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IBM Maintenance Information

VOL. R01	VOL. R02	VOL. R03	VOL. R04	VOL. R05	VOL. R06
INDEX MLX LGND START FSI MSG SENSE MICRO	OLT OPER PANEL CTL-I	DEV-I DATA	HDA ACC	R/W RPI PWR LOC INST	MICFL

Volumes R01 through R06 accompany each Control Module and support all 3350s attached.

3350 Disk Storage

3350	DA0000 Seq. 1 of 2	2358631 Part No.	441300 31 Mar 76				

PREFACE

MAINTENANCE INFORMATION MANUAL ORDERING PROCEDURE (IBM Internal)

Individual pages of the 3350 Maintenance Information Manual 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.

This manual was prepared by the IBM General Products Division, Technical Publishing, Department G26, San Jose, California 95193.

SAFETY

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

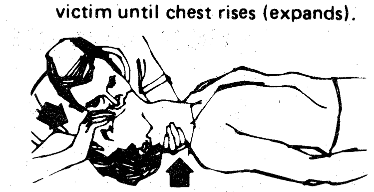
General Considerations

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

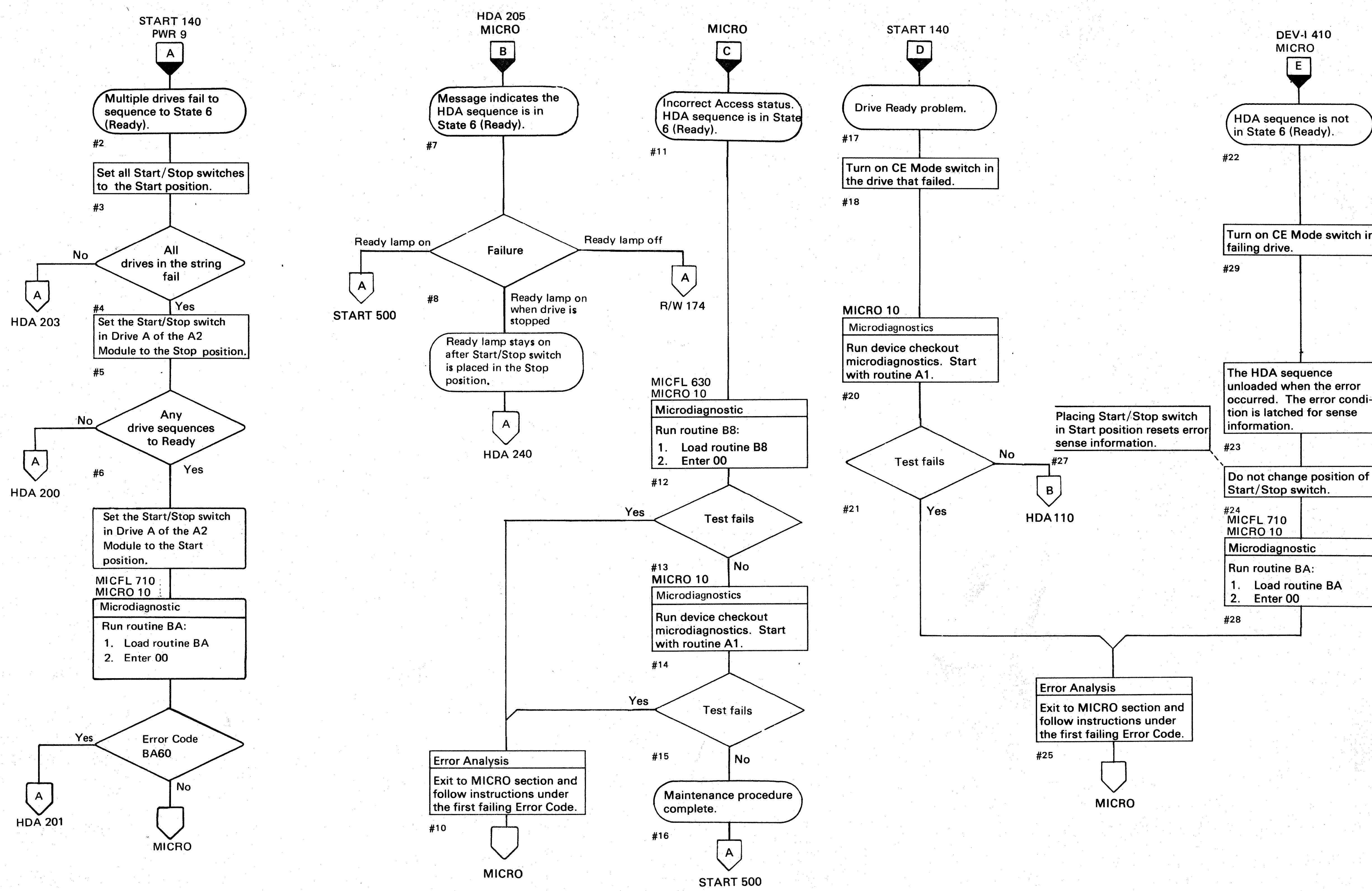
1. Place victim on back; lift neck and tilt head way back. (Quickly remove any noticeable food or objects from mouth.)

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

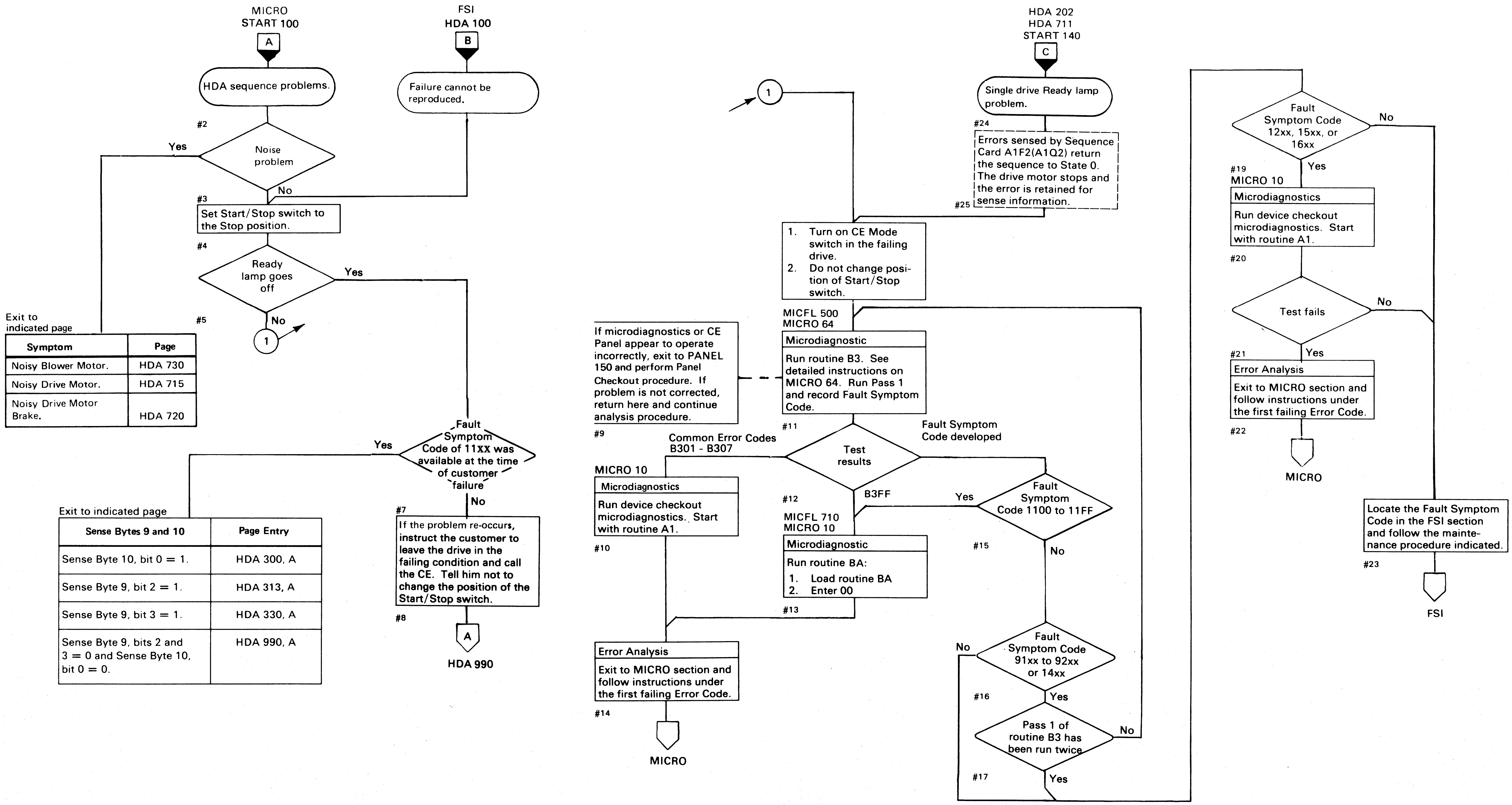


3. Continue breathing for the victim 12 times per minute WITHOUT STOPPING.
4. If chest does not rise (expand), roll victim onto side and pound firmly between shoulder blades to remove blocking material. Also, try lifting jaw higher with your fingers. Resume rescue breathing.

HDA CONTENTS


START 140
PWR 9
A
Multiple drives fail to sequence to State 6 (Ready).
#2
Set all Start/Stop switches to the Start position.
#3
All drives in the string fail
No
A
HDA 203
#4
Yes
Set the Start/Stop switch in Drive A of the A2 Module to the Stop position.
#5
Any drive sequences to Ready
No
A
HDA 200
#6
Yes
Set the Start/Stop switch in Drive A of the A2 Module to the Start position.
MICFL 710
MICRO 10
Microdiagnostic
Run routine BA:
1. Load routine BA
2. Enter 00
Error Code BA60
Yes
A
HDA 201
No
MICRO
HDA 205
MICRO
B
Message indicates the HDA sequence is in State 6 (Ready).
#7
Failure
Ready lamp on
A
START 500
#8
Ready lamp off
A
R/W 174
Ready lamp on when drive is stopped
Ready lamp stays on after Start/Stop switch is placed in the Stop position.
A
HDA 240
Error Analysis
Exit to MICRO section and follow instructions under the first failing Error Code.
#10
MICRO
MICRO
C
Incorrect Access status. HDA sequence is in State 6 (Ready).
#11
MICFL 630
MICRO 10
Microdiagnostic
Run routine B8:
1. Load routine B8
2. Enter 00
#12
Test fails
Yes
#13
No
MICRO 10
Microdiagnostics
Run device checkout microdiagnostics. Start with routine A1.
#14
Test fails
Yes
#15
No
Maintenance procedure complete.
#16
A
START 500
START 140
D
Drive Ready problem.
#17
Turn on CE Mode switch in the drive that failed.
#18
MICRO 10
Microdiagnostics
Run device checkout microdiagnostics. Start with routine A1.
#20
Test fails
#21
No
#27
B
HDA 110
Yes
Placing Start/Stop switch in Start position resets error sense information.
DEV-I 410
MICRO
E
HDA sequence is not in State 6 (Ready).
#22
Turn on CE Mode switch in failing drive.
#29
The HDA sequence unloaded when the error occurred. The error condition is latched for sense information.
#23
Do not change position of Start/Stop switch.
#24
MICFL 710
MICRO 10
Microdiagnostic
Run routine BA:
1. Load routine BA
2. Enter 00
#28
Error Analysis
Exit to MICRO section and follow instructions under the first failing Error Code.
#25
MICRO

DRIVE-MOTOR POWER SEQUENCING



Symptom	Page
Noisy Blower Motor.	HDA 730
Noisy Drive Motor.	HDA 715
Noisy Drive Motor Brake.	HDA 720

Sense Bytes 9 and 10	Page Entry
Sense Byte 10, bit 0 = 1.	HDA 300, A
Sense Byte 9, bit 2 = 1.	HDA 313, A
Sense Byte 9, bit 3 = 1.	HDA 330, A
Sense Byte 9, bits 2 and 3 = 0 and Sense Byte 10, bit 0 = 0.	HDA 990, A

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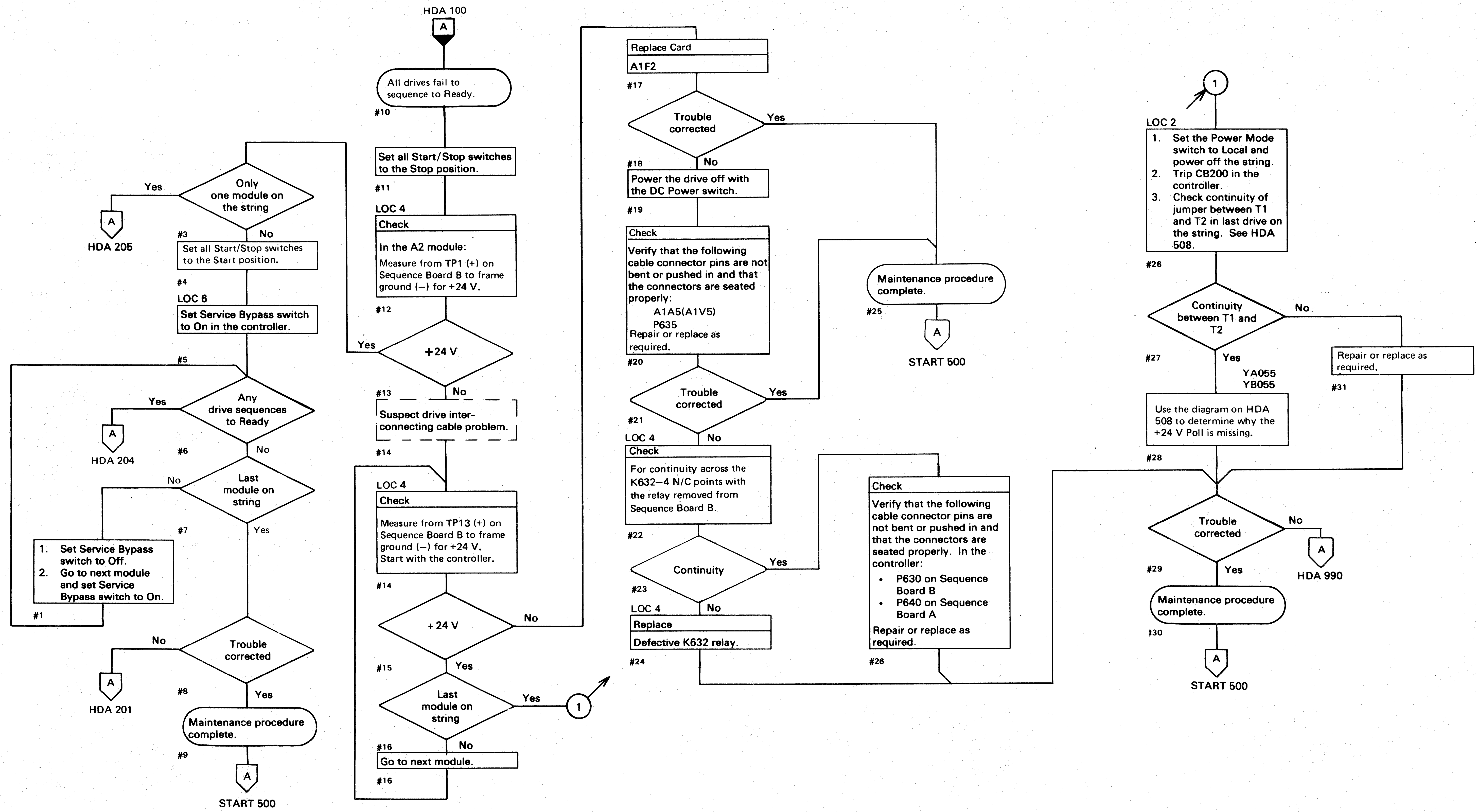
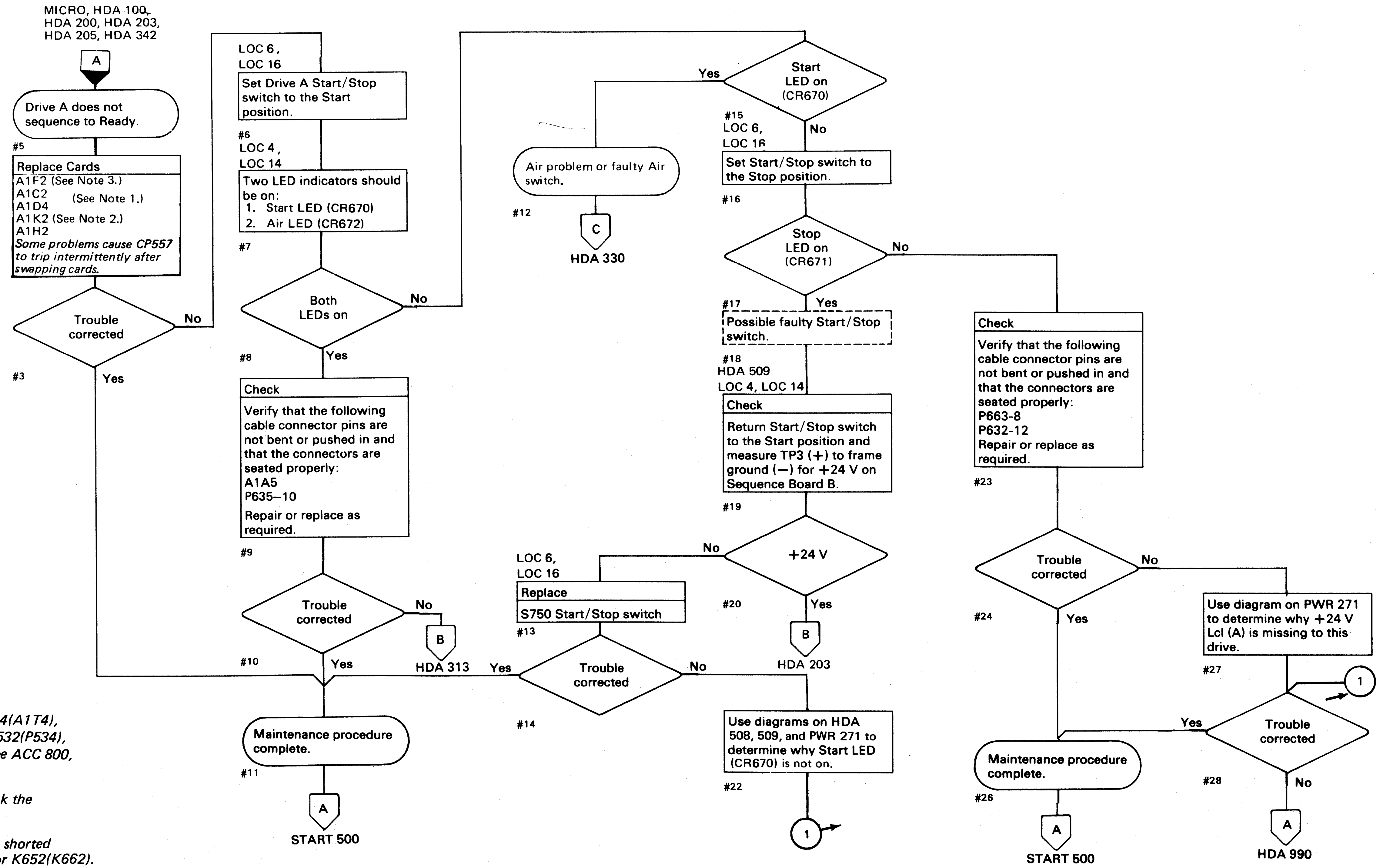
DC0110 Seq. 1 of 2	2358315 Part No.	441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441306 1 Apr 77	



DC0110 Seq. 2 of 2	2358315 Part No.

441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441306 1 Apr 77	

SEQUENCE LOCKED IN STATE 0



Note 1: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

Note 2: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

Note 3: *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*

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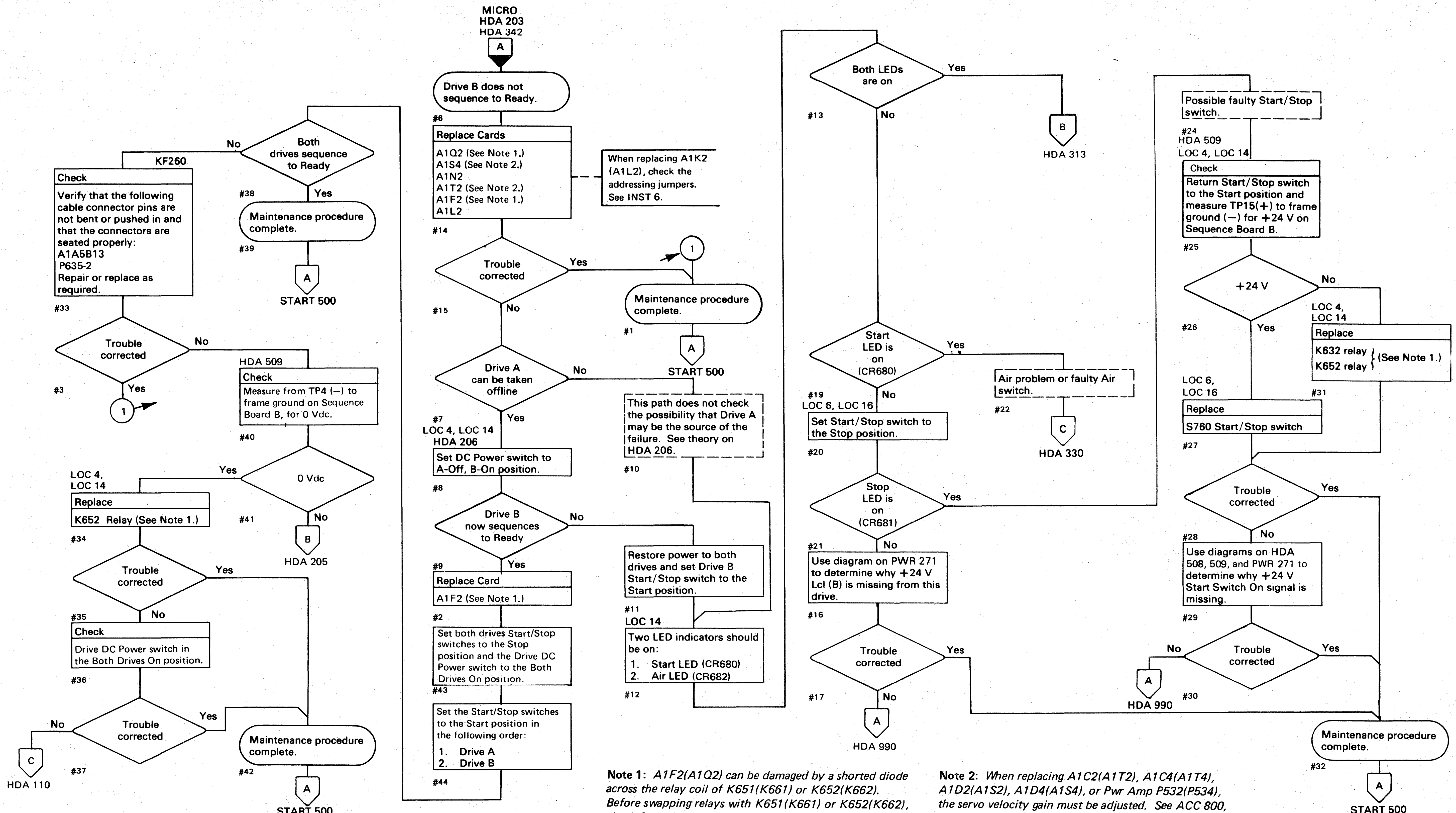
DC0201 Seq. 1 of 2	2358316 Part No.	441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441306 1 Apr 77	

SEQUENCE LOCKED IN STATE 0

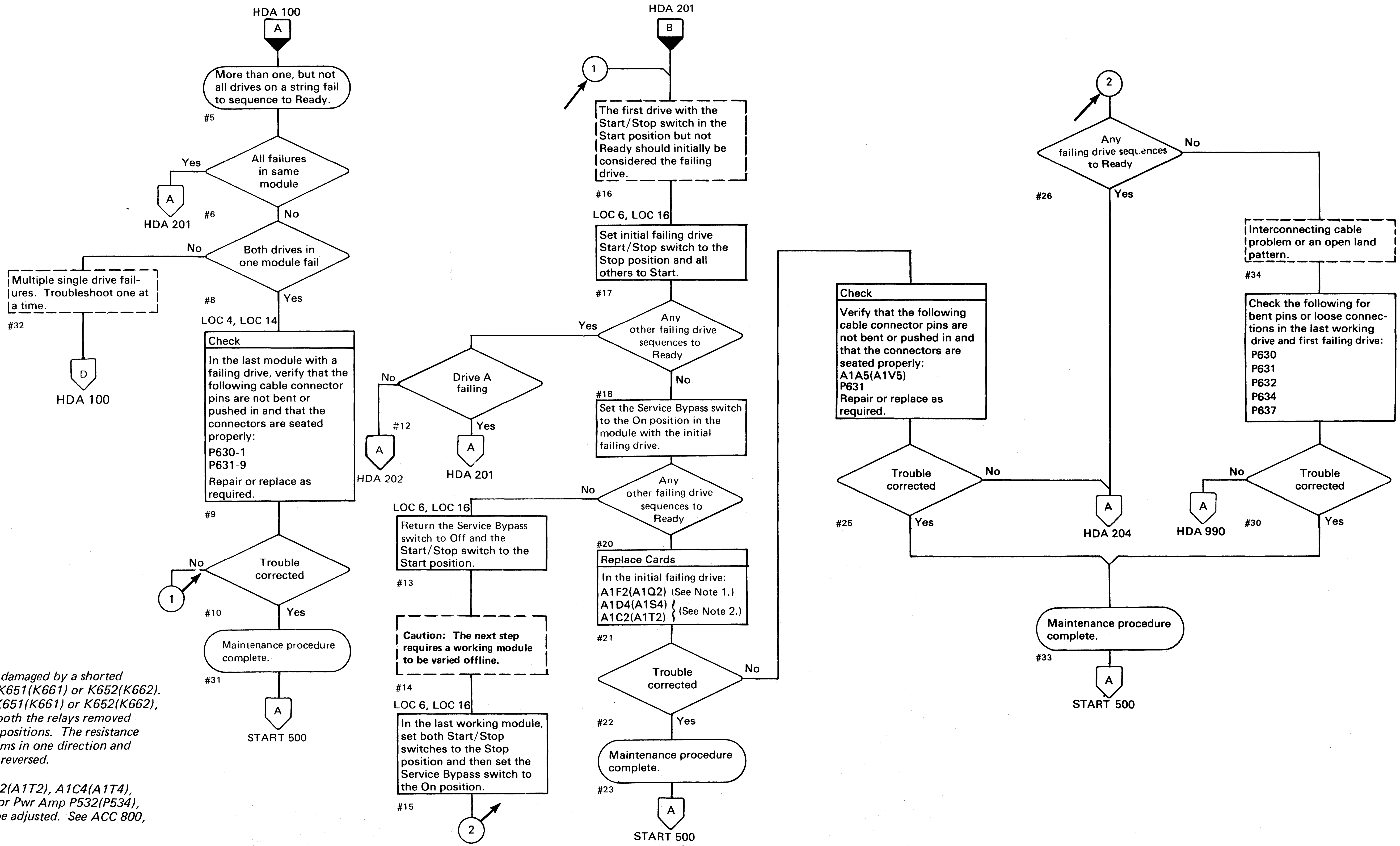


Note 1: *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*

Note 2: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

DC0201 Seq. 2 of 2	2358316 Part No.	441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441306 1 Apr 77	

SEQUENCE LOCKED IN STATE 0



Note 1: *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*

Note 2: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

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DC0203 Seq. 1 of 2	2358317 Part No.	441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441306 1 Apr 77	441310 27 Jun 80

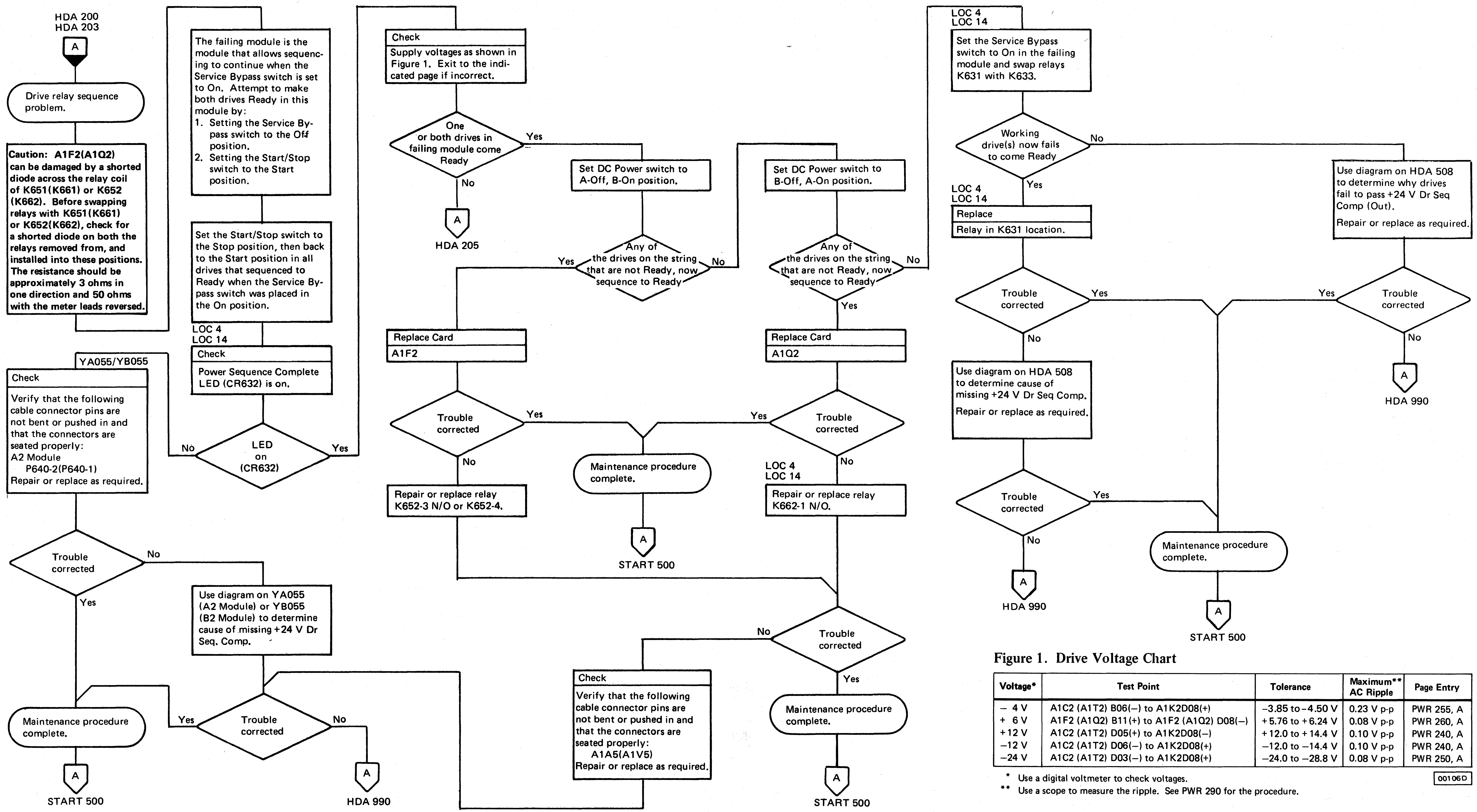


Figure 1. Drive Voltage Chart

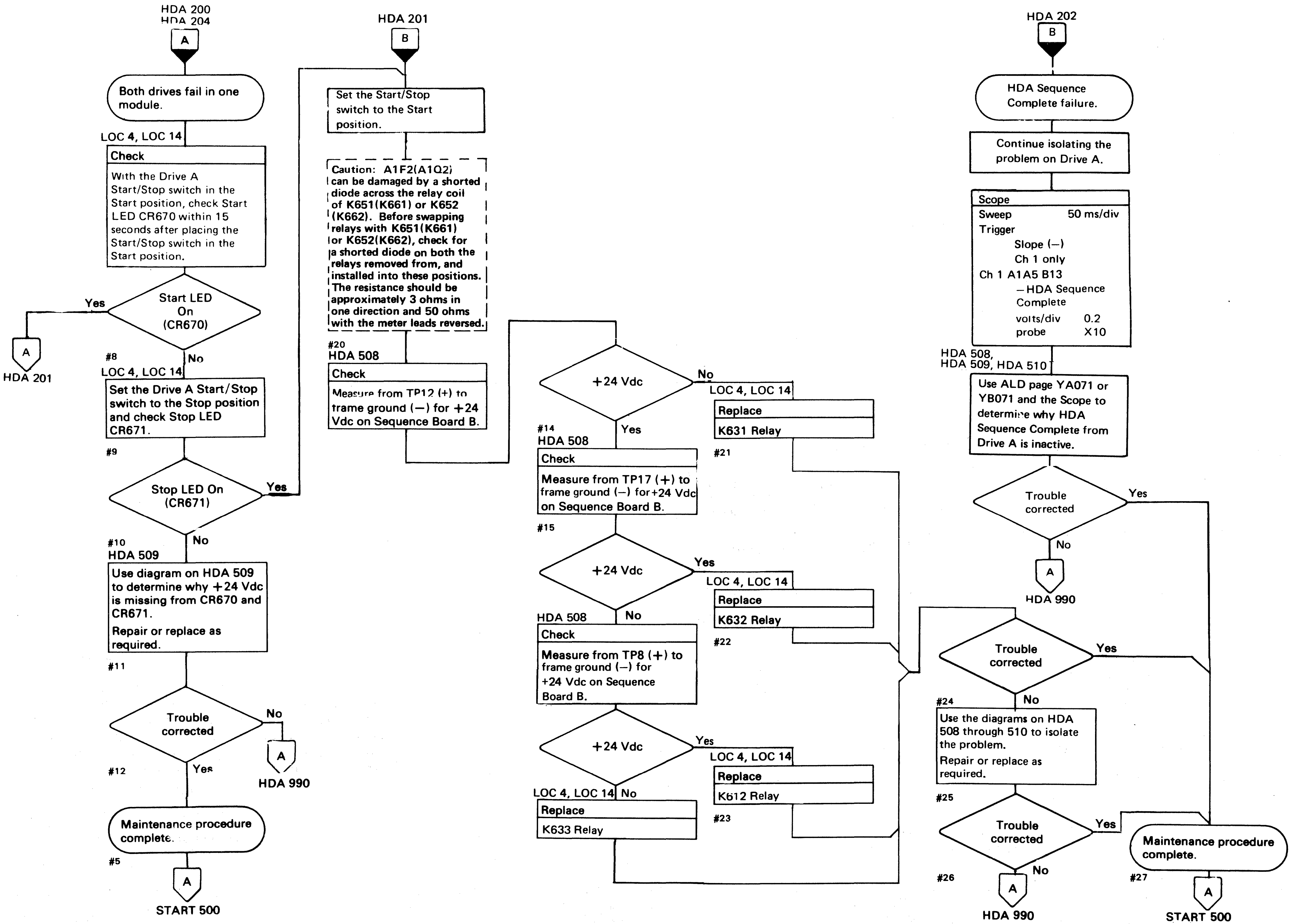
Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
− 4 V	A1C2 (A1T2) B06(−) to A1K2D08(+)	−3.85 to −4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

* Use a digital voltmeter to check voltages.

** Use a scope to measure the ripple. See PWR 290 for the procedure.

00106D

SEQUENCE LOCKED IN STATE 0



DC0205 Seq. 1 of 2	2358318 Part No.	441300 31 Mar 76	441303 30 Jul 76	441306 1 Apr 77		

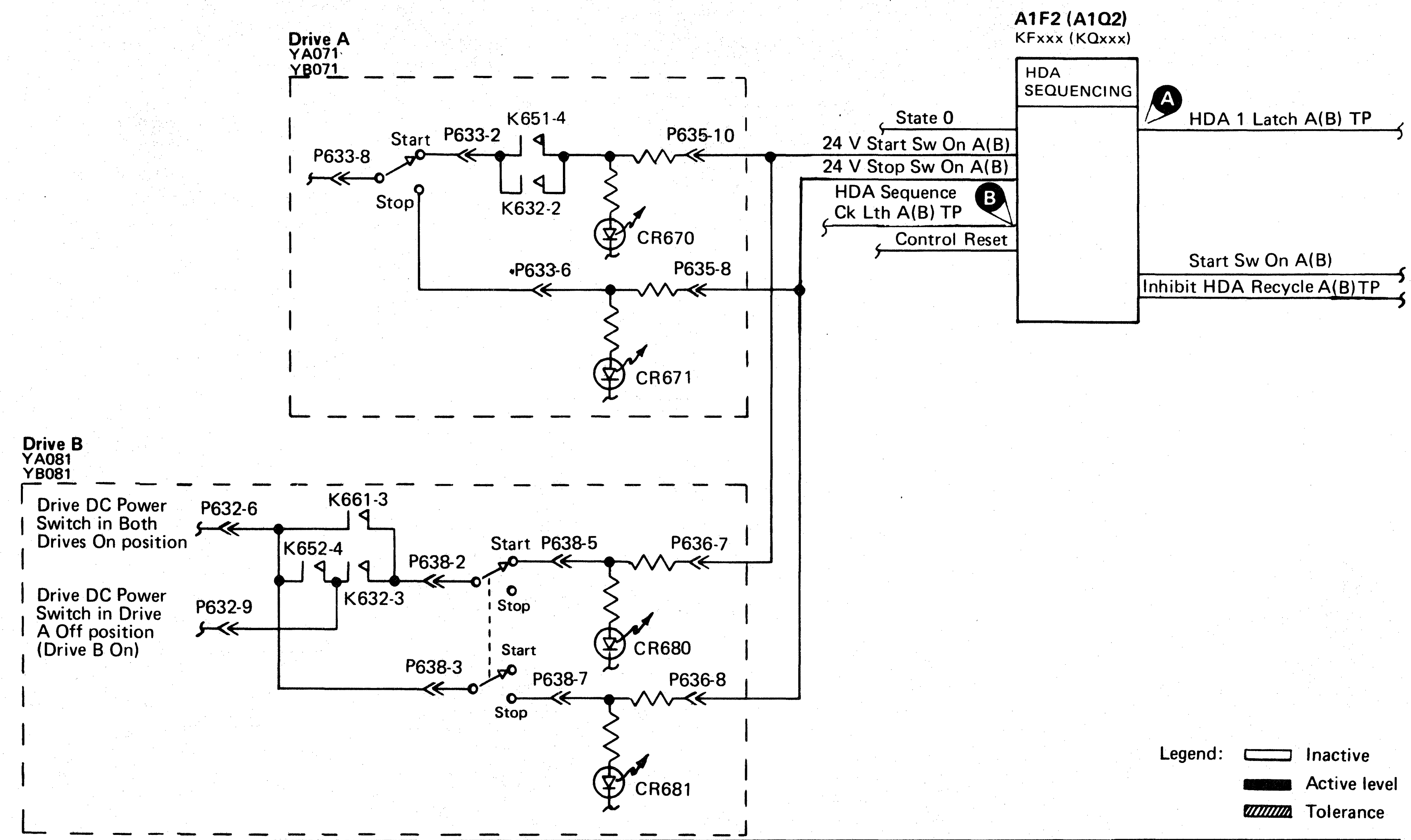
SEQUENCE LOCKED IN STATE 0

To advance from State 0 to State 1, the following lines must be in the indicated condition:

- 24 V Start Sw On is active *.
- State 0 is active.
- Inhibit HDA Recycle is inactive.
- HDA Sequence Ck Lth is inactive.
- Power On Reset is inactive.

*Relay K632 must be picked in order to activate the +24 V Start Sw On line in Drive A. The +24 V Start Sw On line in Drive B is activated by both K632 and K652 being picked. If the Drive DC Power switch is in the Drive A Off (Drive B On) position, the +24 V Start Sw On line in Drive B is activated by K632 only.

See HDA 508 through 510 for additional theory.

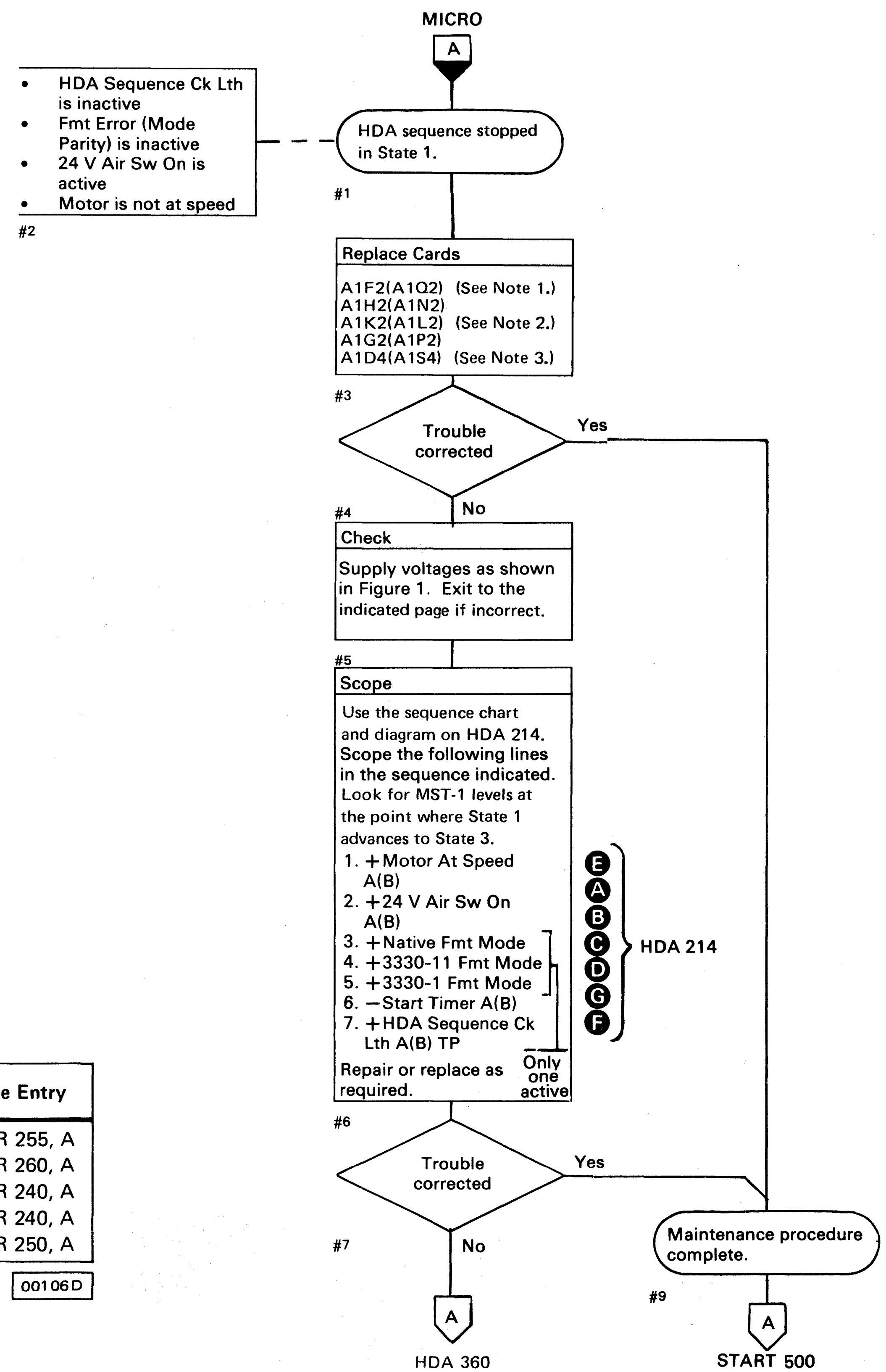


Legend: Inactive; Active level; Tolerance

Chart Line No.	Line Name	ALD	Test Point		States 0	States 1
1	+24 V Start Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) U12			
2	+Start Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) U11			
3	+Inhibit HDA Recycle A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) G05			Inactive
4	+HDA Sequence Ck Lth A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) B12	B		Inactive
5	+HDA 1 Latch A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) B07	A		
6	K632–2 N/O (K632–3 N/O)	YA071 (YA081) YB071 (YB081)				
7	Power On Reset	KF140 (KQ140)	A1F2 (A1Q2) P02			Inactive

DC0205 Seq. 2 of 2	2358318 Part No.	441300 31 Mar 76	441303 30 Jul 76	441306 1 Apr 77		

SEQUENCE LOCKED IN STATE 1



Note 1: *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*

Note 2: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

Note 3: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

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+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

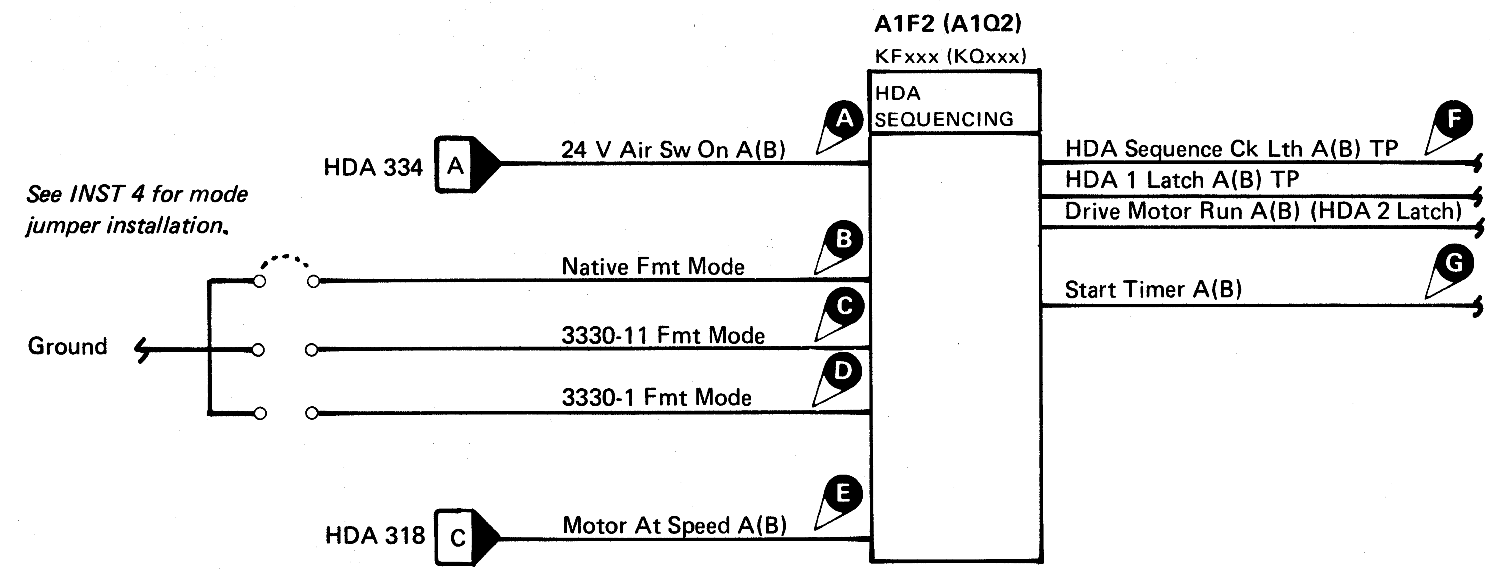
00106D

SEQUENCE LOCKED IN STATE 1

To advance from State 1 to State 3, the following lines must be in the indicated condition:

- 24 V Air Sw On is active.
- One of the three Fmt (format) Mode lines is active.
- HDA Sequence Ck Lth A(B) TP is inactive.
- Motor At Speed is inactive.

See HDA 500 through 510 for additional theory.



Legend: Inactive; Active level; Tolerance

Chart Line No.	Line Name	ALD	Test Point		States (←1→ ←3→)
1	+HDA 1 Latch A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) B07		
2	+Drive Motor Run A(B) (HDA 2 Latch)	KF200 (KQ200)	A1F2 (A1Q2) D09		
3	+24 V Air Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) S10	A	
4	+Motor At Speed A(B)	KF130 (KQ130)	A1F2 (A1Q2) U03	E	Inactive
5	−Start Timer A(B)	KF170 (KQ170)	A1F2 (A1Q2) G09	G	Inactive
6	+HDA Sequence Ck Lth A(B) TP	KF160 (KQ160)	A1F2 (A1Q2) B12	F	Inactive
7	+Native Fmt Mode	KF110 (KQ110)	A1F2 (A1Q2) S08	B	
8	+3330-11 Fmt Mode	KF120 (KQ120)	A1F2 (A1Q2) G08	C	
9	+3330-1 Fmt Mode	KF120 (KQ120)	A1F2 (A1Q2) M08	D	

One mode always active (shown in Native Mode)

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SEQUENCE ERROR OCCURRED IN STATE 3

To advance from State 3 to State 2, the following conditions must exist:

- Drive Motor Run is active.
- 15-Second Timer ends.
- HDA Sequence Ck Lth is inactive.

At the end of 15 seconds, if Motor At Speed is active, the HDA 1 Latch turns off, advancing the HDA sequence from State 3 to State 2.

See HDA 500 through 510 for additional theory.

Note: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

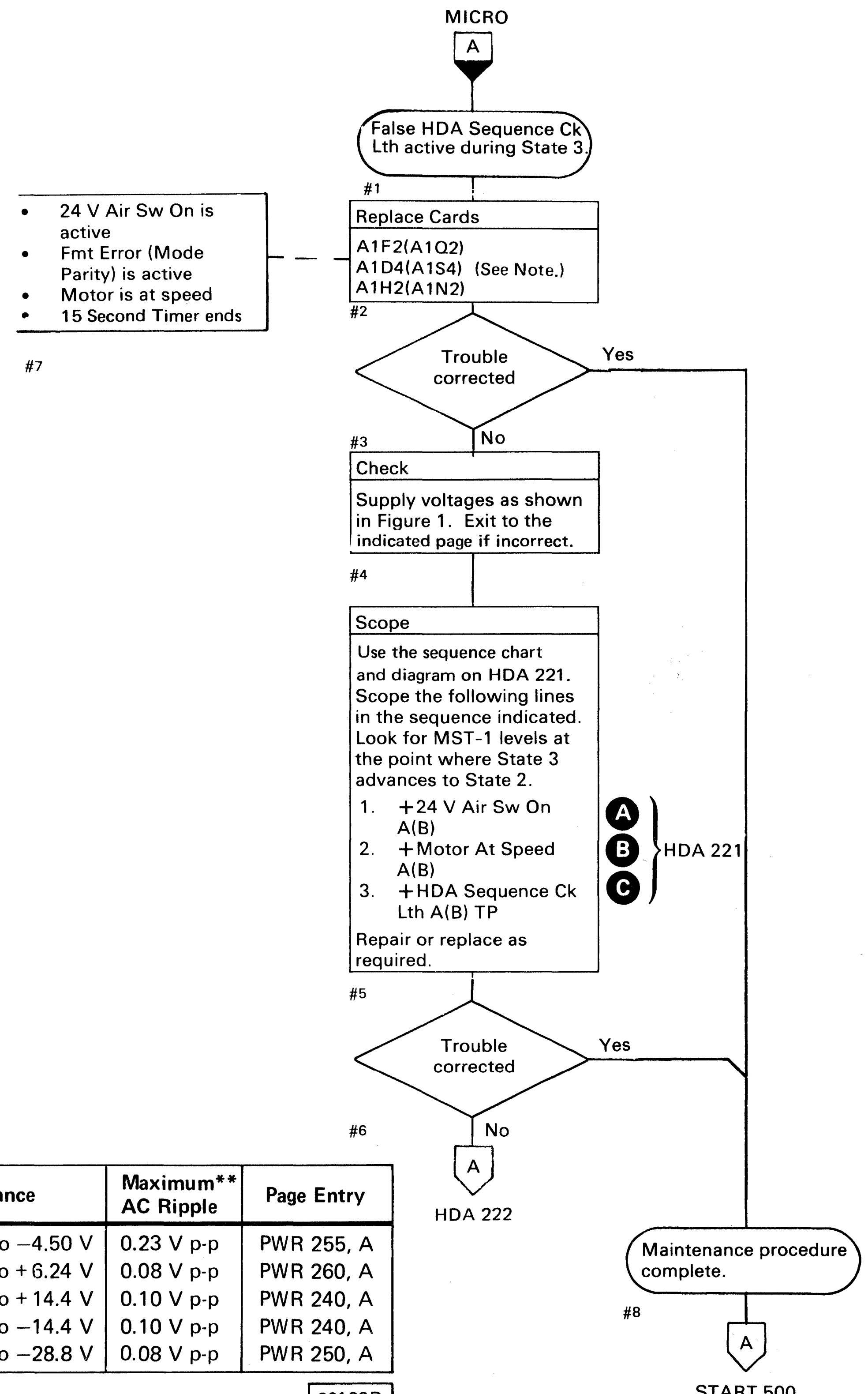

Figure 1. Drive Voltage Chart

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
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+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

00106D

DC0220 Seq. 1 of 2	2358320 Part No.	441300 31 Mar 76	441303 30 Jul 76	441310 27 Jun 80		

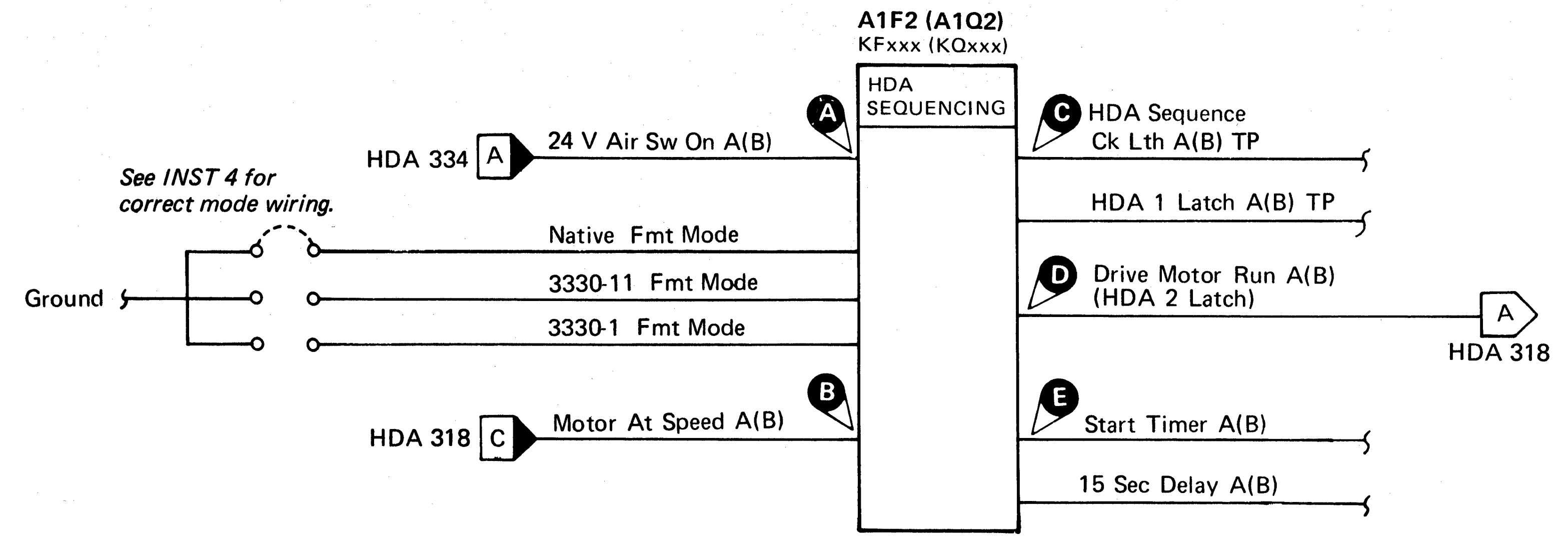
SEQUENCE ERROR OCCURRED IN STATE 3

To advance from State 3 to State 2, the following conditions must exist:

- Motor At Speed is active.
- 15-Second Timer ends.
- 24 V Air Sw On is active.
- HDA Sequence Ck Lth is inactive.

At the end of 15 seconds, if Motor At Speed is active, the HDA 1 Latch turns off, advancing the HDA sequence from State 3 to State 2.

See HDA 500 through 510 for additional theory.



Legend: Inactive; Active level; Tolerance

Chart Line No.	Line Name	ALD	Test Point		States: 3 (15 Sec)	States: 2
1	+HDA 1 Latch A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) B07		4, 12	
2	+Drive Motor Run A(B) (HDA 2 Latch)	KF200 (KQ200)	A1F2 (A1Q2) D09	D		
3	−Start Timer A(B)	KF170 (KQ170)	A1F2 (A1Q2) G09	E	1,2	
4	−15 Second Delay A(B)	KF170 (KQ170)	A1F2 (A1Q2) G11		3	
5	+HDA Sequence Ck Lth A(B) TP	KF160 (KQ160)	A1F2 (A1Q2) B12	C	Inactive	
6	+Motor At Speed A(B)	KF130 (KQ130)	A1F2 (A1Q2) U03	B		
7	+24 V Air Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) S10	A		

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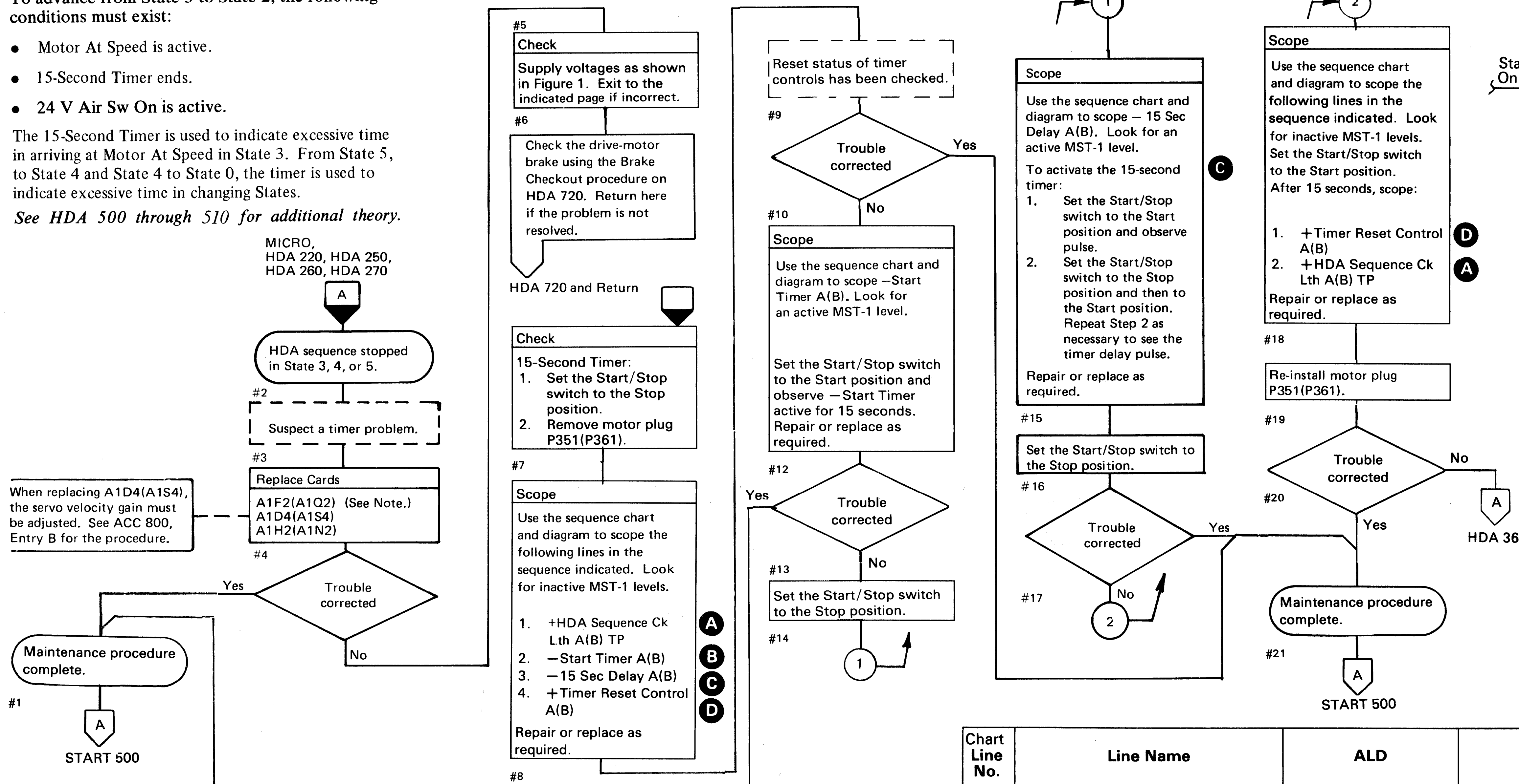
SEQUENCE ERROR OCCURRED IN STATE 3

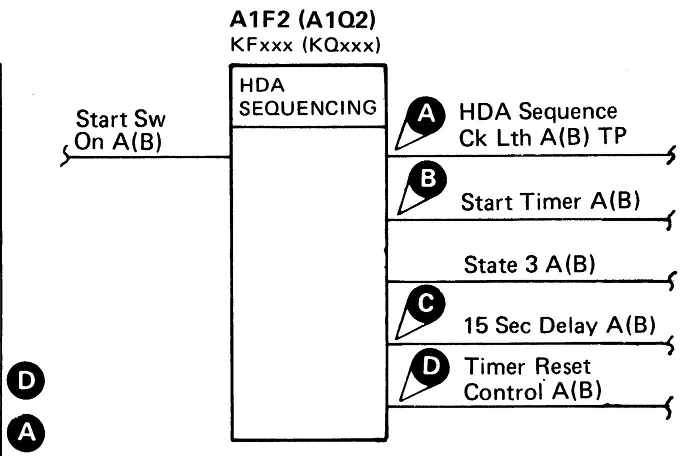
To advance from State 3 to State 2, the following conditions must exist:

- Motor At Speed is active.
- 15-Second Timer ends.
- 24 V Air Sw On is active.

The 15-Second Timer is used to indicate excessive time in arriving at Motor At Speed in State 3. From State 5, to State 4 and State 4 to State 0, the timer is used to indicate excessive time in changing States.

See HDA 500 through 510 for additional theory.





Note: *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*

Figure 1. Drive Voltage Chart

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
− 4 V	A1C2 (A1T2) B06(−) to A1K2D08(+)	−3.85 to −4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

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* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

Legend: Inactive; Active level; Tolerance

Chart Line No.	Line Name	ALD	Test Point		States (0, 1, 2)
1	+Start Sw on A(B)	KF120 (KQ120)	A1F2 (A1Q2) D13		
2	+HDA Sequence Ck Lth A(B) TP	KF160 (KQ160)	A1F2 (A1Q2) B12	A	
3	−Start Timer A(B)	KF170 (KQ170)	A1F2 (A1Q2) G09	B	
4	−15 Sec Delay A(B)	KF170 (KQ170)	A1F2 (A1Q2) G11	C	
5	+Timer Reset Control A(B)	KF170 (KQ170)	A1F2 (A1Q2) J13	D	
6	+State 3 A(B)	KF220 (KQ220)	A1F2 (A1Q2) B09		

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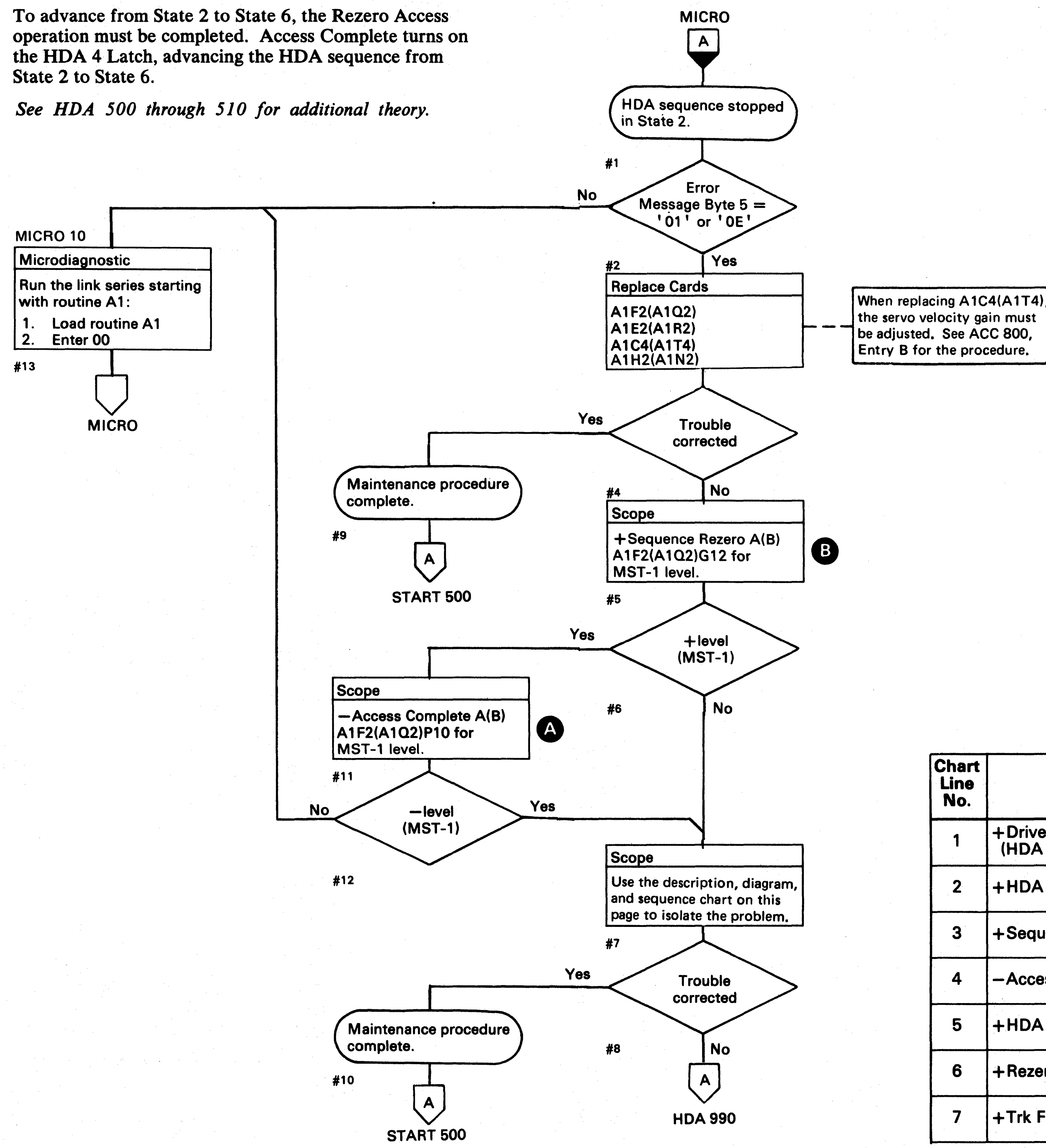
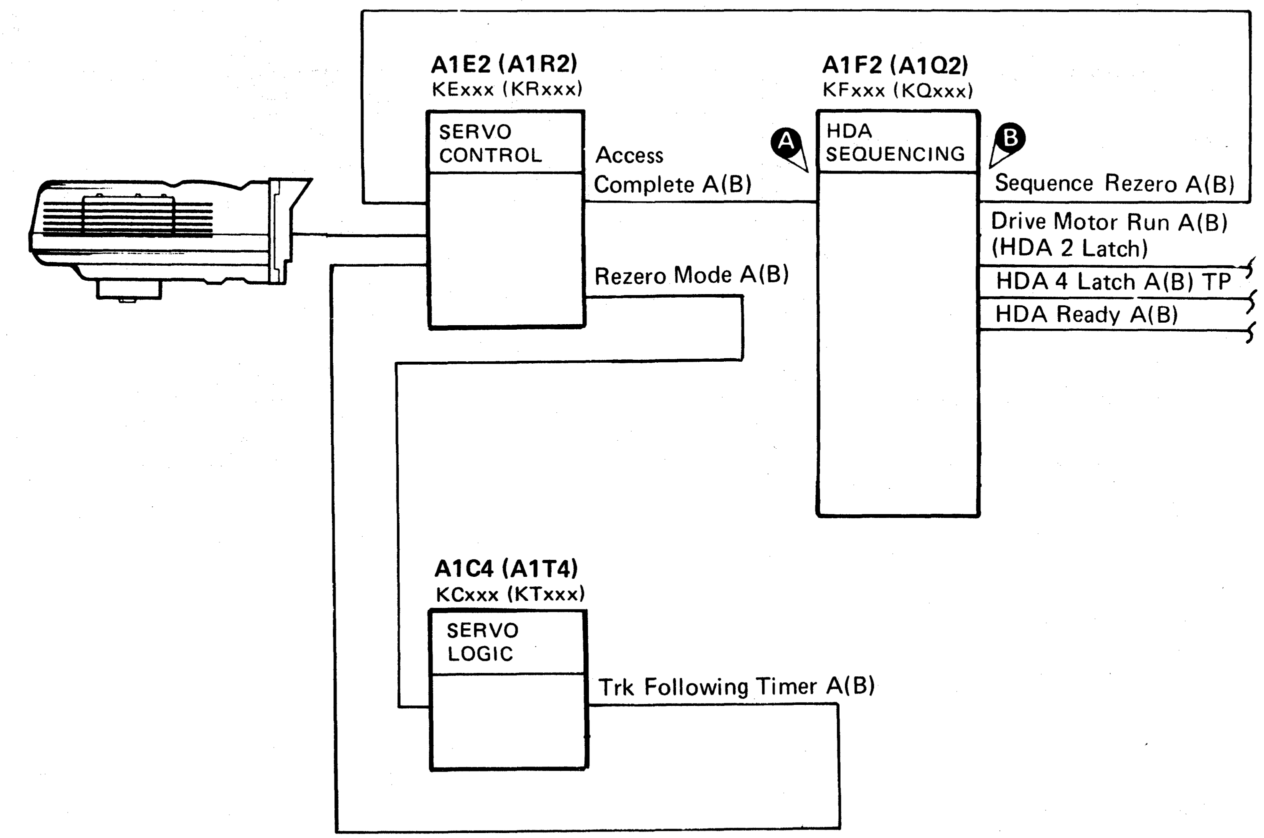
SEQUENCE ERROR OCCURRED IN STATE 2

To advance from State 2 to State 6, the Rezero Access operation must be completed. Access Complete turns on the HDA 4 Latch, advancing the HDA sequence from State 2 to State 6.

See HDA 500 through 510 for additional theory.





Legend: Inactive; Active level; Tolerance

Chart Line No.	Line Name	ALD	Test Point		States 2	States 6
1	+Drive Motor Run A(B) (HDA 2 Latch)	KF200 (KQ200)	A1F2 (A1Q2) D09			
2	+HDA 4 Latch A(B) TP	KF210 (KQ210)	A1F2 (A1Q2) D11			4
3	+Sequence Rezero A(B)	KF150 (KQ150)	A1F2 (A1Q2) G12	B	1	
4	−Access Complete A(B)	KF150 (KQ150)	A1F2 (A1Q2) P10	A		
5	+HDA Ready A(B)	KE150 (KR150)	A1E2 (A1R2) J13			1,2
6	+Rezero Mode A(B)	KE150 (KR150)	A1E2 (A1R2) D13			
7	+Trk Following Timer A(B)	KE110 (KR110)	A1E2 (A1R2) M04			

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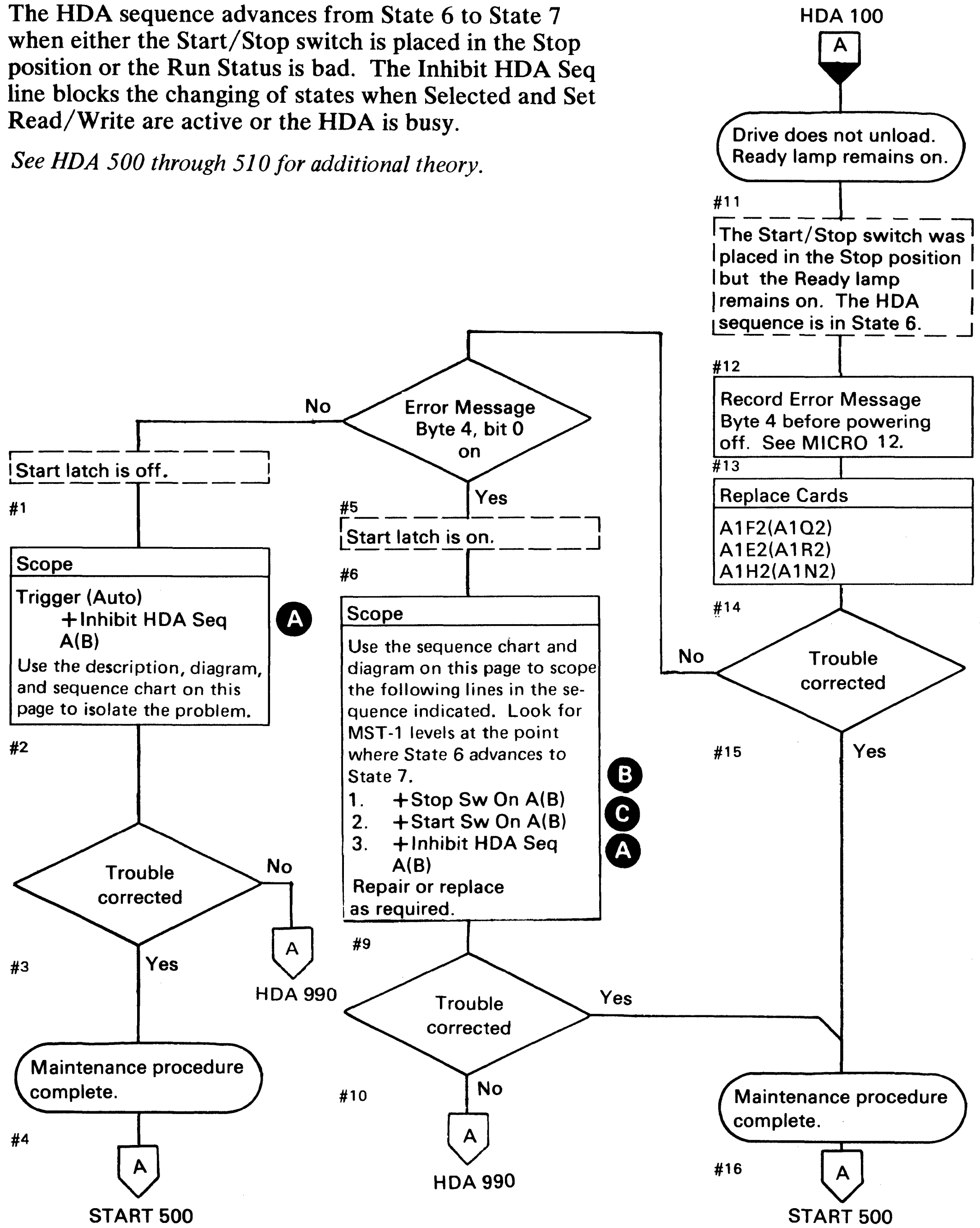
SEQUENCE ERROR OCCURRED IN STATE 6

The HDA sequence advances from State 6 to State 7 when either the Start/Stop switch is placed in the Stop position or the Run Status is bad. The Inhibit HDA Seq line blocks the changing of states when Selected and Set Read/Write are active or the HDA is busy.

See HDA 500 through 510 for additional theory.



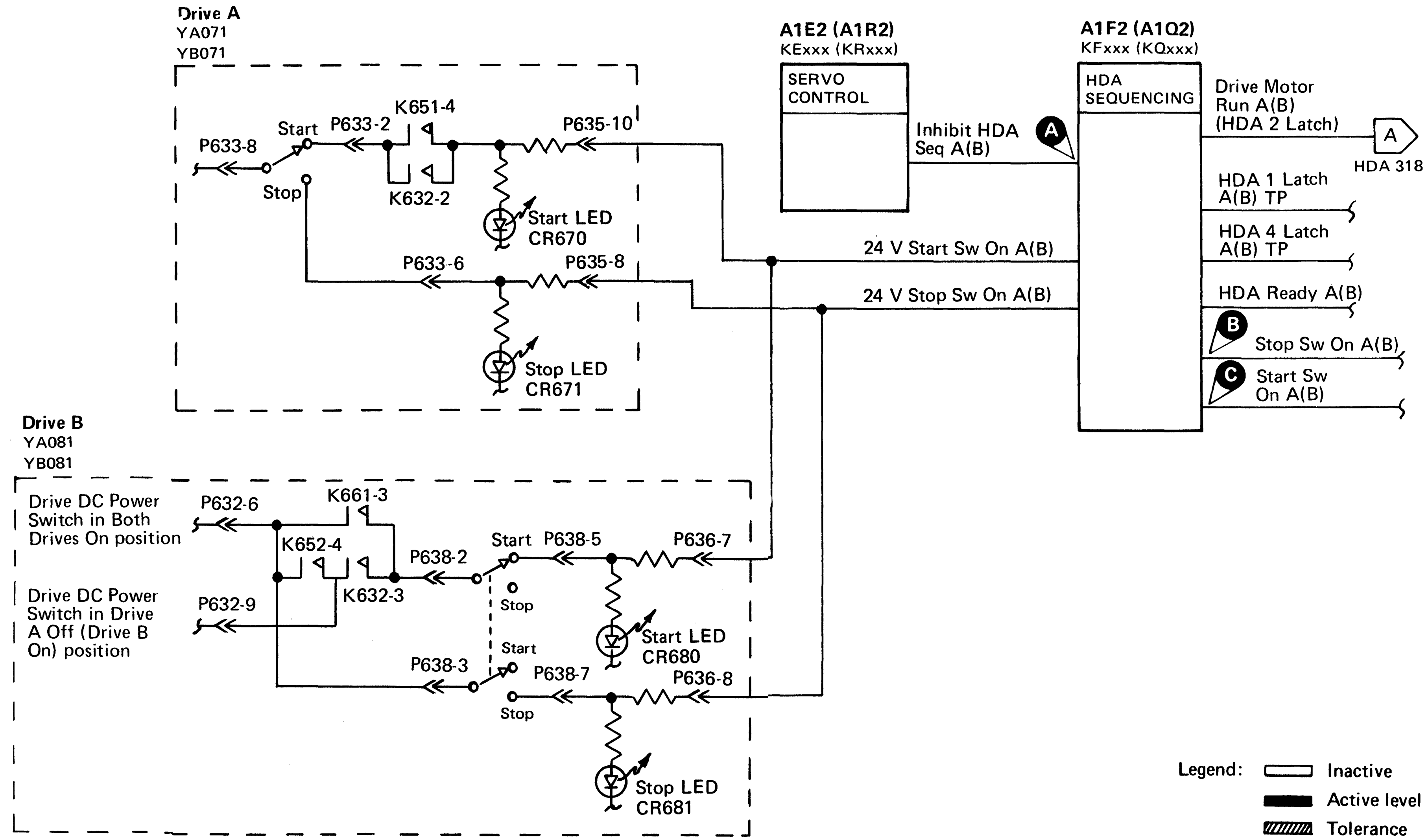


Chart Line No.	Line Name	ALD	Test Point		States 6	States 7
1	+HDA 1 Latch A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) B07			6,8
2	+Drive Motor Run A(B) (HDA 2 Latch)	KF200 (KQ200)	A1F2 (A1Q2) D09			
3	+HDA 4 Latch A(B) TP	KF210 (KQ210)	A1F2 (A1Q2) D11			
4	+HDA Ready A(B)	KF220 (KQ220)	A1F2 (A1Q2) B10		1	
5	+Stop Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) S09	B		
6	+Inhibit HDA Seq A(B)	KF130 (KQ130)	A1F2 (A1Q2) B13	A	Inactive	
7	+24 V Stop Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) U10			
8	+Start Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) U11	C	5	
9	+24 V Start Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) U12		7	

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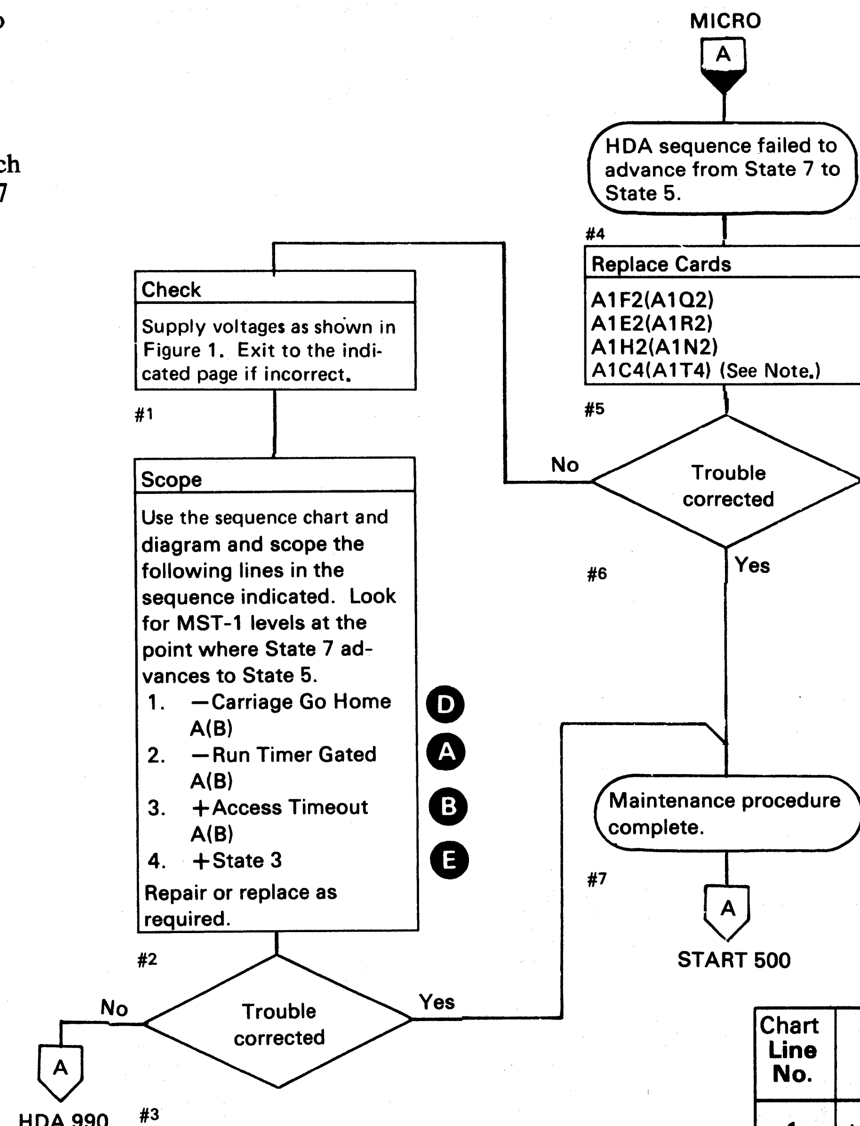
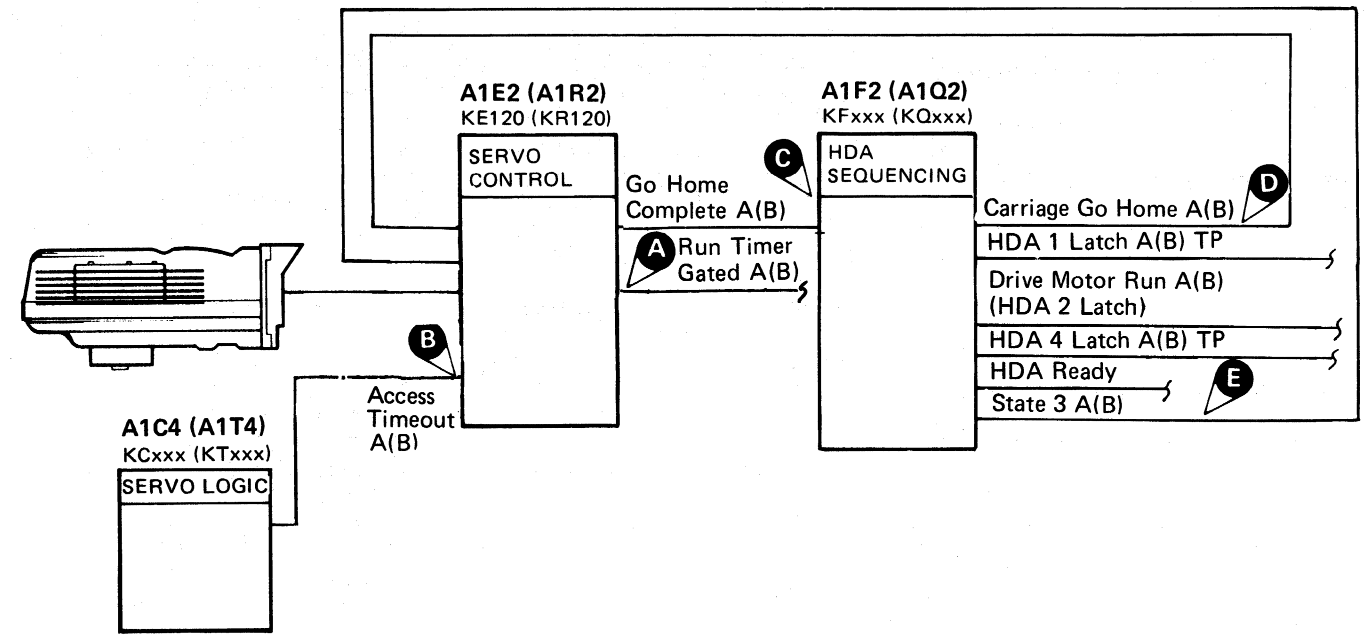
SEQUENCE ERROR OCCURRED IN STATE 7

The HDA checks the Run Status and sends Carriage Go Home to the servo. If Run Status is bad, the Inhibit HDA Recycle latch is set, signaling an HDA Sequence error to the system. Run Timer Gated is activated by Carriage Go Home. Within 220 ms, Access Timeout is activated, generating Go Home Complete. HDA 2 Latch is turned off, advancing the HDA sequence from State 7 to State 5. Carriage Go Home is reset in State 3 of the next HDA load sequence.

See HDA 500 through 510 for additional theory.





Note: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

Legend: Inactive / Active level / Tolerance

Chart Line No.	Line Name	ALD	Test Point		States	
1	+HDA 1 Latch A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) B07			
2	+Drive Motor Run A(B) (HDA 2 Latch)	KF200 (KQ200)	A1F2 (A1Q2) D09		5	
3	+HDA 4 Latch A(B) TP	KF210 (KQ210)	A1F2 (A1Q2) D11			
4	−Carriage Go Home A(B)	KF150 (KQ150)	A1F2 (A1Q2) M02	D		
5	−Go Home Complete A(B)	KF200 (KQ200)	A1F2 (A1Q2) G02	C		8
6	+State 3 A(B)	KF220 (KQ220)	A1F2 (A1Q2) B09	E	Inactive	
7	−Run Timer Gated A(B)	KE120 (KR120)	A1E2 (A1R2) P04	A	1,2,3	
8	+Access Timeout A(B)	KE120 (KR120)	A1E2 (A1R2) M10	B		7

Figure 1. Drive Voltage Chart

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
− 4 V	A1C2 (A1T2) B06(−) to A1K2D08(+)	−3.85 to −4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

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* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

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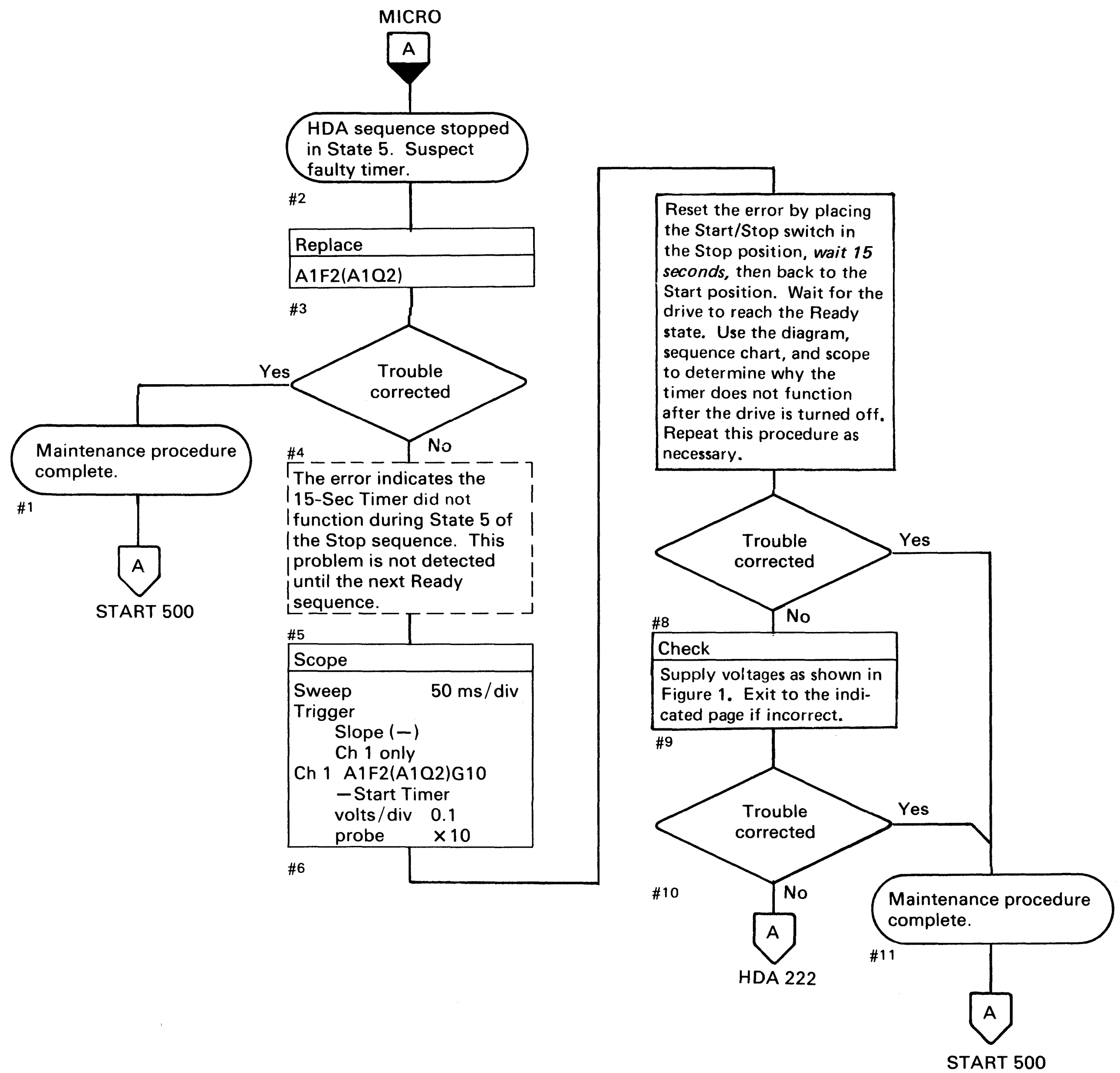
HDA SEQUENCE ERROR OCCURRED IN STATE 5

The following actions occur as the HDA sequence enters State 5:

- 15-Second Timer starts.
- Drive-Motor Run is de-activated.
- The brake de-energizes.

At completion of the 15-second timeout, the HDA 1 latch is turned off, advancing the HDA sequence from State 5 to State 4.

