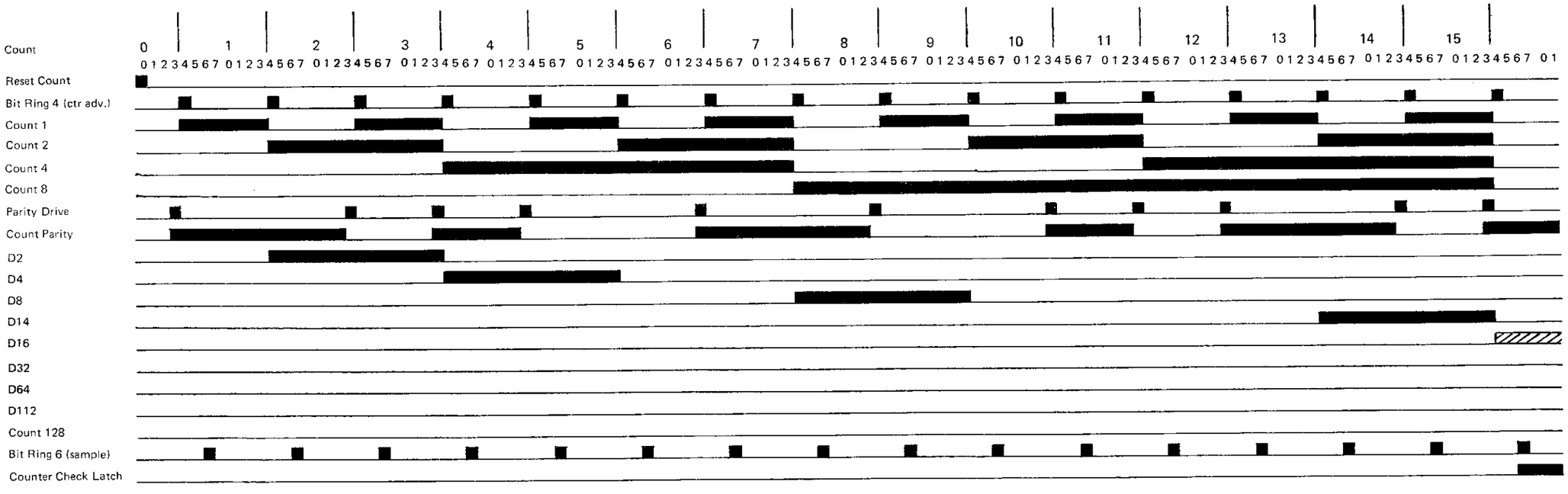
GAP COUNTER PARITY GENERATION/ PREDICTION

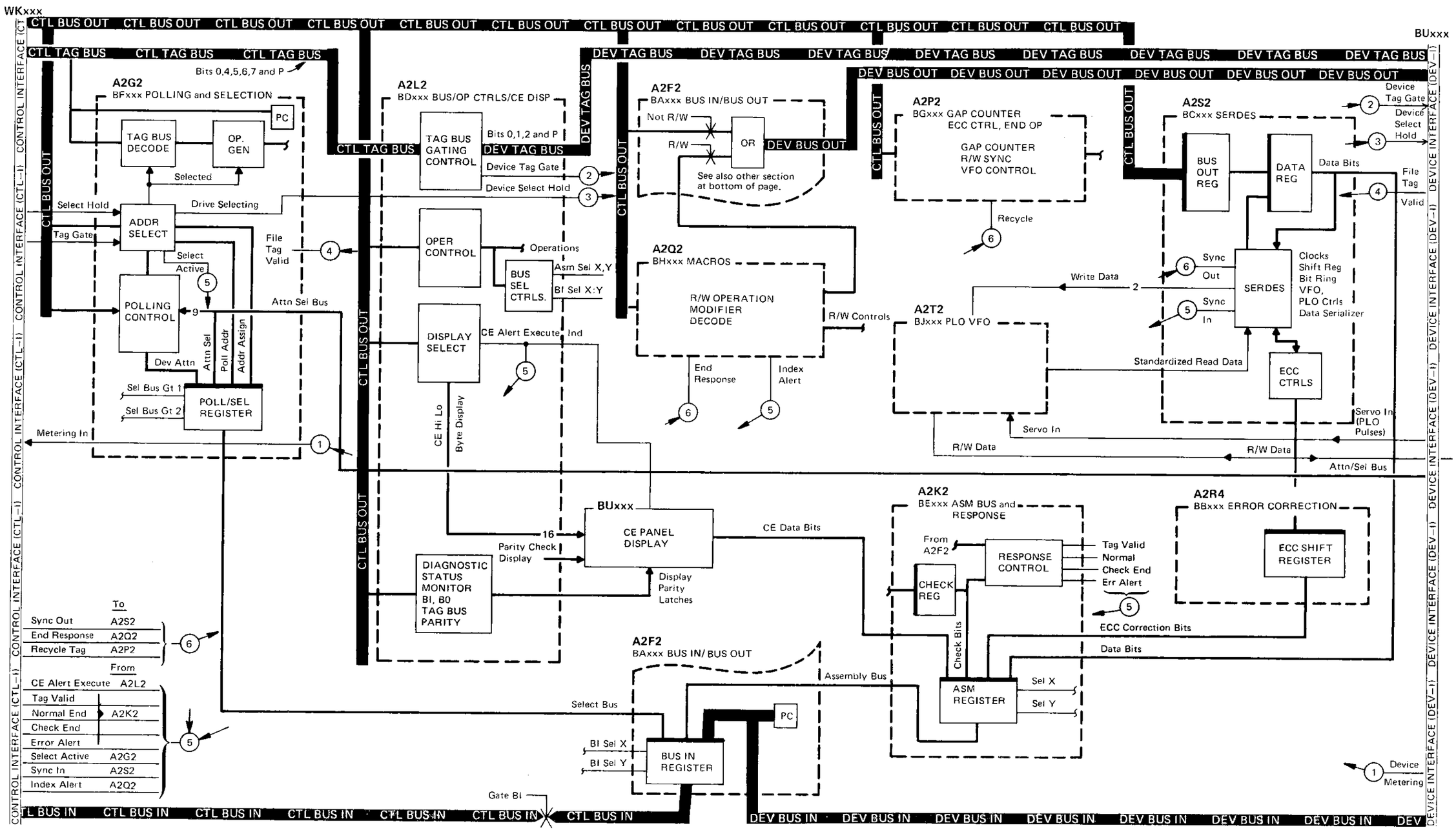
From a reset condition the Count 1 trigger output is sampled at Bit Ring 3 time. Since Count 1 is off, the parity trigger is set on. At Bit Ring 4 time the Count 1 trigger is set on. At the next Bit Ring 3 time, the parity trigger is not changed. At Bit Ring 4 time, the Count 1 trigger is flipped off and Count 2 is set on. D2 comes up at this time. At the next Bit Ring 3 time, the parity trigger can change state because Count 1 is off. At Bit Ring 4, the Count 1 trigger comes on again for a count of 3.

During the next time period at Bit Ring 3 time, the parity trigger can set on again because Count 2 is on and not Count 4. At Bit Ring 4 time, Count 1 and Count 2 turn off and Count 4 is set on. At this time, D2 drops and D4 comes up.

The parity trigger continues to operate under these two controls until the counter reaches 15. Because an additional line (D16) is about to be introduced into the check circuit for the first time, the parity trigger is given an extra pulse as a result of D14 being on.

If D16 failed to come up, the Counter Check latch would set at Bit Ring 6 time because an even number of inactive lines. The Counter Check latch remains set until reset by the + Gen Reset line.





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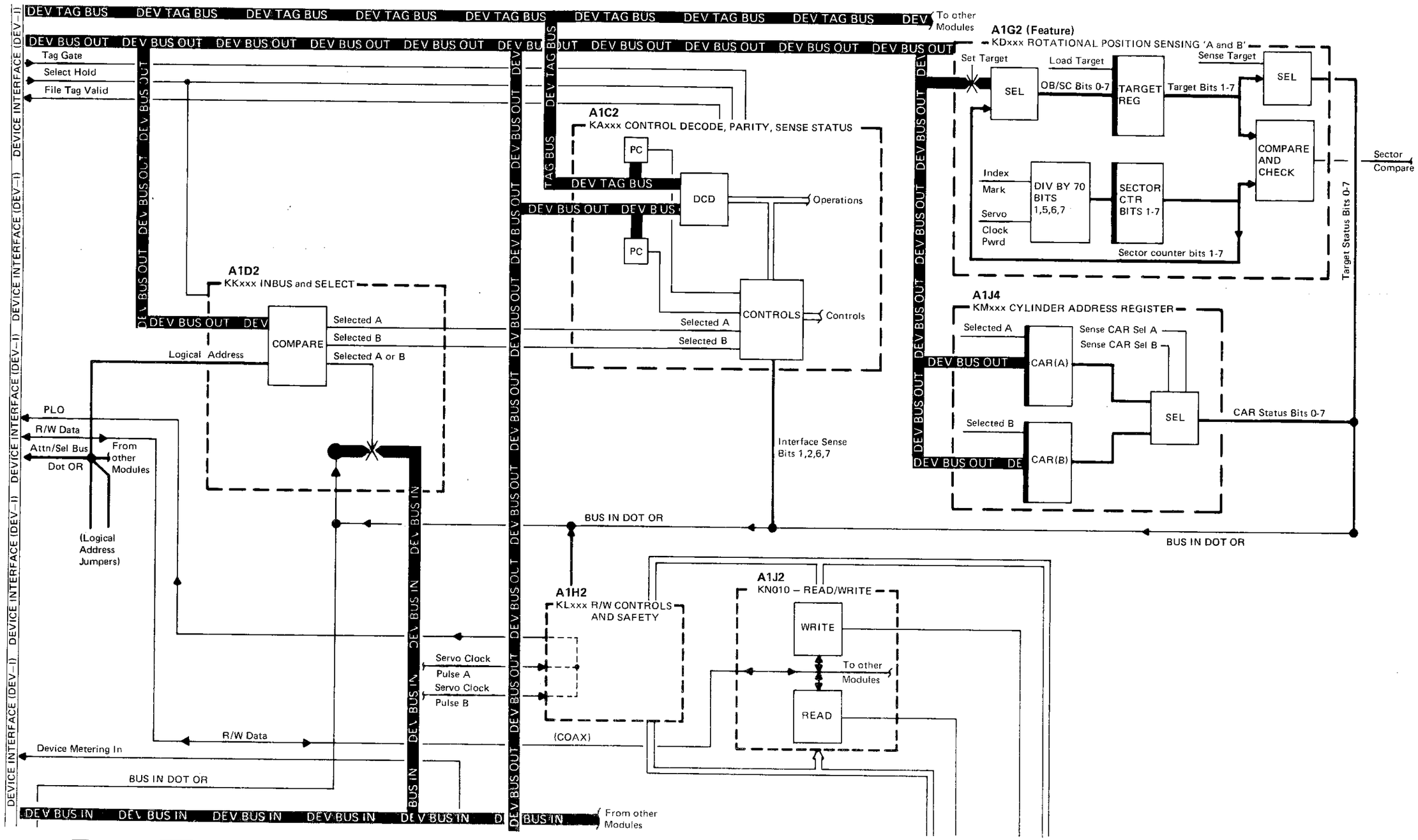
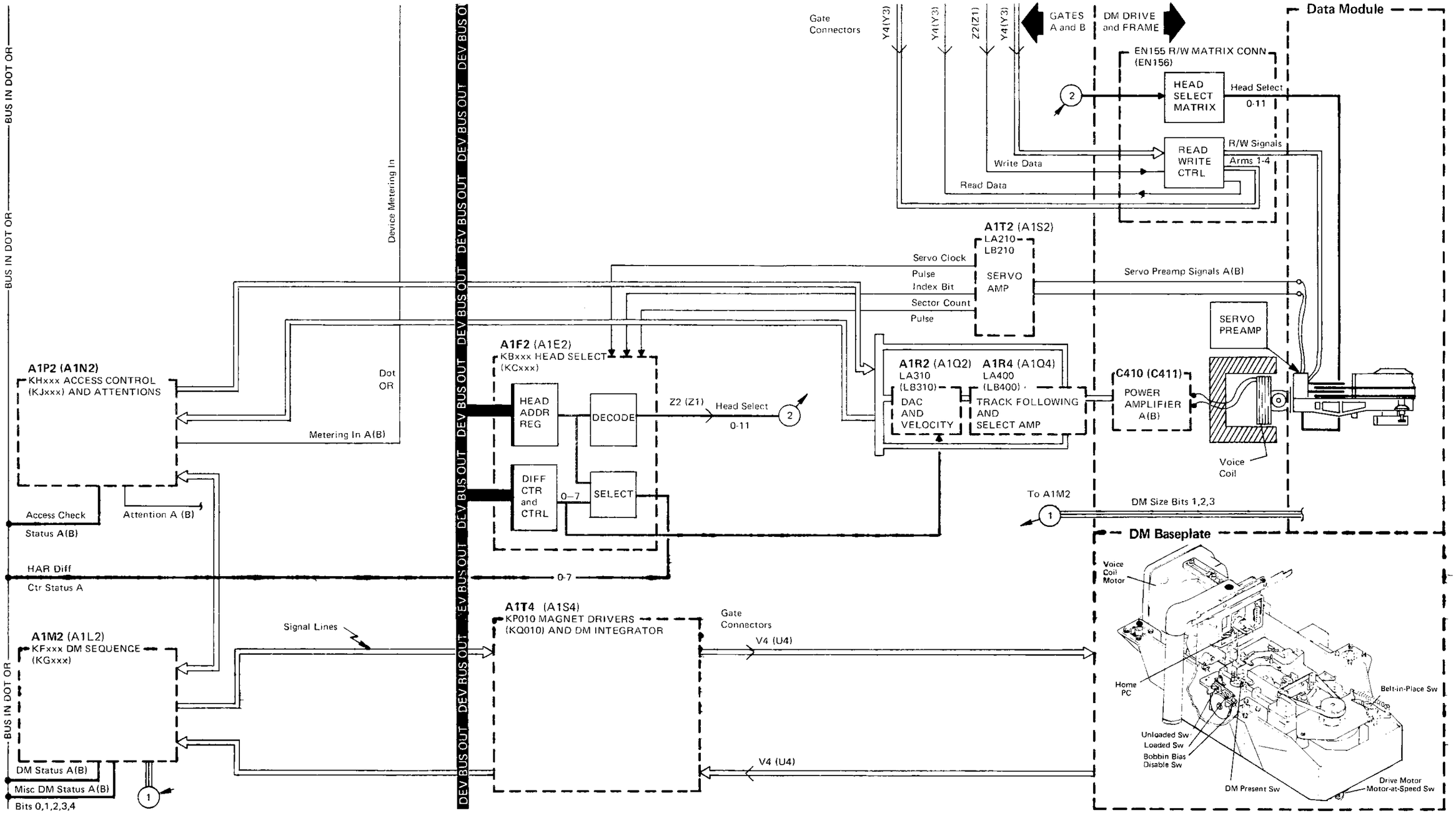
LOGIC FLOW – DRIVE COMMON CARDS, FEATURES



3340	AY0051 Seq. 1 of 2	2747665 Part No. ( )	440203 2 Nov 73	440224 15 Dec 75					

LOGIC FLOW – DRIVE A AND B CARDS

OPER 52



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COMMAND SUMMARY

The charts in this section summarize the storage control commands used by the 3340 subsystem. They describe what the commands do and how they are controlled by storage control. For S/3, refer to the S/3, Model 15 Theory Maintenance Diagram manual for a description of the commands.

CONTROL COMMANDS

Control commands are used to start operations not involving data recorded (or to be recorded) on the data module. These operations include positioning the access mechanism and selecting the head. For most control functions, the entire operation is specified by the command code. If the command code does not specify the entire control function, the data address field of the CCW designates a main storage location containing the additional information.

SENSE COMMANDS

Sense I/O and Read and Reset Buffered Log, transfer sense bytes or usage/error log information from the 3340 subsystem to the using system. Device Release and Device Reserve function the same as the '04' command except the device address is either reserved for, or released from, the storage control issuing the command (string switch only).

READ COMMANDS

Read commands transfer information from the subsystem to main storage of the using system. On all Read commands, the device checks (by means of correction code bytes) the validity of each area of a record as the record is read from a track. A parity bit is added to each byte as it is sent to the channel. All Read commands can operate on overflow records and, except for Read IPL and Read Sector, can operate in multitrack mode.

WRITE COMMANDS

Write commands transfer data from main storage to the subsystem for recording on the data module. While writing data, the device appends the appropriate correction code bytes to each count, key and data field as they are written. Write commands can be grouped into: (1) Format Write commands, used to establish records, and (2) Nonformat Write commands (Write Data and Write Key and Data), used to update previously written records.

SEARCH COMMANDS

Search commands transfer a specific number of bytes from main storage to storage control. Storage control compares these bytes with data read from a track record. When the condition specified in the Search command is satisfied, the status modifier bit is set. The status bytes hold the condition of the status modifier bit until that bit is reset.

Command Summary Chart

Type	Command Name	Hex Code: Single Track	Hex Code: Multi-Track	
Control	No operation	03	–	
	Seek	07	–	
	Seek Cylinder	0B	–	
	Seek Head	1B	–	
	Space Count	0F	–	
	Recalibrate	13	–	
	Restore	17	–	
	Set File Mask	1F	–	
	Set Sector	23	–	
	Diagnostic Load	53	–	
	Diagnostic Write	73	–	
Sense	Device Release	94	–	*String Switch Only*
	Device Reserve	B4	–	*String Switch Only*
	Sense I/O	04	–	
	Read and Reset Buffered Log	A4	–	
	Diagnostic Sense	44	–	
Read	Read Data	06	86	
	Read Key and Data	0E	8E	
	Read Count, Key, and Data	1E	9E	
	Read R0	16	96	
	Read Count	12	92	
	Read Home Address	1A	9A	
	Read IPL	02	–	
	Read Sector	22	–	
Write	Write Data	05	–	
	Write Key and Data	0D	–	
	Write Count, Key, and Data	1D	–	
	Write Spec. Count, Key, and Data	01	–	
	Write R0	15	–	
	Write Home Address	19	–	
	Erase	11	–	
Search	Search Home Address	39	B9	
	Search Equal ID	31	81	
	Search High ID	51	D1	
	Search High Equal ID	71	F1	
	Search Equal Key	29	A9	
	Search High Key	49	C9	
	Search High-Equal Key	69	E9	

MULTITRACK

Setting bit 0 of Read and Search commands enables the drive to automatically select the next sequentially numbered head. However, head switching does not occur if:

- The incremented head address crosses a file protected boundary.
- The incremented head address exceeds the limits of the cylinder.

CONTROL COMMANDS–DESCRIPTIONS

See OPER 113 for Seek operation description.

Command	Code	Function	Data Transferred Across Channel	Error Conditions			
				Error Type	Command Executed	Sense Bit Set	Presented During Ending Status
* No Operation	03	No action. Channel End and Device End are presented during initial status.	None				
Seek	07	1. Moves the access to cylinder specified by the seek address. 2. Selects the head specified by the seek address.	Seek Address (six bytes)	Less than six address bytes transferred.	No	Command Reject	Unit Check Channel End Device End
Seek Cylinder	0B			Address Validity		Command Reject	
Space Count	0F	When chained from a Read, Search, Write or Space Count command, this command locates the start of the next count field (including R0), spaces over the count field, and ends with Channel End and Device End in the gap before the Key field. When not chained, Space Count searches for index, clocks over Gap 1, Home address, Gap 2, and spaces over R0 count. Operation ends in gap following R0 count with Channel End and Device End.	Three bytes used as Key Length (one byte) and Data Length (two bytes) for the next command. See note.	Index point occurs before an address marker is read.		No Record Found	Unit Check Channel End Device End
				Index point sensed while spacing a count area.		Invalid Track Format	
Recalibrate	13	Moves the access to cylinder 0 and selects head 0.	None				
Restore	17	No action. Zero initial status is followed by final status of Channel End and Device End.					
Seek Head	1B	Selects the head specified by the seek address.	Six address bytes. Only the 4 low-order bits of the sixth byte are used for the seek address.	Bus Out Parity	No	Bus Out Parity	Unit Check Channel End Device End
* Set File Mask	1F	Sets the file mask to indicate permitted Write and Seek commands.	One byte of file mask data.	More than one Set File Mask command issued in a chain of CCWs.	Second Set File Mask Number	Second Set File Mask Command Reject.	
Set Sector *Used with the RPS feature. See OPER 150 for description.*	23	Used on disconnected command chaining channels to eliminate the need for the channel to maintain connection with the control unit while waiting for the selected record to reach the head. *Note: If the RPS feature is not installed on the addressed 3340, this command returns Channel End and Device End together in final status. No operation is performed and track orientation is destroyed.*	One byte specifies angular track position (0-63)	Angular position specified is greater than 63 and less than 255.	No	Command Reject	Unit Check Channel End Device End
* Diagnostic Load	53	Transfers the specified 512-byte block from the 23FD to the control storage buffer.	One byte of control information addresses one sector on the 23FD.	Invalid 23FD address	No	Command Reject	Unit Check Channel End Device End
* Diagnostic Write	73	Transfers an inline test from main storage to storage control and executes the test. A 16-byte error code message is stored in the storage control buffer area. A subsequent Diagnostic Sense command transfers the error code message to main storage storage.	A maximum of 512 bytes	Less than 400 bytes	No	Command Reject	Unit Check Channel End Device End

**Storage control commands only.*
***String switch feature only.*

Note: Key length and data length values, which exceed the actual length of the associated field, cause reading in the gap to occur. Data read from the gap area and beyond is unpredictable.

SENSE COMMANDS—DESCRIPTIONS

Command	Code	Function	Data Transferred Across Channel	Error Type**	Comments
*Sense I/O	04	Determines the type of error or unusual condition that caused the last unit check.	24 bytes of sense information.	Command Reject, Bus Out Parity and Overrun.	Sense data is reset after transfer.
*Diagnostic Sense	44	Determines the type of error(s) found on running a diagnostic test (part of a Diagnostic Write command). Transfers a diagnostic test from the storage control unit to the system (after a Diagnostic Load command).	16 bytes of error code message. 512 bytes of diagnostic test data.	Command Reject Bus Out Parity Overrun	If the command is not preceded by a Diagnostic Write or Load command, 16 bytes of data from the error code message area is transferred.
*Read and Reset Buffered Log	A4	Supplies usage or error statistics on the addressed drive.	24 bytes of usage and overrun error information.	Command Reject, Bus Out Parity and Overrun.	Data is reset after transfer.
*Sense I/O Type (with 3344 attached only)	E4	Transfers seven bytes to the channel to identify the Selected Storage Control type and the Device type.	Byte 0 = 'FF' Byte 1 = } Storage Control Byte 2 = } type Byte 3 = Model of Storage Control Byte 4 = } Device Byte 5 = } type Byte 6 = Model of device (see comments)	Unit Check only (Not Channel End or Device End) and Intervention Required if the device is not powered On.	Byte 6 (Device Model): '00' = all 3344s '01' = 3340 with 35 MB DM '02' = 3340 with 70 MB DM.
**Device Release	94	Causes the addressed device to be released from reserved condition.	24 Bytes of Sense Information	Command Reject Bus Out Parity	Sense data is reset after transfer.
**Device Reserved	B4	Causes the addressed device to be reserved for the storage control that issued the command.	24 Bytes of Sense Information	Command Reject Bus Out Parity	Sense data is reset after transfer.

Storage control commands only.
**Sets Unit Check, Channel and Device End.*

READ COMMANDS–DESCRIPTIONS

See OPER 230 for Read operation description.

Command	Code		Function	Data Read	Error Type **			Comments
	Single Track	Multi-Track			Data Overrun	Data Check: Correctable	Data Check: Uncorrectable	
Read Initial Program Load	02	–	Recalibrates to cylinder 0 and head 0, searches for index point and reads R1 data from the drive to main storage.	First data area after R0.	Yes	Data Field. Use ECC.	System repeats operation.	A Read IPL command connot be preceded by a Set File Mask command in the same chain.
Read Data	06	86	Transfers data area of a record from drive to main storage.	First data area after address marker or the data area of the record that was chained from the count or key area of the same record.	Yes	Use ECC.	System repeats operation.	
Read Key Data	0E	8E	Transfers key and data areas of a record from drive to main storage.	First key and data area after address marker or the key and data area that was command chained from the count area of the same record.	Yes	Data Field. Use ECC.	System repeats operation.	If the KL equals 0, the command is executed the same as a Read Data command.
Read Count	12	92	Transfers next count field (8 bytes) from the drive to main storage	Next record count field or first count field after R0.	Yes		System repeats operation.	
Read Record Zero (R0)	16	96	Transfers R0 (count, key, and data) from the drive to main storage.	Record 0	Yes	Data Field. Use ECC.	System repeats operation.	When chained from a Search HA or Read HA command, the Read R0 command is executed immediately and does not initiate a search for index point.
Read Home Address	1A	9A	Transfers 5 bytes (FCCHH) to channel.	Byte 0 = Flag Byte 1 = Cylinder address Byte 2 = Cylinder address Byte 3 = 0 Byte 4 = Head address	Yes		System repeats operation.	
Read Count Key Data	1E	9E	Transfers count, key, and data areas of a record from drive to main storage.	Next record or first record after R0.	Yes	Data Field. Use ECC.	System repeats operation.	
Read Sector *Used with the RPS feature. See OPER 150 for description.*	22	–	Provides one byte of angular position information which is used by a subsequent Set Sector command. When not chained from a Read, Write, or Search CCW, the byte transferred is the angular position required to access the last record processed on the drive. When chained, the byte transferred is the angular position of the record used in the previous CCW.					Causes loss of orientation.

** ***Sets Unit Check, Channel and Device End.***

WRITE COMMANDS—DESCRIPTIONS

See OPER 225 for Write operation description.

Command	Code	Function	Data Written	Error **	Comments
Write Special Count Key Data	01	Same as Write Count, Key, Data command except a 1 is written in bit 4 of the flag byte to indicate a record overflow segment.	Same as Write Count, Key, and Data		Same as Write Count, Key, Data. Not used for last segment of an overflow record.
Write Data	05	Changes the data field of a record.	Data from the system. Write the number of bytes specified by the D_L D_L bytes of the count field of the same record.	Command Reject Bus Out Parity Overrun	If file mask is violated, set Command Reject. Must be chained from a successful Search Equal Key or Search Equal ID command. Also, CCW count must equal D_L D_L.
Write Key Data	0D	Changes the key and data fields of a record.	Data from the system. Write the number of bytes specified by the K_L and D_L D_L bytes of the count field of the same record.		If file mask is violated, set Command Reject. Must be chained from a successful Search Equal ID command. If K_L=0, operation is the same as write data. Also, CCW count must equal K_L and D_L D_L.
Erase	11	Operates exactly like a Write Count Key Data command except data from the channel is not written on the track.	Bytes of 1s to end of track.		The storage control skips writing an address marker, sync byte, or ECC.
Write Record (R0)	15	Writes count, key, data of R0.	Flag byte from HA field. CCHHR$K_L$$D_L$$D_L$ from system written in count field. Key and data from system.		Same as Write Count, Key, Data except must be chained from a write HA or a successful Search HA Equal command.
Write Home Address (HA)	19	Write the 7-byte (SDFCCHH) home address field on the selected drive and track.	7-byte (SDFCCHH) home address field transferred from the system.		Must be chained from a successful Search HA command with a CCW count of four or more. If the CCW count is less than three, Command Reject is posted.
Write Count Key Data	1D	Writes 1 complete record on the selected drive and track.	Count, Key, and Data fields of next record on the track. Data for the fields comes from the system. The count field flag byte. ECC and gap data comes from storage control.	Command Reject Bus Out Parity Overrun. Invalid track format.	If file mask is violated, set Command Reject. Must be chained from Write R0, Write Count-Key-Data, Erase, or a successful Search Equal ID or Search Equal Key command. After last Count, Key, Data command on a track, write 0s to index.

** *Sets Unit Check, Channel and Device End.*

SEARCH COMMANDS–DESCRIPTIONS

- Channel Status byte bit 1, Status Modifier, is set when search is successful.
- If a Search command is unsuccessful, it must be reissued to continue the search.
- Multitrack bit is not on—search until successful or index is passed twice.
- Multitrack bit is on—head switches to the next track at Index.

Command	Code		Function	Data Compared	Errors **	Comments
	Single Track	Multi-Track				
Search Key Equal	29	A9	Locates a key field selected by the system.	The key field bytes from the selected drive and track, with data from the system.	Command reject Bus out parity Overrun End of cylinder No record found Data check.	The key field compared is key field of the next record (excluding R0), unless chained from a Read Count or Search ID command. If chained from a Count operation, the key field searched is in the same record.
Search ID Equal	31	B1	Locates a count field selected by the system.	Five bytes (CCHHR) of the next count field from the selected drive and track, with CCHHR from the system.		
Search Home Address Equal	39	B9	Locates a home address field selected by the system.	Four bytes (CCHH) of home address field from the selected drive and track, with CCHH from the system.		
Search Key High	49	C9	Locates a key field selected by the system.	The key field bytes from the selected drive and track, with key from the system.		Same as search key equal except the key field located is any key field on the track that is higher than the key from the system.
Search ID High	51	D1	Locates a count field selected by the system.	Five bytes (CCHHR) of the next count field from the selected drive and track, with CCHHR from the system.		Locates any ID from the track that is higher than the ID from the system.
Search Key Equal or High	69	E9	Locates a key field selected by the system.	The key field bytes from the selected drive and track, with key from the system.		Same as search key equal except the key field located is equal to or higher than the key from the system.
Search ID Equal or High	71	F1	Locates a count field selected by the system.	Five bytes (CCHHR) of the next count field from the selected drive and track, with CCHHR from the system.		Locates the ID from the track that is equal to or any ID that is higher than the ID from the system.

Note: If a Search operation is started on the track at a point past the key, count, or record being searched for, the information will never be found because head switch occurs at Index. See the Reference Manual for 3340 (Order No. GA26-1619) for the proper start procedure

** *Sets Unit Check, Channel and Device End.*

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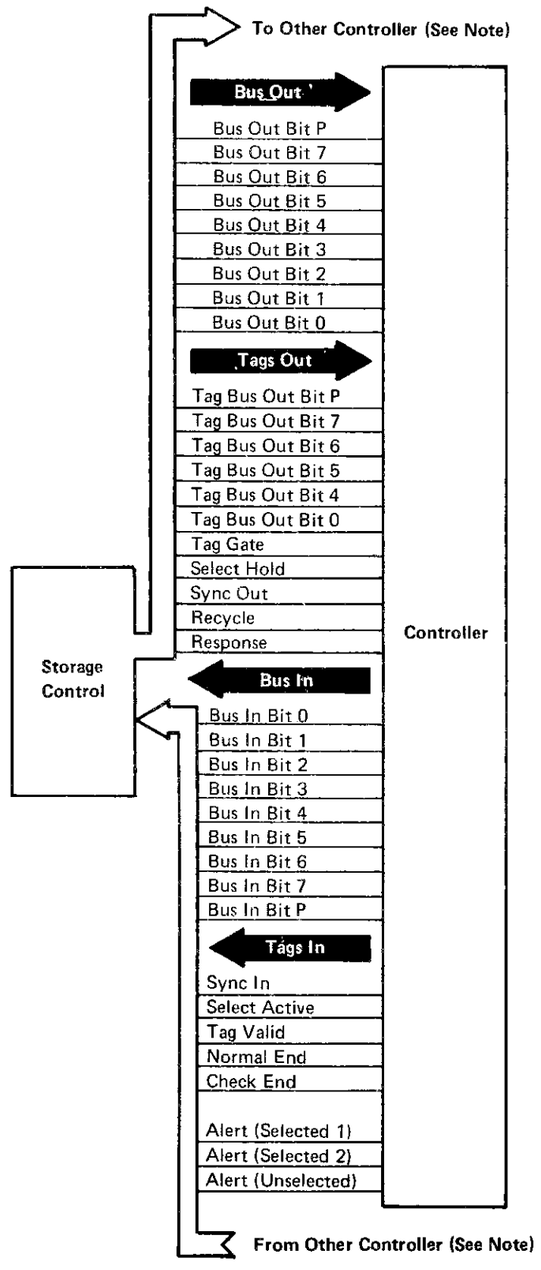
CONTROL INTERFACE

- The control interface is the common connection between storage control and all attached controllers.
- The controllers are attached in parallel to one set of signal lines, allowing simultaneous addressing or polling by the storage control.
- A controller is connected to the interface until transfer of all information is complete and storage control signals to disconnect.
- Only one controller is logically connected to the storage control at a time.
- Signals from different controllers are ORed together for transmission to storage control on common lines.

Note: System/3 and System/7 — 3340 has only one controller.



Bus Out (1 byte, odd parity)

See OPER 98 — 101 for byte summary.

Bus Out transfers data, control, or address information to the controller. When Tag Gate is up, Bus Out contains tag modifiers. When Sync Out is up, this bus transmits the information to be recorded on the data module.

All Bus Out data defined for controller operations or data required by the drive must be valid for at least 100 ns before Tag Gate and must remain valid for at least 150 ns after Tag Gate falls.

All Bus Out data validated by Sync Out must be valid at least 100 ns before the rise of Sync Out and must remain valid for at least 100 ns after the fall of Sync Out.

Tag Bus (5 bits, odd parity)

See OPER 98 — 101 for byte summary.

Tag Bus sends control or instructions to controller to identify the operation to be performed. This bus is validated by Tag Gate.

All Tag Bus data defined for controller operations or data required by the drive must be valid for at least 100 ns before Tag Gate and must remain valid for at least 150 ns after Tag Gate falls.

Tag Gate

Tag Gate indicates presence of an instruction on Tag Bus. Bus Out can further modify the tag information. Tag Gate remains active until acknowledged by the controller with Tag Valid.

An operation must be decoded in the controller within 100 ns after the rise of Tag Gate.

Select Hold

Select Hold rises during any Select Tag. It remains up to maintain selection of a drive until the end signal of the last operation to be performed on the drive is received and acknowledged.

Sync Out

Sync Out is used during controller data transfers and orientation clocking for checking the data count.

Sync Out is not dc-interlocked with any inbound line, but is required to have a minimum pulse width of 60 ns.

Recycle

Forces the Modulo 16 counter (data transfer counter) to wraparound and continue counting bytes. Recycle falls during transmission of the last 16 bytes of data, allowing the Modulo 16 counter to end the data transfer sequence at count 15.

Response

This line indicates acknowledgement of a Normal or Check End condition. Response is not dc-interlocked with any line but must have a minimum pulse width of 60 ns.

Bus In (1 Byte, odd parity)

See OPER 98 — 101 for byte summary.

Bus In transmits data from the drive to storage control when Sync In is active. Certain commands cause status, error, or information originating in the drive to be transmitted on Bus In while Tag Valid is up.

If an abnormal condition occurs during a Read, Write, or ECC Control operation (Extended Operations), Check End is raised and the error information relating to the abnormal condition is presented on Bus In.

During read data transfers, Bus In rises at least 125 ns before Sync In and remains active for at least 125 ns after Sync In falls.

During information transfers, Bus In rises with or before the end tag and is valid until the tag ends.

Sync In

During data transfers from controller to storage control, Sync In validates and times Bus In. It rises after Bus In is valid.

Bus In remains valid until after Sync In falls. During data transfers from the storage control to controller, Sync In provides timing for data transferred.

Select Active

Becomes active as a result of the selection sequence. It remains active to indicate proper selection as long as Select Hold is active and selection of the drive is correctly maintained by the controller.

Tag Valid

Tag Valid indicates that the controller or drive has validated and accepted a tag instruction sent from the storage control. When required, it indicates to storage control that Bus In information is valid.

Normal End

Indicates that the normal ending of an operation occurred with the expected results obtained. Normal End rises with or before Tag Valid for Immediate operations. For Read, Write, Set Read/Write, and ECC Control operations (Extended Operations), Tag Gate falls and the operation is complete before Normal End is presented.

Normal End is presented at the successful completion of the operation. Information on Bus In is valid at the start of Normal End.

When Normal End is generated under Tag Gate, it remains active until Tag Gate falls; otherwise it remains active until Response starts.

Check End

Check End indicates that an abnormal ending condition exists. The abnormal condition is presented on Bus In with proper parity during the time Check End is up.

For Read or Write operations, Check End stays up and Bus In maintains proper parity until the storage control acknowledges the receipt of the status information with the Response line.

Check End is not presented on an Immediate operation.

Alert Lines

Selected Alert lines indicate that certain special events have occurred in the selected drive or controller. They are raised only if Select Active is present.

Unselected Alert indicates that the execution of an appropriate polling sequence is required.

SELECTED ALERT LINE (Alert 1): Indicates an unusual condition (Equipment Check) in the selected controller or drive.

SELECTED ALERT LINE 2 (Index Alert): Indicates the detection of Index or an ECC correctable pattern.

UNSELECTED ALERT LINE 1 (CE Alert Execute): Indicates that a CE Panel Execute switch was operated, and that the Data Entry switches should be read by the storage control.

If more than one controller is on the interface, the storage control must poll to determine which controller raised the Alert.

DEVICE INTERFACE

- The device interface is the common connection between all drives and the controller.
- The interface can accommodate up to eight drives.
- All signals from the controller are received by all drives.
- Like signals from different drives are ORed together on a common line to the controller.
- Read/Write data and PLO reference pulses are carried on two balanced, bi-directional cables.

Device Bus Out (1 byte, odd parity)

See OPER 100 and 101 for byte summary.

Device Bus Out transfers operational information from the controller to the drive. The meaning of the information is determined by the Tag Bus.

Parity is checked at the drive for all functions except Read/Write.

Device Tag Bus (3 bits, odd parity)

See OPER 100 and 101 for byte summary.

The Device Tag Bus lines are coded to define the data presented on Bus Out.

Code	Tag
000	Select
001	Sense Interface
010	Diagnostic Set
011	Set HAR
100	Set Difference (count)
101	Set Target
110	Set Cylinder (address)
111	Control

Tag Gate

The Tag Gate signal is sent to the drives to gate the Tag Bus and Bus Out. It is raised after the data appears on the bus and an appropriate delay has elapsed. (See OPER 95).

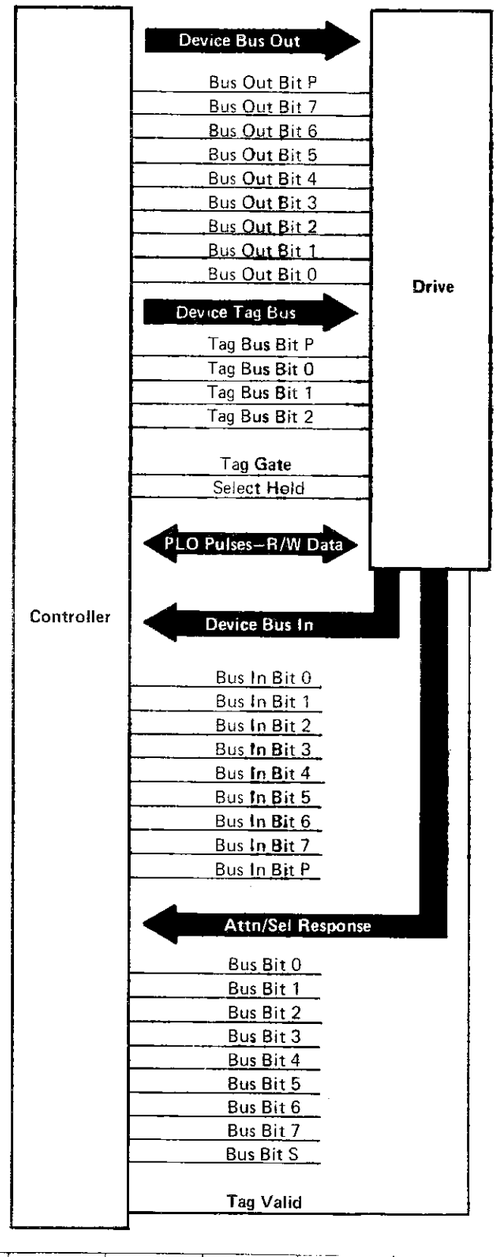
Select Hold

Select Hold is used to maintain selection. It must be raised either before or during Tag Gate and stay up as long as communication is necessary with the selected drive.

PLO Pulses -- Read/Write Data

The read/write data cable carries Read or Write data from the controller to the selected drive when writing, and from the selected drive to the controller when reading.

PLO reference pulses, necessary for write data clocking, are transmitted from the selected drive to the controller via the PLO cable when Select Hold is up.



Device Bus In (1 byte, odd parity)

See OPER 100 and 101 for byte summary.

Device Bus In carries status and sense information from the selected drive to the controller. As soon as a drive is selected, machine status is placed on Device Bus In. Status stays on the bus until one of the following occurs:

a. Select Hold falls.

b. A sense or Read/Write function control tag is raised.

c. A Diagnostic Set or Sense Interface tag is raised.

Attention/Select Response Bus

This bus transmits the unique 1-bit physical drive address to the controller when the drive has an Attention signal to present or when that drive is selected.

Attention is generated by:

a. Data module attention.

b. Seek Complete/Sector Compare.

If a drive is in CE mode, attention appears on Bus bit S (service drive position).

The Select Response signal represents the physical address of the drive that has been selected. Only one bit should appear on the bus when a drive is selected.

Bus Bit	Unique Physical Drive Address
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
S	Service Drive

Tag Valid

This signal is sent from the selected drive to indicate that Device Bus Out and Tag Bus were received with correct parity. Device Tag Valid forces Tag Valid and Normal End in the controller.

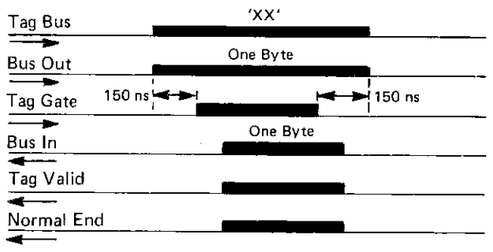
IMMEDIATE OPERATION

An immediate operation transfers a single control instruction to the controller in addition to the transfer of a single byte of information to or from the controller.

The appropriate tag is placed on the CTL-I Tag Bus. At the same time, a single byte of data, either an instruction modifier or a byte of information, may be placed on the CTL-I Bus Out. Tag Gate is raised after allowing for the 150 ns de-skewing.

The controller responds with Tag Valid which forces Normal End. Data sent by the controller is placed on CTL-I Bus In along with Normal End. The storage control must provide for any deskewing for the interface. When Normal End is returned, data on Bus In is the expected response from the controller. Tag Gate drops when Tag Valid and Normal End are recognized by the storage control. The controller resets Tag Valid and Normal End when Tag Gate falls. The storage control cannot raise Tag Gate again until Tag Valid falls.

Check End is not presented on Immediate operations.

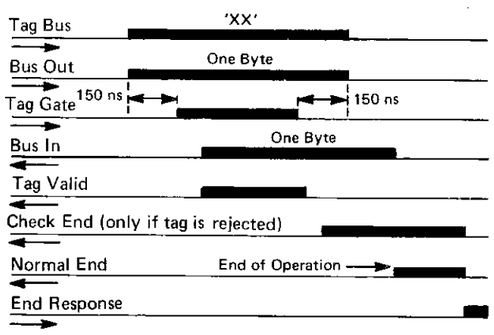


EXTENDED OPERATION

An Extended operation starts a sequence of events in the controller that requires extended time or many transfers across the CTL-I and DEV-I. The Extended operations are Read, Write, Set Read/Write, and ECC Control. The appropriate tag is placed on the CTL-I Tag Bus. Simultaneously, a single byte of data or modifier information is placed on CTL-1 Bus Out. Tag Gate starts after the 150 ns de-skewing interval.

The controller responds with Tag Valid indicating acceptance of the tag which causes the storage control to reset Tag Gate. If the operation cannot be performed, such as Command Overrun, Check End is indicated after Tag Gate falls. CTL-I Bus In indicates the check condition.

Normal End is raised at the completion of the operation. If an abnormal condition occurs, the controller responds with Check End. When Check End is presented, Bus In indicates the unusual condition. Normal End or Check End remains active until Response is returned to the controller to acknowledge either end condition.



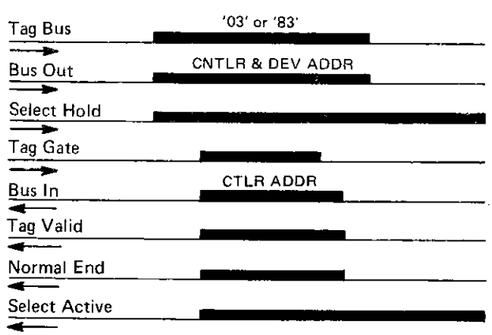
SELECTION

A Selection sequence connects the storage control to a specified controller or drive.

The appropriate select tag is placed on the CTL-I Tag Bus. Modifiers and address information are placed on the CTL-I Bus Out. Assuming that the tag and bus information is correct, Select Hold and Tag Gate are raised.

When selection has been completed, the controller responds with Tag Valid, Select Active and Normal End. When these tags are acknowledged by the storage control, Tag Gate falls. While Tag Valid is present, CTL-I Bus In returns the address of the selected controller. The address contains coding which allows the storage control to check for double selection.

Select Hold maintains selection and must remain active until all operations are complete on the selected controller or drive. Select Active remains active until Select Hold falls. If a selection error occurs within the controller or drive, no response is generated.



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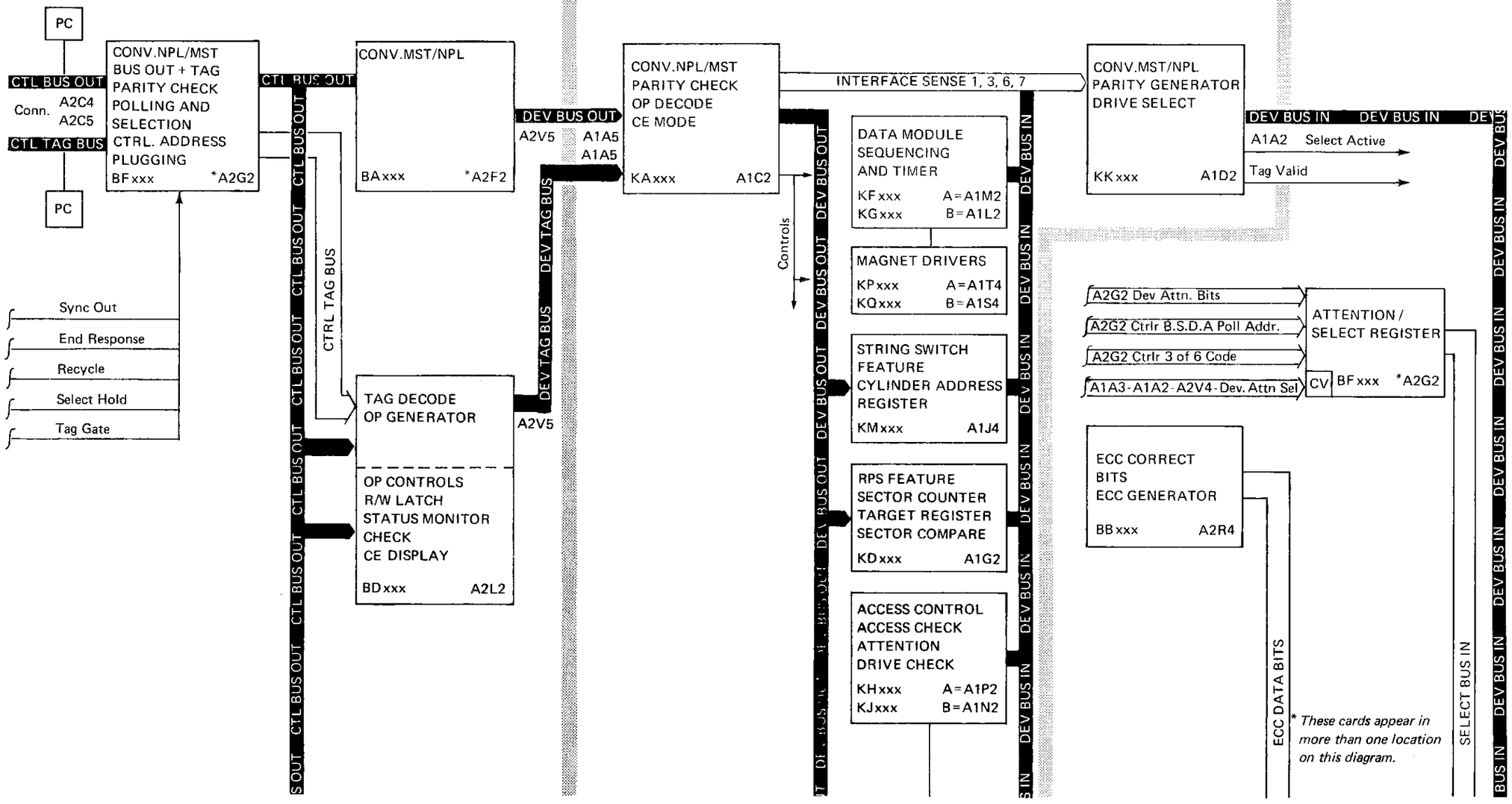
INTERFACE DATA AND CONTROL FLOW

OPER 96

CONTROLLER OUT | DRIVE | CONTROLLER IN



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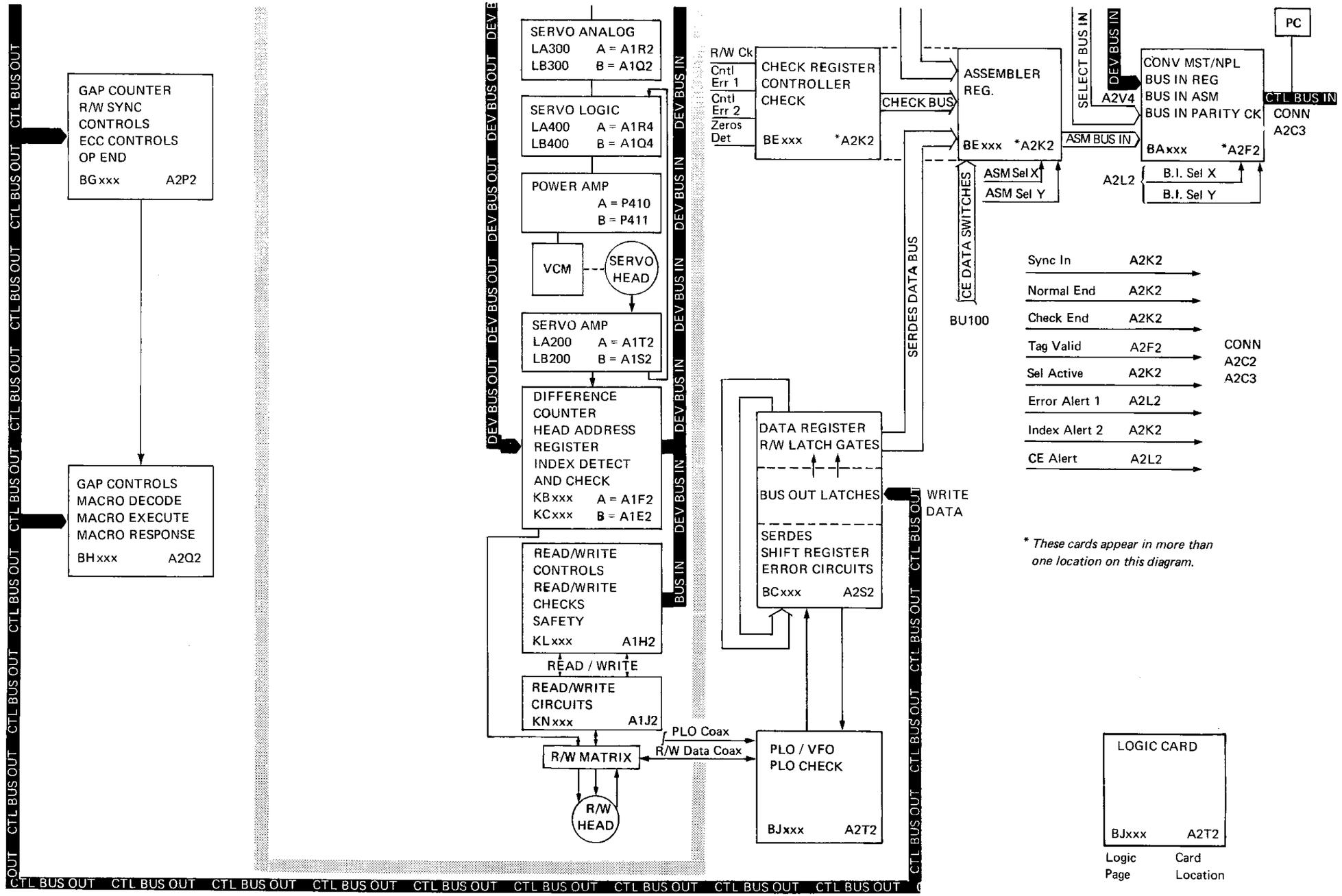
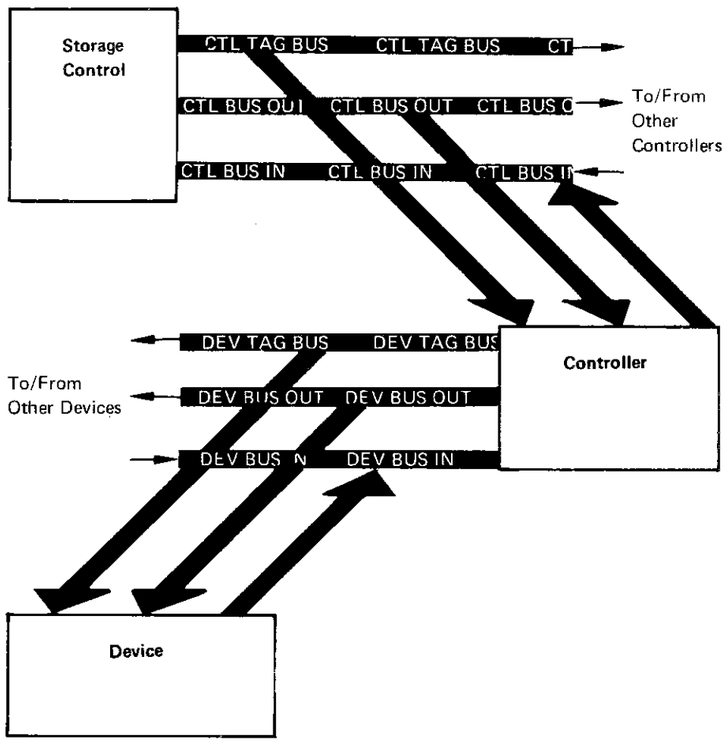
INTERFACE DATA AND CONTROL FLOW OPER 97



* *These cards appear in more than one location on this diagram.*

LOGIC CARD
BJxxx A2T2
Logic Page
Card Location

Tag Bus Decode	0	1	2	3	4	5	6	7	Operations performed by:
01–0F	0	–	–	–	X	X	X	X	Controller only
82–85	1	–	–	–	0	X	X	X	Controller and drive
89–8F	1	–	–	–	1	X	X	X	Drive only



Sense Status tag 04 is modified by Ctl Bus Out. Information placed on Ctl Bus In is determined by the bit active on Ctl Bus Out.

Ctl Tag Bus → Tag (0, 4, 5, 6, 7)

Ctl Bus Out → Storage Control To Controller (CONTROL INTERFACE (CTL–I))	01 Set Unsuppressible Register	02 Poll Controller	03 Select Controller	04 Sense Status					
0	Control 1=set, 0=reset		CA 4	All Zeros	ECC Low				
1			CA 2			ECC High			
2			CA 1						
3		Unsup-pressible	0				Physical Addr		
4	Reserved	CE Poll	0						
5	DA 4		0						
6	DA 2		0					Ctrllr Error 2	
7	DA 1		0						Ctrllr Error 1

CA = Controller Address
DA = Device Address

Ctl Bus In ← Controller To Storage Control (CONTROL INTERFACE (CTL–I))	01 Not Used	02 CA 0	03 CA 4	04 Command Overrun	ECC Low-Order Bits	ECC High-Order Bits	DA 0	PLO Check	Ctrllr Tag Bus Parity
0		CA 0	CA 4	Command Overrun			DA 0	PLO Check	Ctrllr Tag Bus Parity
1		CA 1	CA 2	Data Overrun			DA 1	No PLO	Ctrllr Bus Out Parity
2		CA 2	CA 1	Lost Orientation			DA 2	Serdes Data Check	Drive Select Error
3		CA 3	Busy (SWFE)	Trk O'run or ECC-Data Check			DA 3	Gap Ctr Check	Drive Bus In Parity
4		CA 4	0	Status Overrun			DA 4	Write Data Check	Ctrllr Bus In Parity
5		CA 5	$\overline{CA\ 4}$				DA 5	Monitor Check	I Write Fail
6		CA 6	$\overline{CA\ 2}$	G1 Unoriented			DA 6	ECC Check	0
7		CA 7	$\overline{CA\ 1}$	Active Trk R/W Mode Only			DA 7	ECC Zeros Detected	0

CONTROL AND DEVICE INTERFACE SUMMARY (Continued)

CTL Tag Bus → Tag (0, 4, 5, 6, 7)

CTL Bus Out → CONTROL INTERFACE (CTL—I)

	05	06	07	08	09	0A		0B	0C	0D	0E
	Reset Read/Write	Switch Control 1 (SWFE Feature)	Switch Control 2 (SWFE Feature)	ECC Control	Transmit Control	Read Control (Information gated on Bus In controlled by bit active on Bus Out)		SYNC (During Tag Gate activates test point A2L2J11, logic BD100)	Display CE High	Display CE Low	Read OP
0	0	See OPER 102	See OPER 102		CtrlIr Reset	Device Type		Not Used	Lamp 0	Lamp 0	Modifier Bits
1	0						Data Entry Switches		1	1	
2	0				Set Diag				2	2	
3	0				Reset Diag				3	3	
4	0			Count 8	Reserved				4	4	Count 8
5	0			4	Diag 4				5	5	4
6	0			2	2				6	6	2
7	0			1	1				7	7	1

Type of Read Op defined by bits 0–3:
- 0 0 0 1 Clock G3
- 0 0 1 0 Clock G2
- 0 0 1 1 Read G4
- 0 1 0 0 Read G1
- 0 1 0 1 Read G3
- 0 1 1 0 Read G2
- 0 1 1 1 Read G3 AM Search
- 1 1 1 0 Special Read G2

	0F
	Write OP
0	Modifier Bits
1	
2	
3	
4	Count 8
5	4
6	2
7	1

Type of Write OP defined by bits 0–3:
- 0 0 1 0 Write G2
- 0 0 1 1 Format Reorient
- 0 1 0 0 Format G1
- 0 1 0 1 Format G3
- 0 1 1 0 Format G2
- 0 1 1 1 Format/Erase
- 1 0 1 1 Write G4
- 1 1 0 0 Special Format G1
- 1 1 1 0 Special Format G2

Diagnostic Bit Decodes:
- 000 = Invert DEV Bus In and CTL Bus In P bit
- 001 = Invert Tag Bus P bit
- 010 = Invert Bus Out P bit
- 011 = Suppress Write Gate

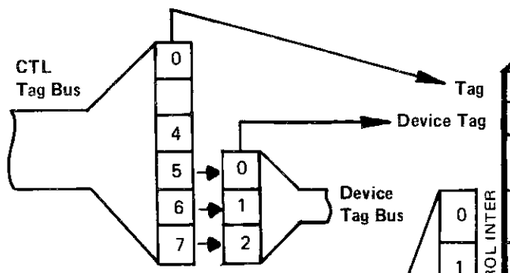
CTL Bus In → CONTROL INTERFACE (CTL—I)

											Tag Valid	Normal End	Check End	Tag Valid	Normal End	Check End
0	Not Used	See OPER 102	See OPER 102		0		CE Switch 0	Not Used	Undefined	Undefined		0	Command Overrun		0	Command Overrun
1					1		1					0	Data Overrun		0	Data Overrun
2					2		2				Lost Orientation	0		Lost Orientation	0	
3					3		3					0	ECC Data Check		0	Track Overrun
4					4		4				Status Overrun	0	No AM Found	Status Overrun	0	
5					5	3340	5					0	No Sync Byte Found		0	
6					6		6				Read G1 Unoriented	0	Data Found		0	
7				ECC Zeros Detected	7		7				Active Track	0		Active Track	0	

CONTROL AND DEVICE INTERFACE SUMMARY (Continued)

The three bits of DEV Tag Bus are forced to 000 for Select Device operation (Tag '83') and to 111 for Set Rd/Wr (Tag '85').

For Tags '89' thru '8F', CTL Tag Bus bits 5, 6, and 7 are shifted to Device Tag Bus bits 0, 1, and 2 without change.



CONTROL AND DEVICE INTERFACE SUMMARY (Continued)

For Drive-Only operations '8A to '8F' shown below, CTL Bus Out is routed through the controller to the device without change. DEV Bus Out and DEV Bus In only are shown.

Control Tag '8F' is modified by Dev Bus Out. Information placed on Dev Bus In is determined by bits active on Dev Bus Out.

Device Bus Out ➡ DEVICE INTERFACE (DEV–I)

	Diagnostic Set	Set HAR	Set HAR (FHFE)	Set Difference	Set Target (RPS Feature)	Set Cylinder (String Switch Feature)	Control																								
	8A	8B	8B	8C	8D	8E	8F																								
	2	3	3	4	5	6	7																								
0	Servo Reset	Direction In	Reserved	Difference Counter 128	Target Register	Cylinder Address Register 256							Direction In						Transfer Sector Count		1	0	0	0							
1	Go Home	Difference Counter 256	Fixed Head 64	64	64	128							Difference Counter 256						Write Gate		0	1	0	0							
2		Reserved	Head Address 32 Register	32	32	64													Unsquelch		0	0	1	0							
3	Spare	Head Address Register 16	16	16	16	32													Read Gate		0	0	0	1							
4	Set Low Gain Check	8	3	8	8	16	Seek Start 1	Attention Reset 0	Check Reset 1	Rezero 0	Spare (Drive Sync) 1	Reset Read/Write Checks (Also Low Gain with FHFE) 0	Set TSF (FHFE) 1	Sense CAR (SWFE) 0	Sense Difference Counter 1	Sense HAR 0	Sense HAR (FHFE) 0	Sense Target 1	Addr Mark Ctrl	Diagnostic Set Read/Write 1	Sense Status 0 (Status FHFE) 0	Sense Status 1 (Drive Checks) 0	Sense Status 2 (DM Sequence) 0	Sense Status 3 (Load Switch Status) 0	Sense Status 4 (Access Status) 0	Sense Read/Write 1						
5		4	4	4	4	8	0	1	1	0	0	1	1	0	0	1	1	1													
6	Force Multihead Check	2	2	2	2	4	0	0	0	1	1	1	1	0	0	0	0	0													
7	Decrement Difference Counter	1	1	1	1	2	0	0	0	0	0	0	0	1	1	1	1	1													

Device Bus In ⬅ DEVICE INTERFACE (DEV–I)

	8F																														
	7																														
0	Undefined	Machine Status*	Machine Status*	Machine Status*	Machine Status*	Machine Status*	Machine Status*	Machine Status*	Machine Status*	Machine Status*	Machine Status*	Not Used	Machine Status*	Machine Status*	Cylinder Address Register 256	Difference Counter 128	Direction 1 = In	Reserved	RPS Installed		Direction 1 = In	DM Loaded Latch	DM Size Check	Drive Start Switch	Access Timeout Check	Multi Head Check						
1															128	64	Difference Counter 256	Fixed Head 64	64	Interface Check	Difference Counter 256	Sector Compare Check	DM Seq Latch 4	DM Present Switch	Overshoot	Capable/ Enable Check						
2															64	32		32	32	Drive Check		Motor at Speed	DM Seq Latch 2	Cover Locked Switch	Servo Off-Track	Write Overrun						
3															32	16	16	16	16	Read/ Write Check		Air/Belt Switch	DM Seq Latch 1	DM Unloaded Switch	Track Crossing	Index Check						
4															16	8	8	8	8	On Line		Write Enable	10 Second Timer	DM Loaded Switch	Servo Latch	R/W Interlock Check						
5															8	4	4	4	4	I Write Sense	Low Gain Check	FHFE DM Size 4	DM Sequence Check	Air/Belt Switch	Linear Mode Latch	Control Check						
6															4	2	2	2	2	Index Mark		DM Size 2	Bias Disable Switch	Carriage Home	Control Latch	Transition Check						
7															2	1	1	1	1	Active Track	FHFE Feature	DM Size 1	Odd Track	Motor at Speed	Wait Latch	Write I Check						

Target Register

Head Address Register

Head Address Reg.

Machine Status bits are same as DEV Bus In under Tag '84', RD/WR ON or RD/WR OFF.

SET UNSUPPRESSIBLE REGISTER – '01'

Sets the unsuppressible register in the controller to mask certain drive addresses and block them from activating Bus In during polling. This allows some interrupt priority decisions to be made at the controller level. This tag is of the immediate class.

Bus Out bits 5, 6, and 7 contain the drive address. The appropriate latch is set when bit 0 is on and reset when off.

The register is reset during power-up.

POLL CONTROLLER –'02'

Allows all controllers to be polled for service requests. Bus Out defines the type of service request the poll is addressing. If Bus Out bits 3 and 4 are zero, then the presence of a drive interrupt from any drive causes the controller to respond with the controller bit significant address on Bus In.

The controller responds to only those drive interrupts that have their drive addresses set in the Unsuppressible Register If Bus Out bit 3 is on. For example, if a drive with address 3 has an interrupt, but bit 3 of the Unsuppressable Register is off, then the controller does not respond on Bus In.

If Bus Out bit 4 is on, the controller responds on Bus In with its bit significant address only if it has a CE maintenance panel request.

Tag Valid and Normal End are initiated by all controllers. This tag is of the immediate class.

SELECT CONTROLLER – '03'

This tag is used when CE panel communication is desired.

Bus Out bits 0–2 contain the controller address. If the address on Bus Out matches that assigned to the controller, Bus In responds with the controller address and its inverse. Tag Valid, Select Active and Normal End are raised. Bus In should be checked to ensure that only one controller is selected.

If the address on Bus Out is not recognized or if either Bus Out or Tag Bus have incorrect parity, no inbound lines are raised. Parity on Bus In is guaranteed if Normal End is present.

If a device control command is issued when only the controller has been selected, no Tag Valid or end responses are present. This tag is of the immediate class.

ERROR BYTES – '04'

This tag reads the drive physical address, controller detected errors, and error correction pattern. Bus Out defines the byte present on Bus In as follows:

1000 0000 Gate ECC Low Byte

Gates the ECC low-order correction byte onto Bus In.

0100 0000 Gate ECC High Byte

Gates the ECC high-order correction byte onto Bus In.

0001 0000 Gate Physical Address

Gates the bit significant physical address of the drive onto Bus In.

0000 0010 Gate Controller Error 2

Gates Error Byte 2 onto Bus In. Except for ECC Zeros Detected (Bus In bit 7), Error Byte 2 contains errors or conditions that were reported as a Controller Check in the status byte. These errors or conditions are defined on OPER 98.

0000 0001 Gate Controller Error 1

Gates Error Byte 1 onto Bus In. Error Byte 1 contains errors or conditions that were reported as a Controller Check in the status byte. These errors or conditions are defined on OPER 98.

0000 0000 Orientation Status Byte

Brings up Tag Valid to check status bytes at the beginning of a Read/Write operation.

RESET READ/WRITE – '05'

Resets the read/write state that was established by Set Read/Write. This tag is of the immediate class. Bus In is not defined and parity cannot be guaranteed.

SWITCH CONTROL 1 – '06' (STRING SWITCH ONLY)

This tag provides a means for setting and resetting the Assignment, Device End, and Pack Change registers in the drive; it also provides a means for reading the switch status.

Bus Out	aaa = binary drive address
1100 Xaaa	Assign Drive to interface
0100 Xaaa	Unassign Drive from interface
1010 Xaaa	Set Device End latch
0010 Xaaa	Reset Device End latch
1001 Xaaa	Set Pack Change latch for opposite interface
0001 Xaaa	Reset Pack Change latch for this interface

Bus In

1001 0XXX	Device End Interrupt is active for this interface.
0101 0XXX	Pack Change Interrupt is active for this interface.
0011 0XXX	Addressed drive is assigned to this interface.
0001 0XXX	Connection is made through a switchable controller.
0001 1XXX	Addressed drive is assigned to the opposite interface.

If the string switch feature is not installed, no Bus In bits are active.

Parity is never generated.

SWITCH CONTROL 2 – '07' (STRING SWITCH ONLY)

Long connection is required when extended operations (see OPER 95) are to be performed. This tag with Bus Out modifiers provides a means for setting and resetting long connection.

The Reset Disable Interlock command is used to activate the disable portion of the Enable/Disable manual switch.

Bus Out

11X0 XXXX	Set Long Connection
01X0 XXXX	Unlock Switch operation (Reset Long Connection latch)
00X1 XXXX	Reset Disable Interlock

ECC CONTROL – '08'

This tag is used when a data check has been detected to determine correctability of the data. This is done while Set Read/Write is still up.

This tag is of the extended class.

TRANSMIT CONTROL – '09'

Initiates an operation as defined by the contents of Bus Out. This tag is of the immediate class.

Bus Out bits, when on, perform the following functions:

Bit 0 Controller Reset

Controller Reset. This resets all the control latches and the check indicator latches.

Bit 1 Unused

Bit 2

Set Diagnostic. Sets the diagnostic modes as defined by the Diagnostic Decode.

Bit 3

Resets any diagnostic mode that is left set in the controller. These modes are also reset by Power On Reset and Controller Reset.

Bit 4

Reserved

Bits 5–7

Diagnostic Decodes. Refer to Control and Device Interface Summary Chart (OPER 99) for decodes.

READ CONTROL – '0A'

Reads control bytes from the controller. The contents of Bus Out define the byte presented on Bus In. Bus Out must have only one bit active. This tag is of the immediate class.

Bus Out

10XX XXX	Gate Device Type Gates a bit that defines the device type to Bus In provided the selected device is online. Bus In bit 5 defines the 3340.
01XX XXXX	Gate CE Switches Gates contents of CE data switches onto Bus In.

SYNC – '0B'

Provides a scope sync.

CONTROL AND DEVICE INTERFACE DESCRIPTION OPER 102

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DISPLAY CE HI – '0C'

Sets the eight high-order positions of the controller CE Panel lights. This tag is of the immediate class. Bus In is not defined and parity cannot be guaranteed.

DISPLAY CE LO – '0D'

Sets the eight low-order positions of the controller CE panel lights. This tag is of the immediate class. Bus In is not defined and parity cannot be guaranteed.

READ OP – '0E'

This tag issues Read or Clock data commands to the controller.
It is of the extended class in that Normal End is not present at the time the tag is sent.
When issued, it is required that the PLO oscillator be locked in. Set Read/Write tag must be up to the drive. Except for the gap codes involving HA and AM Search, all read codes must only be issued after field orientation has been previously established on the active portion of the track. The controller responds with Check End indicating Command Overrun if this is violated.

CTL Bus Out

Defines the type of Read or Clock Data command and a count. Bits 4–7 contain the modulo-16 count of the number of bytes of the next data field to be transferred by the controller. Bits 0–3 contain the type of read and the prefield gap preceding it. The Read and Clock Data commands are as follows:

0001 XXXX Clock G3
0010 XXXX Clock G2

They allow Key and Data fields to be clocked without locking to data and searching for the sync byte.
The controller executes these codes by keeping the VFO locked to PLO and simulating a Write G3 or G2 operation with the Write Gate off. Sync In occurs then as if the field were being written. The data on Bus In is invalid and therefore parity is not generated.

0011 XXXX READ G4

Used for defect skipping. It may be used to extend a gap by 128 bytes if used ahead of a G2 or G3 code or it may be used to define the G4 gap following the Special Read G2 code.

0100 XXXX READ G1

Allows orientation on Home Address. This code is executed in two ways. If the gap counter is counting from index and has not reached byte 52, the execution proceeds immediately. If the counter is past byte 52 or if the counter is not running, the execution is delayed until index occurs. This code never overruns the command. If no sync byte is located before the normal position of HA on the track, a second attempt to read a sync byte is made 128 bytes later. No Sync Found and Check End occurs if the second attempt fails.

0101 XXXX READ G3
0110 XXXX READ G2

Both codes involve the lock VFO to data sequence at the proper point in the gap, search for sync bytes, and if successful, transfers the data read and processes the ECC bytes. The difference between the two is that the Read G3 sets the gap counter to process a G3 prefield gap.while the Read G2 implies a G2 prefield gap. Also the Transfer Sector Counter line is only performed during execution of the Read G3 code.

0111 XXXX READ G3 AM SEARCH

This code initiates an address mark search sequence. Once an address mark is found, the execution is the same as a Read G3 code. Field orientation is established when Address Mark is found. Transfer Sector Count line to the drive is activated when an AM is found.

1110 XXXX SPECIAL READ G2

This code is the same as a Read G2 except that it denotes there is an inter-record gap following and that there is no ECC at the end of the field.

CTL Bus In

Valid for each Sync In as denoted for data transfer after each gap definition. In addition, Bus In is valid for Tag Valid, Normal End, and Check End as follows:

TAG VALID

Information is gated onto Bus In for the purpose of Command Overrun control.

BIT 0: Unused

BIT 1: Unused

BIT 2 LOST ORIENTATION: Indicates that orientation is not established at the time the Read or Write operation is issued.

BIT 3: Unused

BIT 4 STATUS OVERRUN: Indicates that Tag Gate is active too late for the operation to continue successfully. It usually means that the channel has not responded to Status In on a chained Read or Write operation.

BIT 5: Unused

BIT 6 G1 UNORIENTED: Indicates that a Read G1 operation has been issued at a point when the controller is not oriented, that is, not in a G1 gap area.

BIT 7 ACTIVE TRACK: The Active Track signal is present from the selected drive.

NORMAL END

Raised after the last ECC byte or last byte of a skipped record has been transferred and no error condition has been detected. Bus In is all zeros with correct parity.

CHECK END

Raised if an unusual condition occurs. Bus In is never zero when Check End is active. The conditions causing Check End are as follows:

BIT 0 COMMAND OVERRUN 10X1 000X: Bus In bit 0 is set if the Read operation is not received at the controller before the gap counter reaches byte count 54. The Read G1 and Read G3 AM Search codes are exceptions since they do not have an overrun point. The Check End lines rise after Tag Gate falls at the controller. Since the gap counter stops running when Command Overrun occurs, record orientation is lost. Bit 0 is reset by Response.