See HDA 500 through 510 for additional theory.



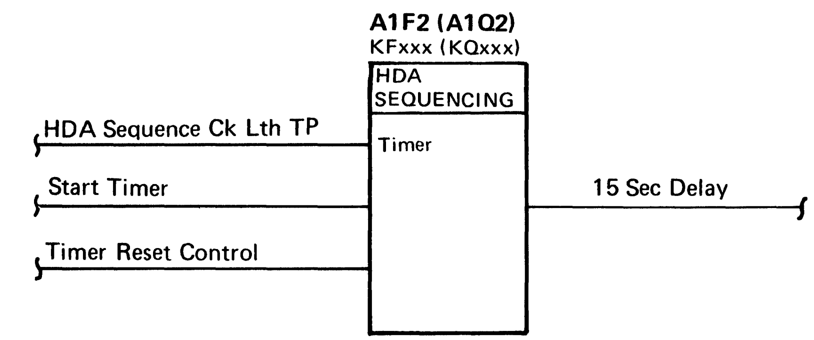


Figure 1. Drive Voltage Chart

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
− 4 V	A1C2 (A1T2) B06(−) to A1K2D08(+)	−3.85 to −4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

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Chart Line No.	Line Name	ALD	Test Point	
1	−Start Timer	KF170 (KQ170)	A1F2 (A1Q2) G09	
2	+HDA Sequence Ck Lth	KF170 (KQ170)	A1F2 (A1Q2) B12	
3	−15 Sec Delay	KF170 (KQ170)	A1F2 (A1Q2) G11	
4	+Timer Reset Control	KF170 (KQ170)	A1F2 (A1Q2) J13	

3350

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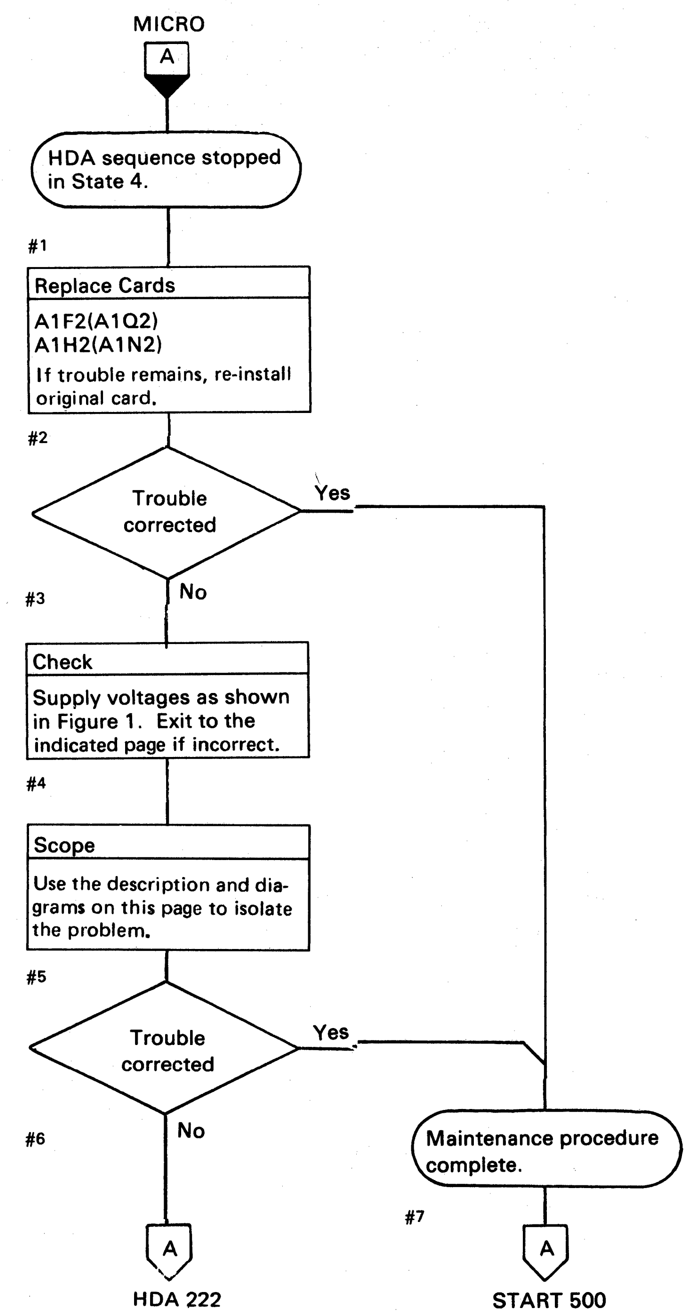
SEQUENCE ERROR OCCURRED IN STATE 4

To advance from State 4 to State 0, the following lines must be in the indicated condition:

- HDA 4 Latch is active.
- 15–Second Timer is active.

The 15-Second Timer was started in State 5. The End 15-Sec Delay line resets the HDA 4 Latch, advancing the HDA sequence from State 4 to State 0.

See HDA 500 through 510 for additional theory.



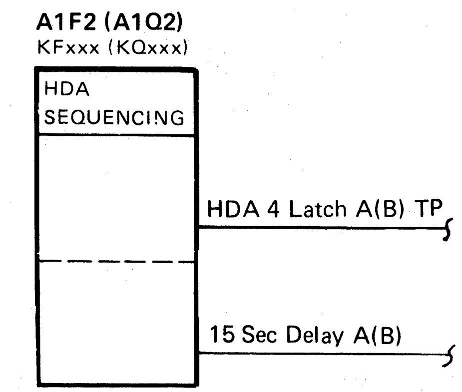


Figure 1. Drive Voltage Chart

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
– 4 V	A1C2 (A1T2) B06(–) to A1K2D08(+)	–3.85 to –4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(–)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(–)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
–12 V	A1C2 (A1T2) D06(–) to A1K2D08(+)	–12.0 to –14.4 V	0.10 V p-p	PWR 240, A
–24 V	A1C2 (A1T2) D03(–) to A1K2D08(+)	–24.0 to –28.8 V	0.08 V p-p	PWR 250, A

* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

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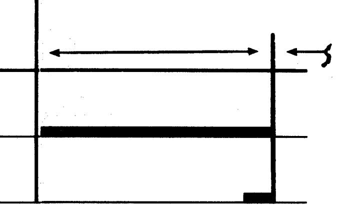
Legend: Inactive / Active level / Tolerance

Chart Line No.	Line Name	ALD	Test Point
1	+HDA 4 Latch A(B) TP	KF210 (KQ210)	A1F2 (A1Q2) D11
2	–15 Sec Delay A(B)	KF180 (KQ180)	A1F2 (A1Q2) M04



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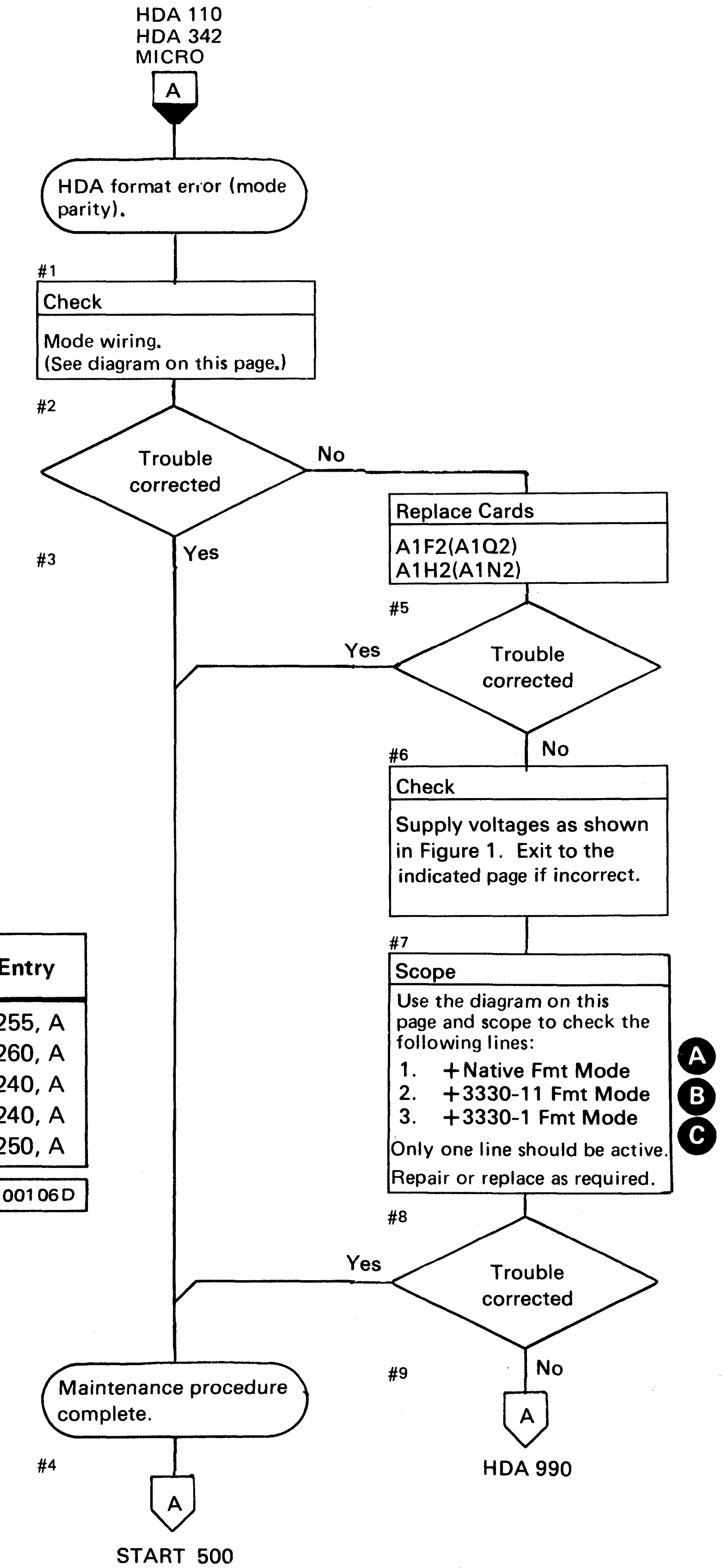
HDA FMT ERROR (MODE PARITY)

The HDA Fmt Error (Mode Parity) is checked in State 1, State 3, and in State 6. If mode parity is incorrect, an Fmt error occurs in State 1 or State 3 and the HDA Sequence Ck Lth is turned on. If an Fmt Error (Mode Parity) occurs in State 6, the HDA then sequences to State 0.

See HDA 504 through 510 for additional theory.



Mode	Wiring (only one wired)
Native	A1F2 (A1Q2) S08 to U08
3330-11	A1F2 (A1Q2) G08 to J08
3330-1	A1F2 (A1Q2) M08 to P08

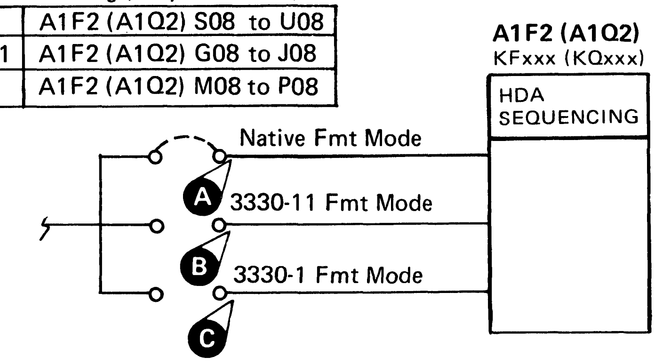


Figure 1. Drive Voltage Chart

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
− 4 V	A1C2 (A1T2) B06(−) to A1K2D08(+)	−3.85 to −4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

00106D

* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

Chart Line No.	Line Name	ALD	Test Point	
1	+Native Fmt Mode	KF110 (KQ110)	A1F2 (A1Q2) S08	A
2	+3330-11 Fmt Mode	KF120 (KQ120)	A1F2 (A1Q2) G08	B
3	+3330-1 Fmt Mode	KF120 (KQ120)	A1F2 (A1Q2) M08	C

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HDA MODE PARITY CHECK

FSI

A

HDA format mode error.

#1

HDA 300 KF120(KQ120)

A jumper is required to indicate which mode (3350 (Native), 3330-1, or 3330-11) the drive is to simulate. An error occurs if no mode is wired or if more than one is wired. This is indicated by a Format 1, Sense Byte 10 bit 1 being active.

#2

INST 6

Check the address jumper card to ensure that the failing drive address and the drive being worked on are the same device.

#3

Trouble corrected — Yes / No

#4

Check

- Verify the microdiagnostic disk is at the correct EC level.
- Verify that the wires are tight and none are missing if any recent EC activity has occurred.

#5

Trouble corrected — Yes / No

#6

1

1

The following cards were replaced on an FSI page:
A1F2(A1Q2)
A1H2(A1N2)

#7

Check

Verify that the following cable connector pins are not bent or pushed in and that the connectors are seated properly:
A1V2B02(D02)
Repair or replace as required.

#8

Trouble corrected — Yes / No

#9

Possible Causes

1. Bent or shorted board pins.
2. Open board circuit.
3. Open jumper wire.
4. Noisy voltages due to:
   - Bad feed-through capacitors.
   - Loose wires at the voltage distribution terminal boards.
   - Poor voltage regulation.

#10

Trouble corrected — Yes / No

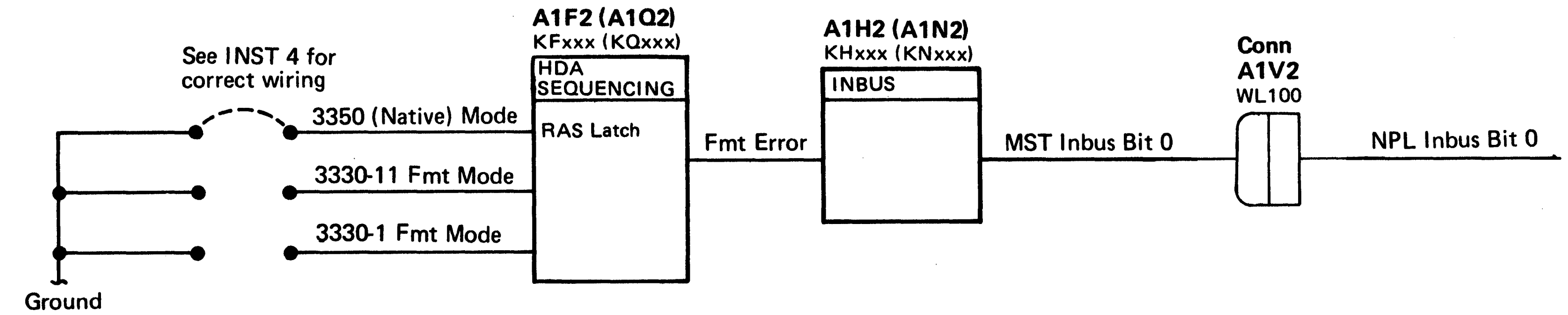
#11

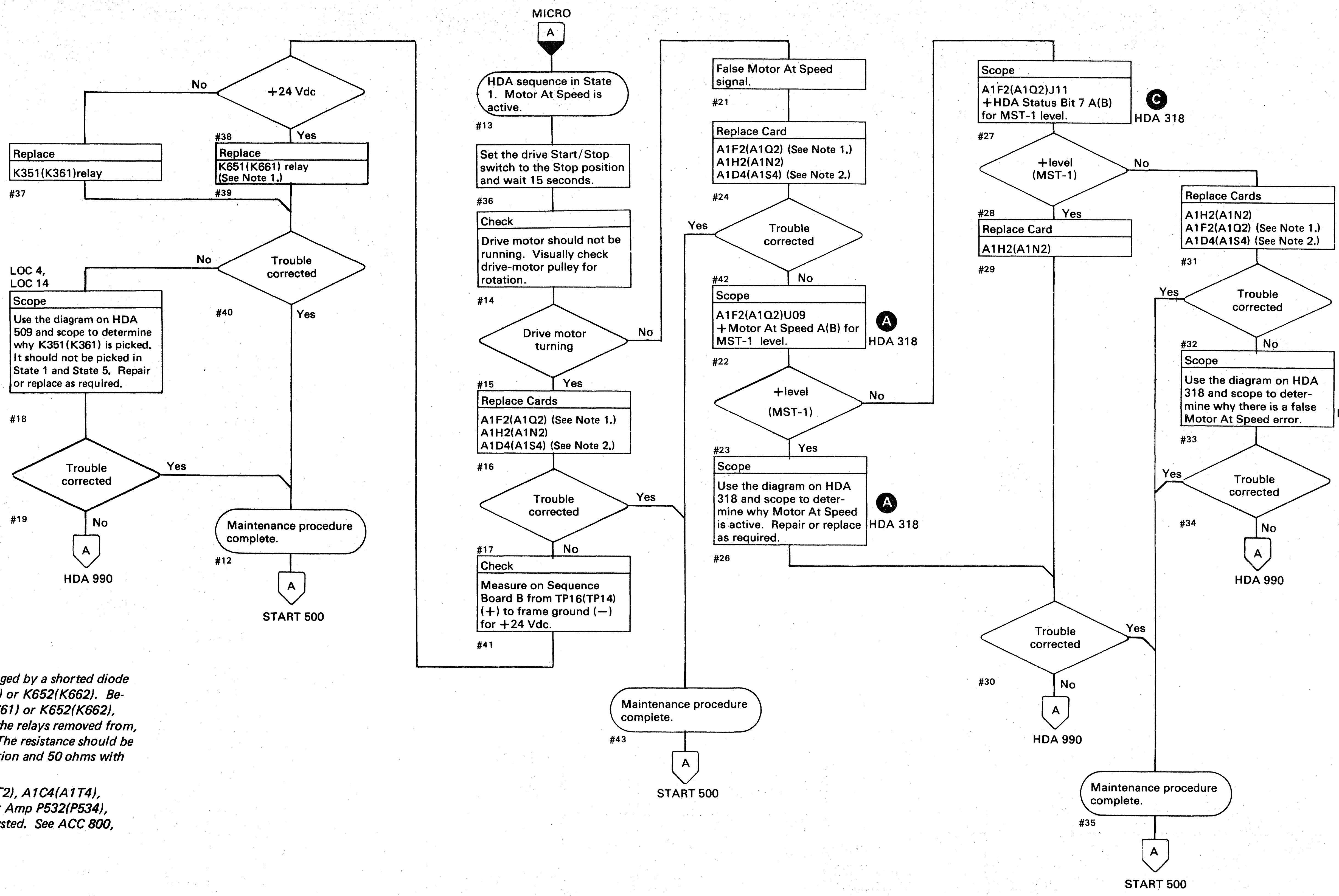
A
HDA 990

Maintenance procedure complete.

#13

A
START 500

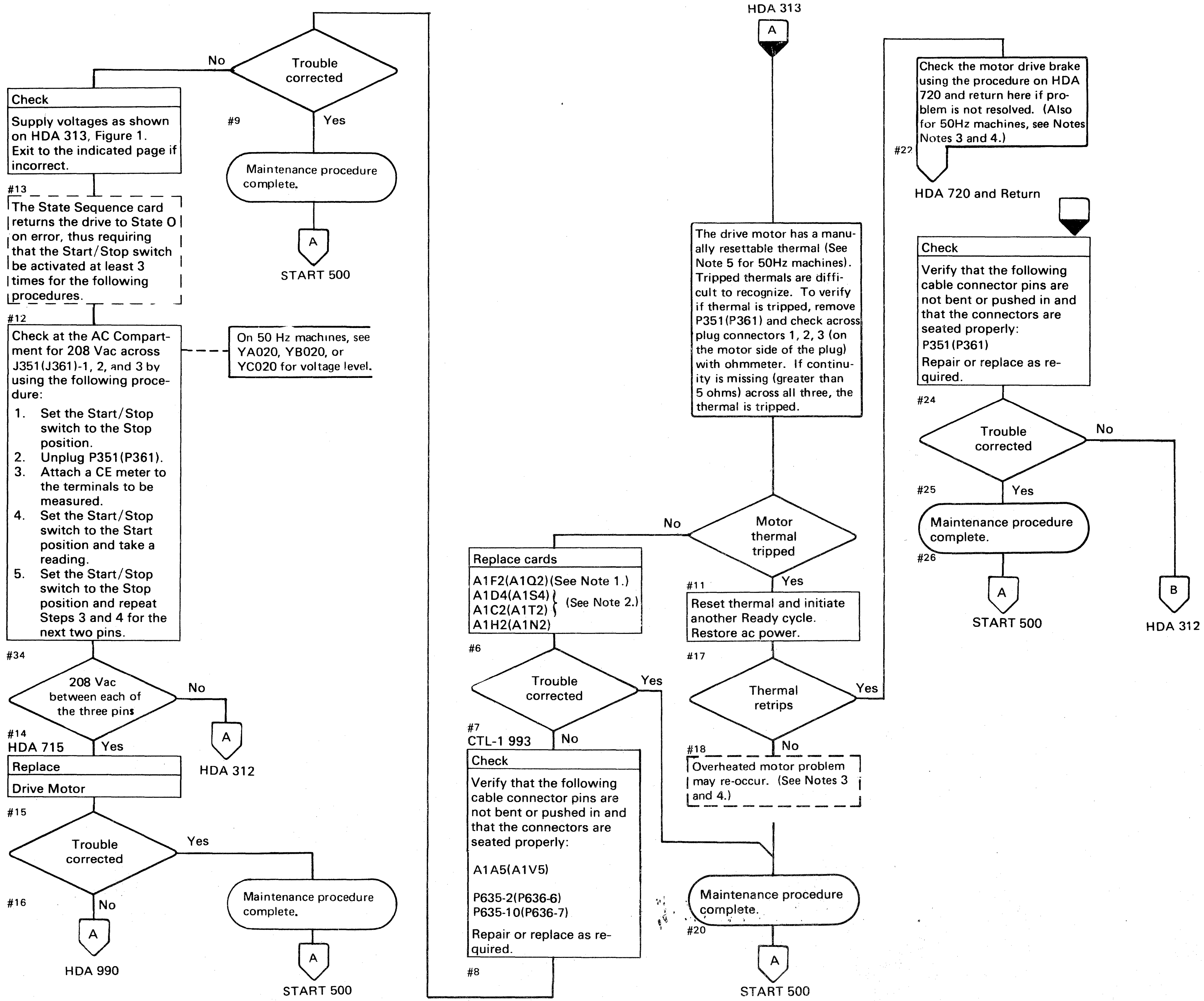




Note 1: *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*

Note 2: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

MOTOR AT SPEED ERROR



Notes:

1. *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*

2. *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

3. *On 50 Hz machines wired for 380/440 Wye, a shorted drive motor filter capacitor can cause the motor thermal to trip. The capacitor is C351 or C532 for Drive A and C364 or C365 for Drive B.*

   To check for a failing capacitor, use one of the following procedurees:

   a. *Place the Start/Stop switch on the failing drive to the Stop position, then reset the motor thermal. A shorted capacitor will cause the thermal to trip again.*
   b. *Remove power from the drive by manually tripping CB230. Remove the cover from the AC Compartment and be sure to observe the safety precautions (Dangerous Voltages). Locate TB351/TB361. Disconnect one end of the capacitor between screws 4 and 8 or 2 and 7 and check for continuity. Replace the capacitor if defective.*

4. *On 50 Hz machines, if a replacement drive motor or capacitor is not available for immediate installation, turn off the main line ac power (CB230). Reset the failing motor thermal and unplug the drive motor cable. Turn on the ac power and place the non-failing drive online.*

   AC power to both drives must be off during motor replacement unless the thermal switch for the failing drive is bypassed

5. *On 50 Hz machines, disregard the contiunity check. The thermal causes a circuit protector, external to the motor, to open. See YA020 (YB020) for the thermal and YA 049 (YB049) for the circuit protector. Aux points for the circuit protector are shown on YA055 (YB055).*

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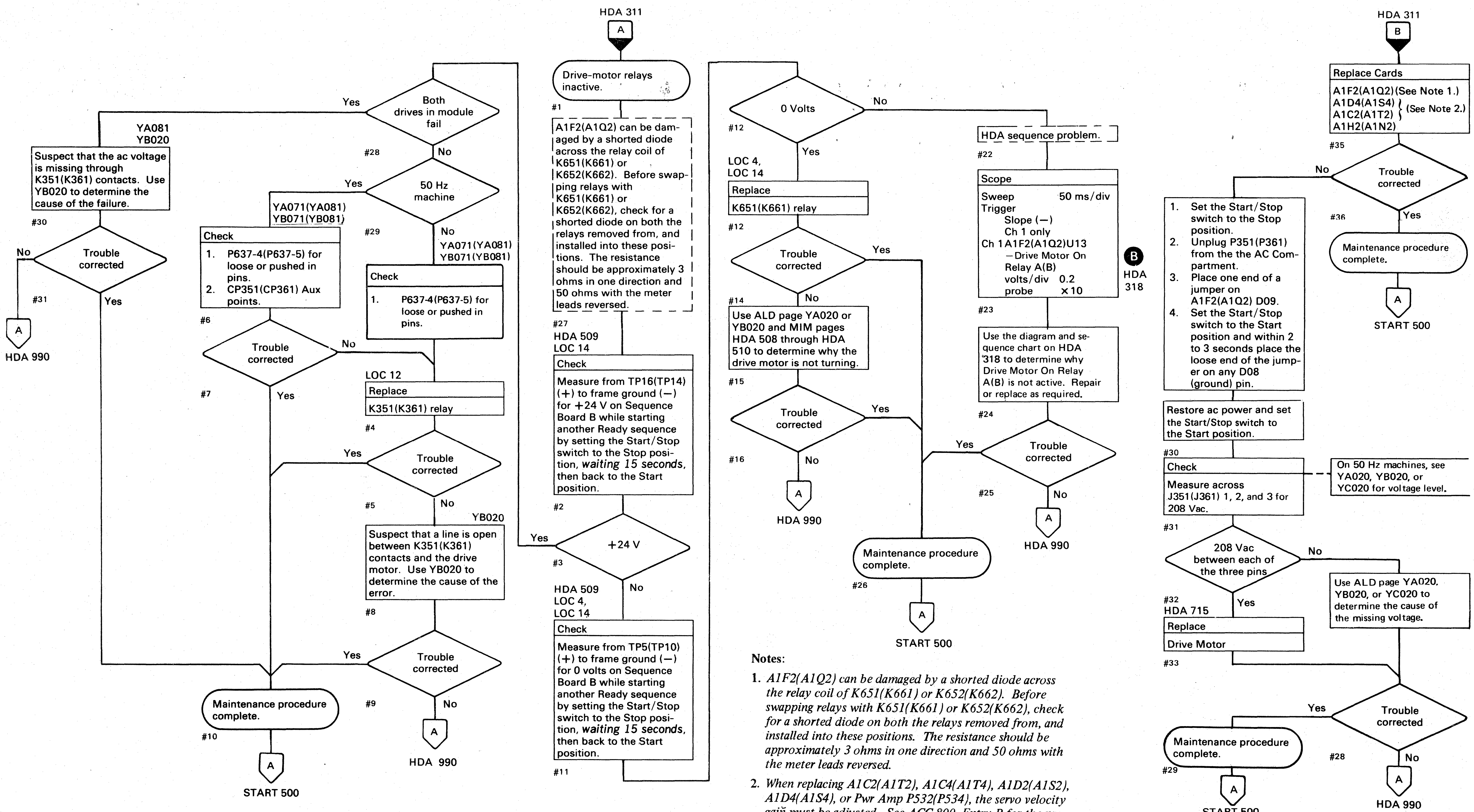

Notes:

1. *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*
2. *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

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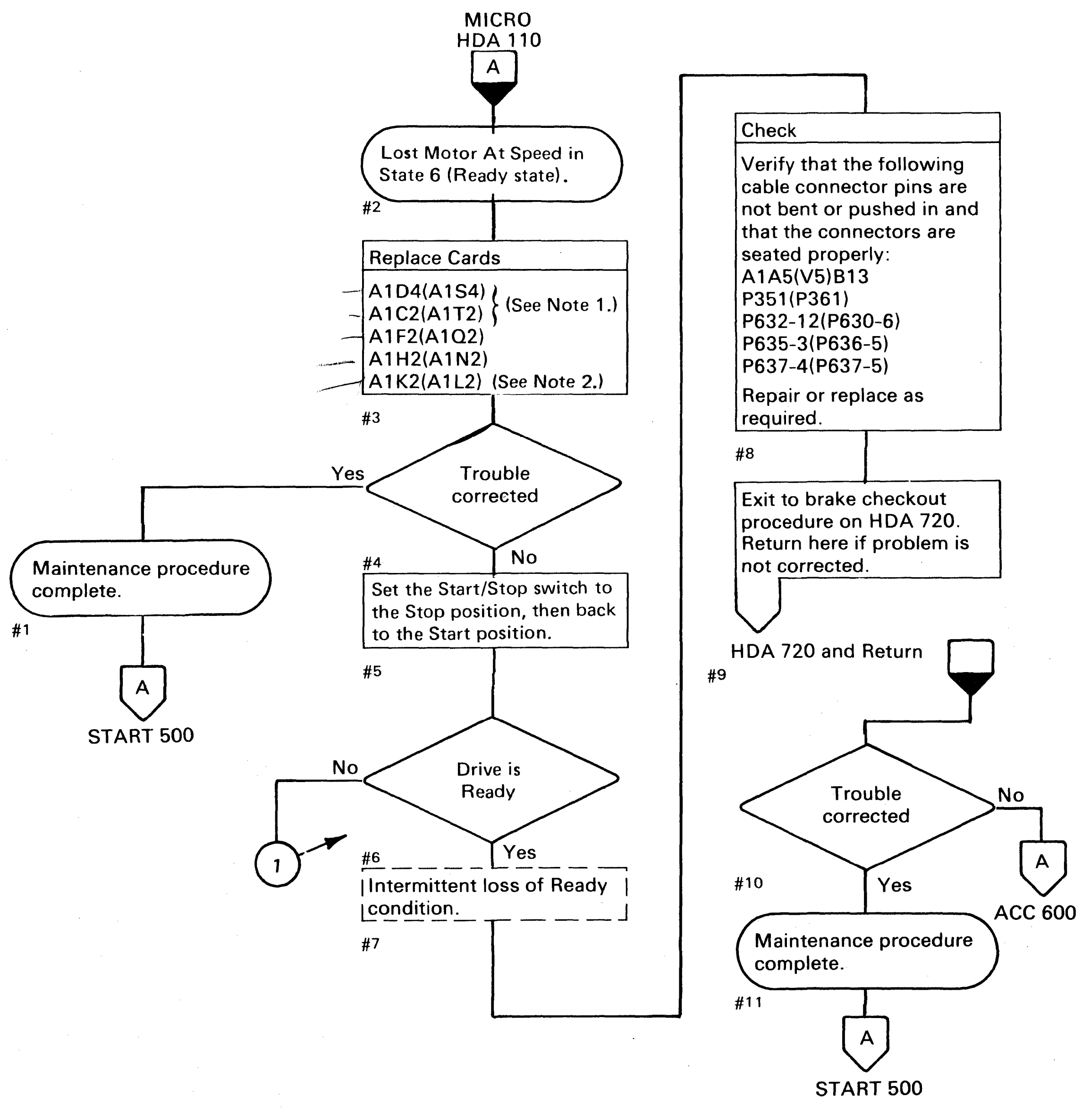
MOTOR AT SPEED



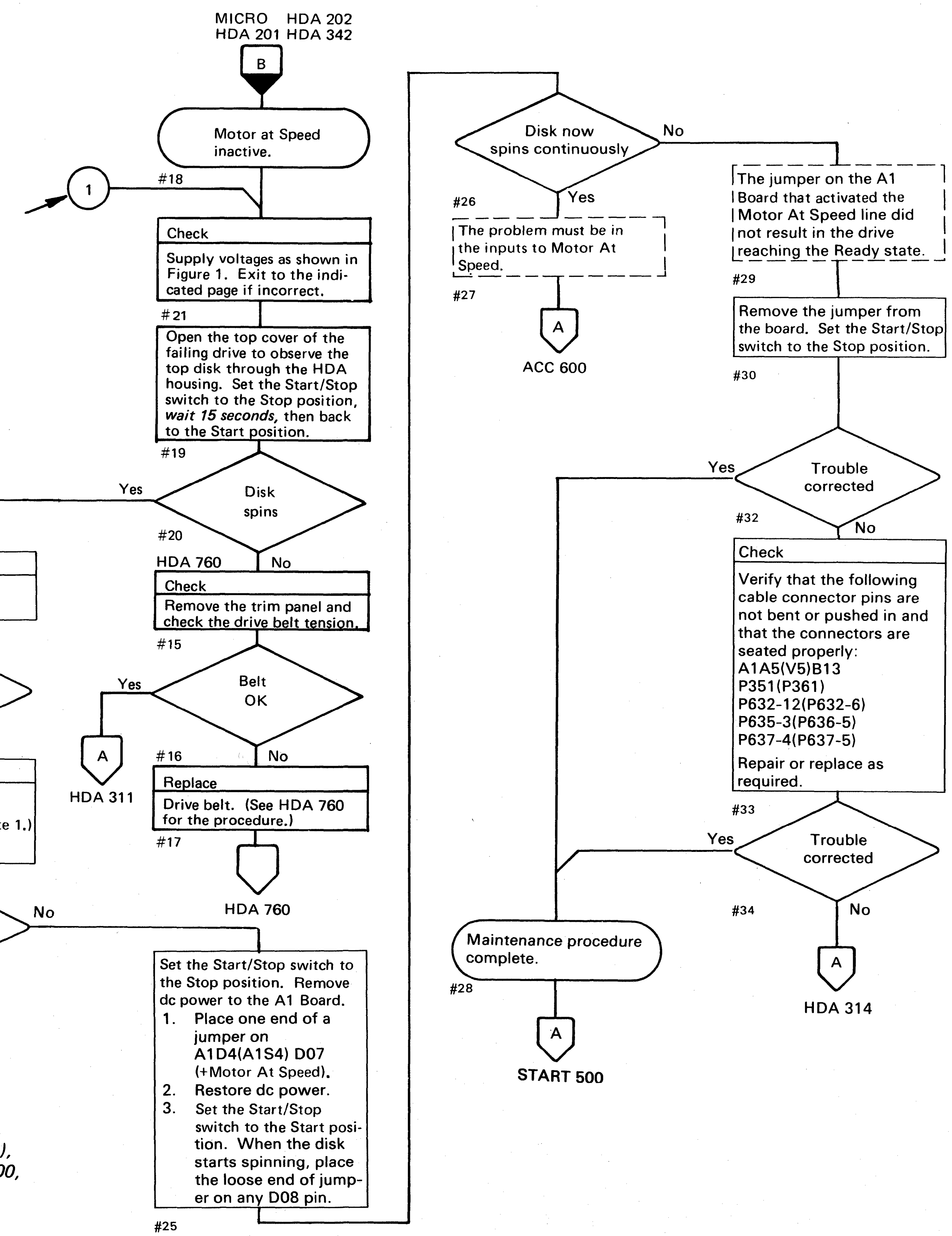


Figure 1. Drive Voltage Chart

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
– 4 V	A1C2 (A1T2) B06(–) to A1K2D08(+)	–3.85 to –4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(–)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(–)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
–12 V	A1C2 (A1T2) D06(–) to A1K2D08(+)	–12.0 to –14.4 V	0.10 V p-p	PWR 240, A
–24 V	A1C2 (A1T2) D03(–) to A1K2D08(+)	–24.0 to –28.8 V	0.08 V p-p	PWR 250, A

00106D

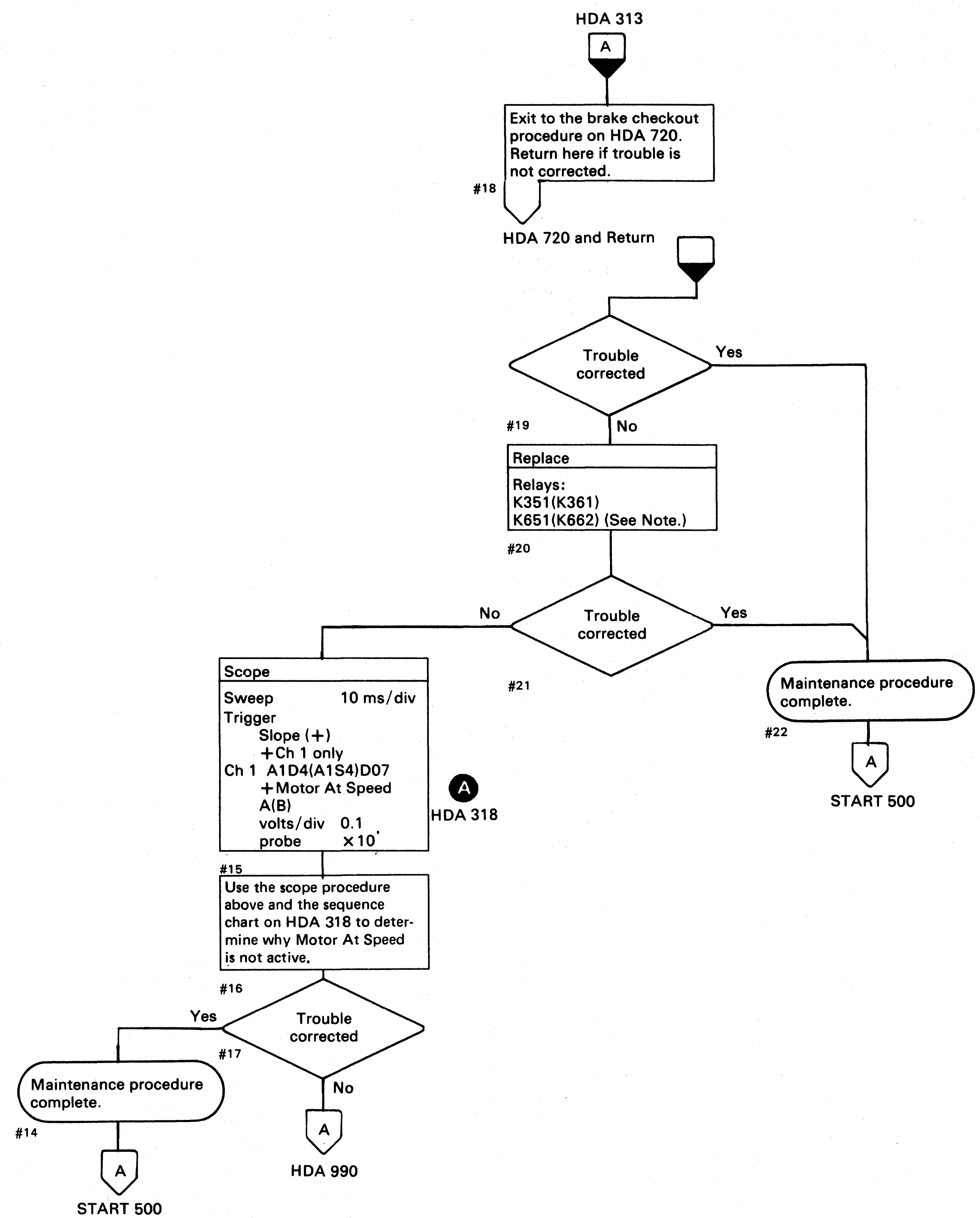
* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

Note 1: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

Note 2: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

DC0313 Seq. 1 of 2	2358326 Part No.	441300 31 Mar 76	441303 30 Jul 76	441306 1 Apr 77	441310 27 Jun 80	

Note: *A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.*



DC0313 Seq. 2 of 2	2358326 Part No.

441300	441303	441306	441310	
31 Mar 76	30 Jul 76	1 Apr 77	27 Jun 80	

MOTOR AT SPEED ERROR

VCO pulses are applied to a counter to detect Motor At Speed. The counter is reset by sync pulses on the Servo Clock line. As the speed of the motor increases, the rate of VCO pulses increases. When the motor reaches 80% of speed (2880 rpm), the counter completes its count before being reset by the sync pulse on the Servo Clock line and the Motor At Speed line is activated.

The AGC Open line remains active until the motor reaches 3400 rpm to inhibit variation on the Motor At Speed line.

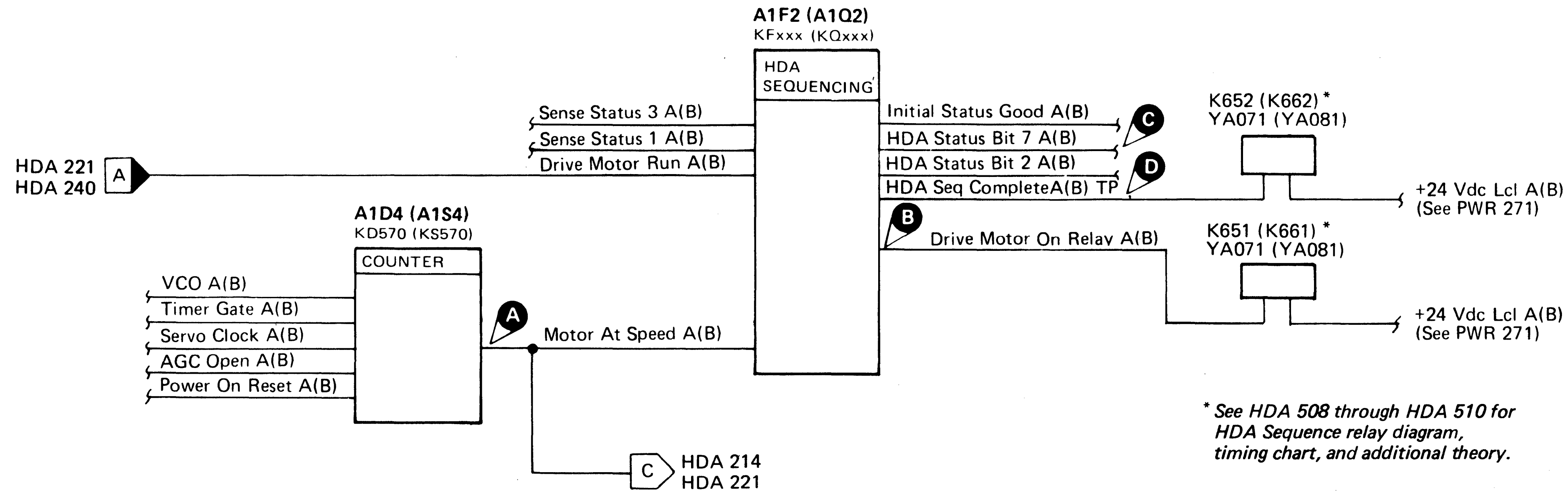
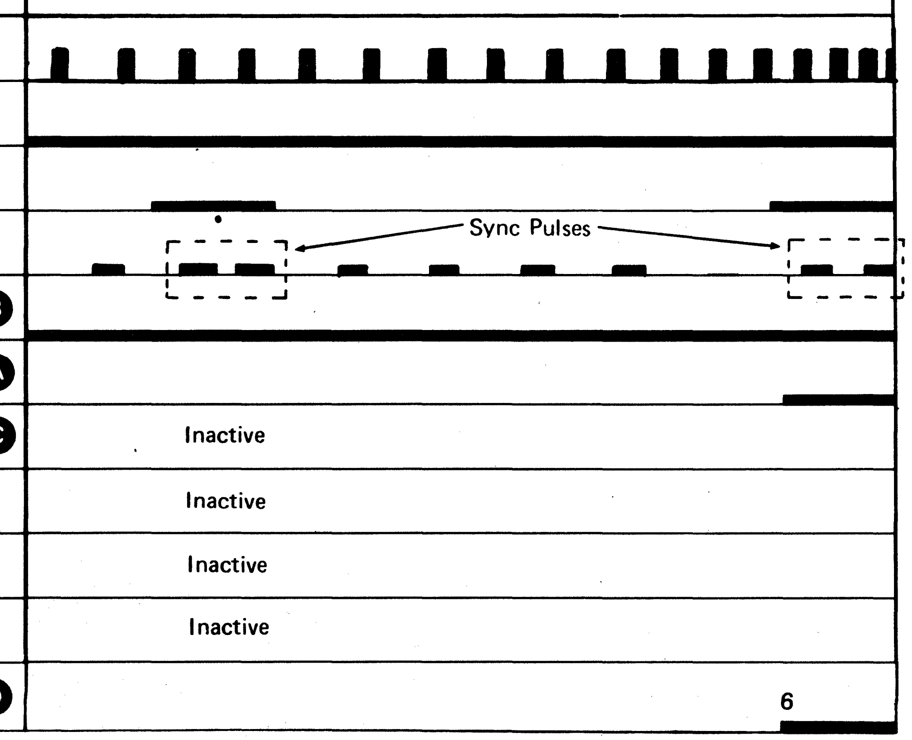
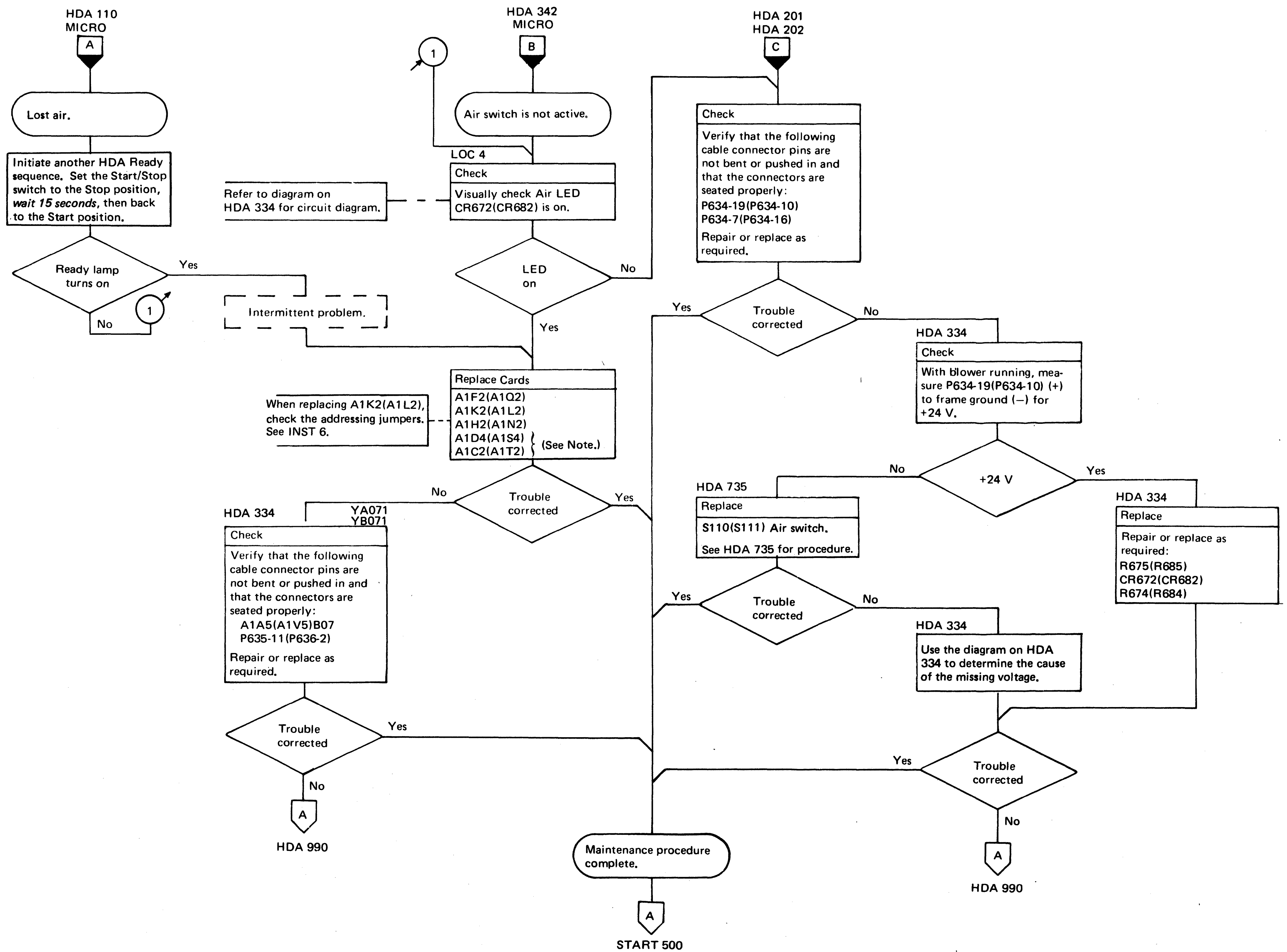
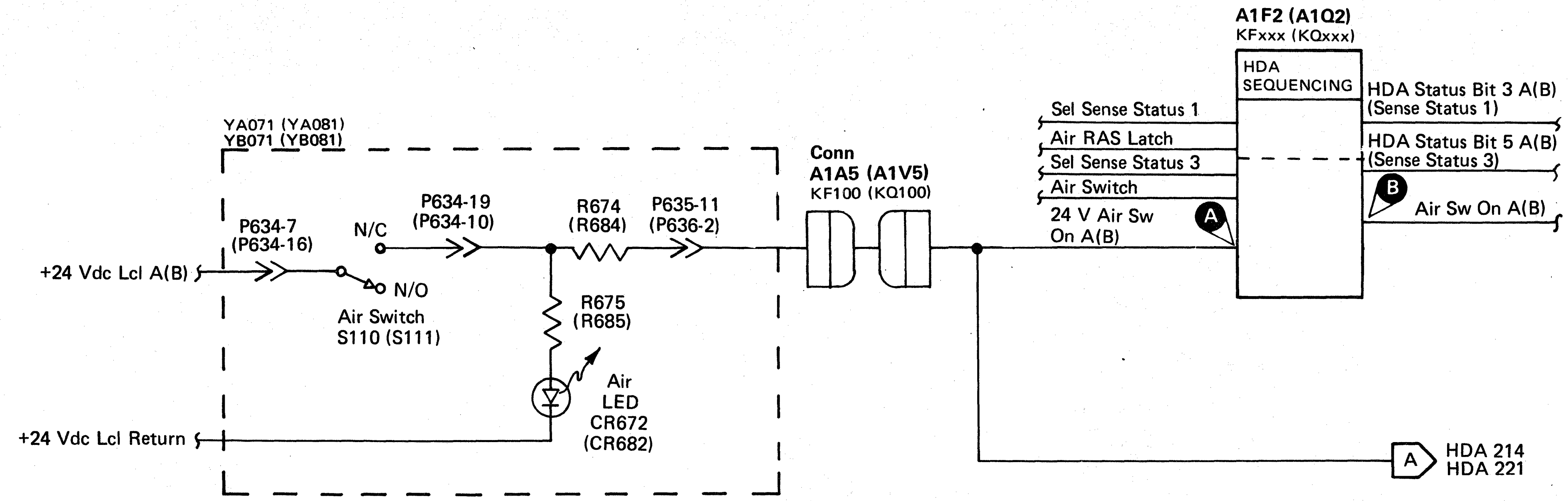


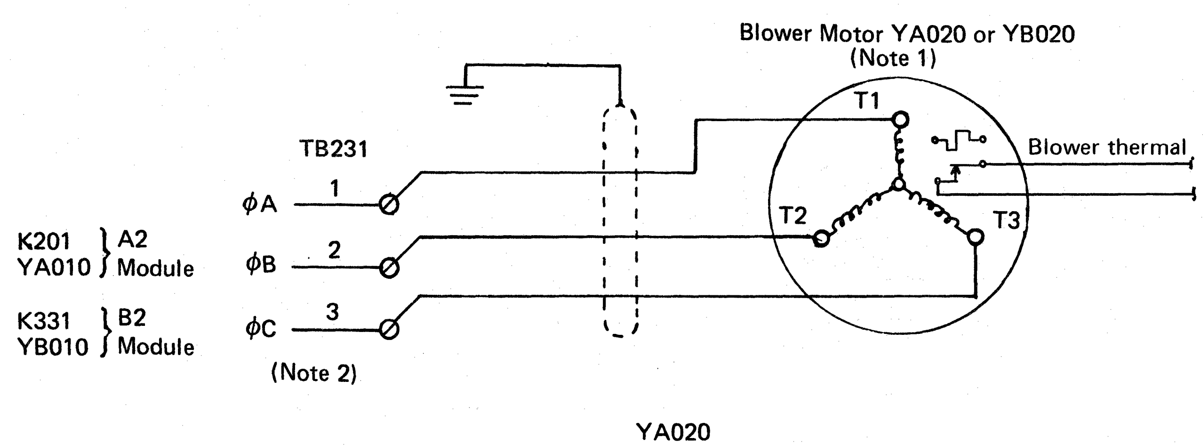
Chart Line No.	Line Name	ALD	Test Point		
1	+VCO A(B)	KD570 (KS570)	A1D4 (A1S4) D13		
2	+AGC Open A(B)	KD570 (KS570)	A1D4 (A1S4) B11		
3	+Timer Gate A(B)	KD570 (KS570)	A1D4 (A1S4) J13		
4	+Servo Clock A(B)	KD570 (KS570)	A1D4 (A1S4) G10		
5	−Drive Motor On Relay A(B)	KF260 (KQ260)	A1F2 (A1Q2) U13	B	
6	+Motor At Speed A(B)	KD570 (KS570)	A1D4 (A1S4) D07	A	
7	+HDA Status Bit 7 A(B)	KF240 (KQ240)	A1F2 (A1Q2) J11	C	Inactive
8	−Sense Status 3 (A)B	KF130 (KQ130)	A1F2 (A1Q2) B04		Inactive
9	+HDA Status Bit 2 A(B)	KF230 (KQ230)	A1F2 (A1Q2) B02		Inactive
10	−Sense Status 1 A(B)	KF130 (KQ130)	A1F2 (A1Q2) D04		Inactive
11	−HDA Seq Complete A(B) TP	KF260 (KQ260)	A1F2 (A1Q2) S02	D	6





Note: *When replacing A1C2(A1T2), A1C4(A1T4), A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*





Note 1: *All components are located in the primary enclosure except motors.*

Note 2: *Motors are capable of operating with 200, 208, or 230 Vac.*

Chart Line No.	Line Name	ALD	Test Point	
1	+24 V Air Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) S10	A
2	+Air Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) S11	B

INVALID STATUS ERROR

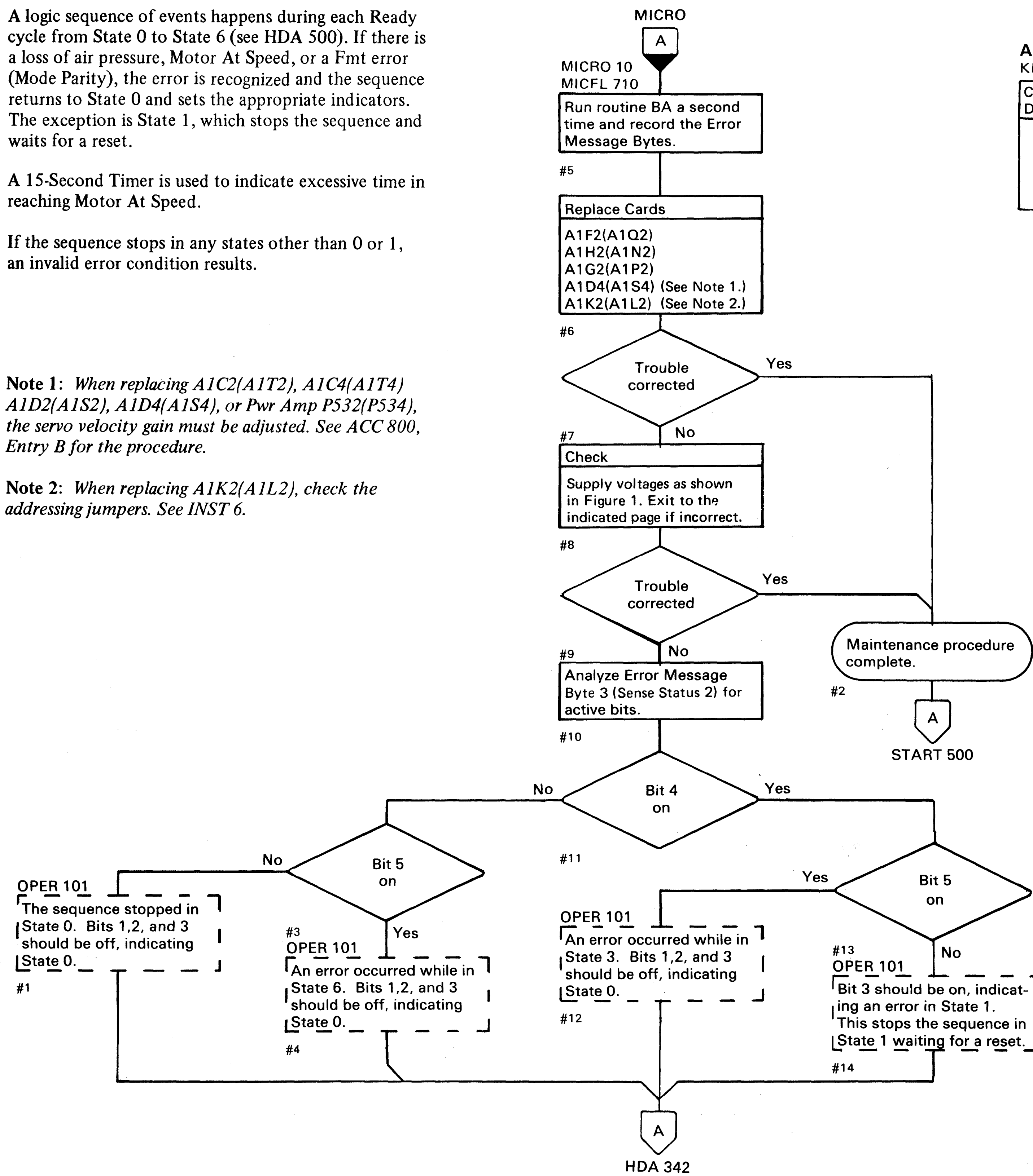
A logic sequence of events happens during each Ready cycle from State 0 to State 6 (see HDA 500). If there is a loss of air pressure, Motor At Speed, or a Fmt error (Mode Parity), the error is recognized and the sequence returns to State 0 and sets the appropriate indicators. The exception is State 1, which stops the sequence and waits for a reset.

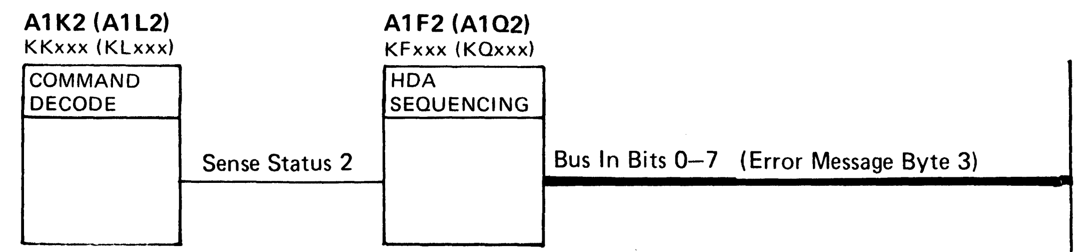
A 15-Second Timer is used to indicate excessive time in reaching Motor At Speed.

If the sequence stops in any states other than 0 or 1, an invalid error condition results.

Note 1: *When replacing A1C2(A1T2), A1C4(A1T4) A1D2(A1S2), A1D4(A1S4), or Pwr Amp P532(P534), the servo velocity gain must be adjusted. See ACC 800, Entry B for the procedure.*

Note 2: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*





Error Message Byte 3 (Sense Status 2)	
Bus In Bit	**Definition**
0	HDA Mode Parity (Fmt error)
1	HDA 4 Latch
2	HDA 2 Latch
3	HDA 1 Latch
4	HDA Sequence Check
5	Inhibit HDA Recycle
6	–
7	Odd Physical Track

Figure 1. Drive Voltage Chart

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
– 4 V	A1C2 (A1T2) B06(–) to A1K2D08(+)	–3.85 to –4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(–)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(–)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
–12 V	A1C2 (A1T2) D06(–) to A1K2D08(+)	–12.0 to –14.4 V	0.10 V p-p	PWR 240, A
–24 V	A1C2 (A1T2) D03(–) to A1K2D08(+)	–24.0 to –28.8 V	0.08 V p-p	PWR 250, A

* Use a digital voltmeter to check voltages.
** Use a scope to measure the ripple. See PWR 290 for the procedure.

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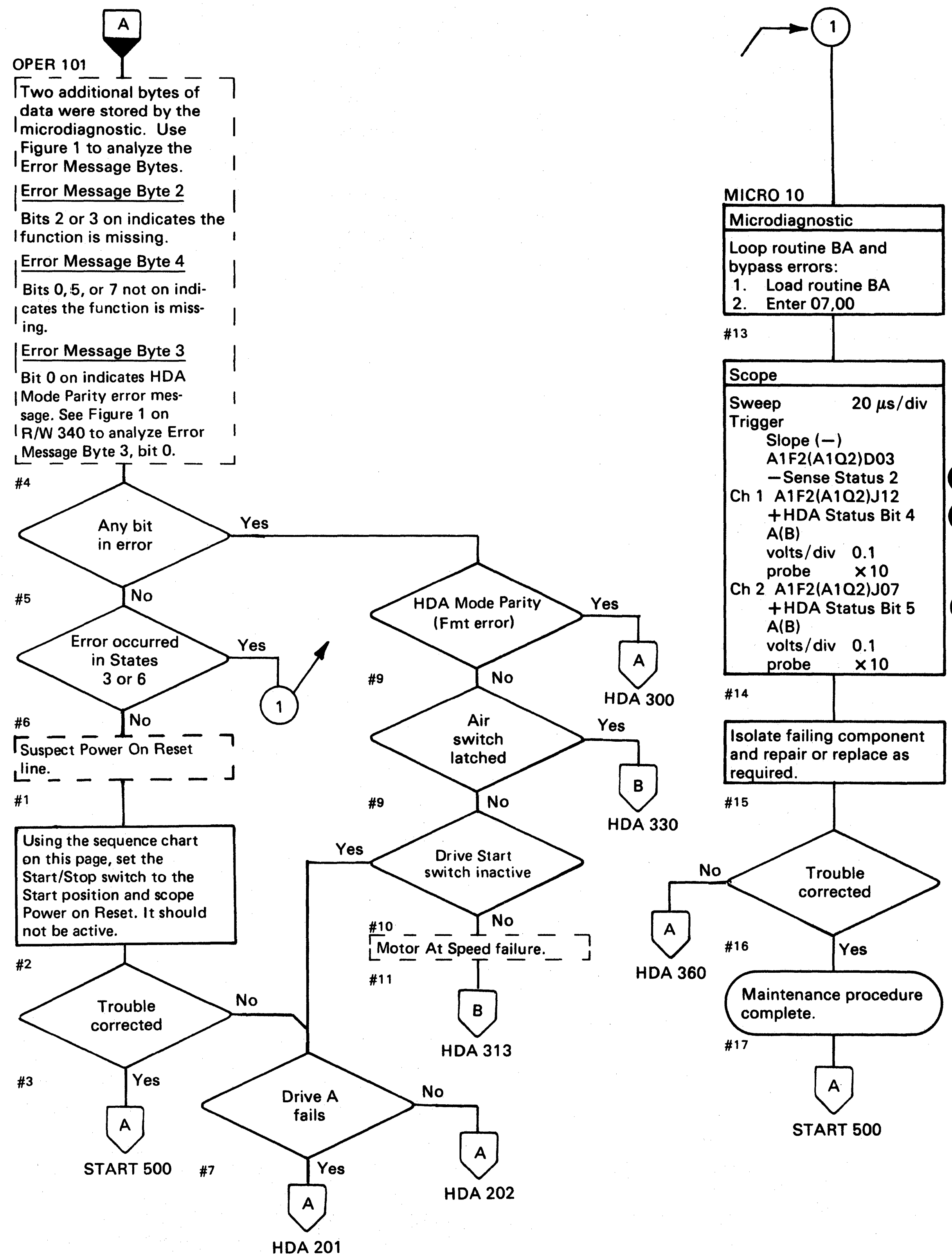
DC0340	2358329	441300	441303	441310		
Seq. 1 of 2	Part No.	31 Mar 76	30 Jul 76	27 Jun 80		

INVALID STATUS



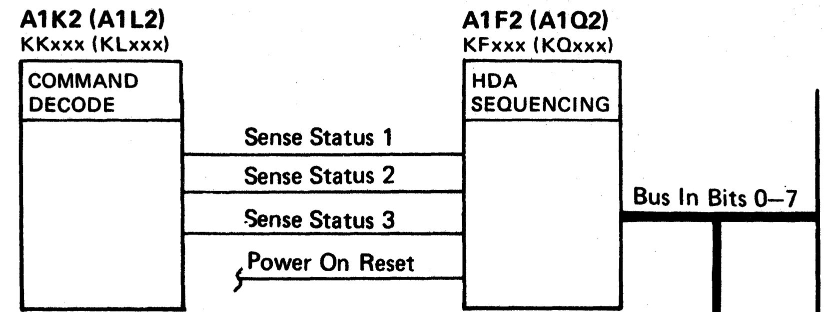


Figure 1. Microdiagnostic Error Message Bytes 2 and 4.

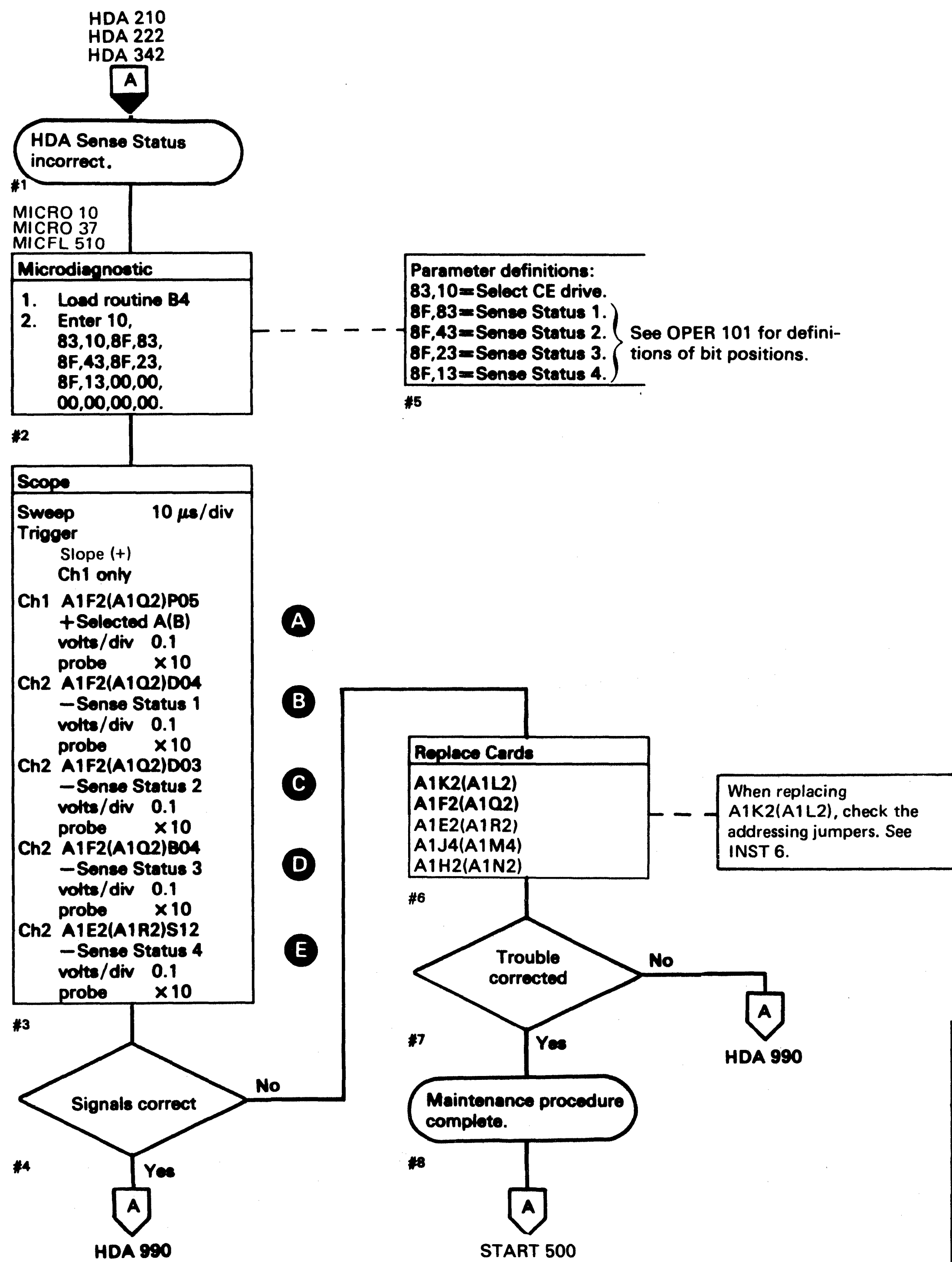
Bus In Bits	Error Message Byte 2 (Sense Status 1)	Error Message Byte 4 (Sense Status 3)
0		Drive Start Switch
1		
2	Motor At Speed Latched	
3	Air Switch Latched	
4		
5		Air Switch
6		
7		Motor At Speed

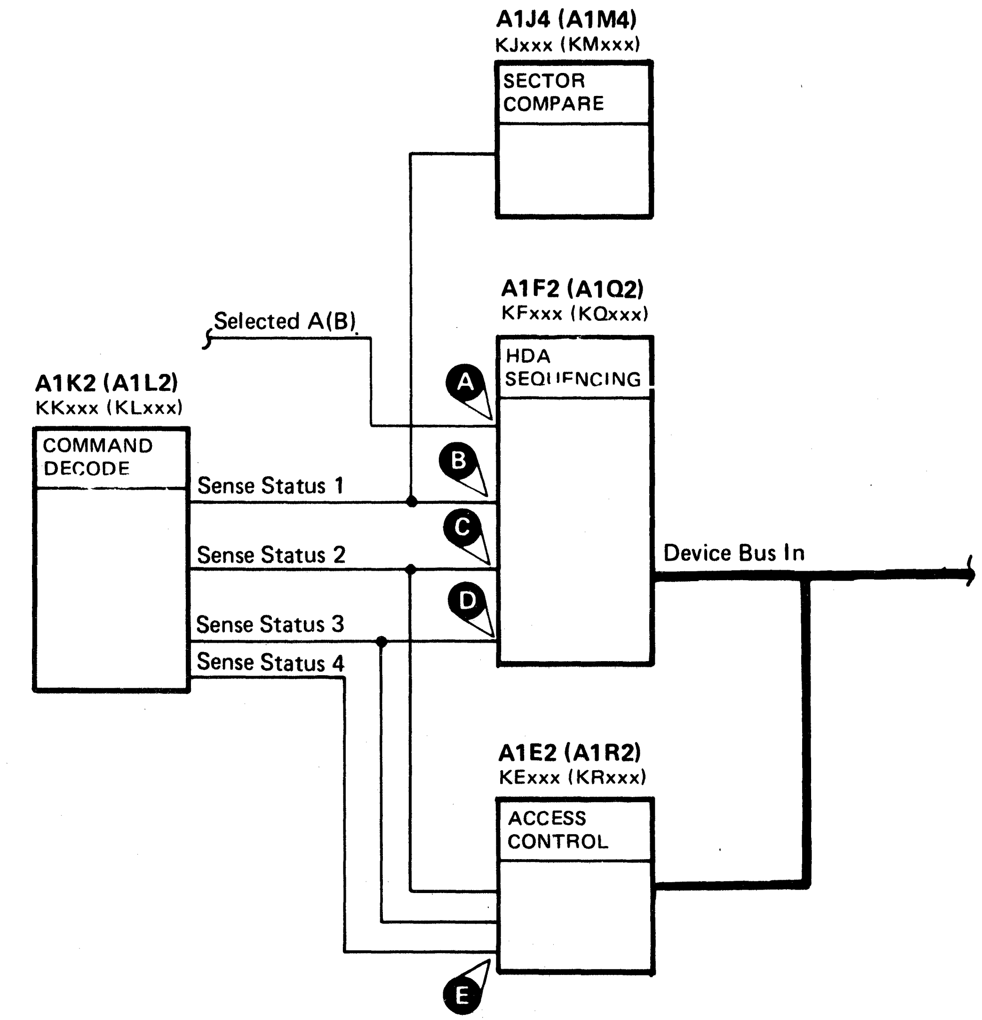
Error Message Byte 3 (Sense Status 2)	
Bus In Bit	Definition
0	HDA Mode Parity (Fmt error)
1	HDA 4 Latch
2	HDA 2 Latch
3	HDA 1 Latch
4	HDA Sequence Check
5	Inhibit HDA Recycle
6	–
7	Odd Physical Track

Legend: Inactive; Active level; Tolerance

Chart Line No.	Line Name	ALD	Test Point		
1	−Sense Status 2	KF130 (KQ130)	A1F2 (A1Q2) D03	A	
2	+Inhibit HDA Recycle A(B) TP	KF140 (KQ140)	A1F2 (A1Q2) G05	C	Inactive
3	+HDA Sequence Ck Lth A(B) TP	KF160 (KQ160)	A1F2 (A1Q2) B12	B	Inactive
4	+HDA Status Bit 4 A(B)	KF240 (KQ240)	A1F2 (A1Q2) J12	D	
5	+HDA Status Bit 5 A(B)	KF240 (KQ240)	A1F2 (A1Q2) J07	E	
6	−Power On Reset	KF140 (KQ140)	A1F2 (A1Q2) G08		Inactive

HDA SENSE STATUS CHECKOUT





Legend: Inactive | Active level | Tolerance

Chart Line No.	Line Name	ALD	Test Point		
1	+Selected A(B)	KF130 (KQ130)	A1F2 (A1Q2) P05	A	
2	—Sense Status 1	KF130 (KQ130)	A1F2 (A1Q2) D04	B	
3	—Sense Status 2	KF130 (KQ130)	A1F2 (A1Q2) D03	C	
4	—Sense Status 3	KF130 (KQ130)	A1F2 (A1Q2) B04	D	
5	—Sense Status 4	KE160 (KR160)	A1E2 (A1R2) S12	E	

DC0360 Seq. 1 of 2	2358330 Part No.	441300 31 Mar 76	441303 30 Jul 76	441306 1 Apr 77		

HDA READY SEQUENCE THEORY

The objectives of the HDA Ready sequence are to:

- Start and bring the drive motor up to speed.
- Allow only one drive motor at a time to start and come up to speed (see description on HDA 100).
- Rezero Access.

The output of the HDA State Sequence latches (HDA 1 latch, HDA 2 latch, and HDA 4 latch) is fed to the State Decoder. The binary value of these latches is decoded as States 0 to 7. The Ready sequence steps from State 0 through State 1, State 3, State 2, to State 6 (Ready).

STATE 0

To advance from State 0 to State 1, the following lines must be in the indicated condition:

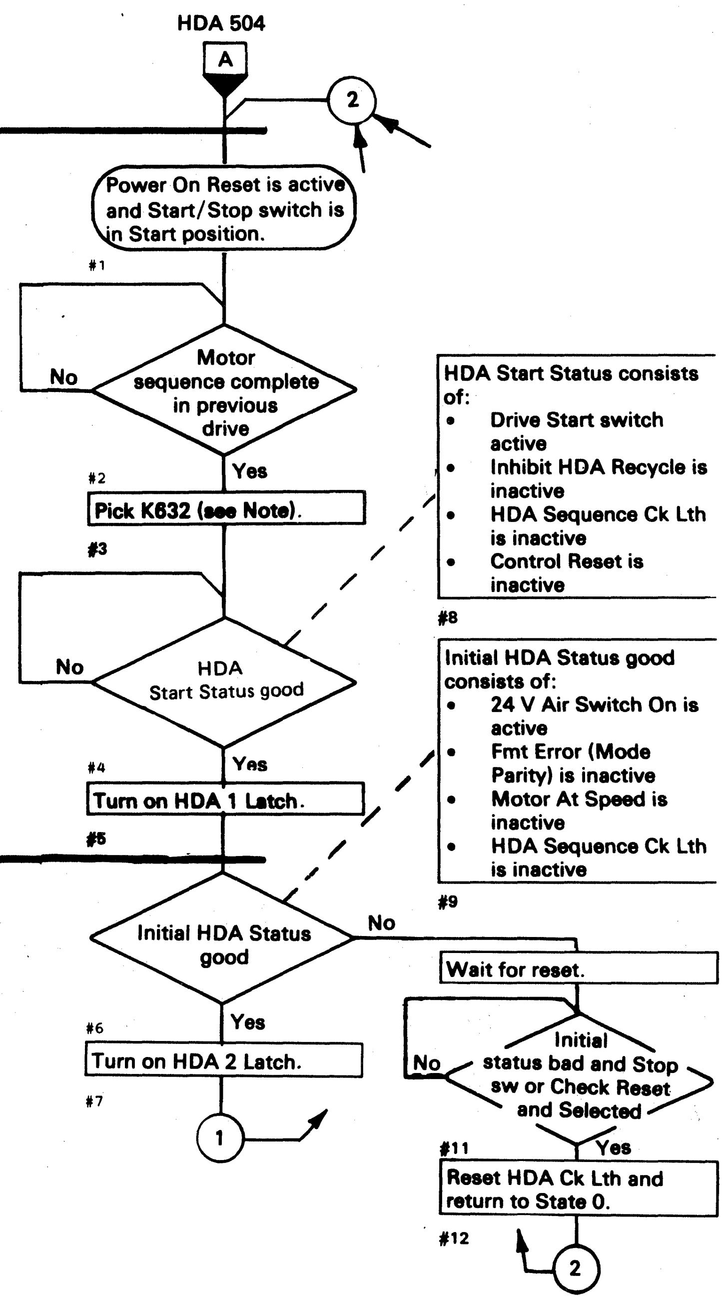
- +24 Vdc Dr Mtr A(B) Start is active (turns on Start latch)
- HDA Sequence Ck Lth is inactive
- Inhibit HDA Recycle is inactive
- Power On Reset is inactive
- State 0 is active

Note: *Relay K632 must be picked to activate +24 V Start Sw On in Drive A. The +24 V Start Sw On in Drive B is activated by both K632 and K652 being picked (see HDA 206).*

STATE 1

To advance from State 1 to State 3, the following lines must be in the indicated condition:

- 24 V Air Switch On is active
- One of the three Fmt (format) Mode lines is active
- Fmt Error (Mode Parity) is inactive
- HDA Sequence Ck Lth is inactive



STATE 3

To advance from State 3 to State 2, the following conditions must exist:

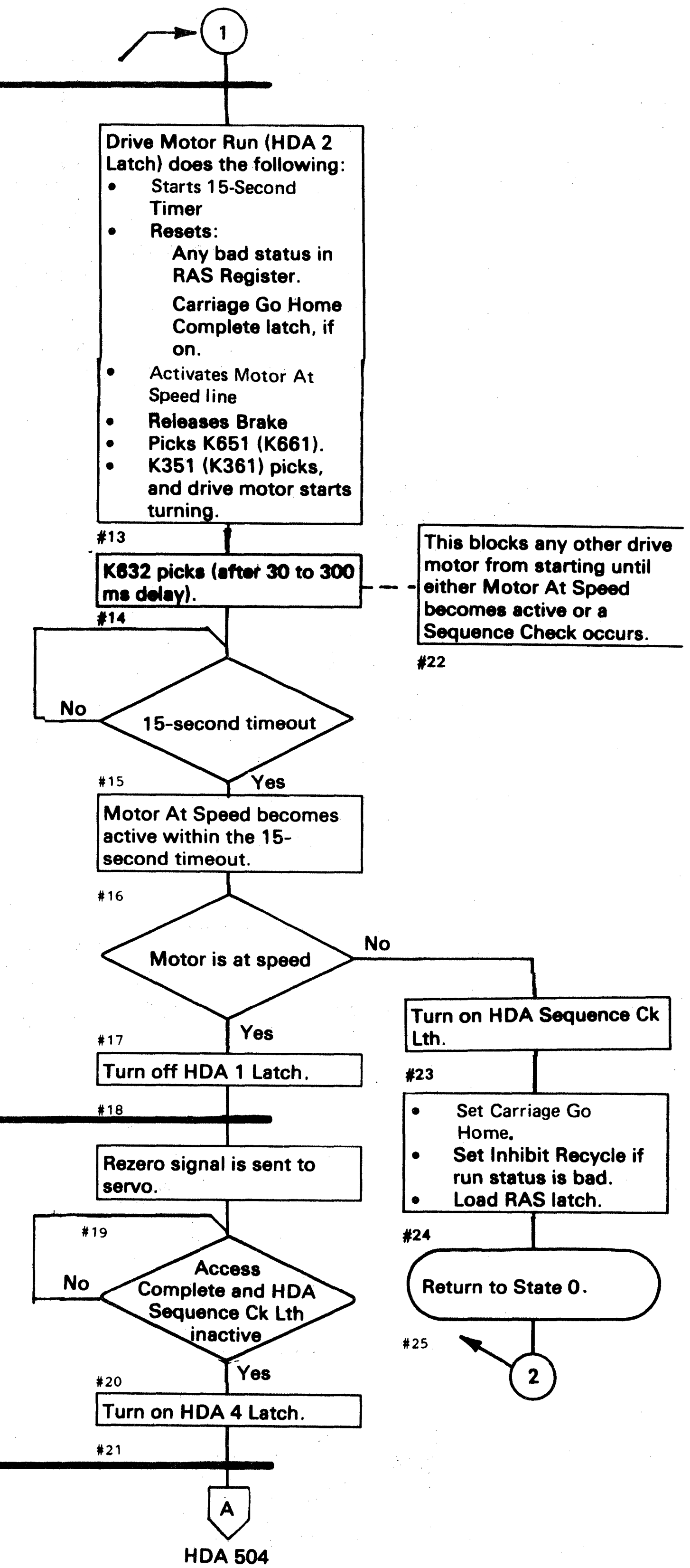
- Drive Motor Run is active
- State 3 is active
- 15-Second Timer ends.
- HDA Sequence Ck Lth is inactive

At completion of the 15-second timeout, the HDA sequence checks the Motor At Speed line. If the motor is at speed, the HDA 1 latch is turned off, advancing the sequence from State 3 to State 2. If the motor is not at speed, the HDA Sequence Ck Lth and Inhibit HDA Recycle latch are turned on and the sequence returns to State 0. An active HDA Sequence Ck Lth activates Sequence Complete, allowing the next drive in the string (with its Start/Stop switch in the Start position) to sequence to Ready.

STATE 2

To advance from State 2 to State 6, the Rezero Access operation must be completed. Access Complete turns on the HDA 4 latch advancing the HDA sequence from State 2 to State 6 (Ready).

STATE 6 (Ready)

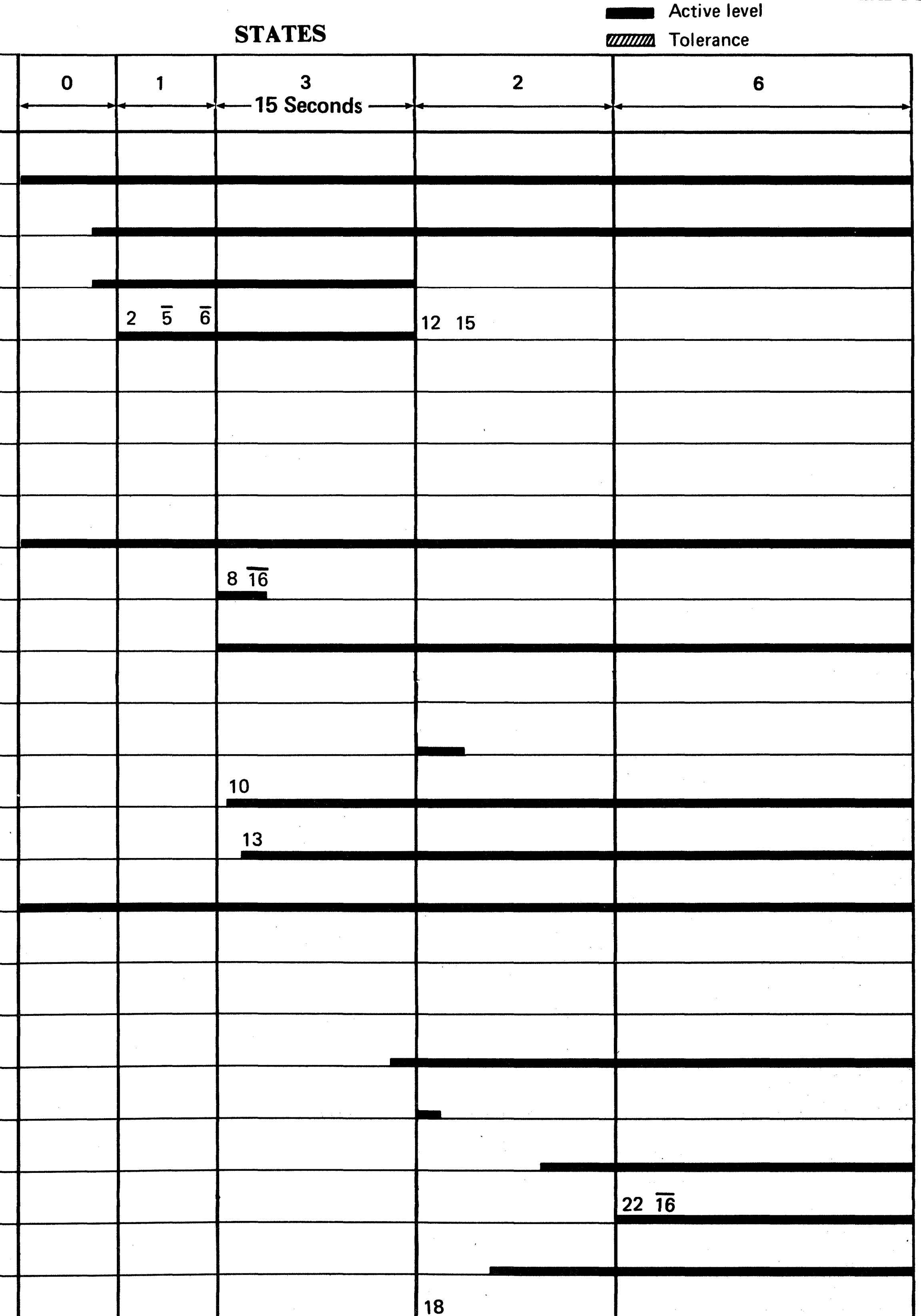


3350	DC0360 Seq. 2 of 2	2358330 Part No.	441300 31 Mar 76	441303 30 Jul 76	441306 1 Apr 77		

HDA READY SEQUENCE CHART

Legend: Inactive / Active level / Tolerance

Group	Chart Line No.	Line Name	ALD	Test Point
States 0–1	1	+Air Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) S11
	2	+24 V Start Sw On A(B)	YA071 (YA081)	A1A5 (A1V5) D10
	3	K632 Start Drvs	YA055	
	4	+HDA 1 Latch A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) B07
	5	+Control Reset	KF190 (KQ190)	
	6	+Inhibit HDA Recycle A(B) TP	KF140 (KQ140)	A1F2 (A1Q2) G05
States 1–3	7	−Initial Status Good	KF130 (KQ130)	
	8	−Start Timer A(B)	KF180 (KQ180)	A1F2 (A1Q2) M05
	9	HDA 2 Latch +Drive Motor Run A(B)	KF200 (KQ200)	A1F2 (A1Q2) D09
States 3–2	10	−15 Sec Delay A(B)	KF180 (KQ180)	A1F2 (A1Q2) M04
	11	K651(K661) Drive Motor Run	YA071 (YA081)	
	12	K351(K361) Drive Motor	YA071 (YA081)	
	13	−Run Status Good	KF190 (KQ190)	
	14	+HDA Sequence Ck Lth A(B) TP	KF160 (KQ160)	A1F2 (A1Q2) B12
States 2–6	15	+Motor At Speed	KF130 (KQ130)	A1F2 (A1Q2) U03
	16	+Sequence Rezero A(B)	KF150 (KQ150)	A1F2 (A1Q2) G12
	17	+HDA Ready A(B)	KE150 (KR150)	A1E2 (A1R2) J13
	18	+HDA 4 Latch A(B) TP	KF210 (KQ210)	A1F2 (A1Q2) D11
	19	−Access Complete A(B)	KF150 (KQ150)	A1F2 (A1Q2) P10
	20	K652 (K662) Drv Mtr Seq Comp	YA071 (YA081)	



3350	DC0502 Seq. 1 of 2	2358331 Part No.	441300 31 Mar 76	441303 30 Jul 76

HDA STOP SEQUENCE THEORY

The objectives of the HDA Stop sequence are to have the:

- **Ready lamp turned off**
- **Carriage moved to Home position**
- **Motor stopped**
- **HDA sequence advanced to State 0**

The output of the HDA State Sequence latches (HDA 1 latch, HDA 2 latch, and HDA 4 latch) is fed to the State Decoder. The binary value of these latches is decoded as States 0 to 7.

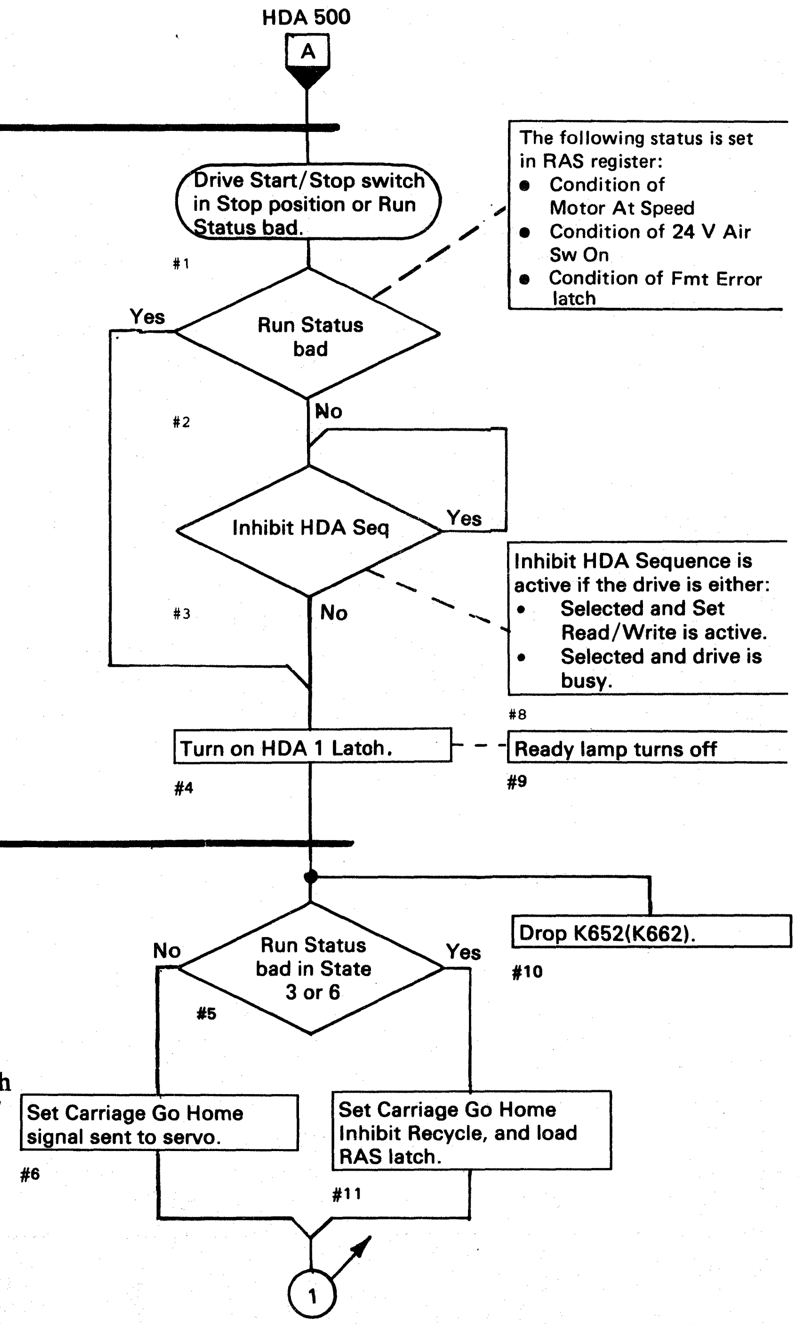
The Stop sequence steps from State 6 (Ready) through State 7, State 5, State 4, to State 0.

STATE 6

The HDA sequence advances from State 6 to State 7 when either the Start/Stop switch is placed in the Stop position or the Run Status is bad. The Inhibit HDA Seq line blocks the changing of states when Selected and Set Read/Write are active, or the HDA is busy.

STATE 7

The HDA checks the Run Status and sends Carriage Go Home to the servo. If Run Status is bad, the Inhibit HDA Recycle latch is set, signaling an HDA sequence error to the system. Run Timer Gated is activated by Carriage Go Home. Within 220 ms, Access Timeout is activated generating Go Home Complete. HDA Sequence 2 Latch is turned off, advancing the HDA sequence from State 7 to State 5. Carriage Go Home is reset in State 3 of the next HDA load sequence.



STATE 5

The following actions occur as the HDA sequence enters State 5:

- The 15-Second Timer starts.
- The Drive Motor Run line becomes inactive.
- The brake solenoid de-engerizes.

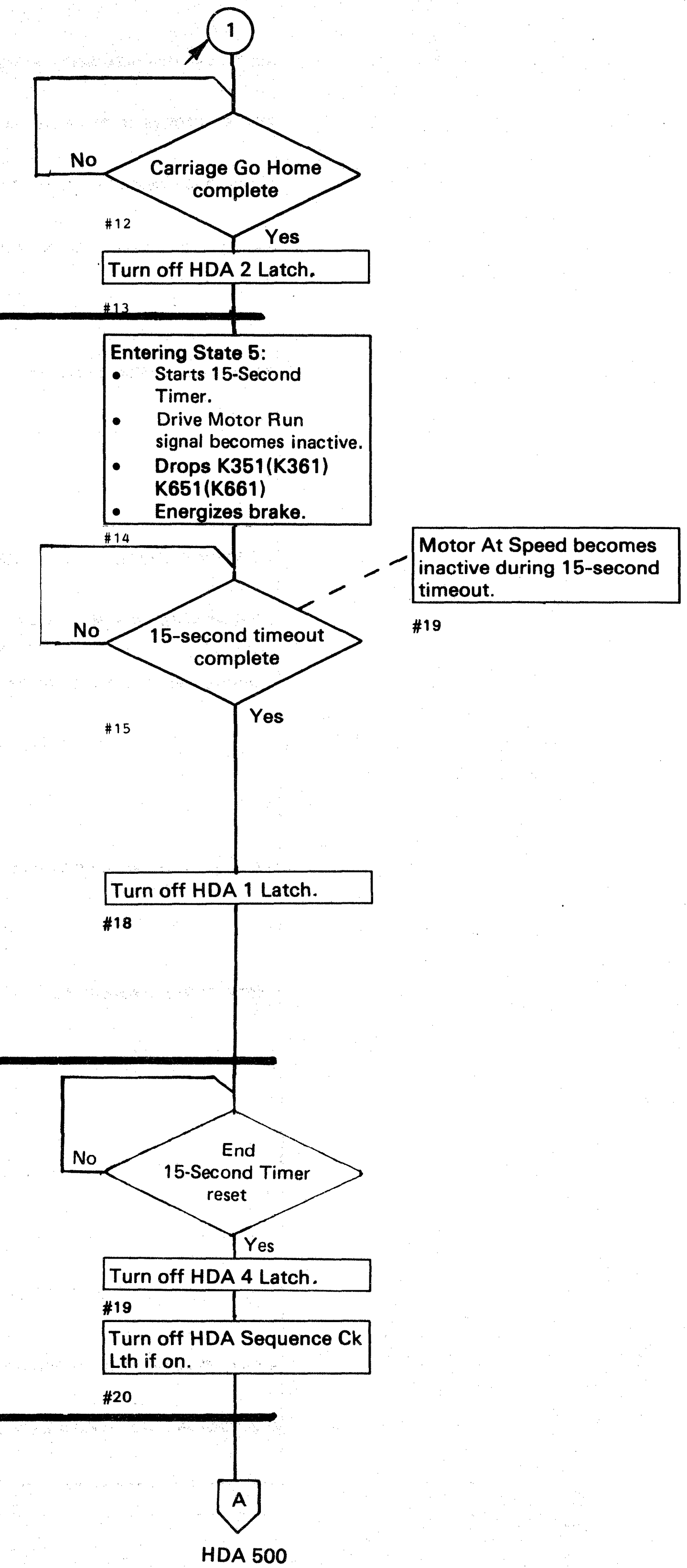
At completion of the 15-second timeout, the HDA sequence is set to State 4.

STATE 4

To advance from State 4 to State 0, the End 15-Second Timer line must be inactive.

The 15-Second Timer was started in State 5. The End 15 Sec Delay becoming inactive and the State 4 lines reset the HDA 4 latch, advancing the HDA sequence from State 4 to State 0.

STATE 0



DC0502 Seq. 2 of 2	2358331 Part No.	441300 31 Mar 76	441303 30 Jul 76			

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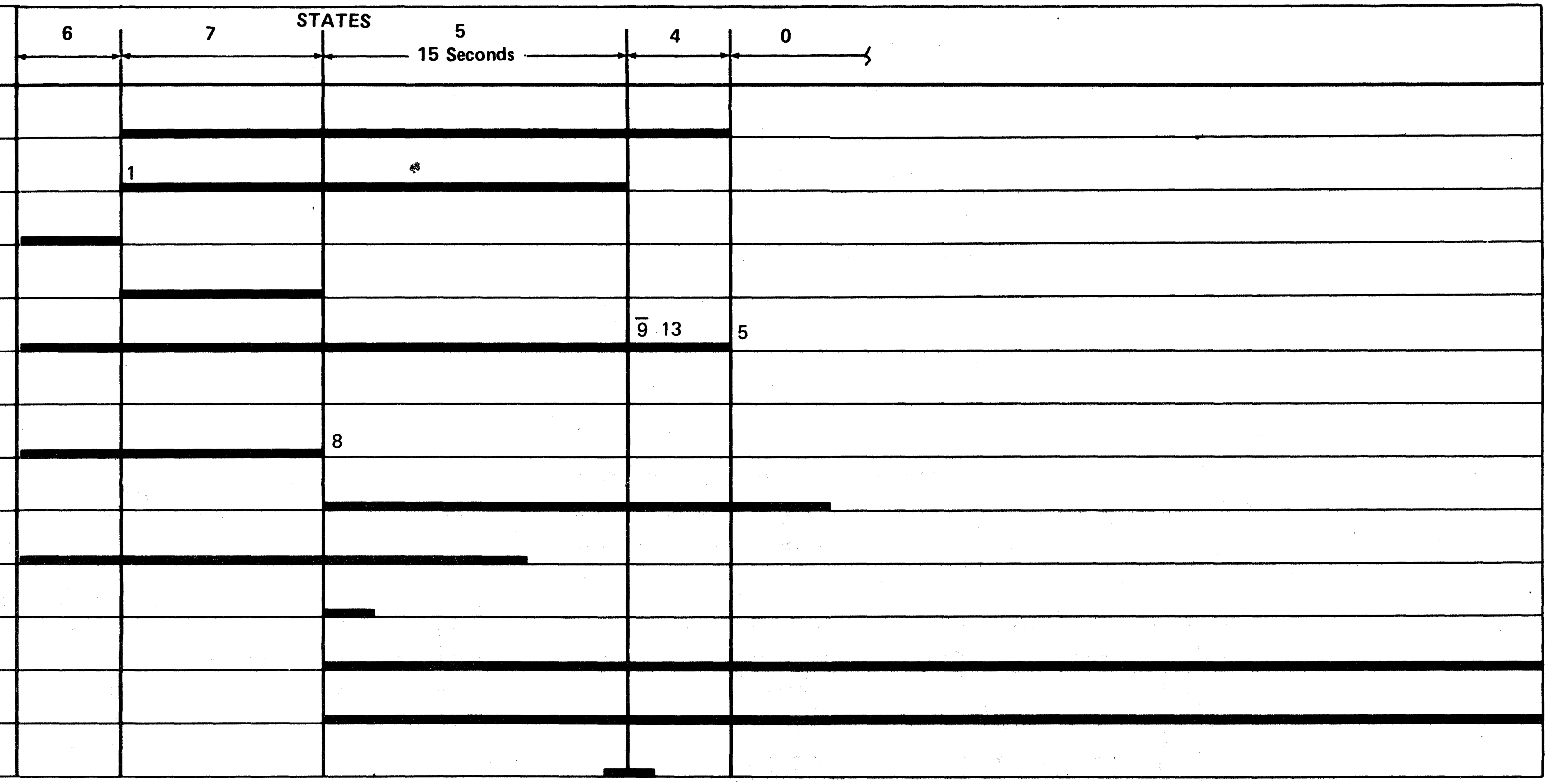
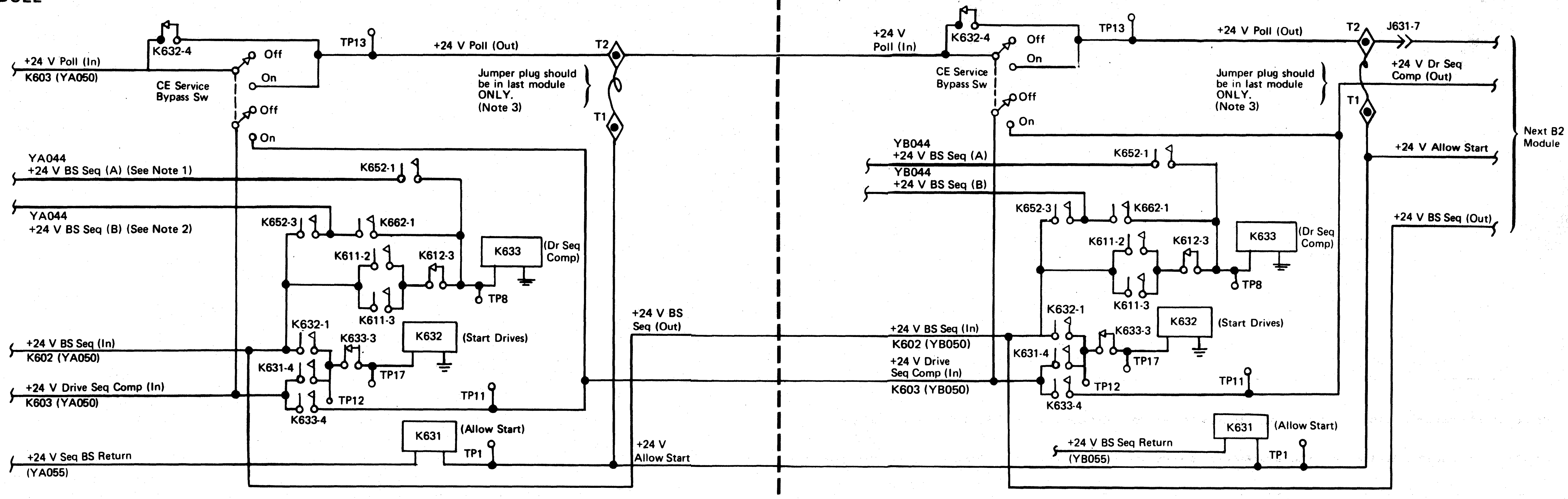
HDA STOP SEQUENCE CHART

Chart Line No.	Line Name	ALD	Test Point
1	+24 V Stop Sw On A(B)	KF100 (KQ100)	A1F2 (A1Q2) U10
2	+HDA 1 Latch A(B) TP	KF190 (KQ190)	A1F2 (A1Q2) B07
3	+HDA Ready A(B)	KE150 (KR150)	A1E2 (A1R2) J13
4	−Carriage Go Home A(B)	KF150 (KQ150)	A1F2 (A1Q2) M02
5	+HDA 4 Latch A(B) TP	KF210 (KQ210)	A1F2 (A1Q2) D11
6			
7	+HDA 2 Latch A(B) TP	KF200 (KQ200)	A1F2 (A1Q2) D09
8	−Go Home Complete A(B)	KE120 (KR120)	A1E2 (A1R2) J11
9	+Motor At Speed	KF130(KQ130)	A1F2(A1Q2)U03
10	−Start Timer A(B)	KF180 (KQ180)	A1F2 (A1Q2) M05
11	K651(K661) Drive Motor Run	YA071 (YA081)	TP5 (TP10)
12	K351(K361) Drive Motor	YA071 (YA081)	TP16 (TP14)
13	−15 Sec Delay A(B)	KF180 (KQ180)	A1F2 (A1Q2) M04

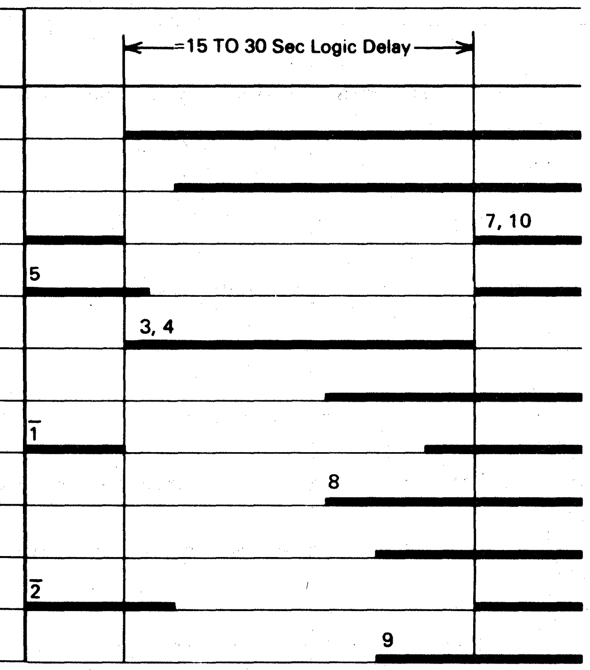


See HDA 510 for a description of relay operation.



Relay Timing Chart (HDA Sequence)

Chart Line No.	Line Name	ALD	Test Point
1	+24 Start Sw On A	YA071	A1A5 D10
2	+24 Start Sw On B	YA081	A1V5 D10
3	K633 Dr Seq Comp	YA055	TP8
4	K631 Allow Start	YA055	TP1
5	K632 Start Drives	YA055	TP17
6	K651 Dr Mtr Run (A)	YA071	TP5
7	K652 HDA Seq Comp (A)	YA071	TP4
8	K351 Dr Mtr (A)	YA071	TP16
9	K661 Dr Mtr Run (B)	YA081	TP10
10	K662 HDA Seq Comp (B)	YA081	TP13
11	K361 Dr Mtr (B)	YA081	TP14



Note 1: *This line is active only when the DC Power switch is set to B—Drive Off (A—On).*

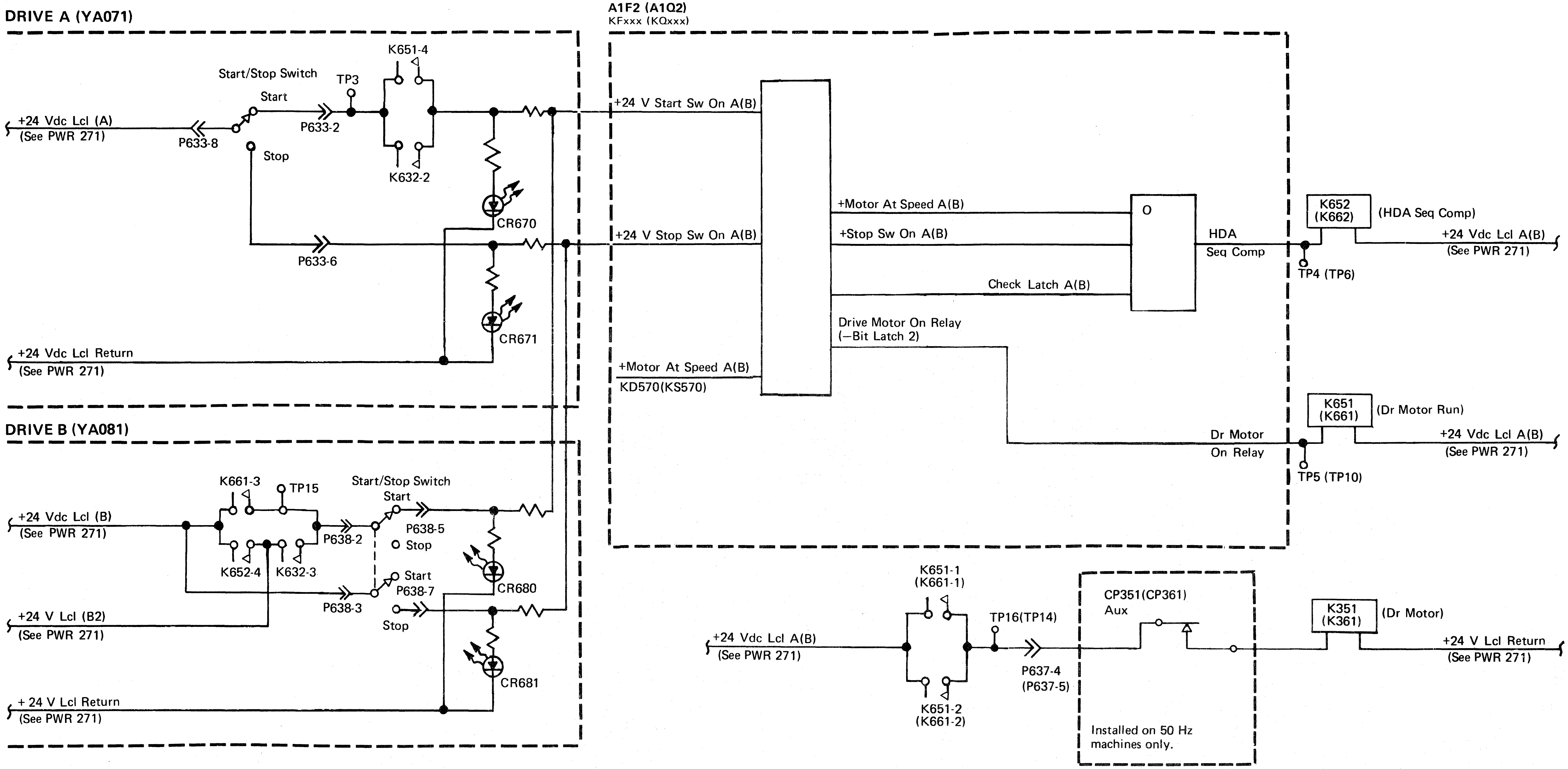
Note 2: *This line is active only when the DC Power switch is set to A Drive Off (B—On).*

Note 3: *This jumper plug functions in any module. If both T1-T2 and T3-T4 are moved to any module other then the last, the drive motors and blower motors in the end modules sequence at the same time drawing excess current.*

A2 MODULE HDA RELAY SEQUENCE DIAGRAM **HDA 508**

HDA RELAY SEQUENCE DIAGRAM

See HDA 510 for description of relay operation.



DC0509 Seq. 1 of 2	2358333 Part No.	441300 31 Mar 76	441303 30 Jul 76	441308 18 Aug 78		

HDA RELAY SEQUENCE THEORY

See HDA 508 and 509 for Relay diagram and sequence chart. HDA 500 through 506 contain the overall HDA Ready sequence and Stop sequence theory.

Initial HDA Relay Sequence

Relay K603 (String Power Sequence Complete) picks when dc power is on in all modules of the string (Power Check LED off in all modules).

K603-2 point passes the +24 V Poll (through each module) to the last module where a jumper between T1 and T2 makes +24 V Allow Start line active. The Allow Start line picks K631 (Allow Start) in each module on the string. K603-2 also activates the line Drive Seq Comp.

Drive Seq Comp picks K632 (Start Drives) in the first drive on the string. K632 picking in any module makes the +24 V Poll line inactive which drops K631 (Allow Start) in all modules. This is to keep all the following drives from sequencing until K633 (Dr Seq Comp) picks in the sequencing module.

Drive A Sequencing (HDA 509)

K632-2 N/O activates +24 V Start Sw On A to the A1F2 card (lights Start LED CR670). The HDA advances from State 0 through State 3 (see HDA 500 through 502 for theory). K651 (Dr Motor Run) is picked when the HDA sequence enters State 3. K351 (Dr Motor A) is picked through K651 N/O points. Motor At Speed line is activated when the drive motor reaches 80% of speed and picks K652 (HDA Seq Comp).

Note: *K652 (HDA Seq Comp) can also be picked by the Start/Stop switch being in the Stop position (Stop LED CR671 being On) or by the HDA Sequence Ck Lth being active. This prevents Drive A from keeping the rest of the drives on the string from sequencing to Ready when either the Start/Stop switch is in the Stop position or an error occurs while the HDA is sequencing.*

Drive B Sequencing (HDA 509)

K632-3 N/O and K652-4 N/O activate +24 V Start Sw On B (with the Start/Stop switch in the Start position) to the A1Q2 card. The HDA sequence advances from State 0 through State 3 (see HDA 500 through 502 for theory). K661 (Dr Motor Run) is picked when the HDA sequence enters State 3. K361 (Dr Motor B) is picked through K661 N/O points. Motor At Speed line is activated when the drive motor reaches 80% of speed and picks K662 (HDA Seq Comp).

Note: *K662 (HDA Seq Comp) can also be picked by the Start/Stop switch being in the Stop position (Stop LED CR681 being On) or by the HDA Sequence Ck Lth being active. This prevents Drive B from keeping the rest of the drives on the string from sequencing to Ready when either the Start/Stop switch is in the Stop position or an error occurs while the HDA is sequencing.*

Next Module Sequencing (HDA 508)

In order to pass the sequence to the next module on the string, K633 (Dr Seq Comp) is picked through K652-3 (HDA Seq Comp A) and K662-1 (HDA Seq Comp B) points. K633 picking drops K632 which re-activates the +24 V Poll line. The +24 V Poll line repicks K631 in all modules. K633-4 N/O passes Drive Seq Comp (In) to the next module on the string. This relay sequence is repeated in each module on the string.

Note: *K633 (Dr Seq Comp) is held after a module has completed to prevent K632 from repicking. K633 is picked immediately through K612-3 N/O (+6 V Sense) points if dc power is not available to the A1 logic board.*

MECHANICAL REMOVALS AND ADJUSTMENT CONTENTS

3350

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COVERS

LOWER FRONT COVERS

Open the lower front covers **9** by inserting a screwdriver below the latch **10** and lifting the latch.

TOP FRONT COVER

1. Open the lower front covers **9** using the procedure above.
2. Open the top front cover **1** by inserting a screwdriver below the top cover latch handle **3**, pushing the interposer hand release **4** toward the back of the machine, and then lifting the top cover handle.

TRIM PANEL

1. Open the top front cover **1** using the procedure above.
2. Remove the two screws from the trim panel **2** and remove the panel.

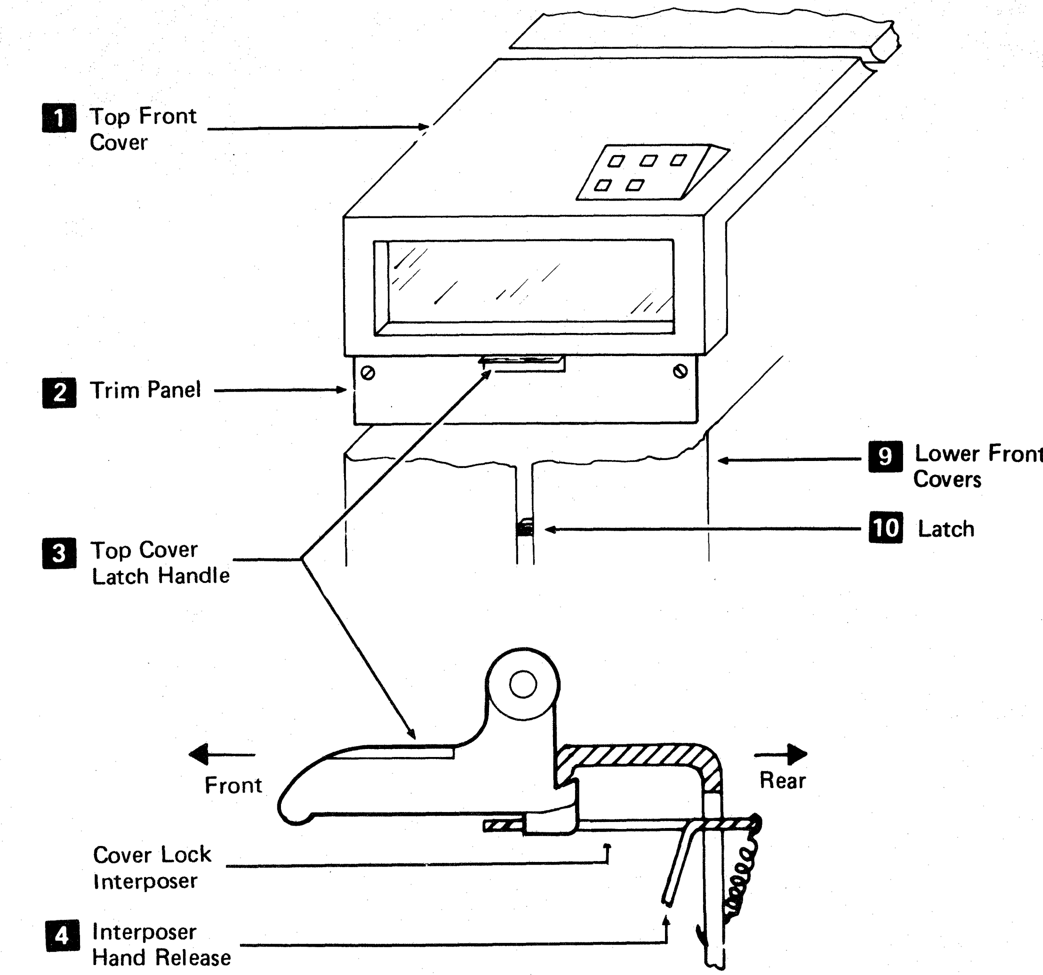
   Note: *It may be necessary to remove the lower front cover before removing the trim panel.*

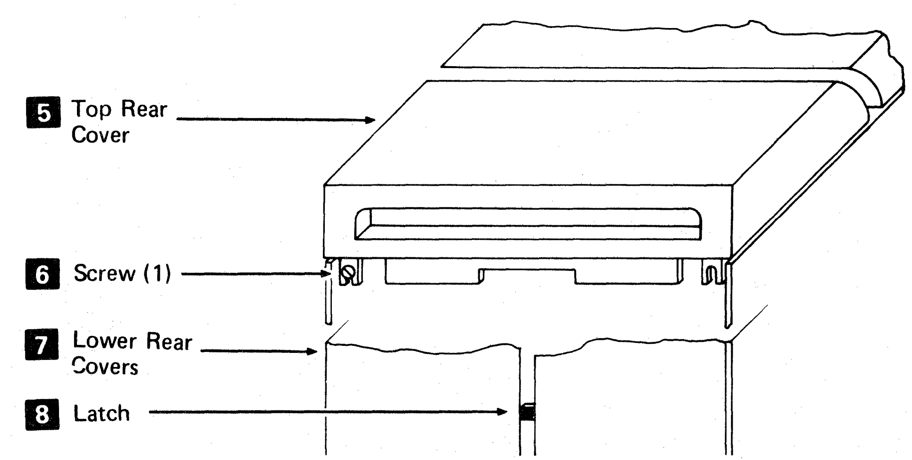
LOWER REAR COVERS

Open the lower rear covers **7** by inserting a screwdriver below the latch **8** and lifting the latch.

TOP REAR COVER

1. Open the lower rear covers **7**.
2. Loosen the top rear cover screw **6** and lift the top rear cover **5**.





VOICE COIL CHECK, REMOVAL, AND REPLACEMENT

CHECKS

Purpose

This procedure describes the basic checks to determine if the voice coil should be replaced and the details for removal and replacement when it is necessary.

A broken or damaged coil or flexure wire can cause the following failure symptoms. These symptoms are described in the 1500 and 1600 Fault Symptom Codes.

- Ready drops
- Ready does not come up
- Overshoot Checks occur
- Servo Off-Track errors occur

Before proceeding with a voice coil removal and replacement, the following areas should be carefully checked:

- Verify that the HDA carriage is not binding (see HDA 712).
- Verify that the servo gain is properly adjusted (see ACC 800, Entry B).
- Verify that the drive motor and brake are not vibrating excessively (see HDA 715 and 720).
- Verify that the coil and flexure wires have an ohm reading of 4.0 to 4.6 ohms. Check this by raising the top of the rear cover (see HDA 705), unplugging the power amplifier cable to VCM terminal A and B **7** and measuring with an ohmmeter. If the continuity (ohm reading) is within the range, replug the power amplifier cable and go to HDA 990. If the coil continuity is not within the range, remove and replace the voice coil using the procedure below.
- Verify that VCM terminals A and B are tight.

Bill of Material and Supplies

The voice coil replacement package may be ordered from Mechanicsburg using B/M 2345225. It contains:

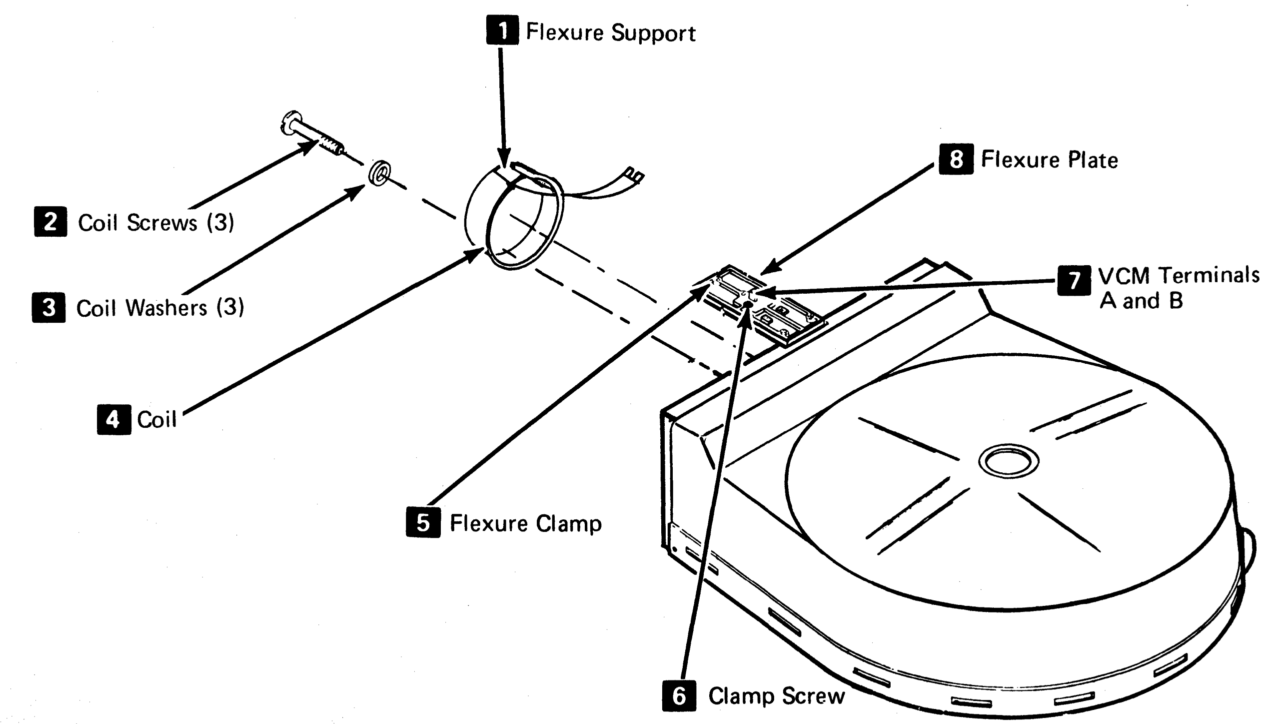
A new voice coil
Three stainless steel screws (4-40)
Three aluminum washers
Locquic Primer†
Loctite A Sealant†
Torque screwdriver
A bit (for the screwdriver)
Lint-free tissues

REMOVAL

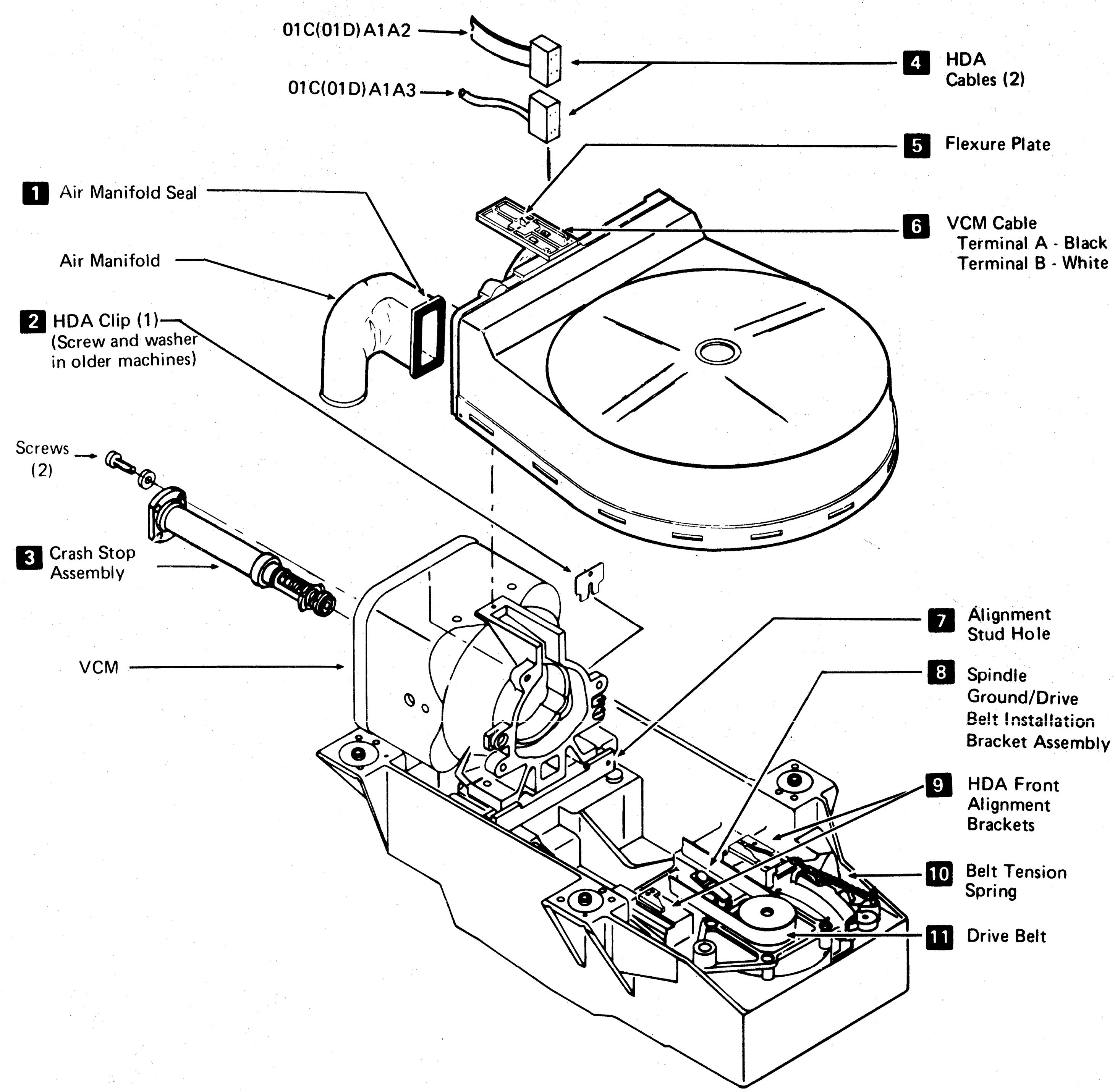
1. Perform Steps 1 through 15 of the HDA Removal procedure on HDA 710 to remove the HDA. The HDA should be placed on a flat unobstructed surface. Be sure that the carriage is pushed back and latched as instructed in Step 11 of the removal procedure and observe the contamination instructions.
2. Tip and support the HDA about 2 or 3 inches (25.4 to 50.8 mm) with the coil end up. This keeps the carriage back into the HDA. Hold the carriage into the HDA when working on the coil. Maintain a clean atmosphere to prevent contaminating the open end of the HDA.
3. Cover the exposed center hole and the space between the carrier struts with lint-free tissues.
4. Loosen the clamp screw **6** that holds the end of the flexure wire to the flexure plate **8**. Slip the flexure wire out of the clamp.
5. Loosen the three screws **2** holding the coil to the carrier. The screws were originally installed with Loctite A Sealant, so they may be a little difficult to turn. Use the screwdriver bit which properly fits the heads of the screws. Remove and discard the screws and the three washers **3**. Remove the coil **4** by carefully slipping it off the strut without twisting or turning it. Do not allow the carrier to move back and forth.

REPLACEMENT

1. Clean off the Loctite particles that came out with the screws. Clean the outside diameter surface of the strut that will receive the new coil. Install the new coil. The fit may be loose or slightly tight. In either case, carefully install the coil squarely and smoothly. Do not allow the coil to bind. Locate the coil so that the slot in the flexure support **1** straddles the top strut. The coil must be bottomed on the three strut shoulders. When handling and installing the coil, do not kink or sharply bend the flexure, especially at the support end. Allow the flexure to flex and bend naturally between the coil and flexure plate. Guide the end of the flexure into the flexure clamp **5** until it bottoms, then tighten the clamp screw **6**. Check the continuity at VCM terminals A and B **7** for 4.0 to 4.6 ohms.
2. Completely coat the new screw threads with Locquic Primer. Lay the screws on a lint-free tissue with the heads down and allow them to dry for at least three minutes.
3. Hold one of the screws horizontally and apply one drop of Loctite A Sealant on the threads. Blot the screw immediately with a lint-free tissue to remove excess sealant. Fit the screw with a washer and insert it into one of the threaded holes in the strut. Tighten to 38 ± 3 inch ounce (27.36 ± 2.16 mm kgf) with the torque screwdriver. Do not undertighten or overtighten the screws. The sealant starts hardening immediately and is completely hard in 10 minutes.
4. Repeat Steps 2 and 3 with the other two screws. Check that all the screws are properly seated and that the washers are snug against the coil.
5. Check the coil continuity for 4.0 to 4.6 ohms at VCM terminals A and B.
6. Remove the lint-free tissues from around the strut and make sure that everything is clean around the open end of the HDA.
7. Install the HDA (see HDA 710).
8. Perform the HDA Checkout procedure (see HDA 711, Steps 1, 2, 5, and 6), then go to START 500.



† Trademark of Loctite Corporation.


01C(01D)A1A2
01C(01D)A1A3
4 HDA Cables (2)
5 Flexure Plate
1 Air Manifold Seal
Air Manifold
6 VCM Cable Terminal A - Black Terminal B - White
2 HDA Clip (1) (Screw and washer in older machines)
Screws (2)
3 Crash Stop Assembly
VCM
7 Alignment Stud Hole
8 Spindle Ground/Drive Belt Installation Bracket Assembly
9 HDA Front Alignment Brackets
10 Belt Tension Spring
11 Drive Belt

HDA REMOVAL AND REPLACEMENT

REMOVAL

Caution: Before removing an HDA for replacement be sure that the customer data, if possible, is either copied or destroyed by the customer.

See HDA 709 for keyed references.

HDA Part Numbers

Models A02, B02, and C02 – P/N 2758812; Models A2F, B2F, and C2F – P/N 2758814 — If ordering a new HDA for a machine that uses a screw instead of a clip **2**, a clip must also be ordered.

Screw **2** 10-32 x 0.375 inch long with lockwasher – P/N 234329; Washer **2** – P/N 23141 (See Step 9 of Removal procedure.) HDA Clip **2** – P/N 2758497

To prevent contamination to the HDA while it is temporarily removed from the machine, obtain a plastic bag or other suitable container to cover it while it is removed from the machine.

1. Set the CE Mode switch to position A (Drive A) or B (Drive B).
2. Set the Drive DC Power switch (see LOC 4 or 14) to Off to remove the dc power from the drive being serviced.

   Note: *The blower operates during this procedure.*
3. Open the top front cover and remove the trim panel (see HDA 705 for the procedure).
4. Remove the belt tension spring **10** from the machine.
5. Open the top rear cover (see HDA 705 for the procedure).
6. Remove the crash stop assembly **3** from the VCM:
   a. Insert the bobbin pushrod through the back of the VCM and thread it into the carrier.
   b. Loosen the two crash stop assembly screws. (The screws must be removed on older machines.)
   c. Turn the crash stop assembly clockwise 90 degrees to uncouple from the carriage.
   d. Use the bobbin pushrod to push the carriage in as far as possible.
   e. Unscrew the bobbin pushrod and remove.
   f. Pull the crash stop assembly from the rear of the VCM.
7. Disconnect the two HDA cables **4** from the rear of the HDA.
8. Disconnect the VCM cable **6** by slipping the wires from Terminal A and Terminal B.
9. Remove the one HDA clip **2** (this may be a screw and washer in older machines).
10. Raise the top rear cover enough to give clearance to the flexure plate **5**. Slide the HDA toward the front of the machine approximately 1/2 inch (1.27 cm).

    Note: *The HDA may seal itself against the VCM and the two may be difficult to separate.*
11. Insert the bobbin pushrod through the back of the VCM and push the carriage in as far as possible. This engages the carriage latch mechanism and prevents the carriage mechanism from moving while the HDA is out of the machine. Remove the bobbin pushrod.
12. Slide the HDA forward and lift from the machine.
13. Put the HDA on a flat unobstructed surface and place it in the plastic bag or other suitable container obtained earlier.

    Note: *If the HDA is shipped back to the plant, pack the HDA in the shipping container received with the replacement HDA. Include all documentation (EREP, AP1, PSA, PSB, PSC, Customer Symptoms) associated with this replacement.*
14. Check the air manifold seal **1** for surface damage.
15. Check the VCM alignment (see VCM replacement procedure, Step 1 on HDA 725).

REPLACEMENT

See HDA 709 for keyed references.

1. Raise the top rear cover enough to give clearance to the flexure plate.

   Note: *Be sure the smooth side of the belt is against the HDA pulley. Place the belt on the belt installation bracket assembly* **8** *so that the HDA pulley sets inside the belt loop. Loop the other end of the belt around the drive motor pulley (be sure the motor remains positioned toward the front of the machine while replacing the HDA.*
2. Set the HDA in the machine aligning the rear alignment stud with the alignment hole **7** and the HDA feet with the front alignment brackets **9**.
3. Slide the HDA into place and install the HDA clip (this may be a screw and washer in older machines). Check the seating of the air manifold seal **1**.
4. Ensure that the blower is operating. Allow the blower to purge the HDA for a minimum of 15 seconds before proceeding.
5. Re-install the crash stop assembly **3**.
   a. Turn the crash stop assembly 90 degrees from its coupled position and slowly insert it into the back of the VCM.
   b. When the back of the crash stop assembly is flush with the VCM, rotate the crash stop assembly 90 degrees counterclockwise to couple it with the carriage. If the crash stop assembly cannot be rotated, insert the bobbin pushrod through the back of the VCM and thread it into the carrier. Pull the carriage toward the back of the machine just enough to allow the crash stop assembly to be rotated 90 degrees.
   c. Tighten the crash stop assembly screws.
6. Install the belt tension spring and check that the drive belt is in place.
7. Reconnect the HDA and VCM cables.

   Caution: When restoring power, do not turn the Drive DC Power switch past the Both Drives On position. If the other drive in the module is online, verify that it is still Ready after power is restored.
8. Bring HDA to Ready condition.
9. Install back panel jumper between:
   C4D09 (T4D09) and ground
   to put servo in zero mode.
10. Check for carriage binding by inserting the bobbin pushrod into the back of the VCM and threading it into the coupler. Move the carriage between the outer and inner stops with the pushrod. If resistance or binding is felt (over 100 grams), use the procedure on HDA 712 to correct the problem. Return here and continue once the trouble is corrected.
11. Remove the bobbin pushrod and jumper.
12. Press Attention button to bring HDA to Ready.
13. Install trim panel, restore power and exit to the HDA Checkout procedure on HDA 711.

BASIC CHECKOUT (ALL HDAs)

1. Start the drive and verify that the Ready lamp comes on. If the Ready lamp does not come on, recheck the installation of the HDA. Verify that the drive belt is installed correctly with the smooth side of the belt against the pulley, the HDA cables are plugged into the correct connectors, the Drive DC Power switch is in the Both Drives On position, and the CE Service Bypass switch is in the Off position.

   If still unable to bring the drive to a Ready condition after rechecking the installation, exit to HDA 110, Entry C, then return here when the problem is corrected.
2. Allow the HDA to stabilize by running for 2 minutes before continuing with the checkout procedure. If a new HDA has been installed, continue below. If the old HDA has been re-installed, perform Steps 5 and 6 and then exit to START 500.
3. If the drive is in 3330 Compatibility Mode, change the mode to 3350 Mode by moving the jumper. See Figure 1 for jumper location. Remove dc power from the drive before removing or installing the jumpers.
4. Adjust the servo gain using the procedure on ACC 800, Entry B. Return here and continue when the procedure is complete.
5. Run the linked series of microdiagnostic routines A1 through BB. Start with routine A1. If errors occur, exit to the MICRO section and follow the instructions under the first failing Error Code.
6. Run microdiagnostic routines B1, B2, and AB. If errors occur, exit to the MICRO section and follow the instructions under the first failing Error Code.
7. If attached to 3830-2 or ISC, load the Fault Symptom Code Generator by replacing the functional micro-program disk and entering '30' with the Data Entry switches.
8. Put the drive online and run T3350 PSC in default mode to build SD (skip displacement) Directory (for running instructions see OLT section). If SD Directory already exists (PSC message) it is not necessary to rewrite it.
9. If the drive is to be operated in 3330 Compatibility Mode, go to Compatibility Mode, on this page, and continue. Otherwise, continue with Step 10.
10. Run OLT 3350PSA (for running instructions see OLT section). If the OLT does not run error free, the HDA must be initialized by the customer using one of the following initialization utilities:

    IBC DASDI
    IEH DASDR
    INTDK
    ICKDSF
    ICLDSF

    If the HDA cannot be initialized, run EREP and exit to START 100 with the error data.
11. The HDA checkout procedure is complete. Exit to START 500.

COMPATIBILITY MODE

1. Move the mode jumper to place the device in 3330-1 or 3330-11 Mode. See Figure 1 for jumper location. Remove dc power from the drive before removing or installing the jumper.
2. Run microdiagnostic routine B2 to format the CE cylinder. If errors occur, exit to the MICRO section and follow the instructions under the first failing Error Code.
3. The HDA must be formatted by the customer using one of the following initialization utilities:

   IBC DSADI
   IEH DASDR
   ICKDSF
   ICLDSF

   If the HDA cannot be initialized, run EREP and exit to START 100 with the error data.
4. Run OLT T3350PSA (for running instructions see OLT section). If the OLT does not run error free, use OLT section to determine the cause of the error.
5. The HDA checkout procedure is complete. Exit to START 500.

Figure 1. Mode Jumper Location

Mode	Jumper Location (See Note)
3350	A1F2 (A1Q2) S08 to U08
3330-1	A1F2 (A1Q2) M08 to P08
3330-11	A1F2 (A1Q2) G08 to J08

Note: *Only one jumper should be installed per drive. Remove dc power from the drive before removing or installing the jumper.*

HDA CARRIAGE BINDING CHECKOUT PROCEDURE

CARRIAGE CHECKOUT FOR BINDING:

1. Ensure that the blower is running before continuing with this procedure. If the blower is not running, use ALD page YB020 to isolate the trouble before returning here.
2. Bring HDA to Ready condition then install a jumper C4D09 (T4D09) to ground to put servo in zero mode.
3. Insert the bobbin pushrod into the back of the VCM and thread into the carriage.
4. Manually move the carriage from the outer stop to the inner stop.
5. Binding is present if any roughness is felt or if the force required to move the bobbin pushrod is greater than 100 grams.
6. If the binding condition is present, continue with the HDA Carriage Binding Procedure below.

Note: *Remove bobbin pushrod and jumper when procedure is complete.*

HDA CARRIAGE BINDING PROCEDURE

The following procedure can be used to determine the cause of the carriage binding condition:

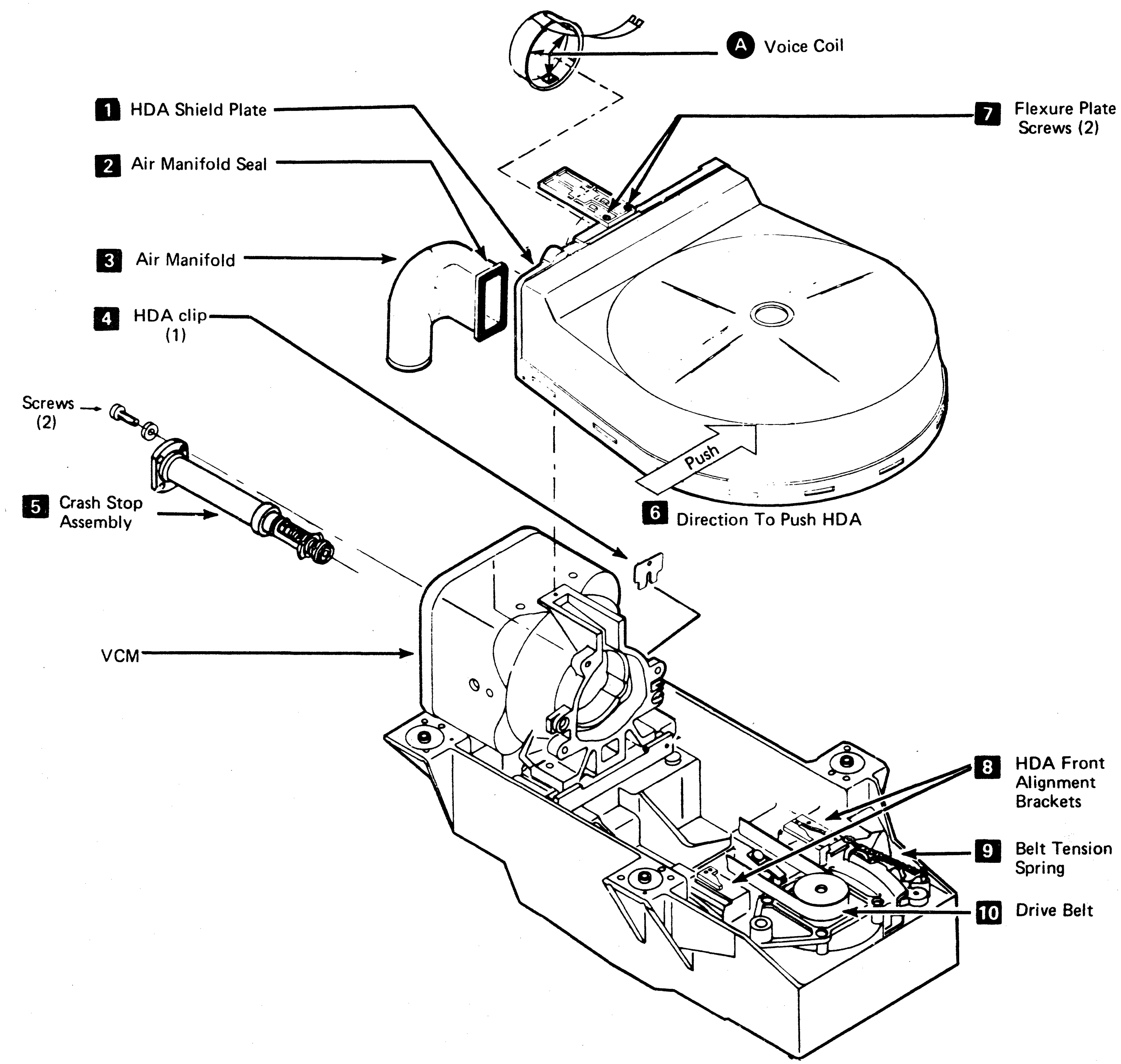
1. Check that the air manifold 3 is nearly parallel to the HDA shield plate 1 with only the air manifold seal 2 touching the HDA. Loosen the air manifold mounting screws and reposition the air manifold as necessary.
2. Check that the HDA feet are in the front alignment brackets 8. If the feet are in the alignment brackets, push the HDA to the right 6 to check for proper registration of the feet in the alignment brackets. Recheck the HDA for binding.
3. Remove the crash stop assembly (see Step 8 of the HDA Removal Procedure on HDA 710) and recheck for binding. If the binding condition disappears, re-install the crash stop assembly and recheck for binding. If binding occurs with the crash stop assembly installed but disappears with the assembly removed, replace the crash stop assembly.

   Note: *It may be possible to eliminate the binding condition by rotating the crash stop assembly on its axis by 180 degrees. If the binding condition disappears, this should be considered only as a temporary repair until a new crash stop assembly is available.*

4. Loosen the two screws 7 holding the flexure plate to the HDA and recheck the carriage for binding. If the binding condition still exists, tighten the flexure plate screws and continue with the next step below. If the binding condition disappears when the flexure plate is loose, reposition the flexure plate and tighten the screws. Recheck for binding.
5. Power down the HDA remove the belt tension spring 9 and remove the HDA clip 4 to allow the HDA to find its natural position. Re-install the HDA clip, replace the belt tension spring, and recheck the carriage for binding.
6. Remove the HDA (see HDA 710 for procedure). Check the voice coil motor (VCM) alignment (see HDA 725 for procedure).

   Note: *Do not replace HDA until Step 7.*

7. Check for voice coil binding using the following procedure.
   a. Use a soft tip marker, such as a felt-tip or fiber-tip pen (do not use a graphite pencil), to mark the inner surface of the voice coil bobbin A between each of the voice coil supports.
   b. Re-install the HDA and check for binding using procedure on this page. If binding condition is still present, remove the HDA and check the marks on the voice coil bobbin A for smearing or rubbing. If smearing or rubbing is present replace the voice coil. See HDA 708 for procedure.
8. If binding condition still exists, replace the HDA.



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HDA CABLE SWAP PROCEDURE

PURPOSE

The HDA Cable Swap Procedure describes the swapping of HDA cables between two HDAs in the same module. After the cables are swapped, HDA-A uses the HDA-B logic and HDA-B uses the HDA-A logic. The Operator Panels and addresses are not interchanged; therefore, the Drive A Start/Stop switch still controls the spindle A drive motor.

PROCEDURE

1. Vary both drives offline.
2. Set both Start/Stop switches to Stop.
3. Set Service Bypass switch to On.
4. Swap voice coil cables as follows:

   Note: *Remove voice coil slide-on connectors before removing ground screw.*

   a. Remove voice coil slide-on connectors from the flexure plate of both drives.
   b. Remove the screw and ground lead from both drives.
   c. Place Drive B ground lead on the voice coil of Drive A and secure with a screw. Repeat the step for Drive B.
   d. Place Drive B voice coil leads on the Drive A voice coil and Drive A leads on Drive B voice coil. The connectors must be installed as shown in Figure 2.
5. Check the mode jumper for both drives in the module to determine the mode of operation. If the drives are operating in different modes, swap the mode jumpers.

Mode	Jumpers
3350	A1F2(A1Q2)S08 to U08
3330-1	A1F2(A1Q2)M08 to P08
3330-11	A1F2(A1Q2)G08 to J08

6. Interchange the cables (see Figure 1) at the HDA:

   a. 01C-A1A2 with 01D-A1A2.
   b. 01C-A1A3 with 01D-A1A3.
7. Place the Service Bypass switch to Off.
8. Set Drive B Start/Stop switch to the Start position and within three seconds, set Drive A Start/Stop to the Start position. If the switches are not turned on in this sequence, the drives do not come Ready.

   Note: *If Ready is dropped on either drive for any reason, place both Start/Stop switches in the Stop position, then repeat Step 8 above to restore the drives to the Ready condition.*
9. Adjust the servo velocity gain on both drives. See ACC 800 Entry B.
10. Run the following microdiagnostics in default mode:

    a. Linked series routines A1 through BB.
    b. Routine B1.
    c. Routine B2.

    Note: *All microdiagnostic failures must be corrected before running OLTs or allowing customer operation to avoid the possibility of erroneously writing over customer data.*
11. If there are no microdiagnostic failures, the following OLTs may be run:

    a. T3350PSA (see OLT section).
    b. T3350 PSB (see OLT section.
12. It is possible to let the customer run with the HDA cables swapped to gather information for problem analysis. To do this, it is necessary to change (swap) the addressing jumpers on cards A1K2 and A1L2 (INST 6).

Caution: Operator should be made aware of the swap when allowing customer operation. The Operator Panels are NOT swapped and confusion could result in a loss of data. The R/W switches are on these panels and an error might result in the wrong HDA being placed in write mode.

13. Restore all cables and jumpers to the original configuration, re-adjust servo gain (see ACC 800, Entry B), then return to MAP.

Figure 1. Voice Coil Motors (Rear View)

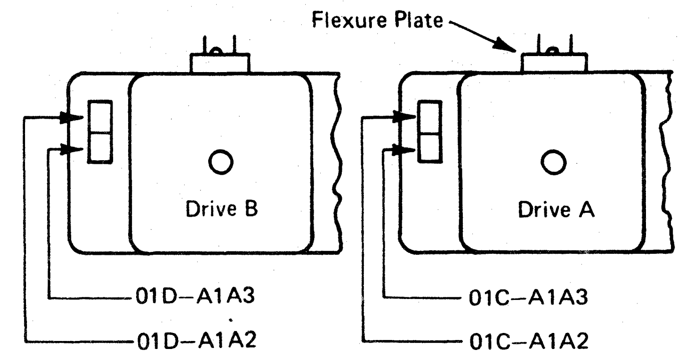
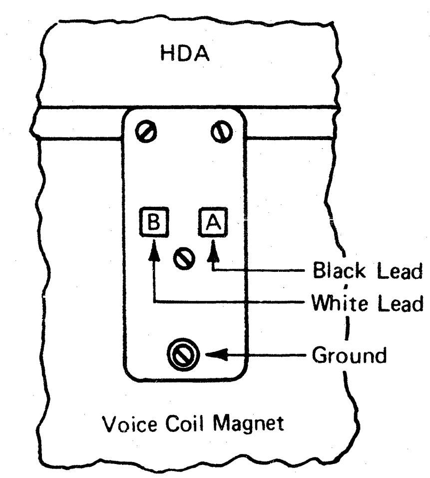


Figure 2. Flexure Plate (Top View)



DRIVE MOTOR REMOVAL AND REPLACEMENT

REMOVAL

1. Remove the HDA using the procedure on HDA 710.
2. Unplug the motor power plug **11** from the AC Compartment.
3. Label and disconnect the wires going to EC601 **7** using one of the following procedures:
   a. For 60 Hz machines, label and disconnect the two cable leads going to EC601.
   b. For 50 Hz machines, the removal of a drive motor requires both drives to be off or the drive thermal circuit protector (CP351/CP361) auxillary points (YA, YB, YC055) to be jumpered. The thermal bypass jumper must be installed before disconnecting the four cable leads at EC601 and must remain installed during motor removal and replacement.
4. Remove the retainer clip from the motor pivot pin **6**.
5. Remove the two mounting screws **9** from the motor support assembly and slide the assembly out of the way.
6. Lift the motor out of the frame.

REPLACEMENT

1. Check the DC Power Switch (see LOC 14) to ensure that DC Power is removed from the drive and check that the Start/Stop switch is in the Stop position.
2. If installing a new drive motor, remove the motor pulley **4** from the old motor and install it on the new motor. If the pulley is bonded, the motor and pulley must be replaced as an assembly.
   a. Remove the brake **12**.
   b. Remove the retaining bolt **1**, keyed washer **2**, washers **8**, and motor pulley **4**, if not bonded.
   c. Install the motor pulley **4** on the new motor, ensuring that the keyed washer **2** is engaged in the drum motor keyway **5** and the pulley keyway **3**. The retaining bolt **1** must be tightened to the following torque value:

      100 ± 5 inch pounds (115.2 ± 5.8cmkgf).
   d. See HDA 720 for brake replacement.
3. Replace the drive motor in the reverse order of the removal procedure. Do not re-install the HDA. Continue with Step 4 below after the drive motor is installed.

   Note: *(For 50 Hz only) If the drive motor thermal auxillary points were bypassed during the removal and replacement, remove the bypass jumper before proceeding.*
4. Check the direction of the drive motor rotation if a new motor is being installed. If re-installing the old drive motor, go to Step 5.
   a. Restore dc power.

      Caution: When restoring power, do not turn the Drive DC Power switch past the Both On position. If the other drive in the module is online, verify that it is still Ready after power is restored.

   DANGER
   Keep hands and objects clear of the motor. The motor will pivot toward the front of the machine when the Start/Stop switch is placed in the Start position.

   b. Hold the flapper valve door open in order to close the Air switch. See HDA 760 for the location.
   c. Set the Start/Stop switch to the Start position.
   d. Observe the drive-motor pulley for direction rotation. The pulley should rotate counterclockwise when viewed from the top of the 3350.
   e. If the drive motor rotation is clockwise, reverse the motor wires in the drive motor connector P351(P361) **11** as follows:

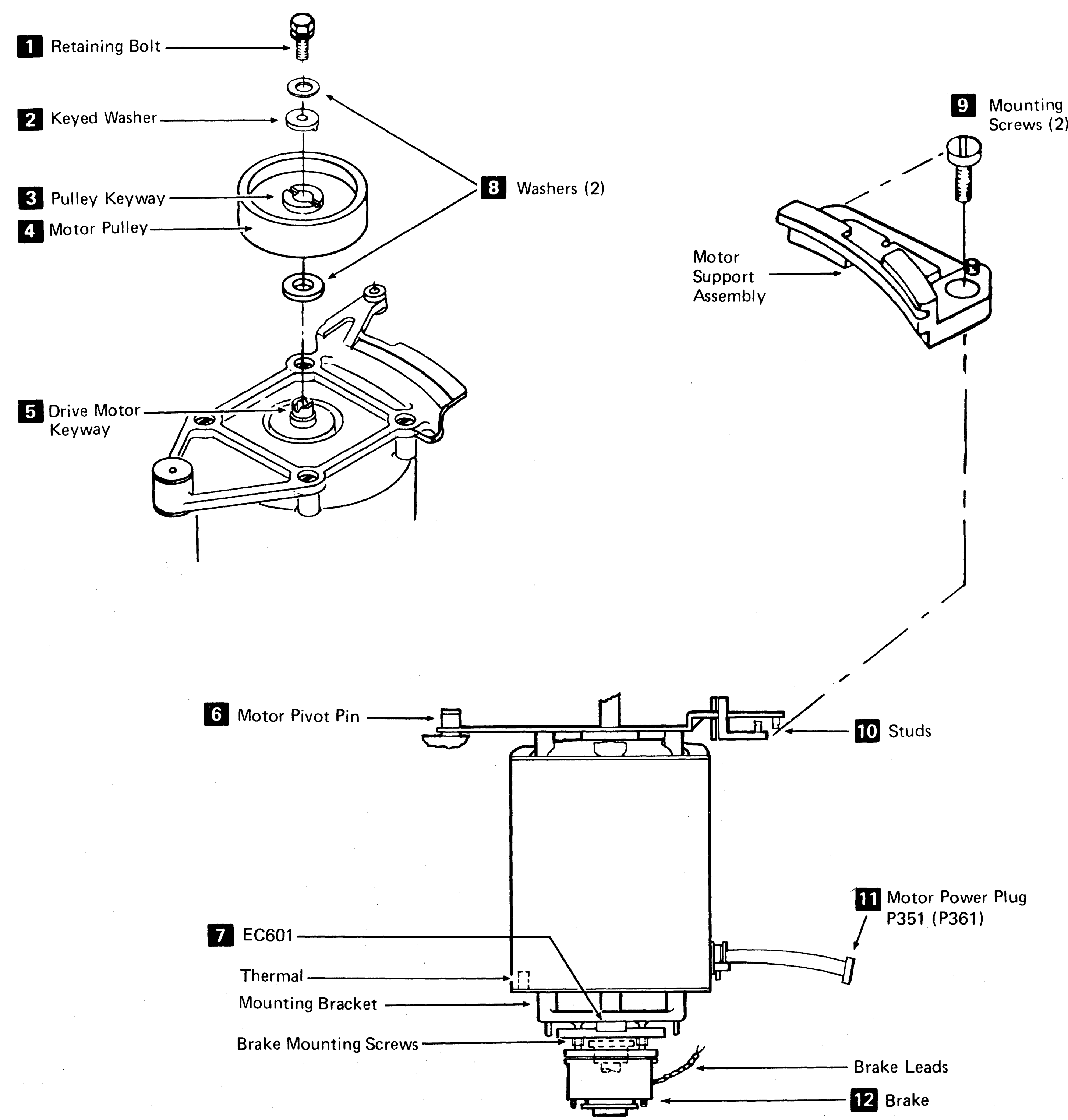
      For 60 Hz – Positions 1 and 2

      For 50 Hz Wye
      (380/440 Vac) – Positions 1 and 2

      For 50 Hz Delta
      (200/220/235 Vac) – Positions 1 and 2 and Positions 4 and 5.

      Logic for the drive motor is shown on ALD page YB020.
   f. Remove dc power from the drive.
5. Replace the HDA using the procedure on HDA 710.
6. Restore power to the drive, set the CE Mode switch to Off (center position), and exit to START 500.

   Caution: When restoring power, do not turn the Drive DC Power switch past the Both On position. If the other drive in the module is online, verify that it is still Ready after power is restored.



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DRIVE MOTOR BRAKE REMOVAL, REPLACEMENT, AND CHECKOUT

REMOVAL

Caution: The brake assembly spring tension adjusting collar is preset at time of manufacture. Excessive wear or damage to the HDA results if this adjustment is altered in the field.

1. Set the CE Mode switch to position A (Drive A) or B (Drive B).
2. Set the Drive DC Power switch (see LOC 4 or 14) to Off for the drive being serviced.
3. Open the front covers (see HDA 705 for the procedure).
4. Disconnect the drive motor power plug **5** from the AC Compartment.
5. Remove the two brake leads from EC601b and EC601f **2**.
6. Remove the four brake mounting screws **6**.
7. Slide the brake down and off the motor shaft.

REPLACEMENT

1. Check the brake collar adjustment **1**, between the lower surface of the mounting bracket and the lower surface of the brake collar.
2. Adjust the collar, if required, by loosening the locking screw and repositioning the collar on the drive motor shaft. Retighten the locking screw.
3. Center the brake disk **7** in the brake assembly **4**.
4. Slide the brake assembly over the brake collar. If necessary, rotate the brake assembly to match the slotted disk with the splines on the brake collar. Push the brake assembly up until its upper surface is mated with the mounting bracket on the drive motor.
5. Replace the four brake mounting screws **6**.
6. Replace the two brake leads in EC601b and EC601f **2**.
7. Ensure that the Start/Stop switch is in the Stop position.
8. Turn the Drive DC Power switch to the Both Drives On position.

   Caution: When restoring power, do not turn the Drive DC Power switch past the Both On position. If the other drive in the module is online, verify that it is still Ready after power is restored.

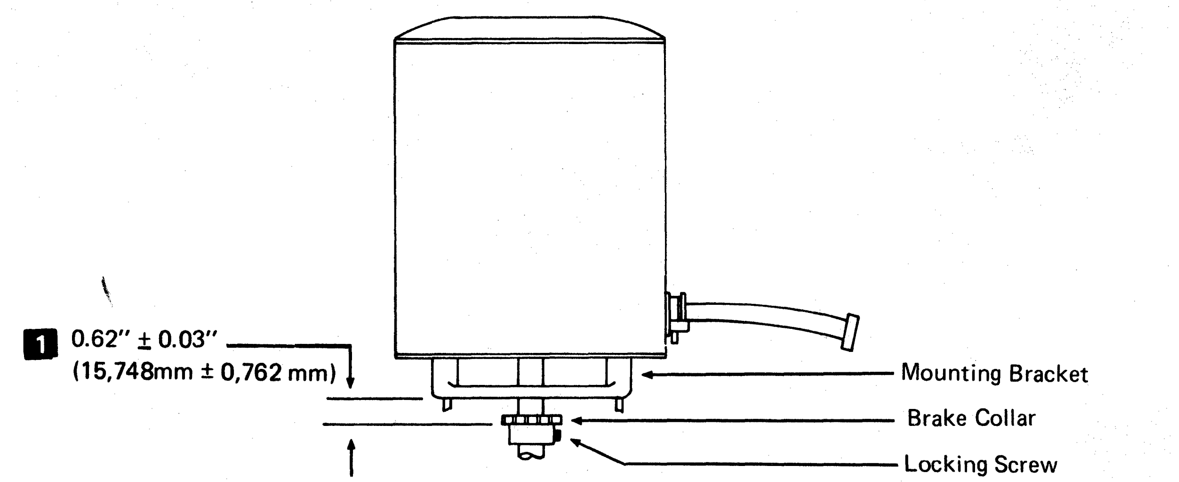
9. Continue with the Checkout procedure.

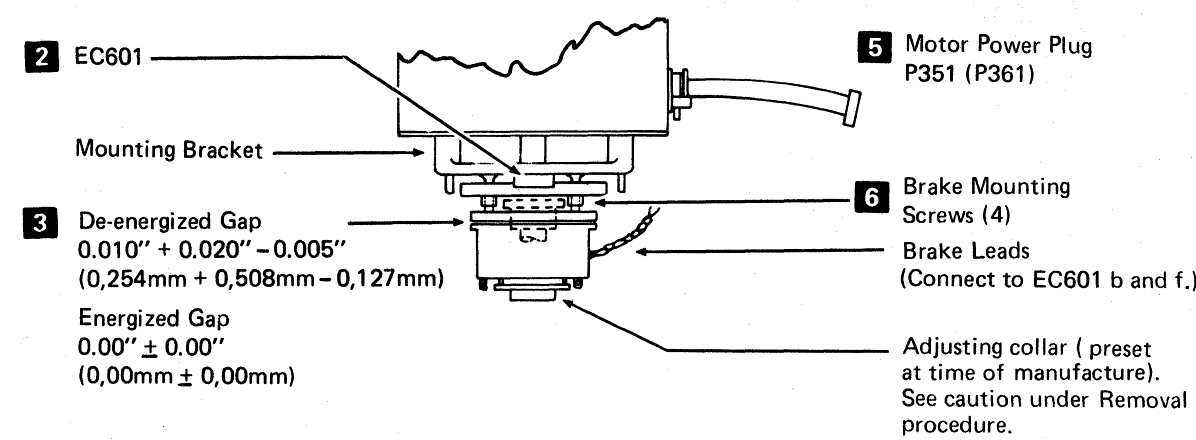
CHECKOUT

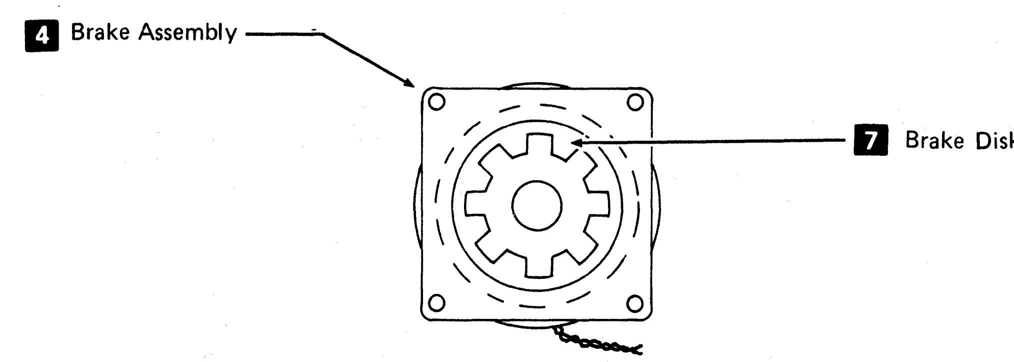
1. Remove the motor power plug, P351(P361) **5**.
2. Turn the Start/Stop switch to the Start position; this energizes the brake.

   Note: *The brake remains energized for 15 seconds. To re-energize the brake, set the Start/Stop switch to the Stop position, then back to the Start position.*

3. Check that there is no air gap at **3**. If there is no air gap, go to the next step. If there is an air gap, check for +24 Vdc between EC601f (−) and EC601b (+). If the voltage is +24 Vdc, the brake is defective; replace it. If the voltage is not +24 Vdc, troubleshoot the brake circuit YA071(YA081) or YB071(YB081).
4. Turn the Start/Stop switch to the Stop position; this de-energizes the brake.
5. Check the air gap at **3** for 0.010" +0.020" −0.005" (0,254mm +0,508mm −0,127mm) clearance. If the air gap is not within tolerance, the brake is defective and should be replaced. The air gap is not adjustable.
6. Replace the motor plug.
7. Make the drive Ready.
8. Turn the Start/Stop switch to the Stop position.
9. Check that the brake stops the HDA within 8 to 14 seconds.
10. Set the CE Mode switch to Off and exit to START 500.







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VOICE COIL MOTOR REMOVAL AND REPLACEMENT

REMOVAL

1. Remove the HDA following the procedure on HDA 710.
2. Remove the VCM cable ground wire screw and ground wire **4**.
3. Remove the three Voice Coil Motor (VCM) mounting screws **1**.

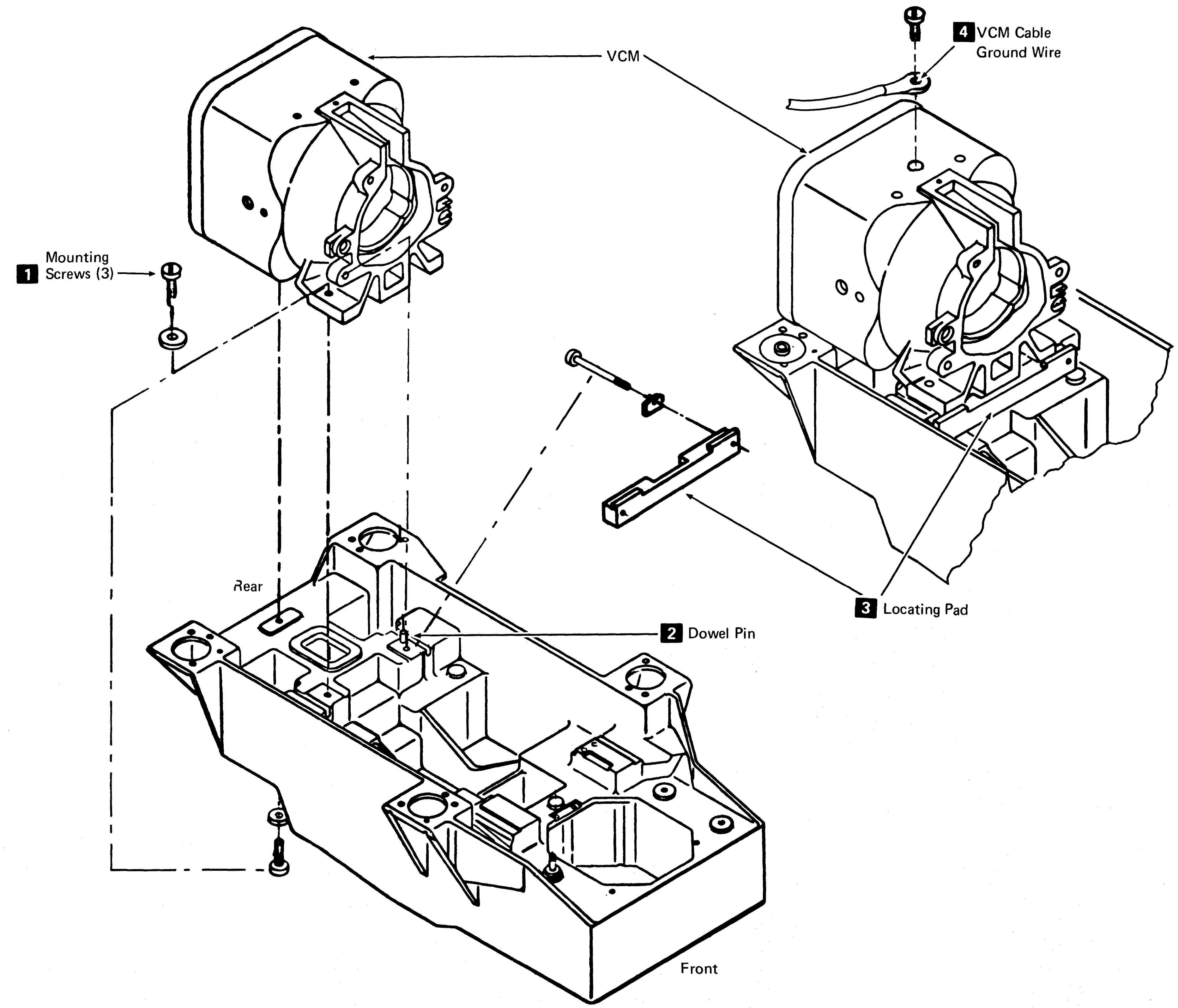
   DANGER
   The VCM exceeds 75 pounds.

4. Remove the VCM from the drive.
5. Leave dc power off until the new VCM is installed.

REPLACEMENT

1. Place the VCM on the baseplate and slide the VCM:
   a. Forward against the locating pad **3**.
   b. To the side against the dowel pin **2**.
2. Replace and tighten the VCM mounting screws.
3. Visually recheck the VCM for registration using Replacement Steps 1a and 1b.
4. Re-install the VCM cable ground wire **4**.
5. Replace the HDA using the procedure on HDA 710.
6. Restore all power, set the CE Mode switch to Off (center position), and exit to START 500.

   CAUTION: When restoring power, do not turn the Drive DC Power switch past the Both On position. If the other drive in the module is online, verify that it is still Ready after power is restored.



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BLOWER MOTOR REMOVAL AND REPLACEMENT

REMOVAL

1. Open the front and back covers. See HDA 705 for the procedure.
2. Remove power from the A2 Module or B2 Module blower:
   a. A2 Module: Set the CE Panel Power Mode switch to Local, set the Power Off/Enable switch on the Power Panel to the Power Off position, and then trip CB200.

   Caution: This removes power from the entire string, including the C2 Module if installed.

   b. B2 Module or C2 Module: Set the Service Bypass switch to On and then trip CB230.
3. Remove the prefilter housing from the front of machine:
   a. Loosen the inner clamp 3 between the prefilter housing and the blower. A filter housing cover 4 installed only on A2 and C2 Modules must be either removed or shifted to the left to gain access to the clamp 3.
   A2 Module: Open the left side cover, remove the two screws 5 from the cover, and remove the cover from the left side of the machine. If the frame bracket 1 blocks removal, bend or break the bracket from the frame.

   Caution: If the bracket is broken from the frame, file any sharp edges.

   C2 Module: Remove the two screws 5 from the cover and slide the cover to the left side of the machine.

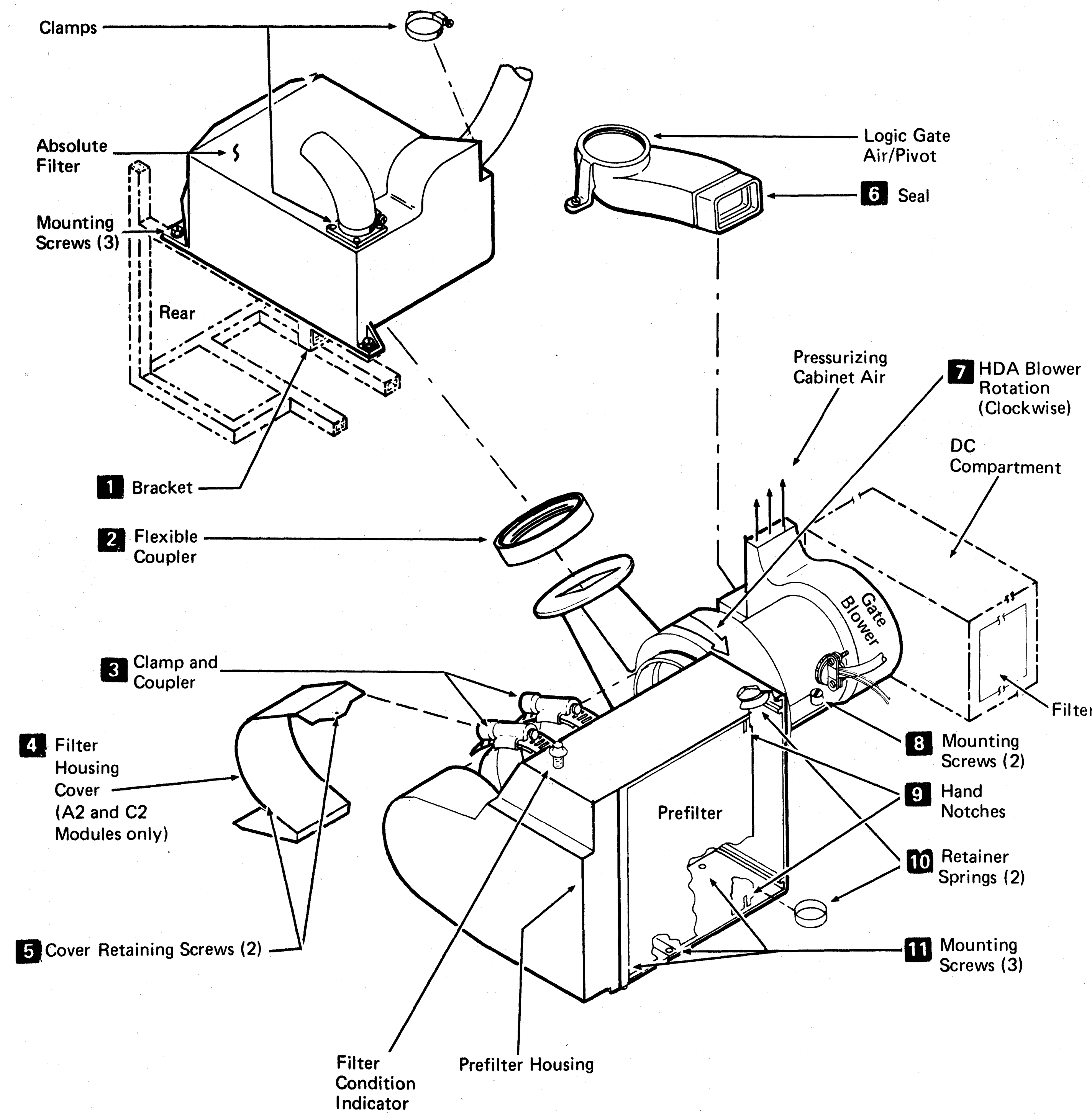
   b. Remove the two filter retainer springs 10, slide the filter to the right using the top and bottom hand notches 9, and remove the filter.
   c. Remove the three mounting screws 11.
   d. Separate the prefilter housing from the blower and remove from the machine.
4. Roll the flexible coupler 2 back onto the blower housing.
5. Fold the upper left and right corners of the logic gate seal 6 back onto the logic gate air/pivot housing separating the logic gate air/pivot assembly from the blower asembly.
6. Remove the blower motor with the blowers attached:
   a. Remove the AC Compartment cover and disconnect the blower motor wires from TB211 (see LOC 2 or LOC 12). Disconnect the ground wire.
   b. Loosen the blower motor cable clamp in the AC Compartment and remove the cable.
   c. Separate the quick disconnects for the two blower motor thermal wires and free the wires from any tie straps.
   d. Remove the two blower motor mounting screws 8 and slide the blower assembly from the machine.
7. Examine all flexible fittings 2, 3, and 6 for signs of deterioration.

REPLACEMENT

1. If installing a new blower assembly, remove all flexible fittings (flexible coupler 2, and clamp and coupler 3) from the old unit and install on the new unit.
2. Replace in the reverse order of removal.

   DANGER
   Before beginning step 3, be sure hand and objects are clear of the blower assembly.

3. Check the blower motor rotation after the blower is re-installed and before re-installing the prefilter housing by restoring power and checking the Air LED CR672 (CR682) and by visually checking direction of rotation 7. If the rotation of the blower is correct, the LED will be on.
4. If rotation is incorrect, remove power and reverse any two motor wires (1 and 2, 2 and 3, or 1 and 3) at TB211 (see LOC 2 or LOC 12). Check blower rotation again.
5. Restore power, close covers, and exit to START 500.



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AIR SWITCH REMOVAL AND REPLACEMENT

REMOVAL

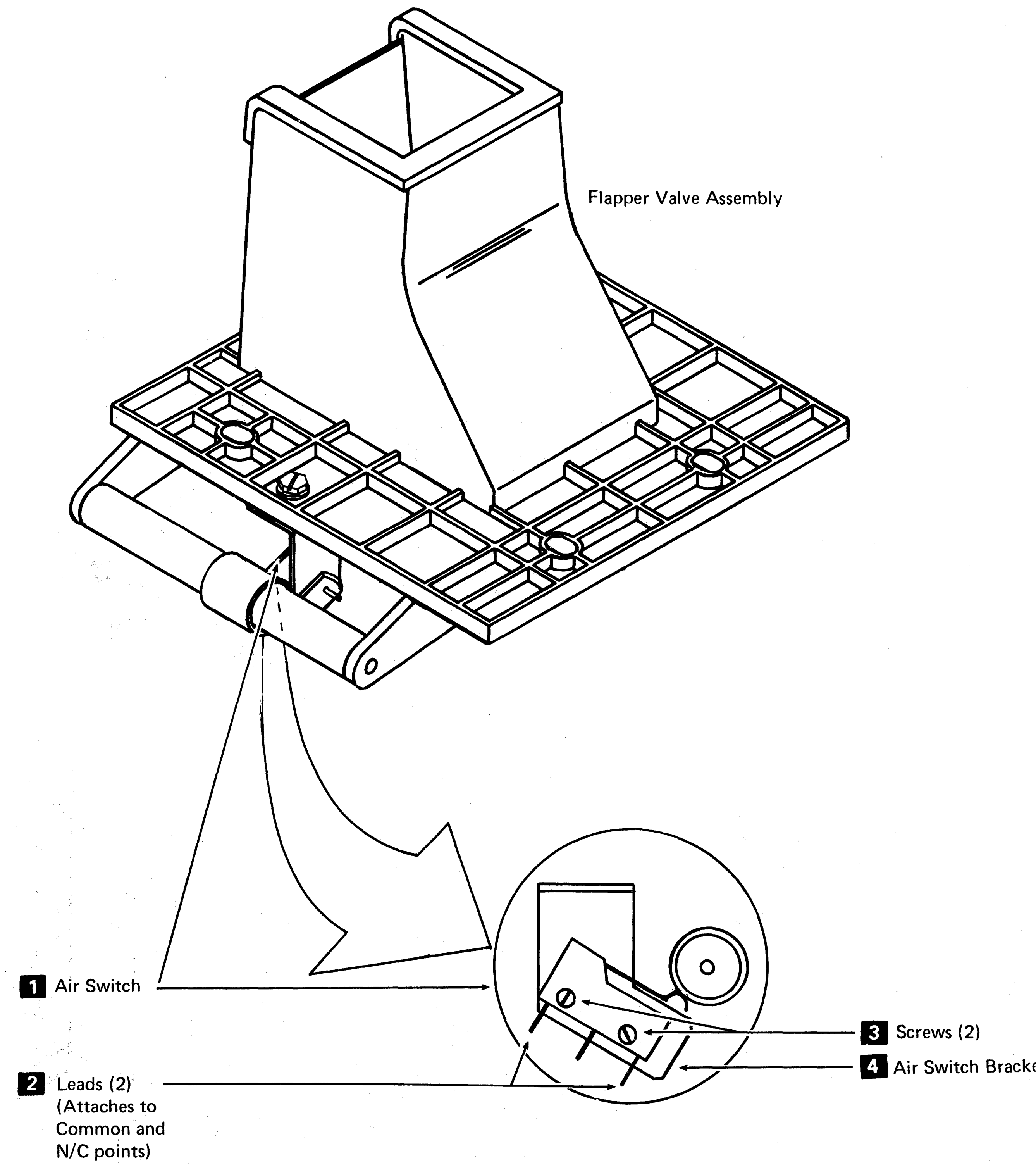
An Air switch, one for each drive, is located on the flapper valve assembly which is mounted under the rear of the baseplate. See the diagram on HDA 760.

1. Open the rear covers (see HDA 705 for the procedure).
2. Set the CE Mode switch to position A (Drive A) or B (Drive B).
3. Set the Drive DC Power switch (see LOC 4 or 14) to the Off position for the drive being serviced.
4. Remove the two leads **2** from the Air switch N/C and common contacts.
5. Remove the two mounting screws **3** and the Air switch **1**.

REPLACEMENT AND ADJUSTMENT

1. Replace the Air switch in the reverse order of removal.
2. Adjust the switch in its bracket **4** so the N/C points just make contact when the door is 0.125" ± 0.063" (3,175 mm ± 1,60 mm) from the closed position.
3. Restore power, set the CE Mode switch to Off (center position), and exit to START 500.

   CAUTION: When restoring power, do not turn the Drive DC Power switch past the Both On position. If the other drive in the module is online, verify that it is still Ready after power is restored.



PREFILTER CHECK AND REPLACEMENT

PREFILTER CHECK

Purpose

The prefilter check indicates whether or not filter replacement is required. Replace the prefilter if the air pressure drop across the filter exceeds 0.90 inches of water. The normal pressure drop across a new filter is approximately 0.50 inches of water. A vacuum is created between the outside atmosphere and the air input to the blower as the filter becomes clogged.

Tools

1. Differential pressure gauge P/N 2200120.
2. Hose and adapter assempy (one required) P/N 2200635.

Test

1. Open left front cover and remove the cap from the nipple **1** on the prefilter housing.
2. Hold the gauge with its face vertical and with the zero dial position at the top. With the gauge still vertical, turn the Zero Set screw **5** until the needle indicates 0.50 inches of water on the pressure side of the scale (the left 0.5 on the gauge) **4**. The gauge is now calibrated and must be held in a vertical position while the reading is taken.
3. Connect a tube **3** between the gauge fitting **8** and the nipple **1**. With the blower running and the gauge held in a vertical position, the needle should indicate between 0.5 inches of pressure **4** and 0.4 inches vacuum **7** for an unclogged air filter.