BIT 1 DATA OVERRUN 01X0 000X: Bus In bit 1 is set if there is a late or extra response to Sync Out. Data transfer stops once this condition is detected. Bit 1 is reset by Response.

BIT 3 ECC DATA CHECK: Bus In bit 3 is set if after processing the ECC bytes the ECC hardware indicates a data check. This bit is not reset until the next read or write operation or by Response.

BIT 4 NO AM FOUND/ECC DATA CHECK 00X0 100X: AM Search code if an address marker is not found. Bit 4 is reset by Response.

This bit is also set with bit 3 as a redundancy data check indicator.

BIT 5 NO SYNC FOUND 00X0 010X: Bus In bit 5 is set if the controller does not find a sync byte. This does not apply to Clock G3 and Clock G2 codes. Bit 5 is reset by Response.

BIT 6 DATA FOUND 00X0 001X: Bus In bit 6 is set if at least a single one bit was found from the start of a sync byte search. This bit is only gated to Bus In if bit 5 (No Sync Found) is on. Bit 6 is reset by Response.

ERROR ALERT CONDITIONS

Raised whenever an error condition is detected that is not covered by Check End. The Error Alert (Selected Alert 1) line may rise at any time and may accompany Tag Valid, Normal End, or Check End. Any condition which sets Error Alert is latched for examination under the Status and Error.

WRITE OP – '0F'

Used to issue Write commands to the controller. This tag is of the extended class in that Normal End is not present at the time the tag is sent.
When this tag is issued, it is required that the PLO oscillator be locked in as a result of the Set Read/Write tag. If the PLO is not locked in, Error Alert reports a PLO error.
Except for the Format G1 code, all other write codes must only be issued after field orientation on the active portion of the track has been previously established. The controller responds with Check End and Command Overrun is noted on Bus In if this requirement is not satisfied.
The Format Write operations cause Write Gate to be set at a predetermined point on the track. From this point Write Gate stays up until index is detected. If subsequent format operations are not activated, zeros are padded throughout the rest of the track. Write Gate is also dropped with Reset Read/Write or the fall of Select Hold. When a format command has been executed, all subsequent Write commands are executed as format commands.
When required, the controller writes the address marker, sync byte, data transferred from storage control, ECC bytes, and gaps. Data transfer is initiated with a Sync In when the controller starts to write the sync byte. The ECC bytes are written immediately following the end of data transfer. ECC hardware sequence is handled by the controller.
The normal updating write command causes Write Gate to be set at a predetermined point in the gap and to be reset at the end of the field after the ECC bytes have been written.

Bus Out

Bits 0–3 contain the type of Write command (modifiers) to be performed and the prefield gap associated with it.
Bits 4–7 contain the modulo-16 residual count of the number of bytes of the next field that is to be transferred to the controller. This count is loaded into the controller data transfer counter. Following is the summary of the write modifiers:

0010 XXXX Write G2

0110 XXXX Format G2

1110 XXXX Special Format G2

0011 XXXX FORMAT REORIENT

Used to reorient when a count field is reached that contains a defect skip within its control. The count field must be rewritten once this is determined. The command is issued in the gap following the count field. Sync In is presented and padding is continued to index. Sync In continues to the reorientation point. The count used to reorient ahead of the R0 count field is 17,753 bytes and 17,749 bytes when ahead of other fields. This places the orientation just after the last byte before the ECC bytes of the data field and prior to the desired count field. Normal End is presented in the normal manner.

0100 XXXX FORMAT G1

This code causes the controller to search for index and active track. G1 is formatted and Home Address is written according to the data transfer. The Transfer Counter line to the drive is activated at byte 59 in the gap.

0101 XXXX FORMAT G3

Formats a G3 prefield gap and writes the address mark. The Transfer Counter line to the drive is activated at byte 59 in the gap.

0111 XXXX FORMAT ERASE

This code causes zeros to be written to index and turns off the Write Gate. Clocking continues until Recycle drops and the modulo-16 count has decremented to zero or index is detected. Track overrun is presented during this command when index is detected.

1011 XXXX WRITE G4

This code is used to extend a gap before the gap definition is presented or is used during an inter-record gap to define the modulo-16 remainder for the second half of the data field.

1100 XXXX SPECIAL FORMAT G1

This code causes a search for Index and Active Track. When found, 128 bytes of zeros are written. After this, the controller continues writing the Format G1.

Bus In

Bus In is valid when Tag Valid, Normal End, or Check End is active.

TAG VALID

BIT 0: Unused

BIT 1: Unused

BIT 2 LOST ORIENTATION: Indicates that orientation is not established at the time the Read or Write operation is issued.

BIT 3: Unused

BIT 4 STATUS OVERRUN: Indicates that tag gate is active too late for the operation to continue successfully. It usually means that the channel has not responded to Status In on a chained Read or Write operation.

BIT 5: Unused

BIT 6: Unused

BIT 7 ACTIVE TRACK: The active track signal is present from the selected drive.

NORMAL END

Raised if no Check End condition exists after the last byte of the ECC field is written.

CHECK END

Bus In is never zero when Check End is raised. Raised if one of the following unusual conditions occur:

BIT 0 COMMAND OVERRUN 10X0 XXXX: Bit zero is set if the command is not received at the controller before the gap counter reaches byte count 54 on operations requiring maintained operation.

BIT 1 DATA OVERRUN 01X0 XXXX: Bit 1 is set if Sync Out arrives too late to service a byte of data or if an extra Sync Out occurs. If Write Gate is on, it will be turned off.

BIT 3 TRACK OVERRUN 00X1 XXXX: Bit 3 is set if the index point is detected while a field is being written. The field includes the prerecord gap through the end of the ECC bytes. Write Gate is dropped and Check End is raised when index is detected, except when Format G1 is being processed.

ERROR ALERT

Raised whenever an error condition is detected which is not covered by Check End. The alert line may rise at any time.

POLL DEVICE – '82'

This tag allows the drives of the addressed controller to be polled for service requests. This tag may only be issued when there is no drive selected on the CTL-I.
Bus Out bits 0–2 contain the address of the desired controller (CA). The controller responds with Tag Valid and Normal End if there is no Bus Out or Tag Bus parity error.
If Bus Out bit 3 and 5 are zero, then the presence of a drive interrupt from any drive causes the bit significant address of that drive (DA) to be activated on Bus In.
If Bus Out bit 3 is on, then the drive address for which an interrupt exists is only seen on Bus In if the corresponding address in the controller Unsuppressable Register is set.
For example, if a drive with address 7 has an interrupt, then Bus In bit 7 is only activated if bit 7 of the Unsuppressable Register is set.
Bit 5 on Bus Out is provided to poll requests from only the drive that is in the service mode. Bus In bit 0 is used to indicate that a request is present. Bus Out bit 3 (Unsuppressible) is not defined when polling the service drive and should not be used.
Parity On Bus In is not guaranteed for Poll Device.
This tag is of the immediate class.

SELECT DEVICE – '83'

Provided to select both a controller and a drive. Bus Out contains the address of the controller and the logical drive address. The controller generates the selection sequence to the drive. Bus Out to the controller is gated on Bus Out to the drive for use of the logical drive address (DA) contained in bits 5–7. The controller responds to this tag with Tag Valid, Select Active, and Normal End if the address on Bus Out matches that assigned to the controller and if Tag Valid is received from the device. Tag Valid is returned from the device to controller provided a drive is selected and there are no device Tag Bus or Bus Out parity checks. Bus In contains the controller address (CA) and its inverse if selection is successful. Bus Out bit 4 = 1 blocks drive selection. Bus Out bit 3 = 1 causes drive in CE Mode to be selected while ignoring bits 5–7.
If the address on Bus Out is not recognized or if either Bus Out or Tag Bus have incorrect parity, no inbound lines are raised.
This tag is of the immediate class.

READ STATUS – '84'

This tag causes the controller to transmit the drive status onto Bus In bits 1 to 7. The tag does not affect the drive.
The Controller Check bit is transmitted on Bus In bit 0.
The drive status has some differences when Set Read/Write is on. Refer to Control and Device summary chart (OPER 100) for a summary of the status bits with Set Read/Write on and off.
This tag is of the immediate class.

Correct parity on Bus In is not guaranteed because of the asynchronous state of the information presented.

CONTROL AND DEVICE INTERFACE DESCRIPTION (Continued)

SET READ/WRITE – '85'

Sets the Read/Write control in the controller and causes the PLO and VFO to be synchronized with Servo Pulses from the activated drive. The Read/Write control to the device is established as follows:

1. Device Tag Bus bits 0, 1, and 2 are forced to all 1s.
2. Device Bus Out bits 5, 6, and 7 are forced to all 1s.
3. Device Bus Out bits 0 thru 4 are conditioned so that the various read and write controls may be transmitted to the device.
4. Device Tag Gate is forced on.
5. The Device Bus Out parity checker is blocked after Set Read/Write is decoded in the device.
6. Upon detection of index, the Read/Write controls are blocked for approximately 63 microseconds. This allows the microprogram to set the head address register to a new value during multitrack Read or Search operations. It is expected that after this tag is issued, Read operation (Tag '0E') or Write operation (Tag '0F') will be issued.

The Read/Write controls are reset by:

1. Reset Read/Write operation (Tag '05').
2. Controller Reset (Tag '09', Bus '80').
3. Dropping Select Hold.

This tag is of the extended class and Normal End usually signals that the read/write logic is ready. Check End is not possible.

Bus In is not defined and parity cannot be guaranteed.

SENSE INTERFACE – '89'

This tag is used to determine the cause of a Device Interface check. Bus In bits 6 and 7 indicate:

Bit 6 – Device Bus Out Parity Check.

Bit 7 – Device Tag Bus Parity Check.

This tag forces Tag Valid even though the Device Interface checks are present. The Device Bus Out and Device Tag Bus Parity Check latches are reset when tag gate drops.

This tag is of the immediate class. Bus Out is not used.

DIAGNOSTIC SET – '8A'

This tag is used in conjuction with Device Bus Out to set the selected drive into predefined hardware status as an aid to troubleshooting.

Device Bus Out

10XX XX00 SERVO RESET

01XX XX00 GO HOME

Go Home causes the access mechanism to go to the home position, fully retracted into the data module.

00XX XX10 FORCE MULTIHEAD CHECK

This command sets Odd Head latch in drive. A subsequent Set Read/Write command forces Multihead Check if HAR bit 6 is off.

00XX XX01 DECREMENT DIFFERENCE COUNTER

Decrement Difference Count causes the difference count to be decreased by one each time Diagnostic Set Tag is applied with Device Bus Out bit 7 active.

SET HEAD – '8B'

This tag is used to transfer the Head Address, Direction bit, and 256 bit of the Difference Count to the Head Address Register from Bus Out.
The Direction bit (HAR bit 0) determines the direction in which a seek is to take place. When this bit is on, the accessing occurs in the direction of increasing track number (toward the spindle).
The Difference Count 256 bit (HAR bit 1) is an extension of the difference counter which is loaded by the Set Difference Tag (Tag '8C') Logical Head Address 16, 8, 4, and 2 bits (HAR bits 3–6) select one of 12 physical heads. Logical Head Address 1 bit (HAR bit 7) selects the Logical Half Track to be reported as the active track in Set Read/Write Status.

SET HEAD '8B' FHFE

Same as above except HAR bit 0 is unused. HAR bit 1 on selects fixed heads during a Read or Write operation.

SET DIFFERENCE – '8C'

This tag loads the Difference Counter of the selected drive. The Difference Counter is loaded with the difference between the current cylinder address and the desired cylinder address as calculated by the controlling system. The 256 bit of the Difference Counter is loaded with the Set Head (Tag '8B'). The difference value, including the 256 bit, must be set at least 8 microseconds before a Seek Start is issued.

SET TARGET – '8D'

This tag is used to transfer a sector number to the Target Register of the selected drive for rotational position sensing. The drive immediately begins to perform a search sector operation to compare the Target Register with the Sector Counter to find a match. This Tag is used only if the Rotational Position Sensing (RPS) feature is installed.

SET CYLINDER – '8E'

This tag loads the Cylinder Address Register (CAR). CAR is not functionally connected to the access mechanism; it serves only as a storage register to contain information as to the current position of the access mechanism for use with the string switch feature of the controller.
CAR is reset by a Rezero Operation to indicate that the heads are positioned over track 0.

CONTROL – '8F'

This tag is used to transfer control information to the selected drive. Under this tag, the Device Bus Out is divided into two groups of four bits each. Device Bus Out bits 4–7 are coded to perform 14 different functions. Bits 0–2 are interpreted to further control certain of these functions. Refer to Control and Device Interface Summary Chart in OPER 101. The functions are:

XXXX 1000 SEEK START

Causes the drive to move the read/write heads as specified by the information contained in the Difference Counter and Head Register. These registers must previously have been set. If the Difference Count is zero, no physical accessing occurs, and the completion of the zero track seek is signaled immediately.
Completion of the action initiated by Seek Start is signaled by Attention. At the termination of a seek, the Seek Complete status bit in the machine status is on. An Access failure is indicated by the Drive Check bit being on with Attention.

XXXX 0100 ATTENTION RESET

Resets the attention signals in the selected drive. To prevent masking of attention signals, Attention Reset should be performed to reset attentions already present prior to the initiation of an operation resulting in an attention. Attention Reset also cancels pending Seek Rezero or Search Sector Attentions.

XXXX 1100 CHECK RESET

Resets check conditions in the selected drive, including Read/Write checks.

XXXX 0010 REZERO

Causes the drive to place the heads over track 0 with HAR and Difference Counter reset to zero, the same condition as after a data module has completed load sequence. Rezero is a low-speed operation used to recover to a known track position after a seek error has occurred. Check Reset must be issued prior to a Rezero operation if an Access Check is present in the drive. The response of the drive to the controller after completion of this control function is similar to Seek Start.

XXXX 1010 DRIVE SYNC TAG

Causes A1C2G02 to shift to a –MST level. The micro-diagnostics use this to provide oscilloscope sync pulses.

XXXX 1110 SET TSF – FHFE

This tag is used to set direction (bit 0) in which a Seek is to take place. When this bit is on, the accessing occurs in the direction of increasing track number (toward the spindle). The difference count 256 bit (bit 2) is an extension of the Difference Counter.

XXXX 0110 READ/WRITE CHECK RESET

Causes the common Read/Write Checks to be reset.

1. Multihead Check
2. Capable/Enable Check
3. Write Overrun
4. Index Check
5. Interlock Check
6. Control Check
7. Transition Check
8. Write Current Check

XXXX 0001 SENSE CYLINDER

Causes the contents of the Cylinder Address Register to be presented on the Device Bus In.

XXXX 1001 SENSE DIFFERENCE COUNTER

Causes the contents of the Difference Counter to be presented on the Device Bus In.

XXXX 0101 SENSE HEAD REGISTER

Causes the contents of the Head Register to be presented on Device Bus In.

XXXX 1101 SENSE TARGET REGISTER

Causes the contents of the Target Register to be presented on the Device Bus In. If the Rotational Position Sensing feature is not installed, the Device Bus In is all zeros in response to this control function.

XXXX 0011 SENSE STATUS

Causes status bytes to be placed on Device Bus In as determined by bits 0-3 of Device Bus Out. For a summary of each of the status bytes, refer to Control and Device Interface Summary Chart on OPER 101.

000 0011 STATUS - FHFE

This tag presents direction in bit (bit 0), difference count 256 bit (bit 1), Low Gain Head write check (bit 5) and fixed Head Feature present on drives (bit 7).

1000 0011 SENSE DRIVE CHECKS/STATUS

Presents Drive Check and DM Size Status on Bus In. Refer to OPER 101 for Bus In bit significance.

0100 0011 DM SEQUENCE CONTROL

Presents data module load sequence information on Bus In. Refer to OPER 101 for Bus In bit significance.

0010 0011 LOAD SWITCH STATUS

Presents data module load switch status on Bus In. Refer to OPER 101 for Bus In bit significance.

0001 0011 ACCESS SWITCH STATUS

Presents access status information on Bus In. Refer to OPER 101 for Bus In bit significance.

0000 1011 SENSE READ/WRITE

Presents Read/Write check conditions on the Device Bus In. Refer to OPER 101 for Bus In bit significance.

XXXX X111 DIAGNOSTIC SET READ/WRITE

Causes bits 0--4 of the Device Bus Out to control Read/Write functions in the device. While the Set Read/Write Control function is present, parity checking of Device Bus Out by the drive is disabled and read/write status of the drive is presented on Device Bus In. Refer to the Control and Device Interface Summary Chart on OPER 101 for the drive status on Device Bus In.

During a normal Set Read/Write, (See Set Read/Write Tag 85 -- OPER 105), the controller hardware controls the action of the bits on Device Bus Out. During a Diagnostic Set Read/Write (Tag '8F', Bus XXXX X111) the diagnostic microprogram must control the bits on Device Bus Out.

The control functions under Device Bus Out are as follows:

Bit 0 Transfer Sector Count: The contents of the Sector Counter are transferred to the Target Register for later read-out. The Target Register is only present if the Rotational Position Sensing feature is installed in the drive.

Bit 1 Write Gate: When on, along with bit 4, Address Mark Control causes writing to be performed on the data module. Read/Write Checks prevent writing.

Bit 2 Unsquelch: Causes the squelch to be removed from the read amplifier to allow read data operations.

Bit 3 Read Gate: Causes the read amplifier, read detector, and data line drives to be set to read mode. Read/Write checks prevent Read operations.

Bit 4 Address Mark Control: Not used in Read mode. In Write mode, it must be used with Write Gate to cause writing to be performed on the data module (allows current source to be unblocked).

Bits 5 through 7 must be ones.

CONTROL AND DEVICE INTERFACE DESCRIPTION (Continued)

CONTROL AND DEVICE INTERFACE DESCRIPTION (Continued)

OPER 106

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INTERFACE SEQUENCING

A timing chart of the Control and Device Interface as used in a typical operation is shown on OPER 108 and 109. A Seek operation (OPER 108) followed by Polling and a Seek Complete Attention (OPER 109) shows the sequence of events that take place on the Bus In, Bus Out, and Tag Bus.

The charts on OPER 98 – 101 show the data on each bus, on both interfaces, for each tag and modifier issued. Note that some tags do not use the Device Interface. See OPER 102–106 for tag descriptions and OPER 95 for tag considerations.

The following is a brief description of the Bus Out and Tag Bus and of the operations shown on OPER 108 and 109.

BUS OUT

The Control Interface Bus Out is propagated to the Device Interface Bus Out at all times except during Read/Write mode.

TAG BUS

The Device Tag Bus uses a register to transmit tags to the device as follows:

1. Selection Tag '83' causes the register to reset. Since the register is not clocked and neither the G1 nor G2 input is active, the register is reset to zero. Tag '83' also causes Tag Gate to rise.
2. Tags with bits 0 and 4 on (Tags '89'–'8F')are device tags. These tags cause the G1 input to the register to be active and Control Interface Tag Bus bits 5, 6, and 7 are set into the register and become Device Tag Bus bits 0, 1, and 2. Selected Tag Gate activates Device Tag Gate.
3. Read/Write mode causes the G2 inputs to be active and causes all bits to be set on. Read/Write mode also forces Device Tag Gate.
4. Controller Tags('00'–'85',except '83') do not affect the register settings. Device Tag Gate is not activated.

SEEK OPERATION

The timing chart of a Seek operation on OPER 108 shows a typical sequence of interface operations and controller and device interaction for a storage-control-initiated operation.

The timing chart is based on a 3830-2 using a microprogram disk that has string switch code and 3340s without the string switch feature.

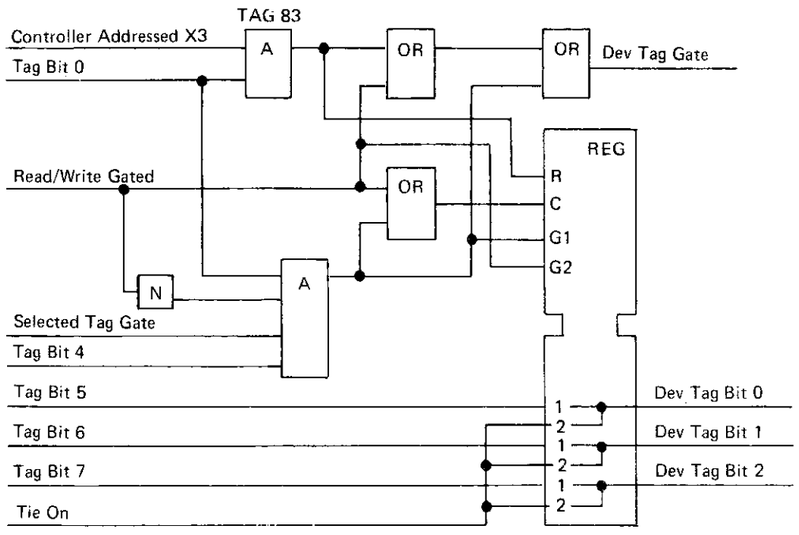
A Start I/O with a Seek command is issued by the CPU. The storage control selects the addressed device and makes certain checks of the device such as: status, features, and device type. The direction and length of the Seek are computed and sent to the device, along with the read address. These values are verified by a Read Back check. Cylinder address values are also transmitted and are verified if the string switch feature is installed. If no errors are encountered, the access is started. As soon as the device becomes Busy, it is deselected and finishes the operation independently. The storage control returns to Polling mode to await an Attention from the device or a channel command.

SEEK COMPLETE ATTENTION

The timing chart on OPER 109 illustrates Polling with a device-initiated sequence of interface operations.

The timing chart is based on a 3830-2 using a microprogram disk that has string switch code and 3340s without the string switch feature.

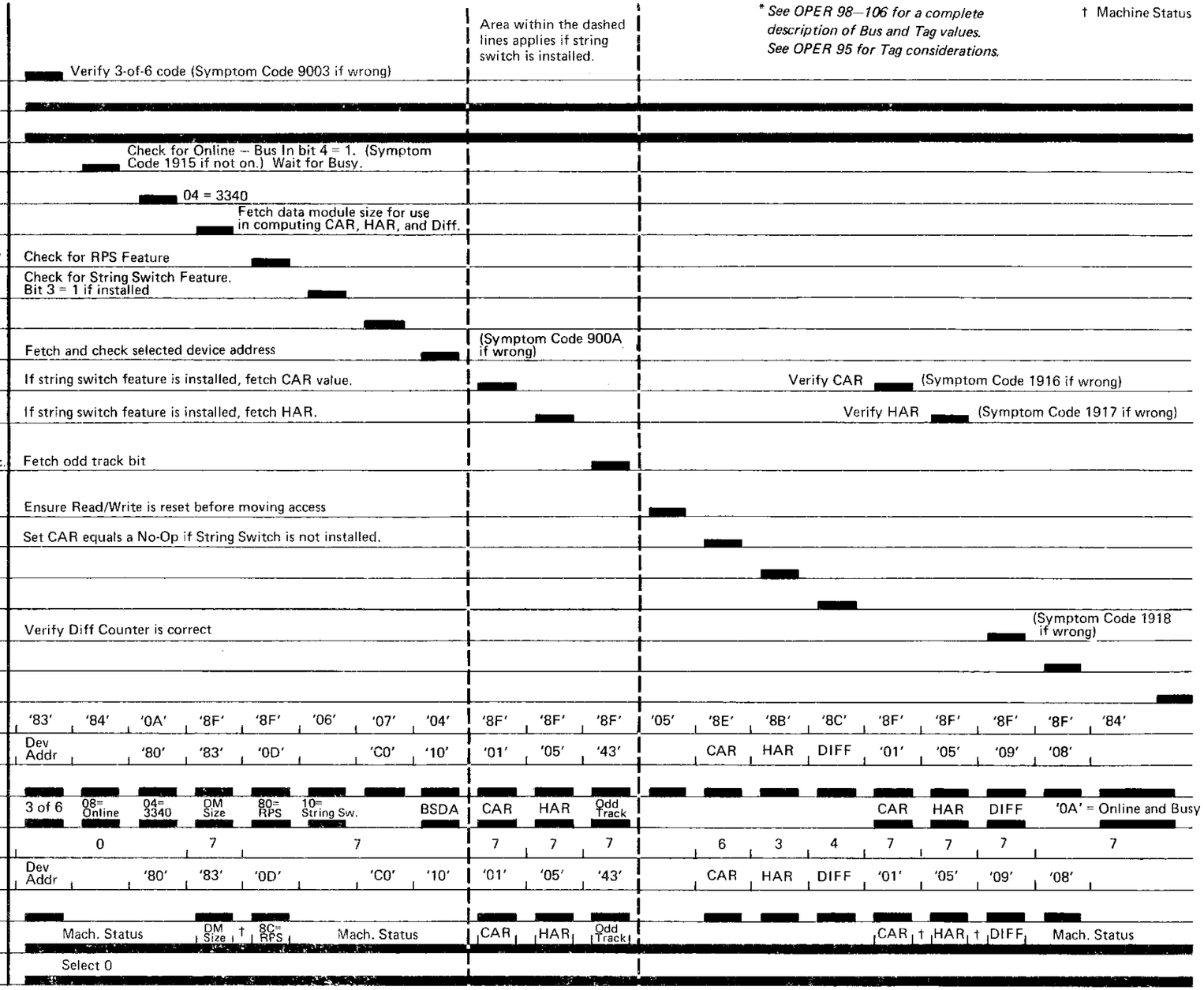
The storage control, when idle, polls all of the attached controllers for outstanding Attentions. If an event such as a Seek Complete has occurred, the device places its Bit Significant Device Address (BSDA) on the Attention/Select Bus to the controller (BSDA equals bit 0 for device 0, bit 1 for device 1, etc.). When the controller is polled, it places the BSDA(s) on the Control Interface Bus In. The storage control then selects the first device and interrogates it (Read Status Tag '84') to determine the type of Attention: Seek Complete/Sector Compare or Pack Change. The Attention is stacked (not reset) as indicated on the timing chart or reset depending upon the storage control/channel requirements.



INTERFACE SEQUENCING (Continued)

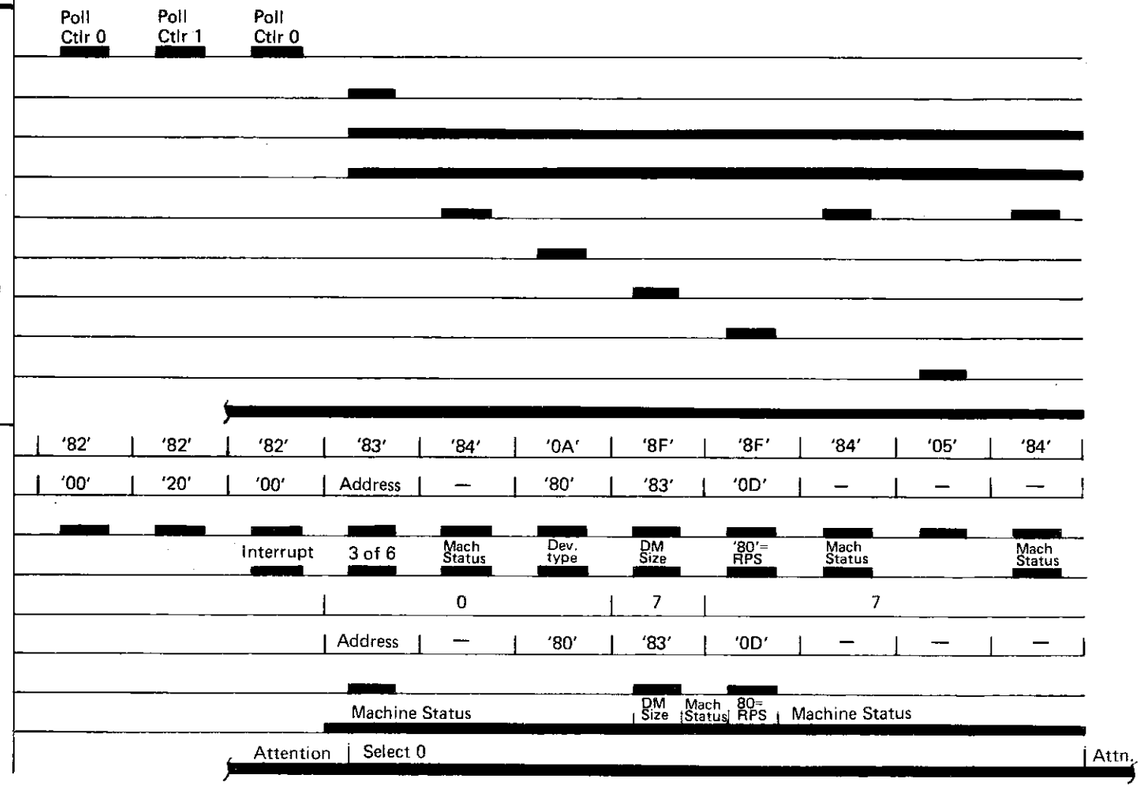
SEEK OPERATION

Line Name	Control Interface* Tag Bus	Control Interface* Bus Out	Control Interface* Bus In	Device Interface* Tag Bus	Device Interface* Bus Out	Device Interface* Bus In
Select Tag	'83'	Addr.	3 of 6	0	Addr.	Mach Status
Select Hold	—	—	—	—	—	—
Selected	—	—	—	—	—	—
Read Status	'84'	—	Mach Status	—	—	Mach Status
Gate Device Type	'0A'	'80'	'04'	—	—	Mach Status
Sense Status 1	'8F'	'83'	DM Size	'7'	'83'	DM Size
Sense Target Register	'8F'	'0D'	'00' or '80'	'7'	'0D'	'00' or '80'
String Switch	'06'	—	'00' or '10'	—	—	Mach Status
Set Long Connection	'07'	'C0'	—	—	—	Mach Status
Gate Physical Address	'04'	'10'	BSDA	—	—	Mach Status
Sense Cylinder Address Register	'8F'	'01'	Cyl. Addr.	7	'01'	Cyl. Addr.
Sense Head Address Register	'8F'	'05'	Hd Addr.	7	'05'	Hd Addr.
Sense Status 2	'8F'	'43'	Odd Track etc.	'7'	'43'	Odd Track etc.
Reset Read/Write	'05'	—	—	—	—	Mach Status
Set Cylinder Address Register	'8E'	Cyl. Addr.	—	6	Cyl. Addr.	Mach Status
Set Head Address Register	'8B'	Hd Addr.	—	3	Hd Addr.	Mach Status
Set Difference Counter	'8C'	—	—	4	—	Mach Status
Sense Diff	'8F'	'09'	Diff	7	'09'	Diff
Seek Start	'8F'	'08'	—	7	'08'	Mach Status
Busy	—	—	—	—	—	—



SEEK COMPLETE ATTENTION

	CONTROL INTERFACE*			DEVICE INTERFACE*		
	Tag Bus	Bus Out	Bus In	Tag Bus	Bus Out	Bus In
Poll	'82'	Ctrl Addr	Intrpt Addr	—	—	—
Select Tag	'83'	Addr	3 of 6	0	Addr	Mach. Status
Select Hold	—	—	—	—	—	—
Selected	—	—	—	—	—	—
Read Status	'84'	—	Mach. Status	—	—	Mach. Status
Gate Device Type	'0A'	'80'	'04'	—	—	Mach. Status
Sense Status 1	'8F'	'83'	DM Size	7	'83'	DM Size
Read Target	'8F'	'0D'	'00' or '80'	7	'0D'	'00' or '80'
Reset Read/Write	'05'	—	—	—	—	—
Seek Complete	—	—	—	—	—	—



**See OPER 98 – 106 for a complete description of Bus and Tag values. See OPER 95 for Tag considerations.*

SELECT OPERATION

UNIT SELECTION

The I/O unit address consists of an 8-bit byte plus parity. Drives 0–7 are attached to the first controller string and drives 8–F are on the second controller string.

0	1	2	3	4	5	6	7
Controller Address				Drive Address			

SELECTION OPERATION

A To select a drive, the controller must also be selected. Tag '83' is placed on CTL Tag Bus.

B The address of the controller and drive are placed on Bus Out (Bus Out bit 3 is zero).

C Tag Gate is raised.

D Select Hold is raised.

E The controller compares its pre-wired 3-bit address to Bus Out bits 0–2.

F If comparison is successful, Select Active is sent back to the using system. The controller returns its address (in 3-of-6 code) on CTL Bus In. The 3-bit address is in bits 0–2 and the inverse in bits 5–7. Therefore, three of the six bits are always active.

G Controller tag '83' decodes to device tag '000', which is Select Gate.

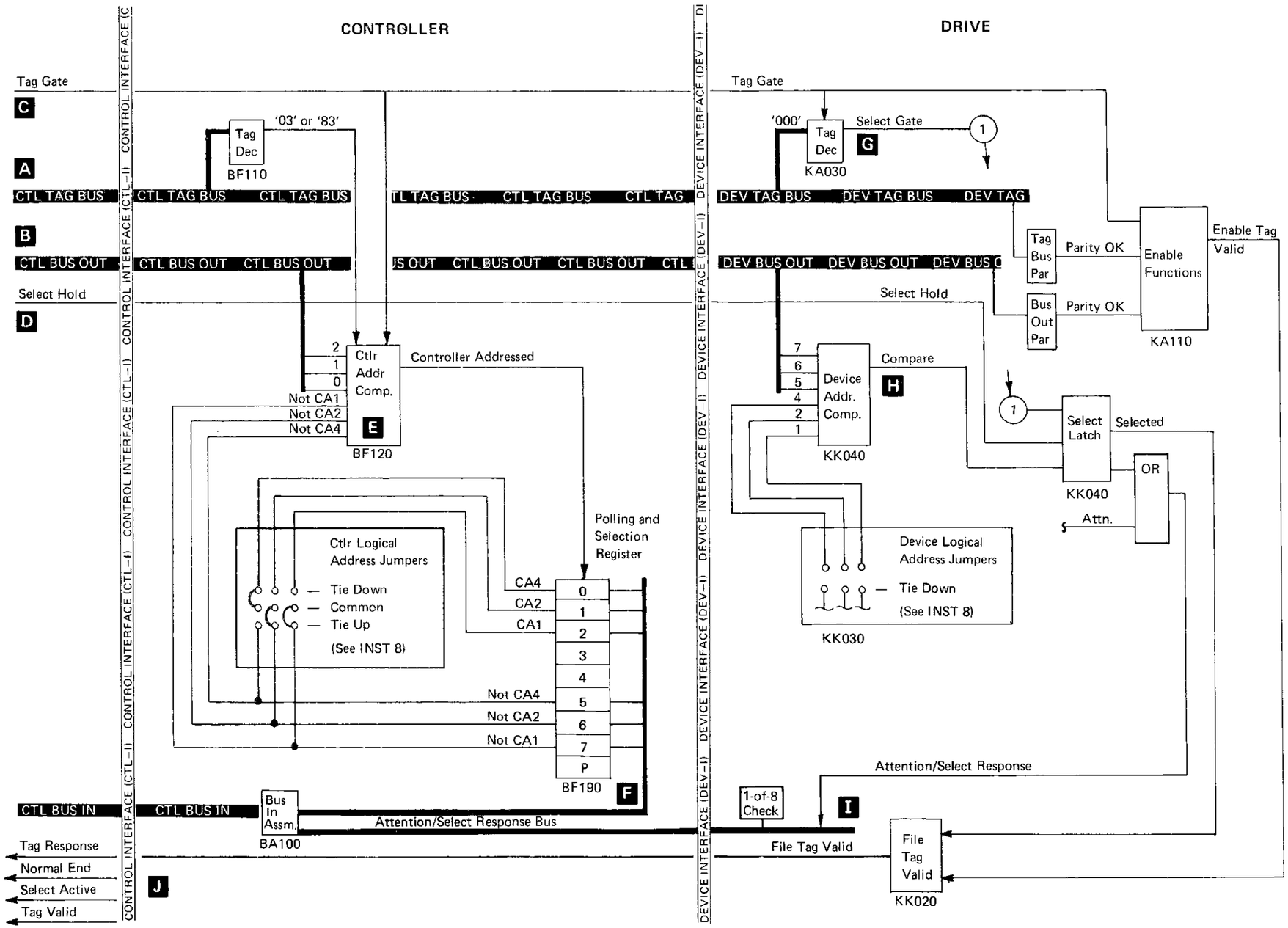
H Drive logical address bits wired (4, 2, 1) are compared with Bus Out bits 5, 6, and 7, respectively, for an address match. A Compare Equal sets the Select latch in the drive.

I The Select latch generates a select response, which activates the unique drive physical address bit on the Attention/Select Response bus. (Drive 0 = bit 0, drive 1 = bit 1, etc.) The Attention/Select Response bus is checked to ensure that one, and only one, bit is active.

The Attention/Select Response bus can later be gated to CTL Bus In by a Sense Physical Address tag (CTL Tag Bus '04', CTL Bus Out '10').

J The Select latch causes Tag Valid to be sent to the controller, provided there are no Device Tag Bus or Device Bus Out parity errors. This in turn causes the controller to send Tag Valid and Normal End to the storage control unit.

Note: See CTL-I 300 for controller selection check and DEV-I 146 for drive selection failure.