REMOVAL

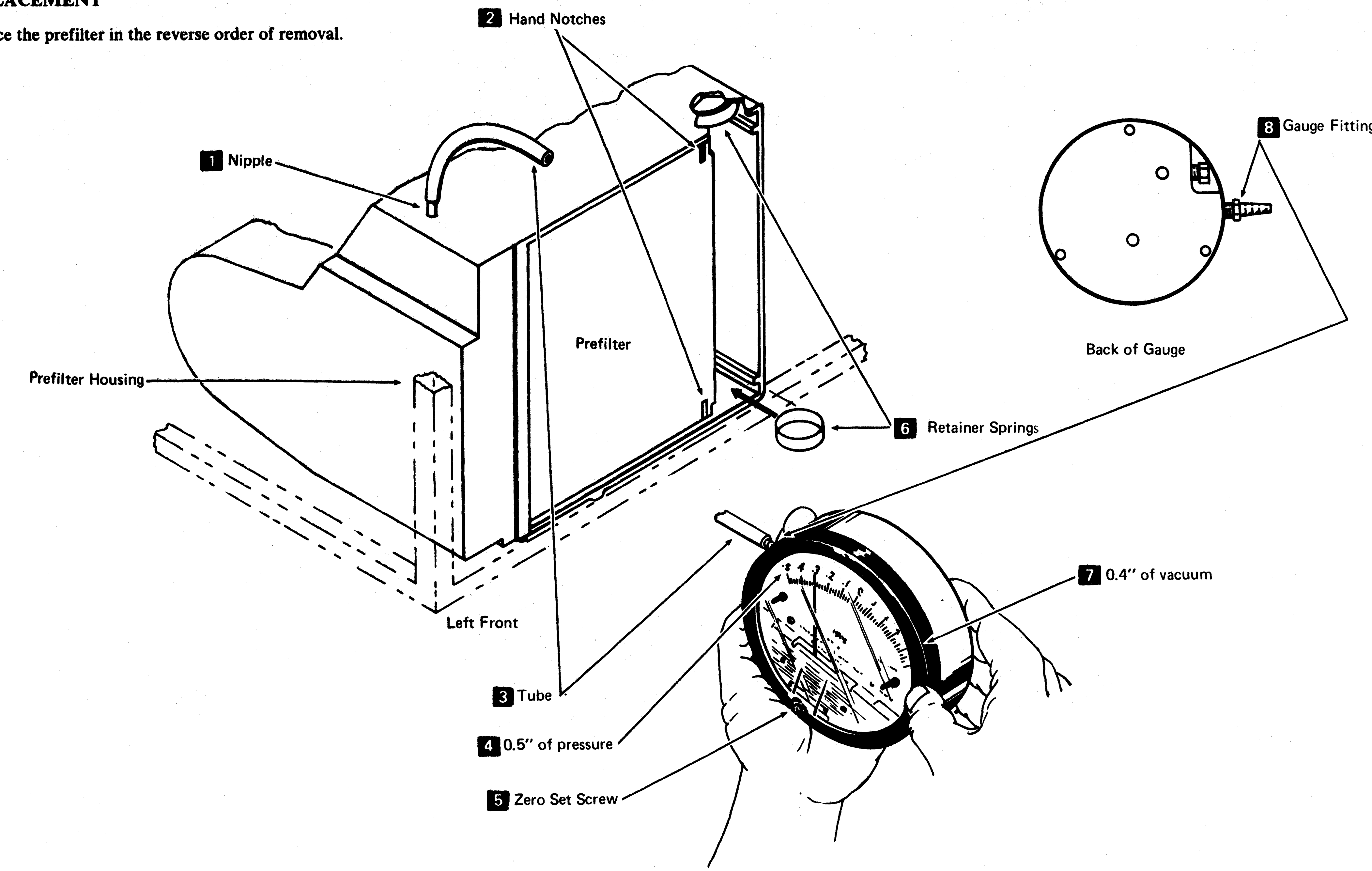
Caution: Turn ac power off* prior to removal of filter.

1. Open the front covers (see the procedure on HDA 705).
2. Remove the two retainer springs **6** by sliding them forward and out of their slots.
3. Use the top and bottom hand notches **2** to slide the prefilter to the right.
4. Remove the prefilter from the front of the prefilter housing.

**Make sure customer is not using associated machines that may be affected by turning ac power off.*

REPLACEMENT

Replace the prefilter in the reverse order of removal.



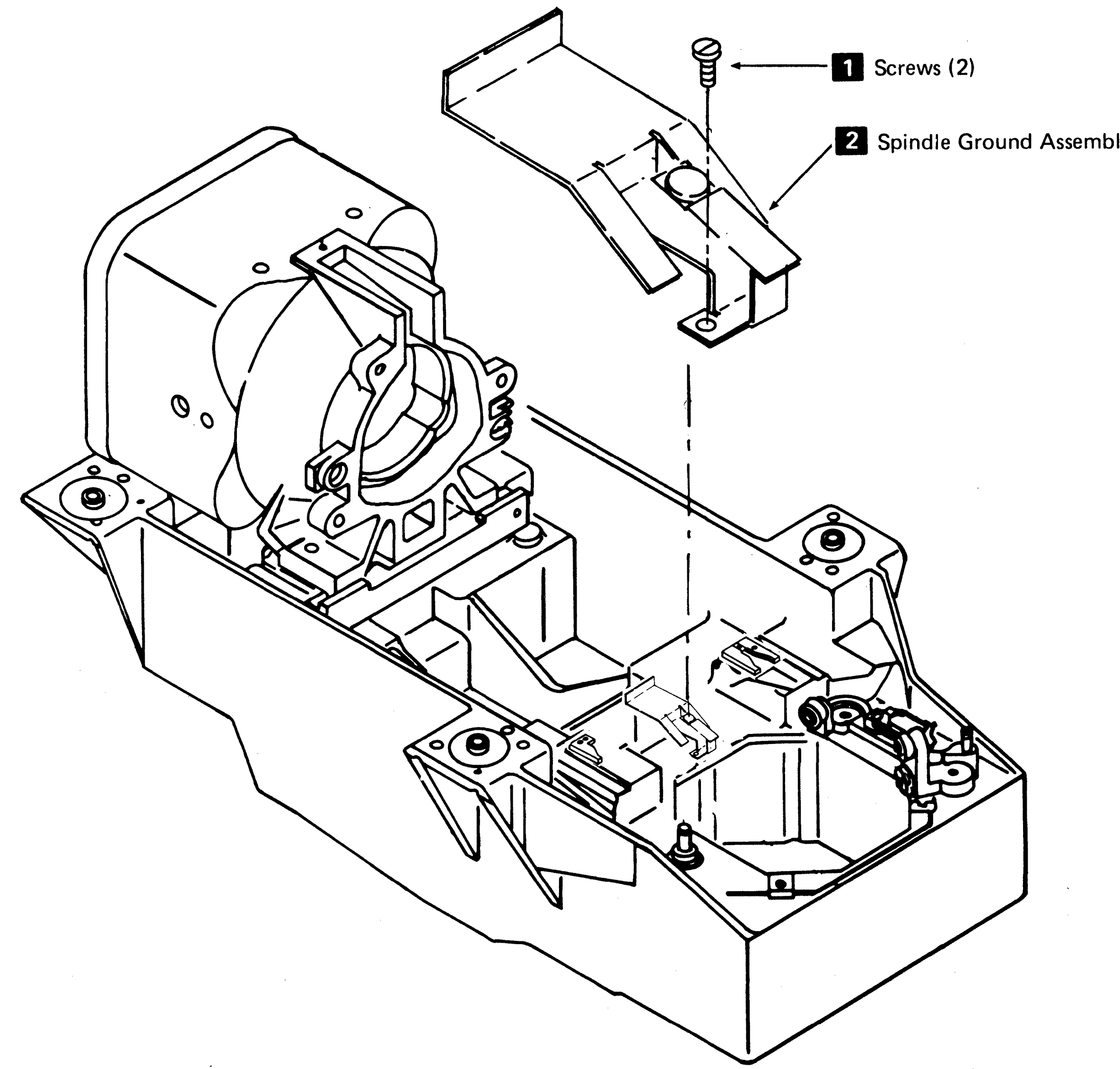
SPINDLE GROUND REMOVAL AND REPLACEMENT

REMOVAL

1. Remove the HDA (see HDA 710 for the procedure).
2. Remove the two spindle ground screws **1** and spindle ground assembly **2**.

REPLACEMENT

1. Replace in the reverse order of removal.
2. Exit to START 500.



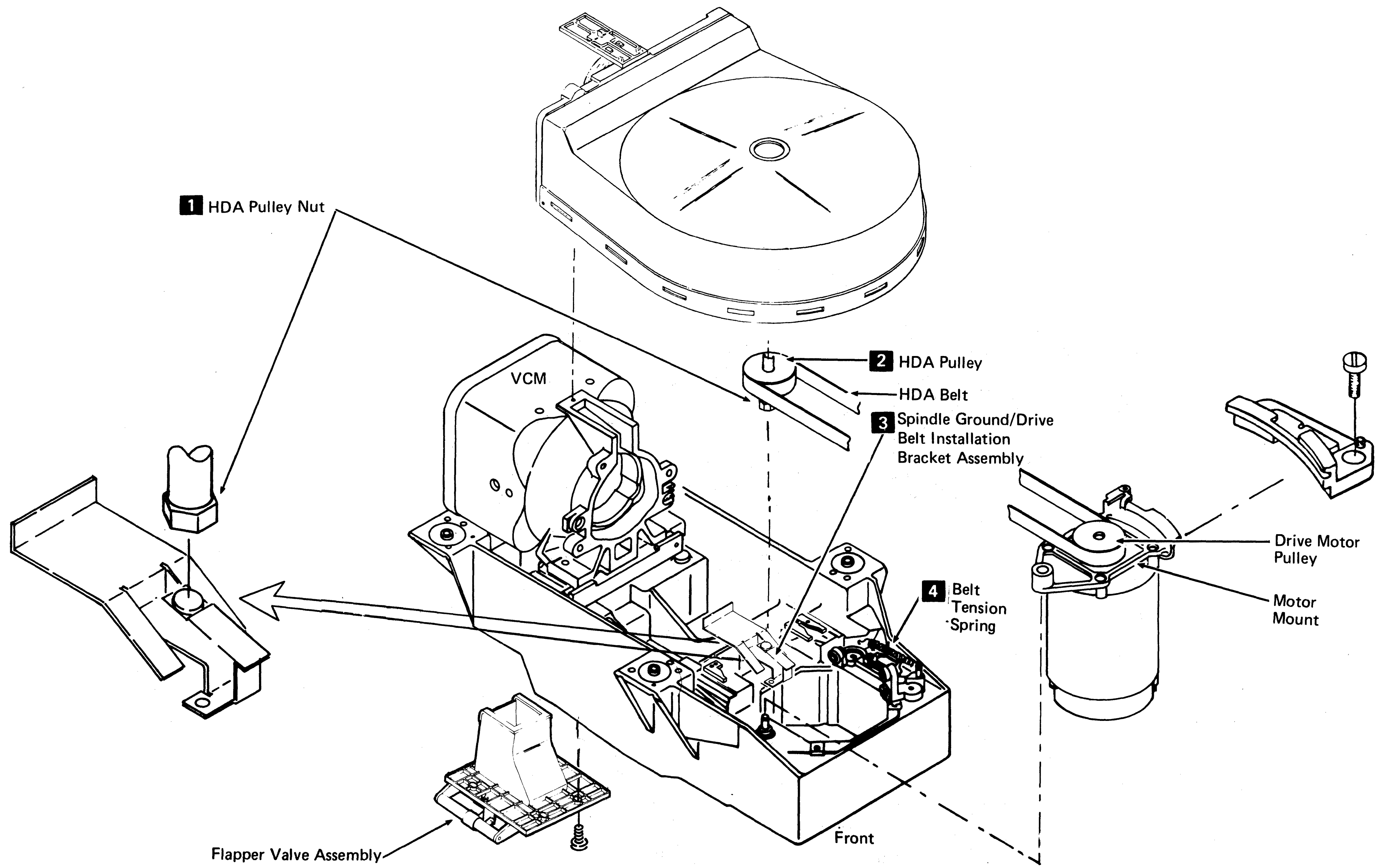
HDA BELT REMOVAL AND REPLACEMENT

HDA BELT REPLACEMENT

1. Set the CE Mode switch to position A (Drive A) or B (Drive B).
2. Set the Drive DC Power switch (see LOC 4 or 14) to the Off position for the drive being serviced.
3. Open the top front cover and remove the trim panel (see HDA 705 for the procedure).

   Note: *Removal of the top cover latch bracket helps in replacing of the belt. See HDA 770 for the procedure.*
4. Disconnect the belt tension spring **4** from the stationary front stud, and push the motor toward the rear of the machine.
5. Cut the HDA belt to prevent damage to the HDA spindle ground and remove.
6. Slide the new HDA belt between the HDA pulley nut **1** and the spindle ground assembly **3**. Use a long blade screwdriver to help slide the belt into place, being careful not to damage the spindle ground.
7. Slide the belt up and around the HDA pulley **2** with the smooth side of the belt against the pulley.
8. Slide the belt over the motor pulley and pull the motor forward to prevent the belt from slipping off the HDA pulley.
9. Install the belt tension spring.
10. Be sure the belt is on both the HDA and drive motor pulleys.
11. Re-install the top front cover latch bracket (see HDA 770 for adjustment) and the trim panel (see HDA 705).
12. Close the top front cover, restore power, and set the CE Mode switch to Off (center position).

    Caution: When restoring power, do not turn the Drive DC Power switch past the Both On position. If the other drive in the module is online, verify that it is still Ready after power is restored.
13. Exit to START 500.



FRONT TOP COVER LATCH REMOVAL AND REPLACEMENT

REMOVAL

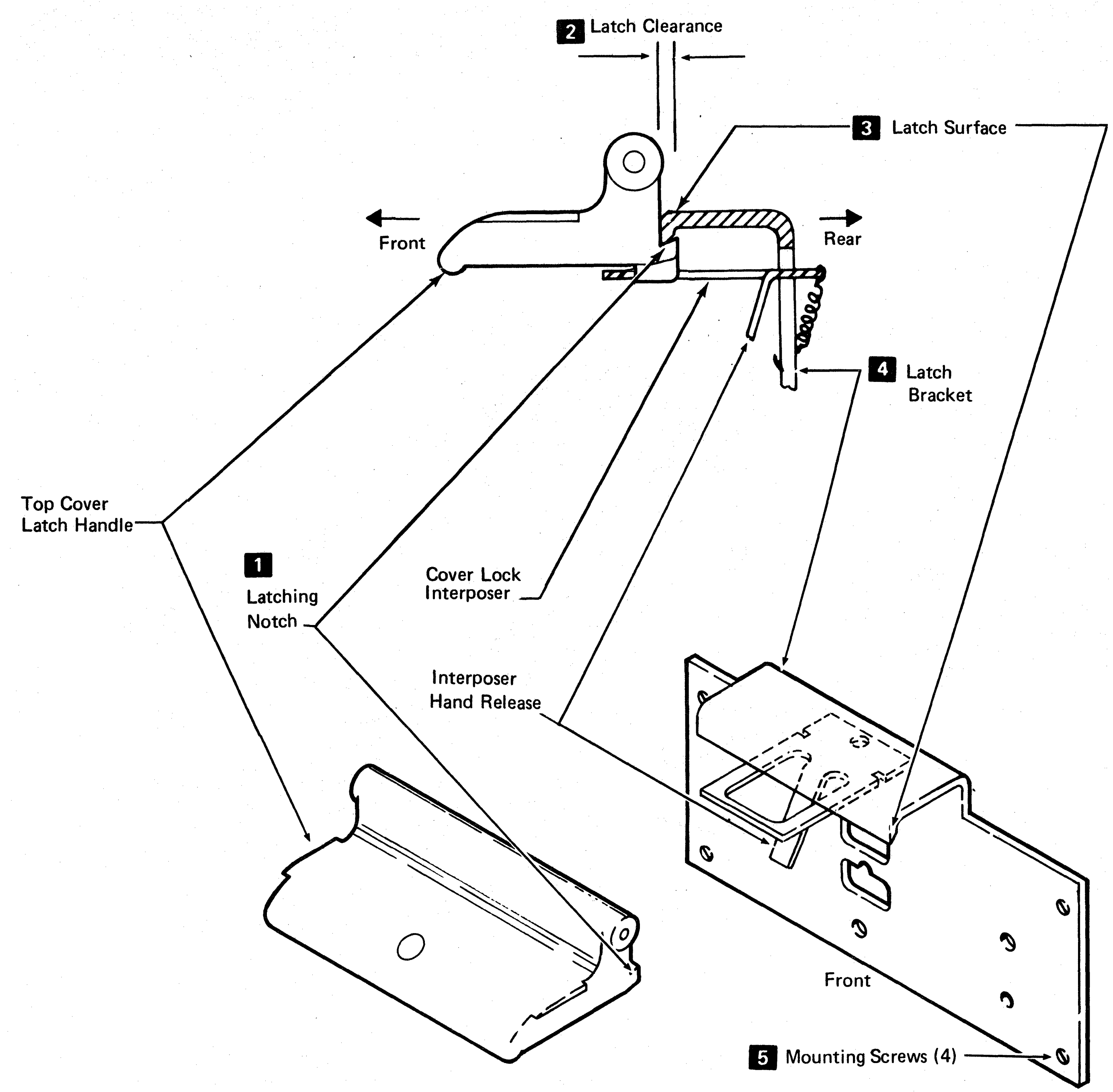
1. Open the top front cover and remove the trim panel. (See HDA 705 for the procedure.)
2. Remove the four screws **5** from the latch bracket **4** and remove the bracket from the drive.

REPLACEMENT

Replace the front top cover latch in the reverse order of removal and adjust using the adjustment procedure below.

CHECK AND ADJUSTMENT

1. Open the top cover and remove the trim panel (see HDA 705 for the procedure).
2. Check that:
   a. The latch surface **3** seats in the latching notch **1**.
   b. The latching notch and the latch surface are parallel.
   c. The cover is held within 0.030 ± 0.020 inch (0,762 ± 0,508mm) of the top of the frame.
3. Adjust the top cover latch by:
   a. Loosening the four cover hinge screws and positioning the cover to obtain a small latch clearance **2**. Retighten the four hinge screws.
   b. Loosening the four mounting screws **5** and positioning the latch bracket **4**, as described in Step 2. Retighten the four mounting screws.
4. Re-install the trim panel and close the top front cover.
5. Exit to START 500.



TROUBLE NOT FOUND

A

This page contains aids for problem resolution where insufficient error information is available to follow the maintenance analysis procedure. It may also be used as an aid in analyzing intermittent errors.

CHECK DEVICE ADDRESS

Check EREP printouts to determine if more than one device is failing.

CHECK MICRODIAGNOSTIC DISK

If the microdiagnostics failed, verify that the disk is the proper EC level for the device that failed.

EC INSTALLATION

If an engineering change has been recently installed, check the EC installation instructions and determine where the change was made. Inspect the back panel for tight wire wraps.

CIRCUIT BREAKERS

Verify that all circuit breakers (CBs) and circuit protectors (CPs) are set.

RELAYS (LOC 4 or 14)

Caution: A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.

Check for loose relays and replace or swap as required.

- Drive A — K351,K651,K652
- Drive B — K361,K661,K662
- Common to Both Drives — K331,K611,K612, K631,K632,K633

CONNECTORS

Check that the following connectors are properly seated:

- AC Compartment (Dr Mtr) — P351,P361
- DC Regulator Board (DC Sequence) — P633,P634,P635, P636,P638
- Sequence Boards A and B (Module Sequence) — P634,P633,P635, P630,P631,P632, P637

Check that the edge connector wires are tight on the following:

- DC Compartment
- Bottom of the drive motor — EC601 (LOC 2 or 12)

TERMINAL BOARDS

Check for loose wires on TB531 (LOC 4 or 14). (Drive dc distribution.)

JUMPERS (LOC 4 or 14)

- Verify that jumpers are installed from T1 to T2 and from T3 to T4 on the Sequence Board B in the last module on the string only (LOC 14).
- Check that -24 V special voltage jumper is installed on A1B1(A1U1)C11.

DRIVE MOTOR

Verify that the drive motor thermal is not tripped (see HDA 715 for location of thermal).

Check:

- Drive motor brake adjustment (HDA 720).
- Belt tension spring (HDA 760).

Check the direction of drive motor rotation. Open the top front cover and observe that the HDA disk rotates counterclockwise.

BLOWER MOTOR

Verify that the blower motor thermal (CP311) is not tripped (LOC 2 or 12).

Check the direction of blower motor rotation (see HDA 730).

Check for loose connections on TB211 (LOC 2).

HDA

Carriage Binding (HDA 712).

Cable Swapping (HDA 713).

Voice Coil Replacement (HDA 708).

Replacement (HDA 710).

VOLTAGE CHECKS

Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
− 4 V	A1C2 (A1T2) B06(−) to A1K2D08(+)	−3.85 to −4.50 V	0.23 V p-p	PWR 255, A
+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

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* Use a digital voltmeter to check voltages.

** Use a scope to measure the ripple. See PWR 290 for the procedure.

Verify that the Drive DC Power switch is in the Both Drives On position (LOC 4 or 14).

Verify correct ac voltages to drive motor.

Check for loose wires on main Ground Bus W1 (hinge end of A1 Gate) (LOC 2 or 12).

WIRING

Check Ready lamp wiring.

Check continuity and connections on the following:

- Drive DC Power switch (LOC 4 or 14)
- Start/Stop switch
- Attention switch
- R/W or Read switch
- Ready lamp
- Service Bypass switch
- CE Mode switch
- Air switch (HDA 735)

(Start/Stop switch through CE Mode switch: LOC 6 or 16)

CARD SOCKETS/PINS

Check for tight wire wraps on A1F2(A1Q2) card socket.

SUMMARY OF CARDS

Reseat or Replace:

A1F2(A1Q2)	HDA Sequence Controls, Integrator, and Magnet Driver
A1E2(A1R2)	Access Control
A1K2(A1L2)	Command Decode and Power On Reset
A1C4(A1T4)	Servo Logic
A1H2(A1N2)	R/W Safety
A1G2(A1P2)	HAR*CAR*Diff/Control
A1D4(A1S4)	Index Decode
A1C2(A1T2)	Servo Amp

REFERENCES

HDA Sequence theory – HDA 500 through 510.

HDA cable swapping procedure – HDA 713.

Functional description of logic cards – OPER 15 through 31.

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Check EREP printouts to determine if more than one device is failing.

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If the microdiagnostics failed, verify that the disk is the proper EC level for the device that failed.

EC INSTALLATION

If an engineering change has been recently installed, check the EC installation instructions and determine where the change was made. Inspect the back panel for tight wire wraps.

CIRCUIT BREAKERS

Verify that all circuit breakers (CBs) and circuit protectors (CPs) are set.

RELAYS (LOC 4 or 14)

Caution: A1F2(A1Q2) can be damaged by a shorted diode across the relay coil of K651(K661) or K652(K662). Before swapping relays with K651(K661) or K652(K662), check for a shorted diode on both the relays removed from, and installed into these positions. The resistance should be approximately 3 ohms in one direction and 50 ohms with the meter leads reversed.

Check for loose relays and replace or swap as required.

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- Sequence Boards A and B (Module Sequence) — P634,P633,P635, P630,P631,P632, P637

Check that the edge connector wires are tight on the following:

- DC Compartment
- Bottom of the drive motor — EC601 (LOC 2 or 12)

TERMINAL BOARDS

Check for loose wires on TB531 (LOC 4 or 14). (Drive dc distribution.)

JUMPERS (LOC 4 or 14)

- Verify that jumpers are installed from T1 to T2 and from T3 to T4 on the Sequence Board B in the last module on the string only (LOC 14).
- Check that -24 V special voltage jumper is installed on A1B1(A1U1)C11.

DRIVE MOTOR

Verify that the drive motor thermal is not tripped (see HDA 715 for location of thermal).

Check:

- Drive motor brake adjustment (HDA 720).
- Belt tension spring (HDA 760).

Check the direction of drive motor rotation. Open the top front cover and observe that the HDA disk rotates counterclockwise.

BLOWER MOTOR

Verify that the blower motor thermal (CP311) is not tripped (LOC 2 or 12).

Check the direction of blower motor rotation (see HDA 730).

Check for loose connections on TB211 (LOC 2).

HDA

Carriage Binding (HDA 712).

Cable Swapping (HDA 713).

Voice Coil Replacement (HDA 708).

Replacement (HDA 710).

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Voltage*	Test Point	Tolerance	Maximum** AC Ripple	Page Entry
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+ 6 V	A1F2 (A1Q2) B11(+) to A1F2 (A1Q2) D08(−)	+5.76 to +6.24 V	0.08 V p-p	PWR 260, A
+12 V	A1C2 (A1T2) D05(+) to A1K2D08(−)	+12.0 to +14.4 V	0.10 V p-p	PWR 240, A
−12 V	A1C2 (A1T2) D06(−) to A1K2D08(+)	−12.0 to −14.4 V	0.10 V p-p	PWR 240, A
−24 V	A1C2 (A1T2) D03(−) to A1K2D08(+)	−24.0 to −28.8 V	0.08 V p-p	PWR 250, A

* Use a digital voltmeter to check voltages.

** Use a scope to measure the ripple. See PWR 290 for the procedure.

00106D

Verify that the Drive DC Power switch is in the Both Drives On position (LOC 4 or 14).

Verify correct ac voltages to drive motor.

Check for loose wires on main Ground Bus W1 (hinge end of A1 Gate) (LOC 2 or 12).

WIRING

Check Ready lamp wiring.

Check continuity and connections on the following:

- Drive DC Power switch (LOC 4 or 14)
- Start/Stop switch
- Attention switch
- R/W or Read switch
- Ready lamp
- Service Bypass switch
- CE Mode switch
- Air switch (HDA 735)

(Start/Stop switch through CE Mode switch: LOC 6 or 16)

CARD SOCKETS/PINS

Check for tight wire wraps on A1F2(A1Q2) card socket.

SUMMARY OF CARDS

Reseat or Replace:

A1F2(A1Q2)	HDA Sequence Controls, Integrator, and Magnet Driver
A1E2(A1R2)	Access Control
A1K2(A1L2)	Command Decode and Power On Reset
A1C4(A1T4)	Servo Logic
A1H2(A1N2)	R/W Safety
A1G2(A1P2)	HAR*CAR*Diff/Control
A1D4(A1S4)	Index Decode
A1C2(A1T2)	Servo Amp

REFERENCES

HDA Sequence theory – HDA 500 through 510.

HDA cable swapping procedure – HDA 713.

Functional description of logic cards – OPER 15 through 31.

DC0990 Seq. 1 of 1	2358341 Part No.

441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441307 3 Oct 77	

ACC CONTENTS

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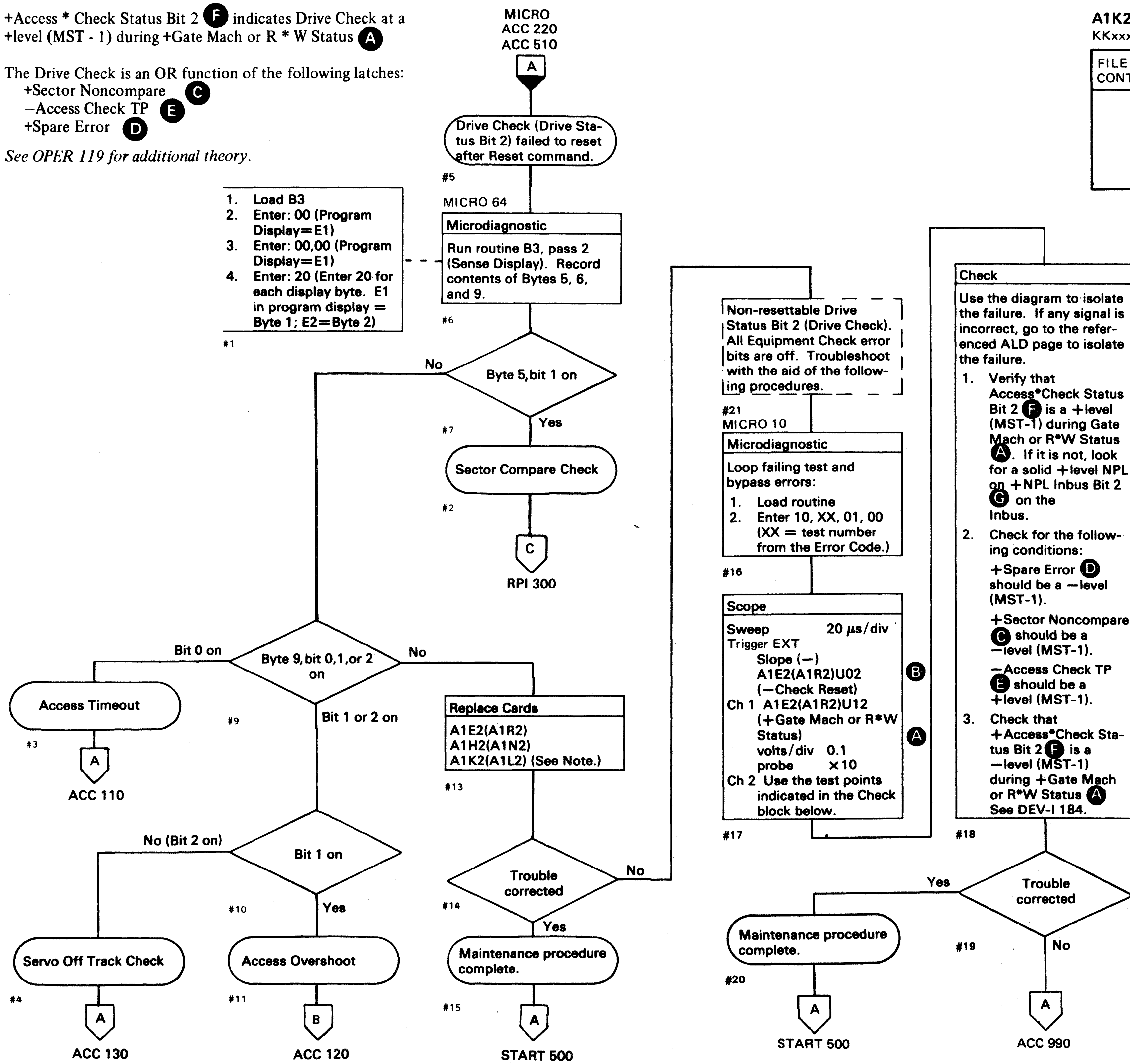
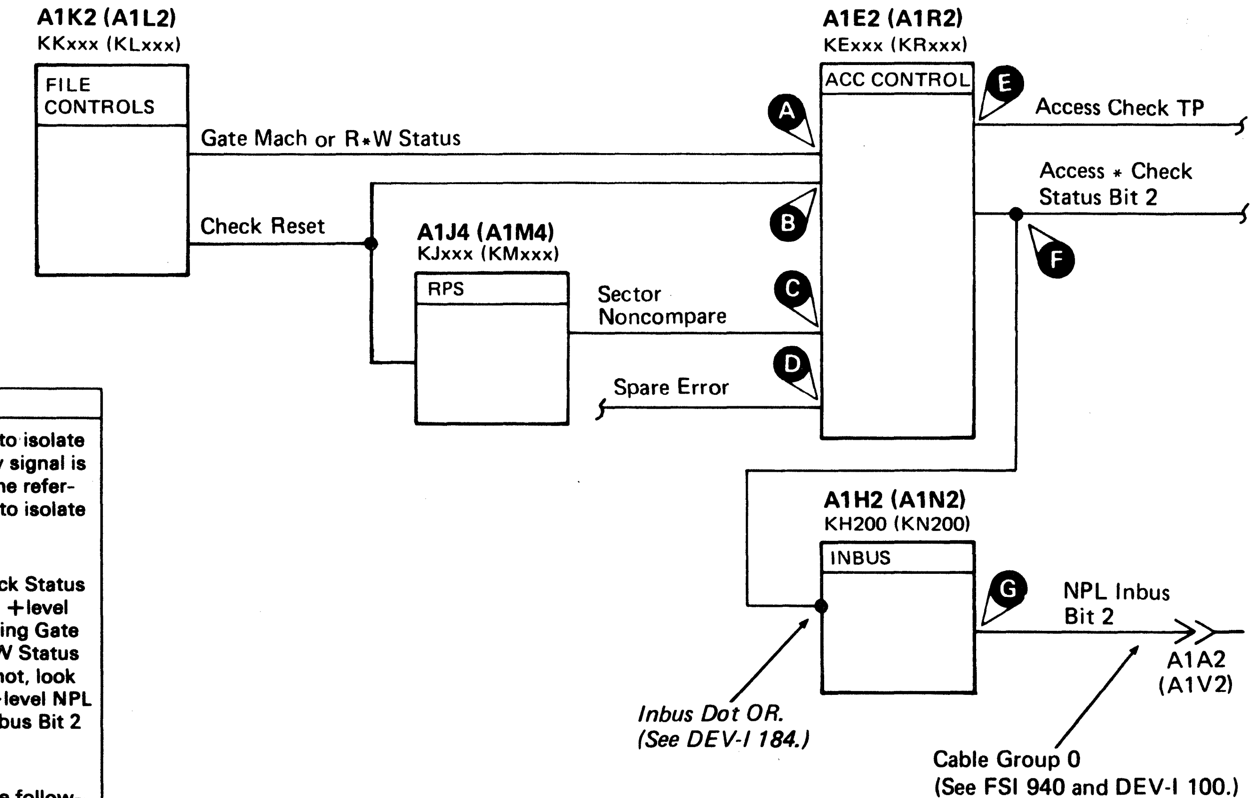
DRIVE CHECK

+Access * Check Status Bit 2 (F) indicates Drive Check at a +level (MST - 1) during +Gate Mach or R * W Status (A)

The Drive Check is an OR function of the following latches:
- +Sector Noncompare (C)
- −Access Check TP (E)
- +Spare Error (D)

See OPER 119 for additional theory.



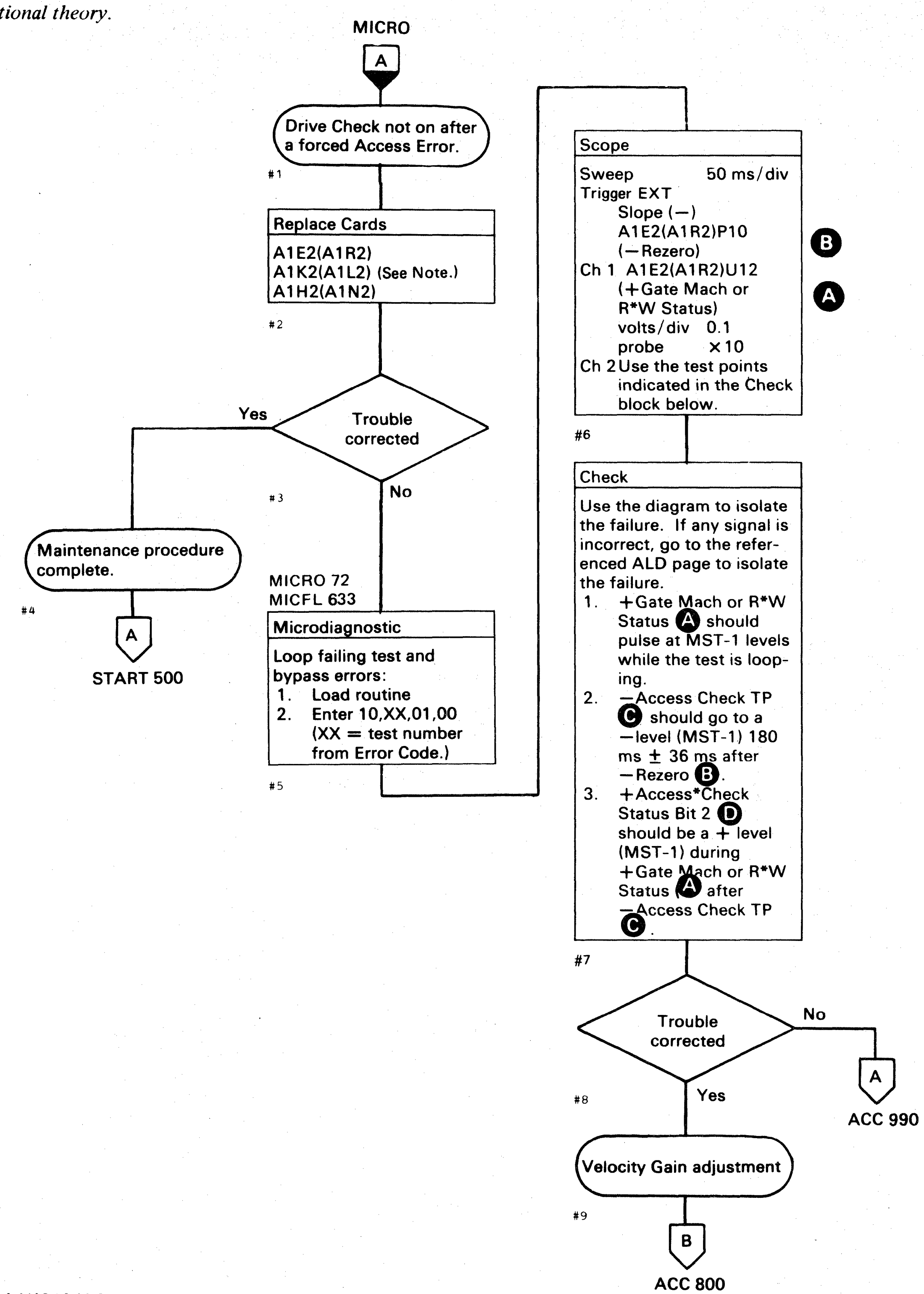


Note: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

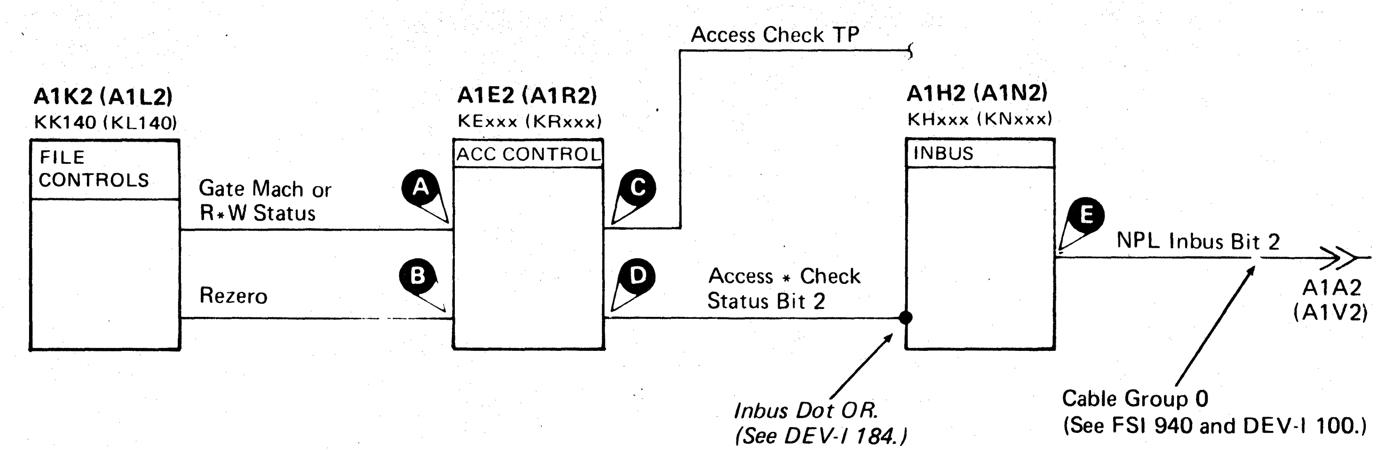
Line Name	ALD	Test Point	
+Gate Mach or R * W Status	KE160 (KR160)	A1E2 (A1R2) U12	A
−Check Reset	KE120 (KR120)	A1E2 (A1R2) U02	B
+Sector Noncompare	KE160 (KR160)	A1E2 (A1R2) U07	C
+Spare Error	KE160 (KR160)	A1E2 (A1R2) S05	D
−Access Check TP	KE120 (KR120)	A1E2 (A1R2) U09	E
+Access * Check Status Bit 2	KE160 (KR160)	A1E2 (A1R2) S10	F
+NPL Inbus Bit 2	KH200 (KN200)	A1H2 (A1N2) B09	G

DRIVE CHECK

See OPER 117 for additional theory.



Note: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*



Line Name	ALD	Test Point	
+Gate Mach or R * W Status	KE160 (KR160)	A1E2 (A1R2) U12	A
−Rezero	KE150 (KR150)	A1E2 (A1R2) P10	B
−Access Check TP	KE120 (KR120)	A1E2 (A1R2) U09	C
+Access*Check Status Bit 2	KE160 (KR160)	A1E2 (A1R2) S10	D
+NPL Inbus Bit 2	KH200 (KN200)	A1H2 (A1N2) B09	E

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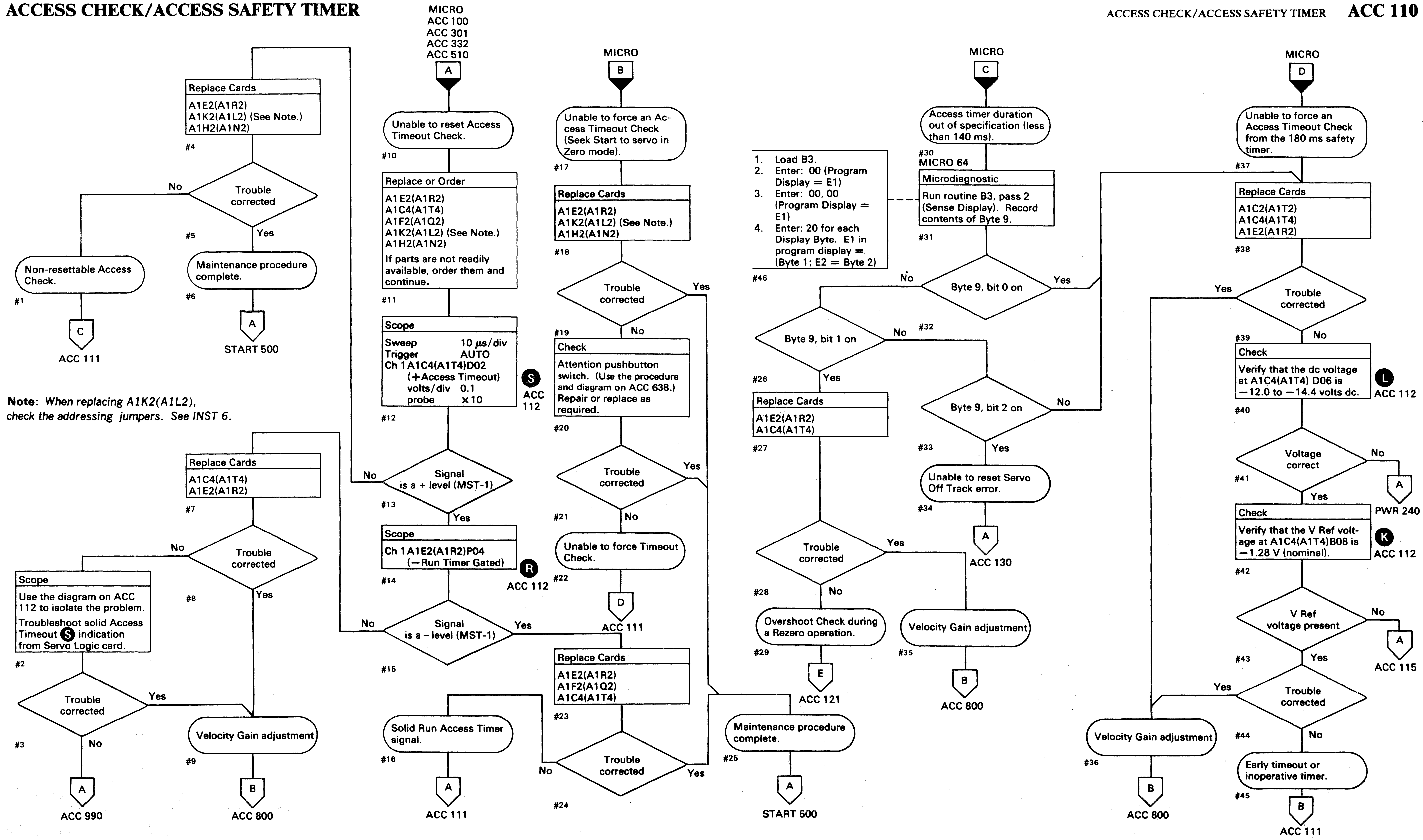

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ACCESS SAFETY TIMER

See the diagram on ACC 112.

The Access Safety Timer generates a (−)Access Timeout pulse 180 ms (± 20%) after the start of −Run Timer Gated (R), unless the timer is reset by normal completion of the Access operation or detection of any Access Check.

The Access Check latch is set by:

- An Access Timeout during any Access operation.
- A Seek Start command (B) issued to Access Control in Zero mode (Q).

The −Sense Status 4 tag (A) gates −Access Check TP (P) to +Access*Check Status Bit 0 (M).

See DEV-I 184 for the complete MST Inbus configuration.

ACC 110 (A)

#1 Solid Run Access Timer signal

#2 **Scope**
Use the diagram on ACC 112 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. +Sequence Rezero (G) should be a −level (MST-1).
2. −Carriage Go Home (E) should be a +level (MST-1).
3. −Run Timer Gated (R) should be a +level (MST-1).

ACC 110 (B)

#3 Early timeout or inoperative timer

MICRO 72
MICFL 633

#4 **Microdiagnostic**
Loop failing test and bypass errors:
1. Load routine B8
2. Enter 10, 02, 01, 00

#5 **Scope**
Sweep 20 ms/div
Trigger
Slope (−)
Ch 1 only
Ch 1 A1E2(A1R2)G07 (−Any Rezero) (N) ACC 112
volts/div 0.1
probe ×10
Ch 2 Use the test points indicated in the block below.

#6 Use the diagram on ACC 112 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. −Any Rezero (N) should be a −pulse (MST-1) of approximately 10 μs.
2. −Run Timer Gated (R) should be a −level (MST-1) for 180 ms ±36 ms. If not correct, trace to +Access Timeout (S).
3. −Access Check TP (P) should go to a −level (MST-1) after 180 ms ±36 ms.
4. Diagnostic Servo Reset (+Diag Set (D) and −MST Outbus Bit 1 (C)) should hold the Servo in Zero Mode (Q) and force Access Timeout error (S).

ACC 110 (C)

#9 Non-resettable Access Check

MICRO 72
MICFL 633

#10 **Microdiagnostic**
Loop failing test and bypass errors:
1. Load routine B8
2. Enter 10, 02, 01, 00

#11 **Scope**
Sweep 20 μs/div
Trigger
Slope (+)
Ch 1 only
Ch 1 A1E2(A1R2)B07 (+Diag Set) (D) ACC 112
volts/div 0.1
probe ×10
Ch 2 A1E2(A1R2)U09 (−Access Check TP) (P) ACC 112
volts/div 0.1
probe ×10

#12 Use the diagram on ACC 112 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
−Access Check TP (P) should go to a +level (MST-1) with +Diag Set (D).

ACC 110 (D)

#13 Unable to force Timeout Check

MICRO 72
MICFL 633

#14 **Microdiagnostic**
Loop failing test and bypass errors:
1. Load routine B8
2. Enter 10, 02, 01, 00

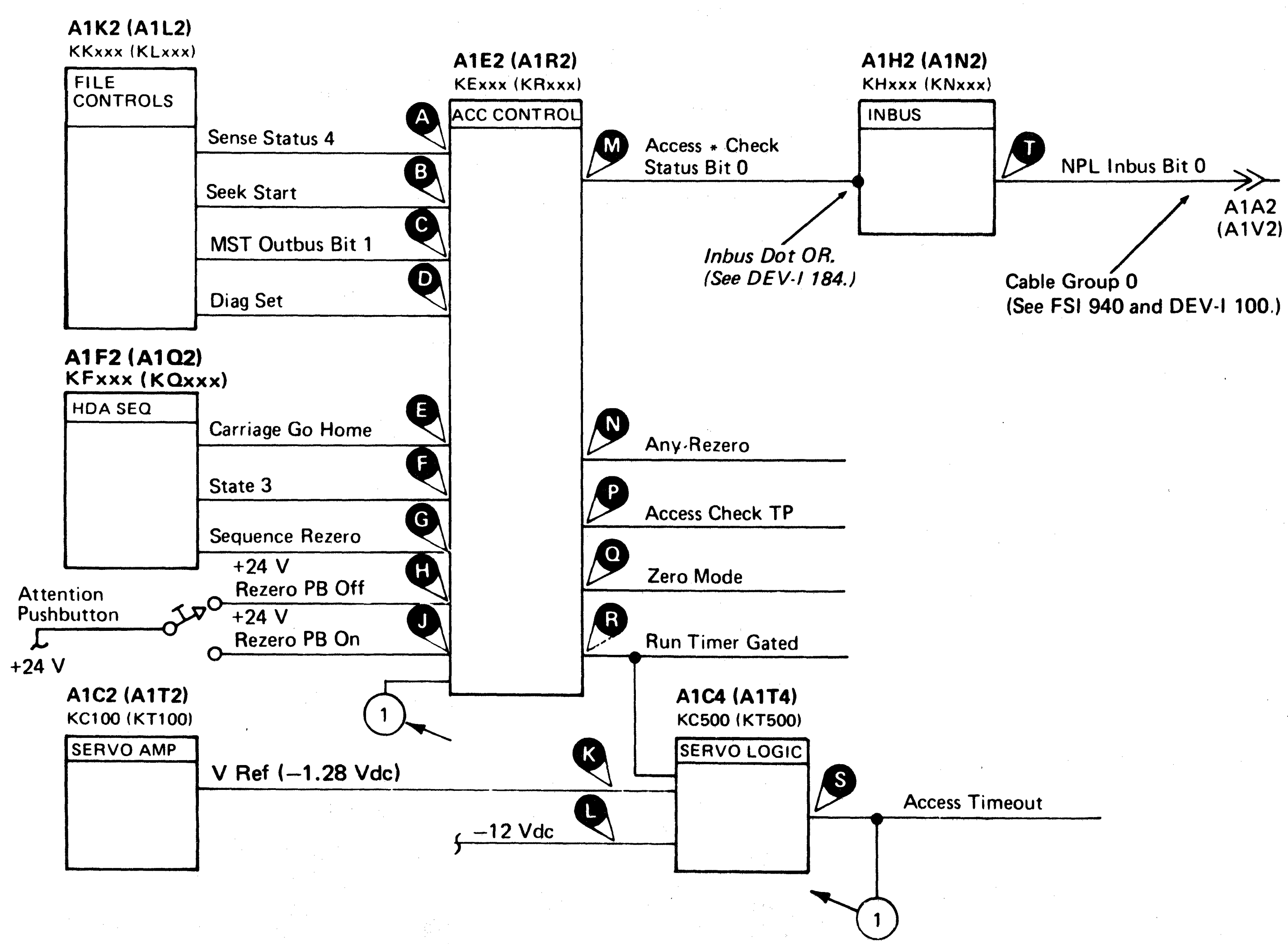
#15 **Scope**
Sweep 10 μs/div
Trigger
Slope (−)
Ch 1 only
Ch 1 A1E2(A1R2)D05 (−Seek Start) (B) ACC 112
volts/div 0.1
probe ×10
Ch 2 Use the test points indicated in the block below.

#16 Use the diagram on ACC 112 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. −Seek Start (B) should be a −pulse (MST-1) of approximately 10 μs.
2. −Access Check TP (P) should go to a −level (MST-1) during −Seek Start.
3. +Access*Check Status Bit 0 (M) should be a +level (MST-1) during −Sense Status 4 (A).

#8 Trouble corrected?
Yes → #7 Velocity Gain adjustment → (B) ACC 800
No → (A) ACC 990

ACCESS SAFETY TIMER

See OPER 117 for theory.



Line Name	ALD	Test Point	
−Sense Status 4	KE160 (KR160)	A1E2 (A1R2) S12	A
−Seek Start	KE100 (KR100)	A1E2 (A1R2) D05	B
−MST Outbus Bit 1	KE110 (KR110)	A1E2 (A1R2) B11	C
+Diag Set	KE110 (KR110)	A1E2 (A1R2) B07	D
−Carriage Go Home	KE120 (KR120)	A1E2 (A1R2) M08	E
+State 3	KE120 (KR120)	A1E2 (A1R2) M07	F
+Sequence Rezero	KE140 (KR140)	A1E2 (A1R2) G12	G
+24 V Rezero PB Off	KE150 (KR150)	A1E2 (A1R2) M03	H
+24 V Rezero PB On	KE150 (KR150)	A1E2 (A1R2) P02	J
V Ref (−1.28 Vdc nom)	KC500 (KT500)	A1C4 (A1T4) B08	K
−12 Vdc	KA100	A1C4 (A1T4) D06	L
+Access*Check Status Bit 0	KE160 (KR160)	A1E2 (A1R2) U10	M
−Any Rezero	KE130 (KR130)	A1E2 (A1R2) G07	N
−Access Check TP	KE120 (KR120)	A1E2 (A1R2) U09	P
+Zero Mode	KE140 (KR140)	A1E2 (A1R2) D02	Q
−Run Timer Gated	KE120 (KR120)	A1E2 (A1R2) P04	R
+Access Timeout	KC500 (KT500)	A1C4 (A1T4) D02	S
+NPL Inbus Bit 0	KH200 (KN200)	A1H2 (A1N2) B05	T

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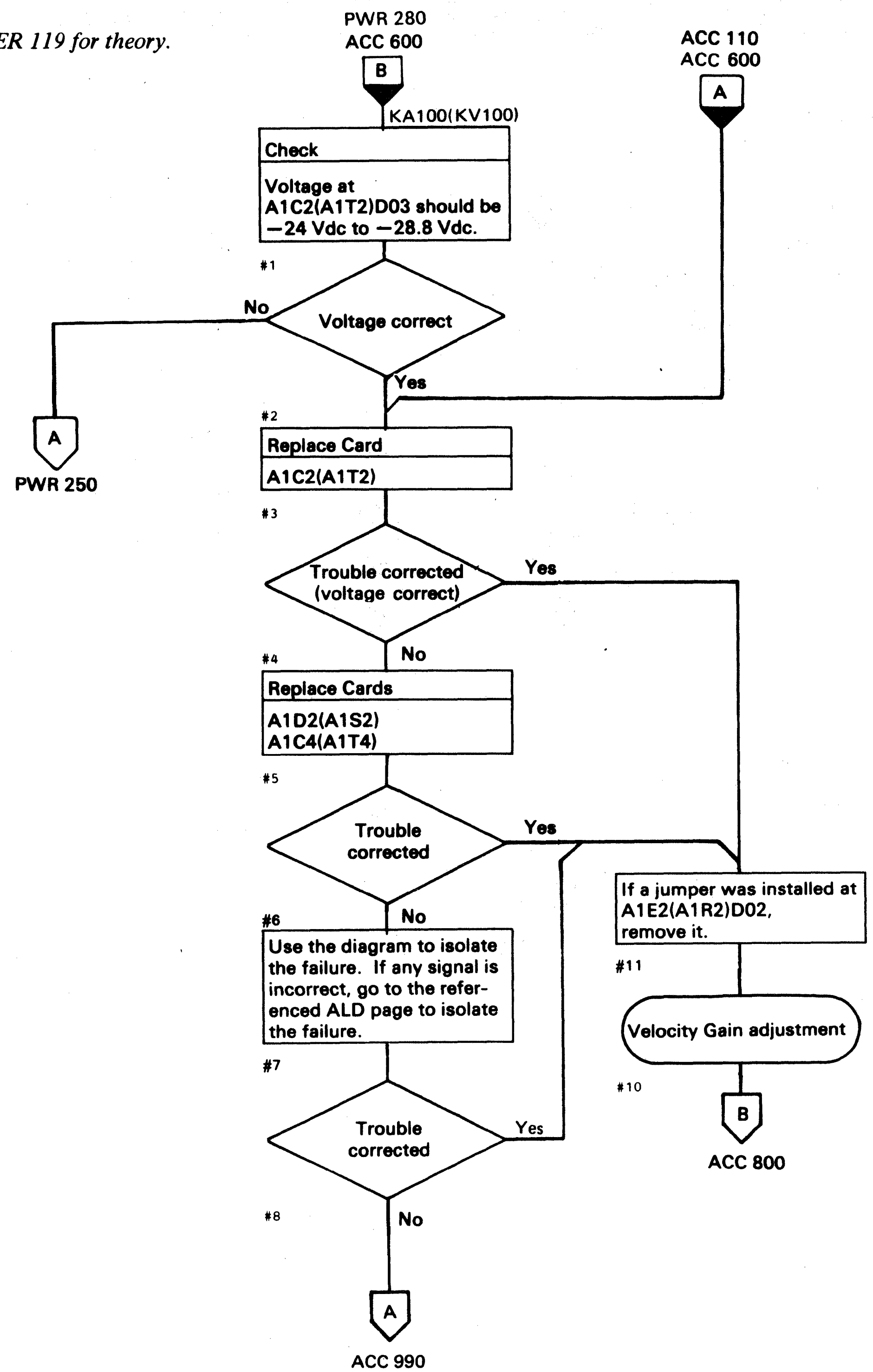
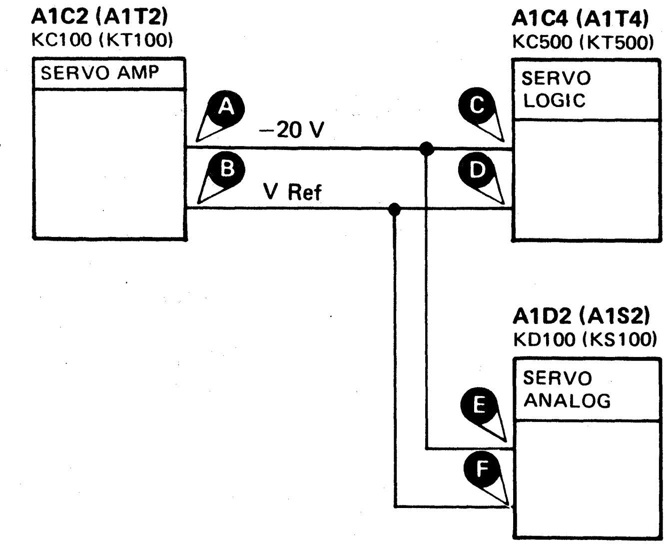
ACCESS CHECK/-20V SERVO REFERENCE

See OPER 119 for theory.





Line Name	ALD	Test Point	
–20 V	KC100 (KT100)	A1C2 (A1T2) B10	A
–20 V	KC500 (KT500)	A1C4 (A1T4) B10	C
–20 V	KD100 (KS100)	A1D2 (A1S2) B10	E
V Ref (–1.28 Vdc)	KC100 (KT100)	A1C2 (A1T2) B08	B
V Ref (–1.28 Vdc)	KC500 (KT500)	A1C4 (A1T4) B08	D
V Ref (–1.28 Vdc)	KD100 (KS100)	A1D2 (A1S2) B08	F

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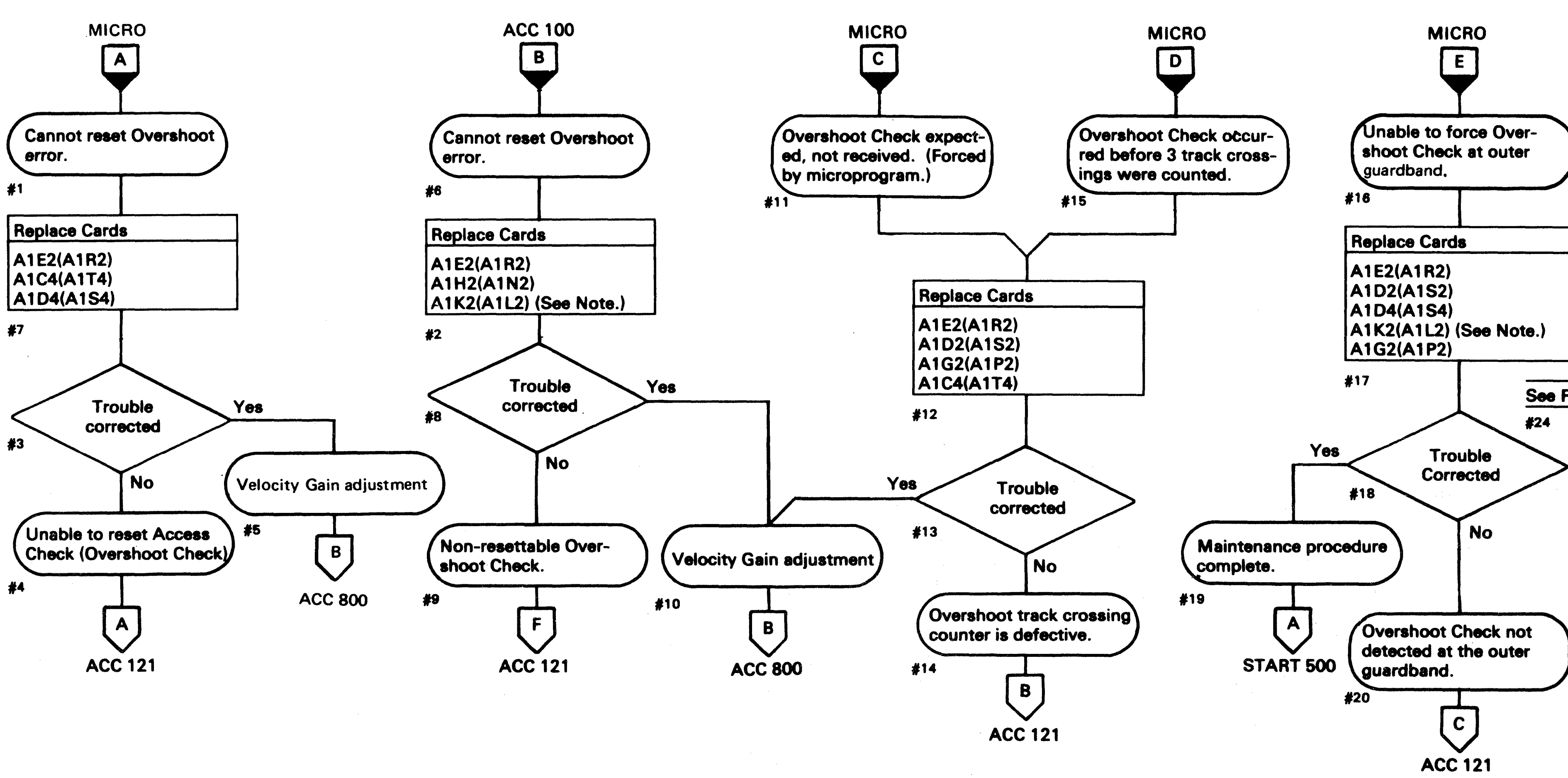
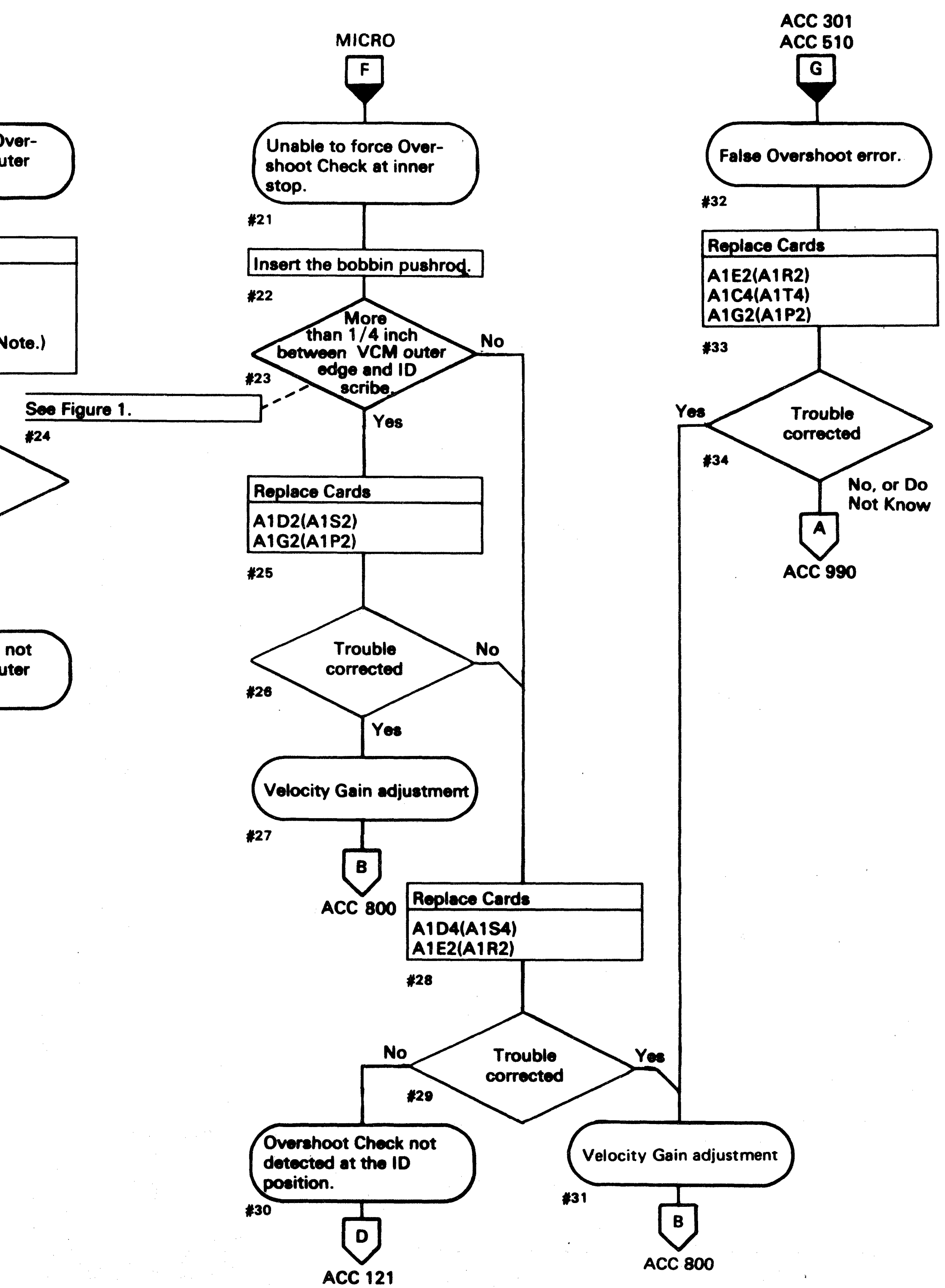
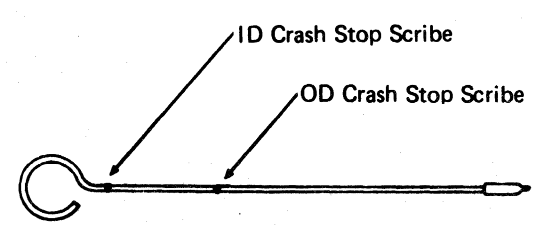
ACCESS CHECK/OVERSHOOT CHECK





Note: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

Figure 1. Bobbin Pushrod



OVERSHOOT CHECK

See the diagram on ACC 122 for the referenced test points.

An Overshoot Check is caused by one of the following:

1. Three track crossing pulses are counted either after the Difference Counter decrements to zero, or after the Access Control advances to Linear Mode.
2. Guardband Latch (H) or ID Position (J) is detected during a Seek Operation (while Allow Diff Ctr (Q) is active).
3. Carriage velocity is measured greater than 20 inches/second (G) during a Rezero operation.

Overshoot Check is reset by a Rezero command (F).

ACC 120 [A]

Unable to reset Access Check (Overshoot Check)

#1 MICRO 72 MICFL 633

Microdiagnostic

Loop failing test and bypass errors:
1. Load routine B8
2. Enter 10,08,01, 00

#2 **Scope**

Sweep 20 μs/div
Trigger
Slope (−)
Ch 1 only
Ch 1 A1E2(A1R2)P10 (−Rezero) volts/div 0.1 probe ×10 — (F) ACC 122
Ch 2 A1E2(A1R2)U09 (−Access Check TP) volts/div 0.1 probe ×10 — (N) ACC 122

#3 Use the diagram on ACC 122 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. −Access Check TP (N) should go to a +level (MST-1) during −Rezero (F) pulse.

#4 Stop the microprogram

#5 With the microprogram stopped:
1. +Access Mode (P) should be a −level (MST-1).
2. +Allow Diff Ctr (Q) should be a −level (MST-1).
3. −Velocity Grtr 20 IPS (G) should be a +level (MST-1).
4. See Overshoot Check theory at start of this page.

#6 → (1)

ACC 120 [B]

Overshoot track crossing counter is defective.

#7 MICRO 72 MICFL 633

Microdiagnostic

Loop failing test and bypass errors:
1. Load routine B8
2. Enter 10,08,01 00

#8 **Scope**

Sweep 200 μs/div
Trigger EXT
Slope (−)
A1K2(A1L2)P10 (−Drive Sync Tag TP)
Ch 1 A1E2(A1R2)J05 (+Diff Ctr Zero) (L) volts/div 0.1 probe ×10 — (L) ACC 122
Ch 2 Use the test points indicated in the next block below.

#9 Use the diagram on ACC 122 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. The program sets +Diff Ctr Zero (L) to a +level (MST-1) during +Access Mode (P) (Seek Operation)
2. Three Track Xing Pulses later (U), the overshoot detection circuits set −Access Check TP (N) to a +level (MST-1).
3. −Direction Bit in (K) should be a −level (MST-1) during +Access Mode (P)
4. See Overshoot Check theory at start of this page.

#10 → (1)

ACC 120 [C]

Overshoot Check not detected at the outer guardband.

#11 MICRO 72 MICFL 633

Microdiagnostic

Loop failing test and bypass errors:
1. Load routine B8
2. Enter 10,08,01, 00

#12 **Scope**

Sweep 5 ms/div
Trigger EXT
Slope (−)
A1E2(A1R2)D05 (−Seek Start) — (D) ACC 122
Ch 1 A1E2(A1R2)M12 (+Access Mode) volts/div 0.1 probe ×10 — (P) ACC 122
Ch 2 Use the test points indicated in the next block below.

#13 Use the diagram on ACC 122 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. +Access Mode (P) should go to a +level (MST-1) during −Seek Start (D) pulse.
2. −Direction Bit In (K) should be a +level (MST-1) during +Access Mode (P)
3. +Allow Diff Ctr (Q) should be a +level (MST-1) during +Access Mode (P).
4. +Guardband Latch (H) should go to a +level (MST-1) during +Access Mode (P). If it does not, troubleshoot a Seek operation with the aid of the microprogram and scope setups on ACC 648 and ACC 649.
5. See Overshoot Check theory at start of this page.

#14 → (1)

ACC 120 [D]

Overshoot Check not detected at the ID position.

#15 MICRO 72 MICFL 633

Microdiagnostic

Loop failing test and bypass errors:
1. Load routine B8
2. Enter 10,0B,01, 00

#16 **Scope**

Sweep 100 μs/div
Trigger
Slope (−)
Ch 1 only
Ch 1 A1E2(A1R2)U11 (−ID Position) volts/div 0.1 probe ×10 — (J) ACC 122
Ch 2 A1E2(A1R2)S11 (+Allow Diff Ctr) volts/div 0.1 probe ×10 — (Q) ACC 122

#17 Use the diagram on ACC 122 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. The program issues a series of 4-track Seeks to move the carriage into the ID Pattern area.
2. An Overshoot Check is forced when the carriage moves past track 561, as indicated by −ID Position (J)
3. −Access Check TP (N) is set to a −level (MST-1) if +Allow Diff Ctr (Q) is a +level (MST-1) when −ID Position (J) is detected.
4. The Overshoot Check latch is gated to the Inbus (M) and (T), by a Sense Status 4 tag (E)
5. See Overshoot Check theory at the start of this page.

#18 → (1)

ACC 110 [E]

Overshoot Check during a Rezero operation.

#19 **Scope**

Use the diagram on ACC 122 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. −Velocity Grtr 20 IPS (G) should be a +level (MST-1).
2. See Overshoot Check theory at start of this page.

#20

ACC 120 [F]

Non-resettable Overshoot Check.

#21 **Scope**

Use the diagram on ACC 122 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. +Access Mode (P) should be a +level (MST-1).
2. +Allow Diff Ctr (Q) should be a −level (MST-1).
3. −Velocity Grtr 20 IPS (G) should be a +level (MST-1).
4. See Overshoot Check theory at start of this page.

#22

---

(1) → Trouble corrected?
- No → [A] ACC 990
- #23 Yes → Velocity Gain adjustment

#24 → [B] ACC 800

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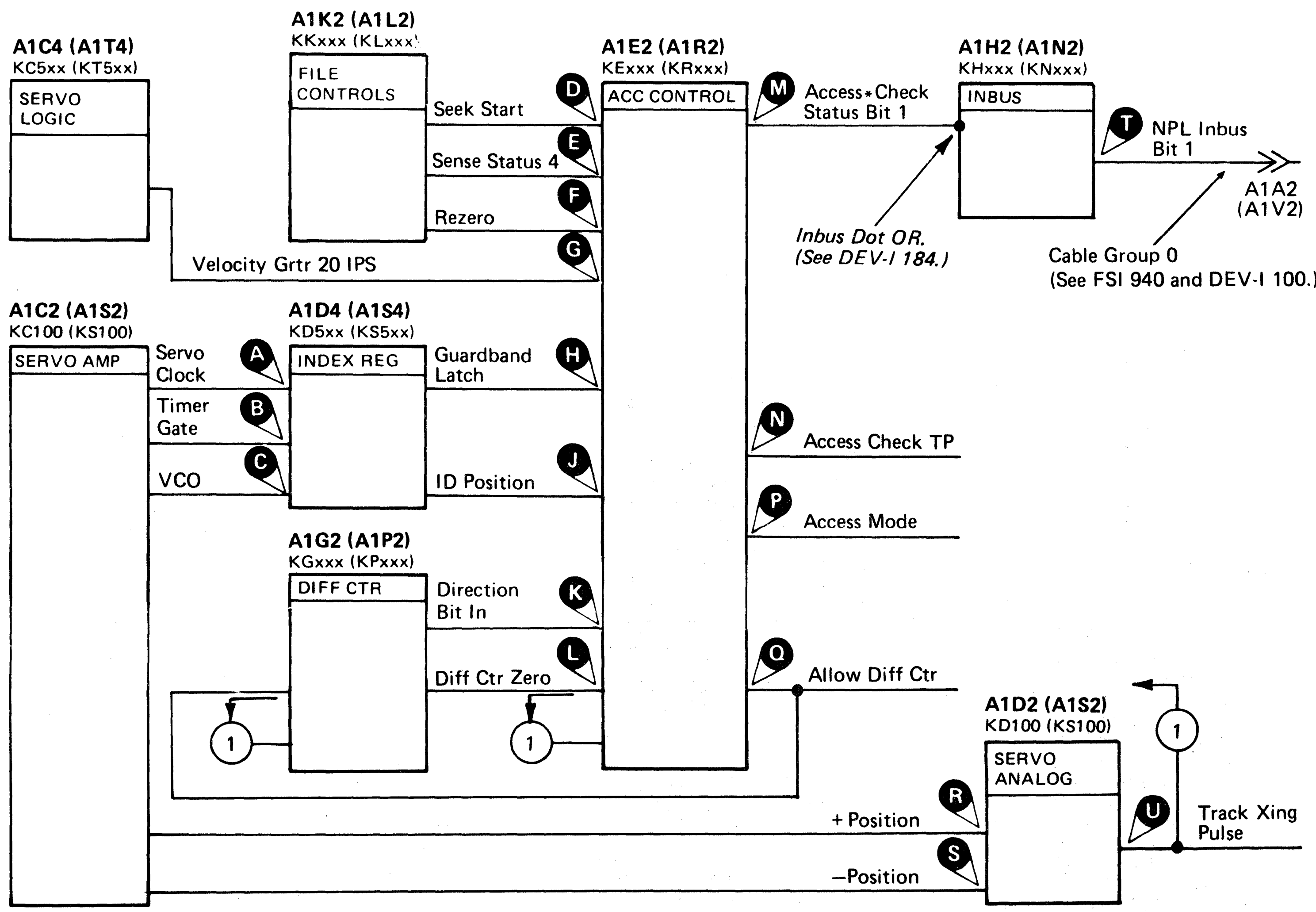
F
L

ACCESS CHECK/OVERSHOOT CHECK

See OPER 119 for theory



Line Name	ALD	Test Point	
+Servo Clock	KD560 (KS560)	A1D4 (A1S4) G10	A
+Timer Gate	KD560 (KS560)	A1D4 (A1S4) J13	B
+VCO	KD530 (KS530)	A1D4 (A1S4) D13	C
−Seek Start	KE100 (KR100)	A1E2 (A1R2) D05	D
−Sense Status 4	KE160 (KR160)	A1E2 (A1R2) S12	E
−Rezero	KE150 (KR150)	A1E2 (A1R2) P10	F
−Velocity Grtr 20 IPS	KE130 (KR130)	A1E2 (A1R2) G03	G
+Guardband Latch	KE140 (KR140)	A1E2 (A1R2) J04	H
−ID Position	KE140 (KR140)	A1E2 (A1R2) U11	J
−Direction Bit In	KE100 (KR100)	A1E2 (A1R2) D06	K
+Diff Ctr Zero	KE100 (KR100)	A1E2 (A1R2) J05	L
+Access*Check Status Bit 1	KE160 (KR160)	A1E2 (A1R2) U13	M
−Access Check TP	KE120 (KR120)	A1E2 (A1R2) U09	N
+Access Mode	KE110 (KR110)	A1E2 (A1R2) M12	P
+Allow Diff Ctr	KE110 (KR110)	A1E2 (A1R2) S11	Q
+Position	KD100 (KS100)	A1D2 (A1S2) J13	R
−Position	KD100 (KS100)	A1D2 (A1S2) G13	S
+NPL Inbus Bit 1	KH200 (KN200)	A1H2 (A1N2) D05	T
+Track Xing Pulse	KD100 (KS100)	A1D2 (A1S2) J04	U

ACC 100
ACC 110
ACC 332
(A)

#1 Unable to reset Servo Off Track error.

#2 Replace Card
A1H2(A1N2)
A1E2(A1R2)

#3 Trouble corrected — Yes: #7; No: #4

#4 Scope
Use the diagram on ACC 131 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. −Set Rd*Wr or Pad Ctrl (A) should be a +level (MST-1) when +Trk Following Timer (D) is a −level (MST-1).
2. See the Servo Off Track theory at the start of ACC 131.

#5 Trouble corrected — Yes: #6; No: (A) ACC 990

#6 Maintenance procedure complete.
(A) START 500

#7 Maintenance procedure complete.
(A) START 500

MICRO
(B)

#8 Unable to force Servo Off Track error.

#9 Replace Card
A1E2(A1R2)

#10 Trouble corrected — Yes: #7; No: #11

MICRO 72
MICFL 633

#11 Microdiagnostic
Loop failing test and bypass errors:
1. Load routine B8
2. Enter 10, 0F, 01, 00

#12 Scope
Sweep 2 ms/div
Trigger EXT
Slope (−)
A1K2(A1L2)P10
(−Drive Sync Tag)
Ch 1 A1E2(A1R2)S03
(−Set Rd*Wr or Pad Ctrl)
volts/div 0.1
probe ×10
Ch 2 Use the test points indicated in the block below.

(A) ACC 131

#13 Use the diagram on ACC 131 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
A Servo Off Track error is forced by issuing a Set Read*Write tag during a Rezero operation.
1. −Set Rd*Wr or Pad Ctrl (A) should go to a −level (MST-1) 10ms after −Drive Sync Tag.
2. +Trk Following Timer (D) should be a −level for a minimum of 10 ms (see note).
3. −Access Check TP (F) should go to a −level (MST-1) with −Set Rd*Wr or Pad Ctrl (A).
4. The Servo Off Track Error latch is gated to +Access*Check Status Bit 2 (E) by −Sense Status 4 (C).
5. See the Servo Off Track theory at the start of ACC 131.

(to #19)

ACC 301
ACC 510
(D)

#14 Invalid Servo Off Track error.

#15 Replace Card
A1E2(A1R2)
A1K2(A1L2)

When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.

#16 Trouble corrected — Yes: #22; No: #17

MICRO 10

#17 Microdiagnostic
Loop failing test and bypass errors:
1. Load routine
2. Enter 10, XX, 01, 00 (XX = test number from the Error Code)

#18 Scope
Use the diagram on ACC 131 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. −Set Rd*Wr or Pad Ctrl (A) should be a +level (MST-1) when +Trk Following Timer (D) is a −level (MST-1).
2. See the Servo Off Track theory.at the start of ACC 131.

#19 Trouble corrected — No: (A) ACC 990; Yes: #20

#20 Maintenance procedure complete.
(A) START 500

#22 Maintenance procedure complete.
(A) START 500

Note: *See Setup B on ACC 643 through ACC 646 for examples of Rezero operation timing photographs.*

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SERVO OFF TRACK

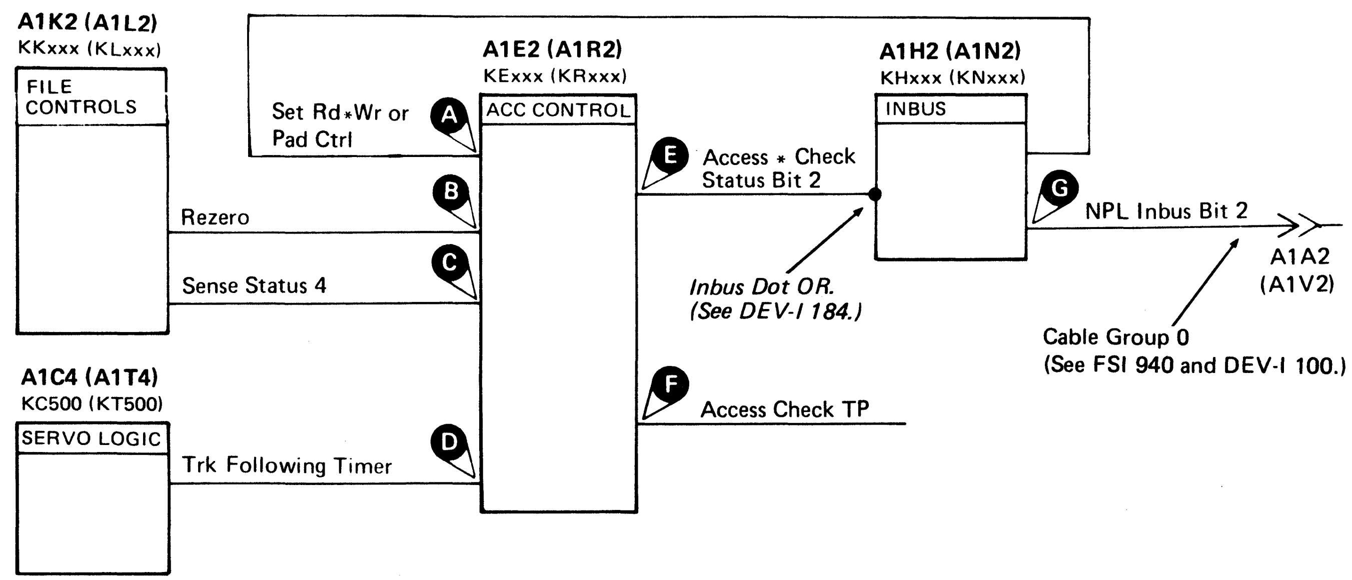
A Servo Off Track error is caused by one of two conditions:

1. Loss of Trk Following Timer (D) during a Read or Write operation.
2. Set Rd*Wr or Pad Ctrl (A) going active when the drive is not Track Following (D) (Access operation).

The Servo Off Track error latch is gated by Sense Status 4 (C) to Access*Check Status Bit 2 (E).

All Access Check conditions (F) are reset when a Rezero tag is issued to the drive.

See OPER 119 for additional theory.



Line Name	ALD	Test Point	
−Set Rd*Wr or Pad Ctrl	KE110 (KR110)	A1E2 (A1R2) S03	A
−Rezero	KE150 (KR150)	A1E2 (A1R2) P10	B
−Sense Status 4	KE160 (KR160)	A1E2 (A1R2) S12	C
+Trk Following Timer	KE100 (KR100)	A1E2 (A1R2) M04	D
+Access*Check Status Bit 2	KE160 (KR160)	A1E2 (A1R2) S10	E
−Access Check TP	KE120 (KR120)	A1E2 (A1R2) U09	F
+NPL Inbus Bit 2	KH200 (KN200)	A1H2 (A1N2) B09	G

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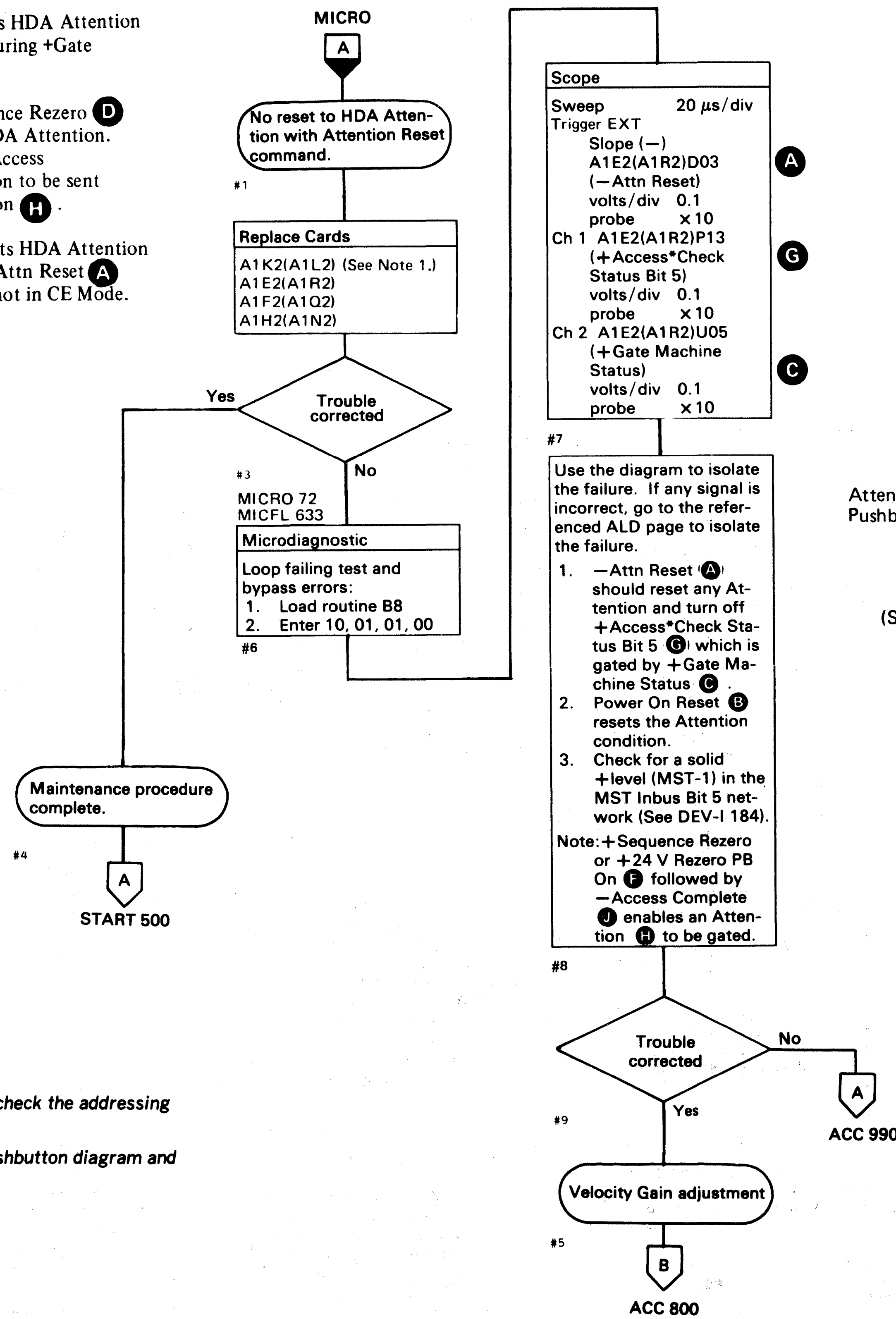
DRIVE STATUS/HDA ATTENTION

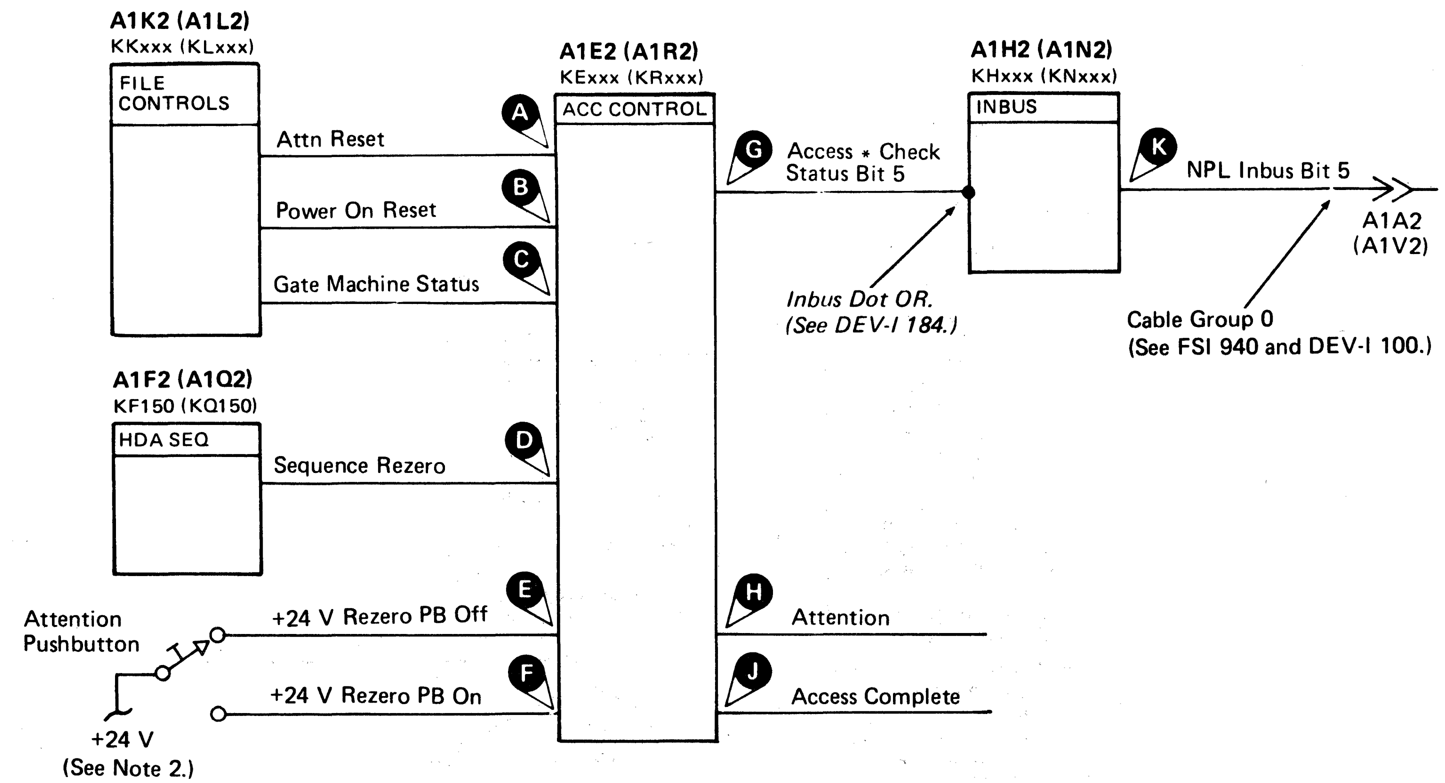
+Access*Check Status Bit 5 (G) indicates HDA Attention (Sense Byte 8, bit 5) at +level (MST-1) during +Gate Machine Status (C).

A Rezero operation, initiated by +Sequence Rezero (D) or +24 V Rezero PB On (F), enables HDA Attention. Completion of the Rezero operation (–Access Complete (J)) allows the HDA Attention to be sent to the Inbus (G) and generates +Attention (H).

In CE Mode, –Access Complete (J) resets HDA Attention (the attention is not sent to Inbus). An Attn Reset (A) resets HDA Attention when the drive is not in CE Mode.

See OPER 119 for additional theory.





Line Name	ALD	Test Point	
–Attn Reset	KE140 (KR140)	A1E2 (A1R2) D03	A
– Power On Reset	KE120 (KR120)	A1E2 (A1R2) B12	B
+Gate Machine Status	KE160 (KR160)	A1E2 (A1R2) U05	C
+Sequence Rezero	KE140 (KR140)	A1E2 (A1R2) G12	D
+24 V Rezero PB Off	KE150 (KR150)	A1E2 (A1R2) M03	E
+24 V Rezero PB On	KE150 (KR150)	A1E2 (A1R2) P02	F
+Access * Check Status Bit 5	KE160 (KR160)	A1E2 (A1R2) P13	G
+Attention	KE170 (KR170)	A1E2 (A1R2) M11	H
–Access Complete	KE130 (KR130)	A1E2 (A1R2) M02	J
+NPL Inbus Bit 5	KH200 (KN200)	A1H2 (A1N2) D02	K

Note 1: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

Note 2: *See ACC 638 for Attention Pushbutton diagram and checkout procedure.*

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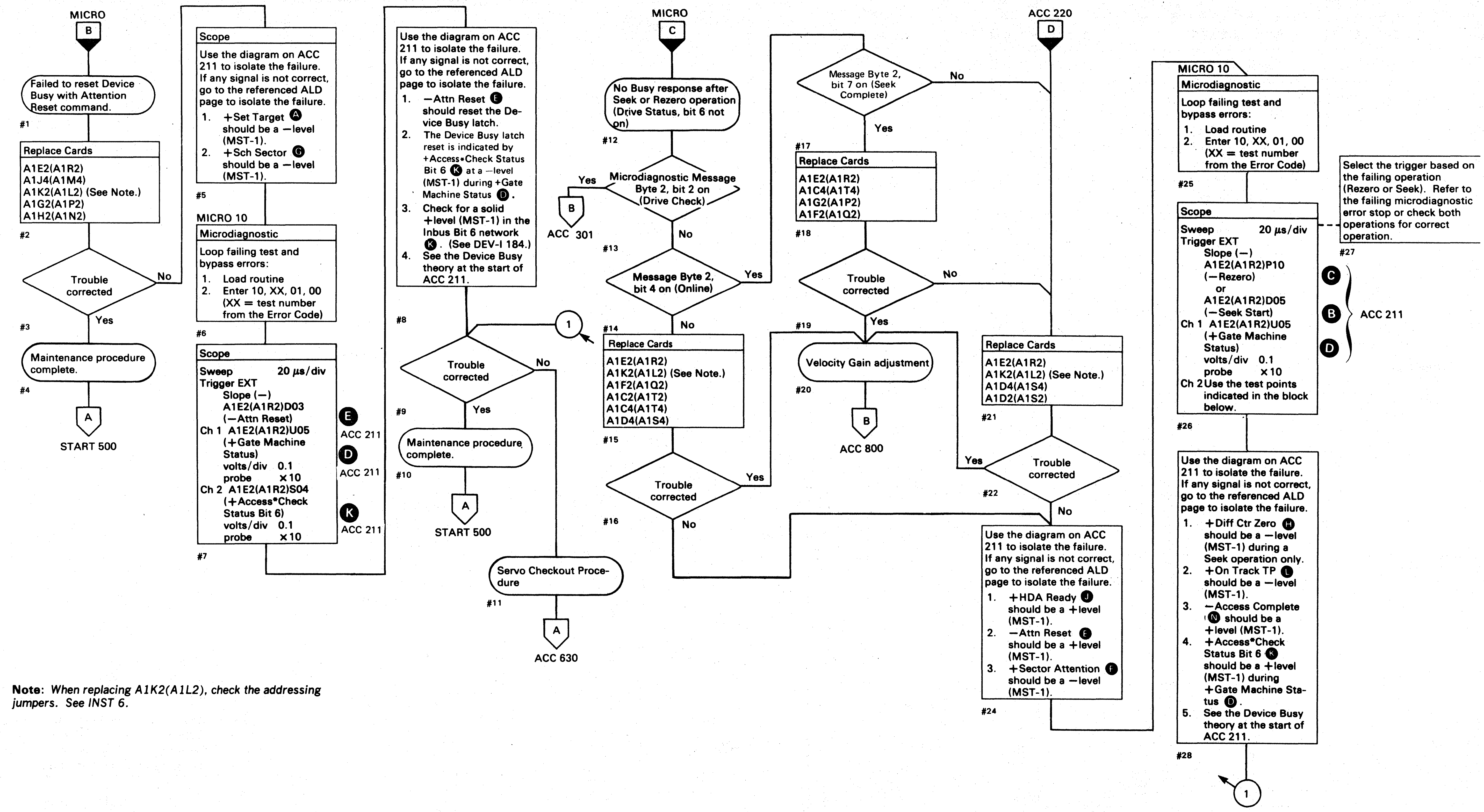


Note: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

DEVICE BUSY DIAGRAM

Device Busy is indicated by +Access*Check Status Bit 6 (K) at a + level (MST-1) during +Gate Machine Status (D).

Device Busy is set by one of the following:

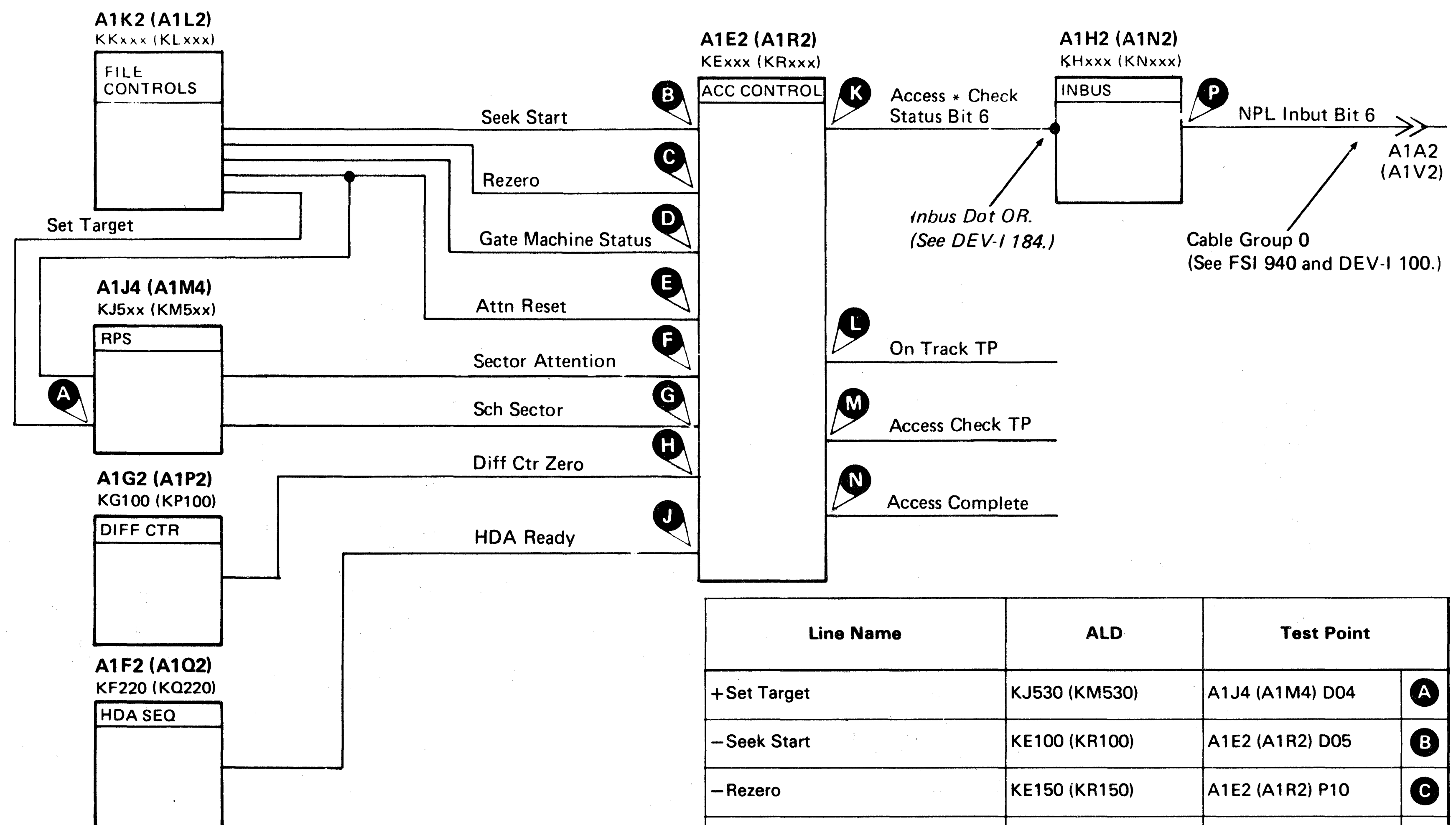
1. −Seek Start (B) AND not +On Track TP (L).
2. −Rezero (C) AND not +On Track TP (L).
3. +Search Sector (G).

Device Busy is inhibited from being sensed by:

1. −Access Complete (N).
2. +Sector Attention (F).

Device Busy is reset by − Attn Reset (E).

See OPER 30 for additional theory.



Line Name	ALD	Test Point	
+Set Target	KJ530 (KM530)	A1J4 (A1M4) D04	A
−Seek Start	KE100 (KR100)	A1E2 (A1R2) D05	B
−Rezero	KE150 (KR150)	A1E2 (A1R2) P10	C
+Gate Machine Status	KE160 (KR160)	A1E2 (A1R2) U05	D
−Attn Reset	KE140 (KR140)	A1E2 (A1R2) D03	E
+Sector Attention	KE170 (KR170)	A1E2 (A1R2) P06	F
+Sch Sector	KE140 (KR140)	A1E2 (A1R2) G13	G
+Diff Ctr Zero	KE100 (KR100)	A1E2 (A1R2) J05	H
+HDA Ready	KE150 (KR150)	A1E2 (A1R2) J13	J
+Access * Check Status Bit 6	KE160 (KR160)	A1E2 (A1R2) S04	K
+On Track TP	KE120 (KR120)	A1E2 (A1R2) B10	L
−Access Check TP	KE120 (KR120)	A1E2 (A1R2) U09	M
−Access Complete	KE130 (KR130)	A1E2 (A1R2) M02	N
+NPL Inbus Bit 6	KH200 (KN200)	A1H2 (A1N2) B02	P

MICRO
A

No Seek Complete response within 220 ms after a Seek or Rezero command. #1

Microdiagnostic message byte 2, bit 2 on (Drive Check) #2 — Yes: #5; No: #27

Microdiagnostic Message Byte 2, bit 4 on (Online) #27 — No: C DEV-I 410; Yes: continue

Microdiagnostic Byte 2, bit 6 on (Busy) — No: D ACC 210; Yes: #3

#3 Replace Cards
A1E2(A1R2)
A1K2(A1L2) (See Note.)
A1H2(A1N2)
A1F2(A1Q2)
#4

Trouble corrected — Yes: #8; No: 1

#5 No Seek Complete with Drive Check. #6

Replace Card
A1E2(A1R2)
#7

Trouble corrected — Yes: #8; No: #10

#8 Maintenance procedure complete. #9
A START 500

The Drive Check existed prior to the failing Seek or Rezero command. #10
A ACC 100

Note: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

Scope
Use the diagram on ACC 221 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. +Sector Attention E should be a –level (MST-1).
2. +Pad Cplt Attn F should be a –level (MST-1).
#11

MICRO 10
Microdiagnostic
Loop failing test and bypass errors:
1. Load routine
2. Enter 10, XX, 01, 00 (XX = test number from the Error Code.)
#12

Scope
Sweep 20 µs/div
Trigger
Slope (–)
Ch 1 only
Ch 1 A1E2(A1R2)D03 (–Attn Reset) — D ACC 221
volts/div 0.1
probe ×10
Ch 2 Use the test points indicated in the block below.
#13

Use the diagram on ACC 221 to isolate the failure. If any signl is not correct, go to the referenced ALD page to isolate the failure.
1. +Attention J should go to a –level (MST-1) after –Attn Reset D.
2. +Access*Check Stat Bit 7 G should be a –level (MST-1) during +Gate Machine Status C after –Attn Reset D. (If incorrect, refer to DEV-I 184).
3. See the Seek Complete theory at the start of ACC 221.
#14

MICRO
B

Seek Complete or Sector Attention does not reset with Attention Reset or Check Reset. #15

Microdiagnostic Message Byte 2, bit 2 on (Drive Check) #16 — Yes: #20; No: #17

Replace Cards
A1H2(A1N2)
A1E2(A1R2)
A1J4(A1M4)
A1K2(A1L2) (See Note.)
#17

Trouble corrected #18 — No: #11; Yes: #19

Maintenance procedure complete. #19
A START 500

No response to Check Reset. #20
A ACC 100

Select the trigger based on the failing operation (Seek or Rezero). Refer to the failing microdiagnostic error stop or check both operations for correct operation. #21

ACC 520
C
MICRO 10
Microdiagnostic
Loop failing test and bypass errors:
1. Load routine
2. Enter 10, XX, 01, 00 (XX = test number from the Error Code)
#22

Scope
Sweep 20 ms/div
Trigger
Slope (–)
Ch 1 only
Ch 1 A1E2(A1R2)P10 (–Rezero) — B ACC 221
or
A1E2(A1R2)D05 (–Seek Start) — A ACC 221
Ch 2 Use the test points indicated in the next block below.
#23

Use the diagram on ACC 221 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. +On Track TP H should be a –level (MST-1) during –Seek Start A or –Rezero B.
2. –Access Complete K should go to a –level (MST-1) within 220 ms of –Seek Start A or –Rezero B.
Note: If Access Complete is not active, refer to ACC 111, Entry B for the Access Safety Timer checkout procedure.
3. The +Access*Check Stat Bit 7 G gated by +Gate Machine Status C indicates Seek Complete. (See the Inbus Dot OR Circuit on DEV-I 184).
#24

Trouble corrected #25 — No: A ACC 990; Yes: #26

Velocity Gain adjustment #26
B ACC 800

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DRIVE STATUS – SEEK COMPLETE DIAGRAM

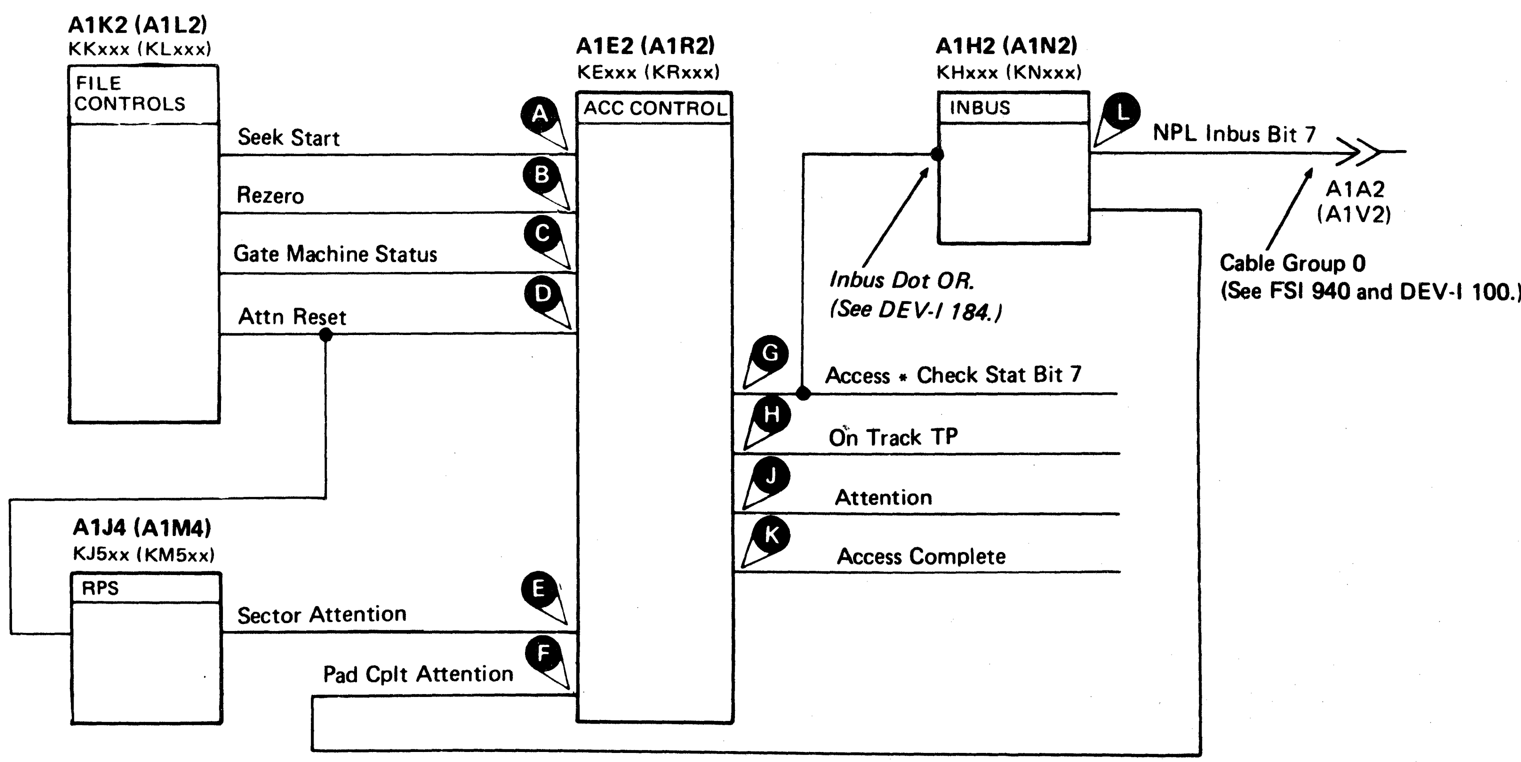
Seek Cplt * Sctr Cmpr * Sch Sctr, KE170(KR170), is gated to Inbus Bit 7 (G) by +Gate Machine Status (C)

The conditions for Seek Complete are:

1. –Access Complete (K) AND Device Busy (see ACC 211).
2. +Sector Attention (E)
3. +Pad Cplt Attn (F).

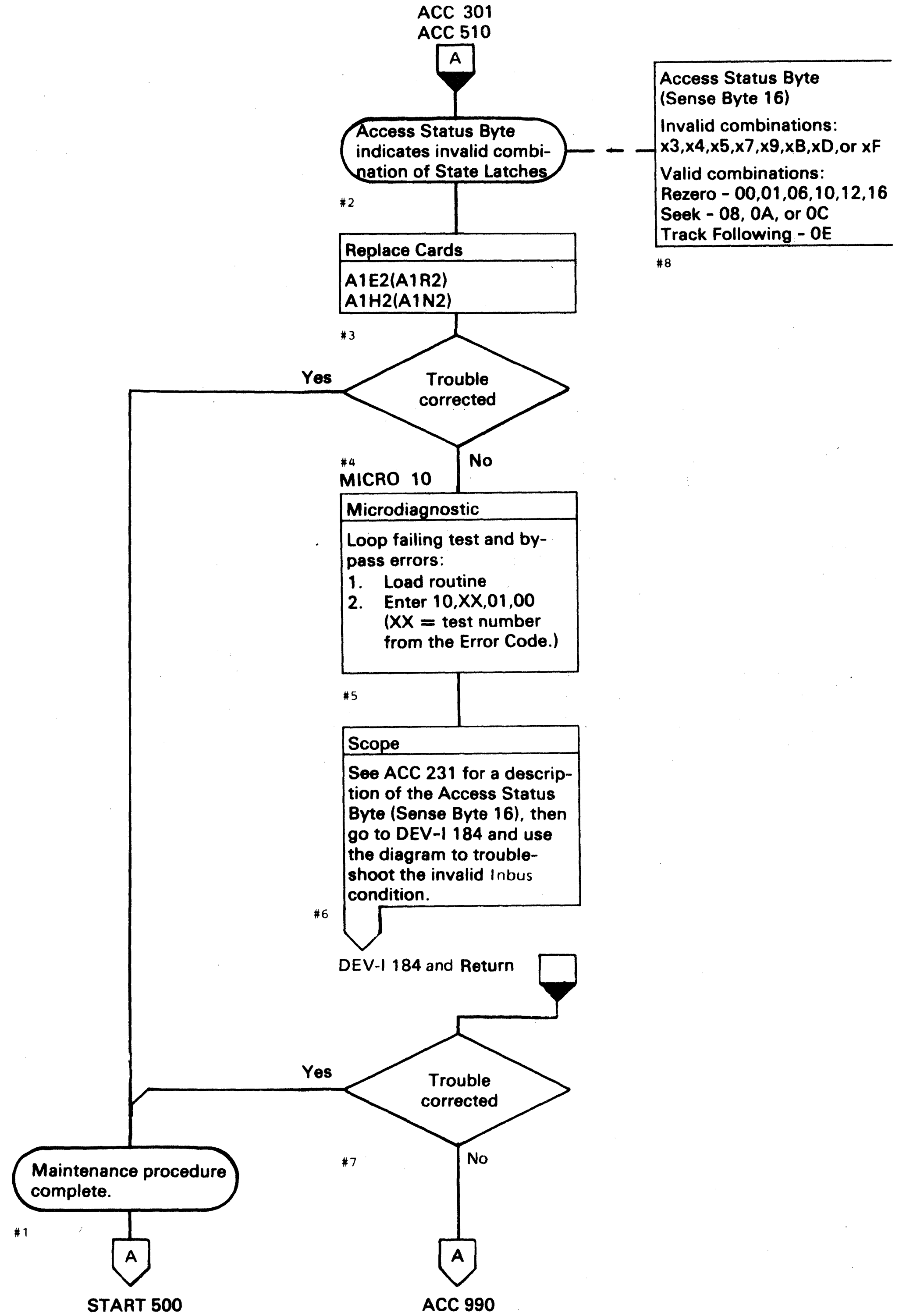
Seek Complete is reset (after a Seek or Rezero operation) by –Attn Reset (D) which resets the Device Busy latch and degates –Access Complete (K) (see ACC 211).

See OPER 107 for additional theory.



Line Name	ALD	Test Point	
–Seek Start	KE100 (KR100)	A1E2 (A1R2) D05	A
–Rezero	KE150 (KR150)	A1E2 (A1R2) P10	B
+Gate Machine Status	KE160 (KR160)	A1E2 (A1R2) U05	C
–Attn Reset	KE140 (KR140)	A1E2 (A1R2) D03	D
+Sector Attention	KE170 (KR170)	A1E2 (A1R2) P06	E
+Pad Cplt Attn	KE170 (KR170)	A1E2 (A1R2) M09	F
+Access*Check Stat Bit 7	KE160 (KR160)	A1E2 (A1R2) M13	G
+On Track TP	KE120 (KR120)	A1E2 (A1R2) B10	H
+Attention	KE170 (KR170)	A1E2 (A1R2) M11	J
–Access Complete	KE130 (KR130)	A1E2 (A1R2) M02	K
+NPL Inbus Bit 7	KH200 (KN200)	A1H2 (A1N2) D06	L

ACCESS STATUS – INVALID STATE



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ACCESS CONTROL SENSE BYTE – CIRCUIT DESCRIPTION

Format 1, Sense Byte 16 contains Access Control Sense information, which is gated to the Inbus by –Sense Status 4.

SENSE BYTE 16 – BIT SUMMARY

Bit 0 Access Timeout Check (ACC 111)
An Access operation (Seek or Rezero) was not completed within 180 milliseconds.

Bit 1 Access Overshoot Check (ACC 121)
During a Seek or Rezero operation, one of the following events caused a Drive Check:

a. Three track crossing pulses were detected after the Difference Counter decremented to zero.

b. Three track crossing pulses were detected after the Access Control advanced to Linear Mode.

c. A Seek operation moved the carriage into the inner or outer crash stop.

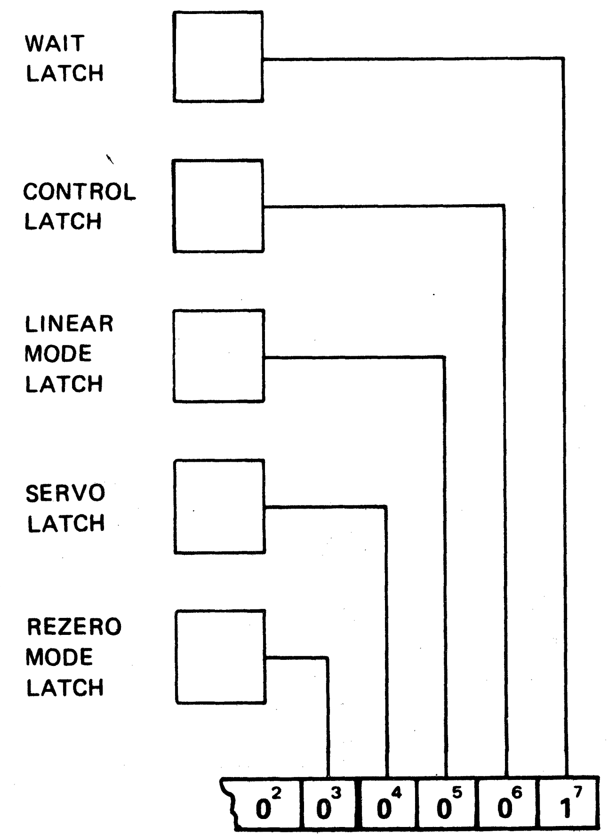
d. During a Rezero operation, carriage velocity was measured at greater than 20 inches/second.

Bit 2 Servo Off Track Check (ACC 131)
The servo is not on track and track following while Set Read * Write is active.

Bit 3 Rezero Latch
Bit 4 Servo Latch
Bit 5 Linear Mode Latch
Bit 6 Control Latch
Bit 7 Wait Latch

(Bits 3–7:) These bits indicate the current state of the Access Control. Depending on which latch(es) is (are) active, the Access Control may be in any of the Access states shown on the right of this page.

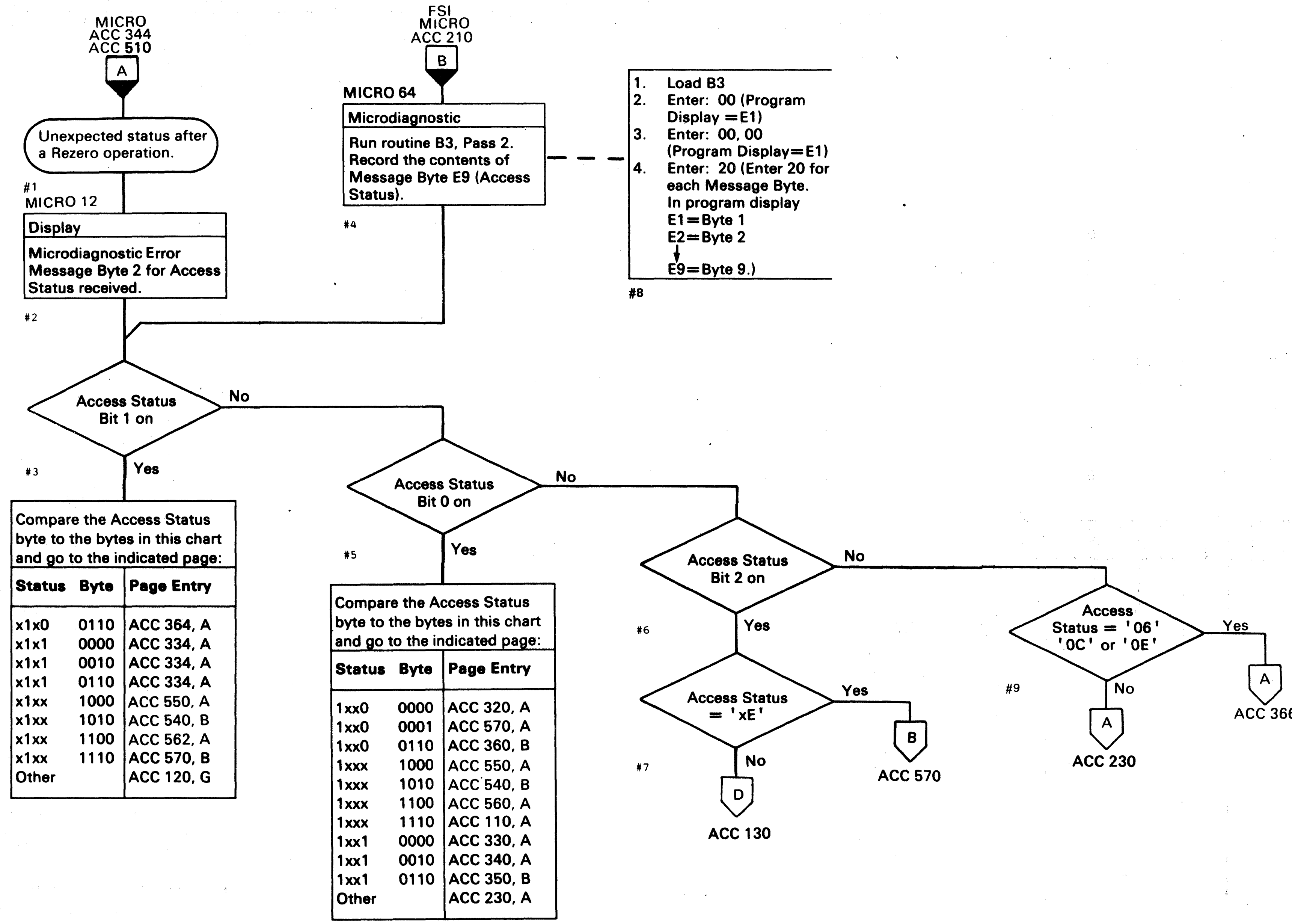
ACCESS CONTROL STATE LATCHES



3	4	5	6	7				
0	0	0	0	1	=	State 01	Wait State	Reset
0	0	0	0	0	=	State 00	Start Rezero	Rezero Operation
1	0	0	0	0	=	State 10	Move Out	
1	0	0	1	0	=	State 12	Turnaround	
1	0	1	1	0	=	State 16	Move In	
0	0	1	1	0	=	State 06	Rezero Linear Mode	
0	1	1	1	0	=	State 0E	On Track	
0	1	0	1	0	=	State 0A	Accelerate	Seek Operation
0	1	0	0	0	=	State 08	Decelerate	
0	1	1	0	0	=	State 0C	Seek Linear Mode	
0	1	1	1	0	=	State 0E	On Track	

ACCESS CONTROL SENSE BYTE - CIRCUIT DESCRIPTION ACC 231

REZERO – INITIAL ANALYSIS



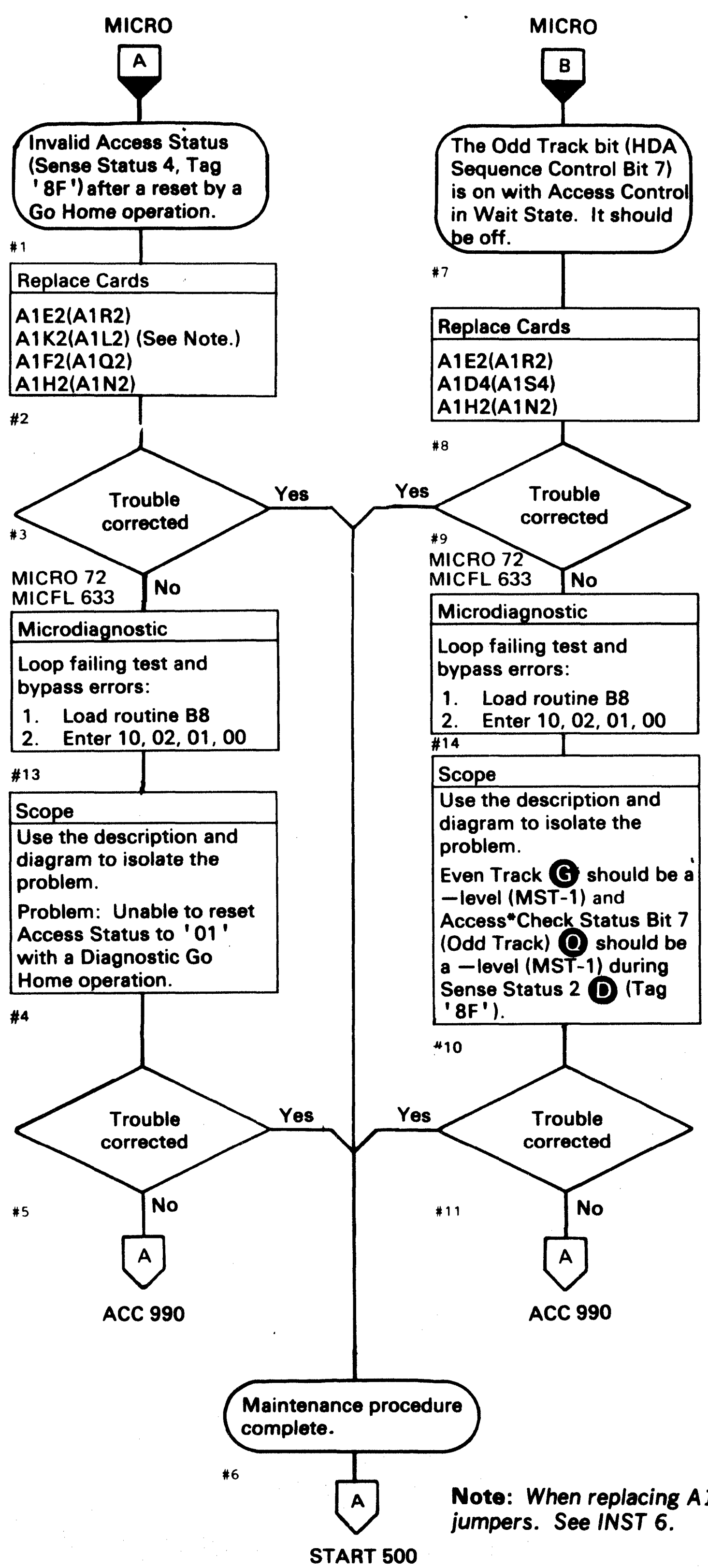
Compare the Access Status byte to the bytes in this chart and go to the indicated page:

Status	Byte	Page Entry
x1x0	0110	ACC 364, A
x1x1	0000	ACC 334, A
x1x1	0010	ACC 334, A
x1x1	0110	ACC 334, A
x1xx	1000	ACC 550, A
x1xx	1010	ACC 540, B
x1xx	1100	ACC 562, A
x1xx	1110	ACC 570, B
Other		ACC 120, G

Compare the Access Status byte to the bytes in this chart and go to the indicated page:

Status	Byte	Page Entry
1xx0	0000	ACC 320, A
1xx0	0001	ACC 570, A
1xx0	0110	ACC 360, B
1xxx	1000	ACC 550, A
1xxx	1010	ACC 540, B
1xxx	1100	ACC 560, A
1xxx	1110	ACC 110, A
1xx1	0000	ACC 330, A
1xx1	0010	ACC 340, A
1xx1	0110	ACC 350, B
Other		ACC 230, A

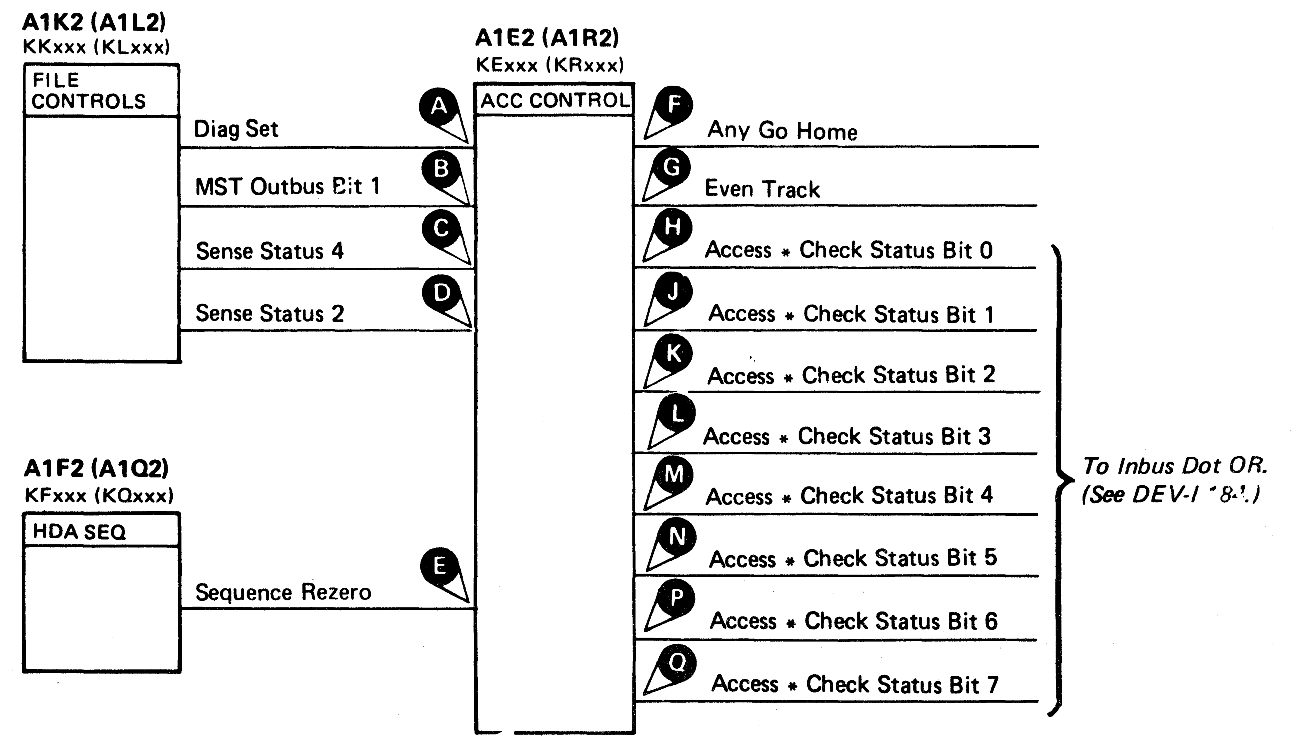
SERVO WAIT STATE (RESET)



Note: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

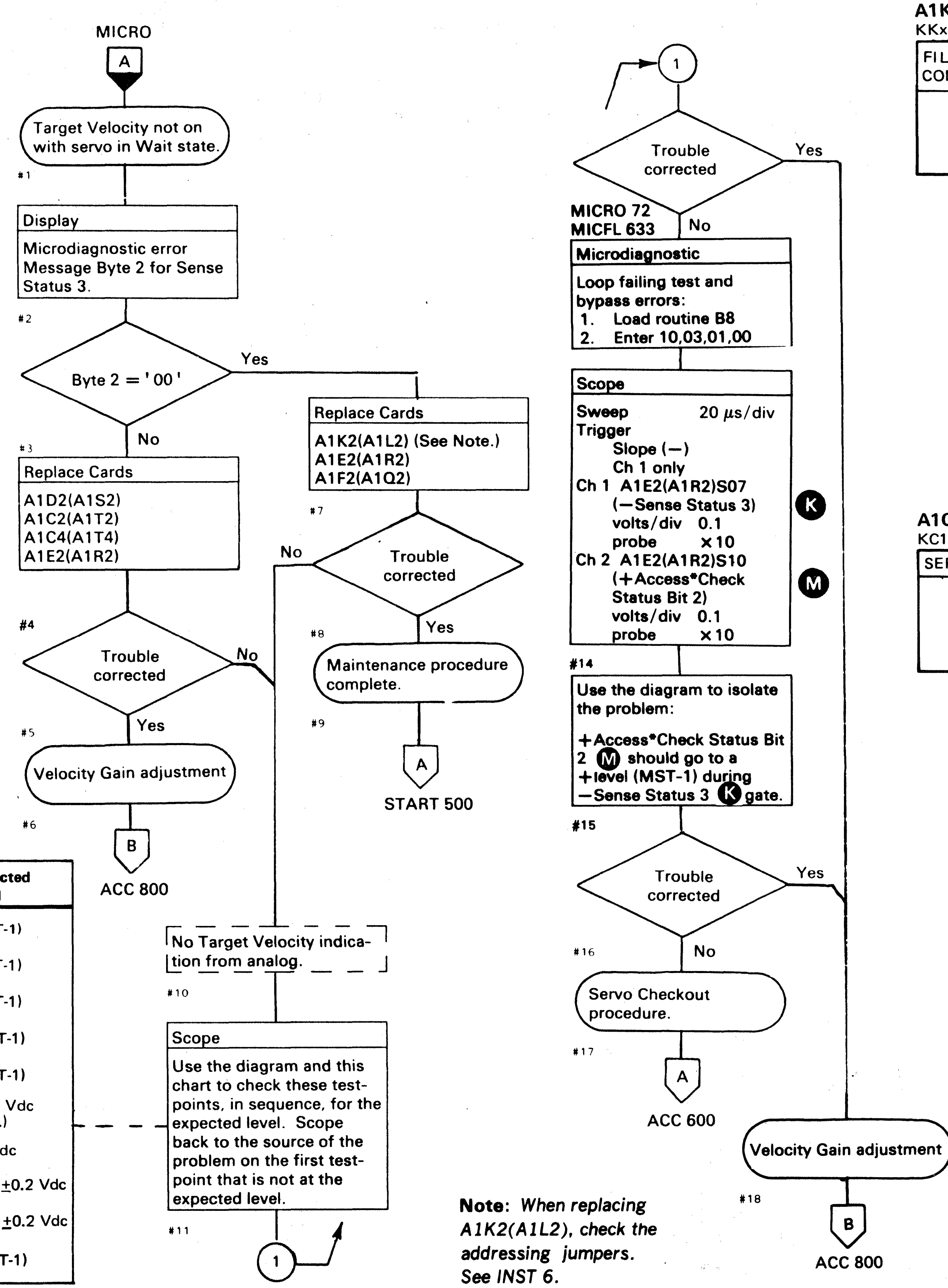
Description:

1. A Diagnostic Set Tag '8A' (Diag Set **A** with —MST Outbus Bit 1 **B** on Bus Out) is a Diagnostic Go Home operation. The Go Home operation is indicated by —Any Go Home **F**.
2. Any Go Home forces Access Control into Wait State (Reset), as indicated by a Bus In value of '01' under Sense Status 4 **C** (Tag '8F', Bus Out '13') and a Bus In value of xxxx xxx0 under Sense Status 2 **D** (Tag '8F', Bus Out '43').
3. +Sequence Rezero **E** should be a — level (MST-1).



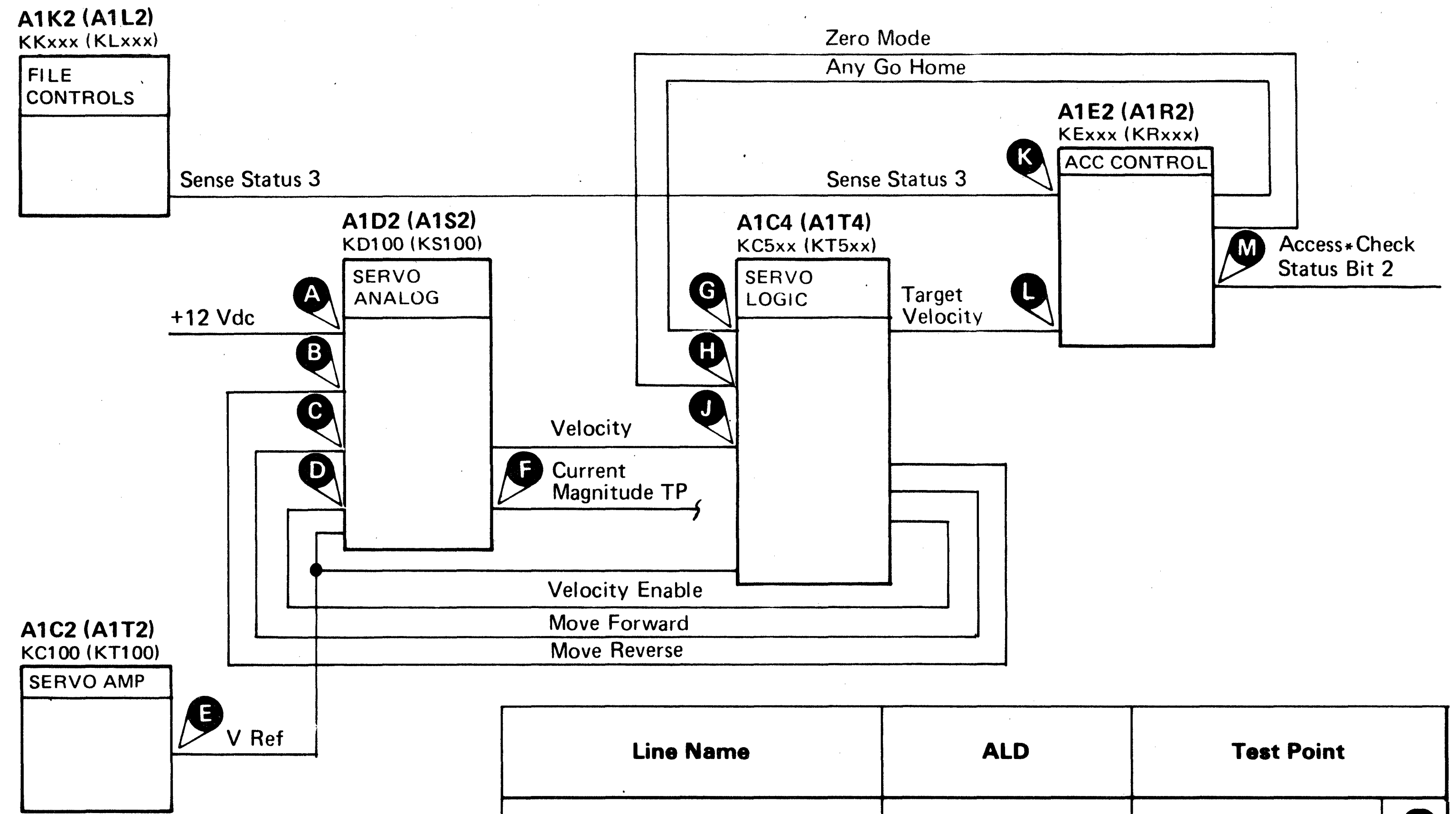
Line Name	ALD	Test Point	
+Diag Set	KE110 (KR110)	A1E2 (A1R2) B07	A
—MST Outbus Bit 1	KE110 (KR110)	A1E2 (A1R2) B11	B
—Sense Status 4	KE160 (KR160)	A1E2 (A1R2) S12	C
—Sense Status 2	KE160 (KR160)	A1E2 (A1R2) S08	D
+Sequence Rezero	KE140 (KR140)	A1E2 (A1R2) G12	E
—Any Go Home	KE120 (KR120)	A1E2 (A1R2) J12	F
—Even Track	KE150 (KR150)	A1E2 (A1R2) B13	G
+Access*Check Status Bit 0	KE160 (KR160)	A1E2 (A1R2) U10	H
+Access*Check Status Bit 1	KE160 (KR160)	A1E2 (A1R2) U13	J
+Access*Check Status Bit 2	KE160 (KR160)	A1E2 (A1R2) S10	K
+Access*Check Status Bit 3	KE160 (KR160)	A1E2 (A1R2) S13	L
+Access*Check Status Bit 4	KE160 (KR160)	A1E2 (A1R2) U04	M
+Access*Check Status Bit 5	KE160 (KR160)	A1E2 (A1R2) P13	N
+Access*Check Status Bit 6	KE160 (KR160)	A1E2 (A1R2) S04	P
+Access*Check Status Bit 7	KE160 (KR160)	A1E2 (A1R2) M13	Q

SERVO WAIT STATE — ANALOG RESET



Test Point	Expected Level
1. G	+(MST-1)
2. H	+(MST-1)
3. D	+(MST-1)
4. C	−(MST-1)
5. B	−(MST-1)
6. E	−1.28 Vdc (Nom.)
7. A	+12 Vdc
8. F	0 Vdc ±0.2 Vdc
9. J	0 Vdc ±0.2 Vdc
10. L	−(MST-1)

Note: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*



Line Name	ALD	Test Point	
+12.0 to 14.4 Vdc	KA100 (KV100)	A1D2 (A1S2) D05	A
+Move Reverse	KD100 (KS100)	A1D2 (A1S2) J10	B
+Move Forward	KD100 (KS100)	A1D2 (A1S2) J12	C
−Velocity Enable	KD100 (KS100)	A1D2 (A1S2) G08	D
V Ref (−1.28 Vdc Nom)	KD100 (KS100)	A1C4 (A1T4) B08 A1D2 (A1S2) B08	E
Current Magnitude TP	KD100 (KS100)	A1D2 (A1S2) B13	F
−Any Go Home	KC510 (KT510)	A1C4 (A1T4) G04	G
+Zero Mode	KC500 (KT500)	A1C4 (A1T4) D09	H
−Velocity	KC510 (KT510)	A1C4 (A1T4) J12	J
−Sense Status 3	KE160 (KR160)	A1E2 (A1R2) S07	K
−Target Velocity	KE160 (KR160)	A1E2 (A1R2) G04	L
+Access*Check Status Bit 2	KE160 (KR160)	A1E2 (A1R2) S10	M

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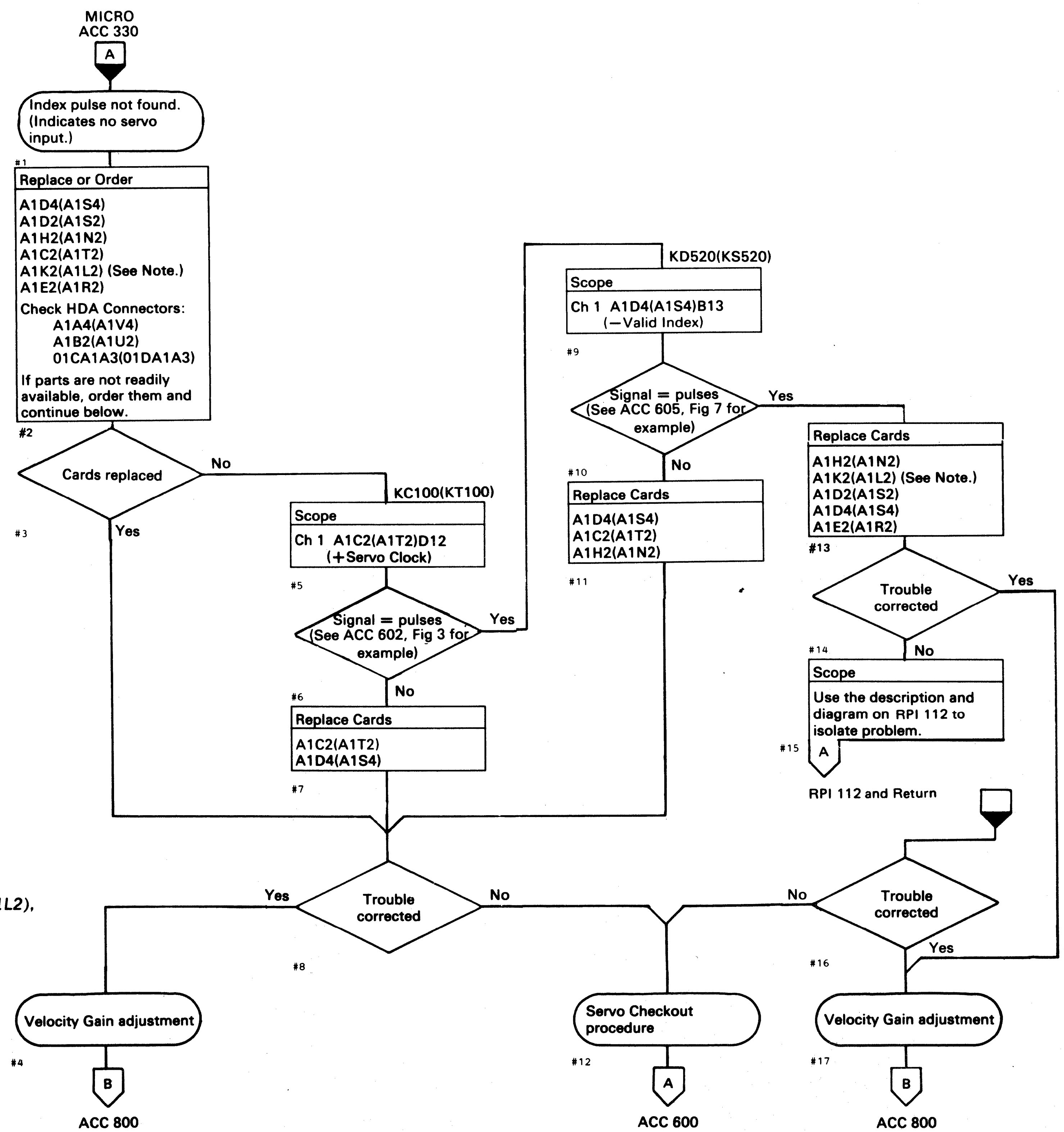
SERVO WAIT STATE – SERVO INPUT



Note: *When replacing A1K2(A1L2), check the addressing jumpers. See INST 6.*

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ACC 301
ACC 332

A

Access Timeout error in Rezero State 00. Access Control failed to set the Rezero Mode latch.
#1

Replace or Order
A1E2(A1R2)
A1D2(A1S2)
A1G2(A1P2)
A1C4(A1T4)
If parts are not readily available, order them and continue below.
#2

Trouble corrected — #3
Yes: Servo Gain adjustment #4 → B ACC 800
No: ↓

With the microdiagnostic stopped at the error, continue below.
#8

Scope
Sweep 2 μs/div
Trigger AUTO
Ch 1 A1E2(A1R2)J05 (+Diff Ctr Zero)
volts/div 0.1
probe ×10
E ACC 321
#9

Signal at +level (MST-1) — #10
No: ↓ Replace Cards
Yes: → Replace Cards (#11)

Replace Cards
A1G2(A1P2)
A1E2(A1R2)
#5

Trouble corrected — #6
Yes: Maintenance procedure complete. #7 → A START 500
No: → Scope (#19)

Scope
Use the diagram on ACC 321 to isolate the failure. If any signal is incorrect, go to the referenced ALD page to isolate the failure.
1. While the Attention pushbutton is being pushed, −Any Rezero J should stay at a − level (MST-1).
2. +Diff Ctr Zero E should be at a + level (MST-1).
#19

Trouble corrected — #20
No: A ACC 990
Yes: Maintenance procedure complete. #21 → A START 500

Replace Cards
A1E2(A1R2)
A1D2(A1S2)
A1C4(A1T4)
#11

Trouble corrected — #12
Yes: Servo Gain adjustment #13 → B ACC 800
No: → MICRO 10

MICRO 10
Microdiagnostics
Loop the failing test and bypass errors:
1. Load routine
2. Enter 10,XX,01,00 (XX = test number from the Error Code)
#14

Scope
Sweep 5 μs/div
Trigger
Slope (−)
Ch 1 only
Ch 1 A1E2(A1R2)P10 (−Rezero)
volts/div 0.1
probe ×10
Ch 2 Use the test points indicated in the next block.
C ACC 321
#15

Use the diagram on ACC 321 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.
1. +Access Start K should go to a + level (MST-1).
2. −Even Track L should be a − level (MST-1).
3. −Any Rezero J should go to a − level (MST-1).
4. +Diff Ctr Zero E should be a + level (MST-1).
5. +Forward B should be a − level (MST-1).
6. −Allow Rezero F should go to a − level (MST-1).
7. −Target Velocity G should be a − level (MST-1).
8. +Rezero Mode M should go to a + level (MST-1).
9. +Access*Check Status Bit 3 H should be a + level (MST-1) when gated by −Sense Status 4 D.
#16

Trouble corrected — #17
No: A ACC 990
Yes: Maintenance procedure complete. #18 → A START 500

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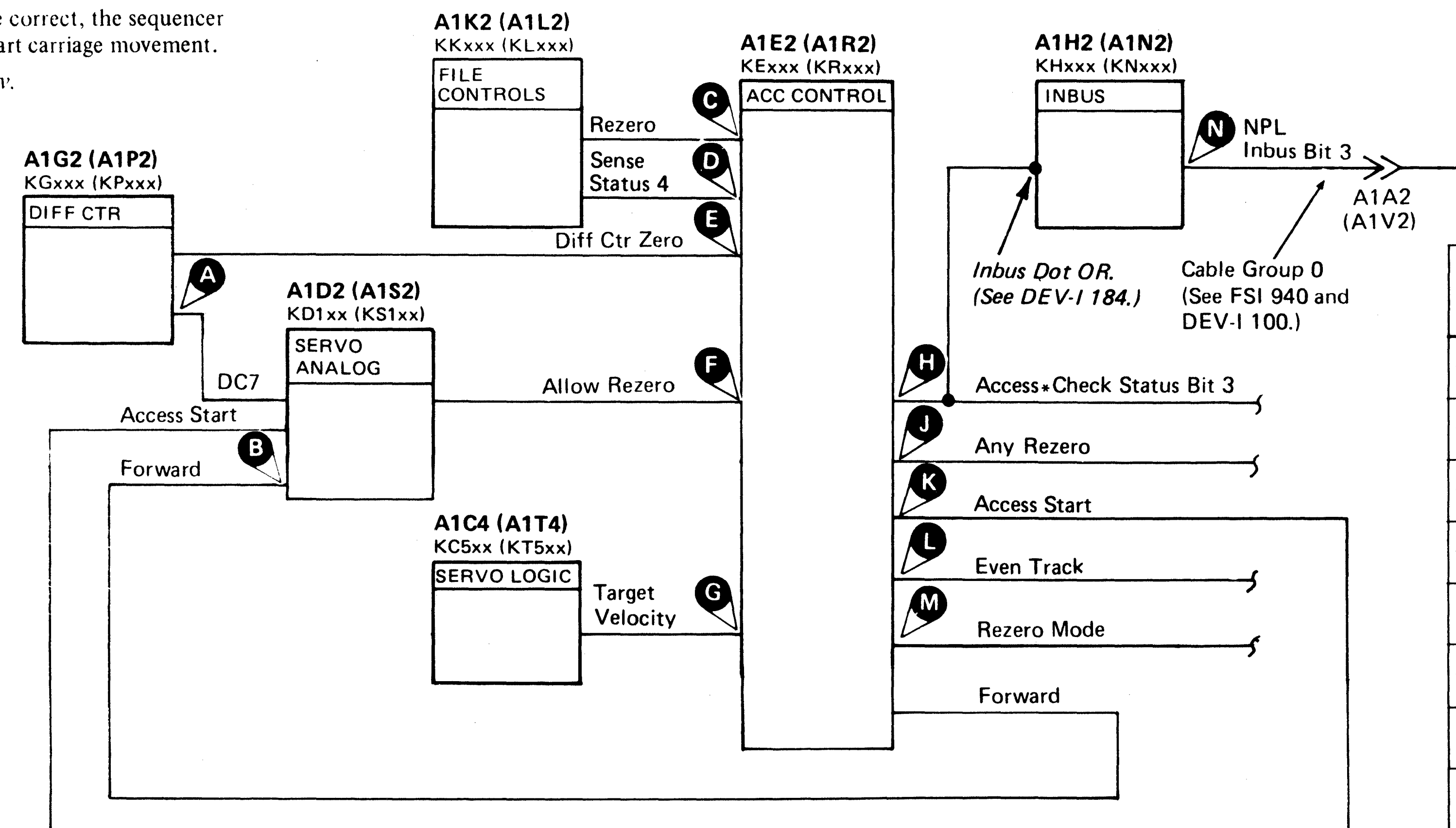
ACCESS STATE 00 – REZERO START

Any Rezero command (System Rezero Tag, Attention PB Rezero, or HDA Sequence Rezero) issued to the servo starts the following sequence of operations:

1. Any Rezero forces the Access Control Sequencer into State 01 Wait (see Note 1). State 01 resets any active Access Check (see Note 2).
2. With Access Checks reset, the sequencer advances to State 00 to test the following initial servo conditions:
   - Even Track latch active.
   - Difference Counter reset to zero.
   - Target Velocity (no carriage movement) active.
   - Allow Rezero active (indicates analog velocity measurement controls are set to the correct starting condition).
3. If the initial servo conditions are correct, the sequencer advances to State 10 or 12 to start carriage movement.

See OPER 130 for additional theory.



Line Name	ALD	Test Point	
−DC7	KD100 (KS100)	A1D2 (A1S2) G10	A
+Forward	KD100 (KS100)	A1D2 (A1S2) G12	B
−Rezero	KE150 (KR150)	A1E2 (A1R2) P10	C
−Sense Status 4	KE160 (KR160)	A1E2 (A1R2) S12	D
+Diff Ctr Zero	KE100 (KR100)	A1E2 (A1R2) J05	E
−Allow Rezero	KE150 (KR150)	A1E2 (A1R2) G02	F
−Target Velocity	KE150 (KR150)	A1E2 (A1R2) G04	G
+Access*Check Status Bit 3	KE160 (KR160)	A1E2 (A1R2) S13	H
−Any Rezero	KE130 (KR130)	A1E2 (A1R2) G07	J
+Access Start	KE110 (KR110)	A1E2 (A1R2) J02	K
−Even Track	KE150 (KR150)	A1E2 (A1R2) B13	L
+Rezero Mode	KE150 (KR150)	A1E2 (A1R2) D13	M
+NPL Inbus Bit 3 (See Note 3.)	KH200 (KN200)	A1H2 (A1N2) D10	N

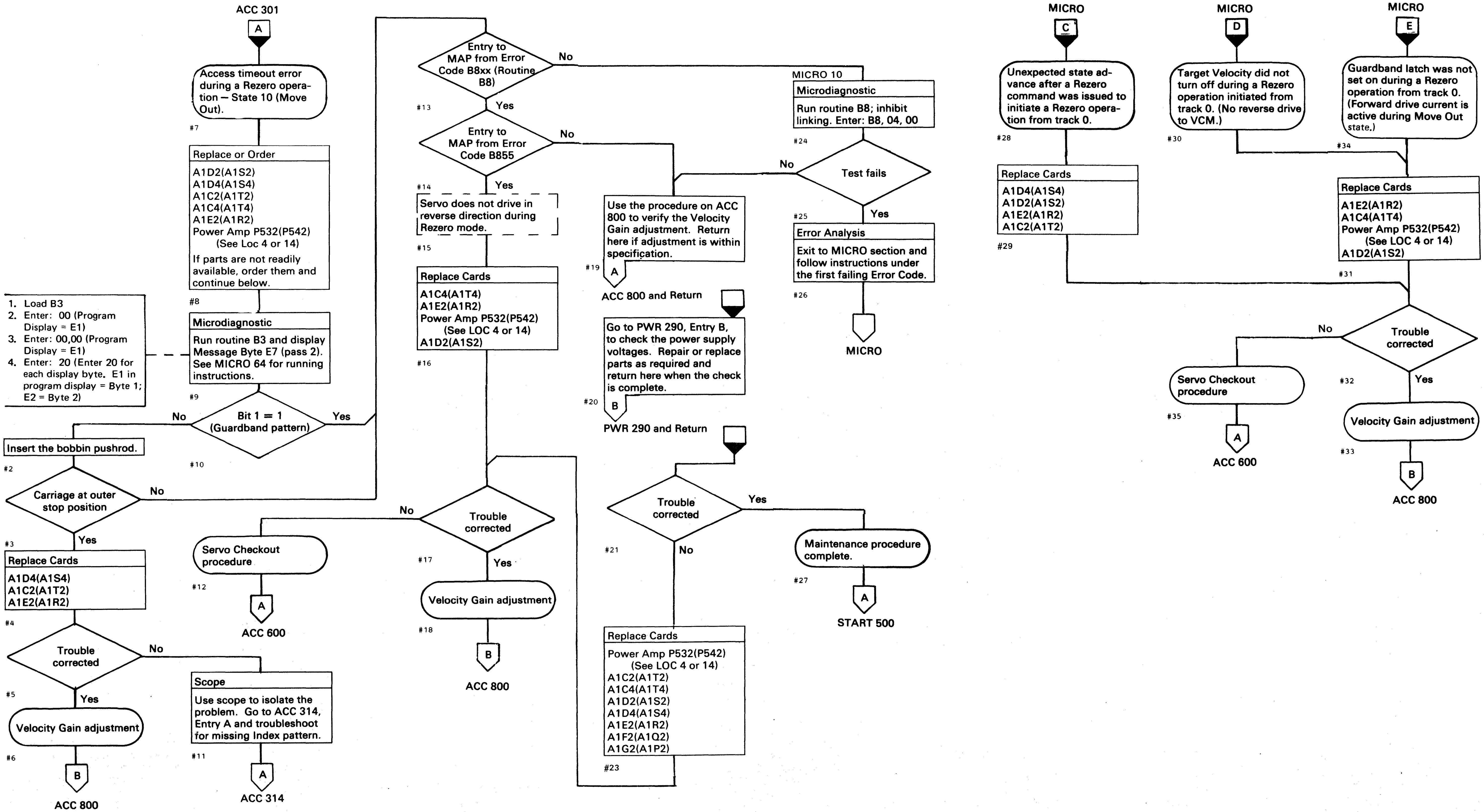
Note 1: *Access Control Sequencer state is indicated in Sense Byte 16, bits 3 through 7 or microdiagnostic routine B3 Error Message Byte 9, bits 3 through 7.*

Note 2: *Access Checks are indicated in Sense Byte 16, bits 0, 1, and 2 or microdiagnostic routine B3 Error Message Byte 9, bits 0, 1, and 2.*

Note 3: *The Rezero Mode latch is gated to Access*Check Status Bit 3 (H) by Sense Status 4 (D). See DEV-I 184 for a detailed diagram of the Inbus Dot OR circuit.*

DG0321 Seq. 1 of 1	2358116 Part No.	441300 31 Mar 76	441303 30 Jul 76			

ACCESS STATE 10 – MOVE OUT



3350	DG0330 Seq. 1 of 2	2358117 Part No.	441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441307 3 Oct 77	

MICRO
A

Target Velocity indicator did not reset before end of the Rezero operation. (No carriage movement)

#6
MICRO 12

Display
Microdiagnostic Error Message Byte 2 for Access Status received.

#7
Byte 2 = 1xx0 0000 (Rezero Start) — Yes → A ACC 320
#8 No

Byte 2 = 1xx0 0001 (Wait) — Yes → A ACC 110
#1 No

Byte 2 = xx1x xxxx — No
#9 Yes

Servo Off Track error not reset by Rezero command.

#14
A ACC 130

Byte 2 = x1xx xxxx — Yes
#2 No

Access Timeout during Rezero Mode (indicates no carriage movement).

#3
Replace Cards
A1C4(A1T4)
A1E2(A1R2)
Power Amp P532(P542) (See LOC 4 or 14)
A1D2(A1S2)

#4 KC500(KT500)
Check
Connector: A1A4(A1V4)D10 to P532 (P542) -9 (Power Amp Drive)

#38
Trouble corrected — No
#37 Yes

Check
Test for an open VCM cable or an open voice coil:
1. Turn drive power off.
2. Remove connector P532(P542) from Power Amp. (See LOC 4 or 14.)
3. With CE meter, check for continuity (3 to 6 ohms) between: P532-1 and P532-2 (P542-1 and P542-2) See YA/YB060.
4. Check for loose VCM ribbon cable connection.

Repair or replace parts as required. (See HDA 708 for voice coil replacement procedure or HDA 710 for HDA replacement procedure.)

#37

Overshoot check during Rezero mode. (No carriage movement detected.)

#10
Replace Cards
A1E2(A1R2)
A1C2(A1T2)
A1C4(A1T4)
A1D2(A1S2)
A1D4(A1S4)

#11

Trouble corrected — Yes / No
#12

Velocity Gain adjustment
#5
B ACC 800

Servo Checkout procedure
#13
A ACC 600

MICRO
B

Track Xing latch did not change state before the end of the Rezero operation.

#18
MICRO 12
Display
Microdiagnostic Error Message Byte 2 for Access Status received.

#19
Byte 2 = '0E' — No
#20 Yes

Replace Cards
A1E2(A1R2)
A1D2(A1S2)
A1C2(A1T2)

#21
Trouble corrected — No
#22 Yes

Velocity Gain adjustment
#23
B ACC 800

Servo Checkout procedure
#24
A ACC 630

Replace or Order
A1C2(A1T2)
A1C4(A1T4)
Power Amp P532(P542) (See LOC 4 or 14)
A1D2(A1S2)
A1D4(A1S4)
A1E2(A1R2)
If parts are not readily available, order them and continue below.

#25
Above cards replaced — Yes
#26 No

KE160(KR160)
Scope
Ch 1 A1E2(A1R2)P07 (—Track Xing)

#27
Insert the bobbin pushrod in the VCM and manually move the carriage across the disk while observing the scope.

#28
The signal pulses at MST-1 levels — Yes → 1
#29 No

Replace Cards
A1C2(A1T2)
A1D2(A1S2)
A1D4(A1S4)
A1E2(A1R2)

#30
Trouble corrected — Yes
#31 No

Servo Checkout procedure
#40
A ACC 600

Check
Test for an open VCM cable or an open voice coil:
1. Turn drive power off.
2. Remove connector P532(P542) from Power Amp. (See LOC 4 or 14.)
3. With CE meter, check for continuity (3 to 6 ohms) between: P532-1 and P532-2 (P542-1 and P542-2) See YA/YB060.
4. Check for loose VCM ribbon cable connection.

Repair ore replace parts as required. (See HDA 708 for voice coil replacement procedure or HDA 710 for HDA replacement procedure.)

#36

1

Replace Cards
A1C4(A1T4)
Power Amp P532(P542) (See LOC 4 or 14)
A1D2(A1S2)
A1E2(A1R2)

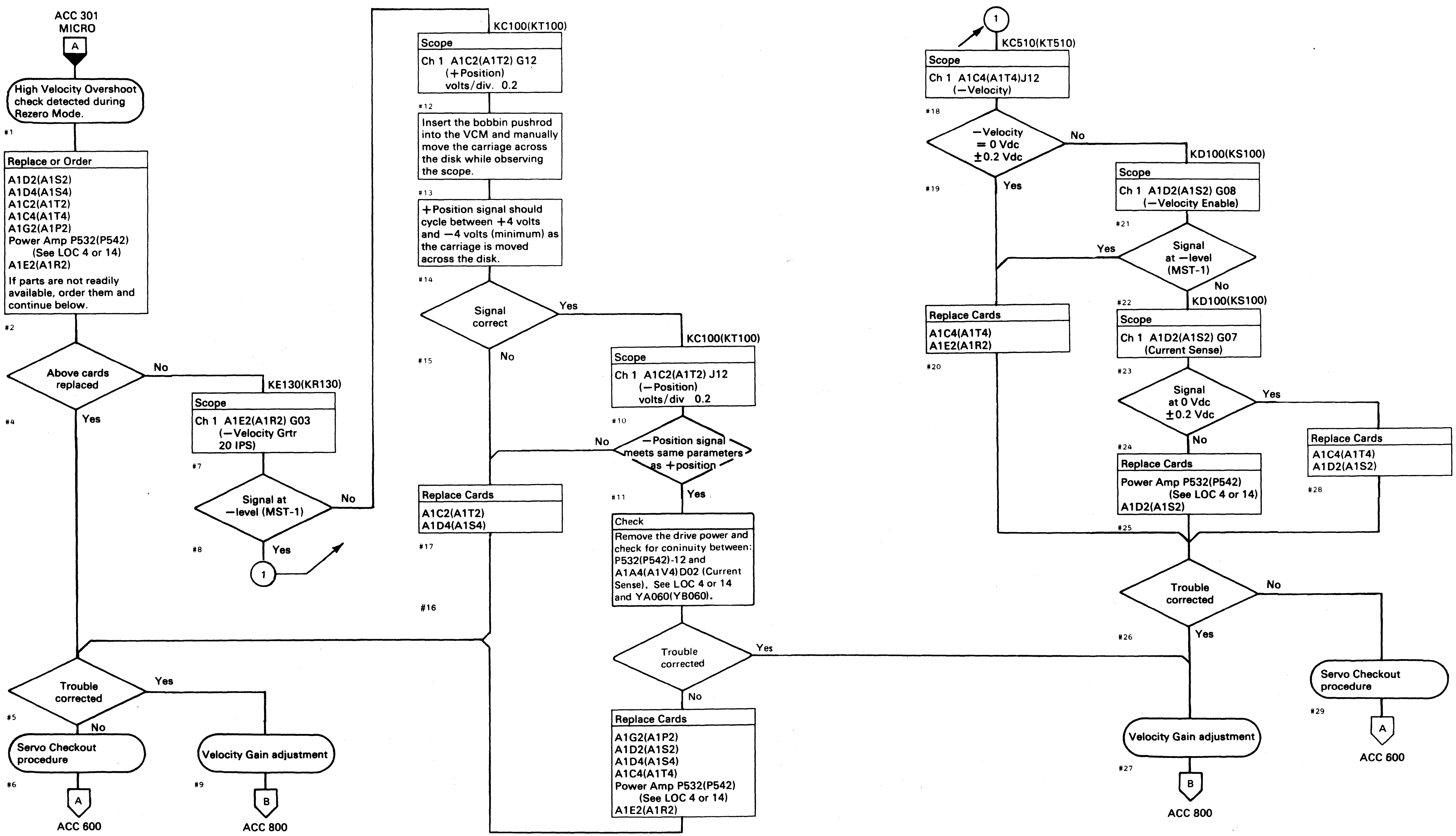
#34
Trouble corrected — Yes
No

KC500(KT500)
Check
Connector: A1A4(A1V4)D10 to P532 (P542) -9 (Power Amp Drive)

#39
Trouble corrected — No
#35 Yes

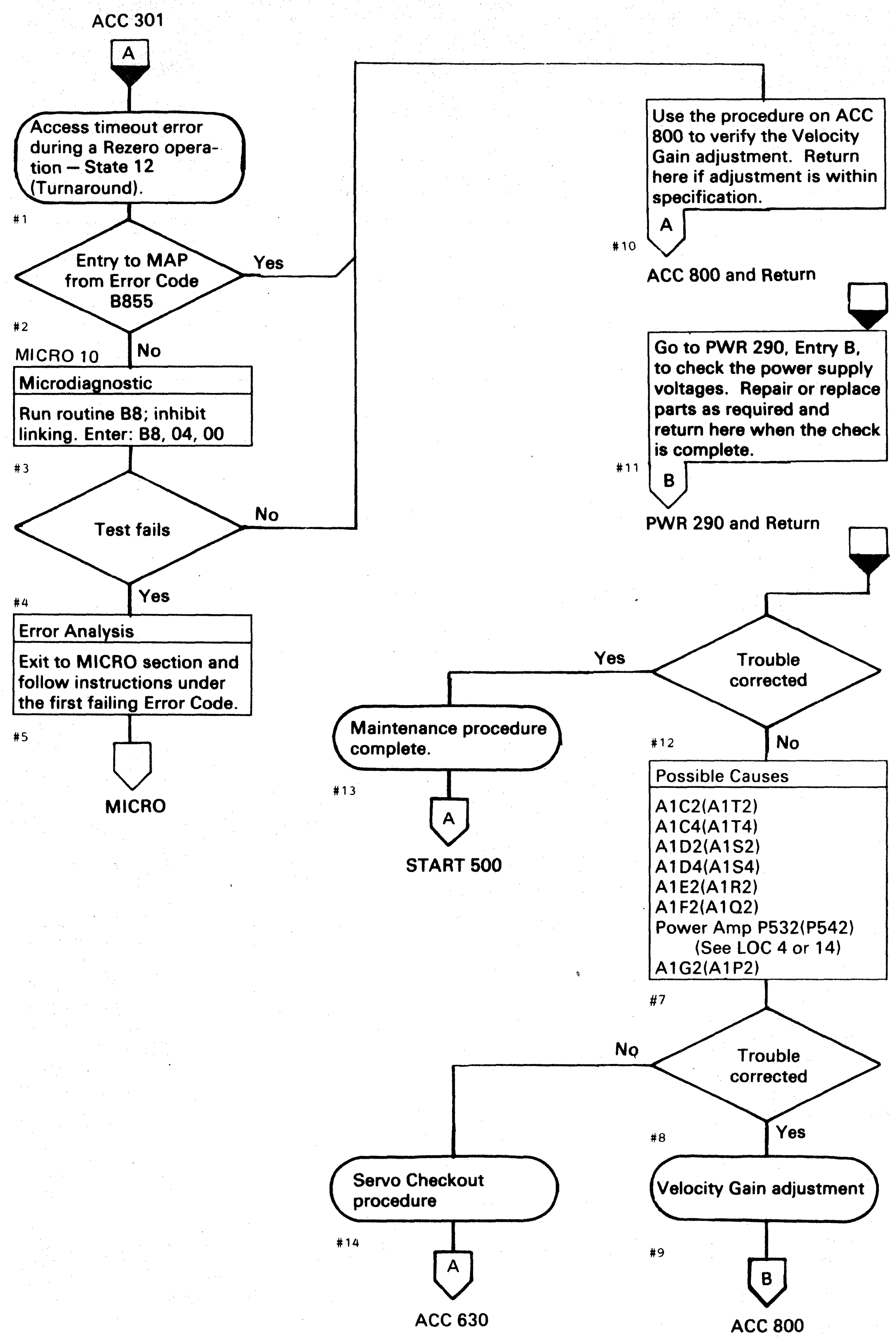
Velocity Gain adjustment
#32
B ACC 800

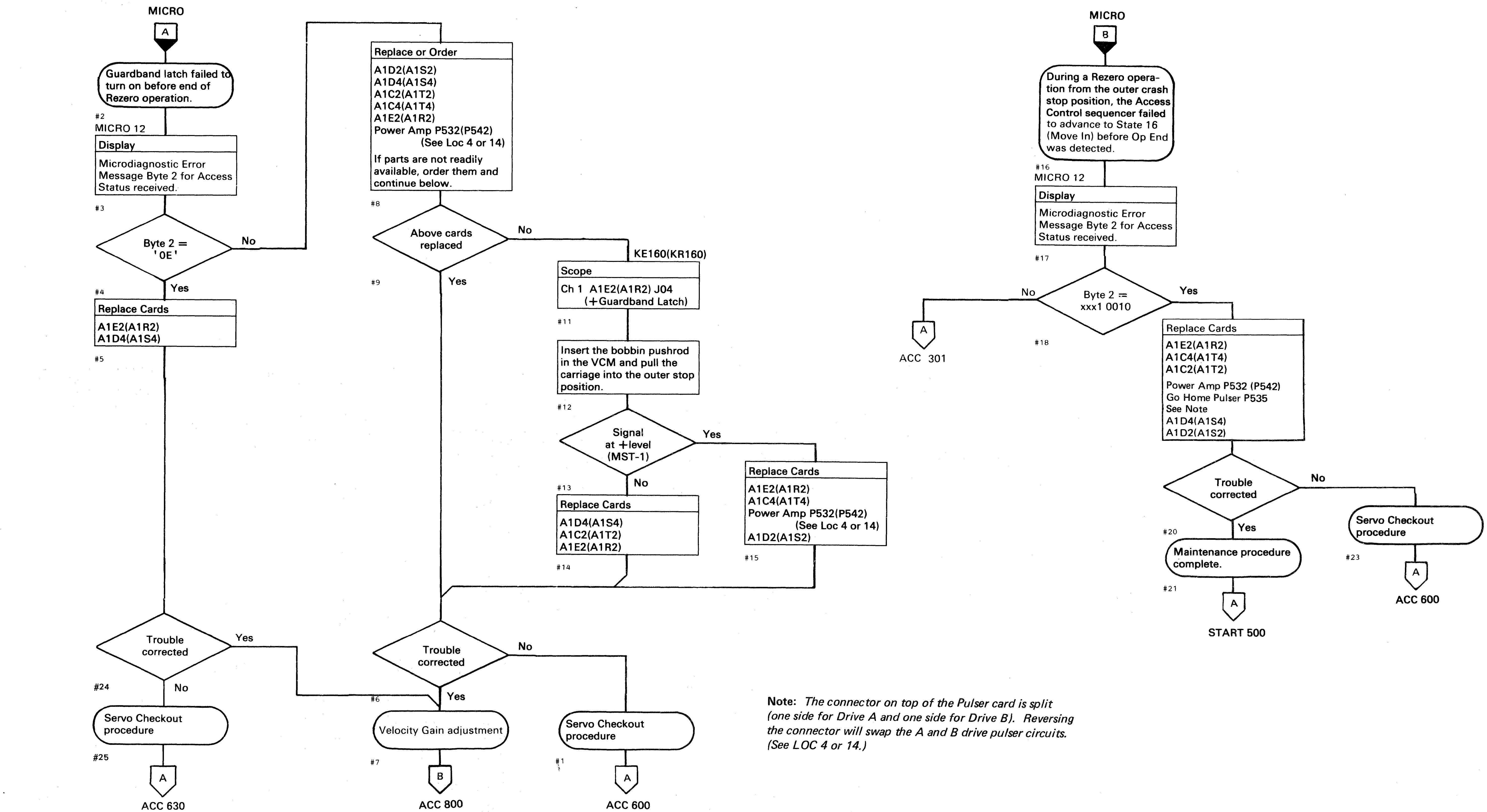
ACCESS STATE 10 – CARRIAGE MOVEMENT



3350	DG0334 Seq. 1 of 2	2358118 Part No.	441300 31 Mar 76	441303 30 Jul 76			

ACCESS STATE 12 – TURNAROUND

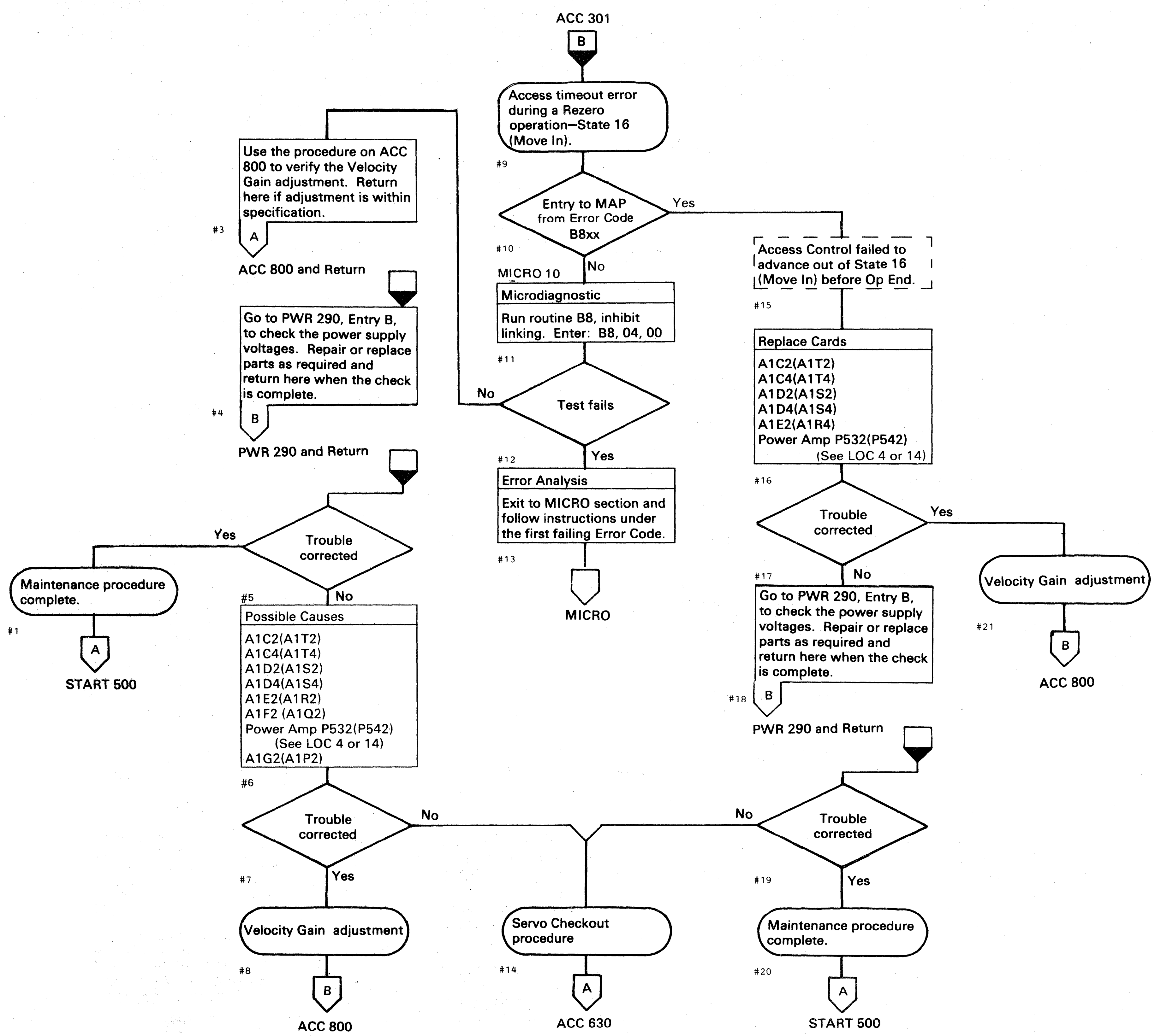




Note: *The connector on top of the Pulser card is split (one side for Drive A and one side for Drive B). Reversing the connector will swap the A and B drive pulser circuits. (See LOC 4 or 14.)*

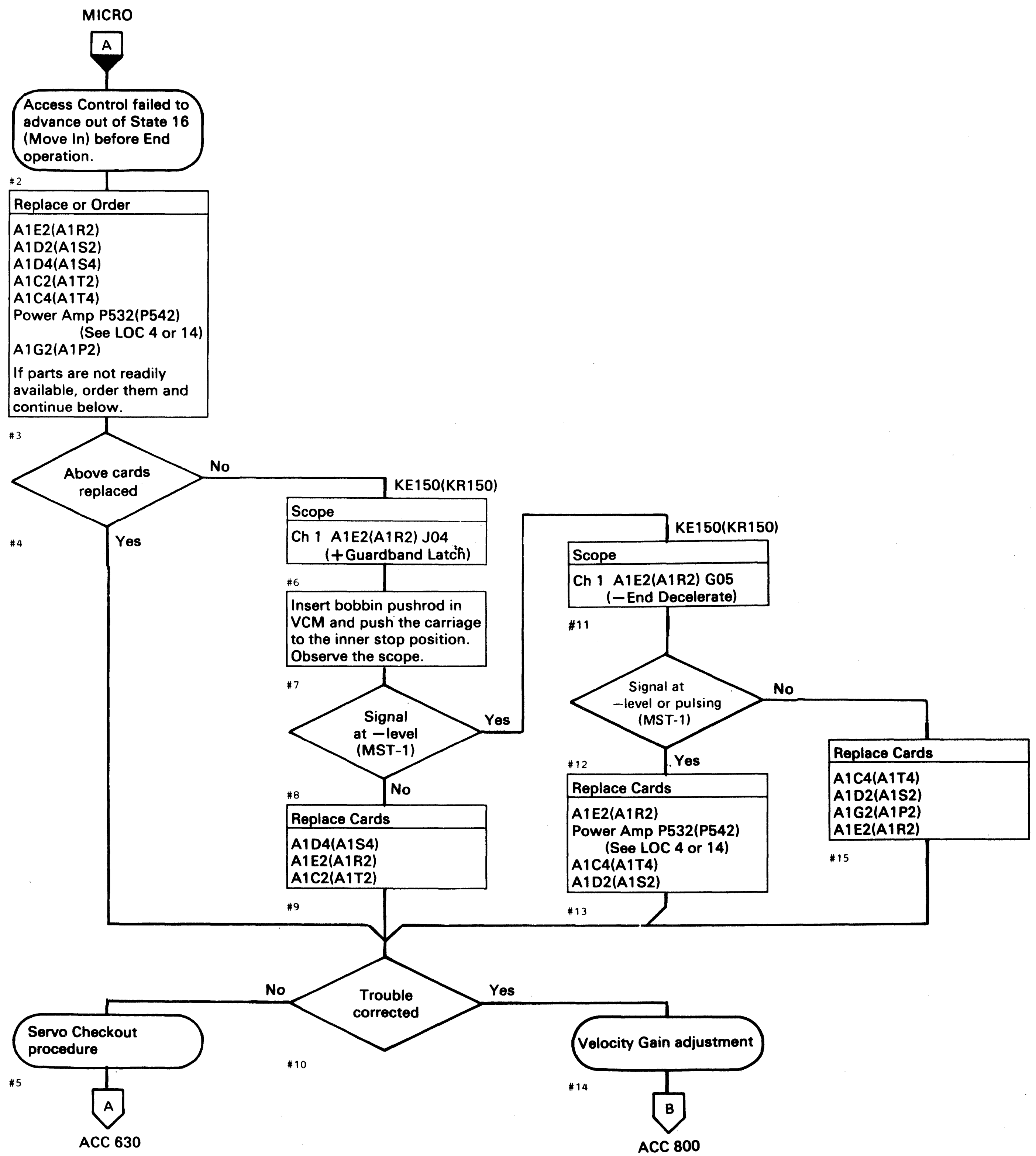
DG0344 Seq. 1 of 2	2358119 Part No.