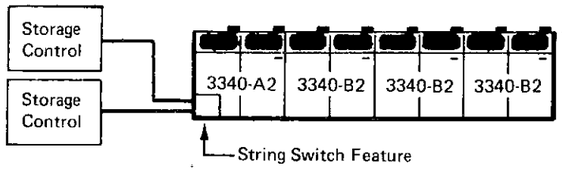


STRING SWITCH OPERATION

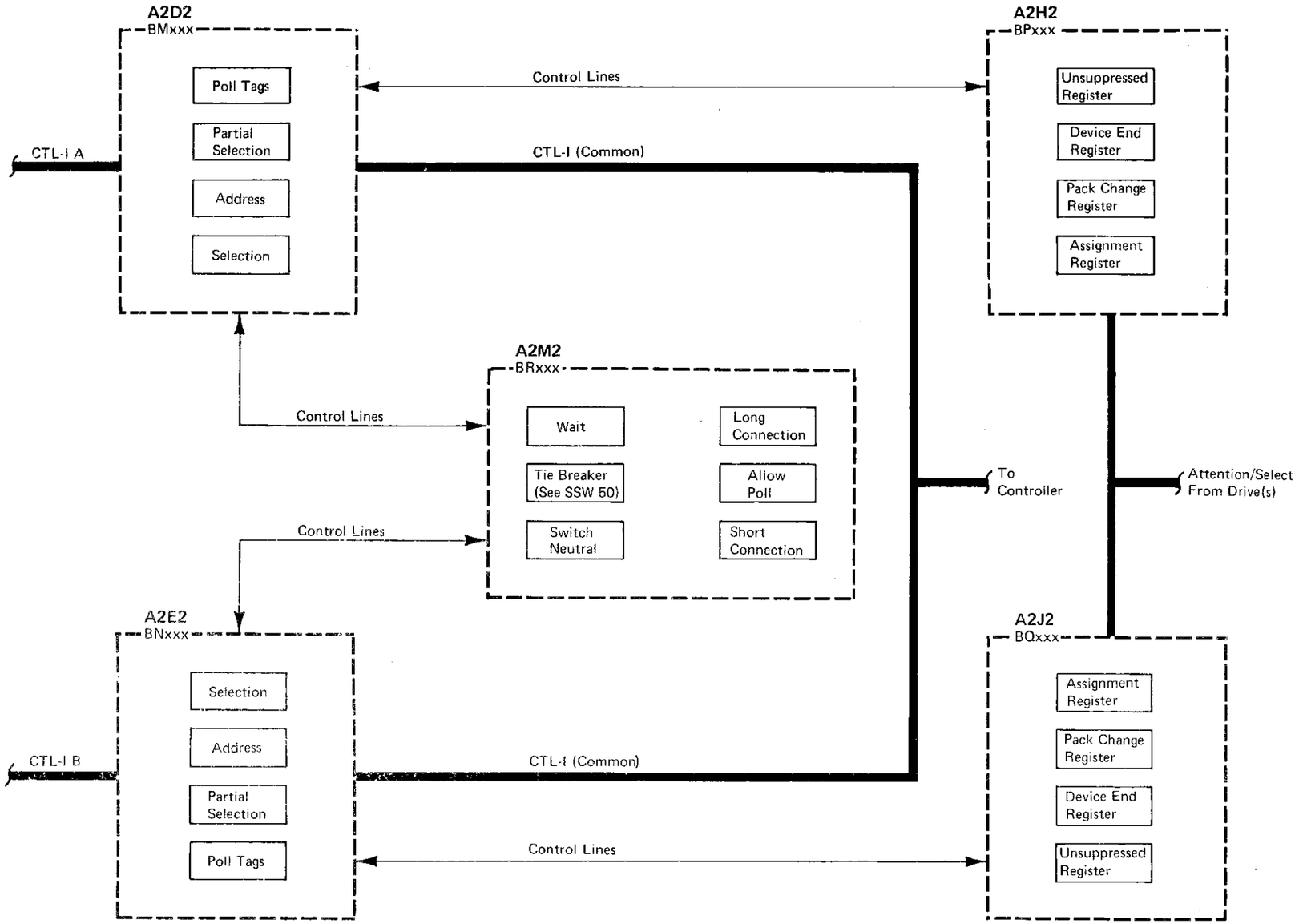
STRING SWITCH

The string switch feature allows an IBM 3340 Disk Storage and Control and its attached string of 3340 disk storage modules to be dynamically shared by various storage control attachments.

The 3340 can be dedicated to a single storage control with an Enable/Disable switch.



TAG	BUS OUT	BUS IN
06	1100 Xaaa Assign drive to interface. 0100 Xaaa Unassign drive from interface. 1010 Xaaa Set Device End Latch. 0010 Xaaa Reset Device End Latch. 1001 Xaaa Set Pack Change Latch for opposite interface. 0001 Xaaa Reset Pack Change Latch for this interface. aaa = Binary drive address	1000 XXXX Device End Interrupt Active for this interface. 0100 0XXX Pack Change Interrupt Active for this interface. 0010 0XXX Addressed Drive Assigned to this interface. 0001 0XXX Connection Through a switchable controller. 0000 1XXX Addressed drive is assigned to the opposite interface.
07	11X0 XXXX Set Long Connection 01X0 XXXX Unlock Switch Operation 00X1 XXXX Reset Disable Interlock	



F
L

STRING SWITCH OPERATION

SELECTION

- With the string switch feature, each storage control tries to select over its own control interface independent of the other storage control by a Tag 03 or Tag 83. Any conflict is resolved by the tie breaker.
- The address plugged into the controller card A2G2 (ref. INST 8) must be plugged into both select cards A2D2 and A2E2.
- The 3340 string may be partitioned off from either/both control interface using the Enable/Disable toggle switch on the operator panel of the control module.
- One of the following will occur when the storage control attempts a selection over its control interface.
  1. Full selection (connection).
  2. Short Busy.
  3. Partial Selection (Busy).

FULL SELECTION (Connection)

- The sequence for full selection is:
  1. A storage control attempts selection and the tie breaker allows the Select latch for that interface to be set (ref. SSW 12, 50).
  2. Setting the Select latch for either interface immediately de-activates Switch Neutral and sets the common Short Connection latch on A2M2 card (ref. SSW 51).
  3. The Select latch, together with the Enable latch, connects control interface from the control storage through the string switch to the controller. The string switch is now transparent to the connected control interface except for certain tags which are recognized and acted upon. Note: The string switch does not generate a response at the completion of a full selection.
  4. Tag 03 or Tag 83 (ref. OPER 100, 101), in addition to initiating the connection, selects the controller. The controller responds with Tag Valid, Normal End and Select Active via the string switch connection.
- After the storage control has achieved full selection of a device, it may assign the device for its exclusive use by issuing Tag 06. This tag is recognized by the string switch.
- The storage control which achieves full selection and is to continue with extended operations must set the common Long Connection latch via Tag 07. The string switch recognizes this tag and executes it without further intervention. The Short Connection latch is automatically reset by this operation (ref. SSW 51).
- The Unlock Switch Operation is accomplished via Tag 07 Bus 40 and dropping Select Hold. This operation resets the Select latch and breaks the string switch connection. If Select Hold is dropped by itself, the controller is deselected, but the string switch connection is maintained.
- If Switch Error occurs while one side is connected to the controller, that side remains connected; all responses to the other side are blocked.

SHORT BUSY

- Short Busy occurs when one side tries to select the device while the other side is connected with the Short Connection latch set.
- The string switch indicates the Short Busy condition by raising Index Alert on the interface of the storage control attempting selection.
- The Short Busy indication (Index Alert) remains during a valid Select Tag until the selected storage control (1) initiates the Unlock Switch operation or (2) sets the Long Connection latch. In the first case the storage control attempting selection now becomes connected. In the second case the storage control becomes partially selected.

PARTIAL SELECTION (Busy)

- Partial Selection occurs when a storage control fails in its selection attempt, but the tie breaker allows the Partial Selection latch of that interface to be set (ref. SSW 50).

  The conditions under which the tie breaker allows the Partial Select latch to be set are:

  1. The Select latch on the other interface is set, or the addressed device is assigned to the other interface.
  2. The Short Connection latch is not set.

  The Partial Select latch in conjunction with the current valid Select Tag causes the string switch to respond with Tag Valid, Normal End and Select Active. In addition, the string switch raises the 3 of 6 controller address and the Busy indication on Bus In. (Bus In Bit 3.)
- An interface that has Partial Selection may execute only Tags 01, 06, and 07 for housekeeping functions.
- Partial Selection does not affect switch neutrality or connection state in any manner. In fact, both sides may be partially selected because of Assignment Busy. However, the Partial Select latch can be reset only by setting the Unlock Switch latch with Tag 07 Bus 40 and then dropping Select Hold.

POLLING

- Polling for interrupts is accomplished by Tag 02 or Tag 82. Each storage control may raise a poll tag at any time and keep it up as long as desired.
- In response to a valid Poll Tag over a control interface, the string switch raises Tag Valid and Normal End.
- All interrupt indications on Bus In are processed by the string switch; the Controller is completely bypassed.

Polling Constraints

- Allow Poll is the general condition under which a device responds to a Poll Tag. This response is a Device Attention which appears on Bus In. Allow Poll is active under these two conditions:
  1. To both interfaces when the string switch is in the neutral state.
  2. To the interface that is connected to the string switch and has set Long Connection.
- Attentions will not appear on an interface from devices which are assigned to the other interface. The assignment status of an addressed device may be determined at the storage control by reading Bus In after issuing Tag 06 Bus XX.

Attentions

- The Attention/Select Bus is wired to both interfaces via the string switch cards A2H2 and A2J2. Attentions generated by the devices are transmitted over this bus. The Controller is also wired to this bus, but it is logically bypassed. The type of attention generated is determined by the storage control fully selecting the interrupting drive and reading File Status.
- The first interface to read and reset a Data Module Ready Attention from a drive must preserve this attention for the other interface. To do this, the Pack Change latch for the affected drive is set on the other interface by the first interface issuing a Tag 06 Bus 9X.
- When a selection attempt over an interface results in Busy (Partial Selection), the storage control may prime an interrupt to notify it when the device becomes available. This is accomplished by setting appropriate Device End Register latch using Tag 06 Bus AX.
- The status of string switch generated attentions for an addressed device is determined by the storage control reading Bus In after issuing Tag 06 Bus XX.
- String switch generated attentions for an addressed device may be reset by the storage control using Tag 06 Bus 2X under Full or Partial Selection.

INITIALIZATION

The controller and the drive must both be selected (Tag '83').

A 6-byte seek address must be transferred from the channel to the storage control.

Tag Gate and Tag Bus must be latched to the drive.

OPERATION

A CTL-I Tag '88' is raised to set the Head Address Register (HAR). Tag bits 6 and 7 are routed through the controller to the device and shifted to DEV-I Tag Bus bits 1 and 2 (see OPER 101).

DEV-I Tag Bus bits 1 and 2 decode to Set HAR.

B Bytes 2 and 3 of the seek address specify the logical cylinder address and byte 5 specifies the logical head address. The storage control converts the logical address to a physical address and places it on Bus Out. Bus Out is routed through the controller and shifted to DEV-I Bus Out to set the Head Address Register and the seek direction.

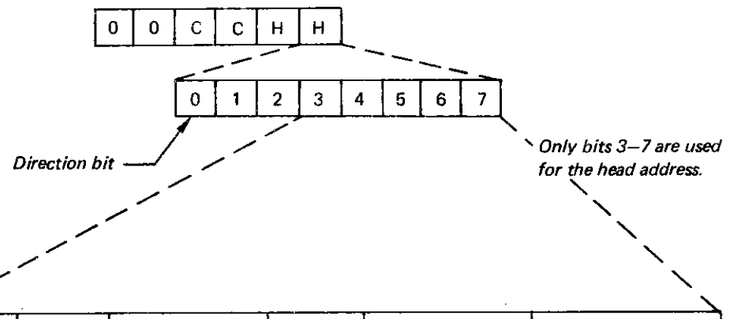
C HAR bit 6 is used to determine whether an even or odd head is selected.

D HAR bit 7 is used in conjunction with Index detection to activate either the odd or even track (see OPER 12).

E CTL-I Tag '8C' is raised to set the Difference Counter. The Difference Counter is loaded with the difference between the current cylinder address and the desired cylinder address as calculated by the storage control (see ACC 530 for Difference Counter control).

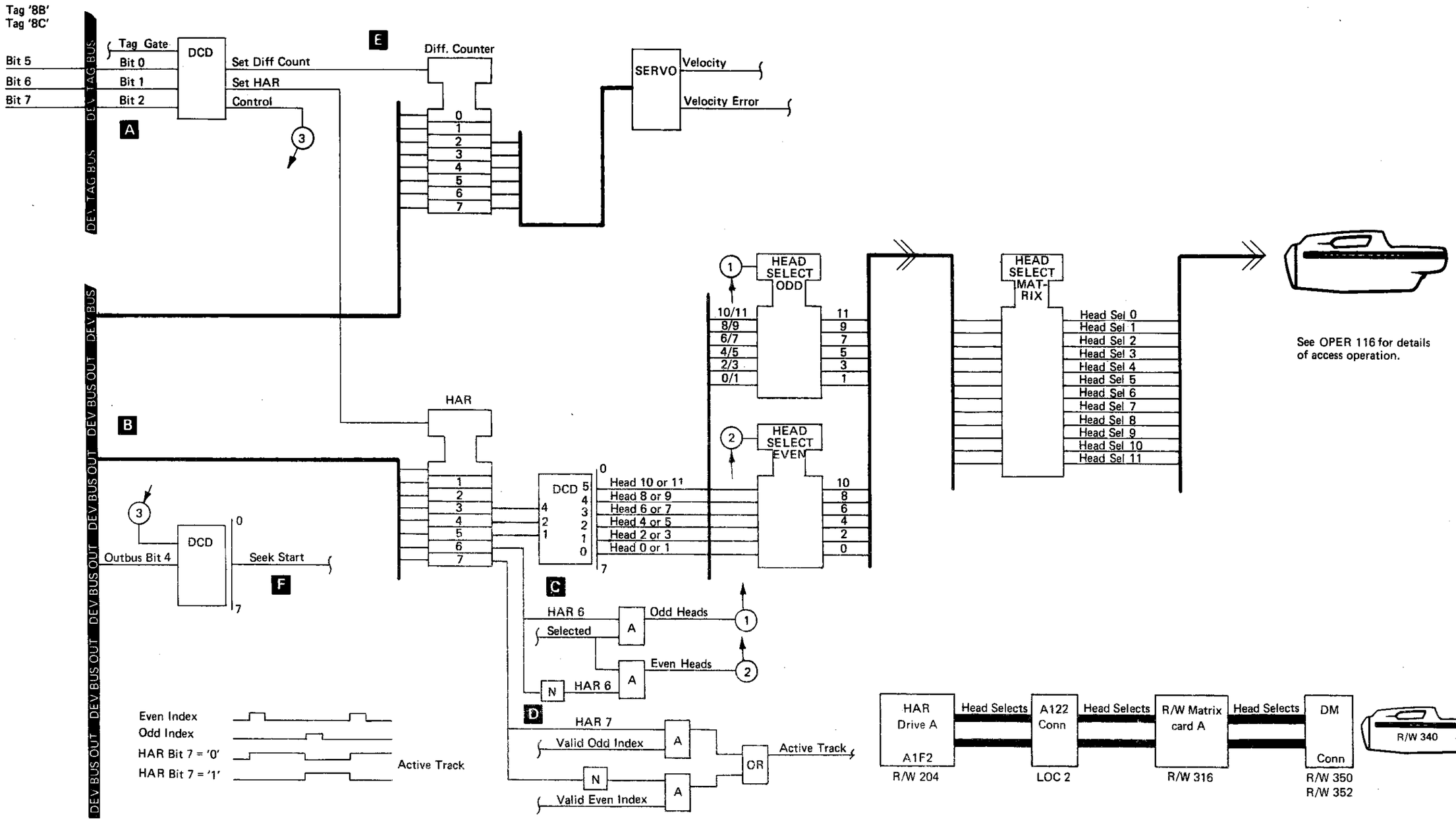
F The storage control sends a Seek Start to the drive access control to start carriage movement (see OPER 115 and ACC 600 for access operation during the seek).

SEEK ADDRESS



HAR	HAR Bit 6	Physical Head Selected	HAR Bit 7	Index Even	Index Odd	Active Track Even	Active Track Odd
00		0		x		x	
01		0	x		x		x
02	x	1		x		x	
03	x	1	x		x		x
04		2		x		x	
05		2	x		x		x
06	x	3		x		x	
07	x	3	x		x		x
08		4		x		x	
09		4	x		x		x
0A	x	5		x		x	
0B	x	5	x		x		x
0C		6		x		x	
0D		6	x		x		x
0E	x	7		x		x	
0F	x	7	x		x		x
10		8		x		x	
11		8	x		x		x
12	x	9		x		x	
13	x	9	x		x		x
14		10		x		x	
15		10	x		x		x
16	x	11		x		x	
17	x	11	x		x		x

SEEK OPERATION (Without FHFE)



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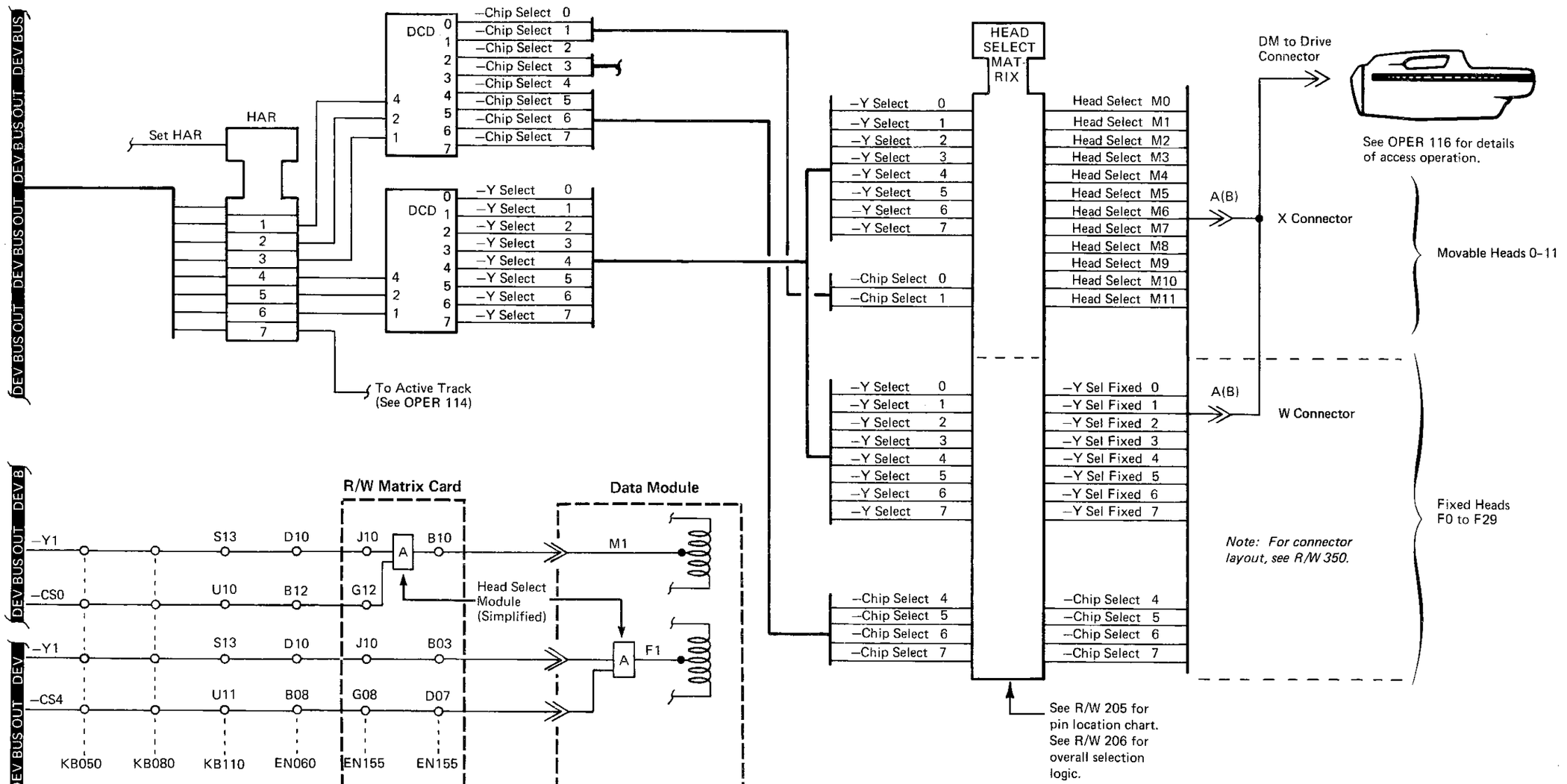
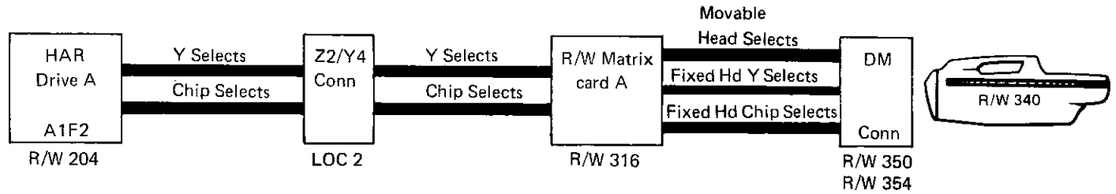
SEEK OPERATION (With FHFE)



MST Bus Out to R/W Head Selection for Fixed Head 1 (F1) and Moveable Head 1 (M1)



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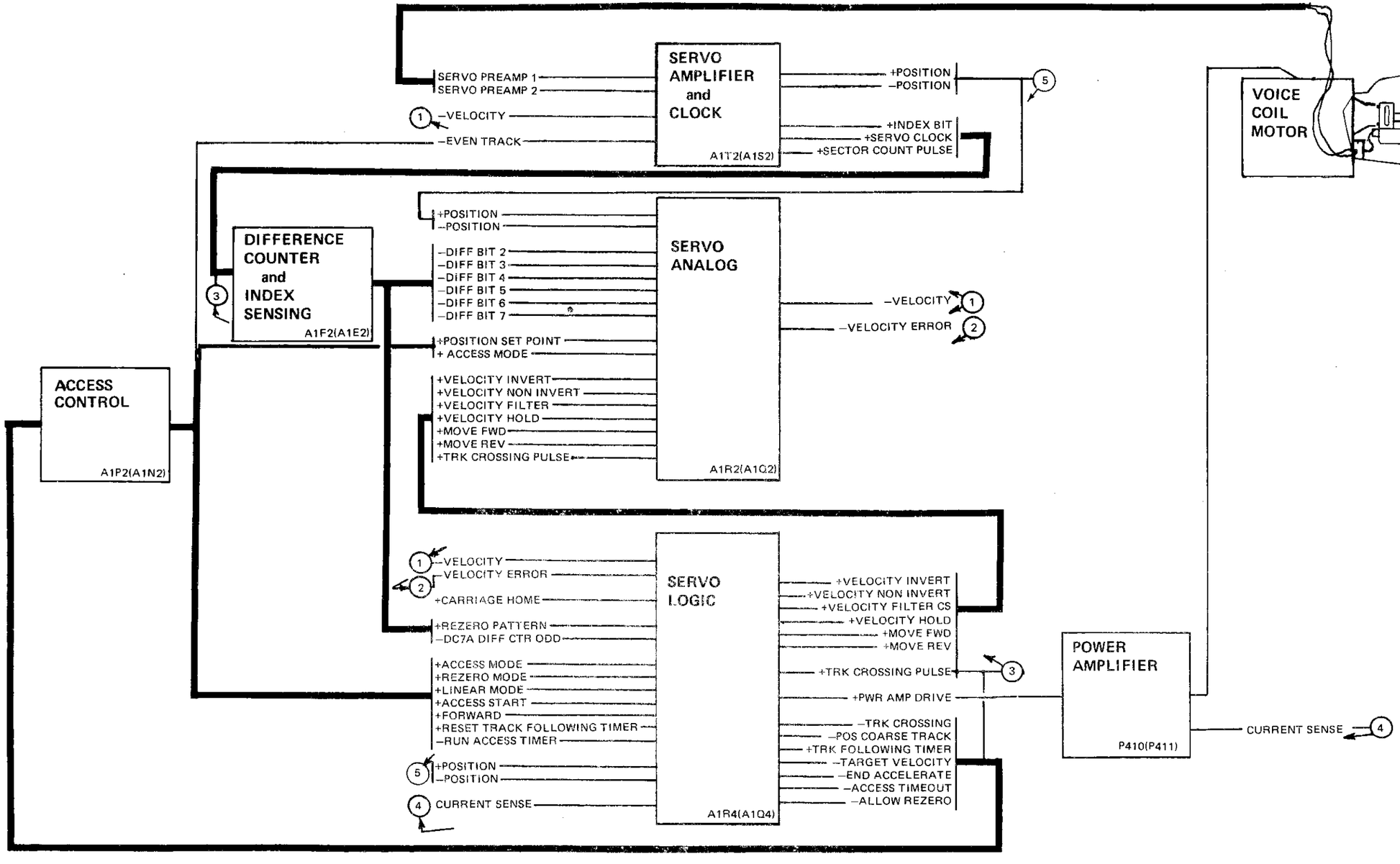
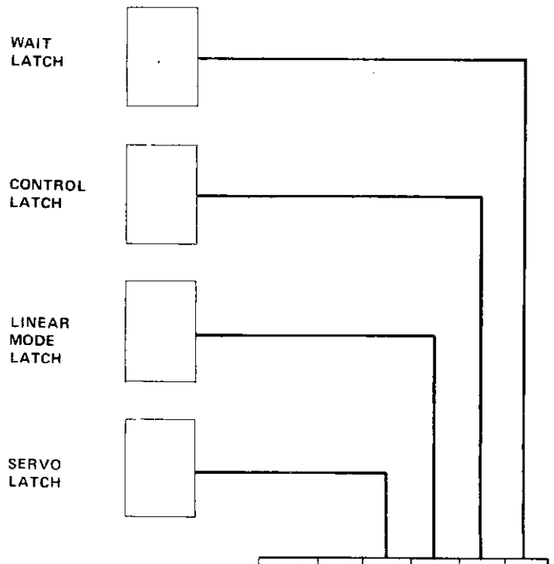
Seq. 1 of 2	Part No. ( )	5 Aug 74	14 Mar 75					



ACCESS OPERATION – CARD DIAGRAM DESCRIPTION

ACCESS CONTROL

Provides control signals for the servo logic to start operations and gives direction and speed for access movement. There are four latches that monitor the correct state of the access operation:



0²	0³	0⁴	0⁵	0⁶	1⁷				
						=	State 1	Wait State	} Reset
0	0	0	0			=	State 0	Move Out	} Rezero Operation
0	0	1	0			=	State 2	Move In	
0	1	1	0			=	State 6	Linear Mode	
1	1	1	0			=	State E	On Track	
1	0	1	0			=	State A	Accelerate	} Seek Operation
1	0	0	0			=	State 8	Decelerate	
1	1	0	0			=	State C	Linear Mode	
1	1	1	0			=	State E	On Track	

DIFFERENCE COUNTER

During Seek operations, the difference counter counts track crossings as the heads move from the start track to the target track.

INDEX DETECTOR

Identifies index patterns for index sensing and identifies the sectors for Rotational Position Sensing (RPS).

SERVO AMPLIFIER

Maintains an even signal from the servo head to develop the Position signal.

CLOCK

Provides input and timing for the PLO clock, sector counter, and index register.

SERVO ANALOG

Converts inputs of position, difference counter, and track crossings into the velocity output signal. Velocity represents the carriage speed.

SERVO LOGIC

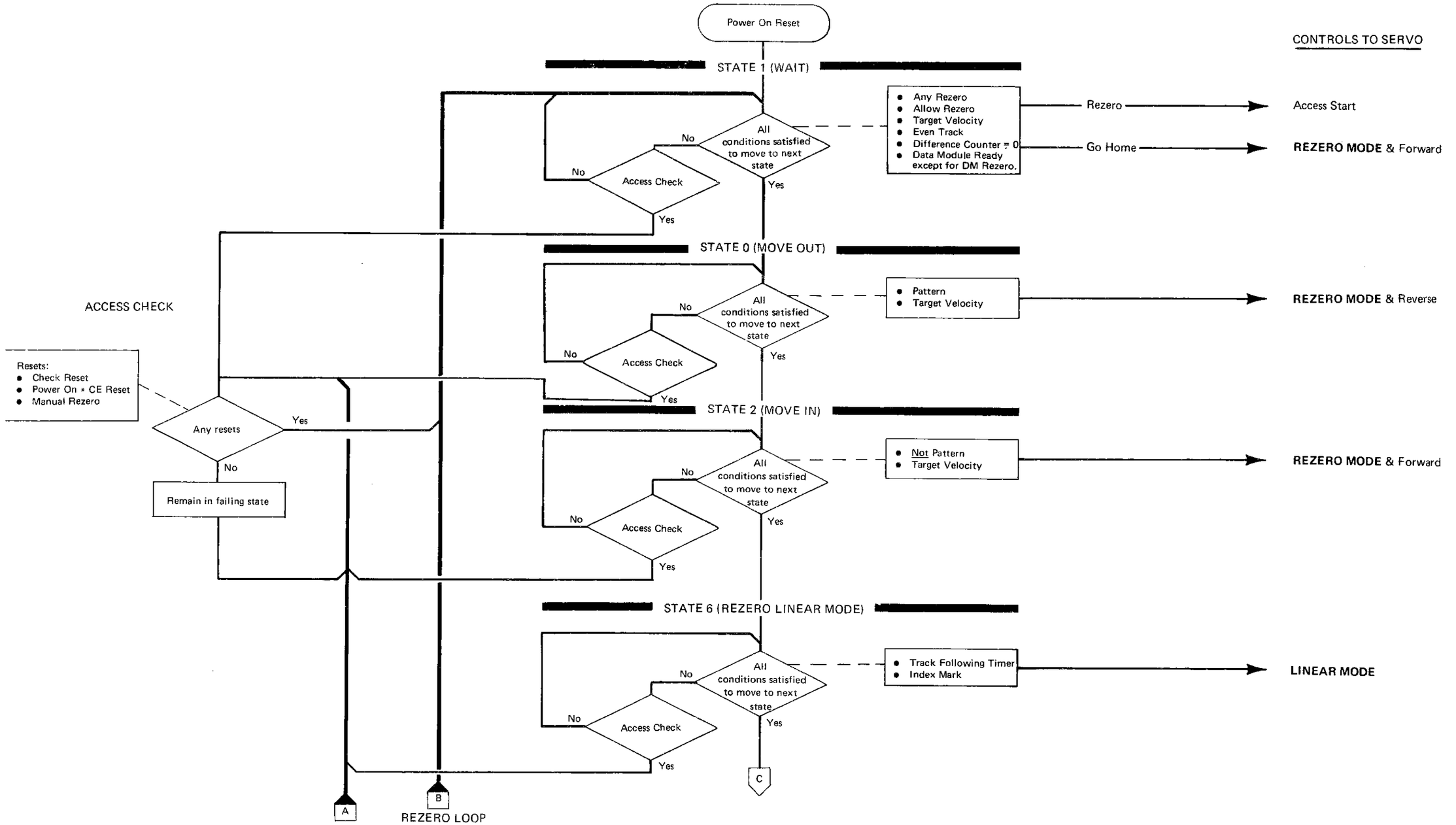
Drives the power amplifier, monitors access operations, and acts as an interface between access control and servo analog.

POWER AMPLIFIER

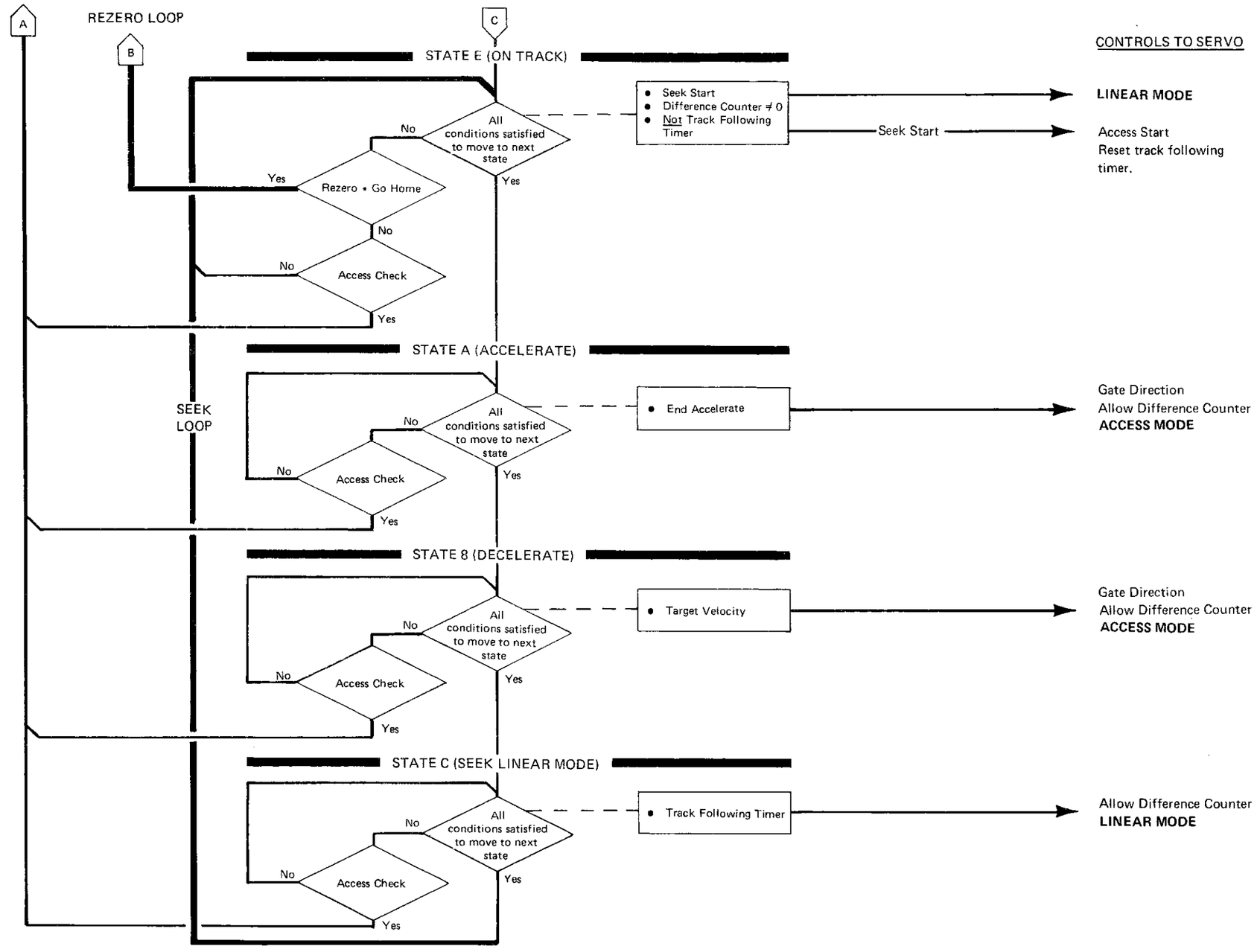
Amplifies forward- or reverse-drive current to move the voice coil.

VOICE COIL MOTOR

Hooks up to the carriage within the data module to move the heads.



ACCESS CONTROL SEQUENCE



TRACK FOLLOWING

All data heads in the data module are tied directly through the carriage to the servo head. When the servo head is on a particular track, every head is on the same track.

At the completion of a Seek or Rezero operation, the servo head locks on the correct track and continues to follow that track until a new Seek or Rezero operation is initiated.

TRACK FOLLOWING LOOP

1 The servo head picks up the servo signal.

2 The Servo Amplifier develops the composite servo signal.

A more detailed description of steps 1 and 2 is presented on OPER 124 and OPER 125.

3 The demodulator produces a voltage level (Position signal) proportional to the servo head's position over the center of the servo track.

4 The compensator uses the Position signal to generate the Position Error signal. This error signal is proportional to the distance that the servo head is off the track center.

5 During track following time, access control provides Linear Mode, which gates Position Error through the select amplifier to generate Power Amp Drive to the power amplifier.

6 The power amplifier, the final block in the loop, provides the current to the voice coil motor to move the servo head On Track.

ACCESS CHECK

A The Position signal is checked by voltage level detectors to determine when the servo head is within the proper On Track region.

B During Linear Mode, the track following timer sends a signal to access control if the heads remain On Track.