441300 31 Mar 76	441303 30 Jul 76	441308 18 Aug 78		



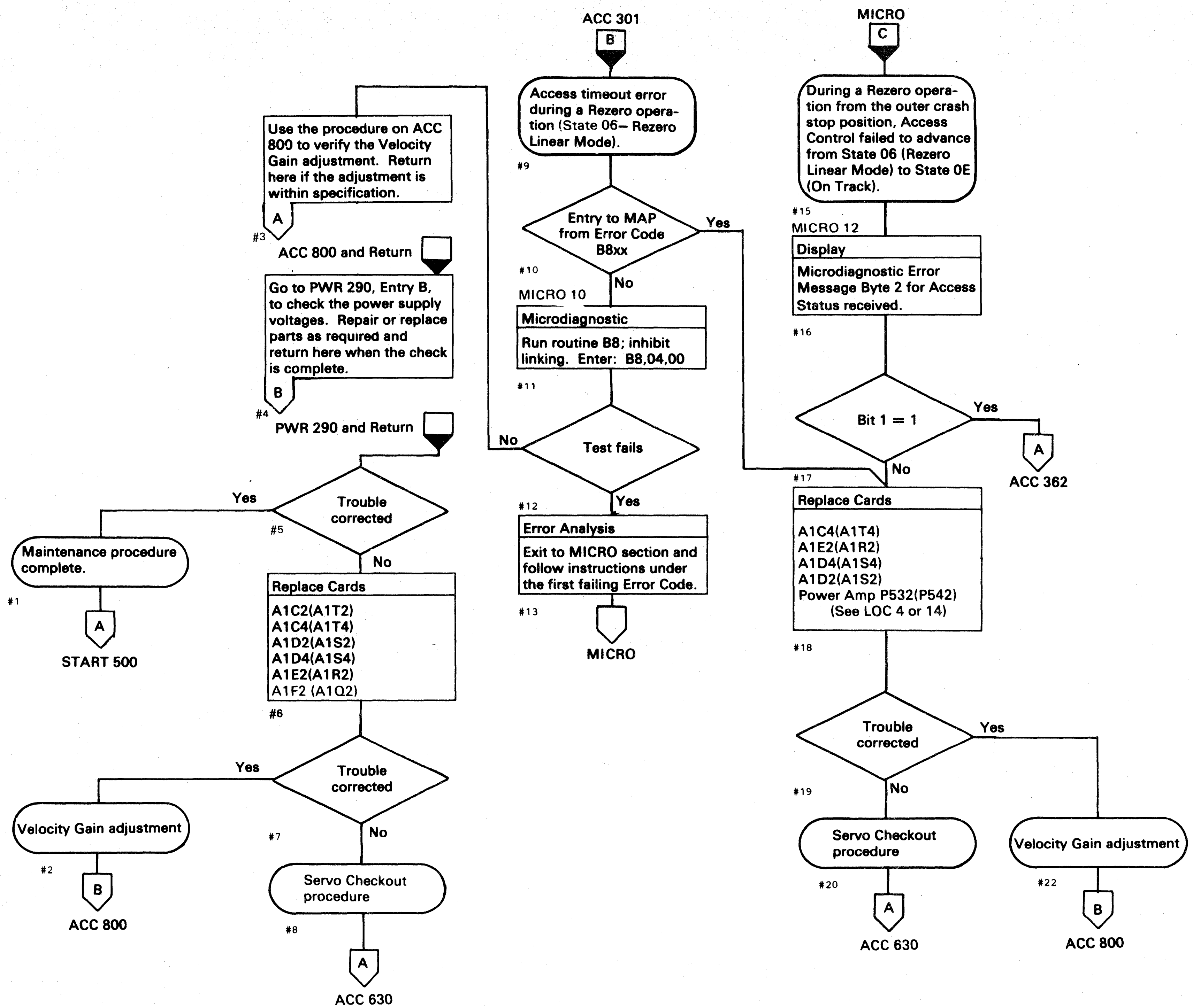
DG0344 Seq. 2 of 2	2358119 Part No.	441300 31 Mar 76	441303 30 Jul 76	441308 18 Aug 78		

ACCESS STATE 16 – MOVE IN

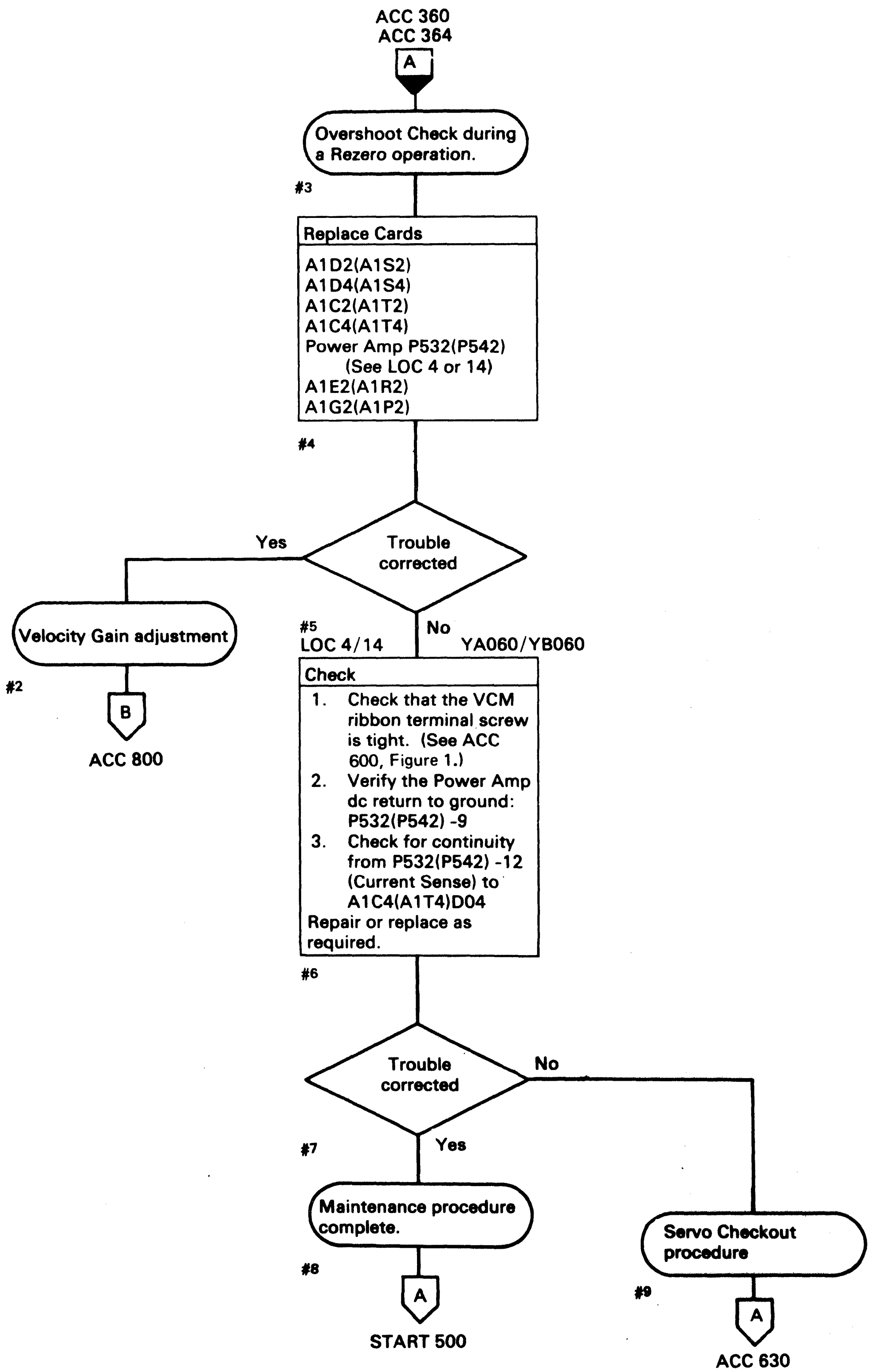


3350	DG0352 Seq. 1 of 2	2358120 Part No.	441300 31 Mar 76	441303 30 Jul 76			

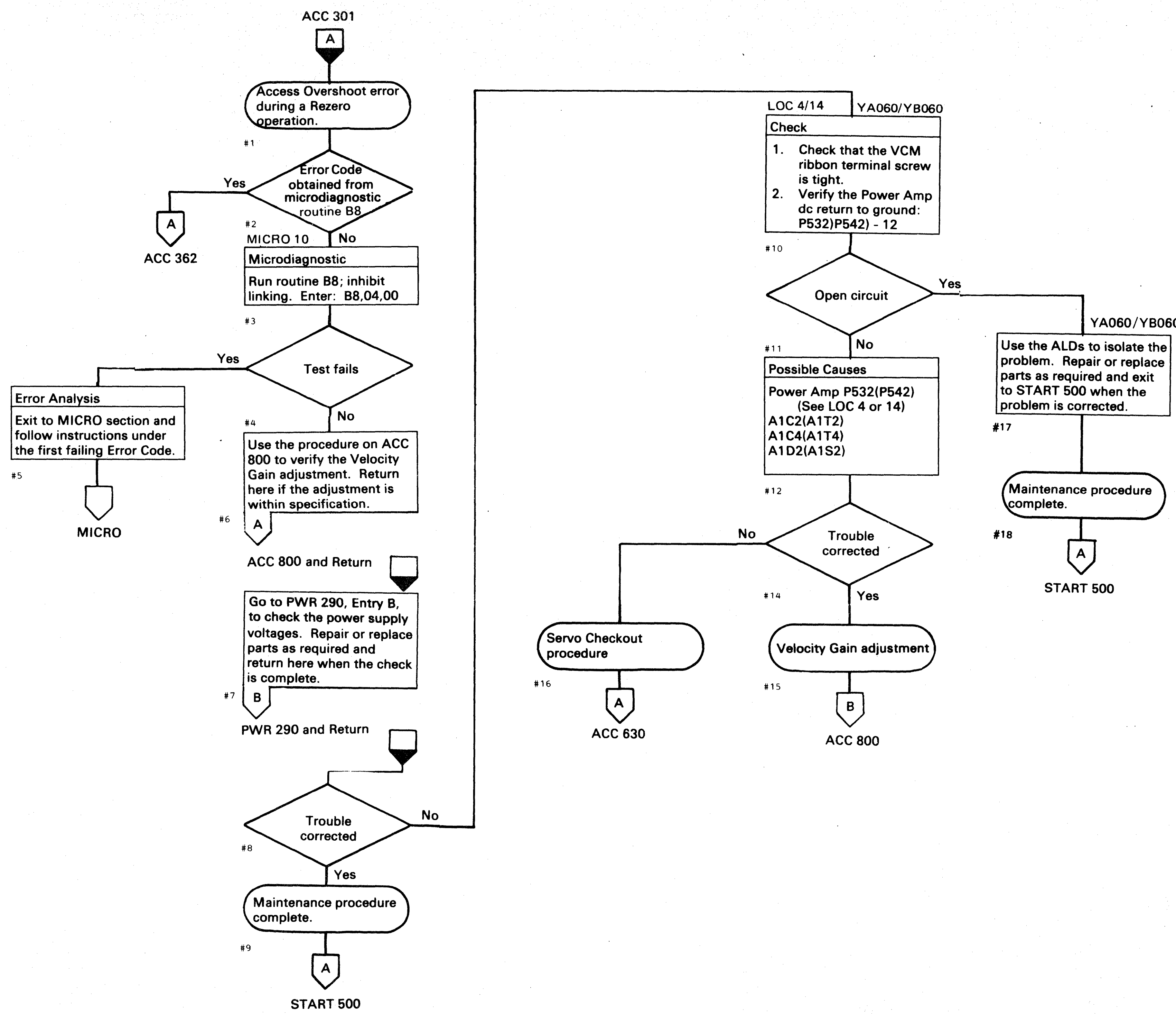
ACCESS STATE 06 – REZERO LINEAR MODE



ACCESS STATE 06 – REZERO LINEAR MODE



ACCESS STATE 06 – REZERO LINEAR MODE



3350	DG0362 Seq. 2 of 2	2358121 Part No.	441300 31 Mar 76	441303 30 Jul 76			

ACCESS STATE 06 – REZERO LINEAR MODE

See OPER 123 for additional theory.

MICRO ACC 301 (A)

#4 Track Following Timer duration is out of spec.

#5 Replace Cards
A1E2(A1R2)
A1C4(A1T4)
A1C2(A1T2)
A1D4(A1S4)

#6 Trouble corrected — Yes: #2 Velocity Gain adjustment → ACC 800 (B); No: #7

#7 Go to PWR 290, Entry B, to check the power supply voltages. Repair or replace parts as required and return here when the check is complete.
(B) PWR 290 and Return

#8 Trouble corrected — Yes: #3 Maintenance procedure complete. → START 500 (A); No: #20

LOC 4/14
#20 Scope
Sweep 2 ms/div
Trigger INT
Slope (+)
Ch 1 only
Ch 1 P535-3(8)
Go Home A(B)
volts/div 0.5
probe x 10

#21 Signal level 0 V ± 2.5 V P-P — Yes: #9; No: #22

#22 Check
P535-10(1) for — 12 Vdc.

#23 — 12 Vdc to — 14.4 Vdc — Yes: #25; No: #24

#24 Use ALDs YA060 or YB060 to isolate the trouble. Repair or replace as required.

#25 Replace
Go Home Pulser P535

#26 Trouble corrected — Yes: #27; No: (1)

#27 Maintenance procedure complete. → START 500 (A)

(1)
MICRO 10
#9 Microdiagnostic
Loop failing test and bypass errors:
1. Load routine
2. Enter 10,XX,01,00 (XX = test number from the Error Code.)

#17 Servo out of control (Noisy) — Yes: #18; No: #10

#10 Scope
Sweep 0.5 ms/div
Trigger
Slope (+)
Ch 1 only
Ch 1 A1C4(A1T4)G05 (A)
+ Linear Mode
volts/div 0.1
probe x 10

#18 Stop the microprogram to prevent damage.

#19 Servo Checkout procedure → ACC 600 (A)

#11 Signal goes to +level (MST-1) (with program loop) — Yes: #12; No: #16

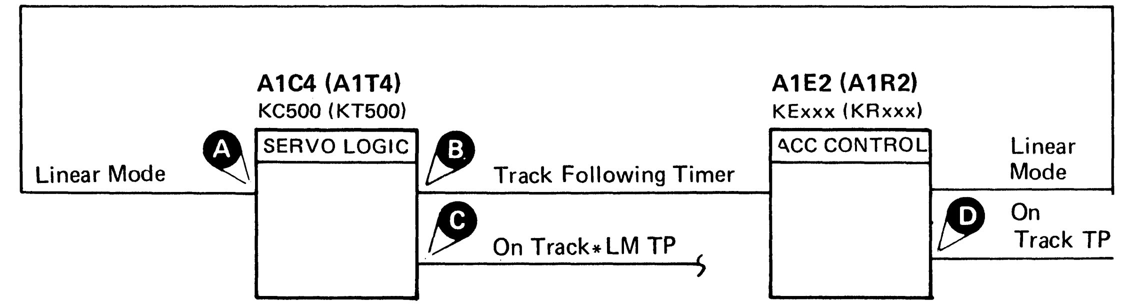
#12 Scope
Sweep 0.5 ms/div
Trigger EXT
Slope (+)
A1C4(A1T4)G05 (A)
+ Linear Mode
Ch 1 A1C4(A1T4)B13 (B)
+ Track Following Timer
volts/div 0.1
probe x 10
Ch 2 A1C4(A1T4)D13 (C)
—On Track*LM TP
volts/div 0.1
probe x 10

#13 Use the diagram to isolate the problem. Check for the following conditions:
1. —On Track*LM TP (C) goes to a —level (MST-1) during Linear Mode (A).
2. +Track Following Timer (B) goes to a +level (MST-1) between 4.5 ms and 5.3 ms after —On Track*LM TP, to set +On Track TP (D) to a +level (MST-1). (Note: —On Track*LM TP must stay minus during this period.)
Repair or replace parts as required.

#14 Trouble corrected — Yes: #15; No: #16

#15 Velocity Gain adjustment → ACC 800 (B)

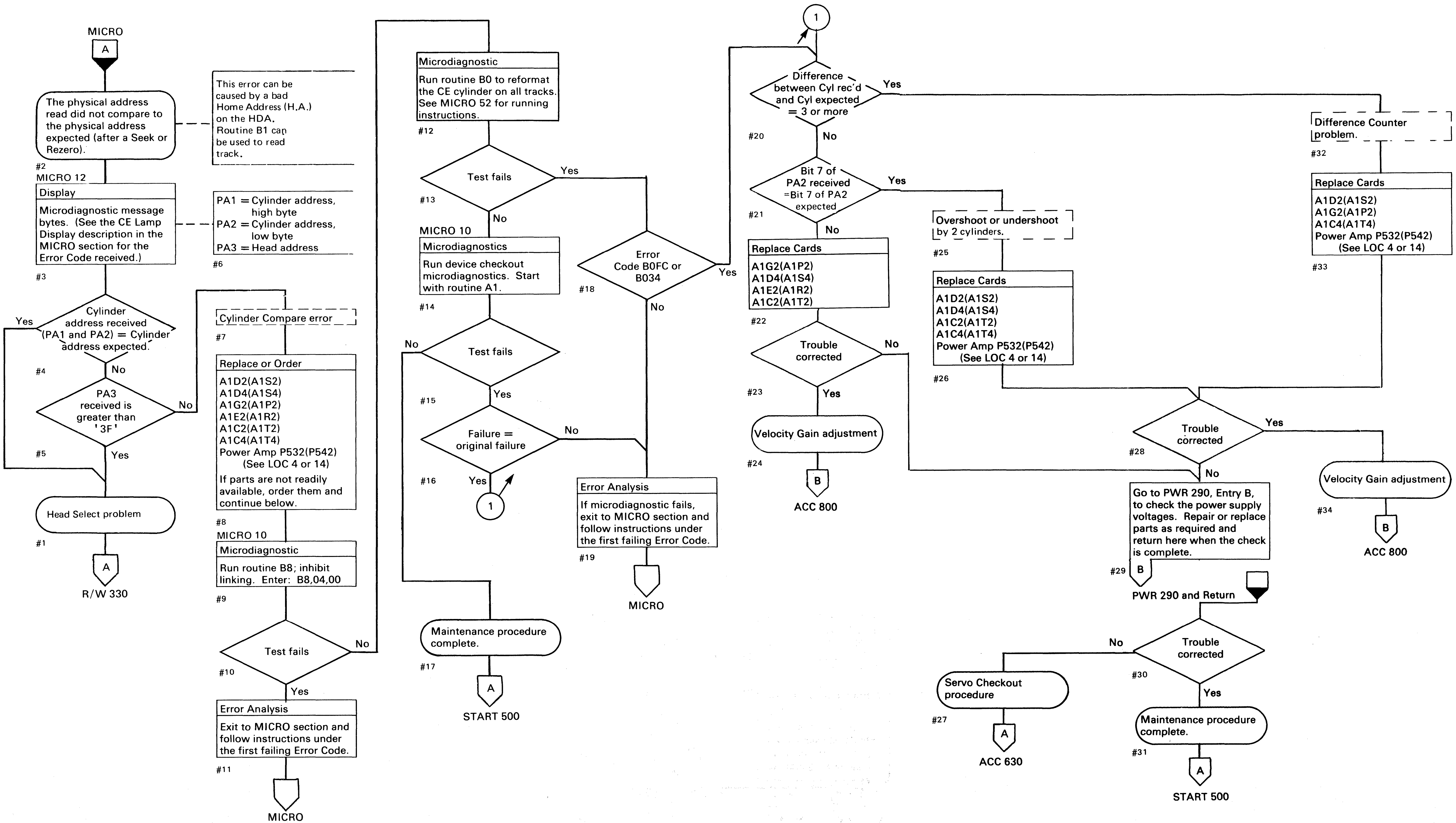
#16 Servo Checkout procedure → ACC 630 (A)



Line Name	ALD	Test Point	
+Linear Mode	KC500 (KT500)	A1C4 (A1T4) G05	A
+Track Following Timer	KC500 (KT500)	A1C4 (A1T4) B13	B
—On Track*LM TP	KC500 (KT500)	A1C4 (A1T4) D13	C
+On Track TP	KE120 (KR120)	A1E2 (A1R2) B10	D

DG0366 Seq. 1 of 1	2358122 Part No.	441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441310 27 Jun 80	

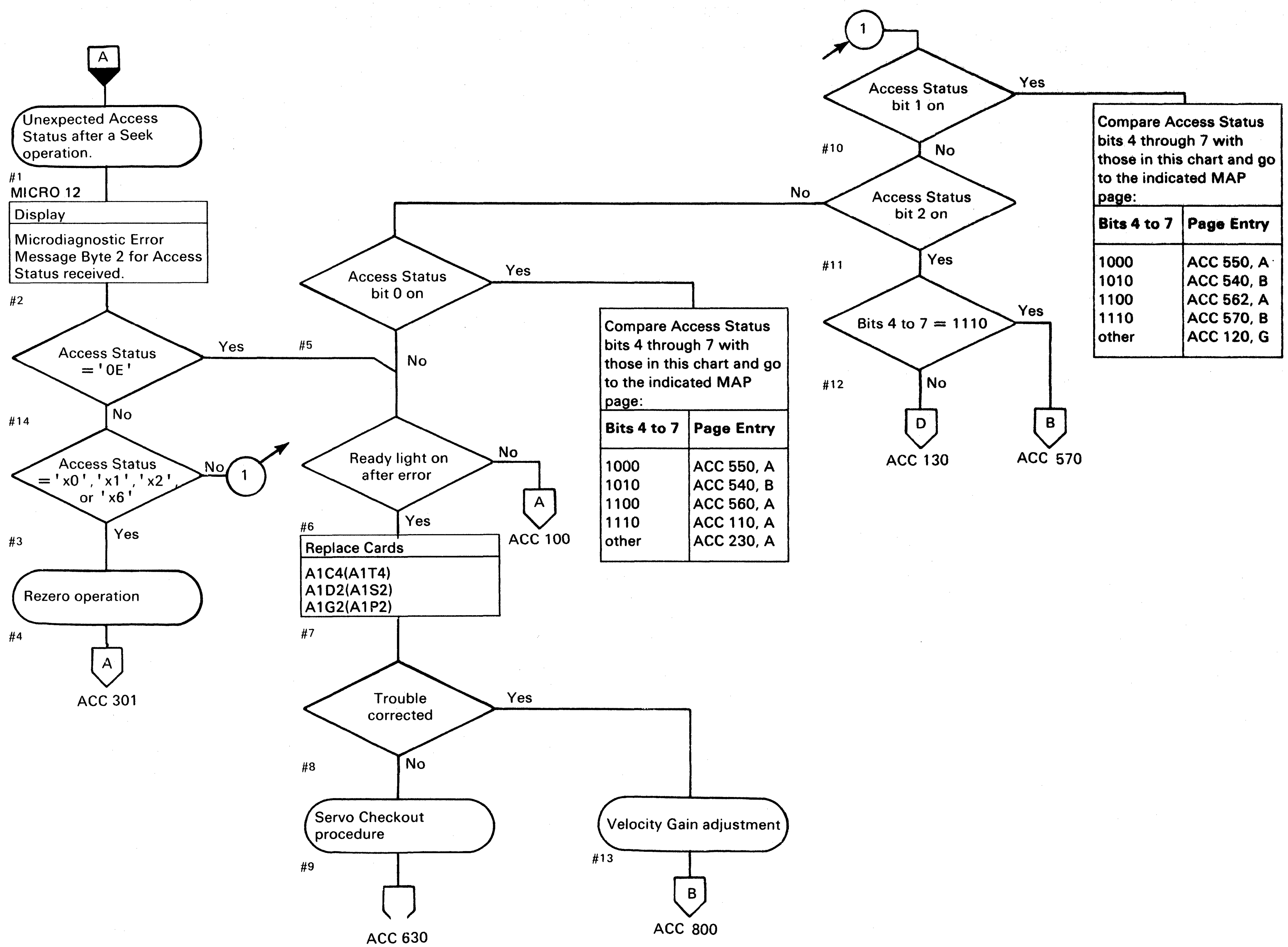
SEEK – VERIFICATION CHECK



DG0501 Seq. 1 of 2	2358123 Part No.

441300 31 Mar 76	441303 30 Jul 76	441310 27 Jun 80		

SEEK – INITIAL ANALYSIS



Compare Access Status bits 4 through 7 with those in this chart and go to the indicated MAP page:

Bits 4 to 7	Page Entry
1000	ACC 550, A
1010	ACC 540, B
1100	ACC 560, A
1110	ACC 110, A
other	ACC 230, A

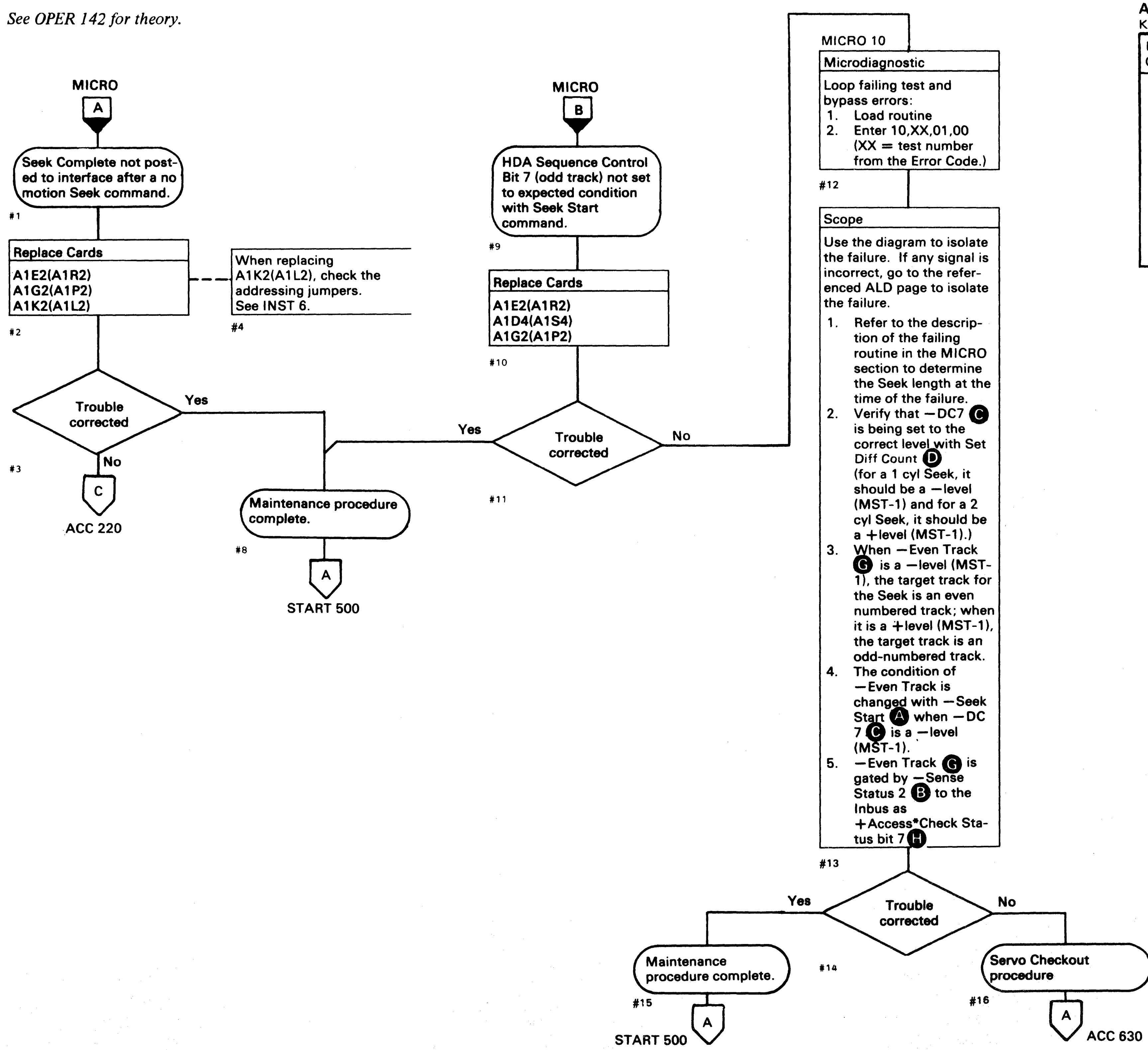
Compare Access Status bits 4 through 7 with those in this chart and go to the indicated MAP page:

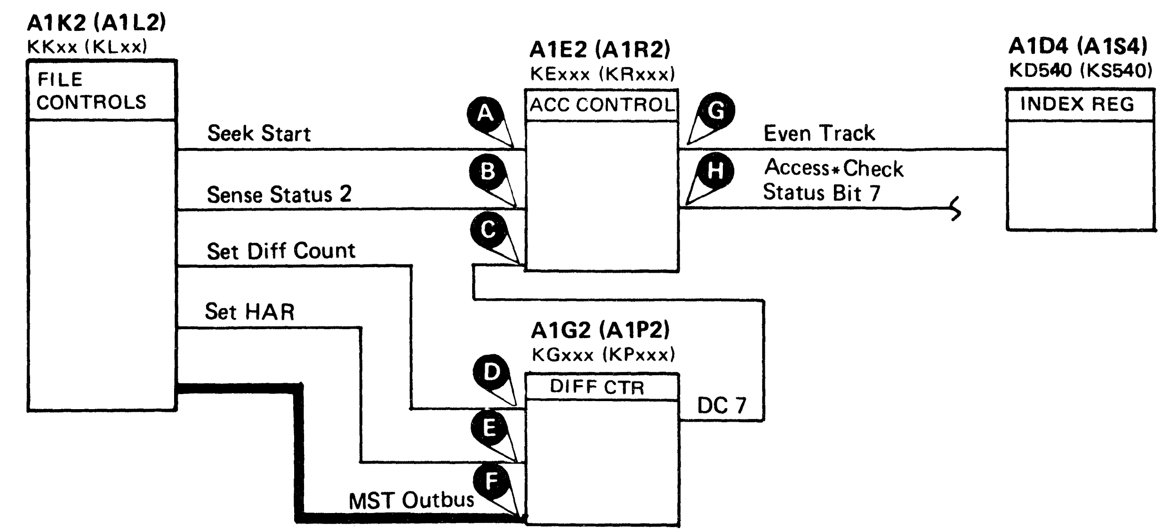
Bits 4 to 7	Page Entry
1000	ACC 550, A
1010	ACC 540, B
1100	ACC 562, A
1110	ACC 570, B
other	ACC 120, G

DG0501 Seq. 2 of 2	2358123 Part No.	441300 31 Mar 76	441303 30 Jul 76	441310 27 Jun 80		

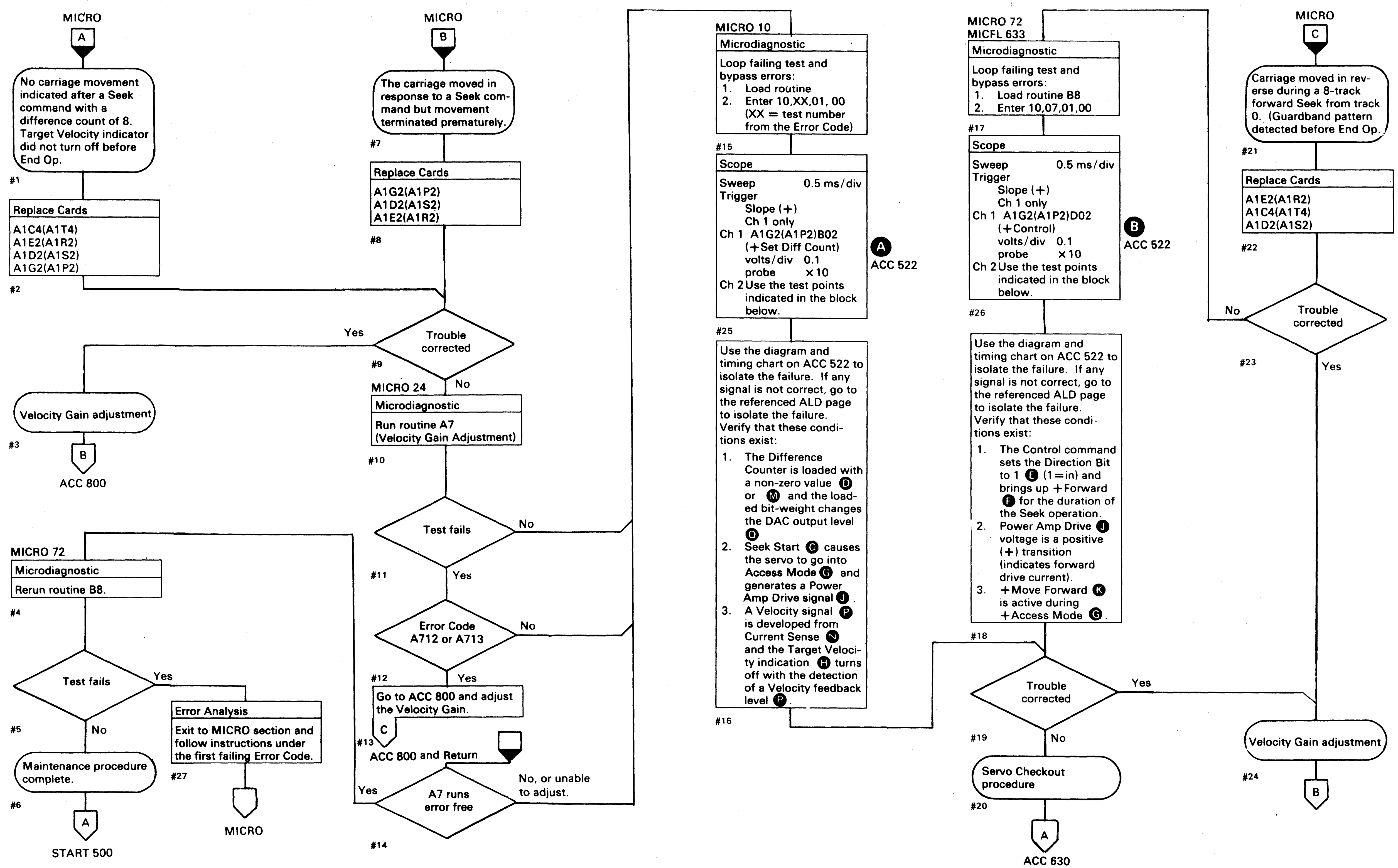
SEEK – START SELECTION AND MOVEMENT

See OPER 142 for theory.



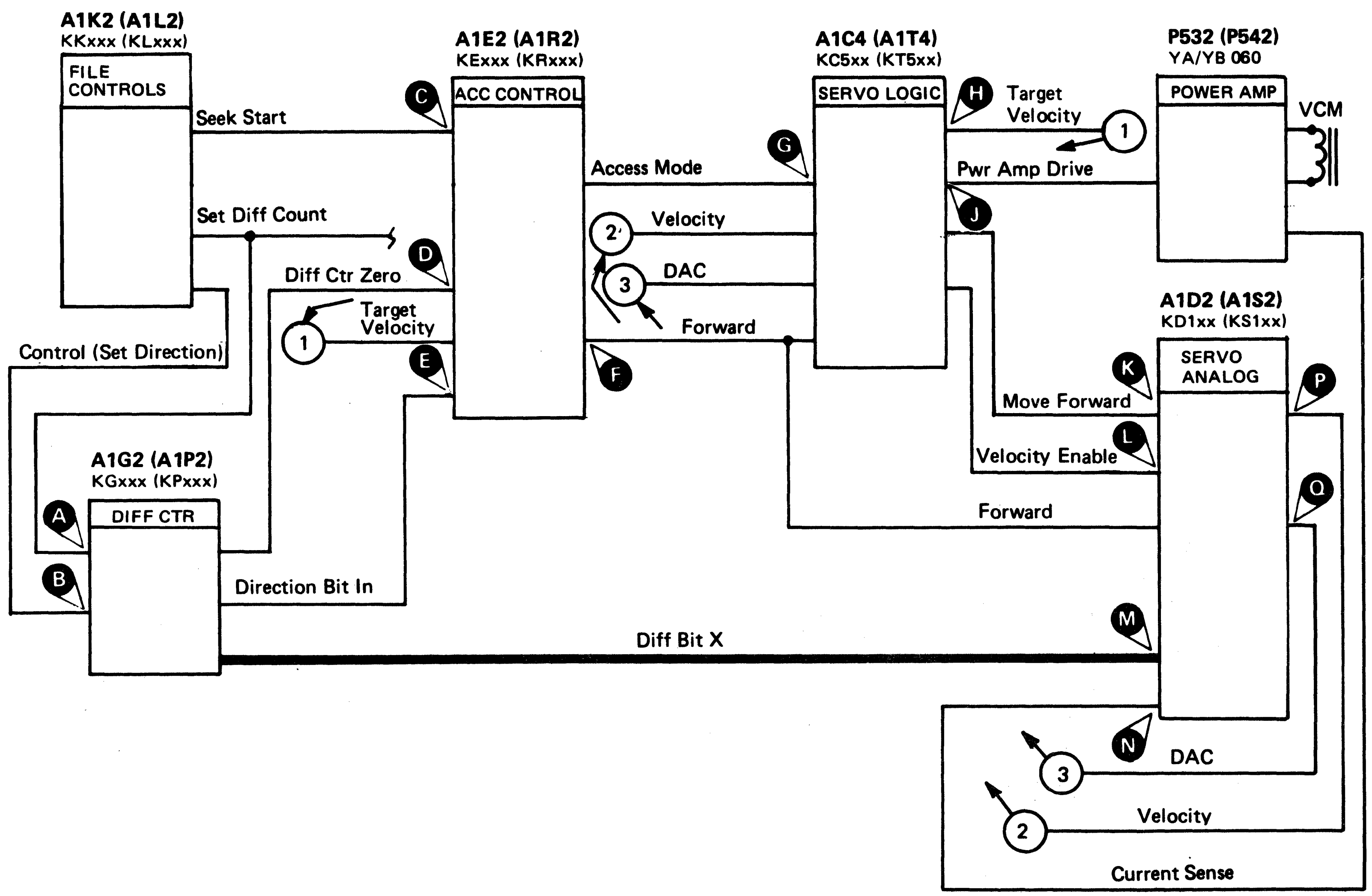


Line Name	ALD	Test Point	
–Seek Start	KE100 (KR100)	A1E2 (A1R2) D05	A
–Sense Status 2	KE160 (KR160)	A1E2 (A1R2) S08	B
–DC 7	KE150 (KR150)	A1E2 (A1R2) B04	C
+Set Diff Count	KG150 (KP150)	A1G2 (A1P2) B02	D
+Set HAR	KG150 (KP150)	A1G2 (A1P2) B04	E
–MST Outbus Bit 0	KG100 (KP100)	A1G2 (A1P2) D11	F
–MST Outbus Bit 1	KG100 (KP100)	A1G2 (A1P2) B09	F
–MST Outbus Bit 2	KG100 (KP100)	A1G2 (A1P2) J06	F
–MST Outbus Bit 3	KG100 (KP100)	A1G2 (A1P2) D09	F
–MST Outbus Bit 4	KG100 (KP100)	A1G2 (A1P2) D12	F
–MST Outbus Bit 5	KG100 (KP100)	A1G2 (A1P2) B07	F
–MST Outbus Bit 6	KG100 (KP100)	A1G2 (A1P2) D13	F
–MST Outbus Bit 7	KG100 (KP100)	A1G2 (A1P2) B13	F
–Even Track	KE150 (KR150)	A1E2 (A1R2) B13	G
+Access*Check Status Bit 7	KE160 (KR160)	A1E2 (A1R2) M13	H



DG0520 Seq. 2 of 2	2358124 Part No.	441300 31 Mar 76	441303 30 Jul 76			

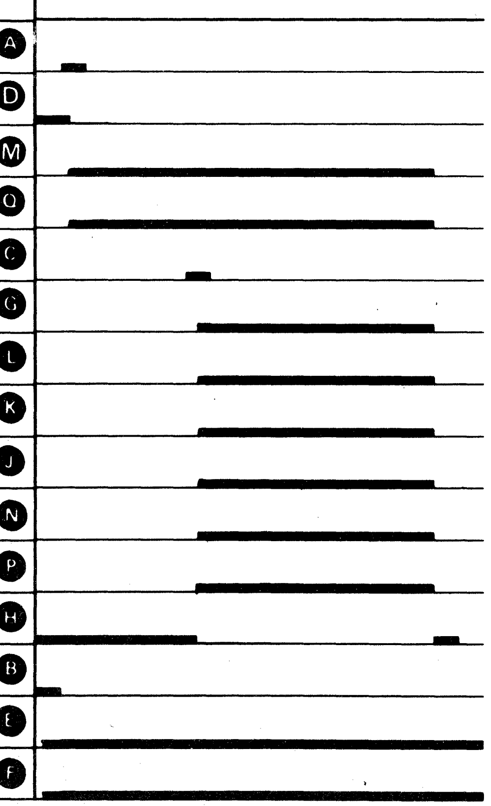
SEEK START – SELECTION AND MOVEMENT



Notes:

1. *See ACC 640 and ACC 641 for an alternate Servo Selection checkout procedure.*
2. *See ACC 648 and ACC 649 for sample Seek operation timing photographs.*
3. *–Level = –0.4 Vdc*
   +Level = +0.6 Vdc

Chart Line No.	Line Name	ALD	Test Point	
1	+Set Diff Count	KG150 (KP150)	A1G2 (A1P2) B02	A
2	+Diff Ctr Zero	KE110 (KR110)	A1E2 (A1R2) J05	D
3	–Diff Bit X (x=1-7) (See Note 3.)	KD100 (KS100)	(See ALD page) *	M
4	+DAC (See ACC 648, Figure 16A)	KD100 (KS100)	A1D2 (A1S2) B03 *	Q
5	–Seek Start	KE100 (KR100)	A1E2 (A1R2) D05	C
6	+Access Mode (See ACC 648, Figure 15A)	KC500 (KT500)	A1C4 (A1T4) B02	G
7	–Velocity Enable	KD100 (KS100)	A1D2 (A1S2) G08	L
8	+Move Forward	KD100 (KS100)	A1D2 (A1S2) J12	K
9	+Pwr Amp Drive (See ACC 648, Figure 17A)	KC500 (KT500)	A1C4 (A1T4) J09 *	J
10	Current Sense (See ACC 648, Figure 17A)	KD100 (KS100)	A1D2 (A1S2) G07 *	N
11	–Velocity (See ACC 648, Figure 16A)	KD100 (KS100)	A1D2 (A1S2) B02 *	P
12	–Target Velocity	KC510 (KT510)	A1C4 (A1T4) G10	H
13	+Control (Set Direction)	KG190 (KP190)	A1G2 (A1P2) D02	B
14	–Direction Bit In	KE100 (KR100)	A1E2 (A1R2) D06	E
15	+Forward	KE100 (KR100)	A1E2 (A1R2) D04	F



*Analog Or Current Switch Voltage Levels.

SEEK – DIFFERENCE COUNTER CONTROL

MICRO

A

Difference Counter value received did not compare with the value expected

#6

Replace or Order

A1E2(A1R2)
A1G2(A1P2)
A1D2(A1S2)
A1C2(A1T2)
If parts are not readily available, order them and continue below.

#7

Trouble corrected

#8

Yes: Velocity Gain adjustment

#9

B ACC 800

No:

MICRO 12

Display

Microdiagnostic Message Bytes 2, 3, and 4 for the Received, Expected, and Original Diff Cntr values. See MICRO 12 for instructions.

#2

Subtract expected value from original value

#3

Difference equals 1

#4

No:

Replace Cards

A1G2(A1P2)
A1D2(A1S2)
A1C2(A1T2)

#10

Yes:

Replace Cards

A1G2(A1P2)
A1E2(A1R2)
A1D2(A1S2)

#5

Trouble corrected

#11

Yes: Velocity Gain adjustment

#12

B ACC 800

No:

Check

Go to ACC 609 and perform the Static Servo checks in steps 10 through 13. Return here if the problem is not corrected.

#16

ACC 609 and Return

Microdiagnostic

Loop failing test and bypass errors:

1. Load routine
2. Enter 10,XX,01,00, (another 00 if routine B9) (XX = test number from the Error Code.)

#17

Caution

If the Servo is out of control (noisy), with the program looping, stop the program (by entering 00) to prevent mechanical damage. Proceed only if all the specified cards have been replaced.

#20

Scope

Sweep 2 ms/div
Trigger
Slope (–)
Ch 1 only
Ch 1 A1K2(A1L2)M12 (–Seek Start)
volts/div 0.1
probe ×10
Ch 2 Use the test points indicated in the Check block below.

#18

C ACC 531

Check

Use the diagram on ACC 531 to isolate the failure. If any signal is not correct, go to the referenced ALD page to isolate the failure.

1. +Allow Diff Ctr F should go to a +level (MST-1).
2. +Track Xing Pulse H should pulse at MST-1 levels.
3. –Dec Diff TP L should pulse at MST-1 levels.
4. Use the Microdiagnostic Error Message Bytes to determine what difference counter bit caused the failure. Verify that the HAR*Diff Ctr Status X values, KG180(KP180), decrement correctly during each –Gate Senses G pulse.

#19

Trouble corrected

#13

Yes: Velocity Gain adjustment

#15

B ACC 800

No: Servo Checkout procedure

#14

A ACC 630

3350	DG0522 Seq. 2 of 2	2358125 Part No.	441300 31 Mar 76				

SEEK – DIFFERENCE COUNTER CONTROL

TRACK CROSSING LATCH

The Track Crossing Latch line (E) is set on with entry into a Fine On Track region and reset by the carriage leaving a Coarse On Track region. (See ACC 609, Step 11 – Track Detection Circuits.)

TRACK CROSSING SINGLE SHOT

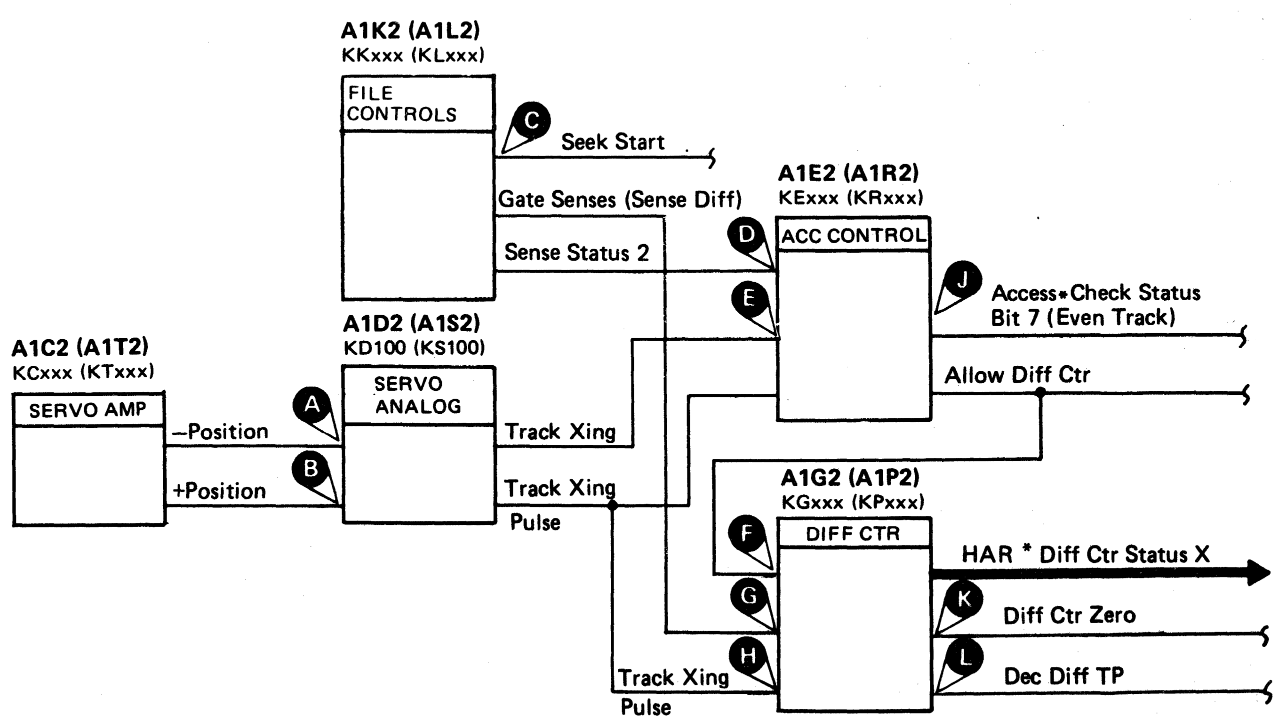
A 3.2 μs ±20% Track Crossing Pulse (H) occurs every time the Crossing Latch is set on with the Servo in either Access Mode or Linear Mode.

DIFFERENCE COUNTER DECREMENT

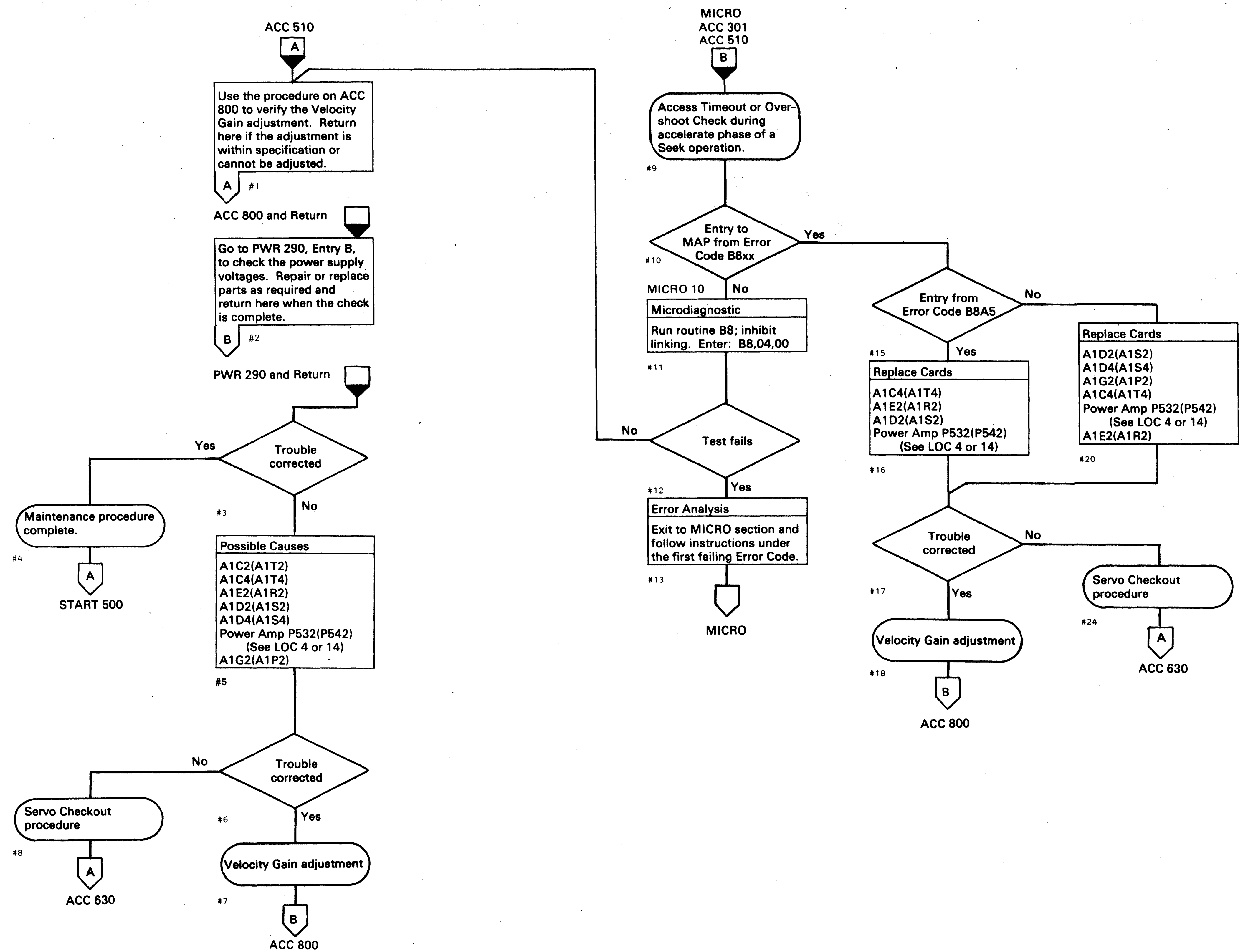
Track Crossing pulses are gated into the Difference Counter by +Allow Diff Ctr (F) and by a −level (MST-1) at +Diff Ctr Zero (K).

During a Seek operation, the Difference Counter is decremented (L) by one every time the Servo head crosses over a track.

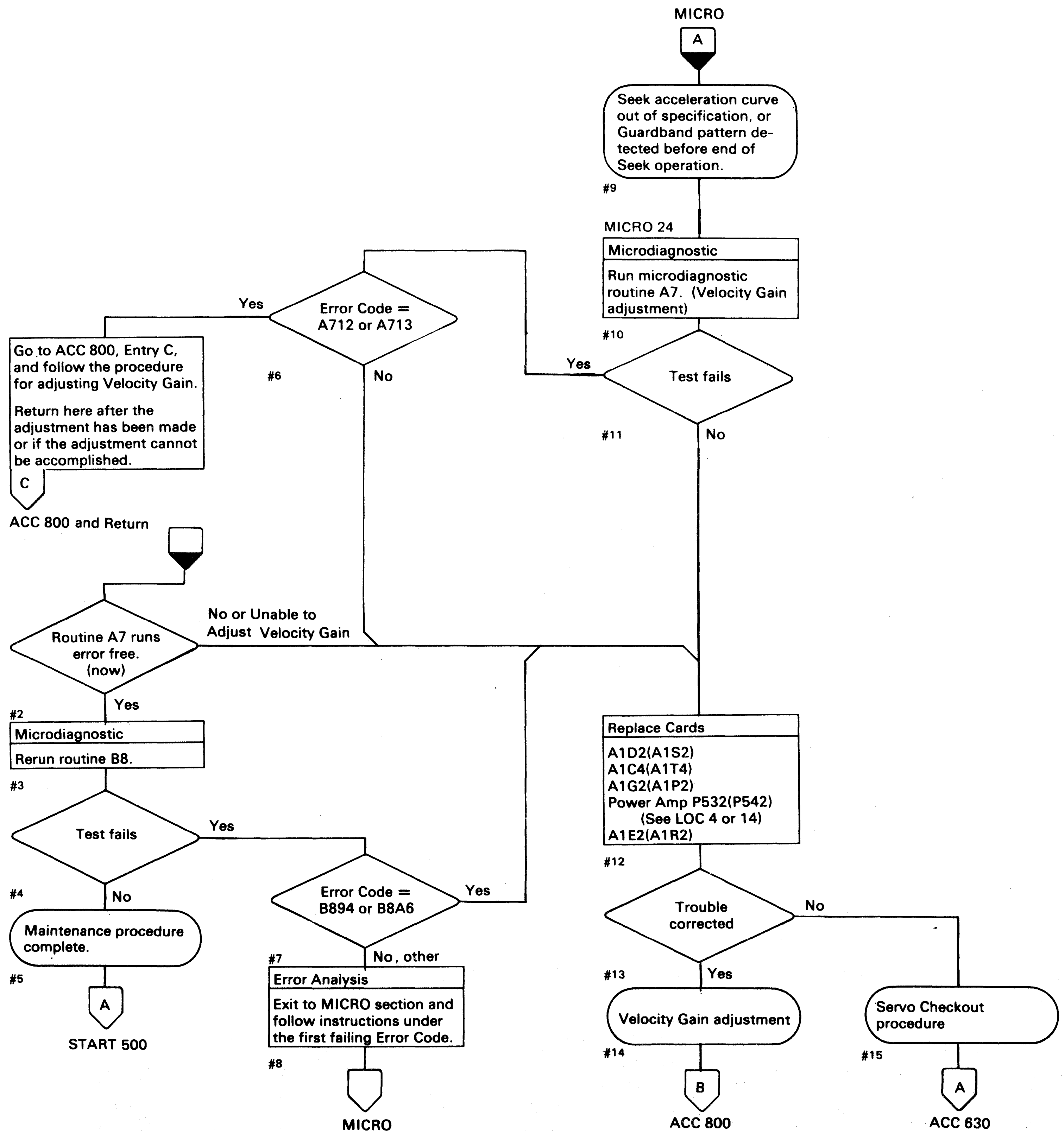
See OPER 139 for additional theory.



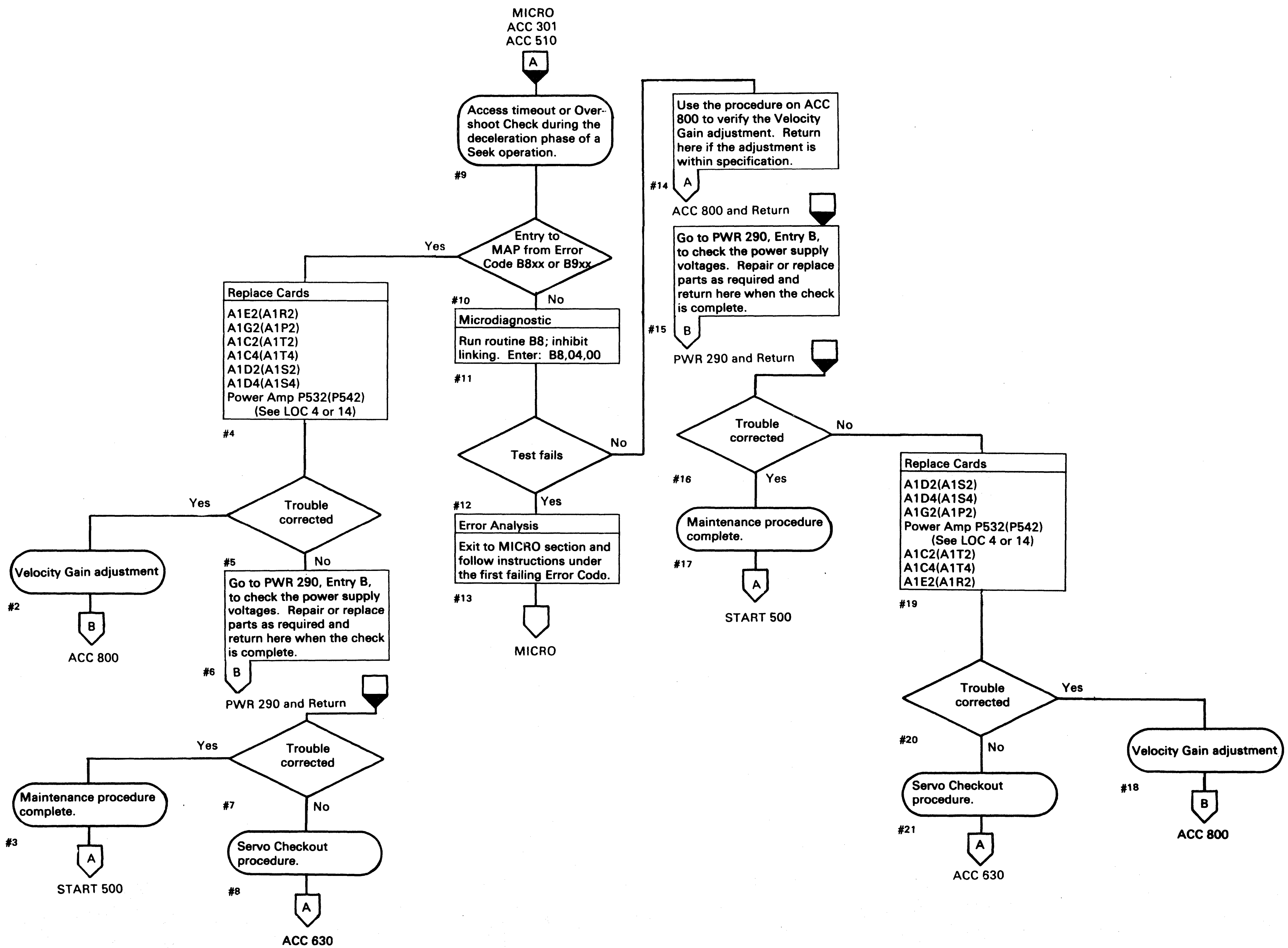
Line Name	ALD	Test Point	
−Position (See ACC 609, Steps 10 & 11)	KD100 (KS100)	A1D2 (A1S2) G13	A
+Position (See ACC 649, Fig. 18)	KD100 (KS100)	A1D2 (A1S2) J13	B
−Seek Start	KK170 (KL170)	A1K2 (A1L2) M12	C
−Sense Status 2	KE160 (KR160)	A1E2 (A1R2) S08	D
−Track Xing (See ACC 649,Fig. 18)	KE160 (KR160)	A1E2 (A1R2) P07	E
+Allow Diff. Ctr	KG150 (KP150)	A1G2 (A1P2) D03	F
−Gate Senses (Sense Diff)	KG190 (KP190)	A1G2 (A1P2) P11	G
+Track Xing Pulse	KG150 (KP150)	A1G2 (A1P2) U02	H
+Access*Check Status Bit 7 (Even Track)	KE160 (KR160)	A1E2 (A1R2) M13	J
+Diff Ctr Zero	KG100 (KP100)	A1G2 (A1P2) J02	K
−Dec Diff TP	KG100 (KP100)	A1G2 (A1P2) G02	L


ACC 510
A
Use the procedure on ACC 800 to verify the Velocity Gain adjustment. Return here if the adjustment is within specification or cannot be adjusted.
A
#1
ACC 800 and Return
Go to PWR 290, Entry B, to check the power supply voltages. Repair or replace parts as required and return here when the check is complete.
B
#2
PWR 290 and Return
Trouble corrected
#3
Yes
No
Maintenance procedure complete.
#4
A
START 500
Possible Causes
A1C2(A1T2)
A1C4(A1T4)
A1E2(A1R2)
A1D2(A1S2)
A1D4(A1S4)
Power Amp P532(P542)
(See LOC 4 or 14)
A1G2(A1P2)
#5
Trouble corrected
#6
No
Yes
Servo Checkout procedure
#8
A
ACC 630
Velocity Gain adjustment
#7
B
ACC 800
MICRO
ACC 301
ACC 510
B
Access Timeout or Overshoot Check during accelerate phase of a Seek operation.
#9
Entry to MAP from Error Code B8xx
#10
Yes
No
MICRO 10
Microdiagnostic
Run routine B8; inhibit linking. Enter: B8,04,00
#11
Test fails
#12
No
Yes
Error Analysis
Exit to MICRO section and follow instructions under the first failing Error Code.
#13
MICRO
Entry from Error Code B8A5
#15
Yes
No
Replace Cards
A1C4(A1T4)
A1E2(A1R2)
A1D2(A1S2)
Power Amp P532(P542)
(See LOC 4 or 14)
#16
Replace Cards
A1D2(A1S2)
A1D4(A1S4)
A1G2(A1P2)
A1C4(A1T4)
Power Amp P532(P542)
(See LOC 4 or 14)
A1E2(A1R2)
#20
Trouble corrected
#17
Yes
No
Velocity Gain adjustment
#18
B
ACC 800
Servo Checkout procedure
#24
A
ACC 630

ACCESS STATE 0A – ACCELERATE (SEEK)



ACCESS STATE 08 – DECELERATE (SEEK)



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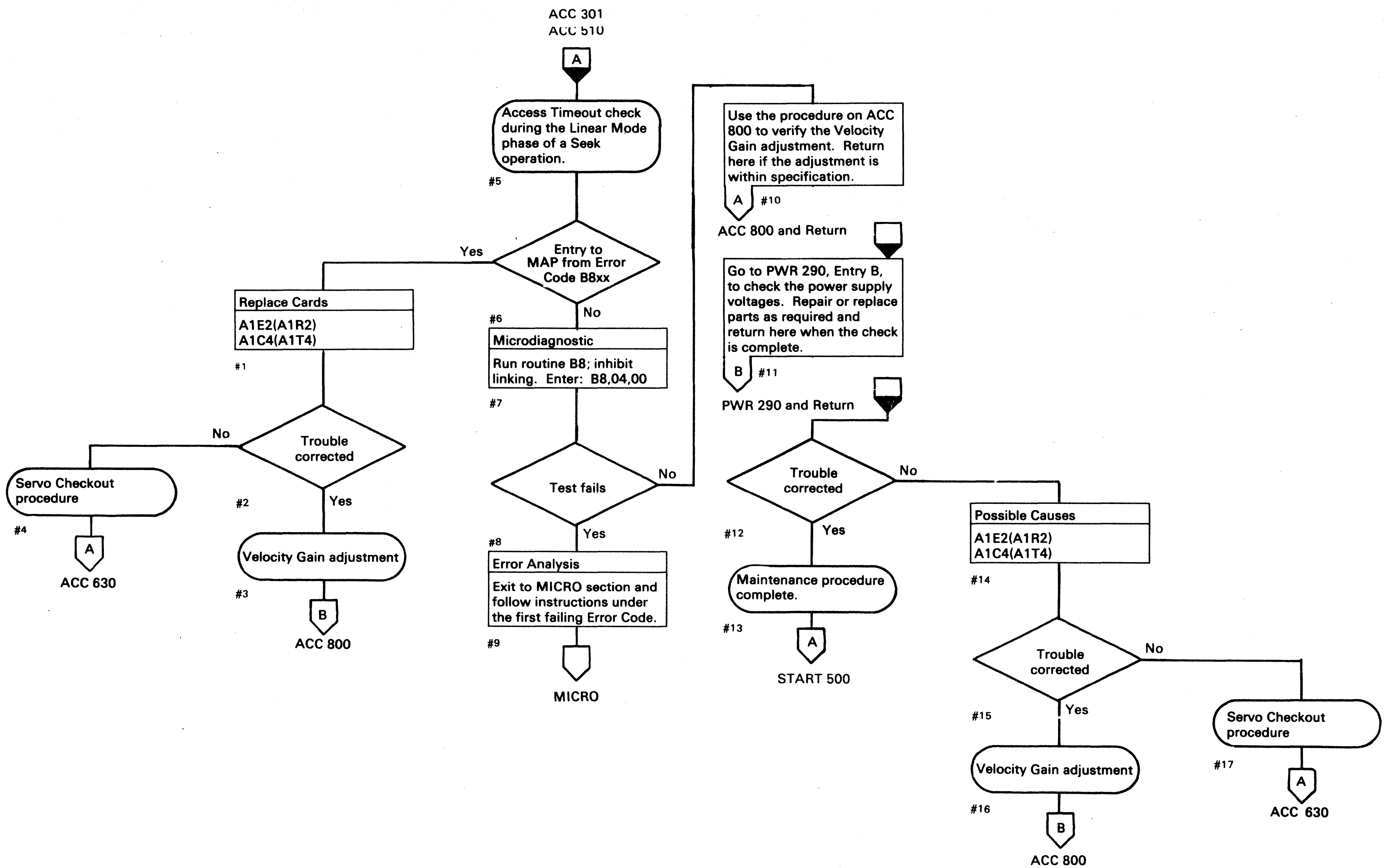
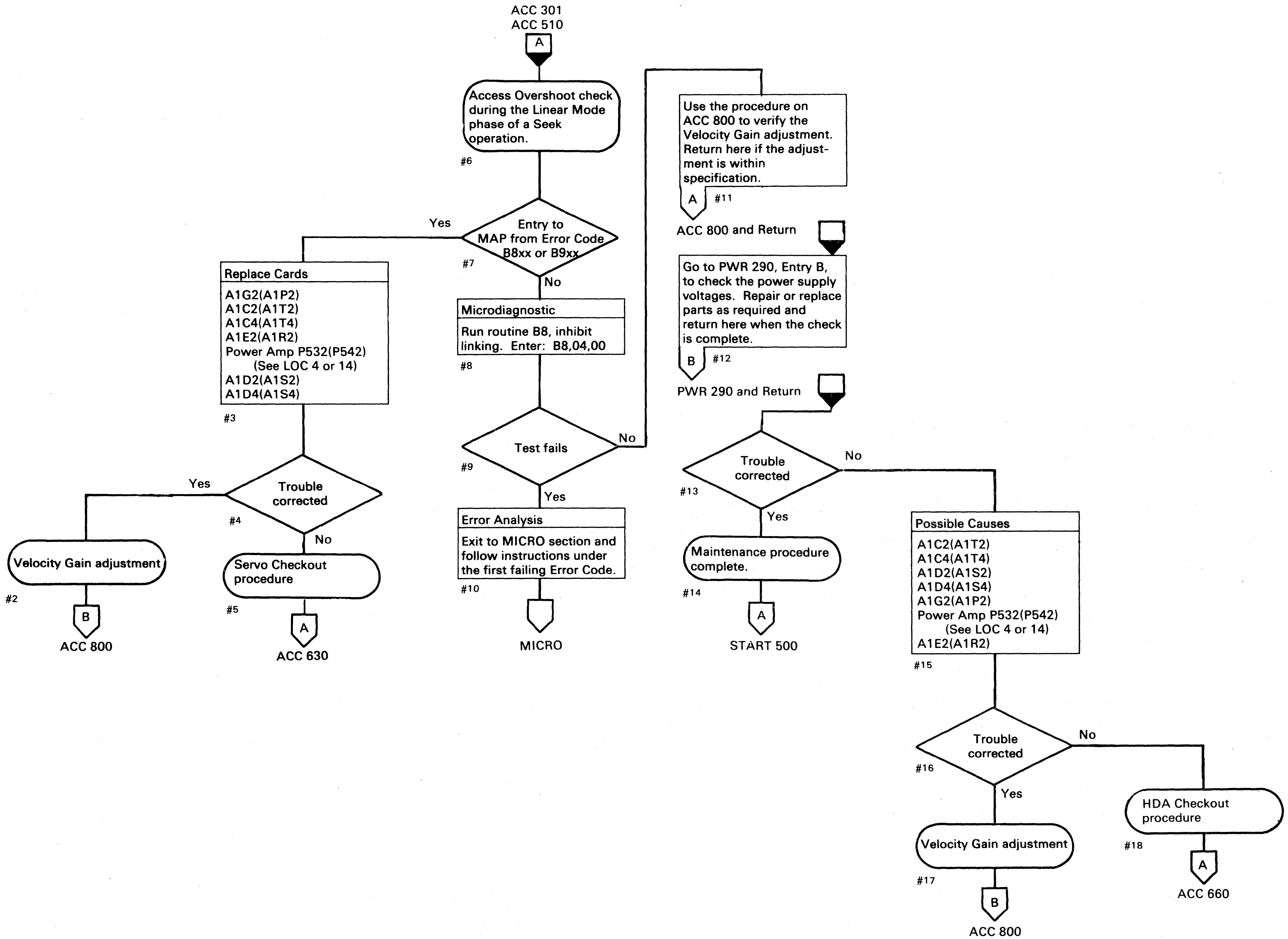
ACCESS STATE 0C – SEEK LINEAR MODE

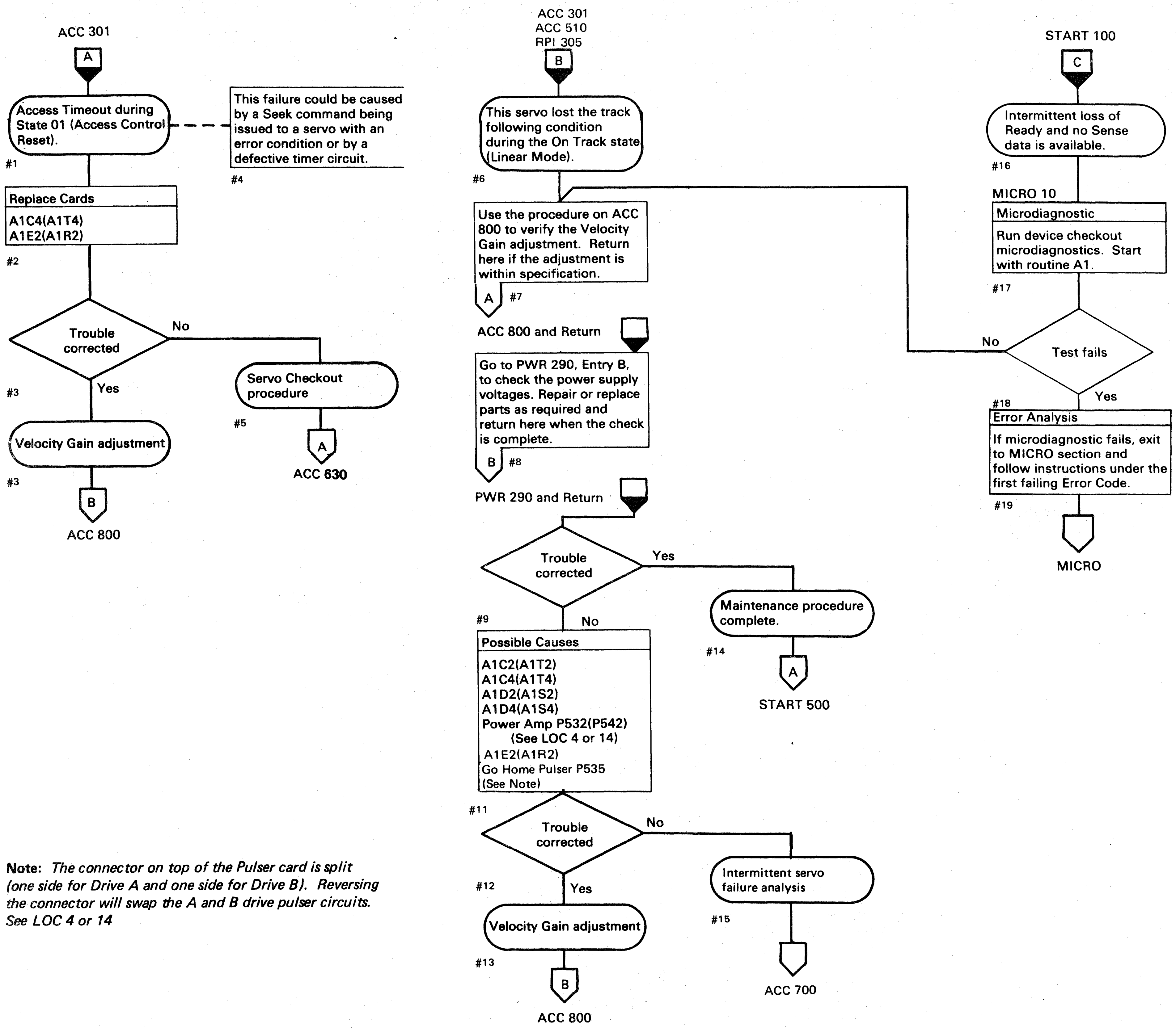


3350 | DG0550 Seq. 2 of 2 | 2358128 Part No. | 441300 31 Mar 76 | 441305 29 Oct 76

ACCESS STATE 0C – SEEK LINEAR MODE



3350	DG0562 Seq. 1 of 2	2358129 Part No.	441300 31 Mar 76	441303 30 Jul 76	441305 29 Oct 76	441308 18 Aug 78	



Note: *The connector on top of the Pulser card is split (one side for Drive A and one side for Drive B). Reversing the connector will swap the A and B drive pulser circuits. See LOC 4 or 14*

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STATIC SERVO CHECKOUT

DC Voltage (Note 1)	Test Point	Range (Volts)	Maximum AC Ripple	MAP	Entry
+6 V	A1C2 (A1T2) B11	+5.76 to +6.24	0.08 V p/p	PWR 260	A
−4 V	A1C2 (A1T2) B06	−3.85 to −4.50V	0.23 V p/p	PWR 255	A
+12 V	A1C2 (A1T2) D05	+12.0 to +14.4	0.10 V p/p	PWR 240	A
−12 V	A1C2 (A1T2) D06	−12.0 to −14.4	0.10 V p/p	PWR 240	A
−24 V	A1C2 (A1T2) D03	−24.0 to −28.8	0.08 V p/p	PWR 250	A
−1.28 V (V Ref)	A1C2 (A1T2) B08	(Nominal)	——	ACC 115	A
−20 V	A1C2 (A1T2) B10	−19.6 to −20.4	0.07 V p/p	ACC 115	B
−8.3 V	A1C2 (A1T2) B02	−8.134 to −8.466	——	See ALD page KC100 (KT100)	
+12 V	P532 (P542) −13 (Power Amp) LOC 4/14	+12.0 to +14.4	0.10 V p/p	PWR 240	E
−12 V	P532 (P542) −11 (Power Amp) LOC 4/14	−12.0 to −14.4	0.10 V p/p	PWR 240	E

Notes:

1. *Use a digital voltmeter for measurement.*
2. *Remove the jumper when the problem is corrected or when leaving the static servo checkout.*

See OPER 117 for theory.

FSI
HDA 313
HDA 314
START 140
ACC Common Entry A

(A)

#23 Failure symptoms indicate a basic servo operation problem.

#24 Microdiagnostic routines A1 to BB have been run — No → #5; Yes → #25

#25 Failure in routine A1 or A2 — Yes; No → #26

#26 Failure in routine B8, tests 1 to 4 — Yes; No → (B) ACC 630

#27 Ready lamp on and stays on — Yes → (B) ACC 630; No

#5 Install Jumper
From A1E2(A1R2)D02 to ground (D08) to prevent mechanical damage (forces the Servo into Zero mode). See Note 2.

(1)

#7 Check
Use this chart to check the power supply voltages to the servo cards (in the order that they are listed). Go to the indicated MAP page or ALD page if a voltage is missing or out of specification.

#28 Check
Use the procedure on HDA 712 to check for carriage binds.

#8 CP557(568) is tripped — Yes → #11; No → #9

LOC 4/14 YA060/YB060

#9 Check
−36 V power supply at P532(P542)−5 (Power Amp card).

#10 Voltage measures −36.0 V to −43.2 V (0.14 V p/p) — Yes → #3; No → (A) PWR 280

#3 Check
Ground at:
P532(P542)-6, and
P532(P542)-10
P535-5(6)
See PWR 281 and ALD page YA060 or YB060.

#4 Ground measured 0 V ± 0.1 V — No → (A) PWR 281; Yes → #2

#2 For a proper and complete checkout, begin at the Introduction on ACC 601. Follow directions and go through the procedure step by step. Skip steps only if directed to by the procedure. → ACC 601

#1 If the jumper is still installed at A1E2(A1R2)D02, leave it there for the remainder of the checkout procedure. Remove it as necessary to verify that the problem is corrected.
Remember to remove the jumper and reinstall the VCM wires, when the problem is corrected.

#11
1. Set the Start/Stop switch to the Stop position.
2. Remove the jumper from A1E2(A1R2)D02 to ground.
3. Reset CB557(CB568)
4. Set the Start/Stop switch to the Start position.

#12 The CP trips again — Yes → #19; No

#19 Replace Cards
Power Amp P532(P542) (See LOC 4 or 14)
A1C4(A1T4)
A1C2(A1T2)
A1D2(A1S2)

#20 Trouble corrected — No → (A) PWR 280; Yes → #21

START 100

(B)

#15 Servo mechanism is out of control.

#16 Install Jumper
From A1E2(A1R2)D02 to ground (D08) to prevent mechanical damage (forces the Servo into Zero mode). See Note 2.

#17 Servo still out of control — Yes → #18; No

#18 Remove the jumper

#13 Replace Cards
A1C4(A1T4)
Power Amp P532(P542) (See LOC 4 or 14)

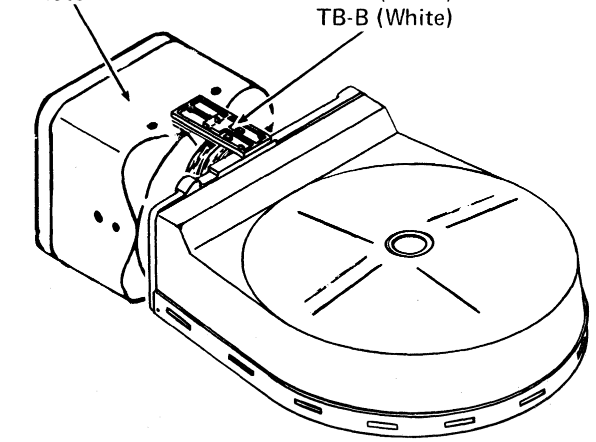
#14 Trouble corrected — Yes → #21; No → #22

#21 Velocity Gain adjustment → (B) ACC 800

#22
1. Turn the Start/Stop switch to the Stop position.
2. Remove the two wires from the top of the Voice Coil Motor. (See Figure 1.)
3. Turn the Start/Stop switch to the Start position.

→ (1)

Figure 1.



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INTRODUCTION

The following checkout procedure is designed to assist in isolating basic servo failures where the problem indication is:

- The HDA Ready lamp does not come on.
- The microdiagnostics either cannot be run or when executed, the results could cause mechanical damage.
- The microdiagnostic failure was not corrected by replacing FRUs.

Review the following checklist. The checklist contains all possible causes of the problems leading to this procedure. If any FRU has not been checked, replaced, or ordered, replace or order it before continuing.

Possible Causes Checklist

Drive A Cards	Drive B Cards
A1E2	A1R2
A1C2	A1T2
A1C4	A1T4
A1D2	A1S2
A1D4	A1S4
Power Amp P-532	Power Amp P-542
A1F2	A1Q2
A1G2	A1P2
Go Home Pulser P535*	Go Home Pulser P535*

Drive A Cables/Connectors	Drive B Cables/Connectors
A1A4	A1V4
A1A5	A1V5
A1B2	A1U2

*The pulser card is common to both drives. The connector on top of the pulser card is split (one side for Drive A and one side for Drive B). Reversing the connector will swap the A and B drive pulse circuits. See LOC 4 and 14.

Preliminary Drive Motor Check

Is the drive motor turning with the Start/Stop switch set to Start?

Yes —▶ Continue with Step 1.

No —▶ Continue.

Set the Start/Stop switch to Stop, wait 15 seconds, then to Start. Does the drive motor start turning?

No —▶ Return to START 100.

Yes —▶ To keep the drive motor turning, a jumper must be installed while the motor is turning in the 15 second Start sequence. Install the jumper from A1D4(A1S4)D07 to ground (D08). Repeat the Start/Stop sequence as necessary. (See ALD page KD570(KS570) for +Motor at Speed.) Continue.

Is the drive motor turning with the Start/Stop switch set to Start?

No —▶ Remove the jumper and go to HDA 990.

Yes—▶ Continue with Step 1. Remove the jumper when the problem is corrected or when leaving the Static Servo Checkout.

1 SERVO INPUT SIGNAL

Scope Setup

(Be sure to use a X1 probe only.)

Sweep		0.5 μs/div
Mode		ALT
Trigger		
	Slope (+)	
	Ch 1 only	
Ch 1	A1C2(A1T2)G13	
	Servo Signal 1	Ⓐ (ACC 602)
	AC Input	
	Volts/div	0.02
	Probe	X1
Ch 2	A1C2(A1T2)J13	
	Servo Signal 2	Ⓑ (ACC 602)
	AC Input	
	Volts/div	0.02
	Probe	X1
	Invert	

Action

With the carriage at the outer stop –

a. Check for signals on both channels 1 and 2 that are similar to those in Figures 1a, 1b, and 1c. (Slight movement of the pushrod in the VCM causes the scope trace to look like any of the three figures.)

Are the signals present?

No —▶ The trouble is in one of the following areas. Perform each step in sequence:

1. Replace A1C2(A1T2)
2. Check the HDA cable. See the diagram on ACC 602.
3. Reseat or replace the HDA. See the HDA Replacement procedure on HDA 710.

Yes —▶ Continue.

b. Is the peak-to-peak amplitude of the displayed signals at least 0.038 volts (min.)?

No —▶ The trouble is in one of the following areas. Perform each step in sequence:

1. Replace A1C2(A1T2)
2. Check the HDA cable. See the diagram on ACC 602.
3. Replace the HDA. See the HDA Replacement procedure on HDA 710.

Yes —▶ Continue.

c. Is the timing within specification?
One cycle = 3.339 μs **1** ±3%
(3.24 min. to 3.44 max., **2**).

No —▶ The trouble is in one of the following areas. Perform each step in sequence:

1. Replace A1F2(A1Q2).
2. Replace the drive motor belt. (See HDA 760.)
3. Replace the drive motor brake. (See HDA 720.)
4. Replace the drive motor. (See HDA 715.)
5. Replace the HDA. See the HDA Replacement procedure on HDA 710.

Yes —▶ Continue with Step 2, ACC 602.

Figure 1A.

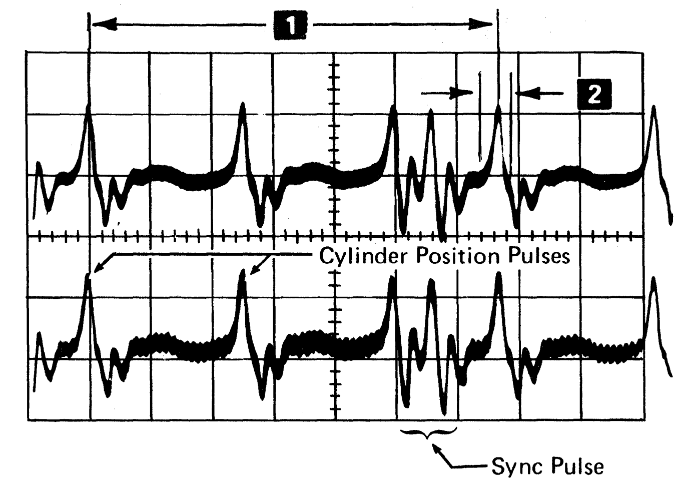


Figure 1B.

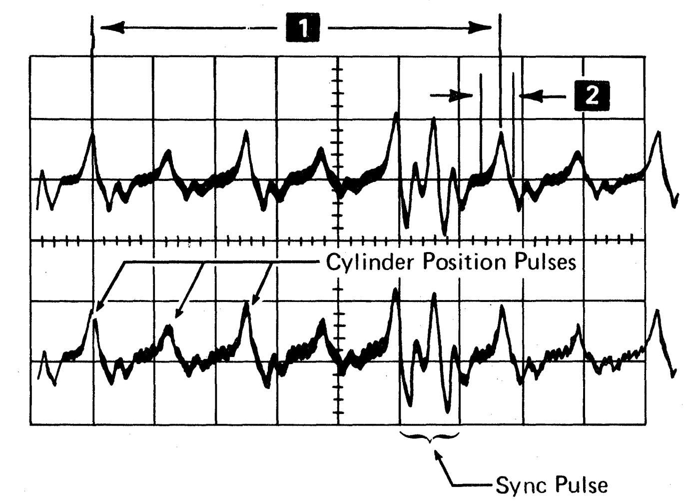
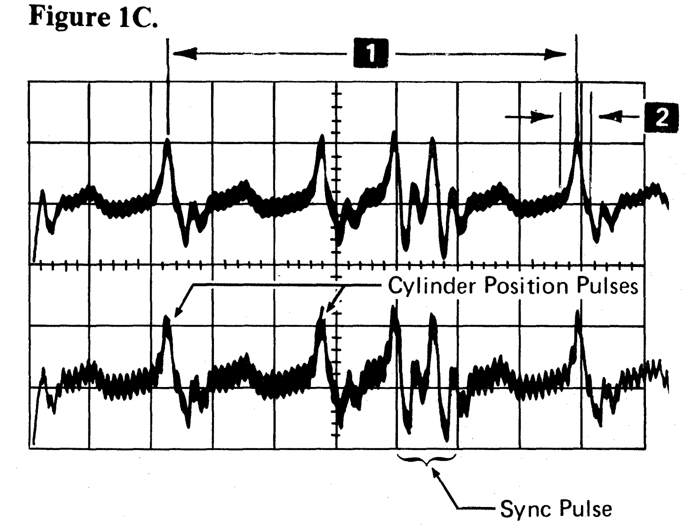


Figure 1C.



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STATIC SERVO CHECKOUT

2 AGC CONTROL

Scope Setup

Sweep Mode		Auto Trig.
Mode		CH 1
Trigger		CH 1 only
Ch 1	A1C2(A1T2)B05 −AGC Active	M
	Volts/div	0.1
	Probe	X10

Action

Is the signal a solid −level (MST-1)?

No —▶ **The trouble is in the A1C2(A1T2) card, the A1D4(A1S4) card, or the associated wiring.**

Yes—▶ **Continue with Step 3.**

3 SERVO AMP OUTPUT

Scope Setup

Sweep		1.0 μs/div
Mode		ALT
Trigger		
	Slope (−)	
	Ch 1 only	
Ch 1	A1C2(A1T2)B03 + Timer Gate	K
	Volts/div	0.1
	Probe	X10
Ch 2	A1C2(A1T2)D12 + Servo Clock	J
	Volts/div	0.1
	Probe	X10

Action

With the carriage at the outer stop, check that both the Channel 1 signal and the Channel 2 signal are pulsing as shown in Figure 3. (Ignore the timing.)

Are both signals pulsing?

No —▶ **The trouble is in the A1C2(A1T2) card, the A1D4(A1S4) card, or the associated wiring.**

Yes—▶ **Continue with Step 4.**

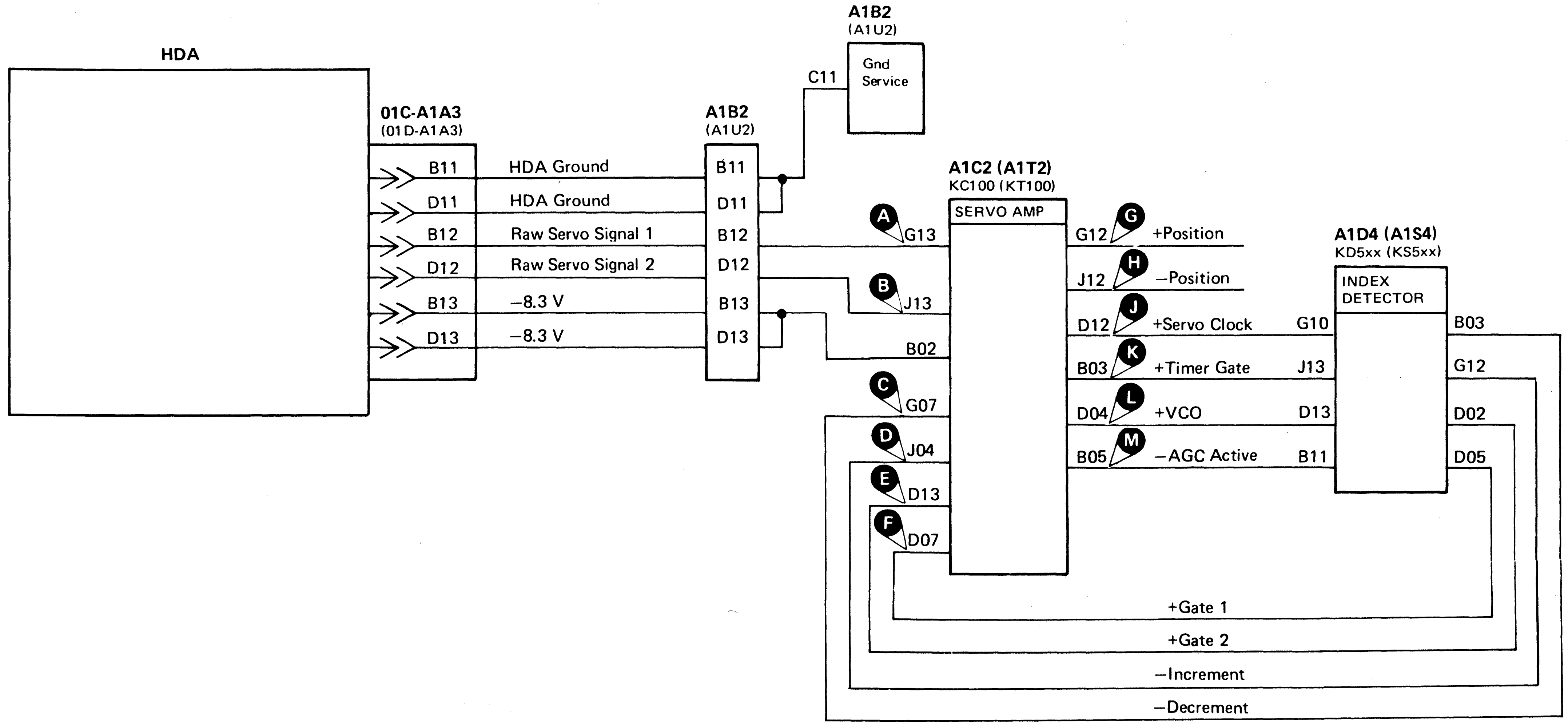
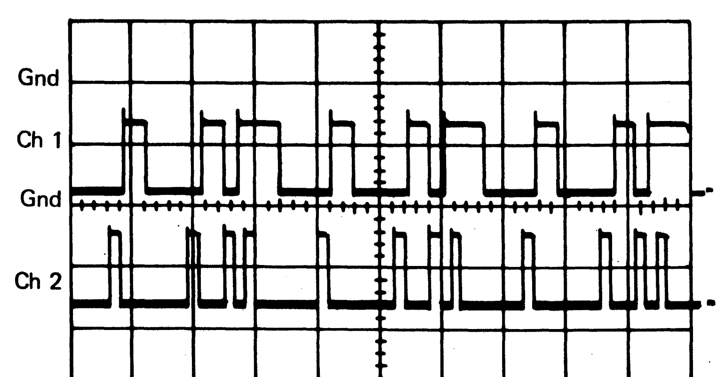


Figure 3.