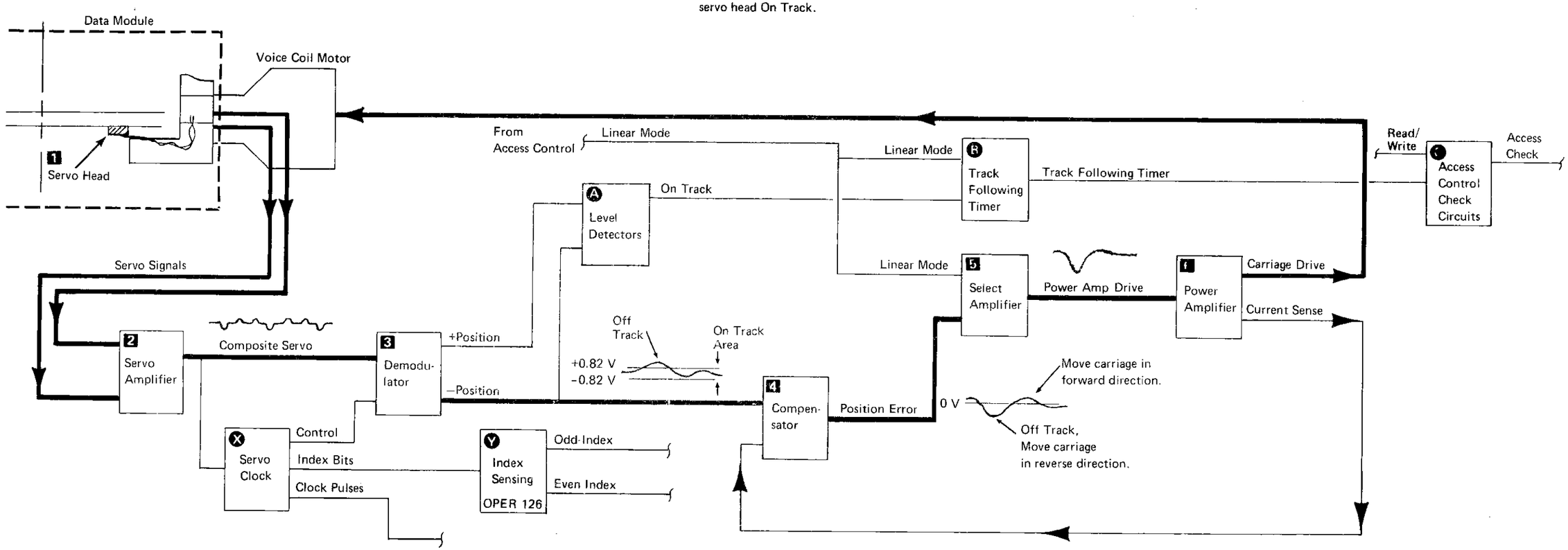
C If the track following timer signal is lost during a Read or Write operation, a Servo Off Track access check is posted.

SERVO CLOCK (X)

The Servo Clock develops clock pulses to synchronize Read/Write operations to the disk and access control lines. The clock also detects Index bits from the composite servo signal. Reference OPER 42.

INDEX SENSING (Y)

Using the Index bits from the servo clock, the index sensing circuit determines when the servo head passes over an odd or even Index. (See OPER 126 for a more detailed description of index detection.)



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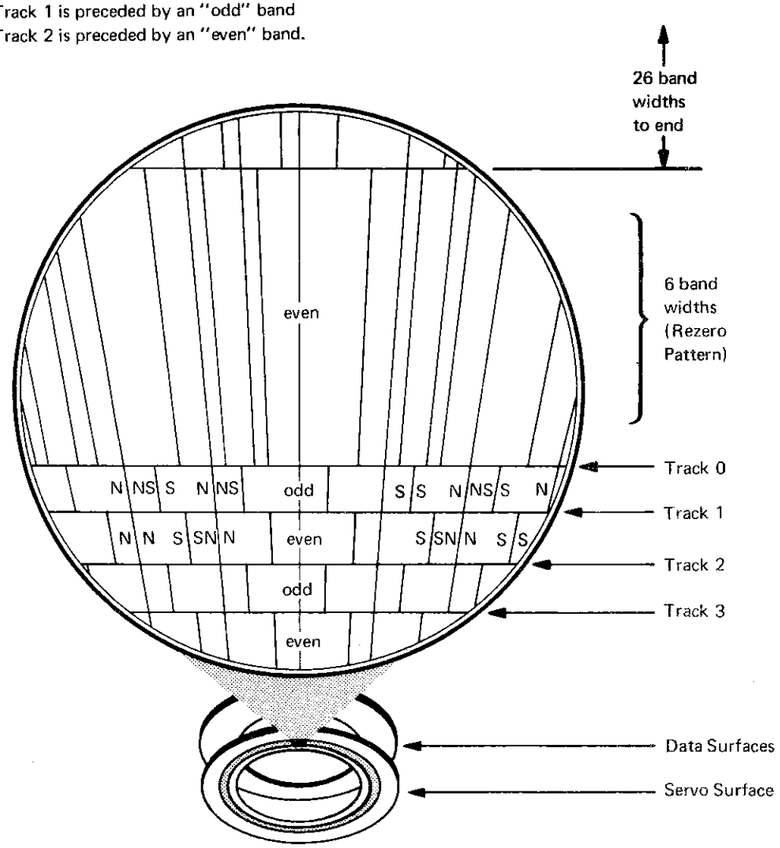
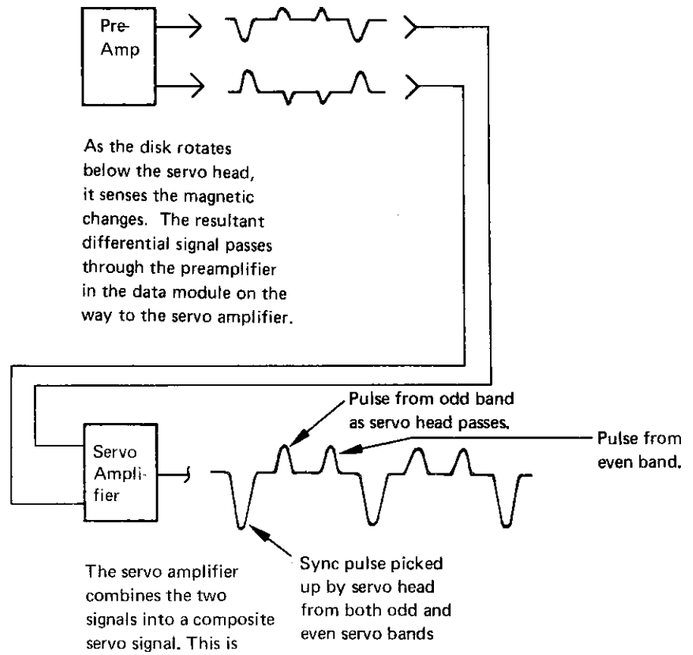
TRACK FOLLOWING

In order for the servo head to be able to track follow, the servo surface of the data module has the following format:

- 350 tracks between special prerecorded bands.
- Bands are either "odd" or "even" and arranged alternately, one even, one odd.
- Bands are recorded like bar magnets, end-to-end, with north and south poles.
- Odd-numbered tracks are preceded by odd bands; even-numbered tracks by even bands, so that:

  Track 1 is preceded by an "odd" band
  Track 2 is preceded by an "even" band.



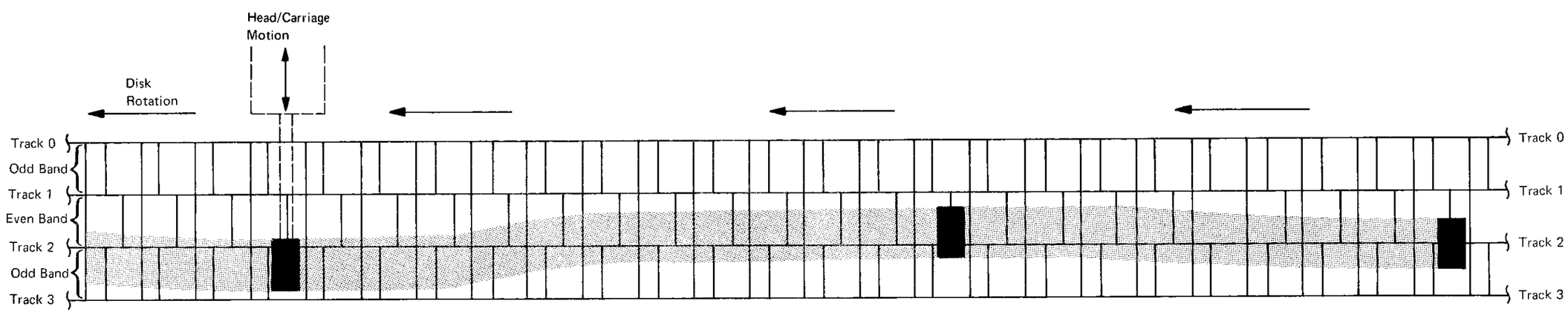


As the disk rotates below the servo head, it senses the magnetic changes. The resultant differential signal passes through the preamplifier in the data module on the way to the servo amplifier.

The servo amplifier combines the two signals into a composite servo signal. This is the basic pattern used by the servo circuits for track following. (Continued on OPER 125.)

TRACK FOLLOWING

When the servo head is exactly between an "odd" and an "even" band, it is *On Track*. In this example, the head is attempting to follow track 2. As the disk rotates under the head, the carriage tries to keep the head on the track center.



If, for instance, the track is not concentric and/or the head drifts off the track center toward the spindle (toward track 3), the composite servo signal becomes unbalanced.

The level of this pulse is higher because more current is induced from the odd servo band than from the even band.

As the head drifts (away from the spindle), it crosses the center of the track and the composite servo signal is balanced.

As the head continues in this direction, the signal is unbalanced again and the servo system recognizes the off-track condition,

and this pulse becomes higher than the other one.

When the servo system recognizes an off-track condition, it moves the carriage in the proper direction to balance the composite servo signal to keep the head On Track.

AY0160 Seq. 2 of 2	2747680 Part No. ( )	440203 2 Nov 73	440204 21 Dec 73	440214 17 Jun 74				

INDEX DETECTION

In order for a Read or Write operation to begin at the correct location, a reference point is needed to indicate the start of a particular track. This is called an Index point.

Since each physical track on the data module has two Indexes, one odd and one even, (see OPER 12), the system must be able to recognize not only an Index point, but also whether it is even or odd.

As the disk rotates, the servo head picks up the servo pattern. The composite servo pattern is shown in Figure 1. At the start of an Index (Figure 2), the head picks up an extra sync bit **1**, and a one (1) is decoded by the index detection circuits (RPI 102).

The rest of the Index is decoded:

Even Index = 1 0 1 1

Odd Index = 1 1 0 1

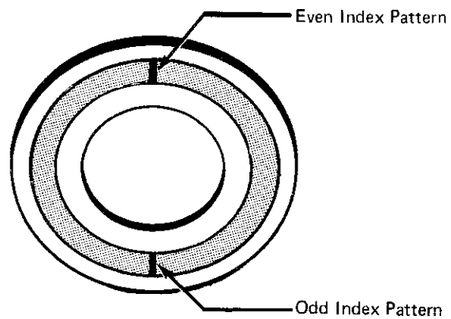


FIGURE 1

Normal Composite Servo Signal

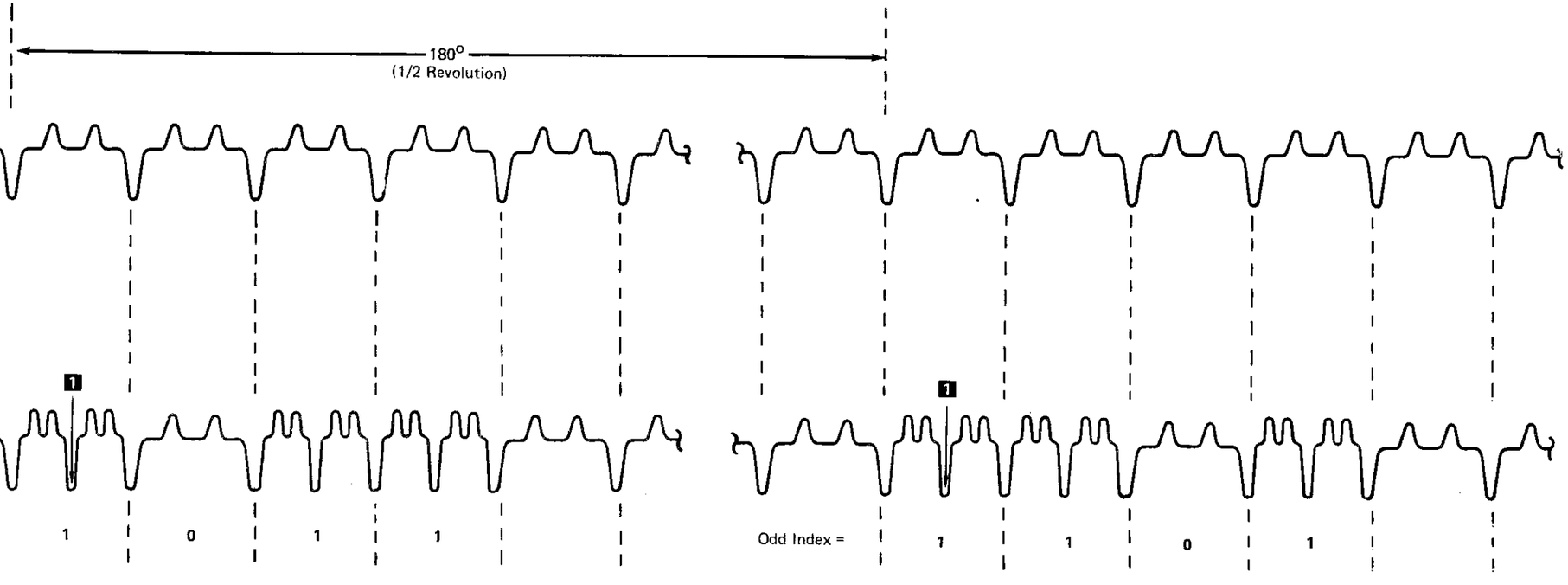
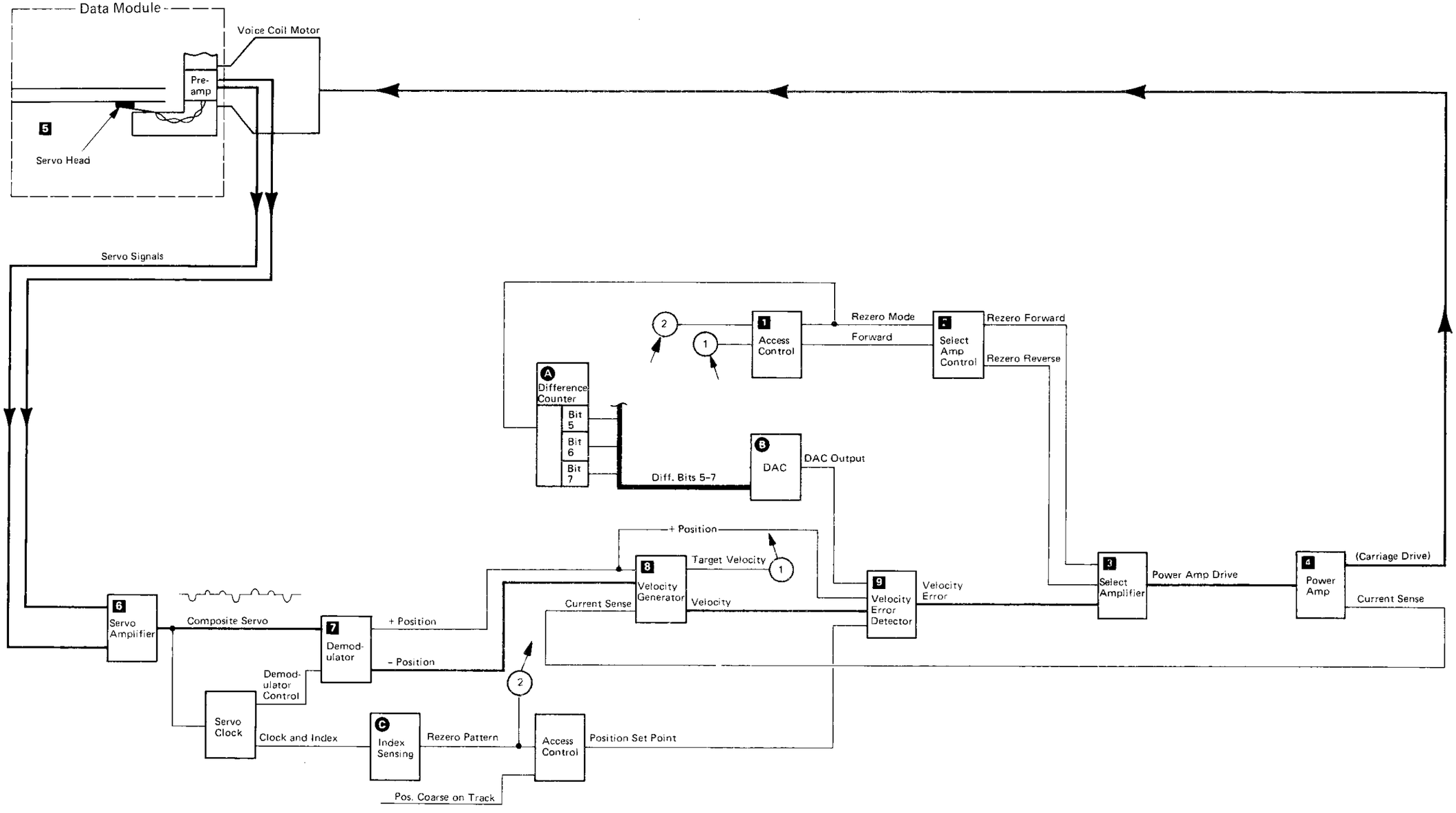


FIGURE 2

Index Patterns

REZERO - FUNCTIONAL BLOCK DIAGRAM



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REZERO (Continued) - BLOCK DIAGRAM DESCRIPTION

The Rezero operation is necessary to establish (or re-establish) a reference point for access control. Rezero causes the carriage to: (1) move out from the center of the disk, past track 000, (2) turnaround, (3) move slowly in the direction of the spindle, and (4) stop and track follow on track 000.

A Rezero operation begins as a result of one of these conditions: data module loaded; a Recalibrate command under program control; or by someone pushing the Rezero pushbutton on the operator panel.

Any rezero to access control 1, causes Rezero Mode to be sent to the select amp control and to the difference counter (A). Rezero Mode at the difference counter forces a difference count of 7 into the Digital-to-Analog Converter (B) to move the carriage at a fixed-velocity of 12 in/sec.

If the servo head is located between track 000 and the inner crash stop, access control drops Forward. If the head is in the rezero pattern area (track 000 to track – 21), Forward is up. For this example, assume that the head is at the inner crash stop at power on time and Forward is down. See Figure 1 for waveform references.

With Rezero Mode and Not Forward as input, the select amp control 2 sends Rezero Reverse to the select amplifier 3, which provides Power Amp Drive for the power amplifier 4 to start the carriage moving outwards from the center of the disk towards track 000.

The servo head 5 picks up the servo signal and sends it through the pre-amp and servo amplifier 6 to the demodulator 7.

At the output of the demodulator, the Position signal reflects track crossings used by the velocity generator 8 to calculate the velocity of carriage movement.

When the rezero pattern is picked up by the servo head between track 0 and track –1 and decoded by the index sensing circuits (C), access control sends Position Setpoint to the velocity error detector 9. (See OPER 131 for a detailed description of rezero pattern detection.) Position Setpoint controls the carriage speed by gating +Position to the velocity error detector. Carriage velocity decreases to 3 in/sec because of the decrease in voltage (from +Position) into the velocity error detector.

As the carriage approaches track –6, the +Position signal amplitude begins to drop, causing the velocity of the carriage to decrease proportionately. When velocity reaches 0.5 in/sec, Target Velocity comes on and at the same time, the servo pattern changes from even to odd. (See OPER 124.)

When access control 1 senses Target Velocity, it sends Forward to the select amp control 2 which in turn sends Rezero Forward to the select amplifier 3.

The Pos Coarse On Track signal comes up when the servo head is in the Coarse On Track area of track –6.

Forward and Pos Coarse On Track gate DAC Output long enough to start the carriage moving forward toward track 0. When Pos Coarse On Track drops, Position Setpoint again takes control of the motion.

As the carriage approaches track 0, the Position Signal begins to drop, Target Velocity comes back on when the velocity equals 0.5 in./sec, and the access enters Linear Mode to begin track following.

If the Rezero operation begins when the carriage is at or near track 000, the sequence is the same but the signal waveforms are more like those in Figure 2.

Note: For this operation, the Rezero starts at (X).

See ACC 431 for details.

Figure 1

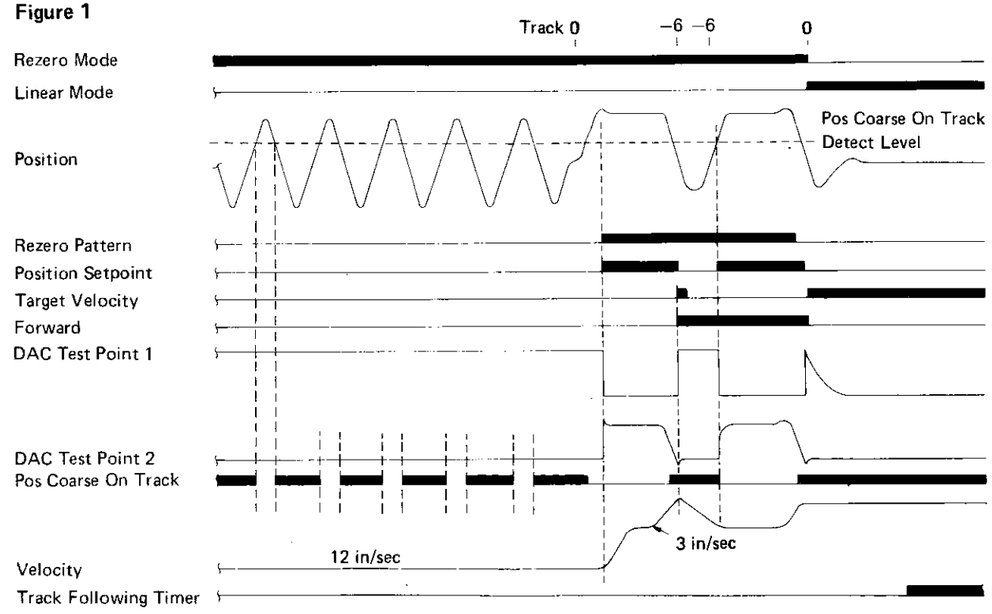
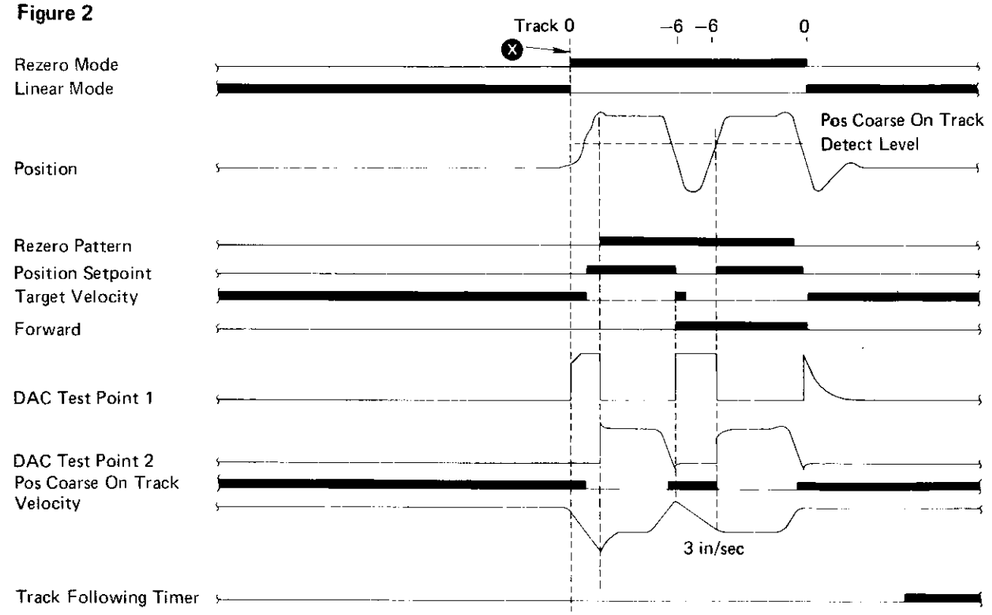
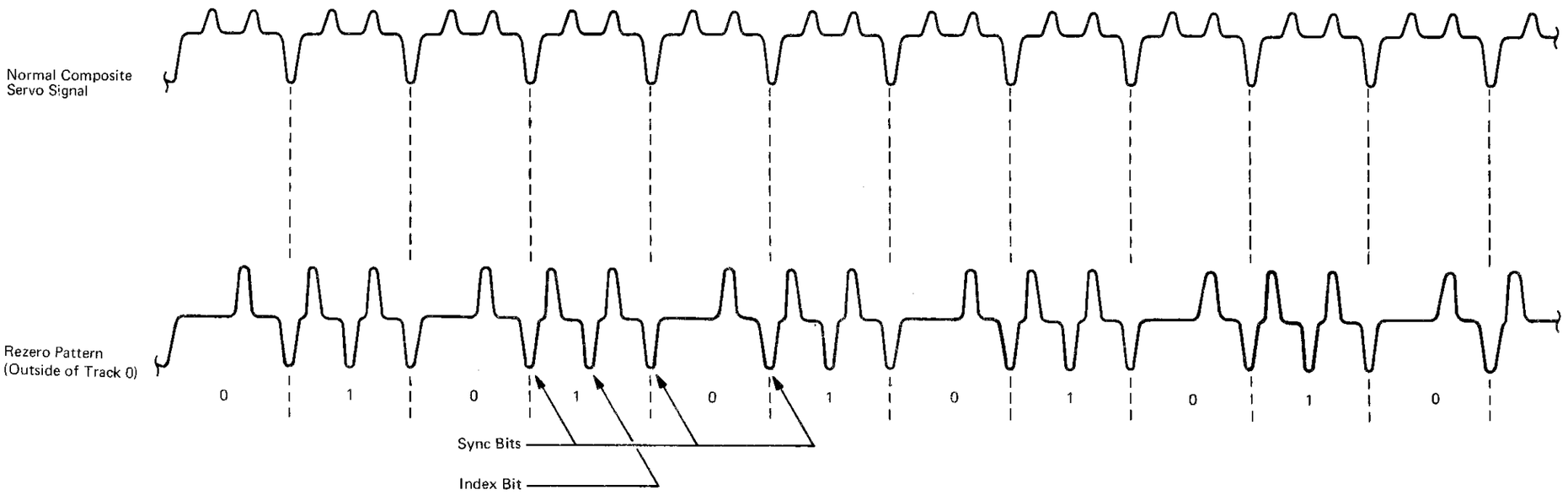


Figure 2



REZERO PATTERN DETECTION

When the servo head enters the rezero area, the Composite Servo signal contains additional information. In the waveform comparisons below, every other cycle of the rezero pattern has an extra bit (Index bit) between the normal sync bits. If each Index bit = 1, the pattern is decoded as 0 1 0 1 0 1 0 and so on. (See also RPI 102)



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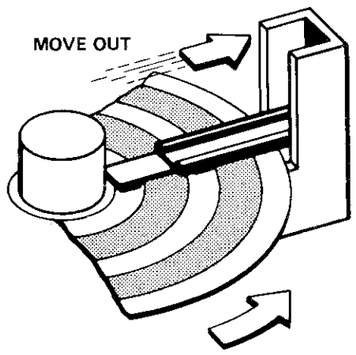
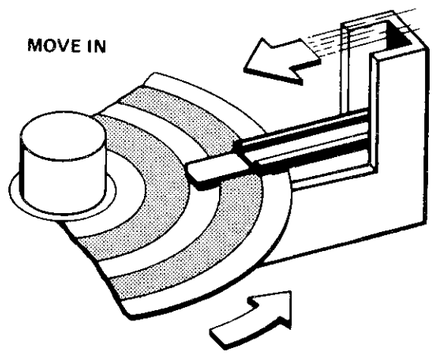
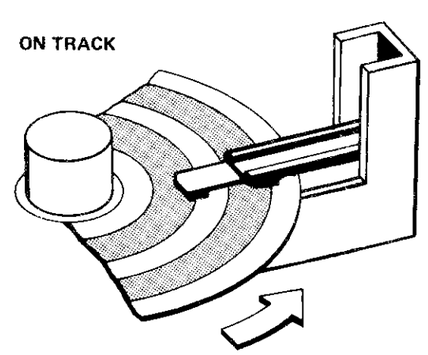
ACCESS OPERATION (REZERO) **OPER 136**







WAIT (STATE 1)

- Access Control is reset.
- Difference Counter is reset to zero, but difference bits 5, 6, and 7 are brought up by Rezero Mode and gated to the DAC. The DAC output is proportional to the difference count. Therefore, the carriage moves out during State 0 at a constant velocity.

MOVE OUT (STATE 0)

- The carriage moves in reverse (out toward the edge of the disk) at a constant velocity of approximately 11 inches per second.
- The carriage slows down when the Rezero pattern area is detected (past track 000).
- Target Velocity is detected at track −006 and the carriage is conditioned for turnaround.

MOVE IN (STATE 2)

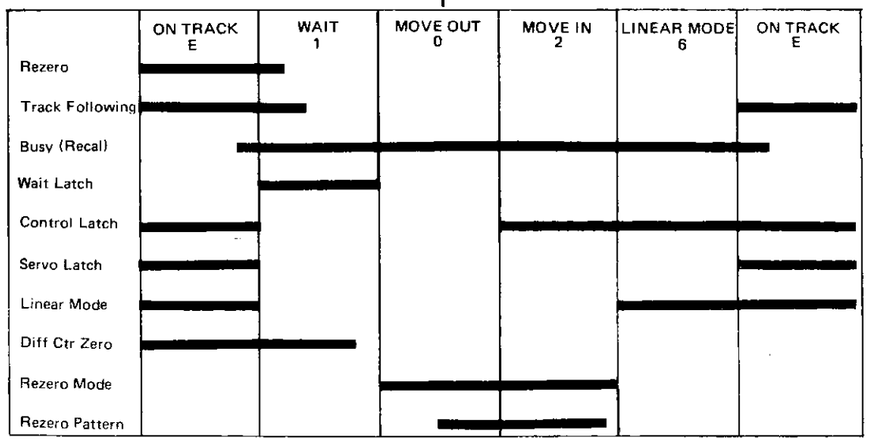
- A short burst of current to the Power Amp reverses the carriage momentum.
- The carriage is now moved slowly forward to track 000.

LINEAR MODE (STATE 6)

- When the carriage is within 250 microinches of track 000, it begins Track Following.
- Search for Index Mark.

ON TRACK (STATE E)

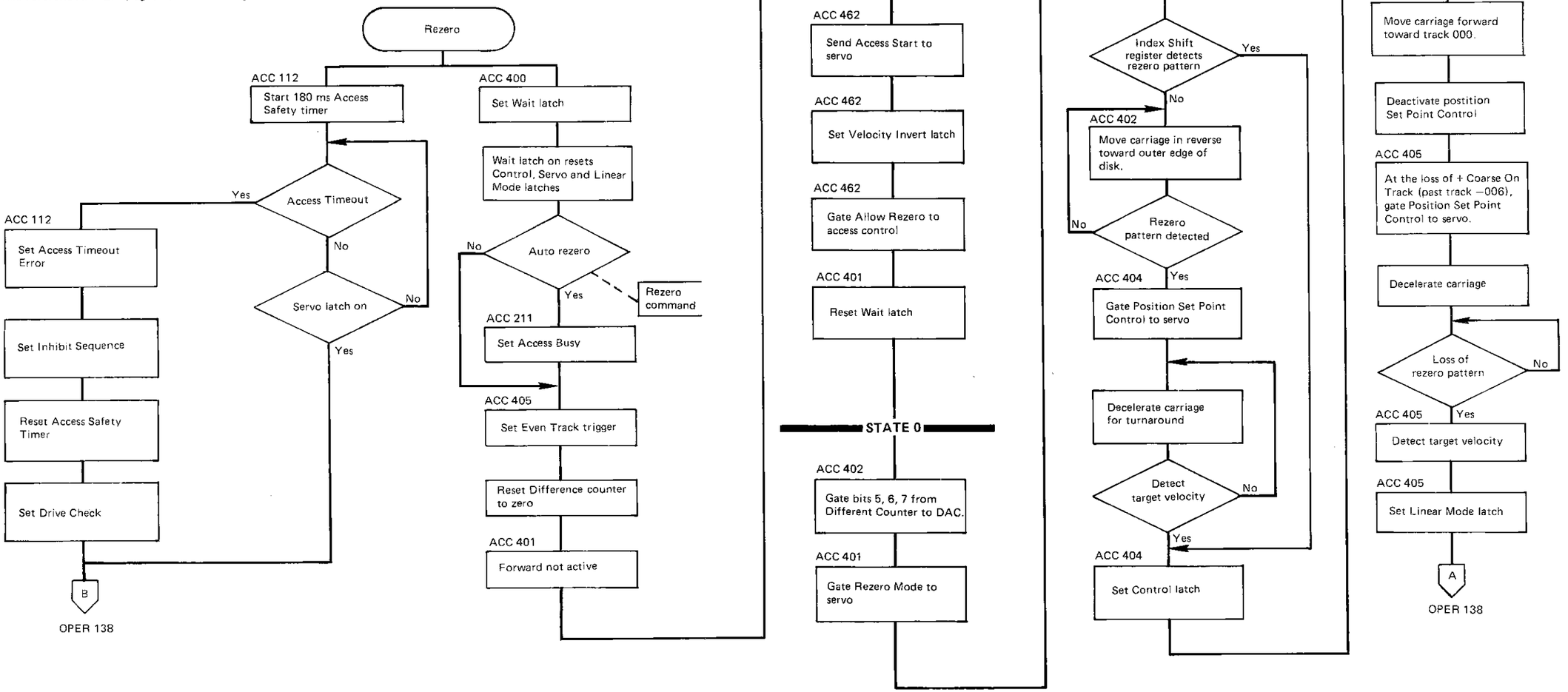
- Index Mark is detected.
- Access Complete is set.
- The drive Ready lamp comes on.



ACCESS OPERATION (REZERO) OPER 136

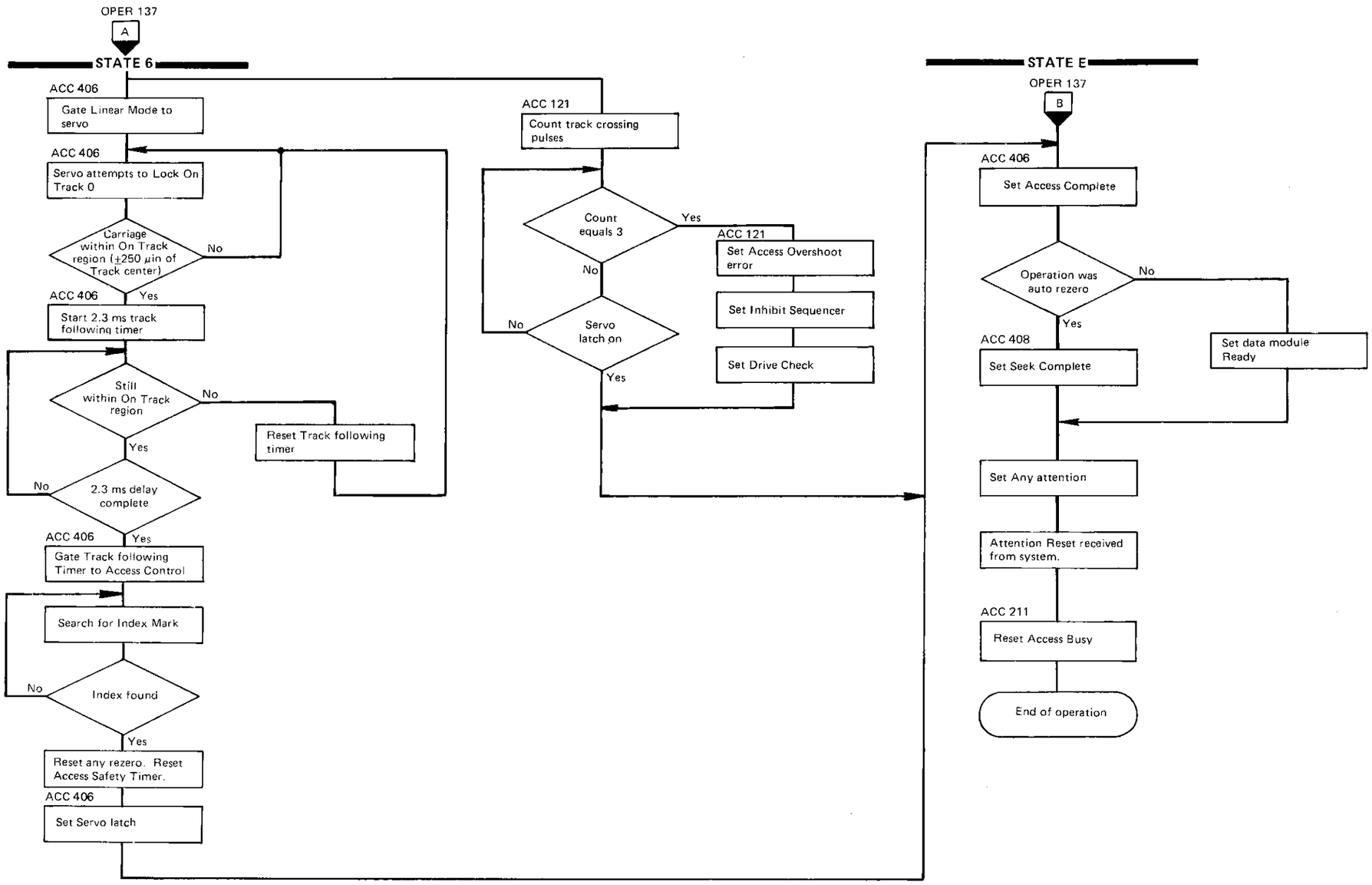
ACCESS OPERATION (REZERO FLOWCHART)

See ACC 430 for servo block diagram.
See referenced MLM pages for circuit diagrams.