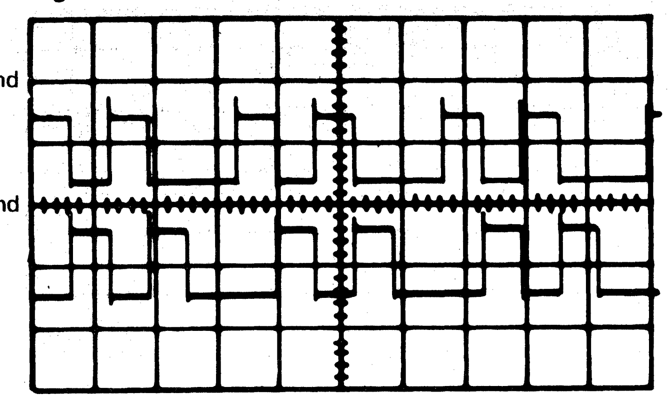


4 INDEX REGISTER OUTPUT

Scope Setup

Sweep		1.0 μs/div
Mode		ALT
Trigger	Slope (+)	
	Ch 1 only	
Ch 1	A1C2(A1T2)D07	
	+Gate 1	F (ACC 602)
	Volts/div	0.1
	Probe	X10
Ch 2	A1C2(A1T2)D13	
	+Gate 2	E (ACC 602)
	Volts/div	0.1
	Probe	X10

Figure 4.



Action

With the carriage at the outer stop, check that both signals are pulsing and that the relative timing of the pulses is similar to that shown in Figure 4.

Are the signals correct?

No —▶ The trouble is in the A1C2(A1T2) card, the A1D4(A1S4) card, the A1E2(A1R2) card, or the associated Gate 1 and Gate 2 wiring network. See ALD page KC100 (KT100).

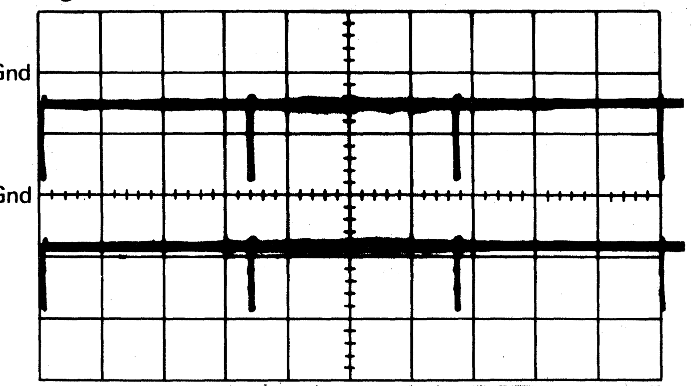
Yes—▶ Continue with Step 5.

5 INDEX REGISTER OUTPUT

Scope Setup

Sweep		1.0 μs/div
Mode		ALT
Trigger	Slope (−)	
	Ch 1 only	
Ch 1	A1C2(A1T2)J04	
	¬Increment	D (ACC 602)
	Volts/div	0.1
	Probe	X10
Ch 2	A1C2(A1T2)G07	
	−Decrement	C (ACC 602)
	Volts/div	0.1
	Probe	X10

Figure 5.



Action

With the carriage at the outer stop, check that both the Channel 1 and the Channel 2 signals are pulsing (at MST-1 levels) as shown in Figure 5. (Ignore the timing.)

Are both signals pulsing?

No —▶ The trouble is in the A1C2(A1T2) card, the A1D4(A1S4) card, or the associated wiring.

Yes—▶ Continue with Step 6.

6 VCO

Scope Setup

Change the Sweep speed to 0.5 μs and move the Channel 2 probe to:

A1C2(A1T2)D04
(+VCO) Ⓛ (ACC 602)

Action

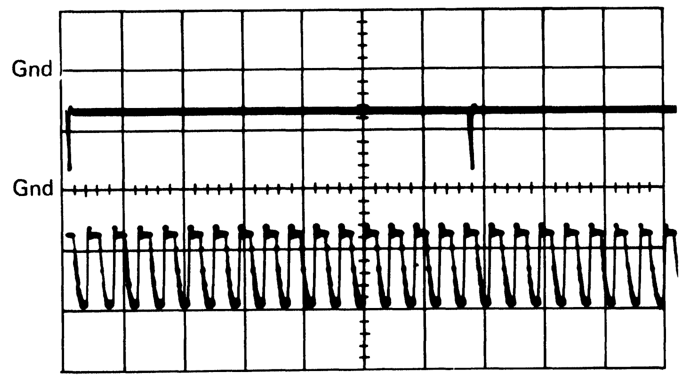
Verify that the Channel 2 signal is stable and is pulsing as shown in Figure 6.

Is the signal correct?

No —▶ The trouble is in the A1C2(A1T2) card, the A1D4(A1S4) card, or the associated wiring.

Yes—▶ Continue with Step 7.

Figure 6.



7 INDEX REGISTER

Scope Setup

Sweep		5 ms/div
Mode		CHOP
Trigger		
	Slope (−)	
	Ch 1 only	
Ch 1	A1D4(A1S4)D04	
	–Any Valid Index TP	
	Volts/div	0.1
	Probe	X10
Ch 2	A1D4(A1S4)B13	
	–Valid Index	
	Volts/div	0.1
	Probe	X10

Reference: ALD page KD520(KS520)

Action

With the carriage at the outer stop, compare the scope signals with those in Figure 7 and look for these conditions:

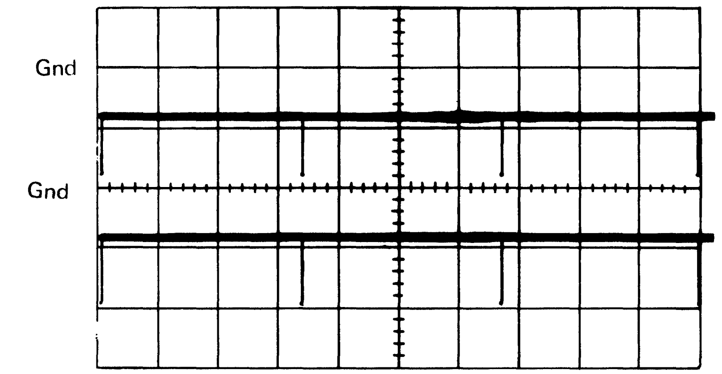
a. Both signals pulse at −levels (MST-1).
b. The timing is correct.
c. The signals do not change when the carriage is moved with the bobbin pushrod.

Are the signals correct?

No —▶ The trouble is in the A1D4(A1S4) card, the A1J4(A1M4) card, the A1H2(A1N2) card, the A1E2(A1R2) card, or the associated wiring.

Yes—▶ Continue with Step 8.

Figure 7.



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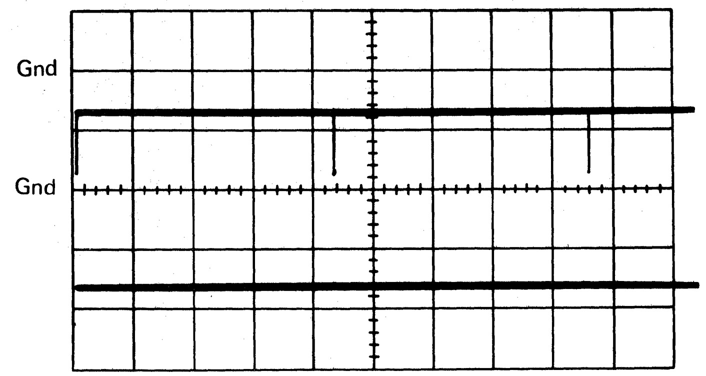
8 GUARDBAND PATTERNS

Scope Setup

Sweep 50 μs/div
Mode CHOP
Trigger
Slope (−)
Ch 1 only
Ch 1 A1D4(A1S4)B09
−Guardband Pattern 2
Volts/div 0.1
Probe X10
Ch 2 A1D4(A1S4)B04
+Guardband Pattern 1
Volts/div 0.1
Probe X10

Reference: ALD page KD520(KS520)

Figure 8.



Action

a. With the carriage at the outer crash stop, verify that:

(1) Channel 2 is a solid −level (MST-1).
(2) Channel 1 is pulsing and the timing is the same as shown in Figure 8.

Are the signals correct?

No —▶ The trouble is in the A1D4(A1S4) card, the A1E2(A1R2) card, or the associated wiring.

Yes—▶ Continue.

b. Change the sweep speed on the scope to 1 sec/div and change the Sweep Mode to Auto Trig. Then, very slowly push the carriage inwards from the outer crash stop with the bobbin pushrod.

The Channel 1 pulses should disappear (change to a solid +level MST-1) and the Channel 2 signal should contain pulses during a very narrow band width position of the carriage, near the outer stop.

Do the signals change as indicated?

No —▶ The trouble is in the A1D4(A1S4) card, the A1E2(A1R2) card, or the associated wiring.

Yes—▶ Continue with Step 9.

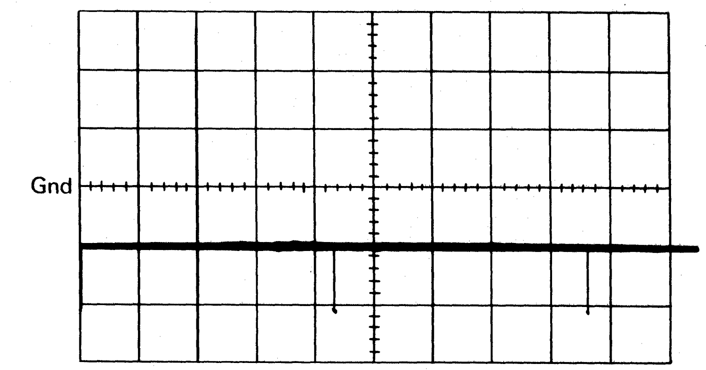
9 ID POSITION PATTERN

Scope Setup

Sweep 50 μs/div
Mode Ch 1
Trigger
Slope (−)
Ch 1 only
Ch 1 A1D4(A1S4)D06
−ID Position
Volts/div 0.1
Probe X10
Ch 2 Not Used

Reference: ALD page KD520(KS520)

Figure 9.



Action

Push the carriage to the inner crash stop with the bobbin pushrod.

Does the signal pulse with the same time relationship as shown in Figure 9?

No —▶ The trouble is in the A1D4(A1S4) card or the associated wiring.

Yes—▶ Continue with Step 10.

STATIC SERVO CHECKOUT

10 POSITION

Scope Setup

Sweep		0.5 ms/div
Mode		CHOP
Trigger		
	Slope (+)	
	Ch 1 only	
Ch 1	A1C2(A1T2)G12	
	+Position	G (ACC 602)
	Volts/div	0.5
	Probe	X10
Ch 2	A1C2(A1T2)J12	
	Position	H (ACC 602)
	Volts/div	0.5
	Probe	X10

Action

With the bobbin pushrod, move the carriage in and out at a steady rate. Check the scope and verify that:

a. Channel 1 and 2 signals cycle both plus (+) and minus (−) to levels greater than 8 volts peak-to-peak.

b. Channel 1 and 2 signals change in frequency as the rate of carriage movement changes. (As the pushrod is moved faster, the frequency of the signals increases.)

c. Channel 1 and 2 signals are 180 degrees out of phase with each other.

Are the signals correct?

No —▶ The trouble is in the A1C2(A1T2) card, the A1C4(A1T4) card, the A1D2(A1S2) card, or the associated wiring.

Yes—▶ Continue with Step 11.

11 TRACK DETECTION CIRCUITS

Scope Setup

Sweep		0.5 ms/div
Mode		Ch 1
Trigger		
	Slope (−) for −signals	
	Slope (+) for +signals	
	Ch 1 only	
	Volts/div	0.1
	Probe	X10

Action

Use Channel 1 to scope each of these lines and look for pulses (at MST-1 levels) as the carriage is moved across the disk with the bobbin pushrod:

a. A1C4(A1T4)G08 (−On Track TP) KC500(KT500)

Is the signal pulsing?

No —▶ The trouble is in the A1C4(A1T4) card or the associated wiring.

Yes—▶ Continue.

b. A1D2(A1S2)J02 (−Fine Track TP) KD100(KS100)

Is the signal pulsing?

No —▶ The trouble is in the A1D2(A1S2) card or the associated wiring.

Yes—▶ Continue.

c. A1D2(A1S2) G02 (−Track Xing) KD100(KS100)
Note: Ignore the stepped (−) level.

Is the signal pulsing?

No —▶ The trouble is in the A1D2(A1S2) card, the A1E2(A1R2) card, or the associated wiring.

Yes—▶ Continue.

d. A1D2(A1S2)J04 (+Track Xing Pulse) KD100(KS100)
Note: The width of the positive pulse should be 3.2 μsec ± 20%. The frequency of the pulses varies with the speed of the carriage movement.

Is the signal pulsing?

No —▶ The trouble is in the A1D2(A1S2) card, the A1E2(A1R2) card, the A1G2(A1P2) card, or the associated wiring.

Yes—▶ Continue.

e. A1D2(A1S2) J09 (−Allow Rezero) KD100(KS100)

Is the signal pulsing?

No —▶ The trouble is in the A1D2(A1S2) card, the A1E2(A1R2) card, or the associated wiring.

Yes—▶ Continue with Step 12.

12 POSITION CURVE

Scope Setup

Sweep		0.5 ms/div
Mode		Ch 1
Trigger		
	Slope (−)	
	Ch 1 only	
Ch 1	A1D2(A1S2)D02	
	−Position Curve TP	
	AC Input	
	Volts/div	0.5
	Probe	X10

Reference: ALD page KD100(KS100).

Action

Move the carriage across the disk with the bobbin pushrod. Check that the signal on the scope is a sine wave with a peak-to-peak amplitude greater than 10 volts. (Note: the positive peak may be clipped.)

Is the signal correct?

No —▶ The trouble is in the A1D2(A1S2) card or the associated wiring.

Yes—▶ Continue with Step 13.

13 DAC

Scope Setup

Sweep		0.5 ms/div
Mode		Ch 1
Trigger		
	Slope (+)	
	Ch 1 only	
Ch 1	A1D2(A1S2)B03	
	+DAC	
	Volts/div	0.01
	Probe	X10

Reference: ALD page KD100(KS100).

Action

Move the carriage across the disk with the bobbin pushrod. The signal on the scope should be the positive half of a sine wave (the negative half is clipped) with the peak amplitude between 0.1 volts and 0.2 volts from ground.

Is the signal correct?

No —▶ The trouble is in the A1D2(A1S2) card or the associated wiring.

Yes—▶ Continue with Step 14.

14 SERVO TESTPOINT CHARTS

Use these charts to scope each testpoint on the A1C4(A1T4) card, the A1D2(A1S2) card, and to isolate the problem. The four columns of the charts are defined as follows:

Pin - The I/O pin number of the testpoint.

Line name - The name of the testpoint as it appears in the ALDs.

Description - The expected voltage level, the expected changes to the signal under various conditions, or a reference back to a previous step in the Static Servo Checkout procedure.

Reference - A cross-reference to a scope timing figure.

If all testpoints are correct, continue with step 15.

A1C4 (A1T4) card; ALD pages KC500 and KC510 (KT500 and KT510)

Pin	Line Name	Description	Reference
B02	+Access Mode	−level (MST-1)	
B03	+Move Forward	−level (MST-1)	ACC 644, Fig. 5
B04	+Move Reverse	−level (MST-1)	ACC 644, Fig. 5
B05	Pos Error TP	Cycles from +2 V to −2 V with carriage movement or Ground if track following (±0.5 V); ripple = less than 1 V peak-to-peak.	
B06	———	−4 V power source	
B07	−Linear Mode CS	Ground; or −1.0 V if track following	ACC 645, Fig. 9
B08	V Ref	−1.28 V (See ACC 600)	
B09	Not Used		
B10	−20 V	−20.0 V (See ACC 600)	
B11	———	+6 V power source	
B12	−End Accelerate	+level (MST-1)	ACC 648, Fig. 15
B13	+Track Following Timer	−level (MST-1); or +level (MST-1) if track following	ACC 647, Fig. 14
D02	+Access Timeout	−level (MST-1)	
D03	Not Used		
D04	Current Sense	0 V (nominal)	ACC 644, Fig. 4
D05	———	+12 V power source	
D06	———	−12 V power source	
D07	+Rezero Mode	−level (MST-1)	ACC 643, Fig. 2
D08	———	Ground	
D09	+Zero Mode	+level (MST-1); or −level (MST-1) if track following	
D10	Position Compensation	0 V (the peak-to-peak amplitude of this signal is a function of carriage velocity)	
D11	−Run Timer Gated	+level (MST-1)	
D12	+Reset Trk Following Timer	+level (MST-1); or −level (MST-1) if track following	
D13	−On Track * LM TP	+level (MST-1); or −level (MST-1) if track following	

STATIC SERVO CHECKOUT

A1C4 (A1T4) card; ALD pages KC500 and KC510 (KT500 and KT510)

Pin	Line Name	Description	Reference
G02	+Guardband Latch	+level (MST-1) at outer stop; −level (MST-1) at inner stop	ACC 645, Fig. 9
G03	−Rezero Mode	+level (MST-1)	ACC 643, Fig. 2
G04	−Any Go Home	+level (MST-1)	
G05	+Linear Mode	−level (MST-1); or +level (MST-1) if track following	ACC 647, Fig. 14
G06	———	−4 V power source	
G07	+Position Enable	−level (MST-1); or +level (MST-1) if track following	
G08	−On Track TP	Pulses (MST-1) with carriage movement	
G09	−End Decelerate	+level (MST-1)	ACC 647, Fig. 13
G10	−Target Velocity	−level (MST-1)	ACC 643, Fig. 2
G11	Not Used		
G12	+DAC	0 V to +0.2 V; or +1.8 V if track following	ACC 648, Fig. 16
G13	−Position	Refer back to Step 10 on ACC 609	ACC 645, Fig. 8
J02	+High Velocity Set Point	−level (MST-1)	ACC 645, Fig. 7
J03	Not Used		
J04	+Forward	−level (MST-1); or +level (MST-1) if track following	ACC 643, Fig. 3
J05	Not Used		
J06	Not Used		
J07	−Velocity Enable	+level (MST-1)	ACC 644, Fig. 6
J08	———	Ground	
J09	+Power Amp Drive	0 V; or approximately 1 V peak-to-peak if track following	ACC 643, Fig. 3
J10	−Velocity Grtr 20 IPS	+level (MST-1)	
J11	Not Used		
J12	−Velocity	0 V	ACC 644, Fig. 6
J13	+Position	Refer back to Step 10 on ACC 609	ACC 645, Fig. 8

A1D2 (A1S2) card; ALD page KD100 (KS100)

Pin	Line Name	Description	Reference
B02	−Velocity	0 V	ACC 644, Fig. 6
B03	+DAC	0 V to +0.2 V; or +1.8 V if track following	ACC 648, Fig. 16
B04	Fill In TP	+0.4 V	
B05	Not Used		
B06	———	−4 V power source	
B07	−Diff Bit 2	+0.4 V	
B08	V Ref	−1.28 V (See ACC 600)	
B09	−Diff Bit 4	+0.4 V	
B10	−20 V	−20.0 V (See ACC 600)	
B11	———	+6 V power source	
B12	−Diff Bit 7	+0.4 V	
B13	Current Magnitude TP	0 V	ACC 644, Fig. 4
D02	−Position Curve TP	Refer back to Step 12 on ACC 609	
D03	Not Used		
D04	Not Used		
D05	———	+12 V power source	
D06	———	−12 V power source	
D07	−Diff Bit 1	+0.4 V	
D08	———	Ground	
D09	−Diff Bit 3	+0.4 V	
D10	−Diff Bit 6	+0.4 V	
D11	−Diff Bit 5	+0.4 V	
D12	+Diff greater than 127	−level (MST-1)	
D13	−Linear Mode CS	0 V; or −0.7 V if track following	ACC 645, Fig. 9

A1D2 (A1S2) card; ALD page KD100 (KS100)

Pin	Line Name	Description	Reference
G02	−Track Xing	Refer back to Step 11c on ACC 609	ACC 645, Fig. 7
G03	+Position Enable	−level (MST-1) at outer stop; +level (MST-1) at inner stop	
G04	+DC Equals 1	−level (MST-1)	
G05	Not Used		
G06	———	−4 V power source	
G07	Current Sense	0 V (nominal)	ACC 644, Fig. 4
G08	−Velocity Enable	+level (MST-1)	ACC 644, Fig. 6
G09	+Access Mode	−level (MST-1)	ACC 648, Fig. 15
G10	−DC7A	+level (MST-1)	
G11	Not Used		
G12	+Forward	−level (MST-1)	ACC 643, Fig. 3
G13	−Position	Refer back to Step 10 on ACC 609	ACC 645, Fig. 8
J02	−Fine Track TP	Refer back to Step 11b on ACC 609	
J03	Not Used		
J04	+Track Xing Pulse	Refer back to Step 11d on ACC 609	
J05	−Coarse Track TP	+level (MST-1)	
J06	−Rezero Mode	+level (MST-1)	ACC 643, Fig. 2
J07	Not Used		
J08	———	Ground	
J09	−Allow Rezero	Refer back to Step 11e on ACC 609	ACC 643, Fig. 1
J10	+Move Reverse	−level (MST-1)	ACC 644, Fig. 5
J11	+Access Start	−level (MST-1)	
J12	+Move Forward	−level (MST-1)	ACC 644, Fig. 5
J13	+Position	Refer back to Step 10 on ACC 609	ACC 645, Fig. 8

STATIC SERVO CHECKOUT

15 VOICE COIL MOTOR

Reference: ALD page YA060/YB060

a. Turn the drive power Off.

b. Remove TB-A (black) from the VCM (See ACC 600, Figure 1).

c. Does the resistance in the voice coil measure between 3 and 6 ohms?

No —▶ If all connections are OK, the problem is in the HDA. (See HDA 708 for the Voice Coil Replacement procedure.)

Yes—▶ Continue.

d. With TB-A still disconnected, turn the drive power On.

e. Does the voltage from TB-A to ground, and from TB-B to ground measure between −36.0 Vdc and −43.2 Vdc?

No —▶ The trouble is in the Power Amplifier card or its associated wiring (see LOC 4 or 14).

Yes—▶ Continue.

f. Turn power Off. Reconnect TB-A and restore power to the drive.

g. Does the voltage from TB-A to ground and from TB-B to ground measure near 0 Vdc or is the same ac signal on both terminals (conditions may vary between drives)?

No —▶ The trouble is in the Power Amplifier card or its associated wiring (see LOC 4 or 14).

Yes—▶ Continue with Step 16.

16 STATIC CHECKOUT EXIT

a. Does the Ready lamp come on when the Attention pushbutton is pressed, then released?

No —▶ Go to c.

Yes—▶ Continue.

b. Do microdiagnostic routines A1 and A2 run error-free?

Yes—▶ Go to the Dynamic Servo Checkout procedure on ACC 630.

No —▶ Exit to the MICRO section and follow the instructions under the first failing Error Code. (Read each MAP statement thoroughly. You may be in a loop.)

c. Have all the FRUs listed under the Possible Causes Checklist on ACC 601 been replaced?

Yes—▶ Go to the HDA Checkout procedure on ACC 630.

No —▶ **Replace them.** Continue on ACC 630 (Dynamic Servo Checkout) if the problem is not corrected by FRU replacement.

DYNAMIC SERVO CHECKOUT

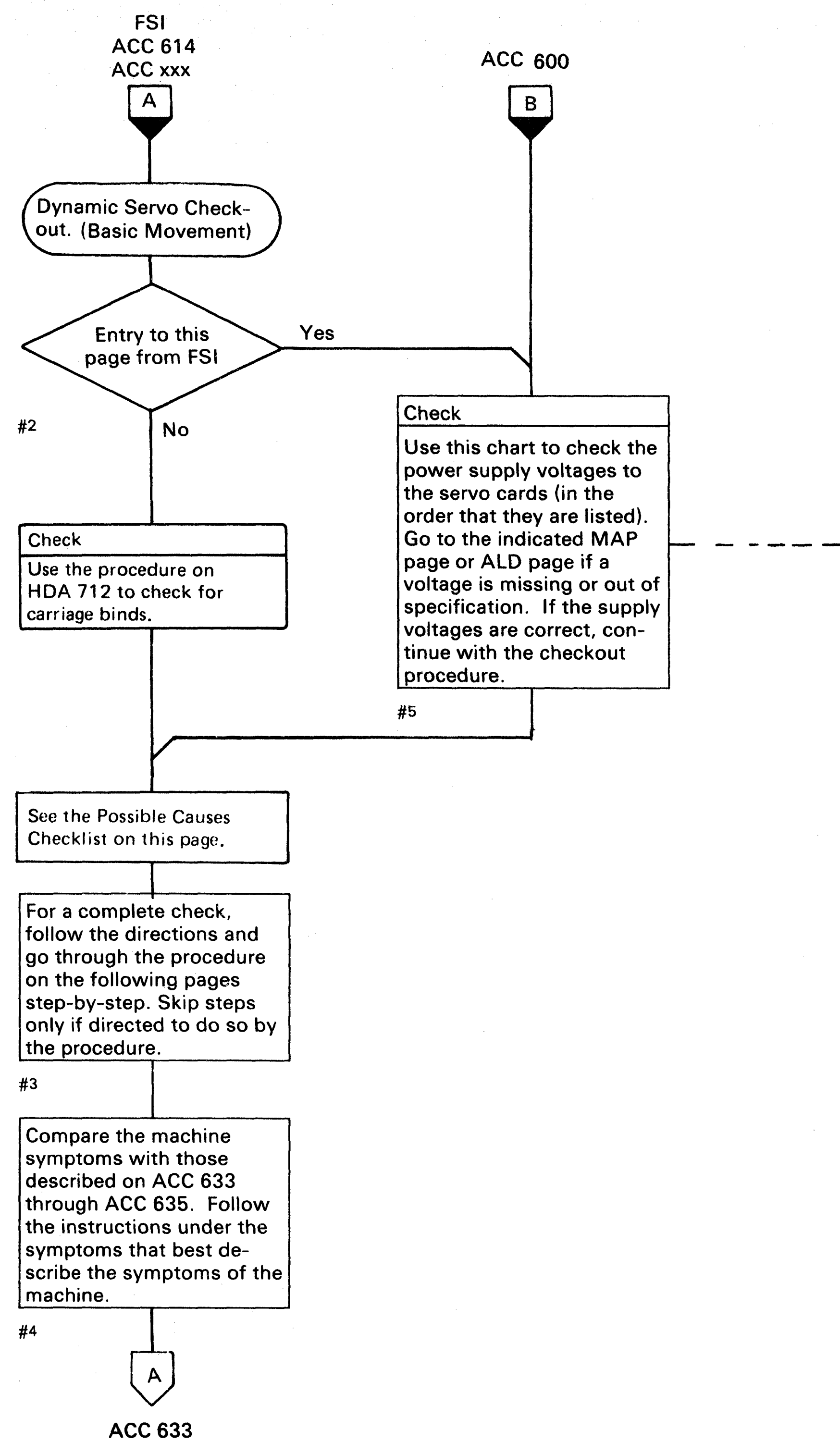
Possible Causes Checklist

Review the following checklist. The checklist contains all possible causes of the problems leading to this procedure. If any FRU has not been checked, replaced, or ordered, replace or order it before continuing.

Drive A Cards	Drive B Cards
A1E2	A1R2
A1C2	A1T2
A1C4	A1T4
A1D2	A1S2
A1D4	A1S4
Power Amp P-532	Power Amp P-542
A1F2	A1Q2
A1G2	A1P2
Go Home Pulser P535*	Go Home Pulser P535*

Drive A Cables/Connectors	Drive B Cables/Connectors
A1A4	A1V4
A1A5	A1V5
A1B2 } HDA	A1U2 } HDA
01C-A1A3 } Cables	01D-A1A3 } Cables

*The pulser card is common to both drives. The connector on top of the pulser card is split (one side for Drive A and one side for Drive B). Reversing the connector will swap the A and B drive pulse circuits. See LOC 4 and 14.



DC Voltage	Test Point	Range (Volts)	Maximum AC Ripple	MAP	Entry
+6 V	A1C2 (A1T2) B11	+5.76 to +6.24	0.08 V p/p	PWR 260	A
−4 V	A1C2 (A1T2) B06	−3.85 to − 4.50V	0.23 V p/p	PWR 255	A
+12 V	A1C2 (A1T2) D05	+12.0 to +14.4	0.10 V p/p	PWR 240	A
−12 V	A1C2 (A1T2) D06	−12.0 to −14.4	0.10 V p/p	PWR 240	A
−24 V	A1C2 (A1T2) D03	−24.0 to −28.8	0.08 V p/p	PWR 250	A
−1.28 V (V Ref)	A1C2 (A1T2) B08	(Nominal)	——	ACC 115	A
−20 V	A1C2 (A1T2) B10	−19.6 to −20.4	0.07 V p/p	ACC 115	B
−8.3 V	A1C2 (A1T2) B02	−8.134 to −8.466	——	See ALD page KC100 (KT100)	
+12 V	P532 (P542) −13 (Power Amp) LOC 4/14	+12.0 to +14.4	0.10 V p/p	PWR 240	E
−12 V	P532 (P542) −11 (Power Amp)	−12.0 to −14.4	0.10 V p/p	PWR 240	E
−36 V	P532 (P542)−5 (Power Amp)	−36.0 to −43.2	0.14 V p/p	PWR 280	A
Ground (−36 V return)	P532 (P542)−6 (Power Amp)	———	——	See PWR 281 and ALD pages YA/YB060.	
Ground	P532 (P542)−10 (Power Amp)	———	——		

Note: *Use a digital voltmeter for measurement.*

ACC 630

A

FAILURE SYMPTOM	RECOMMENDED ACTION
1. Ready lamp does not come on. Microdiagnostic routine 'B8' fails. The Attention pushbutton does not cause the Ready lamp to come on. No carriage movement is observed. Movement can be observed with the bobbin pushrod installed in the rear of the voice coil motor.	1. Perform the Static Servo Checkout procedure starting at ACC 600, Entry A, if not already done. 2. Be sure the bobbin shipping rod is removed (see INST 3). 3. Check the following: • All logic cards are plugged in the correct location (see LOC 2). • Logic board cables and HDA cables are seated properly. • Power Amplifier P532(P542) is seated properly. • Voice coil motor terminals are snug and installed correctly (TB-A = black; TB-B = white). • Continuity is measured through the voice coil with the wires removed (nominal resistance = 3 to 6 ohms). See HDA 708 if resistance does not fall in this range. • CB557(CB568) is not tripped. 4. Troubleshoot Servo Rezero operations. See ACC 643, Figures 1 through 14. Verify that the Servo operation compares with the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem. 5. Troubleshoot Servo Seek operations. See ACC 648, Figures 15 through 20. Verify that the Servo operation compares with the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem.
2. Ready lamp does not come on. Microdiagnostic routine 'B8' fails. Carriage movement is observed. Movement can be observed with the bobbin pushrod installed in the rear of the voice coil motor.	1. Check the following: • All logic cards are plugged in the correct location (see LOC 2). • The logic board cables and the HDA cables are seated properly. • Power Amplifier P532(P542) is seated properly. • The voice coil motor terminals are snug and installed correctly (TB-A = black; TB-B = white). 2. Perform the Static Servo Checkout procedure starting at ACC 600, Entry A, if not already done. 3. Troubleshoot Servo Rezero operations. See ACC 643, Figures 1 through 14. Verify that the Servo operation compares to the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem. 4. Troubleshoot Servo Seek operations. See ACC 648, Figures 15 through 20. Verify that the Servo operation compares with the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem.
3. Drive motor is turning. Ready lamp may be on or off. HDA drive motor cycles off while microdiagnostics are executing. 4. Intermittent loss of online status (Fault Symptom Code 1915) during Drive operation. HDA motor cycles off.	1. Perform the Static Servo Checkout procedure starting at ACC 600, Entry A, if not already done. 2. Replace cards A1C2(A1T2), A1D4(A1S4), and A1F2(A1Q2), if not already replaced. 3. Perform the HDA Checkout on ACC 660.

FAILURE SYMPTOM	RECOMMENDED ACTION
5. CP557(CP568) for −36 Vdc trips intermittently.	1. Replace cards A1C2(A1T2), A1C4(A1T4), and the Power Amplifier P532(P542), if not already replaced. 2. Check: • +12 Vdc or −12 Vdc missing to the Power Amplifier (see YA060/YB060). • −24 Vdc missing to the A1C2(A1T2) card (see YA090/YB090). • −20 Vdc missing to the A1C4(A1T4) card (see ACC 115). • −1.28 Vdc (VRef) missing to the A1C4(A1T4) card (see ACC 115). • Intermittent short in the Power Amplifier, the voice coil motor, or in the interconnecting cables (see YA060/YB060).
6. Ready lamp On after a drive Start sequence (Start/Stop switch). Microdiagnostic routine 'B8', tests 1, 2, 3, 4, or 5 fail.	1. Perform the Static Servo Checkout procedure starting at ACC 600, Entry A, if not already done. 2. Troubleshoot Servo Rezero operations. See ACC 643, Figures 1 through 14. Verify that the Servo operation compares with the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem. 3. Troubleshoot Servo Seek operations. See ACC 648, Figures 15 through 20. Verify that the Servo operation compares to the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem.
7. Ready lamp Off after a drive Start sequence (Start/Stop switch). The Attention pushbutton or microdiagnostic execution causes the Ready lamp to turn On. Microdiagnostic routine 'B8' does not fail.	
8. Ready lamp On after a drive Start sequence (Start/Stop switch). Microdiagnostic routine 'B8', tests 6, 7, 8, 9, A, B, or F fail (Seek or long Rezero).	1. Verify that the Servo Velocity Gain adjustment is within specification. See ACC 800, Entry B. 2. Troubleshoot Servo Rezero operations. See ACC 643, Figures 1 through 14. Verify that the Servo operation compares with the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem. 3. Troubleshoot Servo Seek operations. See ACC 648, Figures 15 through 20. Verify that the Servo operation compares with the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem. 4. Perform the HDA Checkout on ACC 660. (Possible defective HDA or voice coil motor.)
9. Microdiagnostic routine 'B8' does not fail, but another microdiagnostic failure occurred causing the loss of Ready condition.	
10. System failure indicated by Fault Symptom Code 12xx or 15xx.	
11. Servo operation noisy — high pitched noise during carriage movement, with possible intermittent failures.	1. Troubleshoot Servo Rezero operations. See ACC 643, Figures 1 through 14. Verify that the Servo operation compares to the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem. 2. Troubleshoot Servo Seek operations. See ACC 648, Figures 15 through 20. Verify that the Servo operation compares with the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem. 3. Perform the HDA Checkout on ACC 660. (Possible defective HDA or voice coil motor.)

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FAILURE SYMPTOM	RECOMMENDED ACTION
12. Intermittent loss of Ready condition during drive operation. System failure indicated by Fault Symptom Code 160E (Servo Off Track error).	Perform the HDA Checkout on ACC 660. (Possible defective HDA or voice coil motor or Go Home Pulse P535.)
13. Microdiagnostic linked series routines (A1 through BB) run error free. Microdiagnostic routine B1 runs error free. System failure indicated by Fault Symptom Code 191A (Seek Verification error).	Perform the HDA Checkout on ACC 660. (Possible defective HDA or voice coil motor.)
14. Velocity Gain adjustment is unstable. Adjustment does not stay within specification (See ACC 800).	Troubleshoot Servo Seek operations. See ACC 648, Figures 15 through 20. Verify that the Servo operation compares with the scope photos. Use the diagram on ACC 652 and the referenced ALDs to trace and isolate any problem.
15. Ready lamp is on. Attention pushbutton does not cause Ready lamp to turn Off momentarily. (Indicates that the Rezero operation does not occur.)	Perform the Attention Pushbutton Checkout on ACC 638.
16. System failure indicated by Fault Symptom Code 49xx (Intermittent Data Checks).	Perform the HDA Checkout on ACC 660. (Possible defective HDA or voice coil motor.)

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DYNAMIC SERVO CHECKOUT

ATTENTION PUSHBUTTON CHECKOUT

Pressing the Attention pushbutton on the Drive Operator panel causes the servo to perform a Rezero operation. A Rezero is indicated by the Ready lamp turning off when the pushbutton is pressed and by carriage movement when the pushbutton is released. (Carriage movement can be seen with the bobbin pushrod installed in the VCM.)

SCOPE SETUP

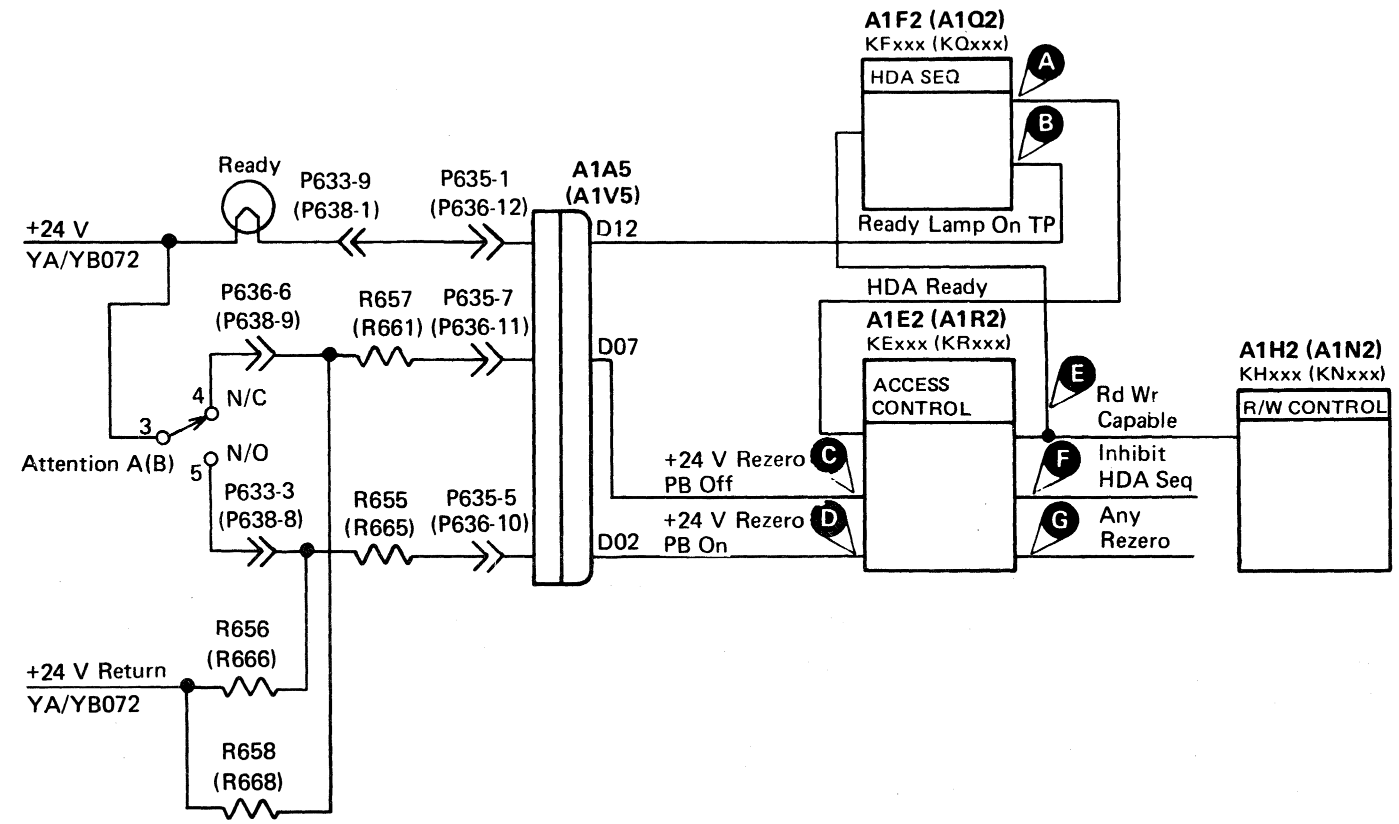
Sweep		10 ms/div
Sweep Mode		CHOP
Trigger		
	Slope (+)	
	Ch 1 Only	
Ch 1	A1E2(A1R2)P02	
	(+24 V Rezero PB On) D	
	Volts/div	1.0
	Probe	X10

ACTION

Using the Ch 2 probe (X10 probe), scope each of the test points in the chart (in sequence) while pressing the Attention pushbutton. Compare the signals with the expected conditions in the chart:

- If any signal *does not compare* with the expected conditions, trace the ALD logic to the source of the problem.
- If all signals *do compare* with the expected results, do two things:

1. Check components for intermittent failures.
2. Return to the symptom charts on ACC 633 through ACC 635.



Line No.	Test Point	Line Name	Ch 2 Volts/div	ALD Page	Expected Conditions
1.	A A1F2 (A1Q2) B03	+HDA Ready	0.1	KF220 (KQ220)	+level (MST-1)
2.	F A1E2 (A1R2) P05	+Inhibit HDA Seq	0.1	KE150 (KR150)	−level (MST-1)
3.	C A1E2 (A1R2) M03	+24 V Rezero PB Off	1.0	KE150 (KR150)	Ground with Attn switch on, +24 V with Attn switch off.
4.	D A1E2 (A1R2) P02	+24 V Rezero PB On	1.0	KE150 (KR150)	+24 V with Attn switch on, Ground with Attn switch off.
5.	G A1E2 (A1R2) G07	−Any Rezero	0.1	KE150 (KR150)	−level (MST-1) while the Attn pushbutton is pressed.
6.	E A1E2 (A1R2) U03	+Rd*Wr Capable	0.1	KE150 (KR150)	−level (MST-1) while the Attn pushbutton is pressed.
7.	B A1F2 (A1Q2) S13	−Ready Lamp on TP	1.0	KF260 (KQ260)	+24 V while the Attn pushbutton is pressed.

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DYNAMIC SERVO CHECKOUT

Note: *During microdiagnostic Setup A, the scope timing may vary between drives.*

SCOPE SETUP

Trigger
Slope (−)
Ch 1 only
Mode CHOP
Ch 1 A1E2(A1R2)P10
−Rezero (ACC 654)
Volts/div 0.1
Probe X10
Ch 2 A1E2(A1R2)G02
−Allow Rezero (ACC 656)
Volts/div 0.1
Probe X10

Trigger EXT
Slope (−)
A1E2(A1R2)P10
−Rezero (ACC 654)
Mode CHOP
Ch 1 A1C4(A1T4)D07
+Rezero Mode (ACC 656)
Volts/div 0.1
Probe X10
Ch 2 A1E2(A1R2)G04
−Target Velocity (ACC 655)
Volts/div 0.1
Probe X10

Trigger EXT
Slope (−)
A1E2(A1R2)P10
−Rezero (ACC 654)
Mode CHOP
Ch 1 A1C4(A1T4)J04
+Forward (ACC 656)
Volts/div 0.1
Probe X10
Ch 2 A1C4(A1T4)J09
Pwr Amp Drive (ACC 657)
Volts/div 0.5
Probe X10

MICRODIAGNOSTIC SETUP

Setup A

Routine B8, test 4 (Rezero from OD, see MICFL 633)

1. Load routine B8
2. Enter 10,04,01,00

Scope Sweep Speed = 2 ms/div

Figure 1A.

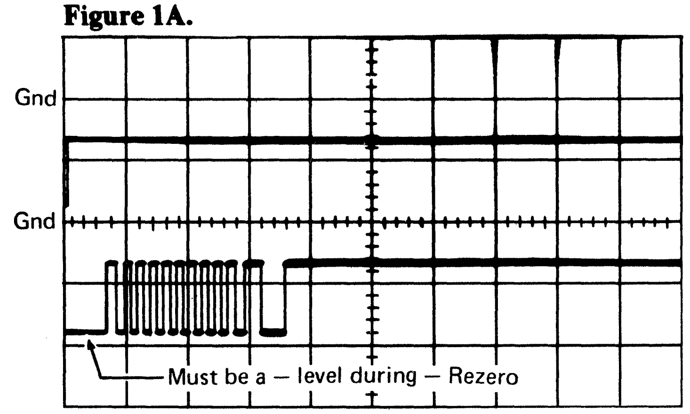


Figure 2A.

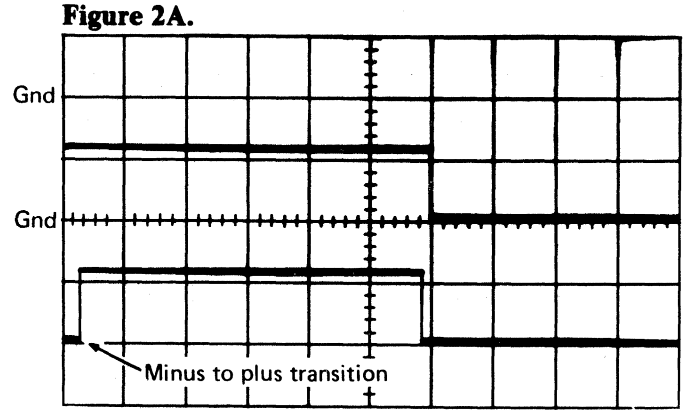
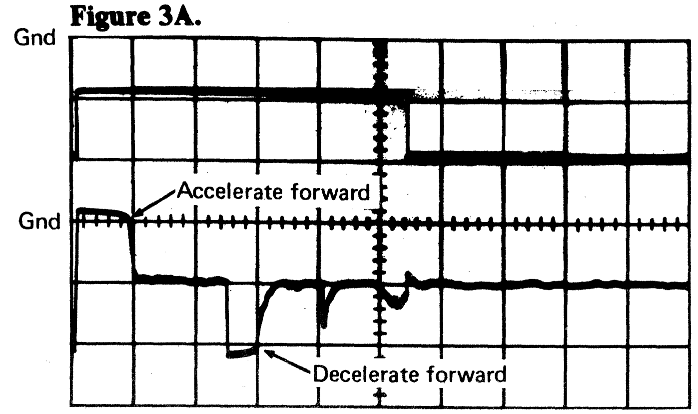


Figure 3A.



Setup B

Routine B8, test 5 (Rezero from cyl 0, see MICFL 633)

1. Load routine B8
2. Enter 10,05,01,00

Scope Sweep Speed = 2 ms/div

Figure 1B.

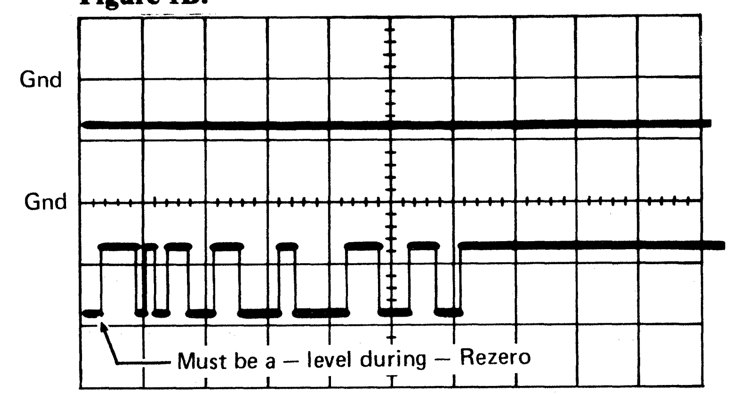


Figure 2B.

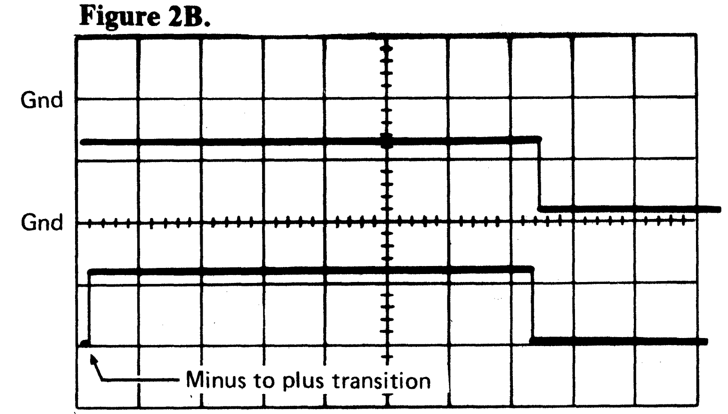
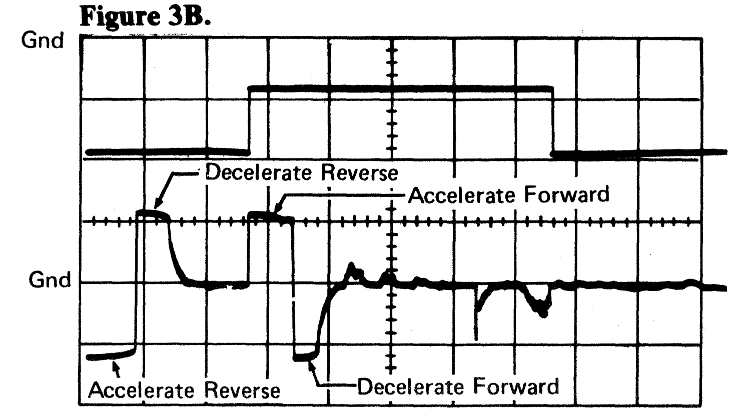


Figure 3B.



Setup C

Routine B8, test 7 (Rezero from cyl 8, see MICFL 633)

1. Load routine B8
2. Enter 10,07,01,00

Scope Sweep Speed = 5 ms/div

Figure 1C.

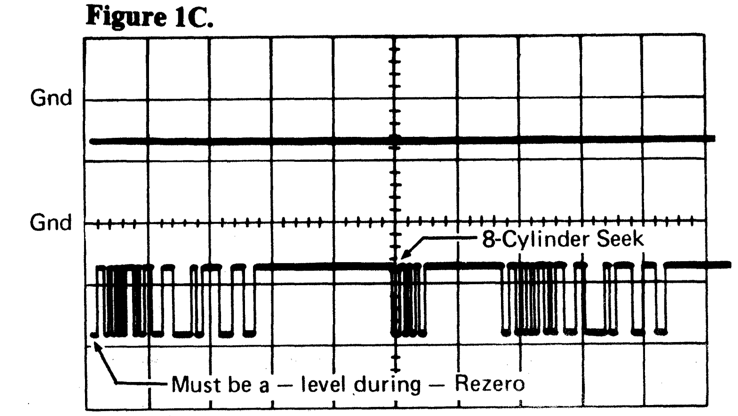


Figure 2C.

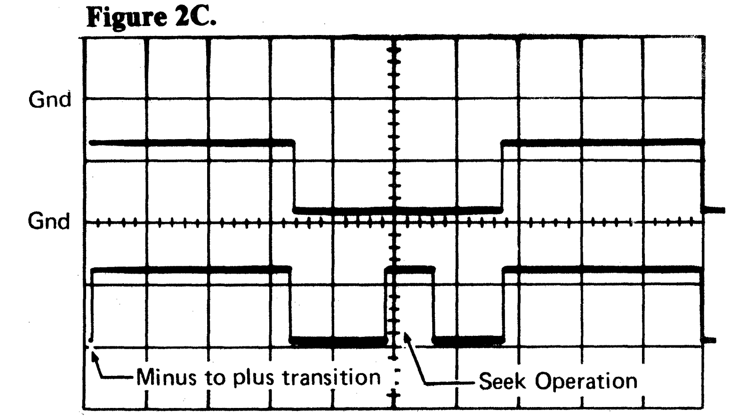
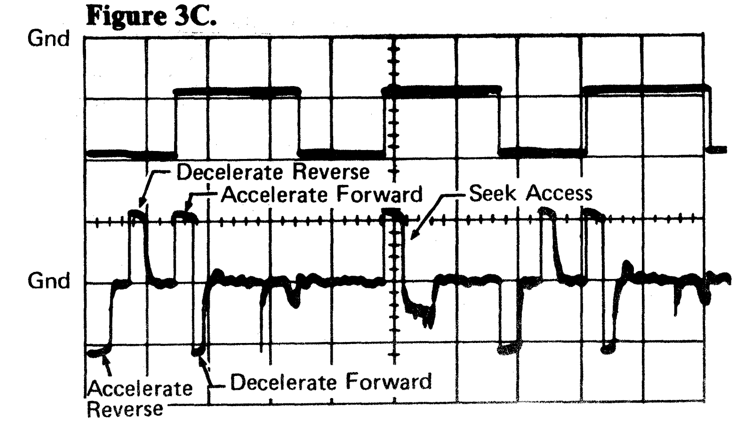


Figure 3C.



DYNAMIC SERVO CHECKOUT

Note: *During microdiagnostic Setup A, the scope timing may vary between drives.*

SCOPE SETUP

Trigger EXT
Slope (–)
A1E2(A1R2)P10
–Rezero (ACC 654)
Mode CHOP
Ch 1 A1C4(A1T4)D10
Current Magnitude (ACC 656)
Volts/div 0.2
Probe X10
Ch 2 A1C4(A1T4)D04
Current Sense (ACC 656)
Volts/div 0.5
Probe X10

Trigger EXT
Slope (–)
A1E2(A1R2)P10
–Rezero (ACC 654)
Mode CHOP
Ch 1 A1D2(A1S2)J12
+Move Forward (ACC 657)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)J10
+Move Reverse (ACC 657)
Volts/div 0.1
Probe X10

Trigger EXT
Slope (–)
A1E2(A1R2)P10
–Rezero (ACC 654)
Mode CHOP
Ch 1 A1D2(A1S2)G08
–Velocity Enable (ACC 657)
Volts/div 0.1
Probe X10
Ch 2 A1C4(A1T4)J12
–Velocity (ACC 656)
Volts/div 0.1
Probe X10

MICRODIAGNOSTIC SETUP

Setup A

Routine B8, test 4 (Rezero from OD, see MICFL 633)

1. Load routine B8
2. Enter 10,04,01,00

Scope Sweep Speed = 2 ms/div

Figure 4A.

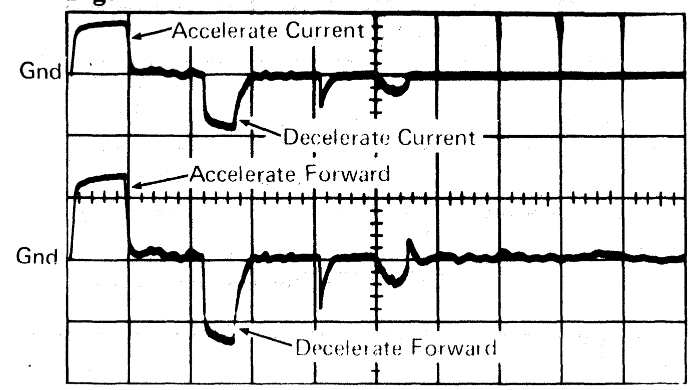


Figure 5A.

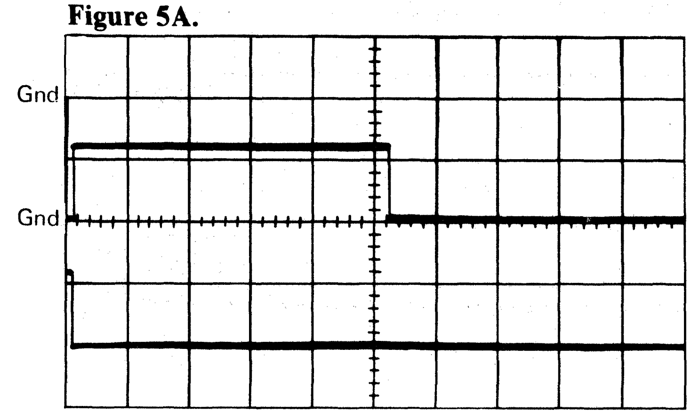
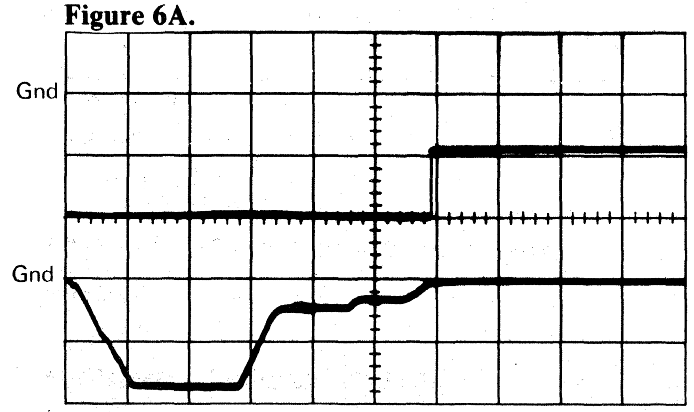


Figure 6A.



Setup B

Routine B8, test 5 (Rezero from cyl 0, see MICFL 633)

1. Load routine B8
2. Enter 10,05,01,00

Scope Sweep Speed = 2 ms/div

Figure 4B.

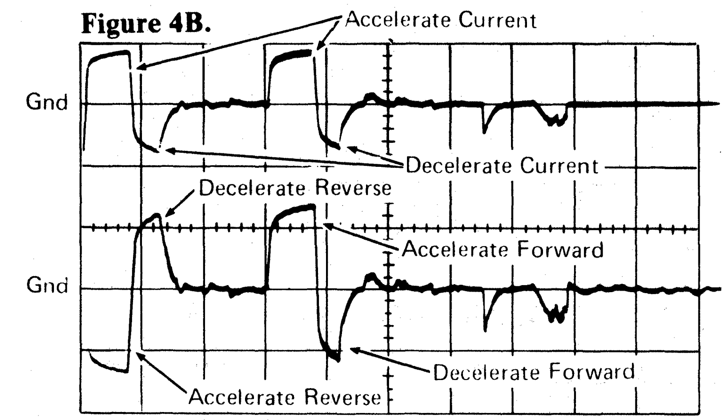


Figure 5B.

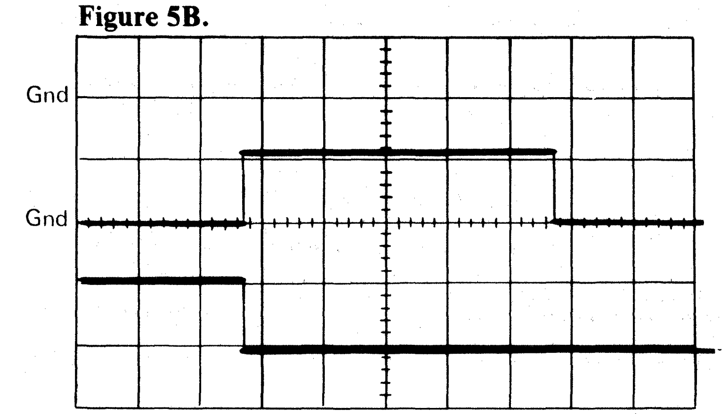
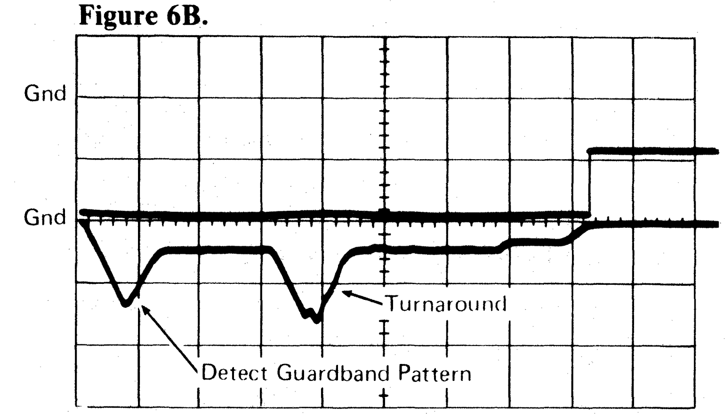


Figure 6B.



Setup C

Routine B8, test 7 (Rezero from cyl 8, see MICFL 633)

1. Load routine B8
2. Enter 10,07,01,00

Scope Sweep Speed = 5 ms/div

Figure 4C.

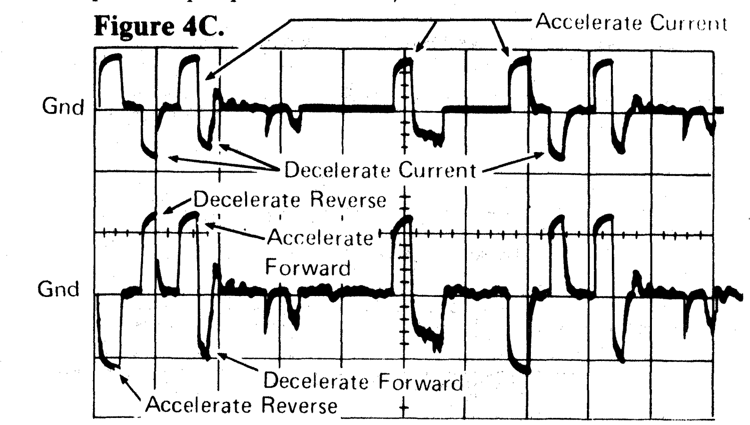


Figure 5C.

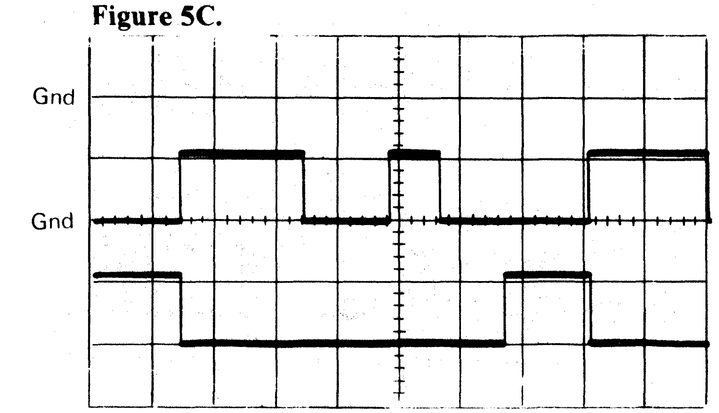
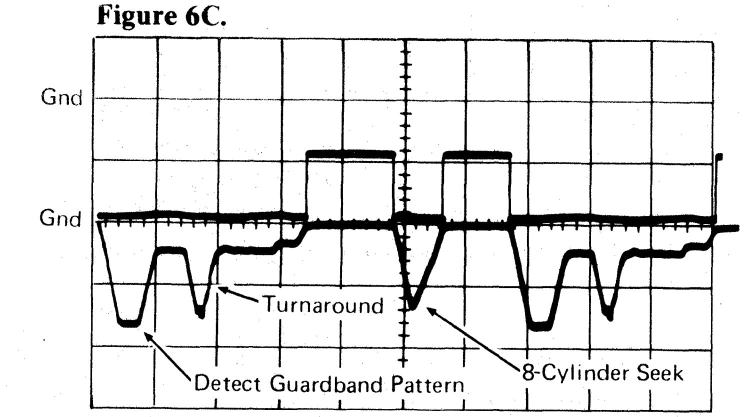


Figure 6C.



DYNAMIC SERVO CHECKOUT

Note: *During microdiagnostic Setup A, the scope timing may vary between drives.*

SCOPE SETUP

Trigger EXT
Slope (–)
A1E2(A1R2)P10
–Rezero (ACC 654)
Mode CHOP
Ch 1 A1C4(A1T4)J02
+ High Velocity Setpoing (ACC 646)
Volts/div 0.1
Probe X10
Ch 2 A1E2(A1R2)P07
–Track Xing (ACC 656)
Volts/div 0.1
Probe X10

Sweep
Trigger EXT
Slope (–)
A1E2(A1R2)P10
–Rezero (ACC 654)
Mode CHOP
Ch 1 A1D2(A1S2)J13
+ Position (ACC 657)
Volts/div 0.5
Probe X10
Ch 2 A1D2(A1S2)G13
–Position (ACC 657)
Volts/div 0.5
Probe X10

Sweep
Trigger EXT
Slope (–)
A1E2(A1R2)P10
–Rezero (ACC 654)
Mode CHOP
Ch 1 A1E2(A1R2)J04
+ Guardband Latch (ACC 655)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)D13
–Linear Mode CS (ACC 657)
Volts/div 0.1
Probe X10

MICRODIAGNOSTIC SETUP

Setup A

Routine B8, test 4 (Rezero from OD; see MICFL 633)

1. Load routine B8
2. Enter 10,04,01,00

Scope Sweep Speed = 2 ms/div

Figure 7A.

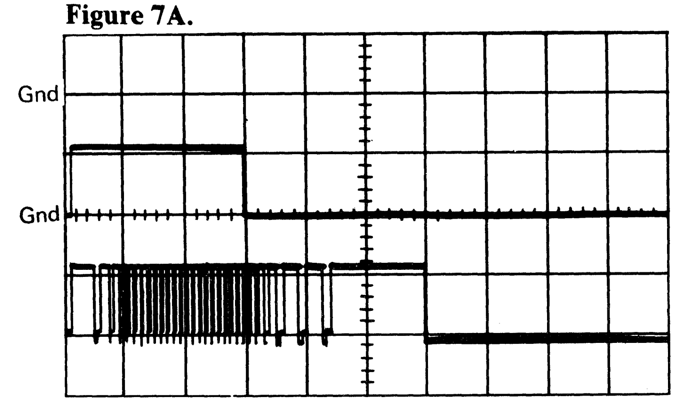


Figure 8A.

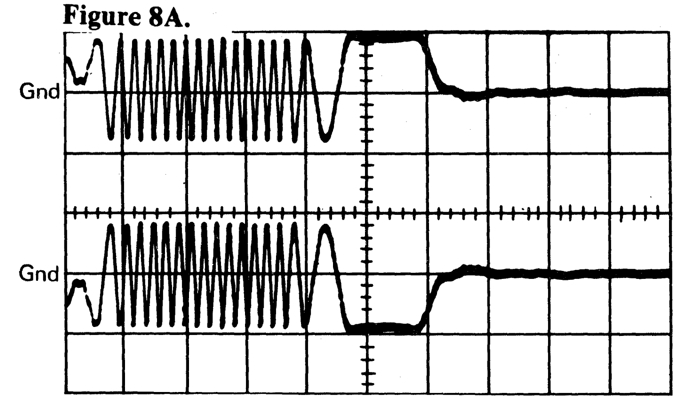
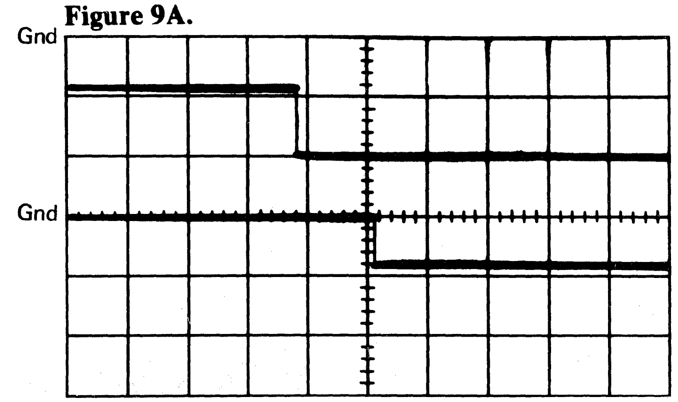


Figure 9A.



Setup B

Routine B8, test 5 (Rezero from cyl 0; see MICFL 633)

1. Load routine B8
2. Enter 10,05,01,00

Scope Sweep Speed = 2 ms/div

Figure 7B.

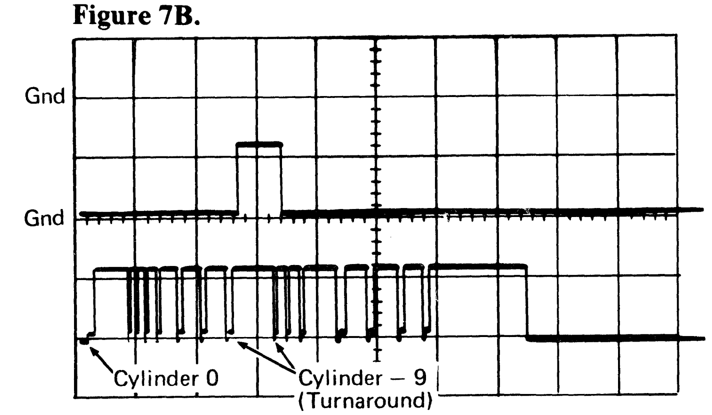


Figure 8B.

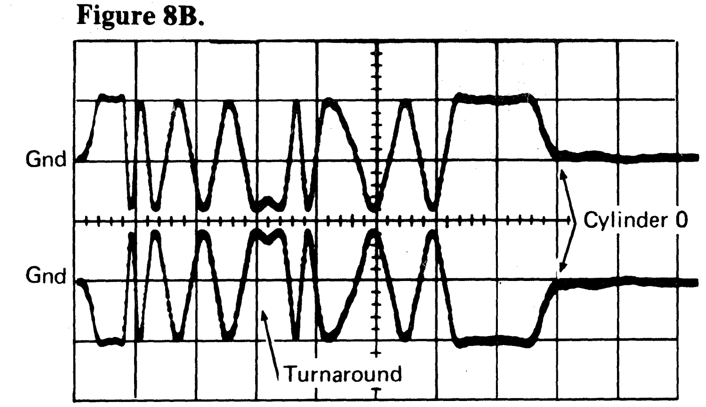
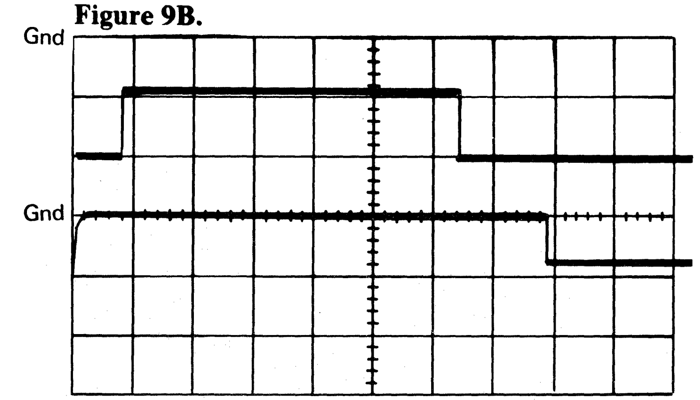


Figure 9B.



Setup C

Routine B8, test 7 (Rezero from cyl 8; see MICFL 633)

1. Load routine B8
2. Enter 10,07,01,00

Scope Sweep Speed = 5 ms/div

Figure 7C.

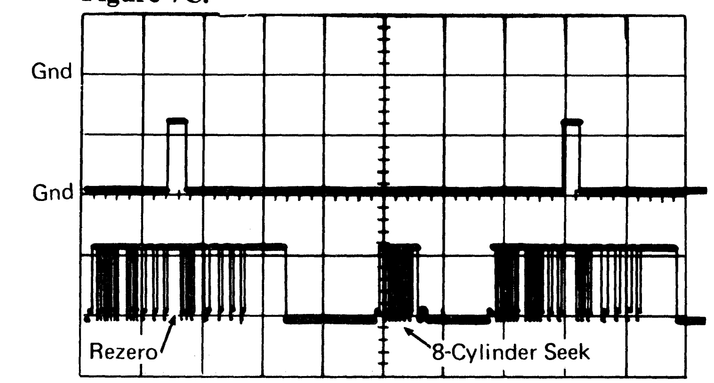


Figure 8C.

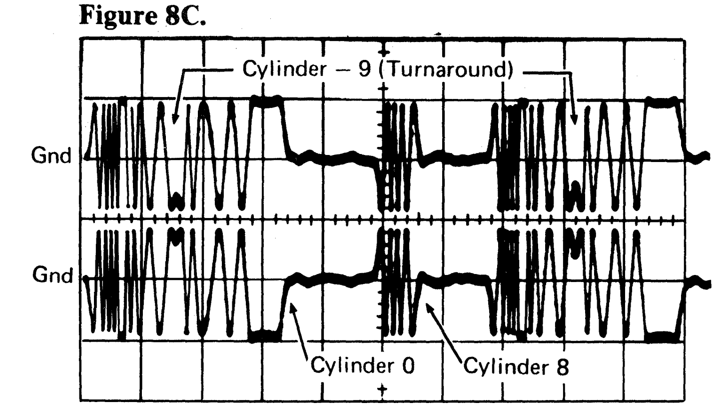
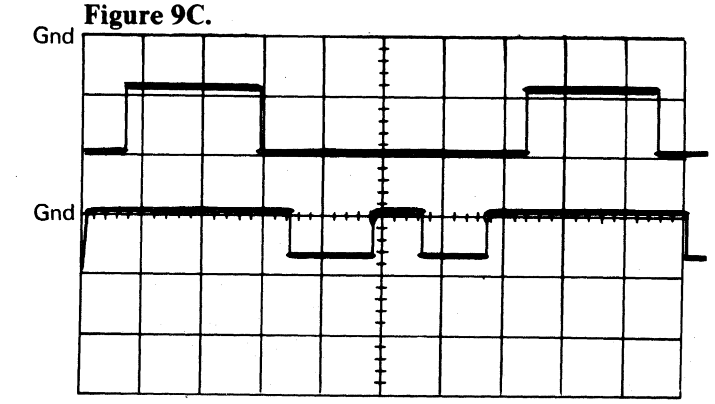


Figure 9C.



DYNAMIC SERVO CHECKOUT

Note: *During microdiagnostic Setup A, the scope timing may vary between drives.*

SCOPE SETUP

Trigger EXT
Slope (−)
A1E2(A1R2)P10
−Rezero (ACC 654)

Mode	ADD
Ch 1 VCM TB−A (See Figure 1, ACC 600)	
AC Input	
Volts/div	2.0
Probe	X10
Ch 2 VCM TB−B (See Figure 1, ACC 600)	
AC Input	
Volts/div	2.0
Probe	X10
Invert	

MICRODIAGNOSTIC SETUP

Setup A

Routine B8, test 4 (Rezero from OD; see MICFL 633)

1. Load routine B8
2. Enter 10,04,01,00

Scope Sweep Speed = 2 ms/div

Setup B

Routine B8, test 5 (Rezero from cyl 0; see MICFL 633)

1. Load routine B8
2. Enter 10,05,01,00

Scope Sweep Speed = 2 ms/div

Setup C

Routine B8, test 7 (Rezero from cyl 8; see MICFL 633)

1. Load routine B8
2. Enter 10,07,01,00

Scope Sweep Speed = 5 ms/div

Figure 10A.

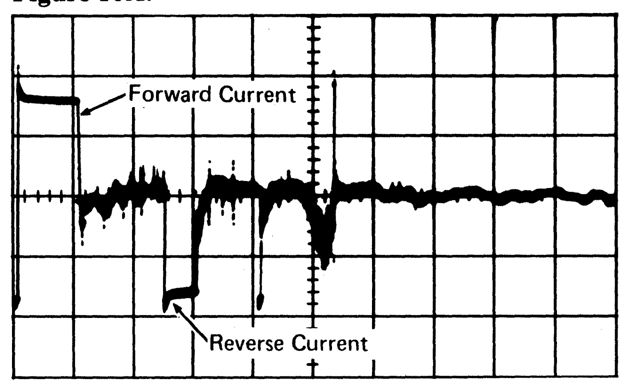


Figure 10B.

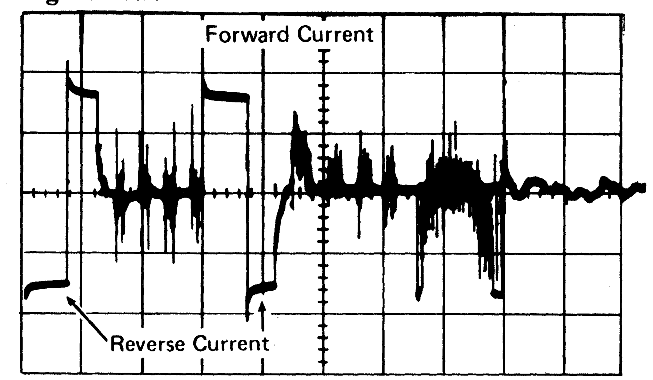
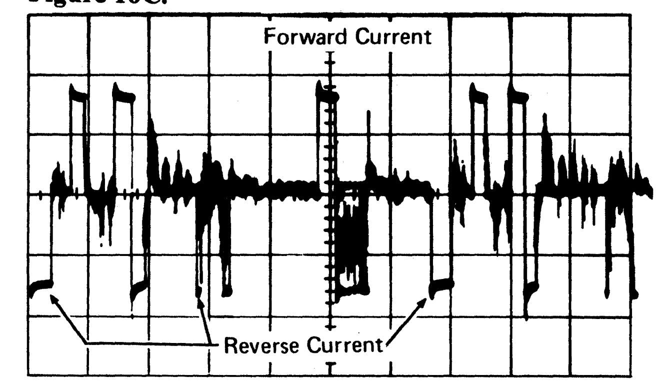


Figure 10C.



MICRODIAGNOSTIC SETUP

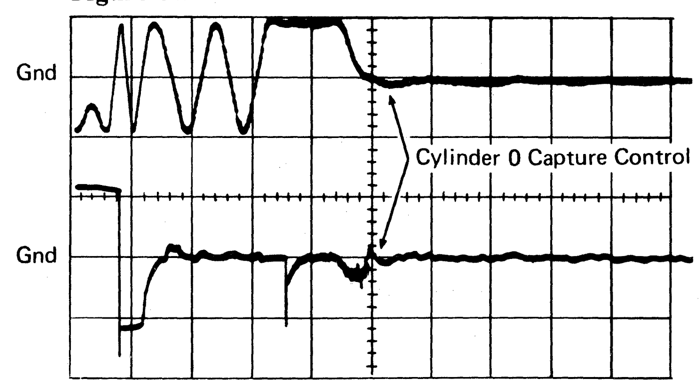
Routine B8, test 5 (Rezero from cyl 0; see MICFL 633)

1. Load routine B8
2. Enter 10,05,01,00

SCOPE SETUP

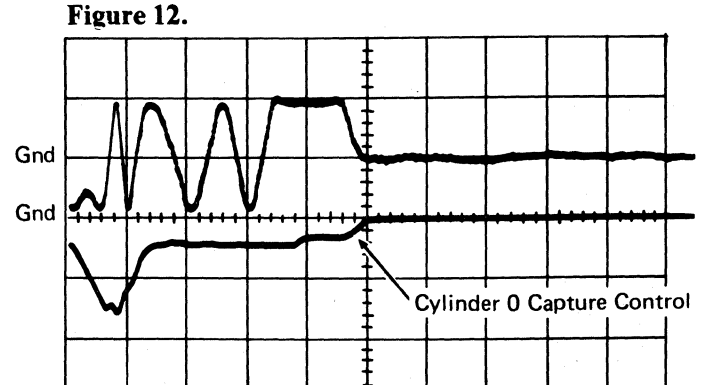
Sweep 2 ms/div
Trigger EXT
  Slope (+)
  A1C4(A1T4)J04
  +Forward (ACC 656)
Mode CHOP
Ch 1 A1D2(A1S2)J13
  +Position (ACC 657)
  Volts/div 0.5
  Probe X10
Ch 2 A1C4(A1T4)J09
  Pwr Amp Drive (ACC 657)
  Volts/div 0.5
  Probe X10

Figure 11.



Sweep 2 ms/div
Trigger EXT
  Slope (+)
  A1C4(A1T4)J04
  +Forward (ACC 656)
Mode CHOP
Ch 1 A1D2(A1S2)J13
  Position (ACC 657)
  Volts/div 0.5
  Probe X10
Ch 2 A1C4(A1T4)J12
  −Velocity (ACC 656)
  Volts/div 0.1
  Probe X10

Figure 12.



MICRODIAGNOSTIC SETUP

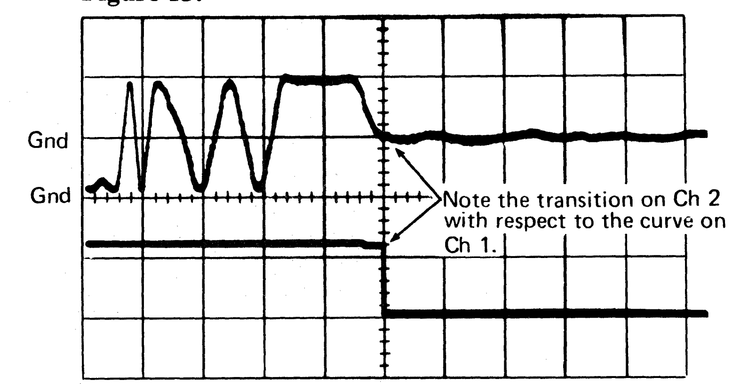
Routine B8, test 5 (Rezero from cyl 0; see MICFL 633)

1. Load routine B8
2. Enter 10,05,01,00

SCOPE SETUP

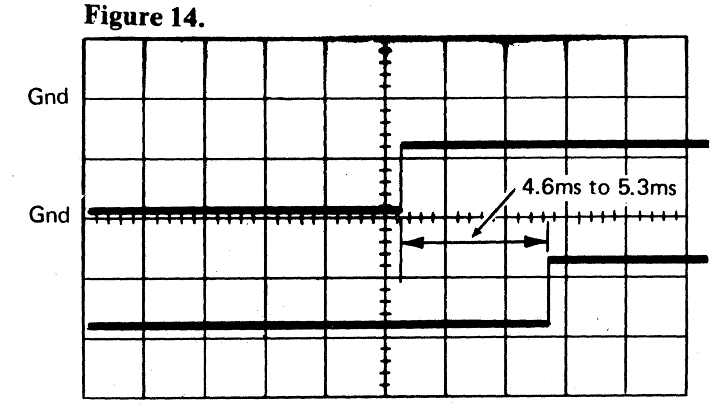
Sweep 2 ms/div
Trigger EXT
  Slope (+)
  A1C4(A1T4)J04
  +Forward (ACC 656)
Mode CHOP
Ch 1 A1D2(A1S2)J13
  +Position (ACC 657)
  Volts/div 0.5
  Probe X10
Ch 2 A1E2(A1R2)G05
  −End Decelerate (ACC 655)
  Volts/div 0.1
  Probe X10

Figure 13.



Sweep 2 ms/div
Trigger EXT
  Slope (+)
  A1C4(A1T4)J04
  +Forward (ACC 656)
Mode CHOP
Ch 1 A1C4(A1T4)G05
  +Linear Mode (ACC 656)
  Volts/div 0.1
  Probe X10
Ch 2 A1E2(A1R2)M04
  +Trk Following Timer (ACC 655)
  Volts/div 0.1
  Probe X10

Figure 14.



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SCOPE SETUP

Trigger EXT
Slope (−)
A1E2(A1R2)D05
−Seek Start (ACC 654)
Mode CHOP
Ch 1 A1D2(A1S2)G09
+Access Mode (ACC 657)
Volts/div 0.1
Probe X10
Ch 2 A1E2(A1R2)D10
−End Accelerate (ACC 655)
Volts/div 0.1
Probe X10

Trigger EXT
Slope (−)
A1E2(A1R2)D05
−Seek Start (ACC 654)
Mode CHOP
Ch 1 A1C4(A1T4)G12
+DAC (ACC 656)
Volts/div 0.1
Probe X10
Ch 2 A1C4(A1T4)J12
−Velocity (ACC 656)
Volts/div 0.1
Probe X10

Trigger EXT
Slope (−)
A1E2(A1R2)D05
−Seek Start (ACC 654)
Mode CHOP
Ch 1 A1C4(A1T4)J09
Pwr Amp Drive (ACC 657)
Volts/div 0.5
Probe X10
Ch 2 A1C4(A1T4)D04
Current Sense (ACC 656)
Volts/div 0.5
Probe X10

MICRODIAGNOSTIC SETUP

Setup A

Routine B8, test 7 (8-cyl Seek; see MICFL 633)

1. Load routine B8
2. Enter 10,07,01,00

Scope Sweep Speed = 0.5 ms/div

Figure 15A.

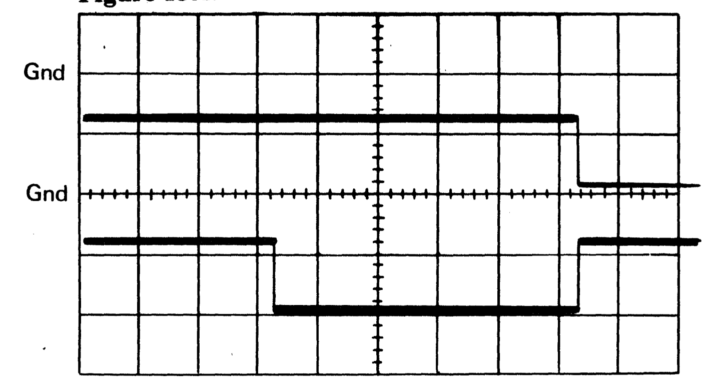


Figure 16A.

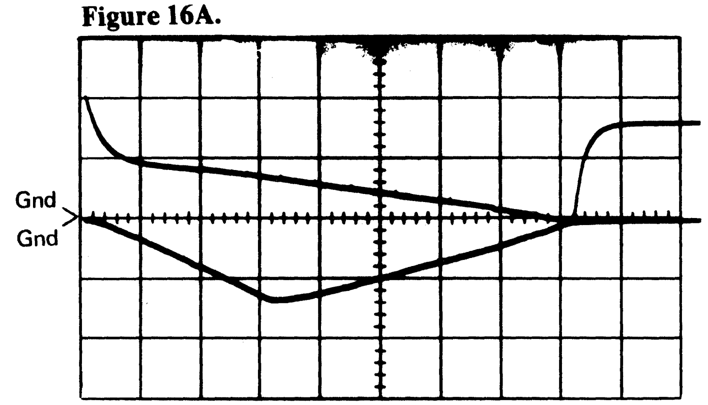
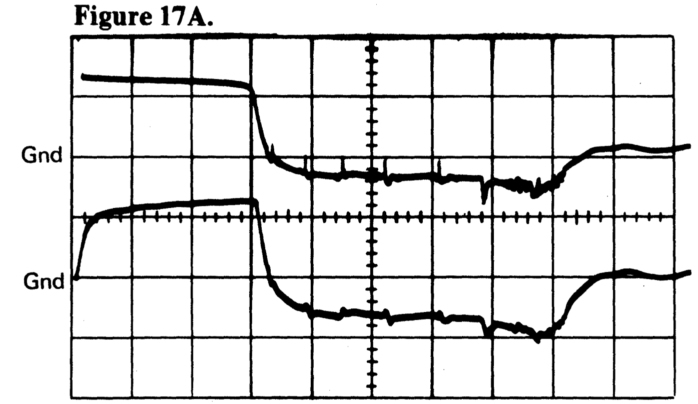


Figure 17A.



Note: *For Figure 16B only, change the volts/div as follows:*

Ch 1 0.2
Ch 2 0.5

Setup B

Routine B8, test A (192-cyl Seek; see MICFL 633)

1. Load routine B8
2. Enter 10,0A,01,00

Scope Sweep Speed = 2 ms/div

Figure 15B.

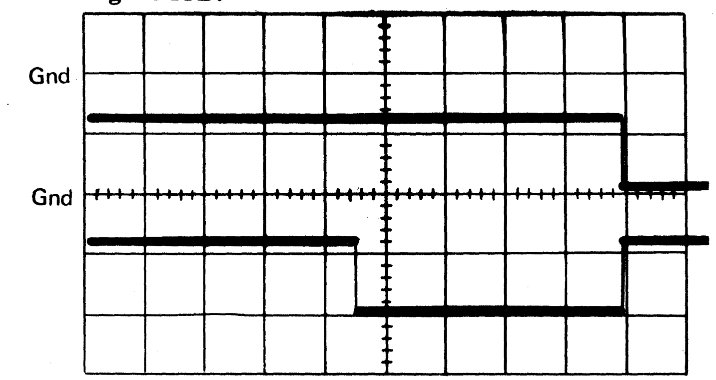


Figure 16B.

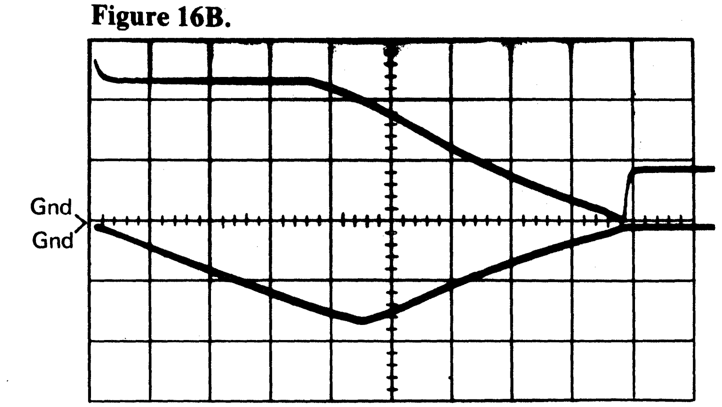
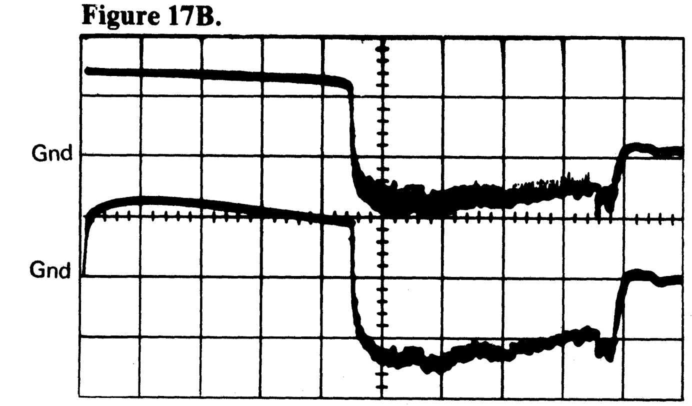


Figure 17B.



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DYNAMIC SERVO CHECKOUT

SCOPE SETUP

Trigger EXT
Slope (–)
A1E2(A1R2)D05
–Seek Start (ACC 654)
Mode CHOP
Ch 1 A1D2(A1S2)J13
+Position (ACC 657)
Volts/div 0.5
Probe X10
Ch 2 A1E2(A1R2)P07
–Track Xing (ACC 656)
Volts/div 0.1
Probe X10

Trigger EXT
Slope (–)
A1E2(A1R2)D05
–Seek Start (ACC 654)
Mode CHOP
Ch 1 A1E2(A1R2)G05
–End Decelerate (ACC 655)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Volts/div 0.1
Probe X10

Trigger EXT
Slope (–)
A1E2(A1R2)D05
–Seek Start (ACC 654)
Mode ADD
Ch 1 VCM TB–A
(See Figure 1, ACC 600)
AC Input
Volts/div 2.0
Probe X10
Ch 2 VCM TB–B
(See Figure 1, ACC 600)
AC Input
Volts/div 2.0
Probe X10
Invert

MICRODIAGNOSTIC SETUP

Setup A

Routine B8, test 7 (8-cyl Seek; see MICFL 633)

1. Load routine B8
2. Enter 10,07,01,00

Scope Sweep Speed = 0.5 ms/div

Figure 18A.