ACCESS OPERATION (REZERO FLOWCHART)

See ACC 430 for servo block diagram.
See referenced MLM pages for circuit diagrams.



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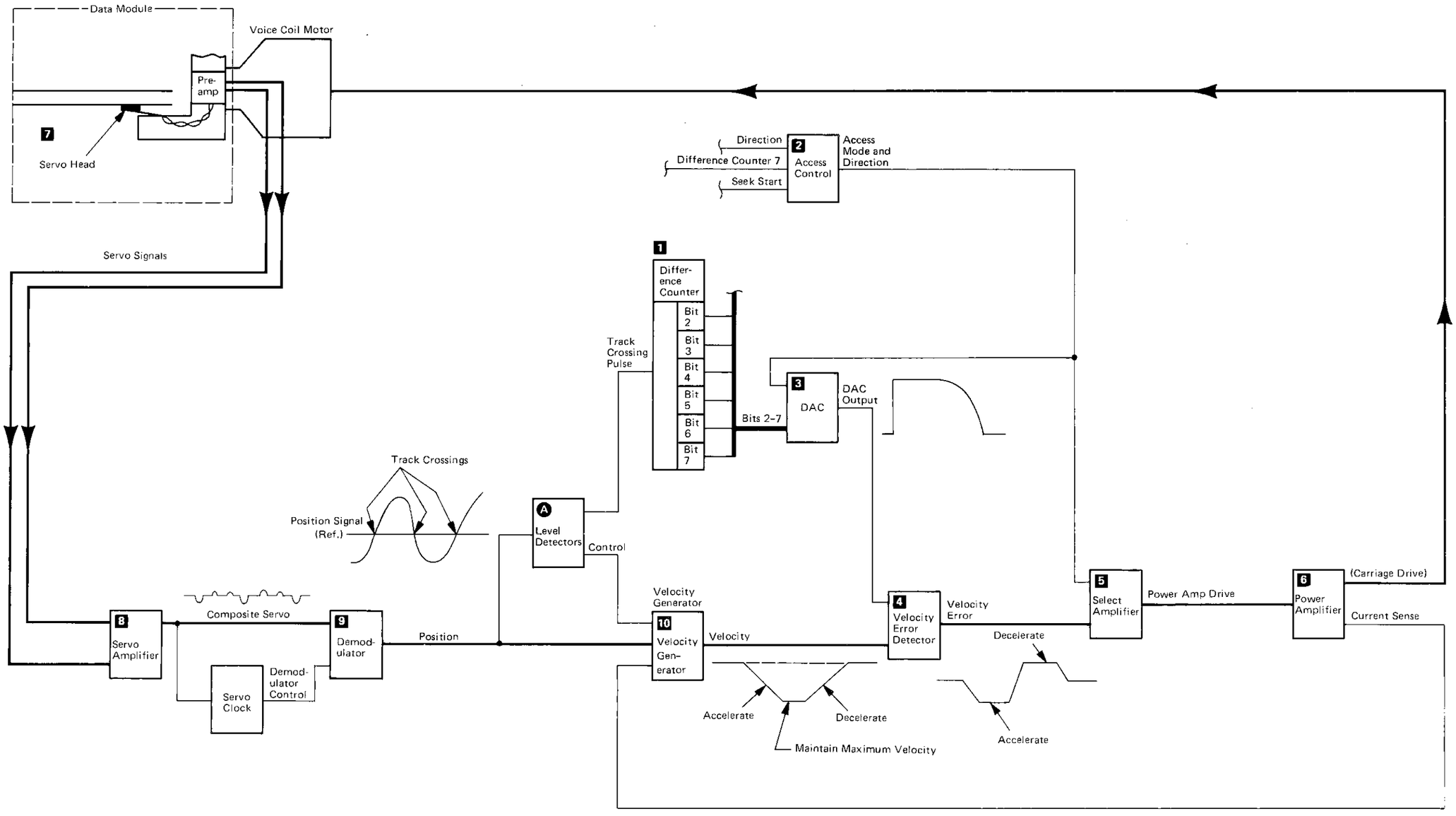

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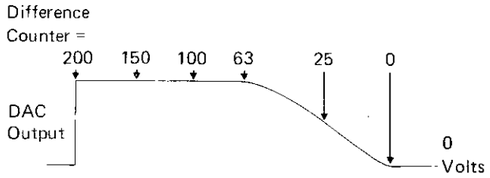
SEEK (Continued) - DESCRIPTION OF BLOCK DIAGRAM

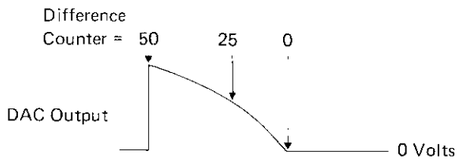
A Seek command causes the carriage to move from one physical track to another by first loading the difference between the current carriage address and the new carriage address into the difference counter. It then places the new head address and direction of the Seek (forward or reverse) in the Head Address Register (HAR). The carriage is moved the correct number of tracks to the new location and track follows on the new track.

The operation begins after the difference counter **1** is loaded and access control **2** sends Access Mode and the direction of the Seek to the servo circuits. This allows the DAC **3** (Digital-to-Analog Converter) to set the speed of the carriage.

If the difference counter has a value of 63 or above, the DAC output voltage is at its maximum point. During the Seek, as the difference counter decrements, the DAC output remains at maximum until the count reaches 63. At that time, the DAC output voltage begins to decrease proportionately to the value in the difference counter. This is done to keep the maximum carriage speed (velocity) at 30 inches per second. As a result, if the difference counter is 200 at the start of a Seek, the DAC Output signal curve is:



If the Seek starts with a difference count of less than 63 (for example 50), the curve is more like the following:



The output of the velocity error detector **4**, Velocity Error, is the sum of DAC Output and Velocity. Velocity Error feeds the select amplifier **5** which feeds a voltage signal to the power amplifier **6** to drive the carriage toward the target track.

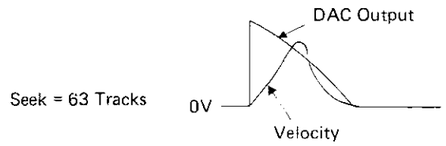
As the servo head **7** moves across the tracks, the servo signal is fed through the servo amplifier **8** to the demodulator **9** where the resulting output Position signal reflects the frequency of the track crossings.

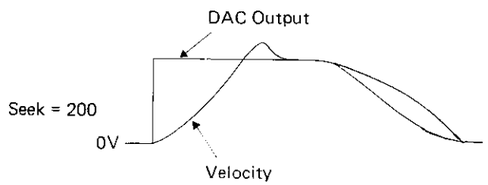
The level detectors **A** use the Position Signal to develop the Coarse On Track and Fine On Track signals, and from them, the Track Crossing Pulse. (See Figure 1 for the relationship of these signals to each other.)

The velocity generator **10** also uses the Position signal to determine the speed of the carriage and sends the Velocity signal to the velocity error detector.

The velocity error detector takes DAC output and the Velocity signal, sums them together algebraically, and produces Velocity Error. DAC output represents an ideal carriage velocity; Velocity is the actual velocity of the carriage. The figures below show the Velocity signal superimposed on the DAC output signal to show their relationship for two different length seeks.

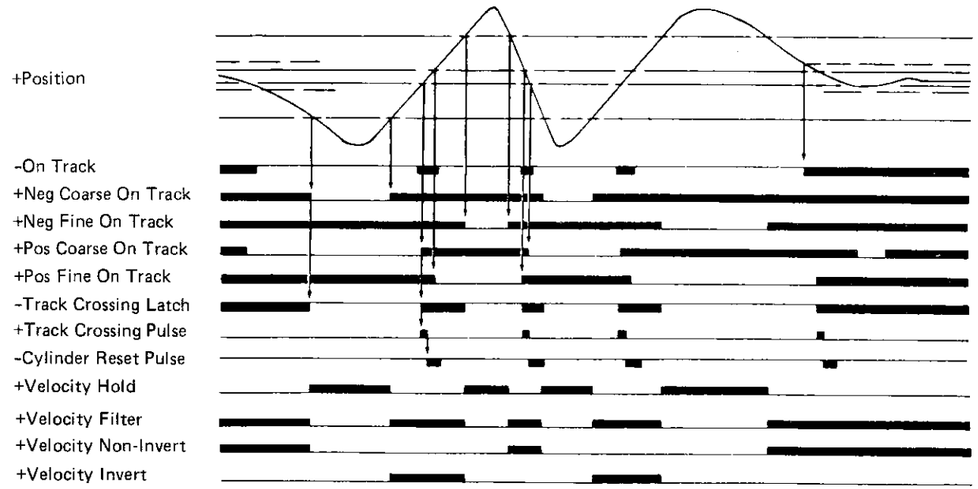
Note: The Velocity signal is inverted in this illustration to show the relationship.

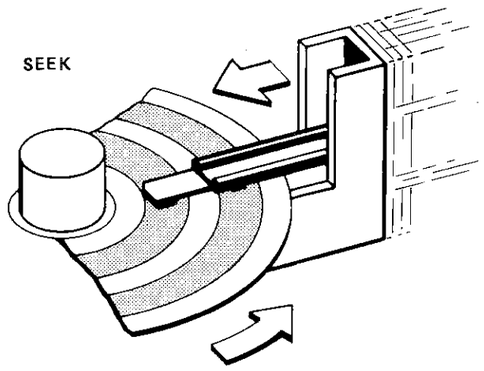


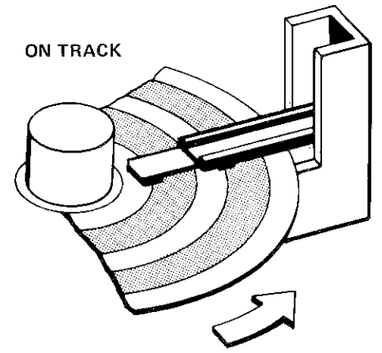


When the Velocity signal becomes greater than the DAC output, reverse current is applied to the VCM to slow down the carriage. As the difference counter decrements, the carriage continues to slow down until the target track is reached. At that point, the carriage stops, access control goes to Linear Mode, and the servo system begins track following on the new track.

Figure 1.







ON TRACK (STATE E)

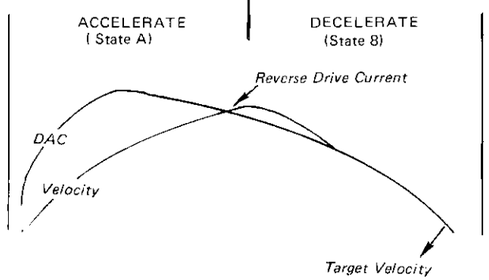
- The selected drive is Ready and Track Following.
- The access control receives the Seek Start command.
- This resets the on track mode of operation and advances the access control to State A.

ACCELERATE (STATE A)

- During State A, full current is applied to the voice coil motor to accelerate the carriage toward the desired track.
- The measured carriage velocity is compared constantly to the DAC output and when their sum produces a null, a decelerate Error Drive signal is sent to the Power Amplifier.
- This indicates that the carriage is going as fast as required for the length of the specific seek in operation.
- VCM current is now reversed to slow down the carriage.
- When the VCM slow down current is sensed, the access control advances to State 8.

DECELERATE (STATE 8)

- During this state the servo controls the carriage velocity to slow it down until it stops directly on the target track.
- The Difference Counter is decremented each time the servo head crosses a track.
- The DAC output is proportional to the Difference Counter value.
- Therefore, the DAC output controls the rate of change of carriage deceleration.
- The comparison of DAC and measured velocity generates the Error Drive signal that allows the carriage to coast or slow down.
- When the carriage has decelerated to a velocity of less than 0.5 in/sec (Target Velocity), the access control advances to State 6.

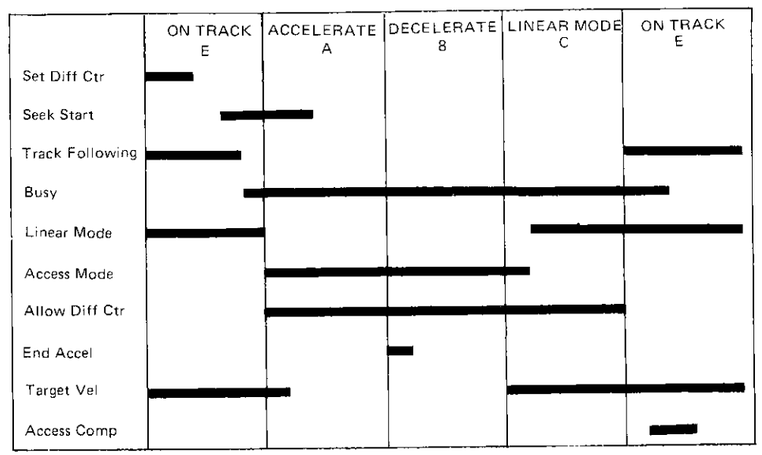


LINEAR MODE (STATE C)

- The Power Amp is now driven by the Compensator in a linear mode.
- When the carriage is within 250 microinches of the target track, it begins Track Following.

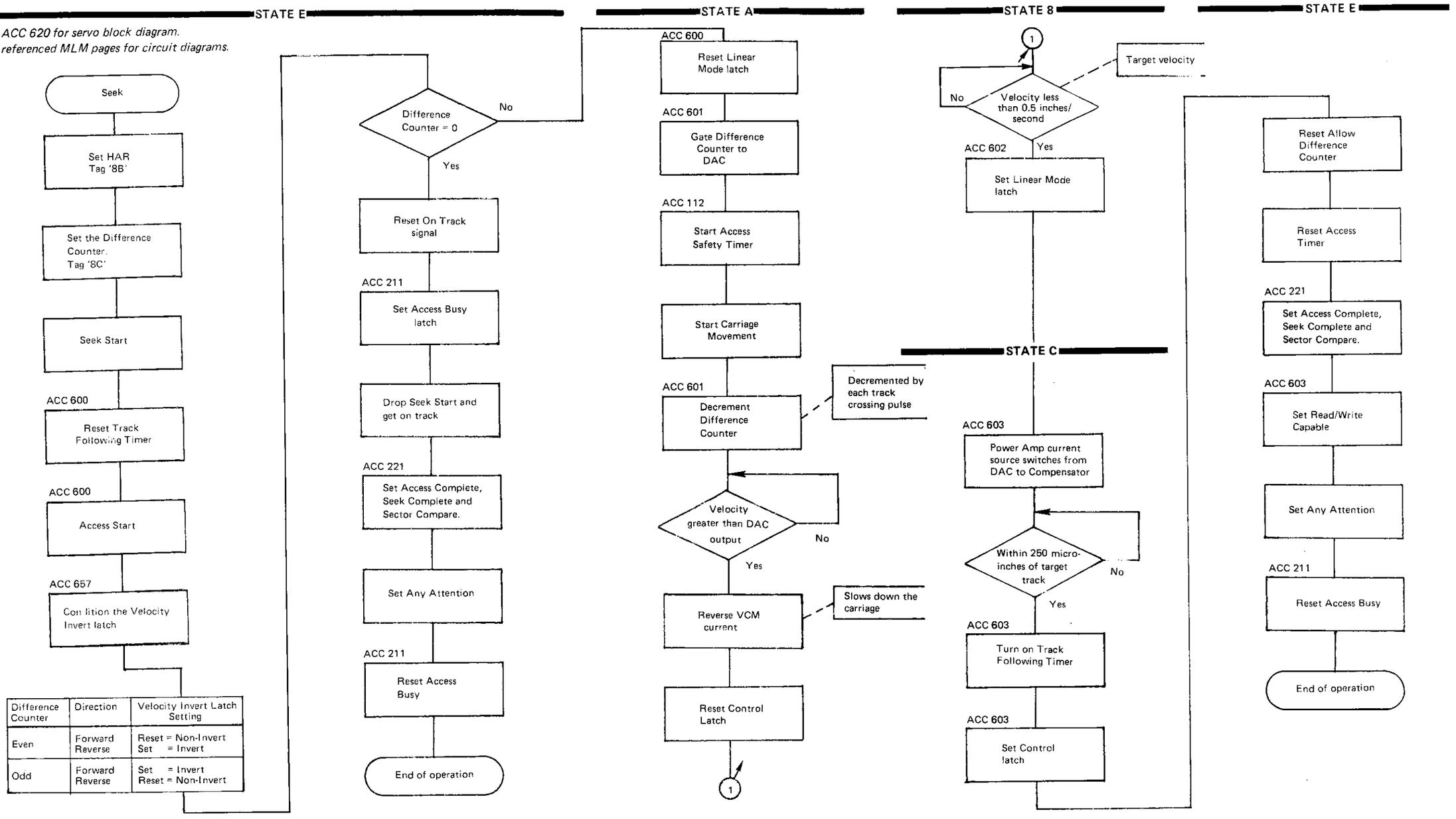
ON TRACK (STATE E)

- When the carriage has stayed within the track following region for at least 2.3 milliseconds, the Track Following Timer is activated.
- This indicates that the heads are within the physical limits to allow safe reading and writing.
- The timer stays active as long as the carriage stays withing the track following region.
- Seek is completed.



ACCESS OPERATION (SEEK FLOWCHART)

See ACC 620 for servo block diagram.
See referenced MLM pages for circuit diagrams.



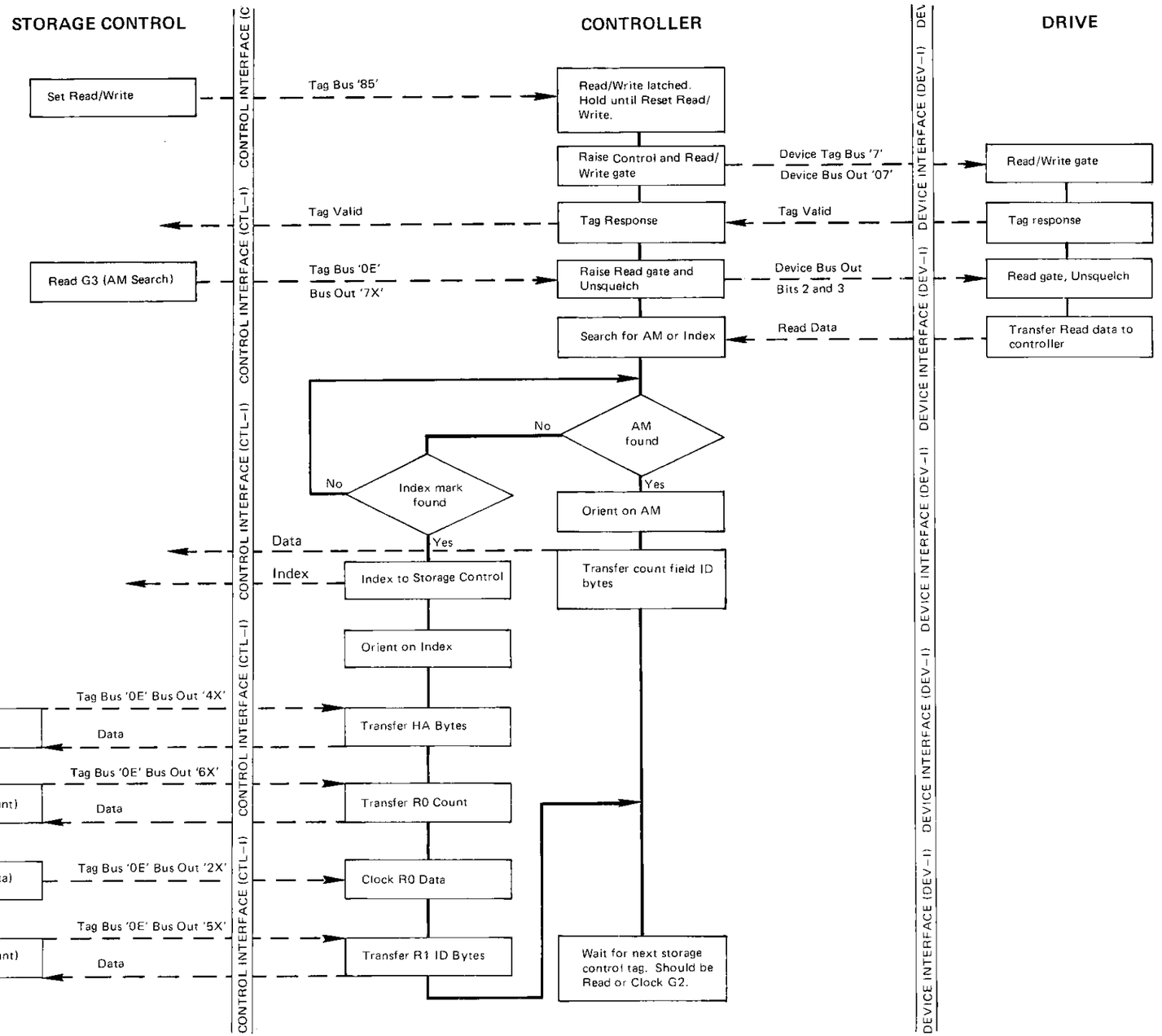
SEARCH ID EQUAL

Storage control compares data from the system with data read from the module. (The ID bytes for Search HA or Search ID; Key field bytes for Search Key).

Only one record is operated on for each Search command.

When search is unsuccessful, the channel must reissue the command. This is done by the use of a Transfer in Channel (TIC) back to the Search command.

When the search is successful, the Status Modifier bit in the CSW is set on. This causes the channel to skip the next CCW (TIC) in the chain.



When Index is sensed during an AM search, this sequence of operations is performed to maintain orientation and read the R1 Count field. If the second active index is sensed before the search is successful, No Record Found is set. (Sense byte 1, bit 4. Reference OPER 234.)

READ/WRITE CONTROL

This page describes how the Set Read/Write Operation conditions the 3340 for a data transfer. Additional detail and related information can be found on the following pages:

Set and Reset Read/Write Operations (Tags '85' and '05')
- Description - - - - - - - - - - - - OPER 213
- Circuit Diagram - - - - - - - - - - OPER 214
- Timing
  - Set Read/Write Operations - - - - - - OPER 217
  - Reset Read/Write Operations - - - - OPER 218

Write Operation - - - - - - - - - - - - OPER 225
Read Operation - - - - - - - - - - - - OPER 230
Control and Device Interface Summary - - - OPER 101

A The Set Read/Write Op (Tag '85') conditions the controller and the drive for a data transfer between the drive and the storage control.

Both the controller and the drive must be selected prior to issuing the Set Read/Write Op.

B Set Read/Write Op is latched in the controller and remains active until a Reset Read/Write Op (Tag '05') is issued or until the controller is reset by the storage control.

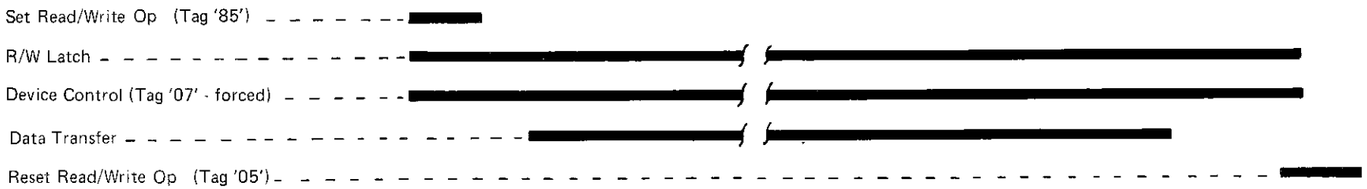
C The data controls, such as SERDES, PLO/VFO, etc., are conditioned by the Set Read/Write Op. The actual transfer of data is controlled by a Read Op (Tag '0E') or a Write Op (Tag '0F').

D To enable the Read/Write controls in the drive, Device Bus Out bits 5–7 and all Device Tag Bus bits are forced to the active state. These conditions are forced by the Set Read/Write Op in the controller.

E The controller uses Device Bus Out bits 0–4 to set up different read and write controls in the drive during the data transfer.

F The Set Read/Write Op establishes a data transfer interface between the controller and the drive.

TIMING (Not Accurate -- for Description Only)



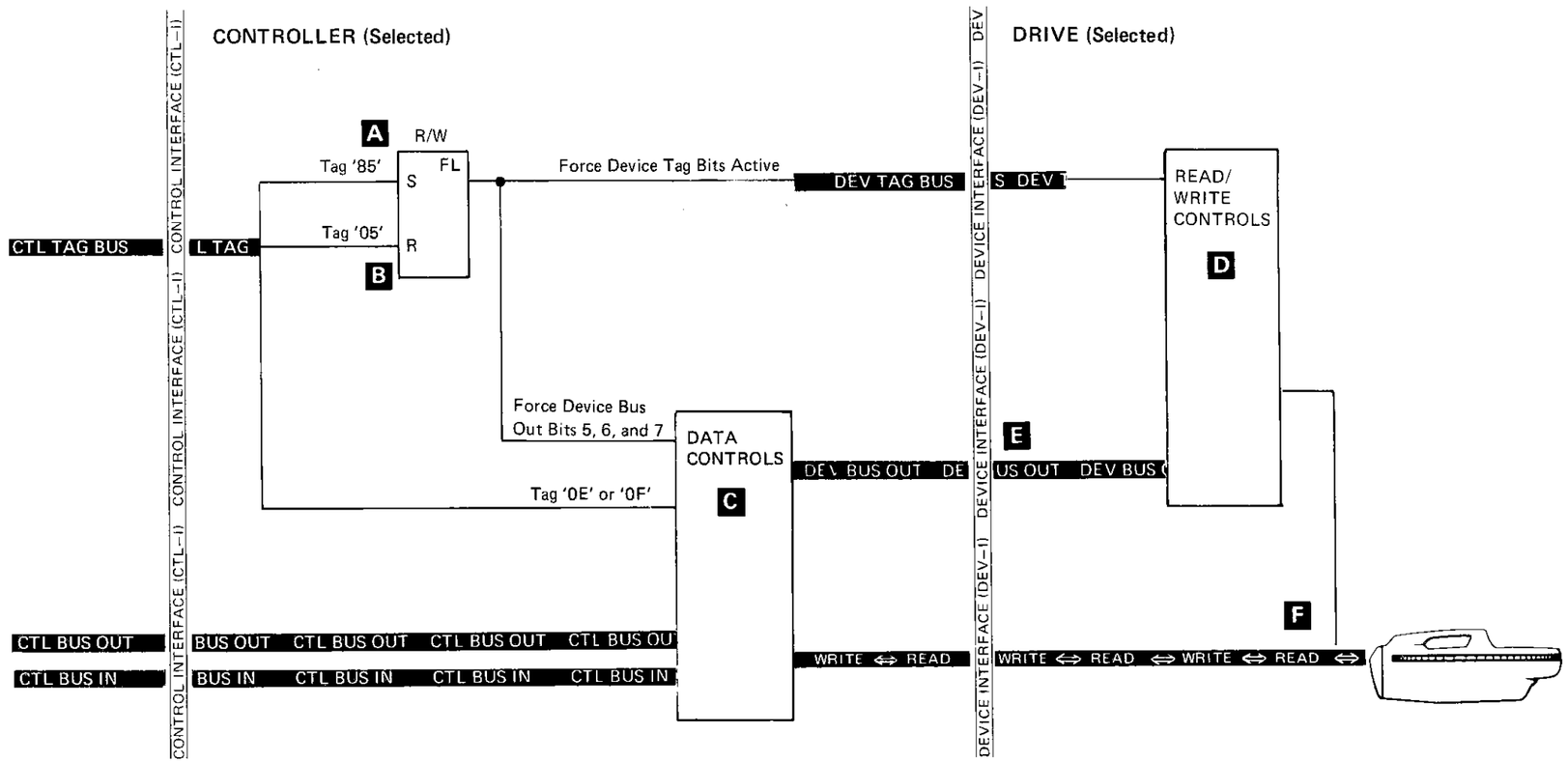


Diagram on OPER 214
Timing on OPER 217, 218

SET READ/WRITE OP (Tag '85')

Set Read/Write Op (Tag '85') conditions the controller and drive for a data transfer in the following way:

- Sets the Read/Write Latch (A) (this defines an extended operation; see OPER 95).
- Activates gate 2 on the Device Tag Reg (B) causing tag bits 0, 1, and 2 to be sent to the device (drive).
- Activates Device Tag Gate (C).
- Activates Rd Wr Gate which activates gate 2 of the Bus Out Selector (E). This deconditions the normal bus out bits (from storage control) and allows the device Bus Out to carry read/write control information to the drive (from controller hardware). Bus Out bits 5, 6, and 7 are held active by the Rd Wr Gate. The other Bus Out bits are manipulated by controller hardware (D) to control the data transfer. The device checks the condition of Bus Out ('07') after the Set Read/Write Op is issued, but prior to the data transfer.
- Places device in control mode. (F)
- Activates Set Rd*Wr (G) in the device; this is a result of control mode and Bus Out bits 5, 6, and 7 being active. The Set Rd*Wr line:
  1. Blocks normal device Bus Out Parity Error detection.
  2. Gates machine read/write status to Device Bus In (H) (OPER 100).
  3. Activates Set Rd*Wr Safe if no R/W Check conditions exist. (K)
  4. Provides a path for the read/write control lines to the read/write matrix card of the selected drive. (M)
  5. Causes a Read/Write head to be selected in accordance with the value in HAR. (N)
  6. Allows monitoring the read/write control lines for proper sequence. (J)
  7. Establishes a data path between the controller and the selected drive. (L)
- Enables the following functions of the data transfer control hardware (D):
  1. Index processing.
  2. Gap counter control.
  3. Function pulse generation.
  4. Synchronization of PLO/VFO with controller and PLO pulses on servo track.
  5. Orientation (must be established between microprogram and disk rotational position for most operations).
- Signals the microprogram (with Normal End) that the controller and the device are conditioned to receive a data transfer tag (Read '0E', Write '0F').

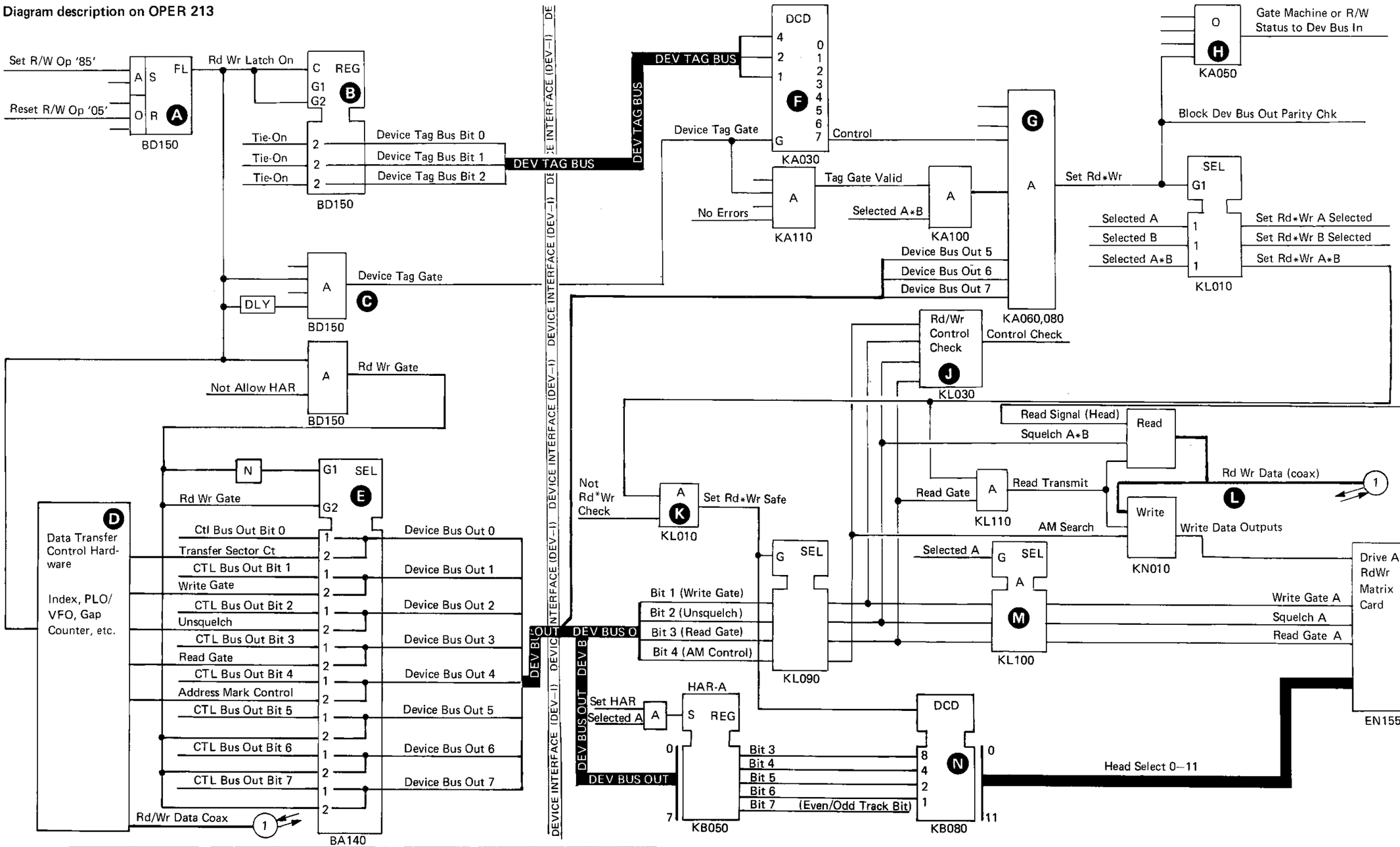
RESET READ/WRITE OP (Tag '05')

Reset/Write Op (Tag '05') resets the controller and device hardware, previously conditioned by a Set Read/Write Op, in the following way:

- Resets the Read/Write Latch (A).
- Deactivates Device Tag Gate (C), which removes the device from control mode, disabling the device read/write hardware.
- Restores data transfer control hardware (D) functions to non-data transfer condition:
  1. Allows bit ring 0 time pulse to reset the gap counter and control the function pulse.
  2. Disables index processing.
  3. Disables PLO/VFO synchronization.
  4. Disables Orientation.
- Returns control of Device Bus Out to the storage control. (E)
- Resets conditions set up during a Read (Tag '0E') or Write (Tag '0F') operation.
- Signals the microprogram with Normal End. (Immediate operation; see OPER 95.)

READ/WRITE CONTROLS, SIMPLIFIED DIAGRAM

Diagram description on OPER 213



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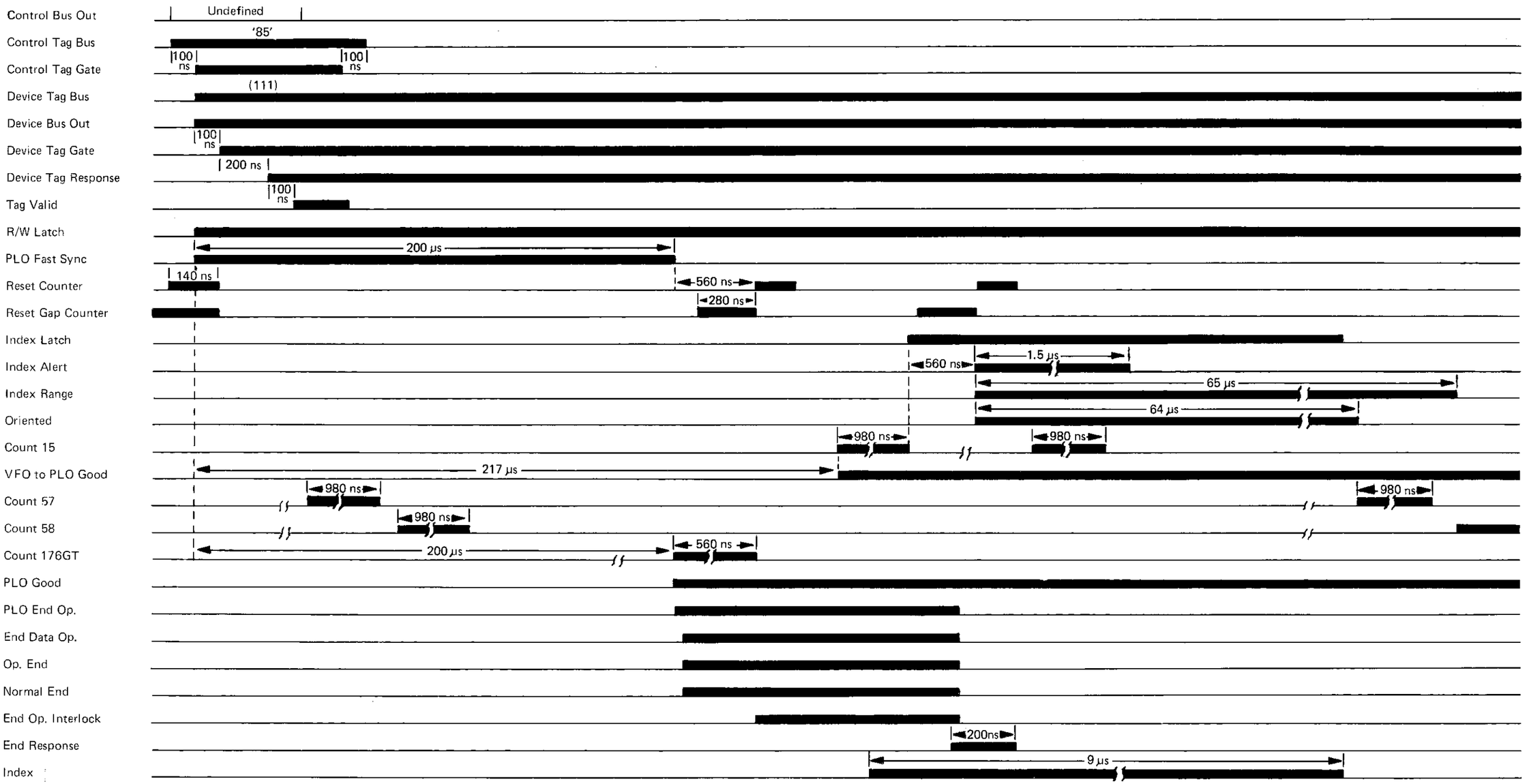
TIMING DIAGRAM FOR SET READ/WRITE OP (Tag '85')



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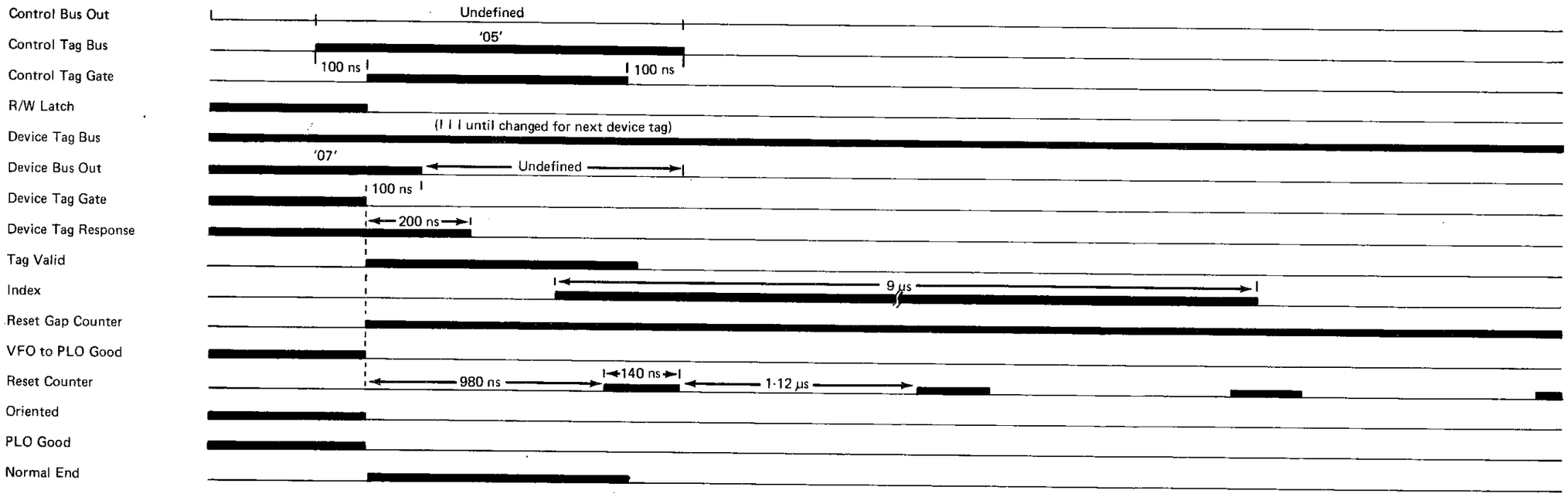
TIMING DIAGRAM FOR RESET READ/WRITE OP '05'



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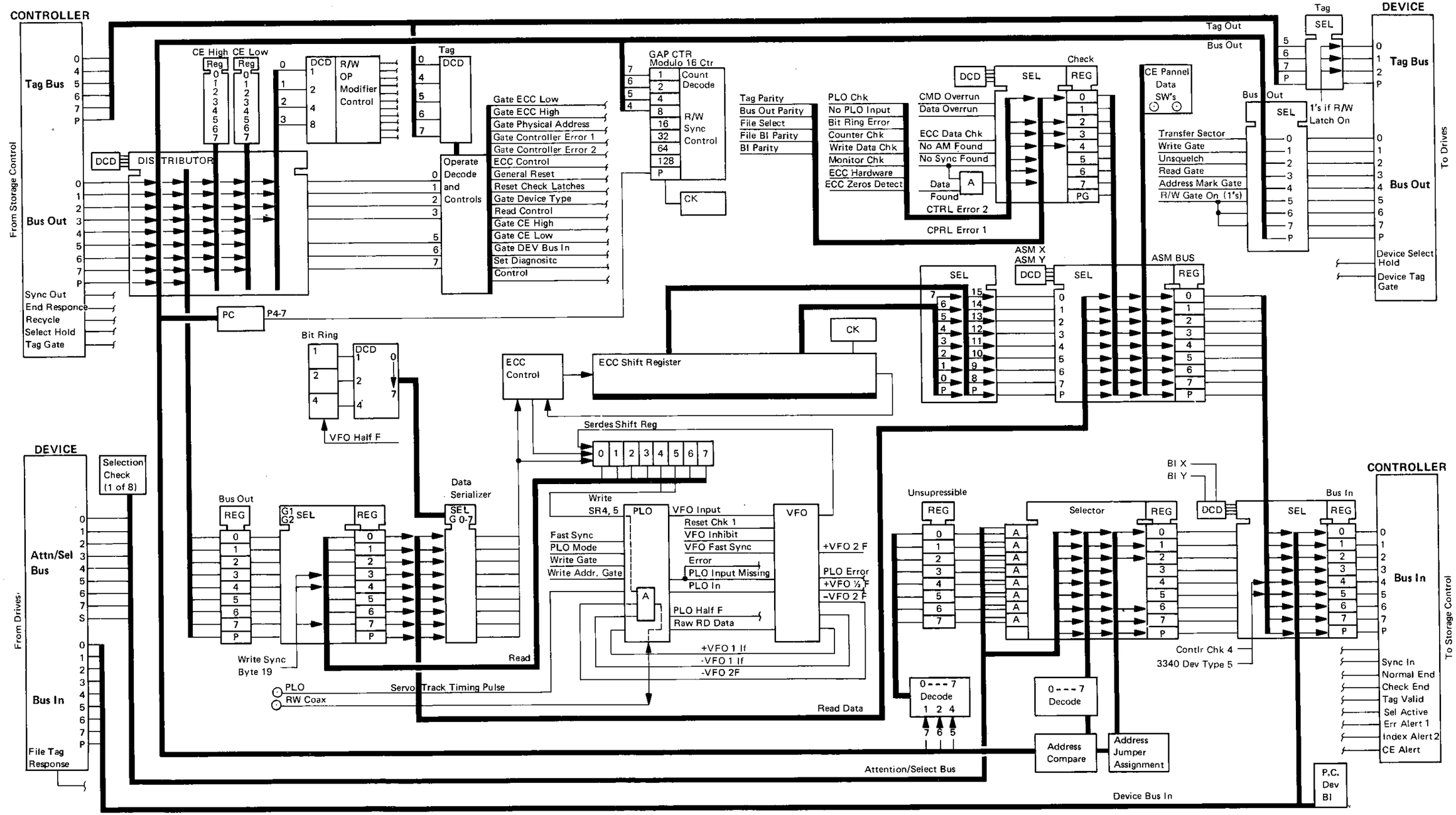
R/W CONTROL - LOGIC OVERVIEW



WRITE OPERATION DESCRIPTION

See OPER 227 for Write Operation Timing chart.

The Controller enables all write hardware for writing data on the disk surface.

INITIALIZATION

- The Controller and the drive must both be selected (Tag '83').
- Set Read/Write (Tag '85') must be latched.
- Tag Gate and Tag Bus must be latched up to the drive.
- PLO must be locked in.
- Orientation must be established (except Write Home Address Format G1).

OPERATION

A Write command '0F' is placed on CTL Tag Bus.

CTL Bus Out contains a modifier that specifies the type of write command and the pre-field gap.

Bus Out bit	0	1	2	3	Operation
	0	0	1	0	Write G2
	0	0	1	1	Fmt Reorient
	0	1	0	0	Fmt G1
	0	1	0	1	Fmt G3
	0	1	1	0	Fmt G2
	0	1	1	1	Fmt/Erase
	1	0	1	1	Write G4
	1	1	0	0	Spec Fmt G1
	1	1	1	0	Spec Fmt G2

B Verify orientation and set Write Gate. Write Gate is also raised to the drive.

C Write Mode is set and stays up until transfer ECC time.

D Write Mode enables the return of Sync In to the user, which indicates the controller is ready to accept the first byte of data on Bus Out (sync byte '19').

E Sync Out and the first byte of write data are transferred.

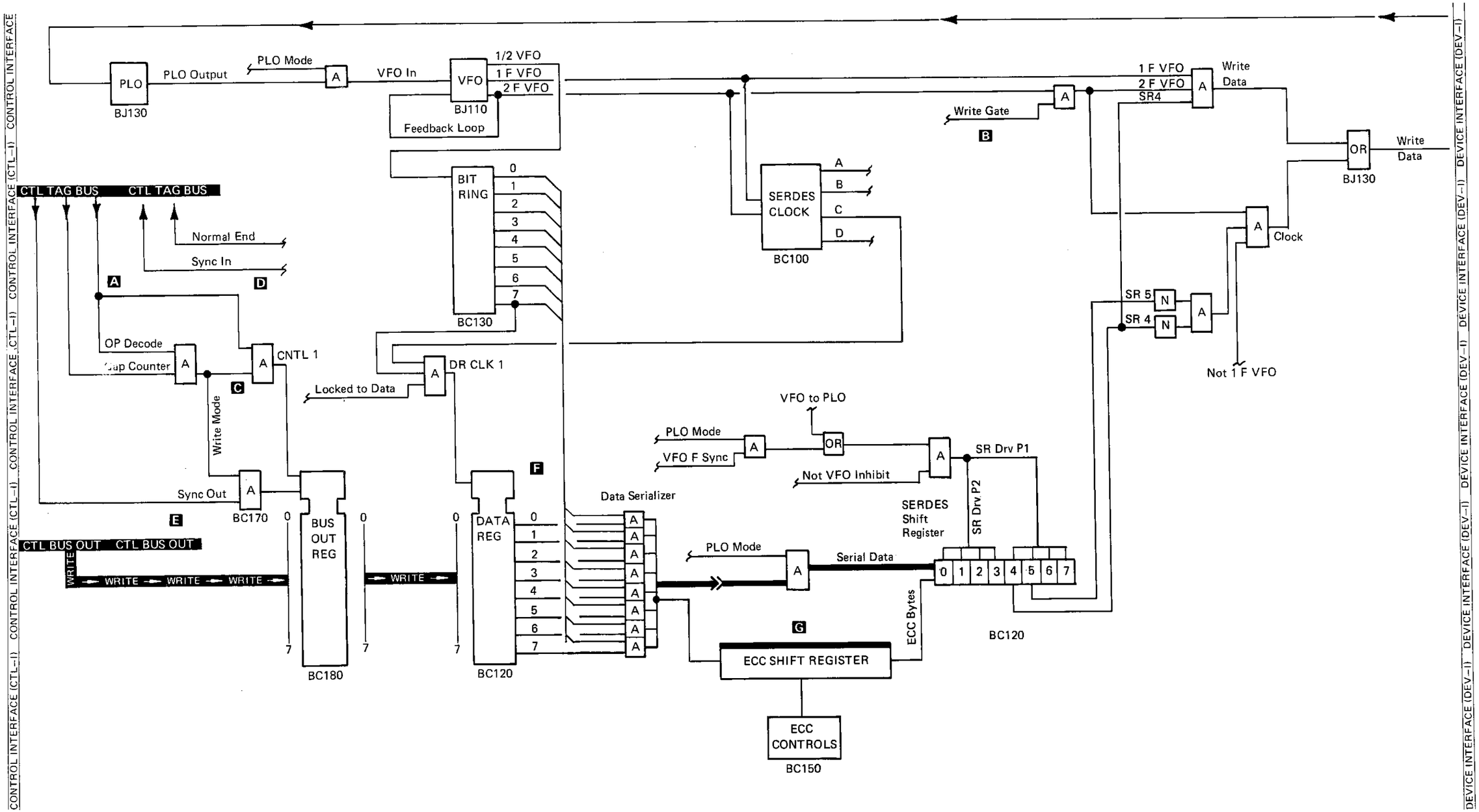
F Data on Bus Out is sent to the Data Register and serialized by SERDES for recording on the disk surface. The controller is now in the data transfer mode.

G The controller continues to transfer data until End Data is detected. The path between the ECC Shift register and the SERDES shift register is enabled. Six bytes of ECC are transferred from the ECC Shift register, through the SERDES Shift register, and recorded at the end of the data field.

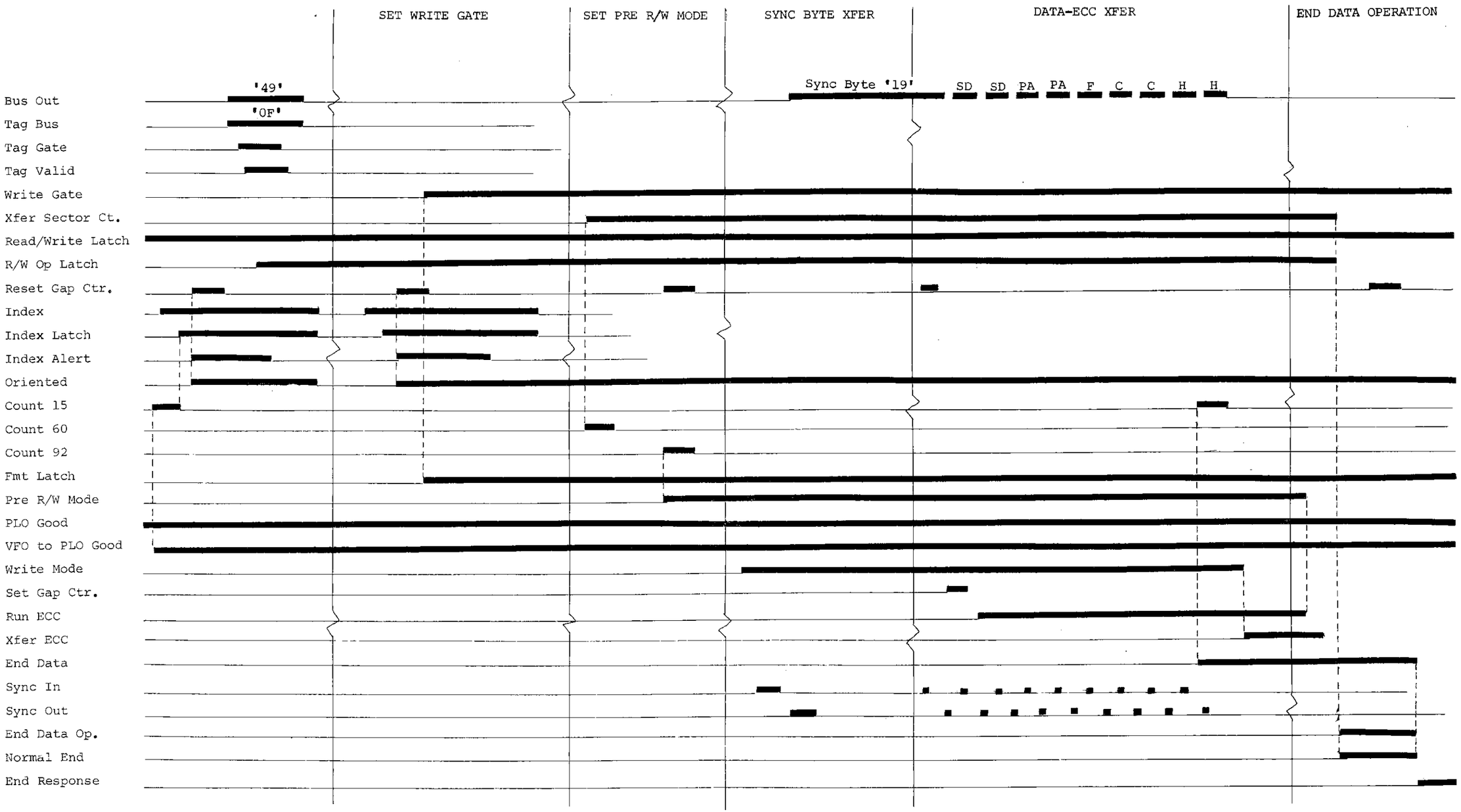
H After End Data is detected, the controller resets the Write Op latch and raises Normal End to the user if there are no check conditions.

The user answers with End Response.

WRITE DATA PATH



WRITE TIMING CHART (FORMAT G1)



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READ GAP/CLOCK GAP OPERATIONS

Diagram on OPER 231.

When a Read or Search command is issued by the CPU to storage control, appropriate tags are issued by storage control to the controller and drive in the proper sequence to obtain the desired data.

The Read Op Tag '0E' is modified by CTL Bus Out, specifying the type of gap preceding the field to be read. Refer to OPER 99 and OPER 103 for definition and description of the modifiers.

Example:

If Read Count command is chained to Read Data command the following tags are used:

Read G3	(Tag Bus '0E', Bus Out '5X') to read the Count field.
Clock G2	(Tag Bus '0E', Bus Out '2X) to clock past the Key field, maintaining orientation.
Read G2	(Tag Bus '0E', Bus Out '6X') to read the Data fiefd.

Description

READ OP '0E'

Tag '0E' is placed on CTL Tag Bus to define a Read operation.

The Read operation is further defined by modifiers on CTL Bus Out bits 0–3.

The Read operation causes the controller reading and clocking circuits to retrieve data from the drive. After receiving Tag '0E' (and while the heads are in the gap prior to the field to be read), the controller (1) raises read controls to the drive, (2) locks the VFO to data from the drive, and (3) waits for the sync byte at the end of the gap.

The sync byte starts the data transfer which continues under control of the gap counter and bit ring.

Data transfer is ended when the gap counter signals that all data has been read. The six ECC bytes are then shifted through the ECC shift register, and the controller sends either Normal End or Check End to storage control.

Initialization

The controller and drive must both be selected (Tag '83'). See OPER 110.

Set Read/Write (Tag '85') must be latched. See OPER 213.

VFO must be locked to PLO.

Orientation must be previously established between the storage control microprogram and the track being read. Exceptions are Read Home Address (Read G1) and Address Mark Search (Read G3).

The essential differences in execution of the various read operations are in orientation and in gap counter timings. The following description gives details of the Read G1 operation. Variations are noted for the other read operations, and the differences in gap counter timings can be seen on OPER 232 and 233.

Operation

READ G1 (Read Home Address) Tag '0E', Bus Out '49'.

- Orients to index.
- Sets up Read operation during Gap 1 (107 bytes).
- Reads Home Address field.

1. Read Op Tag '0E' is placed on CTL Tag Bus. CTL Bus Out contains a modifier in bits 0–3 that specifies the type of Read or Clock command D. CTL Bus Out bits 4–7 contain the modulo count (units digit of the hex byte count) and are latched for future use by the gap counter F. For a Read G1 the modulo count is always 9.
2. Tag Valid is returned to the storage control if there are no control interface errors I.
3. The gap counter is reset at index time and orientation is established when active track is present J. The gap counter starts counting and at count 58 time Read Gate is raised to the drive H. At count 68 time Unsquelch is raised to the drive H. Device Bus Out bits 2 and 3 are used to transfer these controls to the selected drive K. These controls are necessary to amplify and transfer read data from the selected drive to the controller A.
4. Count 92 resets the gap counter.
5. Count 1 time locks VFO to data and activates VFO Fast Sync C.
6. Count 8 resets VFO Fast Sync and gates Standardized Data to SERDES E.
7. When a sync byte is detected in SERDES, Read mode is raised B. The gap counter is set to the fifteens complement of the modulo count. For a Read G1, the complemented modulo count is 6 (see Step 1).
8. Bit ring 7 transfers the sync byte from SERDES to the data register G.
9. During the next complete bit ring cycle the first data byte is assembled in SERDES. At bit ring 1 time of that cycle, Sync In is set to the storage control and the sync byte is placed on CTL Bus In M.
10. Run Modulo is raised and the gap counter is put in modulo 16 mode (causes gap counter to step from 15 to 0 instead of 16).
11. At bit ring 4 time the gap counter is stepped to 7.
12. Bit ring 7 transfers the first data byte to the data register. Bit ring 1 of the next bit ring cycle raises Sync In to the storage control with the data byte on CTL Bus In. Bit ring 4 increments the gap counter to 8. The next data byte is being assembled in SERDES and will be ready to be transferred to the data register at bit ring 7 time.
13. Data transfer continues until the gap counter is stepped from 15 to 0. Read mode is reset and prevents any further data transfer B.
14. Count 15 raises transfer ECC control to allow the next byte (first ECC byte) to be gated to the ECC Shift Register. L
15. The six ECC bytes are transferred to the ECC Shift Register. If ECC Zeros Compare is active after the six ECC bytes are transferred, ECC Data Check is blocked.
16. Op End is raised and Normal End is sent to the storage control provided no errors have occurred. N
17. End Response is returned from the storage control and Reset End condition is raised in the controller.

Note: See R/W 323 for timing chart of Read G1 operation.

READ G2 Tag '0E', Bus Out '6X'

- Orientation must be previously established.
- Sets up Read operation during Gap 2 (68 bytes).
- Reads Key fields, Data fields and R0 Count field.

1. Orientation must be established from a previous Read command (Read G1 or Read G3 AM Search).
2. If the key or data field is longer than 15 bytes, the Recycle line on the control interface is used by the storage control to prevent the data transfer from ending when the gap counter steps from 15 to 0. The gap counter recycles the 0 to 15 count as long as the storage control holds the Recycle line active.

SPECIAL READ G2 Tag '0E', Bus Out 'EX'.

- Sets up Read operation in G2.
- Reads first portion of Key or Data field that has been split for defect skipping.
- Saves ECC shift register contents at end of data transfer.

1. The count on Bus Out bits 4–7 is the count of the first portion of the field, calculated by storage control. Data transfer stops when this number of bytes has been read and transferred.
2. The ECC shift register operation is suspended when data transfer stops, as there are no ECC bytes at the end of the first portion. ECC shift register operation is resumed in the following Read G4 operation.
3. After the end of data transfer, 6 bytes of zeros are clocked before the gap counter is reset and the operation ended.

READ G3 Tag '0E', Bus Out '5X'.

- Orientation must be previously established.
- Sets up Read operation during Gap 3 (72 bytes).
- Reads Count fields except R0.

1. Orientation must be established from a previous Read command (Read G1 or Read G3 AM Search).

READ G3 AM SEARCH Tag '0E', Bus Out '7X'.

- Orients on Address Mark in G3 gap; otherwise same as Read G3.

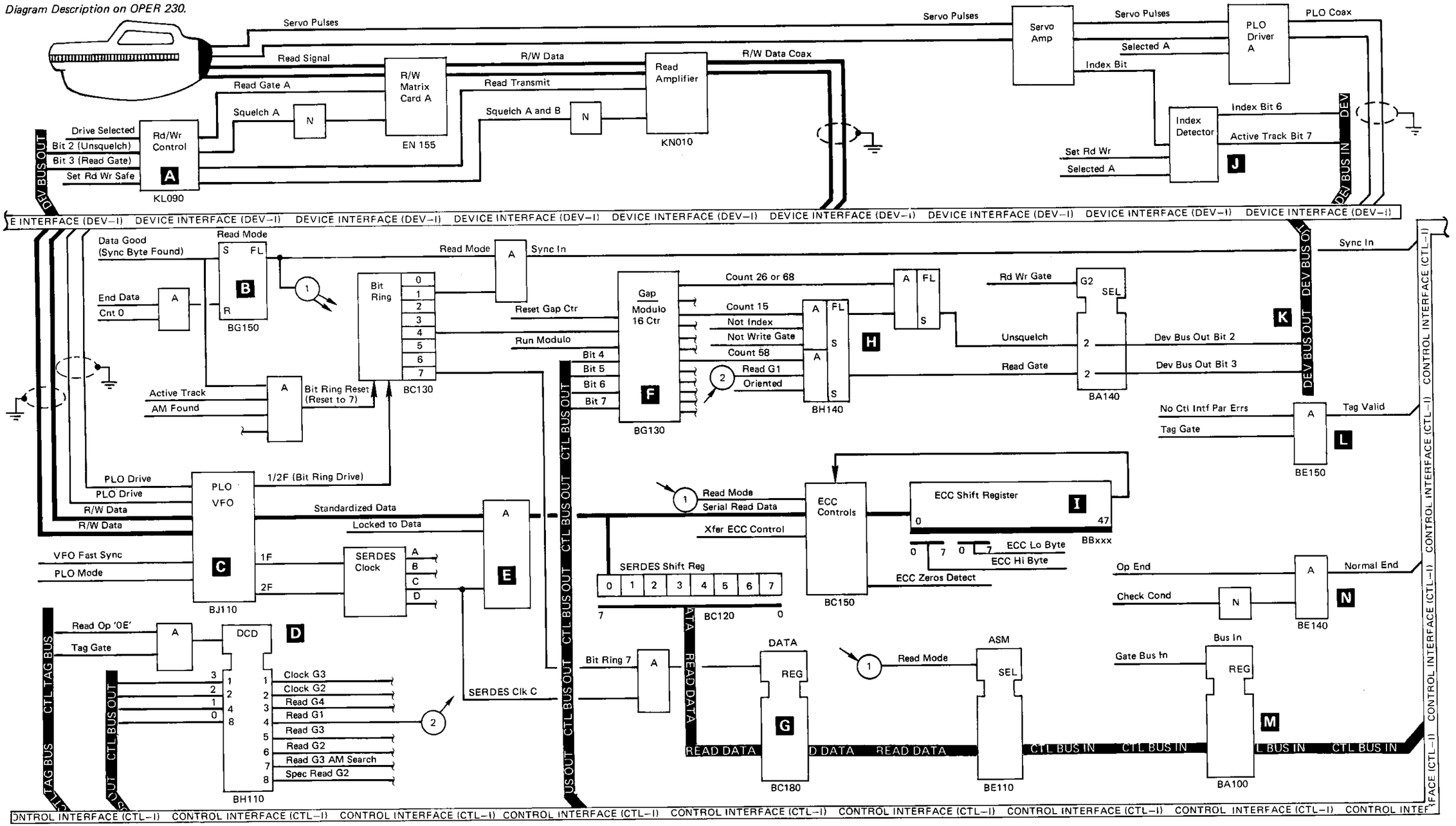
READ G4 Tag '0E', Bus Out '3X'.

- Reads a 128-byte G4 gap containing a track defect.
- The G4 gap may be within a split Key or Data Field, or preceding a moved field.

1. For a split field, the count on Bus Out bits 4–7 is the number of bytes in the second portion of the field. After the sync byte is detected, the second portion of the field is read. The ECC shift register contents were saved at the end of the preceding special Read G2 operation. Data transfer is resumed, the data and ECC bytes in the second portion of the field are shifted through the ECC shift register, and a check is made for ECC Zeros Compare after the last ECC byte.
2. In the case of a moved field, the Read G4 operation clocks past the 128-byte gap and is ended. A normal Read G2 or Read G3 is issued by storage control to read the following field.

READ DATA FLOW, SIMPLIFIED DIAGRAM

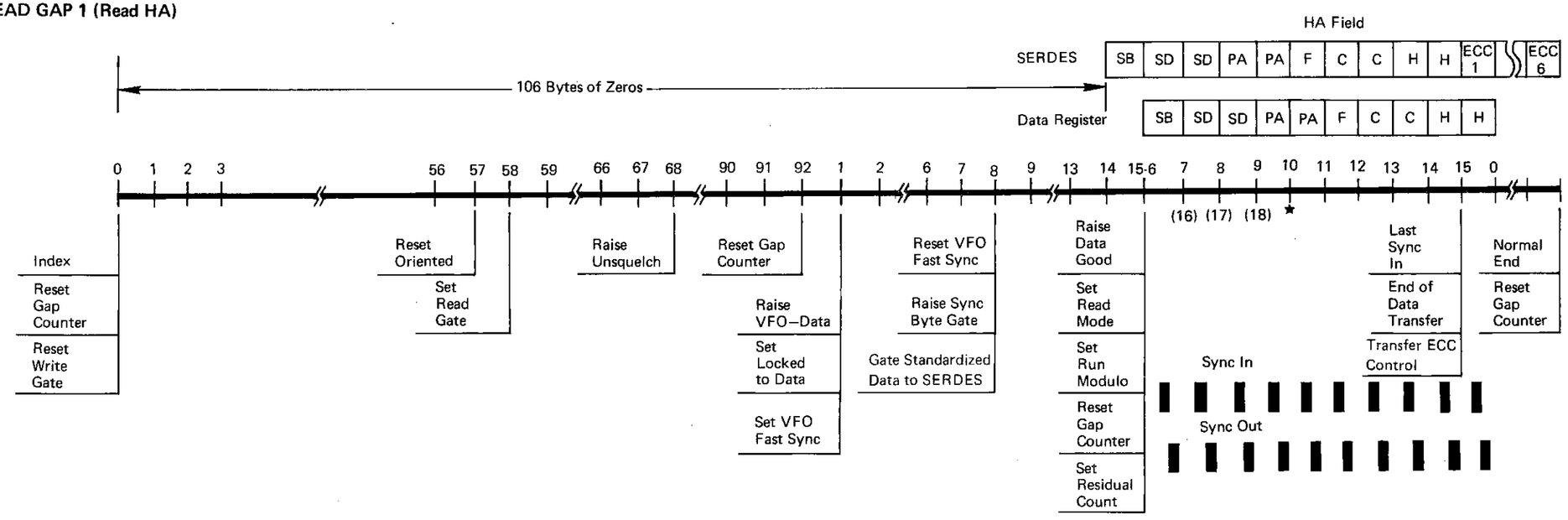
Diagram Description on OPER 230.



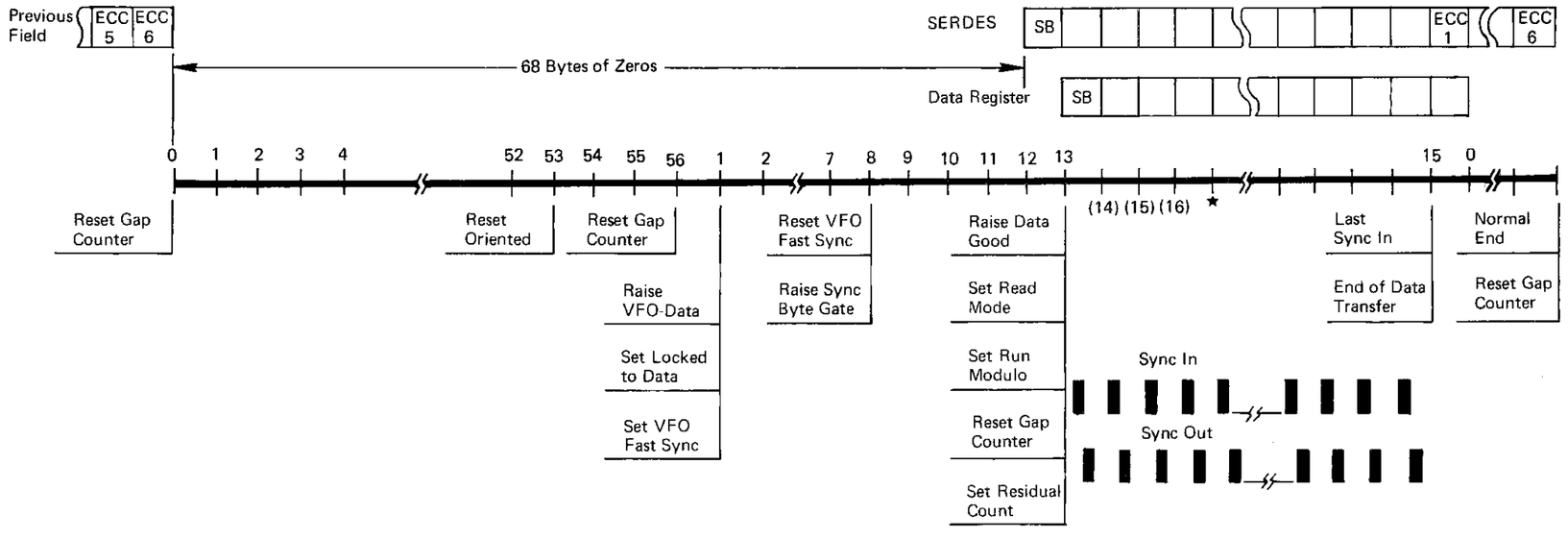
READ G1/G2 TIMING REFERENCE

READ G1/G2 TIMING REFERENCE OPER 232

READ GAP 1 (Read HA)



READ GAP 2 (Read Key, Data, R0 Count)



Legend

SB = Sync Byte
SD = Skip Displacement
PA = Physical Address
F = Flag
C = Cylinder
H = Head
ECC = Error Correction Code

★The sync byte can be recognized from count 8 to count 21. When the sync byte is detected in SERDES, the gap counter is reset to the Modulo-16 complement of the byte count units position.

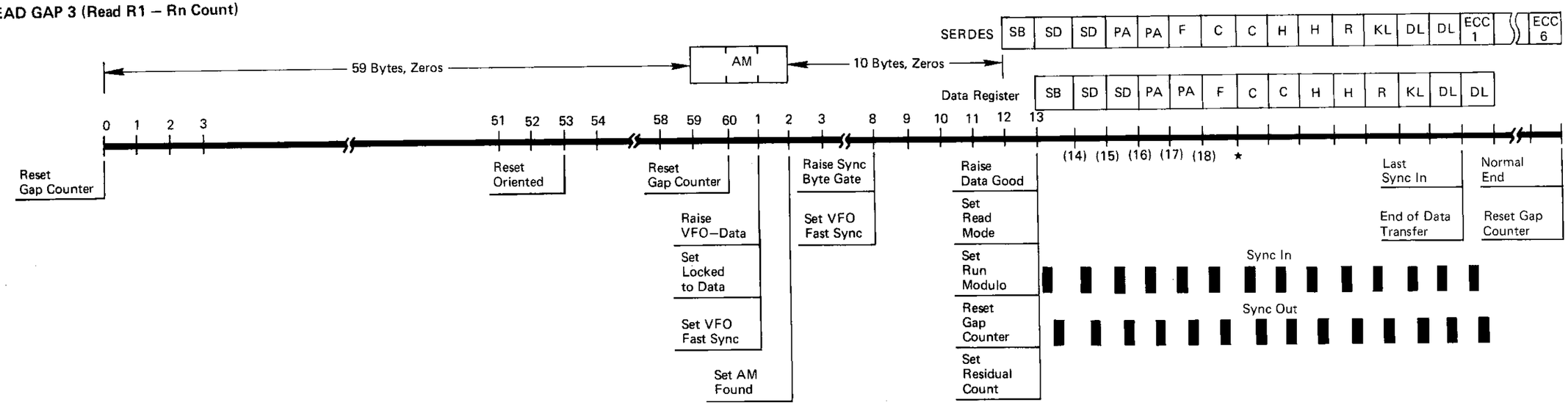
If the count reaches 21 while performing a Read G1, a defect skip is assumed and at count 128 the Gap Counter is again reset to zero and a new attempt is made to detect the sync byte.

If the count reaches 21 while performing a Read G2 or Read G3, a Check End results and No Sync Byte Found is returned to storage control.

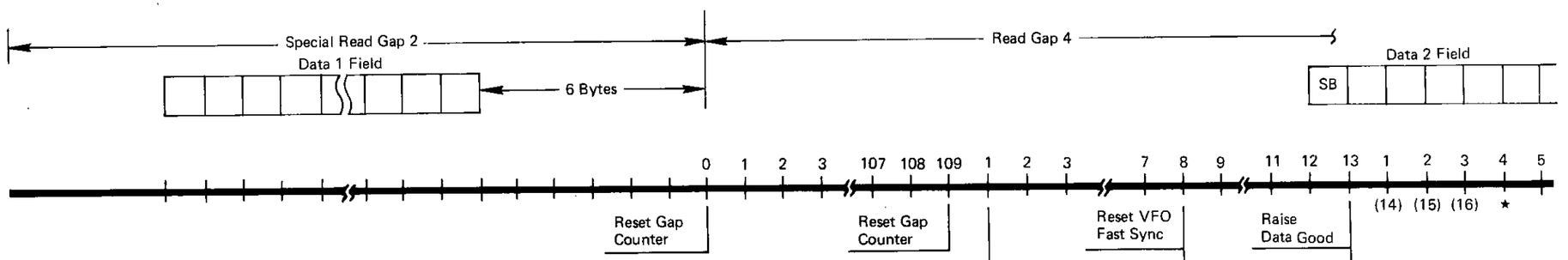
READ G1/G2 TIMING REFERENCE OPER 232

READ G3/G4 TIMING REFERENCE

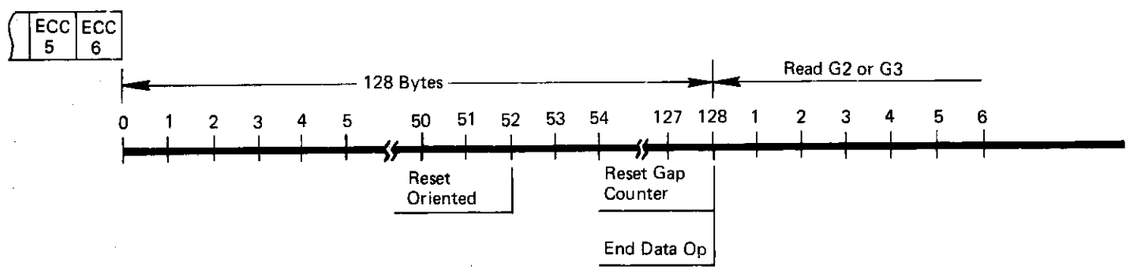
READ GAP 3 (Read R1 – Rn Count)



READ GAP 4 (Split Field)



READ GAP 4 (Moved Field)



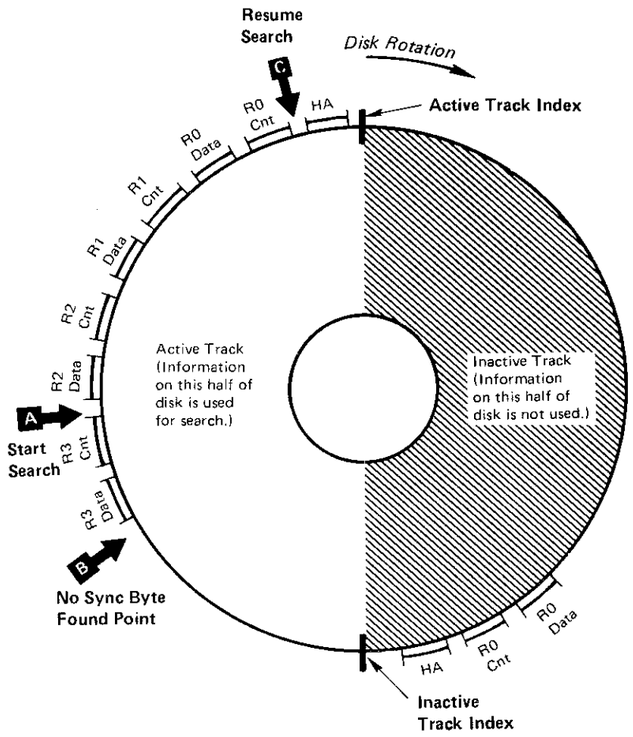
NO RECORD FOUND

A No Record Found condition exists when active track index has been passed twice in the same non-multitrack search and TIC loop. When the No Record Found condition is detected, the storage control posts a unit check with No Record Found indicated in sense byte 1 bit 4.

To illustrate the No Record Found operation, assume the track is formatted as shown below and the following command chain has been issued:

Seek
Search ID Equal Record 5
TIC-8 (Transfer In Channel To The Previous CCW)
Read Count Key Data

When a non-multitrack search and TIC are successive commands in a command chain, the loop continues until either the search is successful or until the active track index has been passed twice.



If the search is started at A, the operation becomes oriented on the Address Mark in the gap prior to the record 3 Count Field. The record 3 count field (record 3) is read and compared against the search argument (record 5) and a non-compare results. The TIC-8 causes the search command to be reissued.

There are no fields after record 3, therefore no sync byte is found at B. Because no sync byte is found, the storage control suspends the search at B until active track index is encountered.

When active track is encountered, it is counted as the first active track index. After the active track index is passed, the storage control reads and clocks the home address field and saves certain information. This operation is transparent to the command chain.

The search command, which was suspended at B is resumed at C beginning with record 0 Count Field. As before, a non-compare results and a TIC-8 occurs.

The search command is reissued for record 1, record 2, and record 3 with non-compare results. Then the search command is issued for the last time. As before, the search is suspended at B because no sync byte is found.

When the active track index is encountered again, it is counted as the second active track index. The storage control signals a unit check which breaks the command chain to terminate the operation.

Sense information is formatted with Byte 1 bit 4 set to 1 to indicate No Record Found.

The index counter is reset whenever a read data, read home address, or any write sense or control command is issued subsequent to a successful search. This allows each separate search loop to search past index twice before posting No Record Found.

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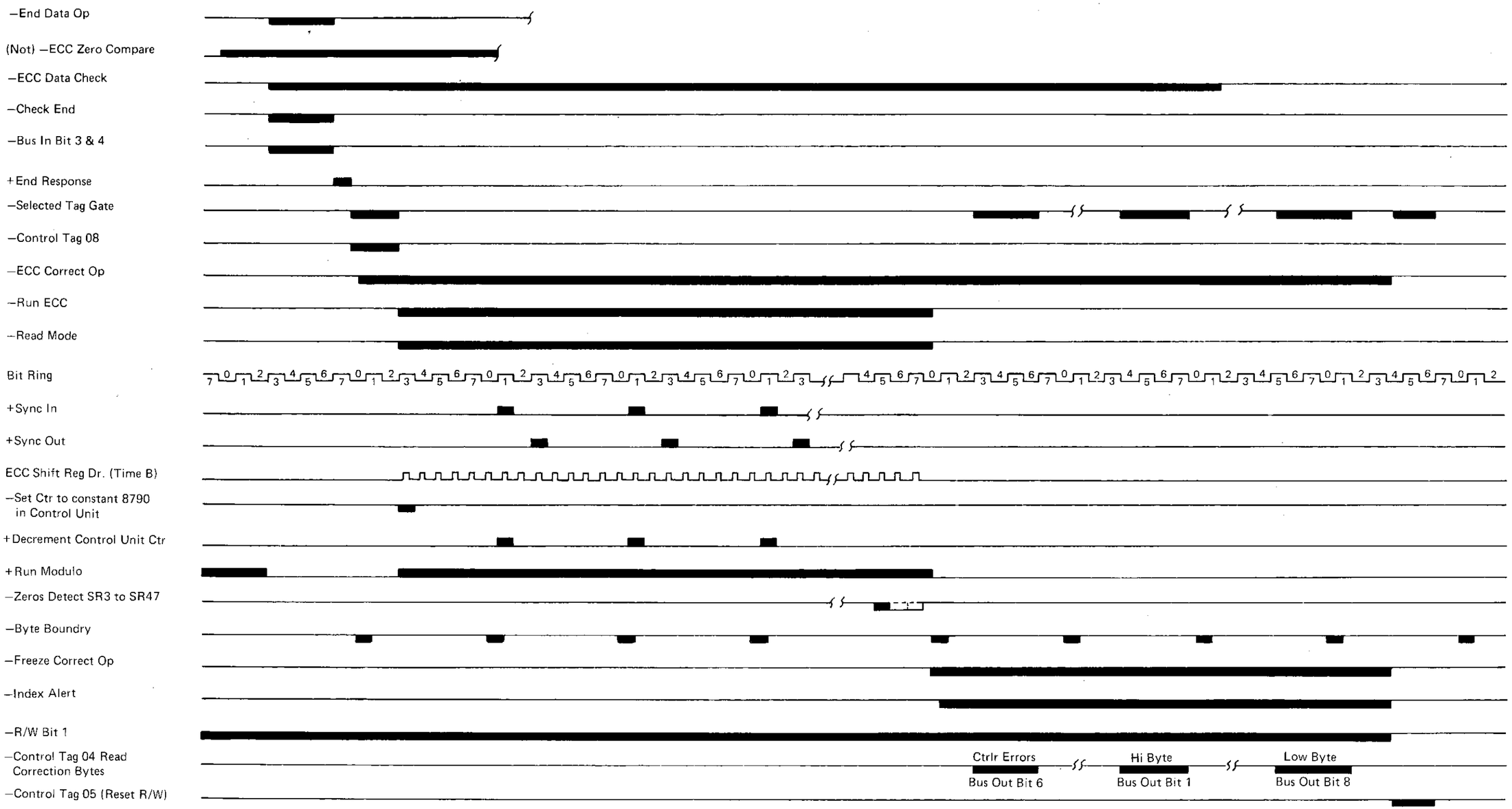
ECC CORRECT OP

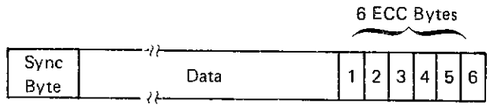


ECC CORRECT OP

ECC (Error Correction Code)

See OPER 240 for timing diagram.

Each block of information (Home Address, Count, Key, or Data written on the data module has a 6-byte hardware-generated ECC burst appended to it.



The six ECC bytes added to the Home Address, Count or Key fields provide error detection capability and are called Detection Code Bytes (DCBs).

The six ECC bytes added to data areas provide error correction as well as error detection capabilities and are called Correction Code Bytes (CCBs).

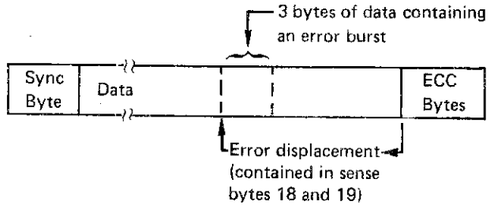
The DCB and CCB detect any error burst of an 11-bit span or less. The CCB can be used to correct errors of a 3-bit span or less.

As the data plus six ECC bytes are shifted through the ECC Shift Register, it is divided by the generator polynomial. If there are no data errors, the contents of the ECC Shift Register is zero after shifting the six ECC bytes giving ECC Zeros Compare. The detection of zeros inhibits the setting of the ECC Data Check Latch at End Data Op time (approximately 7.84 microseocnds after Transfer ECC Latch is set).

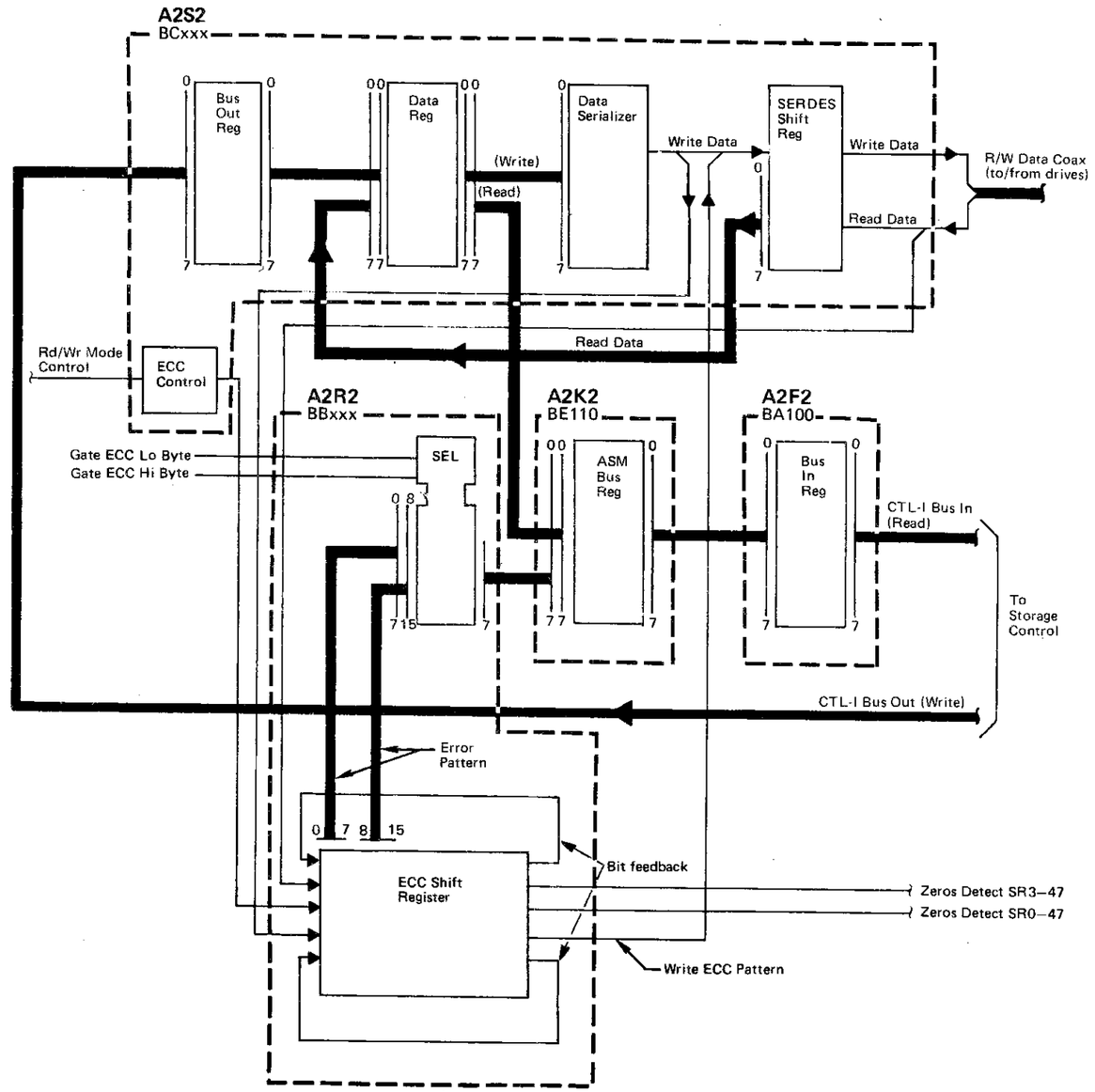
Op End is enabled with the setting of End Data Op and raises Normal End to the user. The user responds with End Response, resetting End Data, End Data Op, and dropping Normal End to the user. If the remainder in the ECC Shift Register is not zero, the ECC Data Check latch is set by End Data Op time and Check End is raised under Op End. The storage control issues an ECC Correct Op (Tag '08') starting error correction procedures. A constant of 8790 is set into a counter and the ECC shift register is caused to shift. The control unit counter is decremented at bit ring one time until zeros are detected in Shift Register positions 3 through 47 (SR3 to SR47) or the counter is decremented to zero.

After zeros are detected in SR3 to SR47, the Shift Register continues shifting bits until the next byte boundary is reached. The error correction pattern is now contained in the ECC shift register positions 0 to 15. The pattern is gated to storage control by control tag '04' (Read correction bytes) and Bus Out bit 8 (gate ECC low byte, ECC Shift Register position 0 to 7) and Bus Out bit 1 (gate ECC Hi byte, ECC Shift Register position 8 to 15).

The error pattern is placed in sense bytes 20, 21, and 22 (byte 22 contains all logical zeros). The storage control calculates the displacement of the error from the last byte of data. The error displacement is placed in sense bytes 18 and 19.



Error correction is accomplished by aligning the error pattern from sense bytes 20, 21, and 22 with the erroneous data from storage and exclusive ORing the pattern with the erroneous data.



ROTATIONAL POSITION SENSING

- Rotational Position Sensing (RPS) is an optional feature on the 3340.
- RPS allows the channel and storage control to be released during most of a record's search time, thereby increasing their availability for other operations.
- The tracks in each physical cylinder are divided into 128 equally spaced sectors (64 sectors per addressable track).
- The sector location is not indicated on the tracks, but stored at the beginning of all Read, Write, and Search commands.
- Two commands are added for the RPS feature, Read Sector and Set Sector:

  Read Sector – provides the sector number required to access the record processed by the previous command.

  Set Sector – fetches the sector number from the main storage.

See OPER 251 for details of RPS operation.

CHANNEL OPERATION

Read Sector

The Read Sector command transfers one byte of information from storage control to the channel. This byte provides the sector number (angular displacement from index) of the last record processed. If the last record processed was an overflow record, the sector number returned is the first segment processed in the current command chain.

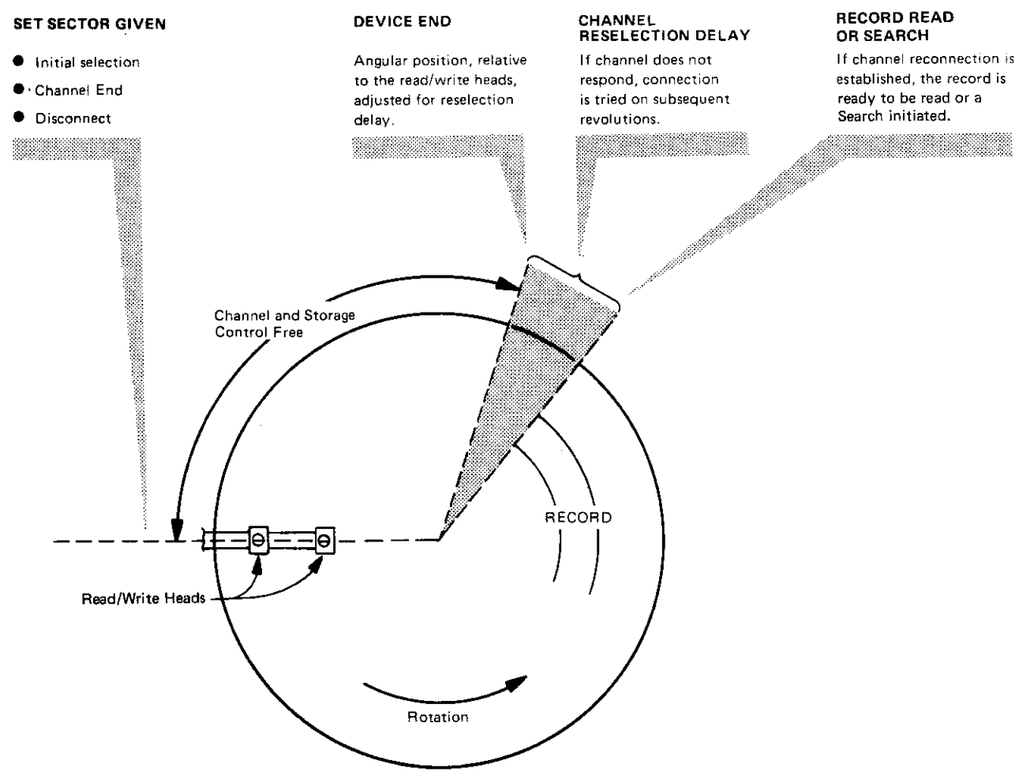
Execution of a Read Sector command causes loss of the previously established record orientation. Therefore, if further processing of records of the same track (or cylinder) is desired, a search for the desired record must be made.

Set Sector

The Set Sector command transfers one byte of data from the channel to the storage control. This byte specifies one of 128 possible angular positions per track. The byte value is checked for validity by the storage control. If the value is correct, the storage control generates Channel End and allows the channel to disconnect.

When the desired angular position (which has an adjusted reselection delay factor) is reached, the storage control signals Device End. The channel can then reconnect to continue the command chain. If the channel does not respond, connection is tried on subsequent revolutions by again raising Request In.

Read And Set Sector Operation



ROTATIONAL POSITION SENSING

SECTOR COMPARE

Sector 0 occurs just after even index.

Sector 127 occurs just prior to even index.

Each sector is 158 microseconds ±3% in duration (153 microseconds to 163 microseconds).

Set Target command sets Target Register with value of Bus Out.

Search Sector latch is set when Set Target command is issued and Busy is set. Search Sector remains active until Attention Reset or Check Reset is issued.

When the Sector Counter equals the value in the Target Register, Sector Compare (Bus In bit 7) and Sector Attention occur for one sector in duration. Busy (Search Sector) is inactive during Sector Compare time.

SECTOR COUNTER OPERATION

The Sector Count pulse **1** is fed into the Div by 70 Counter.

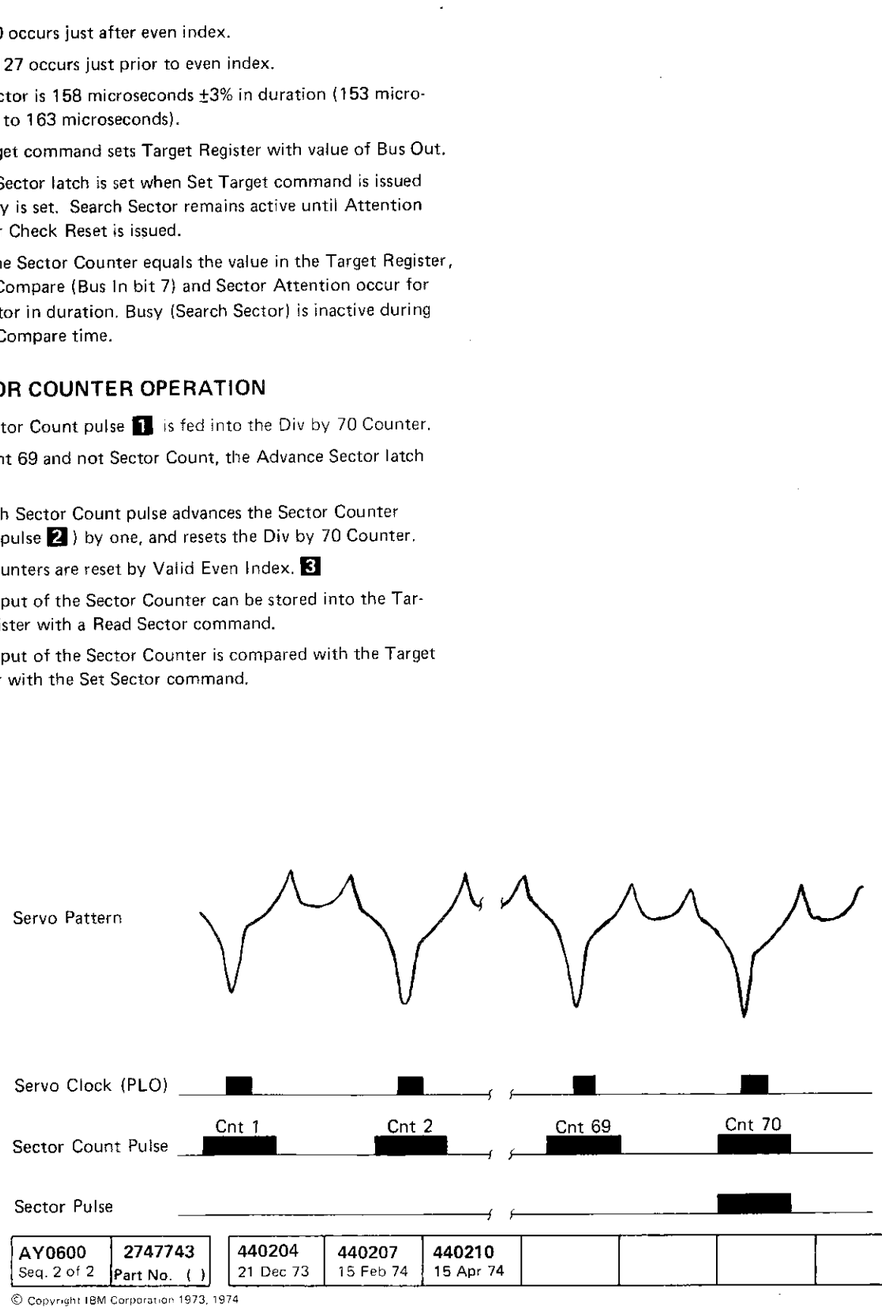
At Count 69 and not Sector Count, the Advance Sector latch is set.

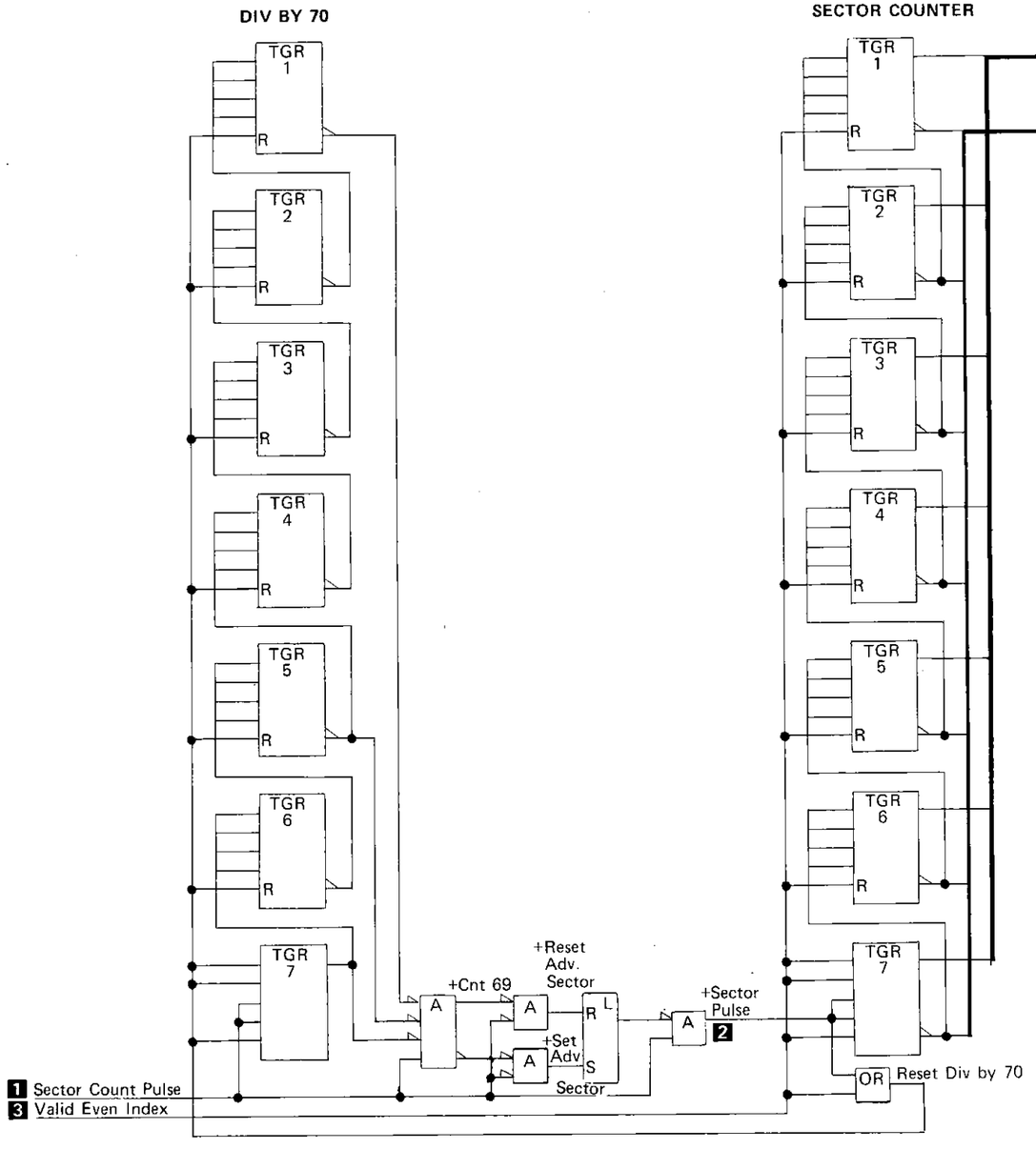
The 70th Sector Count pulse advances the Sector Counter (Sector pulse **2**) by one, and resets the Div by 70 Counter.

Both counters are reset by Valid Even Index. **3**

The output of the Sector Counter can be stored into the Target Register with a Read Sector command.

The output of the Sector Counter is compared with the Target Register with the Set Sector command.





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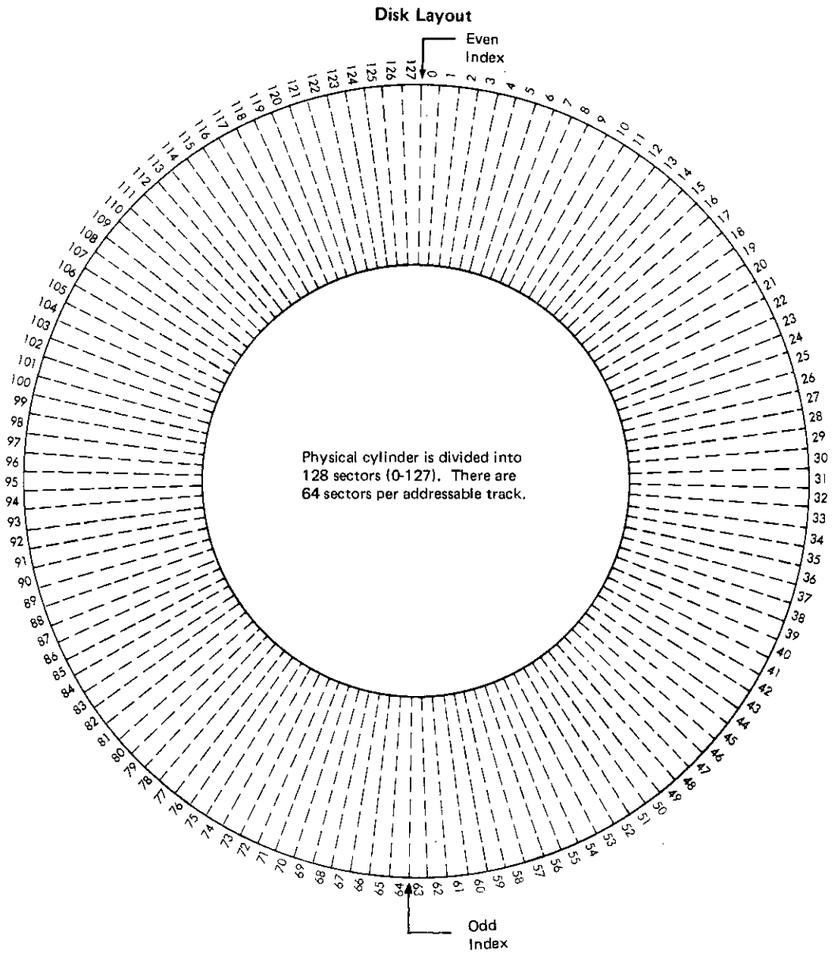
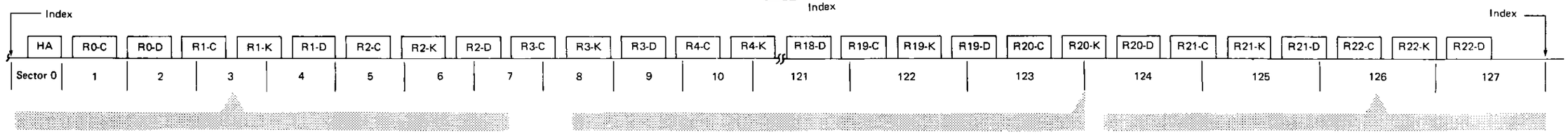
ROTATIONAL POSITION SENSING

TRACK OPERATION



Track Layout



B **Assume:**
Head position at point in time when a Set Sector command is received (sector 126).
Sector 124 is set in target register of selected module when a record starting in sector 126 is to be searched. Target always sets two less than desired sector.

C When sector counter and target register compare, storage control raises Request In to the channel. Channel can then do a Search ID for record 22 with a minimum loss of CPU time.

A When record is written, the sector number is stored by a Read Sector command. Example: Record 22 is written. Sector 126 is stored by use of the Read Sector command.
The sector can be calculated by the system if the record size is fixed.

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ERROR ALERT

Error Alert signals the storage control that a hardware malfunction occurred in the controller or that a condition has been detected in the drive that could endanger data integrity during Read/Write operations.

Error Alert may be blocked through use of the Diagnostic Set command (Tag '09', Bus '2x')

See CTL-I 403 for logic diagram.

Controller Errors That Cause Error Alert

PLO CHECK – DATA 270

One of the following conditions occurs:

- Two successive PLO pulses are out of phase with the VFO on a Write operation.
- Three successive PLO pulses are missing on a Write operation.
- A phase error is detected in the PLO.

NO PLO INPUT – DATA 260

Three successive PLO pulses are missing on a Write operation. This also causes a PLO check.

SERDES CHECK – DATA 250

SERDES Shift Register parity does not match its predicted parity.

GAP COUNTER CHECK – DATA 240

Incorrect parity is detected in the Gap Counter.

WRITE DATA CHECK – DATA 230

A parity error is detected at the output of the SERDES Shift Register.

MONITOR CHECK – DATA 220

An error occurs in the Bit Ring and associated hardware for a period of three servo pulses.

ECC CHECK – DATA 200

One of the following conditions occurs:

- An odd number of ECC Shift Register bits at B time.
- Missing C pulse to the Shift Register.
- Missing B pulse to the Shift Register.

CONTROL INTERFACE TAG BUS PARITY CHECK – CTL-I 380

A parity error is detected on the Control Interface Tag Bus while Tag Gate is active.

CONTROL INTERFACE BUS OUT PARITY CHECK – CTL-I 370

A parity error is detected on the Control Interface Bus Out while Tag Gate is active.

DRIVE SELECTION CHECK – DEV-I 110

Indicates that more than one drive is selected.

DEVICE BUS IN PARITY CHECK – DEV-I 180

A parity error is detected on Device Bus In.

CONTROL INTERFACE BUS IN PARITY CHECK – CTL-I 390

The controller detects bad parity on the control Interface Bus In.

WRITE FAIL (I WRITE SENSE) DATA 120

The controller fails to detect I Write Sense from the device within approximately nine microseconds after the rise of Write Gate.

DEVICE BUS OUT PARITY CHECK – DEV-I 122

A parity error is detected on the Device Bus Out.

DEVICE TAG BUS PARITY CHECK – DEV-I 120

A parity error is detected on the Device Tag Bus.

Drive Errors That Cause Error Alert

MULTIPLE HEAD SELECT CHECK – R/W 201

More than one head is selected in the selected drive.

CAPABLE/ENABLE CHECK – R/W 210

One of the following conditions occurs:

- Set Read/Write is present when the drive is not read/write capable (track following).
- Writing is attempted on a data module which is in the Read Only condition.
- Writing is attemtped on a data module while Active Track is not present

WRITE OVERRUN – R/W 220

Writing through an index mark is attempted. It is permissible to write into or out of an Index mark, but not both.

INDEX CHECK – RPI 100

An invalid index mark is detected when Set Read/Write is present.

R/W INTERLOCK CHECK – R/W 240

Indicates that read/write cards or cables may be loose or missing.

CONTROL CHECK – R/W 250

One of the following conditions occurs:

- The Write Gate signal is present with the Unsquelch or Read Gate signals.
- Address Mark Control is present without Read Gate.

TRANSITION CHECK – R/W 260

One of the following occurs:

- Write transitions are not detected four microseconds (nominally) after Write Gate is turned on.
- Write transitions are not present when Write Gate is turned off.
- Write transitions are detected while reading.

WRITE CURRENT CHECK – R/W 270

One of the following occurs:

- No write current is detected during a Write operation.
- Write current is detected while not writing.
- Low gain check (FHFE only) – R/W 290
  incorrect read preamp gain has been detected.

FALSE DRIVE CHECK – DEV-I 240

Drive Check is active without a drive error condition.

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CHECK END CONDITIONS

See OPER 272 for diagram.

The Check End 7 signal may be returned instead of Normal End on the 3340 Controller Interface if one of the following check conditions occurs:

- ECC Data Check 1

  This indicates that the ECC circuits have detected a data check error in the data stream.

- Track Overrun Check 2

  This indicates that a Write operation was still active at Index time of the next logical track.

- Command Overrun Check 3

  This indicates that one of two possible conditions exist:

  1. A nonoriented Write command exists at index time.
  2. An oriented type command is trying to Read or Write in a nonoriented mode.

- No Address Mark Found 4

  This indicates that an Address Mark Search command failed to identify an Address Mark. This may mean that an Index Mark occurred prior to an Address Mark under an AM Search command. Note that AM Search does not hold through a nonactive track to continue an unfulfilled Search. AM Search searches only to the next index pulse on the active track.

- No Sync Byte Found Check 5 (See DATA 135).

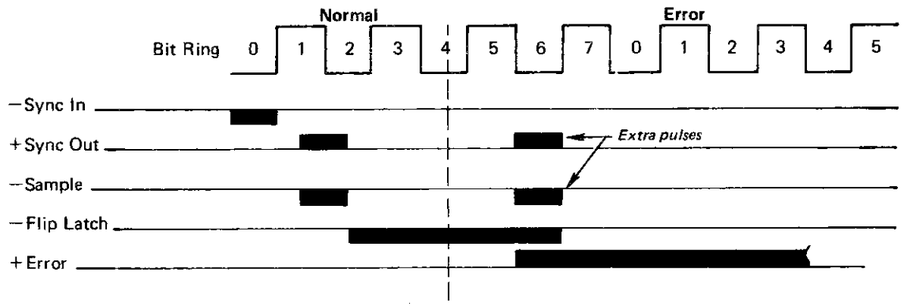
  This indicates that one of three possible conditions exist:

  1. There is no Sync Byte detectable in the Home Address area.
  2. There is no Sync Byte detectable in either the Gap 2 or Gap 3 area being searched.
  3. A false Address Mark. A void or erased area exists on a track, that looks similar to an Address Mark, but no Sync Byte exists.

- Sync Out Signal Time Check 6

  This indicates that either:

  1. A Sync Out signal was identified on the Controller Interface, which was not a response to a prior Sync In signal.



  2. A Controller Interface Sync Out signal is either missing or late. A Service Response remembers that a Sync In has previously been issued to the Controller Interface. If, by Bit Ring 7 time, the Sync Out line of the Controller Interface has failed to respond, the Sync Out Signal Time Check latch is set.

CHECK END CONDITIONS