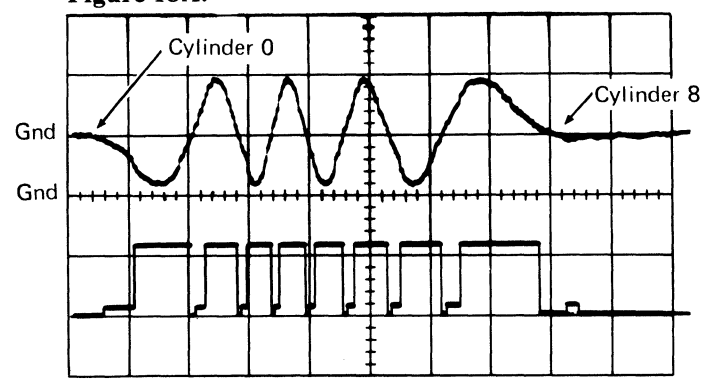


Figure 19A.

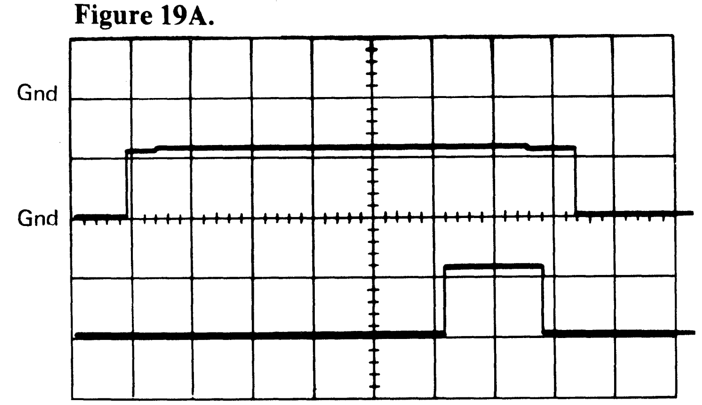
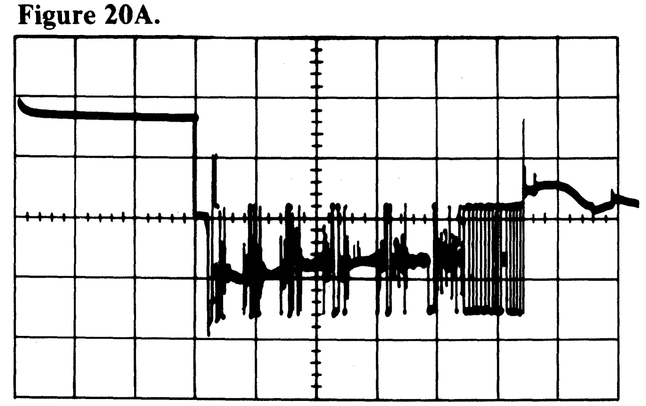


Figure 20A.



Setup B

Routine B8, test A

1. Load routine B8 (192-cyl Seek; see MICFL 633)
2. Enter 10,0A,01,00

Scope Sweep Speed = 2 ms/div

Figure 18B.

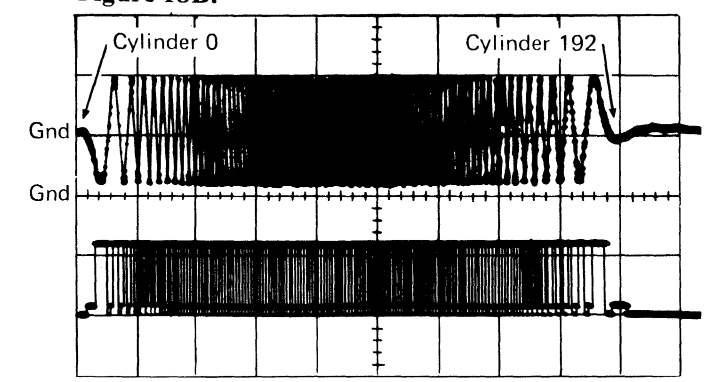


Figure 19B.

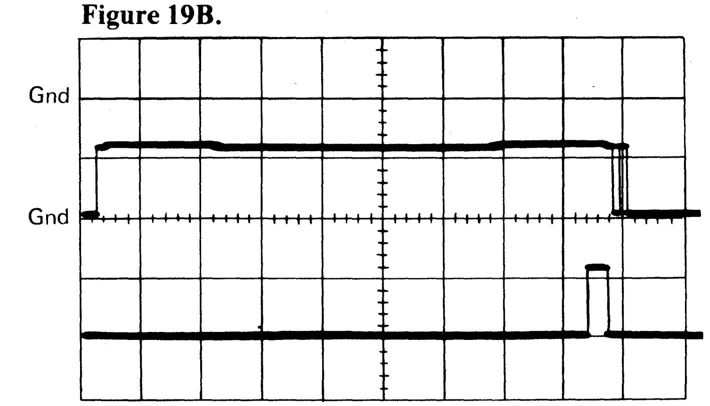
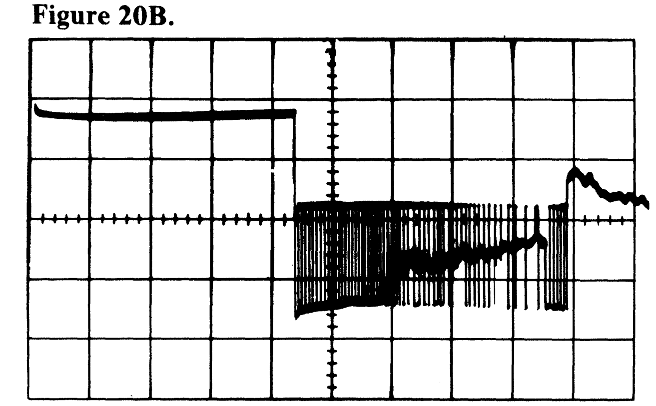
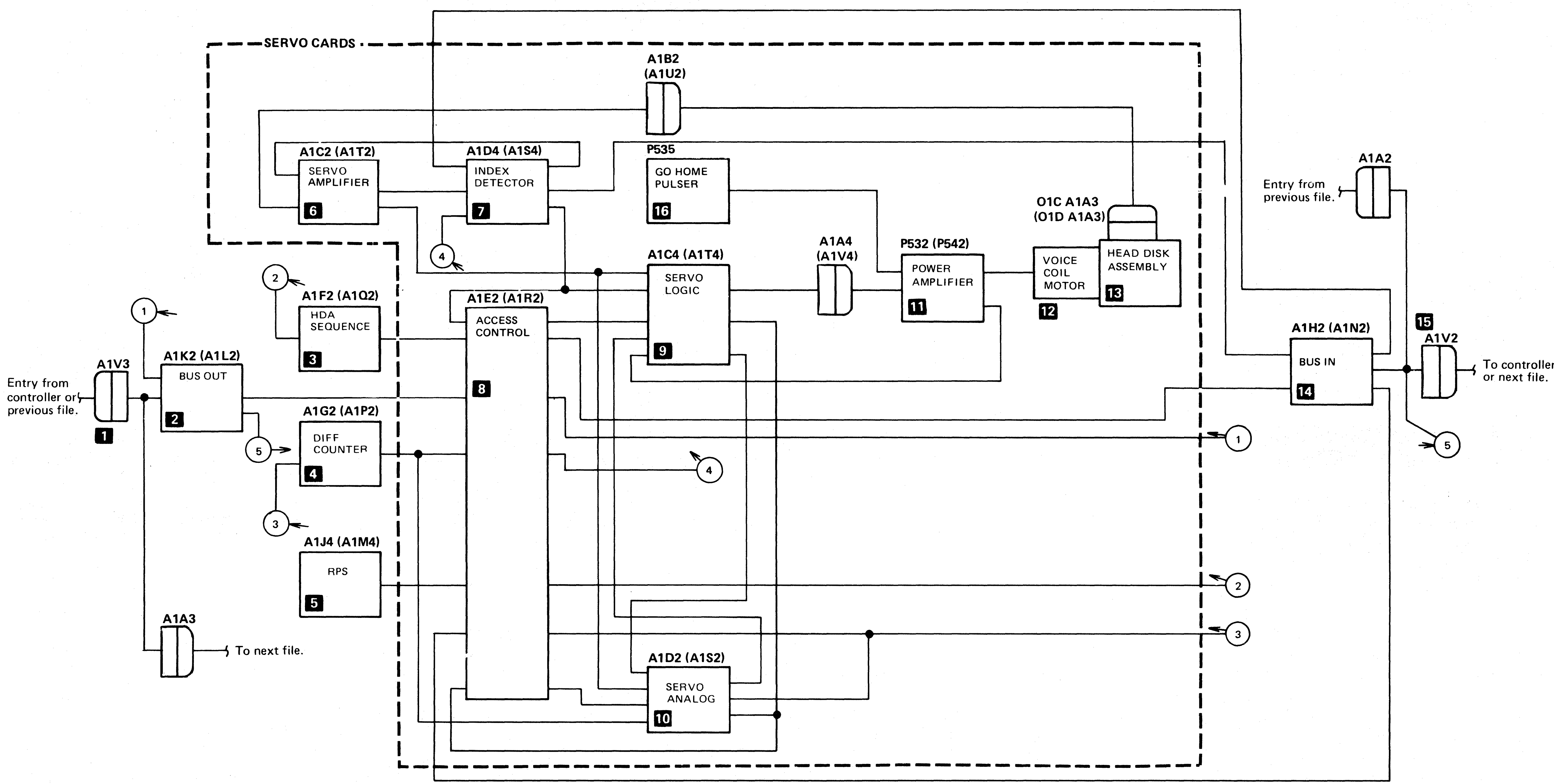


Figure 20B.



DYNAMIC SERVO CHECKOUT

Use this diagram with the charts beginning on ACC 653.
See OPER 116 for additional theory.



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DYNAMIC SERVO CHECKOUT

DIAGRAM CHARTS

The charts beginning on this page describe the card interconnections for Servo operations – Rezero or Seek.

The diagram on ACC 652 shows no more than one line between two card blocks. Each line on the diagram represents the group of lines (one or more lines) that go *to* a particular card *from* another card.

The charts are organized by line group. The first line group in the chart is To Bus Out **2** From Access Control **8**. The chart lists the key Input lines *to* Bus In *from* Access Control and indicates the expected condition of those key lines during a Rezero operation or a Seek operation.

INBUS AND OUTBUS CONNECTORS

The Inbus connectors **15** and the Outbus connectors **1** are not included in the chart. However, their purpose and their pin assignments are shown here for reference.

Outbus Connector 1

A1A3 = Exit connector to the next module, or the terminator connector if it is in the last module on the string.

A1V3 = Entry from the controller if it is in the Control module, or the entry from the previous module.

B02	+NPL Outbus Bit 0	D02	+NPL Tagbus 0
B03	Gnd	D03	+NPL Tagbus 1
B04	+NPL Outbus Bit 1	D04	Gnd
B05	+NPL Outbus Bit 2	D05	+NPL Tagbus 2
B06	+NPL Outbus Bit 3	D06	+NPL Tagbus P
B07	GND	D07	+NPL Tag Gate
B08	+NPL Outbus Bit 4	D08	Gnd
B09	+NPL Outbus Bit 5	D09	+NPL Select Hold
B10	+NPL Outbus Bit 6	D10	
B11	Gnd	D11	
B12	+NPL Outbus Bit 7	D12	Gnd
B13	+NPL Outbus Bit P	D13	+NPL Tag Valid

Inbus Connector 15

A1V2 = Exit connector to the controller or to the next module.

A1A2 = Entry from the previous module, or the terminator connector if it is in the last module in the string.

B02	+NPL Inbus Bit 0	D02	+NPL Attn Sel Bit 0
B03	Gnd	D03	+NPL Attn Sel Bit 1
B04	+NPL Inbus Bit 1	D04	Gnd
B05	+NPL Inbus Bit 2	D05	+NPL Attn Sel Bit 2
B06	+NPL Inbus Bit 3	D06	+NPL Attn Sel Bit 3
B07	Gnd	D07	+NPL Attn Sel Bit 4
B08	+NPL Inbus Bit 4	D08	Gnd
B09	+NPL Inbus Bit 5	D09	+NPL Attn Sel Bit 5
B10	+NPL Inbus Bit 6	D10	+NPL Attn Sel Bit 6
B11	Gnd	D11	+NPL Attn Sel Bit 7
B12	+NPL Inbus Bit 7	D12	Gnd
B13	+NPL Inbus Bit P	D13	+NPL Service Attn

Line Group (Input)		Line Name	Test Point	ALD Page	Expected Condition or Purpose	
To	From				During a Rezero	During a Seek
Bus Out **2**	Access Control **8**	+ Attention	A1K2 (A1L2) G08	KK150 (KL150)	• Generates NPL Service Attention when the drive is in CE mode. • Generates NPL Attention Select Response when the drive is not in CE mode. + Attention is generated during a Servo operation by −Access Complete. (−Access Complete is an input line to HDA Sequence **3**.)	Same as Rezero.
		− Any Rezero	A1K2 (A1L2) D02	KK180 (KL180)	Clears the CE Mode latch after the CE switch is turned off. Activated with the Attention pushbutton.	Not used.
HDA Sequence **3**	Access Control **8**	+ Inhibit HDA Seq	A1F2 (A1Q2) B13	KF130 (KQ130)	+Level (MST-1).	+Level (MST-1).
		−Access Complete	A1F2 (A1Q2) P10	KF150 (KQ150)	−Level (MST-1) within 220 ms of −Rezero.	−Level (MST-1) within 220 ms of Seek Start.
		−Go Home Complete	A1F2 (A1Q2) G02	KF200 (KQ200)	+Level (MST-1); goes to a −level only during an HDA unload sequence.	+Level (MST-1).
		+ Rd * Wr Capable	A1F2 (A1Q2) S04	KF260 (KQ260)	Goes to +Level (MST-1) at the normal completion of a Servo operation (−Access Complete without Drive Checks). Causes the Ready lamp to turn on.	Same as Rezero.

Line Group (Input) To	Line Group (Input) From	Line Name	Test Point	ALD Page	Expected Condition or Purpose: During a Rezero	Expected Condition or Purpose: During a Seek
Diff Counter 4	Access Control 8	−Any Rezero	A1G2 (A1P2) D04	KG150 (KP150)	−Pulse (MST-1). Causes the Difference Counter, HAR, and CAR to reset to zero. (Verified by microdiagnostic routine B8, test 3.)	+Level (MST-1).
		+Allow Diff Cntr	A1G2 (A1P2) D03	KG150 (KP150)	−Level MST-1).	+Level (MST-1) during Seek movement. Allows Track Xing pulses to decrement the Difference Counter. (Verified by error check B892.)
Diff Counter 4	Servo Analog 10	+Track Xing Pulse	A1G2 (A1P2) U02	KG150 (KP150)	Pulses (MST-1). (Not used by Diff Counter during Rezero operation.)	Pulses (MST-1). Each positive transition causes the Difference Counter to decrement one count. (Verified by error check B892.)
Servo Amplifier 6	Index Detector 7	+Gate 1	A1C2 (A1T2) D07	KC100 (KT100)	See ACC 603, Figure 4.	See ACC 603, Figure 4.
		+Gate 2	A1C2 (A1T2) D13	KC100 (KT100)	See ACC 603, Figure 4.	See ACC 603, Figure 4.
		−Increment	A1C2 (A1T2) J04	KC100 (KT100)	See ACC 603, Figure 5.	See ACC 603, Figure 5.
		−Decrement	A1C2 (A1T2) G07	KC100 (KT100)	See ACC 603, Figure 5.	See ACC 603, Figure 5.
Servo Amplifier 6	Head Disk Assembly 13	Servo Input	See diagram on ACC 602.	KC100 (KT100)	See ACC 601, Figure 1. See ACC 664, Figure 1.	Same as Rezero.
Index Detector 7	Servo Amplifier 6	+VCO	A1D4 (A1S4) D13	KD530 (KS530)	See ACC 605, Figure 6.	See ACC 605, Figure 6.
		+Servo Clock	A1D4 (A1S4) G10	KD550 (KS550)	See ACC 602, Figure 3.	See ACC 602, Figure 3.
		+Timer Gate	A1D4 (A1S4) J13	KD560 (KS560)	See ACC 602, Figure 3.	See ACC 602, Figure 3.
		−AGC Active	A1D4 (A1S4) B11	KD570 (KS570)	−Level (MST-1) when the spindle motor is at speed.	Same as Rezero.

Line Group (Input) To	Line Group (Input) From	Line Name	Test Point	ALD Page	Expected Condition or Purpose: During a Rezero	Expected Condition or Purpose: During a Seek
Index Detector 7	Access Control 8	−Even Track	A1D4 (A1S4) D03	KD540 (KS540)	−Level (MST-1). (Verified by error checks B825, B837, and B844.)	−Level (MST-1) during Seeks to even tracks. (Verified by error check B8AD). +Level (MST-1) during Seeks to odd tracks. (Verified by error checks B930 and B933.)
Index Detector 7	Bus In 14	−Set Rd * Wr or Pad Ctrl	A1D4 (A1S4) G02	KD500 (KS500)	• Gates Index Mark to the controller. Verified by error check B832.) • Enables the Index checking circuits. (Verified by error check B8F5.)	
Access Control 8	Bus Out 2	−Seek Start	A1E2 (A1R2) D05	KE100 (KR100)	+Level (MST-1).	−Level (MST-1) for 6 μs (maximum)
		−MST Outbus Bit 0	A1E2 (A1R2) D12	KE110 (KR110)	+Diag Set: • With −MST Outbus Bit 0 = Diagnostic Servo Reset. This combination forces the servo into Zero mode. • With −MST Outbus Bit 1 = Diagnostic Go Home. This combination forces the servo into Wait state and moves the carriage.	Same as Rezero.
		+Diag Set	A1E2 (A1R2) B07	KE110 (KR110)		
		−MST Outbus Bit 1	A1E2 (A1R2) B11	KE110 (KR110)		
		−Attn Reset	A1E2 (A1R2) D03	KE140 (KR140)	Resets Access Busy status after Seek Complete.	Same as Rezero.
		−Rezero	A1E2 (A1R2) P10	KE150 (KR150)	−Pulse (MST-1). Initiates the Rezero operation.	+Level (MST-1).
		−Sense Status 3	A1E2 (A1R2) S07	KE160 (KR160)	See DEV-I 184	See DEV-I 184.

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DYNAMIC SERVO CHECKOUT

Line Group (Input)		Line Name	Test Point	ALD Page	Expected Condition or Purpose	
To	From				During a Rezero	During a Seek
Access Control 8	Bus Out 2	+Gate Mach or R*W Status	A1E2 (A1R2) U12	KE160 (KR160)	See DEV-I 184.	See DEV-I 184.
		−Sense Status 4	A1E2 (A1R2) S12	KE160 (KR160)	See DEV-I 184.	See DEV-I 184.
		+Gate Mach Status	A1E2 (A1R2) U05	KE160 (KR160)	See DEV-I 184.	See DEV-I 184.
		−Sense Status 2	A1E2 (A1R2) S08	KE160 (KR160)	See DEV-I 184.	See DEV-I 184.
Access Control 8	HDA Sequence 3	−Carriage Go Home.	A1E2 (A1R2) M08	KE120 (KR120)	+Level (MST-1). Active only during HDA State 7.	Same as Rezero.
		+State 3	A1E2 (A1R2) M07	KE120 (KR120)	−Level (MST-1). Active only during HDA State 3.	Same as Rezero.
		−Power On Reset	A1E2 (A1R2) B12	KE120 (KR120)	+Level (MST-1).	+Level (MST-1).
		+Sequence Rezero	A1E2 (A1R2) G12	KE140 (KR140)	+Level (MST-1) during HDA On sequence only (HDA State 2).	−Level (MST-1).
		+HDA Ready	A1E2 (A1R2) J13	KE140 (KR140)	+Level (MST-1).	+Level (MST-1).
Access Control 8	Diff Counter 4	+Diff Cntr Zero	A1E2 (A1R2) J05	KE100 (KR100)	+Level (MST-1).	−Level (MST-1).
		−Direction Bit In	A1E2 (A1R2) D06	KE100 (KR100)	+Level (MST-1).	+Level (MST-1) for Seek toward outer part of disk. −Level (MST-1) for Seek toward the spindle.
		−DC7	A1E2 (A1R2) B04	KE150 (KR150)	+Level (MST-1).	−Level (MST-1) for an odd cylinder Seek during Seek Start. (Verified by microdiagnostic routine B9, Test 3.) +Level (MST-1) for an even cylinder Seek during Seek Start. (Verified by microdiagnostic routine B9, Test 4.)

Line Group (Input)		Line Name	Test Point	ALD Page	Expected Condition or Purpose	
To	From				During a Rezero	During a Seek
Access Control 8	RPS 5	+Sch Sector	A1E2 (A1R2) G13	KE140 (KR140)	−Level (MST-1).	−Level (MST-1).
		+Sector Noncompare	A1E2 (A1R2) U07	KE160 (KR160)	−Level (MST-1)	−Level (MST-1).
		+Sector Attention	A1E2 (A1R2) P06	KE170 (KR170)	−Level (MST-1)	−Level (MST-1).
Access Control 8	Index Detector 7	−Guardband Pattern 2	A1E2 (A1R2) D07	KE100 (KR100)	See ACC 607, Figure 8.	+Level (MST-1).
		+Guardband Pattern 1	A1E2 (A1R2) G11	KE100 (KR100)	See ACC 607, Figure 8.	−Level (MST-1).
		+Guardband Latch	A1E2 (A1R2) J04	KE100 (KR100)	See ACC 645, Figure 9.	−Level (MST-1).
		−Any Valid Index	A1E2 (A1R2) P11	KE110 (KR110)	See ACC 605, Figure 7.	See ACC 605, Figure 7.
		−ID Position	A1E2 (A1R2) U11	KE140 (KR140)	+Level (MST-1). Indicates that the carriage is in the ID area of the disk. ID area = area beyond track 561, toward spindle. −Level verified by microdiagnostic routine B8, Test B.	Same as Rezero.
Access Control 8	Servo Logic 9	+Trk Following Timer	A1E2 (A1R2) M04	KE100 (KR100)	See ACC 647, Figure 14.	See ACC 647, Figure 14.
		−End Decelerate	A1E2 (A1R2) G05	KE100 (KR100)	See ACC 647, Figure 13.	See ACC 649, Figure 19.
		−End Accelerate	A1E2 (A1R2) D10	KE110 (KR110)	Not used.	See ACC 648, Figure 15.
		+Access Timeout	A1E2 (A1R2) M10	KE120 (KR120)	−Level (MST-1) Verified by microdiagnostic routine B8, Test 2.)	−Level (MST-1).
		−Velocity Grtr 20 IPS	A1E2 (A1R2) G03	KE130 (KR130)	+Level (MST-1).	+Level (MST-1).
		−Target Velocity	A1E2 (A1R2) G04	KE150 (KR150)	See ACC 643, Figure 2.	See ACC 643, Figure 2.

Line Group (Input)		Line Name	Test Point	ALD Page	Expected Condition or Purpose	
To	From				During a Rezero	During a Seek
Access Control 8	Servo Analog 10	+Track Xing Pulse	A1E2 (A1R2) J06	KE130 (KR130)	+Pulses (MST-1). 3.2 μsec ± 20%. (Sync = −Track Xing.)	Same as Rezero.
		−Allow Rezero	A1E2 (A1R2) G02	KE150 (KR150)	See ACC 643, Figure 1.	Not Used.
		−Track Xing	A1E2 (A1R2) P07	KE110 (KR110)	See ACC 645, Figure 7.	See ACC 649, Figure 8.
Access Control 8	Bus In 14	−Set Rd*Wr or Pad Ctrl	A1E2 (A1R2) S03	KE110 (KR110)	+Level (MST-1).	+Level (MST-1).
		+Pad Cplt Attn	A1E2 (A1R2) M09	KE170 (KR170)	−Level (MST-1).	−Level (MST-1).
Servo Logic 9	Servo Amplifier 6	+Position	A1C4 (A1T4) J13	KC500 (KT500)	See ACC 645, Figure 8.	See ACC 649, Figure 18.
		−Position	A1C4 (A1T4) G13	KC500 (KT500)	See ACC 645, Figure 8.	See ACC 645, Figure 8.
Servo Logic 9	Index Detector 7	+Guardband Latch	A1C4 (A1T4) G02	KC510 (KT510)	See ACC 645, Figure 9.	−Level (MST-1).

Line Group (Input)		Line Name	Test Point	ALD Page	Expected Condition or Purpose	
To	From				During a Rezero	During a Seek
Servo Logic 9	Access Control 8	+Reset Trk Following Timer	A1C4 (A1T4) D12	KC500 (KT500)	Not Used.	+Level (MST-1) during Seek Start
		−Run Timer Gated	A1C4 (A1T4) D11	KC500 (KT500)	−Level (MST-1) until Seek Complete.	−Level (MST-1) until Seek Complete.
		+Linear Mode	A1C4 (A1T4) G05	KC500 (KT500)	See ACC 647, Figure 14.	See ACC 647, Figure 14.
		+Zero Mode	A1C4 (A1T4) D09	KC500 (KT500)	−Level (MST-1) during Rezero mode or Linear Mode.	−Level (MST-1) during Access mode or Linear mode.
		+Forward	A1C4 (A1T4) J04	KC500 (KT500)	See ACC 643, Figure 3.	+ or −Level (MST-1), depending on carriage direction.
		+Rezero Mode	A1C4 (A1T4) D07	KC500 (KT500)	See ACC 643, Figure 2.	−Level (MST-1).
		−Any Go Home	A1C4 (A1T4) G04	KC500 (KT500)	+Level (MST-1).	+Level (MST-1).
		+Access Mode	A1C4 (A1T4) B02	KC500 (KT500)	−Level (MST-1).	See ACC 648, Figure 15.
		+High Velocity Setpoint	A1C4 (A1T4) J02	KC510 (KT510)	See ACC 645, Figure 7.	−Level (MST-1).
Servo Logic 9	Servo Analog 10	−Gated Position Derived	A1C4 (A1T4) B09	KC500 (KT500)	Not Used.	See ACC 667, Figure 3.
		+DAC	A1C4 (A1T4) G12	KC510 (KT510)	See ACC 648, Figure 16.	See ACC 648, Figure 16.
		Current Magni- tude	A1C4 (A1T4) D10	KC510 (KT510)	See ACC 644, Figure 4.	See ACC 644, Figure 4.
		−Velocity	A1C4 (A1T4) J12	KC510 (KT510)	See ACC 644, Figure 6.	See ACC 648, Figure 16.
Servo Logic 9	Power Amplifi- er 11	Current Sense	A1C4 (A1T4) D04	KC500 (KT500)	See ACC 644, Figure 4.	See ACC 648, Figure 17.

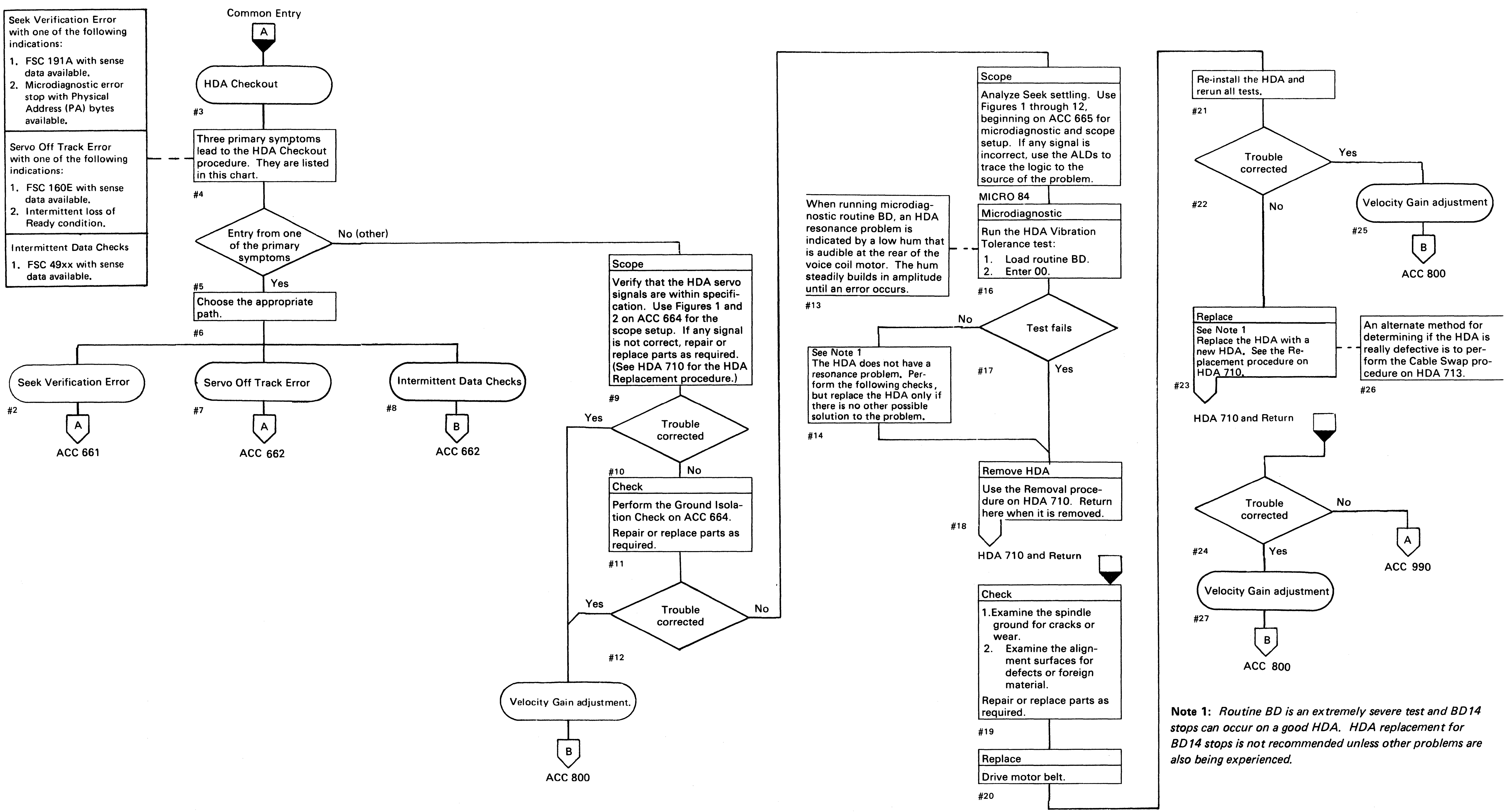
DYNAMIC SERVO CHECKOUT

Line Group (Input)		Line Name	Test Point	ALD Page	Expected Condition or Purpose	
To	From				During a Rezero	During a Seek
Servo Analog 10	Diff Counter 4	−DC 7	A1D2 (A1S2) G10	KD100 (KS100)	+Level (MST-1).	−Level (MST-1) for odd cylinder Seeks.
		+Diff greater than 127	A1D2(A1S2) D12		−Level (MST-1).	+Level (MST-1) until the Difference Counter decrements to less than 127.
		−Diff Bit 7	A1D2 (A1S2) B12		+0.4 Vdc (CS level.)	These lines reflect the 7 low-order bits of the Difference Counter.
		−Diff Bit 6	A1D2 (A1S2) D10			
		−Diff Bit 5	A1D2 (A1S2) D11			+Level = +0.4 Vdc
		−Diff Bit 4	A1D2 (A1S2) B09			−Level = −0.6 Vdc
		−Diff Bit 3	A1D2 (A1S2) D09			
		−Diff Bit 2	A1D2 (A1S2) B07			
		−Diff Bit 1	A1D2 (A1S2) D07			
		+DC Equals 1	A1D2 (A1S2) G04		−Level (MST-1).	See ACC 649, Figure 19.
Servo Analog 10	Servo Amplifier 6	+Position	A1D2 (A1S2) J13	KD100 (KS100)	See ACC 645, Figure 8.	See ACC 649, Figure 18.
		−Position	A1D2 (A1S2) G13	KD100 (KS100)	See ACC 645, Figure 8.	See ACC 645, Figure 8.
Servo Analog 10	Access Control 8	+Access Mode	A1D2 (A1S2) G09	KD100 (KS100)	−Level (MST-1).	See ACC 648, Figure 15.
		+Forward	A1D2 (A1S2) G12	KD100 (KS100)	See ACC 643, Figure 3.	+Level (MST-1) for forward (toward spindle) Seeks.
		+Access Start	A1D2 (A1S2) J11	KD100 (KS100)	+Pulse (MST-1) < 100 nanoseconds during −Rezero pulse time.	+Level (MST-1) during −Seek Start pulse time.

Line Group (Input)		Line Name	Test Point	ALD Page	Expected Condition or Purpose	
To	From				During a Rezero	During a Seek
Servo Analog 10	Servo Logic 9	−Velocity Enable	A1D2 (A1S2) G08	KD100 (KS100)	See ACC 644, Figure 6.	See ACC 644, Figure 6.
		+Move Forward	A1D2 (A1S2) J12	KD100 (KS100)	See ACC 644, Figure 5.	See ACC 644, Figure 5.
		+Move Reverse	A1D2 (A1S2) J10	KD100 (KS100)	See ACC 644, Figure 5.	See ACC 644, Figure 5.
		Current Sense	A1D2 (A1S2) G07	KD100 (KS100)	See ACC 644, Figure 4.	See ACC 648, Figure 17.
		−Linear Mode CS	A1D2 (A1S2) D13	KD100 (KS100)	See ACC 645, Figure 9.	See ACC 645, Figure 9.
		−Rezero Mode *DAC 1 Off	A1D2 (A1S2) J06	KD100 (KS100)	−Level (MST-1) during Rezero mode.	See ACC 667, Figure 4.
		+Position Enable	A1D2 (A1S2) G03	KD100 (KS100)	−Level (MST-1) During Rezero Reverse or Guardband.	+Level (MST-1).
Power Amplifier 11	Servo Logic 9	+Power Amp Drive	A1C4 (A1T4) J09	KC500 (KT500)	See ACC 643, Figure 3.	See ACC 648, Figure 17.
Power Amplifier 11	Go Home Pulser 16	Go Home	P535-3(8)	YA060/YB060	0 V ± 2.5 V p-p. − 20 V pulses only when drive ac power is turned Off or On.	Same as Rezero.
Voice Coil Motor 12	Power Amplifier 11	VCM TB-A	VCM TB-A	YA060/YB060	See ACC 646, Figure 10.	See ACC 649, Figure 20.
		VCM TB-B	VCM TB-B			
Bus In 14	Index Detector 7	−Valid Index	A1H2 (A1N2) S02	KH140 (KN140)	See ACC 605, Figure 7. This signal develops Index Mark for the controller. (Verified by microdiagnostic routine B8, test 3, with Error Code B832.)	Same as Rezero.

Line Group (Input)		Line Name	Test Point	ALD Page	Expected Condition or Purpose	
To	From				During a Rezero	During a Seek
Bus In 14	Access Control 8	+Access * Check Status Bit 0	A1H2 (A1N2) B12	KH010 (KN010)	See OPER 101 for the Interface summary chart under Sense Status. See DEV-I 184 for a diagram of the Inbus Assembler.	Same as Rezero.
		+Access * Check Status Bit 1	A1H2 (A1N2) D09	KH010 (KN010)		
		+Access * Check Status Bit 2	A1H2 (A1N2) D12	KH010 (KN010		
		+Access * Check Status Bit 3	A1H2 (A1N2) D13	KH010 (KN010)		
		+Access * Check Status Bit 4	A1H2 (A1N2) B10	KH020 (KN020)		
		+Access * Check Status Bit 5	A1H2 (A1N2) D11	KH020 (KN020)		
		+Access * Check Status Bit 6	A1H2 (A1N2) B13	KH020 (KN020)		
		+Access * Check Status Bit 7	A1H2 (A1N2) G02	KH020 (KN020)		

HDA SERVO CHECKOUT



Note 1: *Routine BD is an extremely severe test and BD14 stops can occur on a good HDA. HDA replacement for BD14 stops is not recommended unless other problems are also being experienced.*

ADDRESS CONVERSION

Expected Address (Sense Bytes 5 and 6)

The Expected address is in *logical* format. See R/W 400 for instructions to convert from the logical to the physical format.

Old Address (Sense Bytes 13 and 14)

The Old address is in *physical* format, as shown in Figure 1. The Old address value is normally zero, indicating a starting position of cylinder 0 for each retry Seek operation.

Received Address (Sense Bytes 20 and 21)

The Received address is in the *physical* format as in Figure 1.

Figure 1.

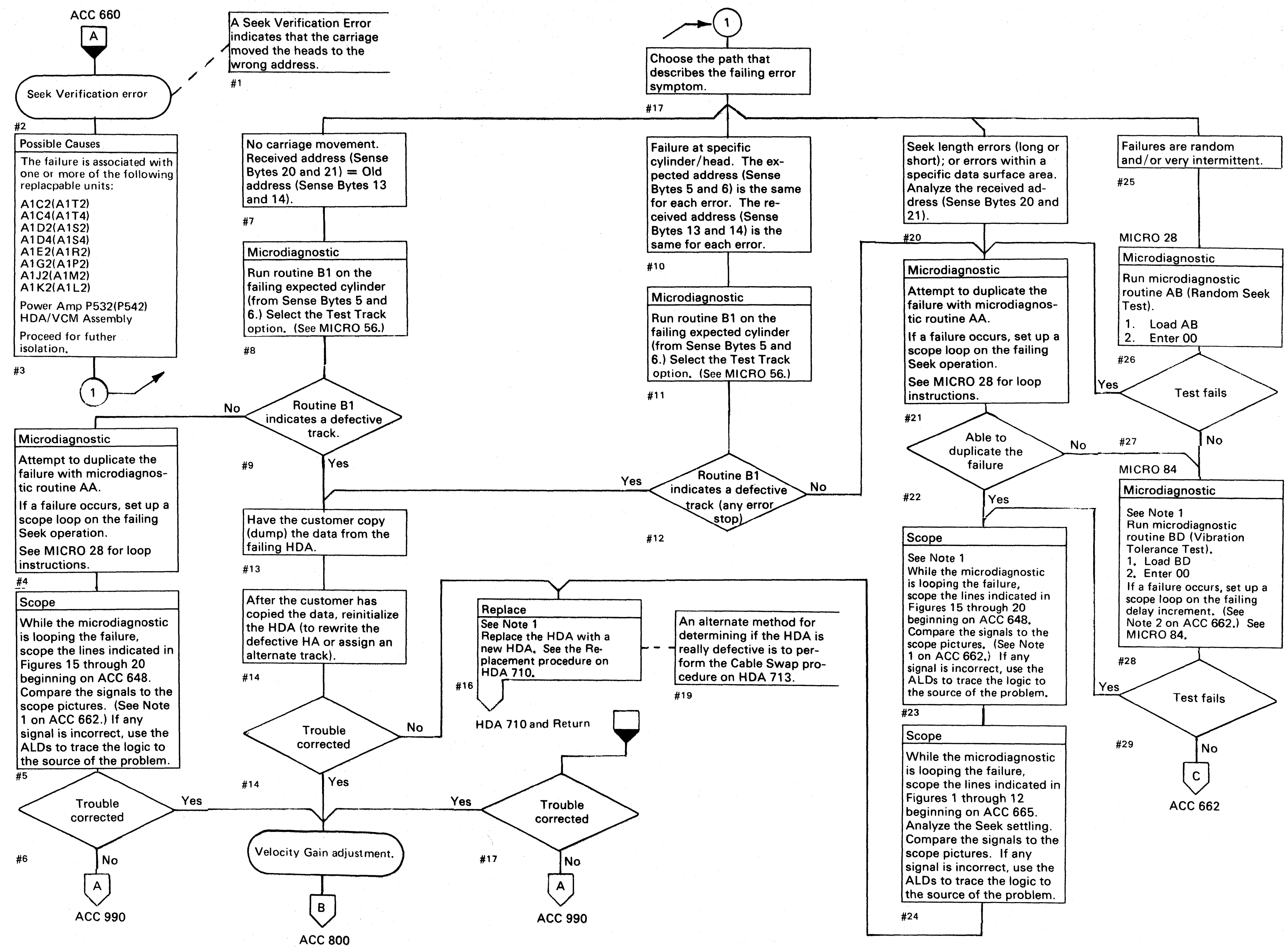
Byte 13 or 20

Movable Heads	CYL 128	CYL 64	CYL 32	CYL 16	CYL 8	CYL 4	CYL 2	CYL 1
Fixed Heads	0	0	0	0	0	0	0	0

Byte 14 or 21

Movable Heads	CYL 512	CYL 256	HD 32	HD 16	HD 8	HD 4	HD 2	HD 1
Fixed Heads	1	1	HD 32	HD 16	HD 8	HD 4	HD 2	HD 1

Note 1: *Routine BD is an extremely severe test and BD14 stops can occur on a good HDA. HDA replacement or further maintenance action is not recommended unless other problems are also being experienced.*



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HDA SERVO CHECKOUT

MICRO ACC 660 (A)

Servo Off Track error or HDA Resonance error.

#1

Possible Causes

The failure is associated with one or more of the following replaceable units:

A1C2(A1T2)
A1C4(A1T4)
A1D2(A1S2)
A1D4(A1S4)
A1E2(A1R2)
A1G2(A1P2)
A1H2(A1N2)
A1K2(A1L2)
Power Amp P532(P542)
HDA/VCM Assembly

#2

ACC 660 (B)

Intermittent Data Checks

#3

Possible Causes

The failure is associated with one or more of the following replaceable units:

A1C2(A1T2)
A1C4(A1T4)
A1D2(A1S2)
A1D4(A1S4)
A1E2(A1R2)
A1G2(A1P2)
A1J2(A1M2)
Power Amp P532(P542)
HDA/VCM Assembly

#4

Scope

Verify that the HDA Servo signals are within specification. Use Figures 1 and 2 on ACC 664 for the scope setup. If any signal is not correct, repair or replace parts as required.

#5

MICRO 84

Microdiagnostic

Run microdiagnostic routine BD (Vibration Tolerance Test).
1. Load BD
2. Enter 00

If a failure occurs, set up a scope loop on the failing delay increment. (See Note 2.) See MICRO 84.

#6

When running microdiagnostic routine BD, an HDA resonance problem is indicated by a low hum that is audible at the rear of the voice coil motor. The hum steadily builds in amplitude until an error occurs.

#7

Test fails — No / Yes

#8

Scope

See Note 3
While the microdiagnostic is looping the failure, scope the lines indicated in Figures 15 through 20 beginning on ACC 648. Compare the signals to the scope pictures. (See Note 1.) If any signal is incorrect, use the ALDs to trace the logic to the source of the problem.

#9

Scope

While the microdiagnostic is looping the failure, scope the lines indicated in Figures 1 through 12, beginning on ACC 665. Analyze the Seek settling. Compare the signals to the scope pictures. (See Note 1.) If any signal is incorrect, use the ALDs to trace the logic to the source of the problem.

#10

ACC 661 (C)

Scope

Analyze Seek settling. Use Figures 1 through 12, beginning on ACC 665 for microdiagnostic setup and scope setup. If any signal is incorrect, use the ALDs to trace the logic to the source of the problem.

#11

Check

Perform the Ground Isolation Check on ACC 664.

Repair or replace parts as required.

#12

Trouble corrected — No / Yes

#13

Velocity Gain adjustment

#14

(B) ACC 800

Remove HDA

See Note 3
Use the Removal procedure on HDA 710. Return here when it is removed.

#15

HDA 710 and Return

Check

1. Examine the spindle ground for cracks or wear.
2. Examine the alignment surfaces for defects or foreign material.

Repair or replace parts as required.

#16

Replace

Drive motor belt.

#17

Re-install the HDA and rerun all diagnostic tests.

#18

Trouble corrected — No / Yes

#19

Velocity Gain adjustment

#20

(B) ACC 800

Replace

See Note 3
Replace the HDA with a new HDA. See the Replacement procedure on HDA 710.

#21

HDA 710 and Return

Trouble corrected — Yes / No

#22

(A) ACC 990

An alternate method of determining if the HDA is really defective is to perform the Cable Swap procedure on HDA 713.

#23

Notes:

1. *Routines AA and BD execute both forward and reverse Seeks. Therefore, the polarity of the signals on your scope may not match the polarity of the scope figures in the manual. The figures on ACC 648 and ACC 649 reference a forward Seek only.*
2. *Routine BD uses a 7-cylinder Seek in default mode. The scope loop option requires that the Seek length be specified. Start the loop with a Seek length of 7 cylinders and the failing delay increment, but alter the parameters as required to stress the failure.*
3. *Routine BD is an extremely severe test and BD14 stops can occur on a good HDA. HDA replacement or further maintenance action is not recommended unless other problems are also being experienced.*

HDA SERVO CHECKOUT

GROUND ISOLATION CHECK

1. Power off the drive and remove both HDA cables: 01C A1A2(01D A1A2) and 01C A1A3(01D A1A3)
2. Remove the frame ground from the base plate (A).
3. Measure the resistance from frame ground to the base plate. Resistance should measure infinity (∞) with a slight capacitive indication as the capacitor C1 is touched to the baseplate.
4. Verify that the motor plate ground is isolated from the base plate ground. Check the mechanical area for potential intermittent ground shorts.
5. Check the mechanical area for broken or loose parts.

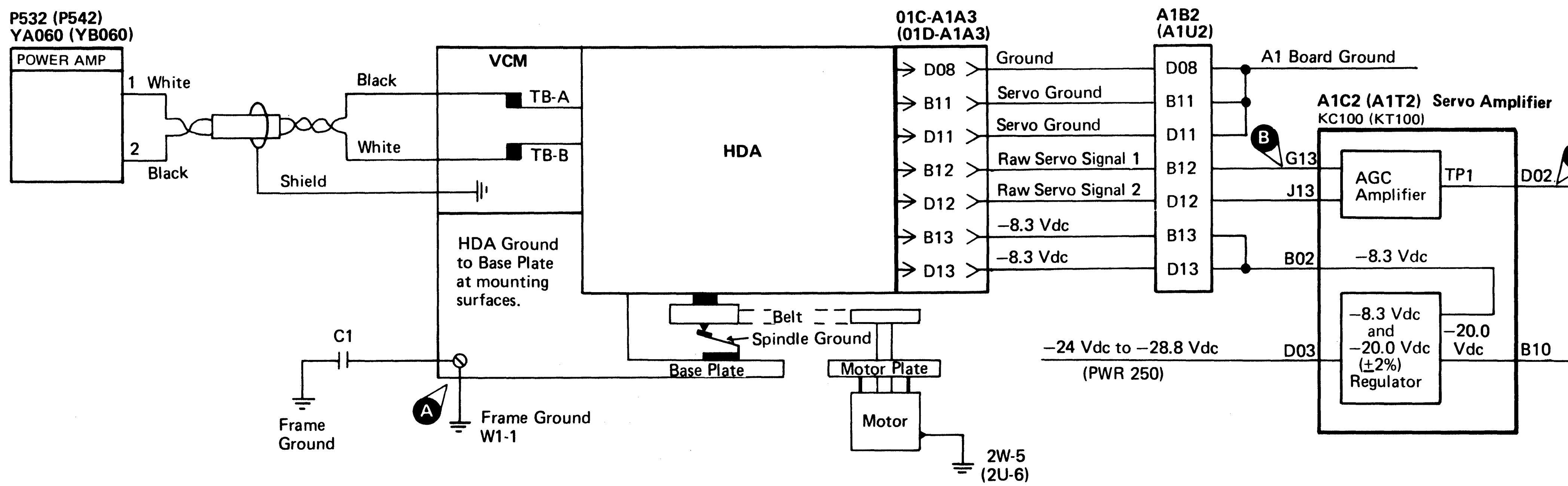
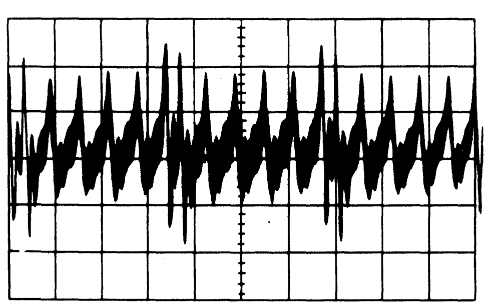


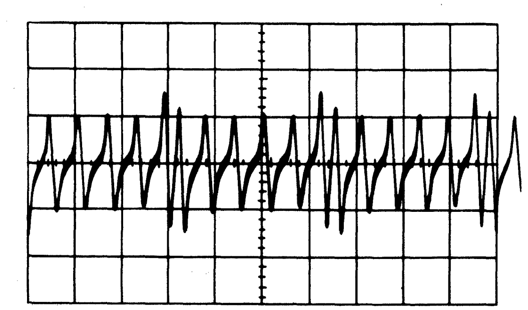
Figure 1. (B)



Scope Setup

Sweep	1 μs/div
Mode	ADD
Trigger	
Slope (–)	
Ch 1 only	
Ch 1 A1C2(A1T2)G13	
Raw Servo Signal 1	
AC Input	
Volts/div	0.01 (Invert)
Probe	X1
Ch 2 A1C2(A1T2)J13	
Raw Servo Signal 2	
AC Input	
Volts/div	0.01
Probe	X1
Invert	

Figure 2. (C)



Scope Setup

Sweep	1 μs/div
Mode	CH 1
Trigger	
Slope (–)	
CH 1 only	
CH 1 A1C2(A1T2)D02	
TP1	
Volts/div	0.2
Probe	X10

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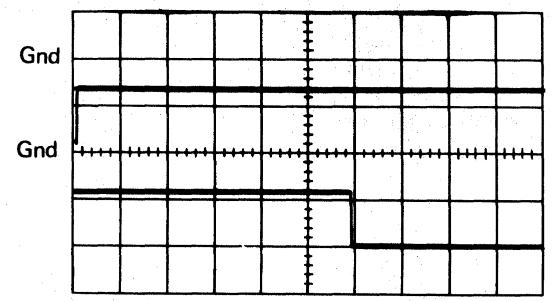
Figure 1A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger
Slope (−)
Ch 1 only
Ch 1 A1E2(A1R2)D05
−Seek Start (ACC 654)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Volts/div 0.1
Probe X10



Note: *The microdiagnostic is performing 1-cylinder Seeks.*

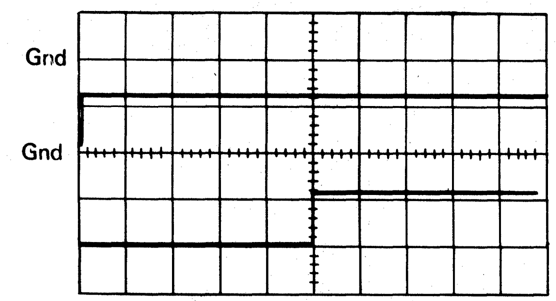
Figure 1B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger
Slope (−)
Ch 1 only
Ch 1 A1E2(A1R2)D05
−Seek Start (ACC 654)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Volts/div 0.1
Probe X10



Note: *The microdiagnostic is performing 2-cylinder Seeks.*

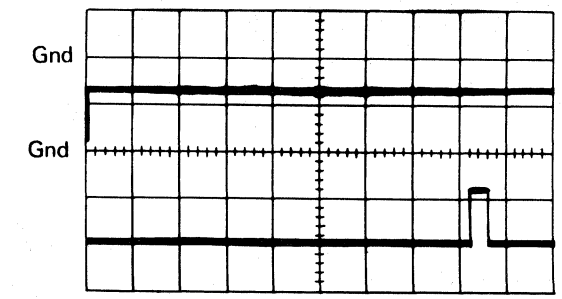
Figure 1C.

Microdiagnostic

Routine B8, test A
1. Load B8.
2. Enter 10, 0A, 01, 00

Scope Setup

Sweep 2 ms/div
Mode CHOP
Trigger
Slope (−)
Ch 1 only
Ch 1 A1E2(A1R2)D05
−Seek Start (ACC 654)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Volts/div 0.1
Probe X10



Note: *The microdiagnostic is performing 192-cylinder Seeks.*

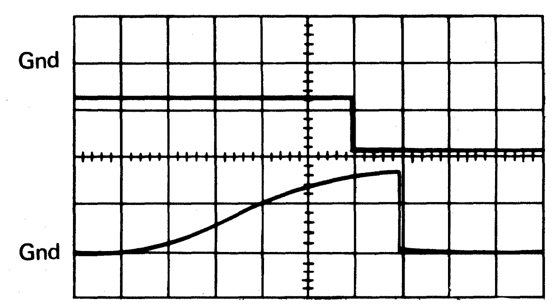
Figure 2A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger
Slope (+)
Ch 1 only
Ch 1 A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)B04
Fill In TP [KD100(KS100)]
Volts/div 0.5
Probe X10



Note: *The microdiagnostic is performing 1-cylinder Seeks.*

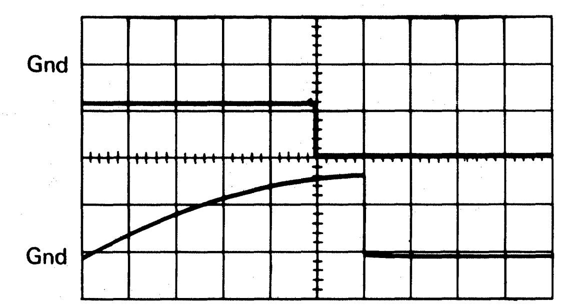
Figure 2B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger
Slope (+)
Ch 1 only
Ch 1 A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)B04
Fill In TP [KD100(KS100)]
Volts/div 0.5
Probe X10



Note: *The microdiagnostic is performing 2-cylinder Seeks.*

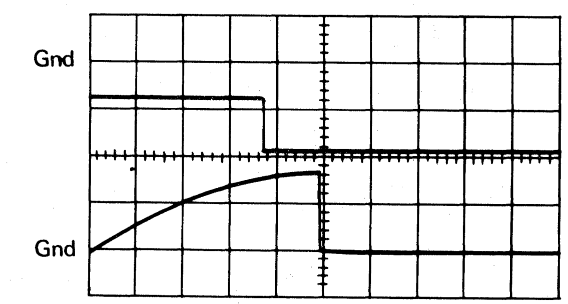
Figure 2C.

Microdiagnostic

Routine B8, test A
1. Load B8
2. Enter 10, 0A, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger
Slope (+)
Ch 1 only
Ch 1 A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Volts/div 0.1
Probe X10
Ch 2 A1D2(A1S2)B04
Fill In TP [KD100(KS100)]
Volts/div 0.5
Probe X10



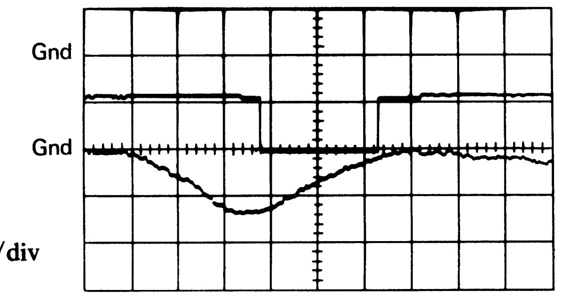
Note: *The microdiagnostic is performing 192-cylinder Seeks.*

HDA SERVO CHECKOUT

Figure 3A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01, 00



Note: *The microdiagnostic is performing 1-cylinder Seeks.*

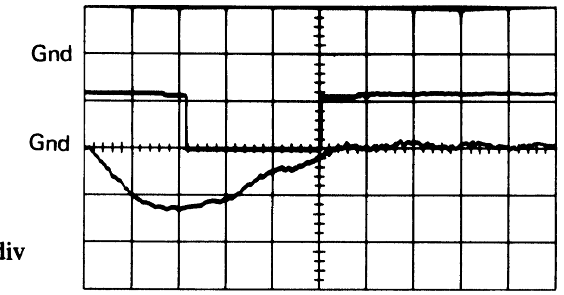
Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)B09
−Gated Position Derived (ACC 656)
Volts/div 0.1
Probe ×10
Ch 2 A1D2(A1S2)D02
−Position Curve TP [KD100(KS100)]
Volts/div 0.5
Probe ×10

Figure 3B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00



Note: *The microdiagnostic is performing 2-cylinder Seeks.*

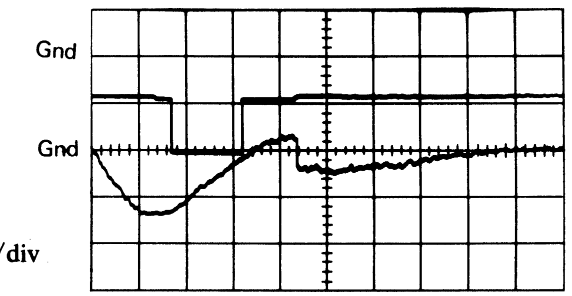
Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)B09
−Gated Position Derived (ACC 656)
Volts/div 0.1
Probe ×10
Ch 2 A1D2(A1S2)D02
−Position Curve TP [KD100(KS100)]
Volts/div 0.5
Probe ×10

Figure 3C.

Microdiagnostic

Routine B8
1. Load B8
2. Enter 10, 0A, 01, 00



Note: *The microdiagnostic is performing 192-cylinder Seeks.*

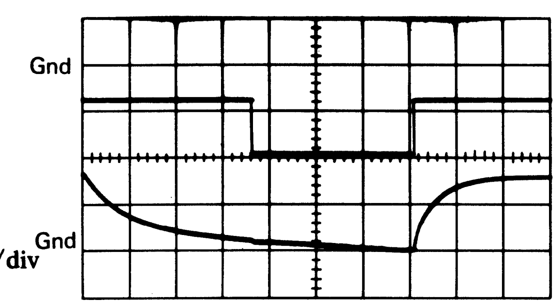
Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)B09
−Gated Position Derived (ACC 656)
Volts/div 0.1
Probe ×10
Ch 2 A1D2(A1S2)D02
−Position Curve TP [KD100(KS100)]
Volts/div 0.5
Probe ×10

Figure 4A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01, 00



Note: *The microdiagnostic is performing 1-cylinder Seeks.*

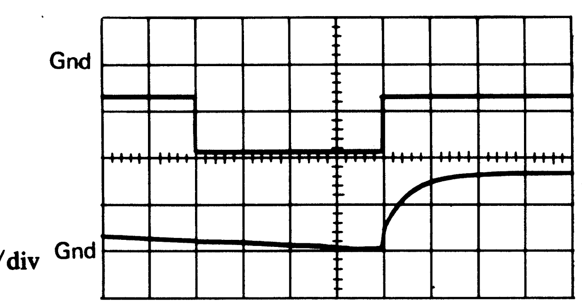
Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1D2(A1S2)J06
−Rezero Mode*DAC 1 Off (ACC 657)
Volts/div 0.1
Probe ×10
Ch 2 A1C4(A1T4)G12
+DAC (ACC 656)
Volts/div 0.1
Probe ×10

Figure 4B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00



Note: *The microdiagnostic is performing 2-cylinder Seeks.*

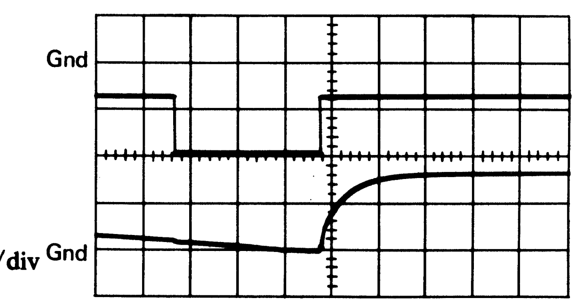
Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1D2(A1S2)J06
−Rezero Mode*DAC 1 Off (ACC 657)
Volts/div 0.1
Probe ×10
Ch 2 A1C4(A1T4)G12
+DAC (ACC 656)
Volts/div 0.1
Probe ×10

Figure 4C.

Microdiagnostic

Routine B8
1. Load B8
2. Enter 10, 0A, 01, 00



Note: *The microdiagnostic is performing 192-cylinder Seeks.*

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1D2(A1S2)J06
−Rezero Mode*DAC 1 Off (ACC 657)
Volts/div 0.1
Probe ×10
Ch 2 A1C4(A1T4)G12
+DAC (ACC 656)
Volts/div 0.1
Probe ×10

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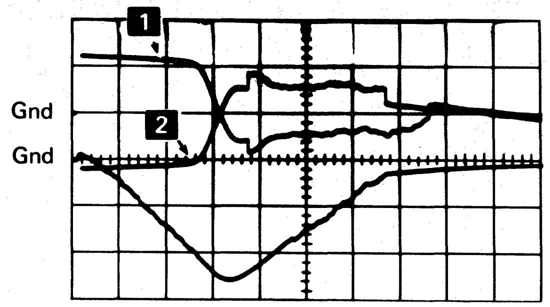
Figure 5A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)J09
+Pwr Amp Drive (ACC 657)
Volts/div 0.5
Probe X10
Ch 2 A1C4(A1T4)J12
−Velocity (ACC 656)
Volts/div 0.02
Probe x10



Note: *The microdiagnostic is performing 1-cylinder Seeks.*

The Ch 1 signal should look like **1** *for forward Seeks, and like* **2** *for reverse Seeks.*

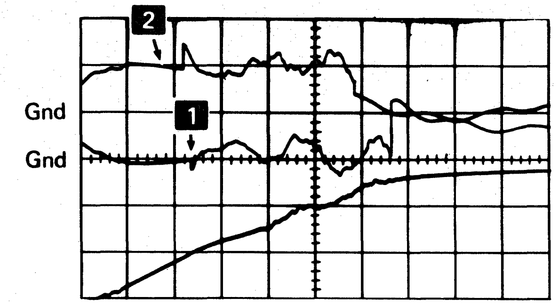
Figure 5B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)J09
+Pwr Amp Drive (ACC 657)
Volts/div 0.2
Probe X10
Ch 2 A1C4(A1T4)J12
−Velocity (ACC 656)
Volts/div 0.02
Probe X10



Note: *The microdiagnostic is performing 2-cylinder Seeks.*

The Ch 1 signal should look like **1** *for forward Seeks, and like* **2** *for reverse Seeks.*

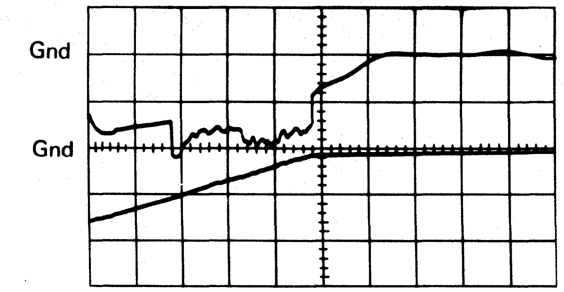
Figure 5C.

Microdiagnostic

Routine B8, test A
1. Load B8
2. Enter 10, 0A, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)J09
+Pwr Amp Drive (ACC 657)
Volts/div 0.2
Probe X10
Ch 2 A1C4(A1T4)J12
−Velocity (ACC 656)
Volts/div 0.05
Probe X10



Note: *The microdiagnostic is performing 192-cylinder Seeks.*

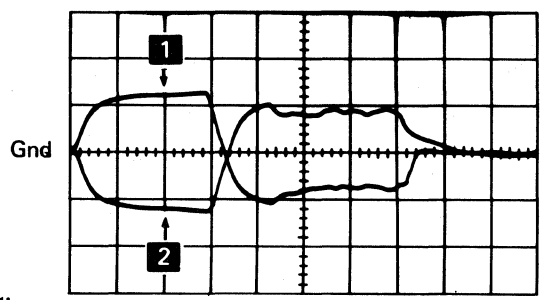
Figure 6A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CH 1
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)D04
Current Sense (ACC 656)
Volts/div 0.5
Probe X10



Note: *The microdiagnostic is performing 1-cylinder Seeks.*

The Ch 1 signal should look like **1** *for forward Seeks, and like* **2** *for reverse Seeks.*

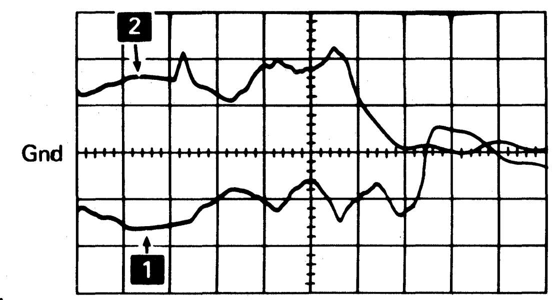
Figure 6B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CH 1
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)D04
Current Sense (ACC 656)
Volts/div 0.2
Probe X10



Note: *The microdiagnostic is performing 2-cylinder Seeks.*

The Ch 1 signal should look like **1** *for forward Seeks, and like* **2** *for reverse Seeks.*

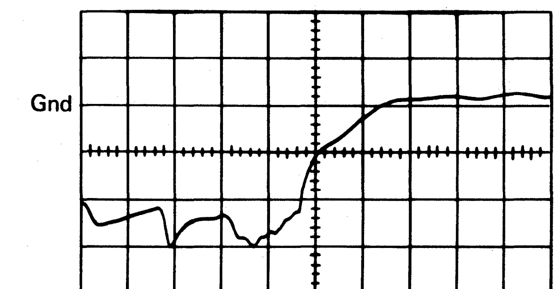
Figure 6C.

Microdiagnostic

Routine B8, test A
1. Load B8
2. Enter 10, 0A, 01, 00

Scope Setup

Sweep 0.2 ms/div
Mode CH 1
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)D04
Current Sense (ACC 656)
Volts/div 0.2
Probe X10



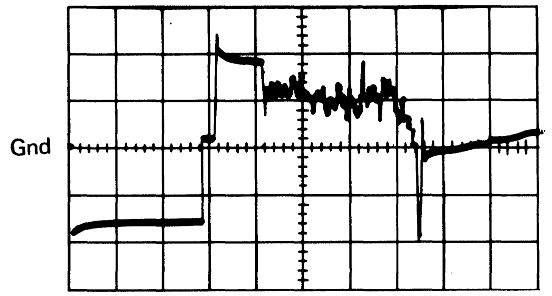
Note: *The microdiagnostic is performing 192-cylinder Seeks.*

HDA SERVO CHECKOUT

Figure 7A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01, 00



Note: *The microdiagnostic is performing 1-cylinder Seeks.*

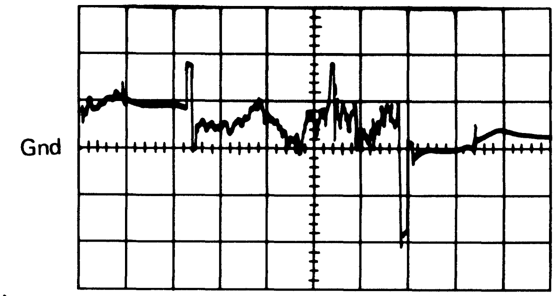
Scope Setup

Sweep 0.2 ms/div
Mode ADD
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 VCM TB-A
(See Figure 1, ACC 600.)
Volts/div 2.0
Probe ×10
Ch 2 VCM TB-B (Invert)
(See Figure 1, ACC 600.)
Volts/div 2.0
Probe ×10

Figure 7B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00



Note: *The microdiagnostic is performing 2-cylinder Seeks.*

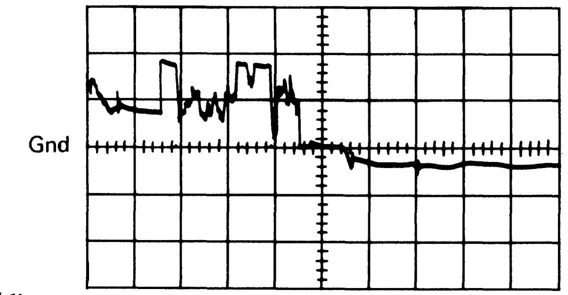
Scope Setup

Sweep 0.2 ms/div
Mode ADD
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 VCM TB-A
(See Figure 1, ACC 600.)
Volts/div 2.0
Probe ×10
Ch 2 VCM TB-B (Invert)
(See Figure 1, ACC 600.)
Volts/div 2.0
Probe ×10

Figure 7C.

Microdiagnostic

Routine B8, test A
1. Load B8
2. Enter 10, 0A, 01, 00



Note: *The microdiagnostic is performing 192-cylinder Seeks.*

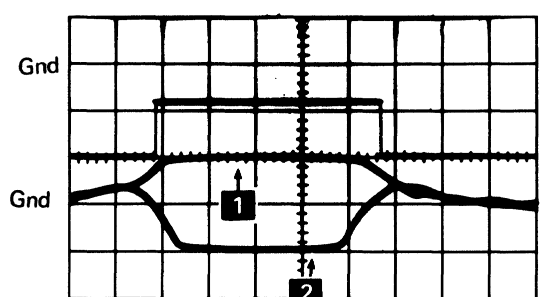
Scope Setup

Sweep 0.2 ms/div
Mode ADD
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 VCM TB-A
(See Figure 1, ACC 600.)
Volts/div 2.0
Probe ×10
Ch 2 VCM TB-B (Invert)
(See Figure 1, ACC 600)
Volts/div 2.0
Probe ×10

Figure 8A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01 00



Note: *The microdiagnostic is performing 1-cylinder Seeks.*

The Ch 2 signal should look like [1] *for forward Seeks, and like* [2] *for reverse Seeks.*

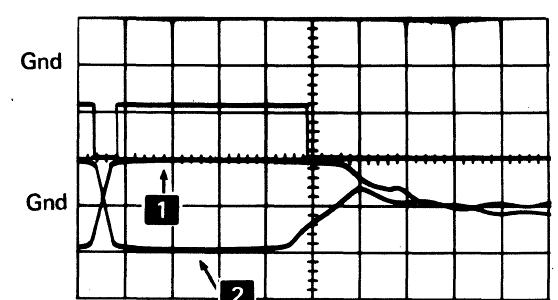
Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)G08
−On Track TP [KC500(KT500)]
Volts/div 0.1
Probe ×10
Ch 2 A1C4(A1T4)B05
Pos Error TP [KC500(KT500)]
Volts/div 0.2
Probe ×10

Figure 8B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00



Note: *The microdiagnostic is performing 2-cylinder Seeks.*

The Ch 2 signal should look like [1] *for forward Seeks, and like* [2] *for reverse Seeks.*

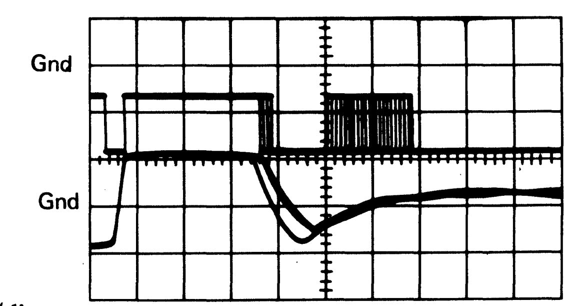
Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1C4(A1T4)G08
−On Track TP [KC500(KT500)]
Volts/div 0.1
Probe ×10
Ch 2 A1C4(A1T4)B05
Pos Error TP [KC500(KT500)]
Volts/div 0.2
Probe ×10

Figure 8C.

Microdiagnostic

Routine B8, test A
1. Load B8
2. Enter 10, 0A, 01, 00



Note: *The microdiagnostic is performing 192-cylinder Seeks.*

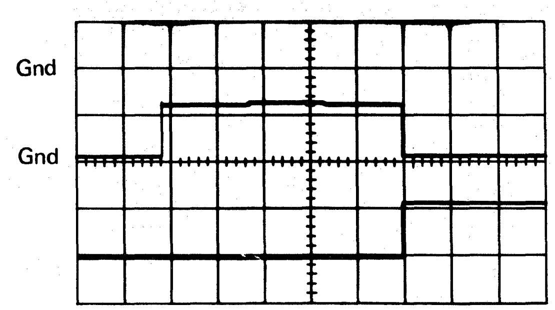
Scope Setup

Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC657)
Ch 1 A1C4(A1T4)G08
−On Track TP [KC500(KT500)]
Volts/div 0.1
Probe ×10
Ch 2 A1C4(A1T4)B05
Pos Error TP [KC500(KT500)]
Volts/div 0.2
Probe ×10

Figure 9A.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 01, 01, 00



Scope Setup

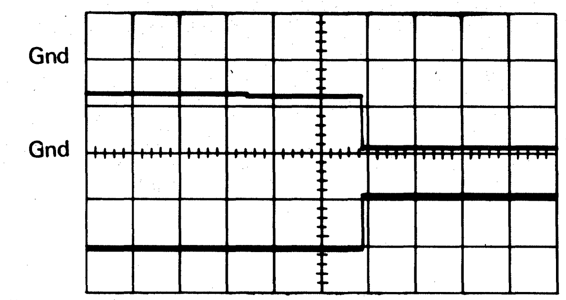
Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1E2(A1R2)G05
−End Decelerate (ACC 655)
Volts/div 0.1
Probe X10
Ch 2 A1C4(A1T4)G05
+Linear Mode (ACC 656)
Volts/div 0.1
Probe X10

Note: *The microdiagnostic is performing 1-cylinder Seeks.*

Figure 9B.

Microdiagnostic

Routine A9
1. Load A9
2. Enter 10, 02, 01, 00



Scope Setup

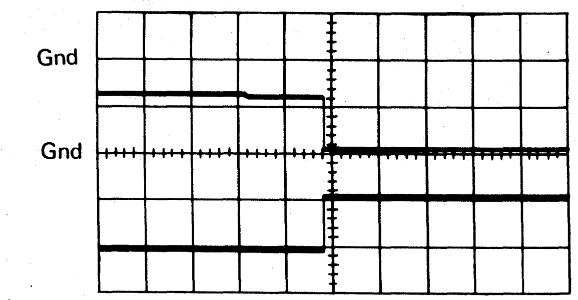
Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1E2(A1R2)G05
−End Decelerate (ACC 655)
Volts/div 0.1
Probe X10
Ch 2 A1C4(A1T4)G05
+Linear Mode (ACC 656)
Volts/div 0.1
Probe X10

Note: *The microdiagnostic is performing 2-cylinder Seeks.*

Figure 9C.

Microdiagnostic

Routine B8, test A
1. Load B8
2. Enter 10, 0A, 01, 00



Scope Setup

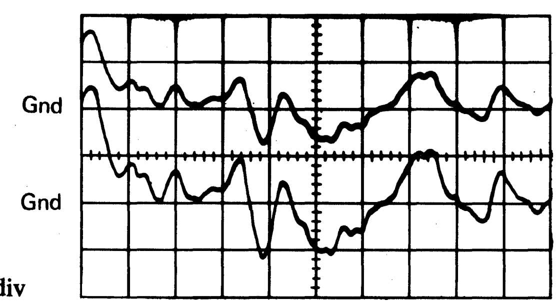
Sweep 0.2 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1D2(A1S2)G04
+DC Equals 1 (ACC 657)
Ch 1 A1E2(A1R2)G05
−End Decelerate (ACC 655)
Volts/div 0.1
Probe X10
Ch 2 A1C4(A1T4)G05
+Linear Mode (ACC 656)
Volts/div 0.1
Probe X10

Note: *The microdiagnostic is performing 192-cylinder Seeks.*

Figure 10.

Microdiagnostic

None
(Track Following mode)



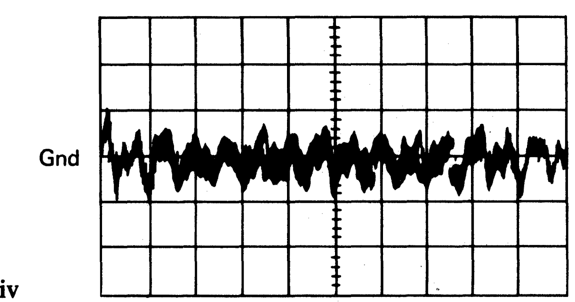
Scope Setup

Sweep 0.5 ms/div
Mode CHOP
Trigger
Slope (+)
Ch 1 only
Ch 1 A1C4(A1T4)B05
Pos Error TP [KC500(KT500)]
Volts/div 0.02
Probe X10
Ch 2 A1C4(A1T4)J09
+Pwr Amp Drive (ACC 657)
Volts/div 0.02
Probe X10

Figure 11.

Microdiagnostic

None
(Track Following mode)



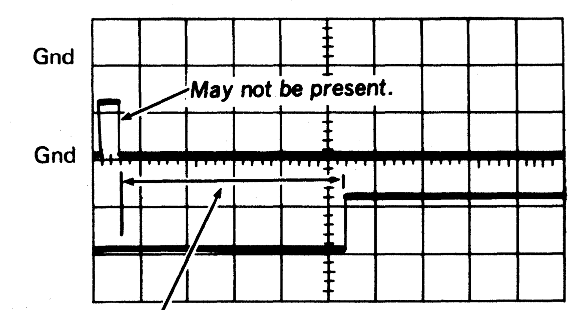
Scope Setup

Sweep 5 ms/div
Mode CH 1
Trigger
Slope (−)
Ch 1 only
Ch 1 A1C2(A1T2)G12
+Position (ACC 656)
Volts/div 0.05
Probe X10

Figure 12.

Microdiagnostic

Routine B8, test A
1. Load B8
2. Enter 10, 0A, 01, 00



Note: *The distance from +Linear Mode or from the last negative transition of −On Track to +Trk Following Timer must be between 4.6 ms and 5.3 ms. If out of specification, replace A1C4(A1T4.)*

Scope Setup

Sweep 1 ms/div
Mode CHOP
Trigger EXT
Slope (+)
A1C4(A1T4)G05
+Linear Mode (ACC 656)
Ch 1 A1C4(A1T4)G08
−On Track TP [KC500(KT500)]
Volts/div 0.1
Probe X10
Ch 2 A1E2(A1R2)M04
Trk Following Timer (ACC 655)
Volts/div 0.1
Probe X10

F
L

INTERMITTENT SERVO FAILURE ANALYSIS

DESCRIPTION

The ACC 7xx pages contain reference information to aid in the diagnosis of intermittent servo failures.

Is the problem intermittent?

Yes → Continue below.
No → Exit to ACC 600, Entry A.

The reference information contains:

- Circuit descriptions of the access error detection circuits.
- Failure modes of the Access Rezero, Seek, and Track Following operations.
- Cross-references to diagrams, check procedures, and scope pictures that relate to the Fault Symptom Codes.

Use the Index to determine where information that is applicable to the failure is located.

INDEX

GENERAL INFORMATION

EQUIPMENT CHECKS

Sense Byte 0, bit 3=1 indicates an Equipment Check. This indicates that a device hardware or channel failure was detected. Equipment Checks are further defined by the following format 1 sense bytes:

Sense Byte 7 (Format/Message) = '1X' ('X' is the format 1 message)

Sense Byte 8, bit 0 = 1	Controller Check
Sense Byte 8, bit 1 = 1	Device Interface Check
Sense Byte 8, bit 2 = 1	Drive Check
Sense Byte 8, bit 3 = 1	Read/Write Check
Sense Byte 18, bits 4–7	Microprogram detected errors.

For additional information see:
MSG 12
MSG 14
SENSE 100 through 109.

DRIVE CHECK

Sense Byte 8, bit 2 = 1 indicates a Drive Check.

Fault Symptom Codes: 12XX, 13XX, 15XX, or 16XX.

Drive Check is activated by either Sector Compare Check (Sense Byte 9, bit 1 = 1) or by Access Check (Sense Byte 16, bits 0, 1, or 2 = 1). A Fault Symptom Code of 1310 indicates a false Drive Check. *See ALD page KE160 (KR160).*

SECTOR COMPARE CHECK (FSC 1301)

A Sector Compare Check is activated as a result of a Sector Non-Compare. A Sector Non-Compare occurs if a Sector Compare is not found within two Index Marks. The Sector Compare Check is reset by activating either the Check Reset or Attention Reset line.

For additional information see:
RPI 317, Sector Compare Check.
ALD page KJ510 (KM510).
Microdiagnostic routine A5.
See MICRO 24 and MICFL 130.

ACCESS CHECK (FSC's 12XX, 15XX, or 16XX)

Access Check is activated by one of the following:

- Seek operation failure.
- Rezero operation failure.
- Loss of Track Following during a Data Transfer operation.

The three types of Access Checks are Access Timeout (FSC 12xx), Access Overshoot (FSC 15XX), and Servo Off Track (FSC 16XX). Access Checks are reset by starting a Rezero operation.

For additional information see:
ALD page KE120 (KR120).
Microdiagnostic routine B8, tests 01, 02, 08, and 0F.
See MICRO 72 and MICRO 630.
ACC 704 and ACC 706.

ACCESS TIMEOUT CHECKS (FSC 12XX)

Format 1 Sense Byte 16, bit 0 = 1 indicates an Access Timeout Check.

The 180 millisecond Access Safety Timer is used to force a Servo Operation Complete signal to the system if the normal servo sequence fails.

The Access Timeout Check is activated by one of the following:

- An Access operation (Seek or Rezero) that failed to indicate an On Track condition before the end of the 180-millisecond Access Safety Timer. *See ALD page KE120 (KR120).*
- Seek Start command issued to a servo that is not ready or track following. *See ALD page KE140 (KR140).*

The Access Safety Timer is also used to time the Carriage Go Home portion of the HDA Stop sequence. The Access Timeout Check latch is reset in State 3 of the next HDA Ready sequence. *See ALD page KC500 (KT500).*

Types of Failures

LOGIC FAILURES

Failure in the access sequence control logic circuits can activate the Access Timeout Check latch. The logic can fail because the conditions to advance to the next state are not present or the State latch is defective.

CARRIAGE DRIVE CIRCUIT FAILURE

Carriage drive circuit failures can:

- Reduce drive signal amplitude.
- Prevent drive signal from reaching the VCM.

This type of failure will either not allow the carriage to move or to move very slowly causing Access Timeout Checks.

MECHANICAL FAILURES

Carriage binds which are severe enough to stop carriage motion cause an Access Timeout Check. Momentary binds in the carriage, which are overcome by the VCM, usually cause an Access Overshoot Check. *See HDA 712 for the Carriage Bind Checkout procedure.*

Note: *Access Timeout Checks are seldom the result of intermittent failures. Due to the time involved (180 milliseconds in the Access Safety Timer), errors that cause an access timeout failure are usually solid errors.*

For additional information see:
SENSE 108, Access Timeout description.
Microdiagnostic routine B8, tests 01 through 0A.
MICRO 72, MICFL 630 and 633.
ACC 110 through 112, Access Timeout Check MAPs and diagram.

ACCESS OVERSHOOT CHECK (FSC 15XX)

Format 1 Sense Byte 16, bit 1 = 1 indicates an Access Overshoot Check.

Access overshoot detection is designed into the servo circuits to prevent mechanical damage if a servo failure causes loss of carriage control. The Access Overshoot Check is activated by one of the following:

- Three track-crossing pulses are detected after either the Difference Counter is decremented to zero or after the Access Control advances to linear mode. The Access Overshoot Check de-activates the VCM drive current. These type of failures are identified by Fault Symptom Code 1506, 1508, 150A, 150C, or 150E. See below for further description of these errors. *See ALD page KE130 (KR130).*
- The Guardband latch or ID position is detected during a Seek operation. If the carriage moves out of the disk's data area during a Seek operation, the Access Overshoot Check is activated and the VCM drive current is de-activated before the carriage hits the crash stop. This type of failure is identified by the following Fault Symptom Codes 1508, 150A, 150C, or 150E. *See ALD page KE140 (KR140).*
- Carriage velocity is greater than 20 in/sec during a Rezero operation. Normal rezero carriage velocity should not exceed 15 in/sec. Carriage velocity is determined from the VCM current and the track crossing frequency. The velocity measurement circuits produce an analog voltage level that is proportional to the actual mechanical velocity of the carriage. If the velocity exceeds 20 in/sec, the Access Overshoot Check is activated and the VCM drive current is de-activated. This type of failure is identified by the following Fault Symptom Codes: 1510, 1512, or 1516. *See ALD page KE130 (KR130).*

Types of Failures

SERVO VELOCITY FEEDBACK FAILURES

Logic and analog circuit defects in the servo velocity feedback loop can cause Access Overshoot Checks. This type of circuit defect includes the following functions:

- Servo input from the HDA.
- Detection, clocking, and demodulation circuits that develop the track position signal.
- VCM current sense feedback from the Power Amplifier.
- Course and fine track detection circuits that develop the track-crossing pulse and control the velocity measuring circuits.
- DAC/velocity summation circuits that develop the error signal which controls the amplitude and polarity of the power amplifier drive voltage.
- Velocity threshold detectors that control the sequence state advancement by determining the points where End Accelerate and End Decelerate occur.
- All voltage sources for the above functions.

GUARDBAND DETECTION FAILURE

Logic failures in the inner and outer guardband pattern detection circuits.

DIFFERENCE COUNTER FAILURE

Logic failures in the Difference Counter or the Difference Counter decrement controls.

HDA FAILURES

Access Overshoot Checks can be caused by one of the following:

- HDA mechanical resonance caused by mechanical defects in the HDA bobbin, carriage, or head mounting structure.
- Momentary carriage binding caused by a misalignment between the HDA and VCM. *See HDA 712 for the Carriage Bind Checkout procedure.*

MARGINAL MECHANICAL/ELECTRICAL FAILURES

Any marginal mechanical part or electrical circuit associated with the servo mechanism has the potential of causing an Overshoot Check.

For additional information see:
SENSE 108, Access Overshoot Check description.
Microdiagnostic routine B8, tests 03 through 0B.
MICRO 72 and MICFL 630.
Microdiagnostic routine BD.
MICRO 84 and MICFL 810.
ACC 120 through 122, Access Overshoot Check MAPs and diagram.

ACCESS CHECKS

SERVO OFFTRACK CHECK (FSC 16XX)

Format 1 Sense Byte 16, bit 2 = 1 indicates a Servo Offtrack Check.

Servo Offtrack Check is activated any time the servo looses track following while Set Read*Write is active. If the servo allows the carriage to move out of the fine on track area during a Data Transfer operation, the Servo Offtrack Check is activated and the Read/Write gate and VCM drive current are de-activated. Read/Write Check is also activated but the Drive Check (see ACC 702) takes precedence over the Read/Write Check. Drive Check initiates the Error Recovery Program (ERP) for servo recovery.

Servo Offtrack errors are characteristically the result of intermittent analog failures. The failure symptoms vary depending on the problem and the operating mode of the drive at the time of the failure. FSC 150E indicates that the servo lost track following and activated the Access Overshoot Check while Set Read*Write was inactive. FSC 120E indicates that the loss of track following did not activate the Access Overshoot Check and a subsequent Seek Start command was issued. Visual indication of track following problems is a blinking Ready lamp. *See ALD page KE110 (KR110).*

Types of Failures

ANALOG CIRCUIT FAILURES

An analog circuit failure in the track following servo loop can cause a Servo Offtrack Check. This includes failures in the following functions:

- Servo input from the HDA.
- Detection, clocking, and demodulation circuits that develop the track position signal.
- VCM current sense feedback from the power amplifier.
- Position error (null) signal gated to the power amplifier drive.

TARGET TRACK CAPTURE

Carriage velocity being either too high or too low at the target track capture point or a capture control circuit failure can result in Track Following servo instability. *See scope procedures and pictures on ACC 665 through 673.*

HDA FAILURE

Servo Offtrack errors can be caused by one of the following:

- Failure in the HDA caused by mechanical resonance due to mechanical defects in the HDA bobbin, carriage, or head mounting structure. *See Microdiagnostic routine BD, MICRO 84, and MICFL 810 for vibration tests.*
- Mechanical vibration induced into the HDA from an external source such as the drive motor. Under normal machine vibration levels, mechanical noise can be induced into the HDA by defective shock mounts or incorrect HDA mounting.

ELECTRICAL NOISE

Servo Offtrack failures can be caused by electrical noise from loose connections, poor grounding, or incorrect cable routing.

For additional information see:
SENSE 108, Servo Offtrack Check description.
Microdiagnostic routine B8, test F.
MICRO 72
MICFL 630 and MICFL 665
ACC 130 and 131, Servo Offtrack MAPs and diagram.
OPER 123 through 125, Track Following description.

Rezero Operation Failure Fault Symptom Codes

1120*	1200	1500	1600	191B
	1201	1501	1601	900B
	1206	1506	1606	
	1210	1510	1610	
	1212	1512	1612	
	1216	1516	1616	

**Failure of the Drive to Sequence to Ready on a HDA Ready sequence.*

For additional information see:
ACC 3XX, Rezero failure MAPs and diagrams.
ACC 643 through ACC 647, Rezero Operation Scoping Checkout procedure.
OPER 119 and 120, Access State sequence.
OPER 129 and 130, Rezero block diagram.

INITIATE REZERO OPERATION

HDA Ready Sequence

The Rezero command is initiated by the HDA sequence control logic during State 2 of the HDA Ready sequence. Motor At Speed activates the HDA sequence State 2 latch which activates the Rezero command (see HDA 500). Completion of the Rezero operation, with or without a failure, advances the HDA sequence to State 6 (Ready). If the Rezero operation fails, the Ready lamp is not turned on, On Line status is not activated, and a Drive Check is activated. *See ALD page KE140 (KR140).*

Attention Pushbutton

Pressing the Attention pushbutton on the Operator Panel initiates a Rezero operation only if the HDA sequence is in State 6 (Ready).

The Rezero operation begins when the Attention pushbutton is pressed but carriage movement does not start until the pushbutton is released. *See ALD page KE150 (KR150).*

System Rezero Command (Tag '8F' Bus '02')

A Rezero operation is initiated by a system Rezero command. The system Rezero command is normally used by the Error Recovery Program (ERP) to reset an access-related error and re-align the carriage to cylinder 0. *See ALD page KE150 (KR150).*

REZERO STATE 01 (Wait)

Fault Symptom Codes: 1120, 1201, 1501, 1601, 191B, or 900B.

All Rezero operations begin by resetting the access sequence control to State 01. No carriage movement is involved.

Purpose

The Set Wait latch function resets any active Access Check and activates the Wait latch when the Time-out Check latch is inactive.

Wait latch on does the following:

- Resets the access to State 01 by resetting the following latches:

  Rezero Mode
  Servo
  Control
  Linear Mode

- Initiates the following actions:

  It activates the Even Track latch to condition the analog circuits in order to capture, then track follow on cylinder 0.

  Gates the Any Rezero signal which resets the Difference Counter, Head Address Register (HAR), and Carriage Address Register (CAR) to zero. Any Rezero also resets the Direction Bit In latch to indicate reverse direction to the servo (not forward).

If the Rezero operation is initiated by a System Rezero command, the Busy latch (Sense Byte 8, bit 6) is activated during State 01. *See ALD page KE140 (KR140).*

State Advance Conditions

The access sequence advances to State 00 (Wait latch is reset) when all of the following conditions are met:

- All access Checks are reset (inactive).
- The Even Track latch is active.
- The Rezero Mode, Servo, Linear Mode, and Control latches are inactive (Sense Byte 16, bits 3, 4, 5, and 6 respectively).
- Start Manual Rezero is inactive (Attention pushbutton is in the released position).

For additional information see:
ALD page KE130 (KR130)
Microdiagnostic routine B8, test 3
MICRO 630 and 637.

Possible Error Conditions

Access Checking circuits are not enabled during State 01 of a Rezero operation. If tne State Advance conditions are not met due to a logic failure, the following symptoms result:

- HDA Ready Sequence State 2 initiates the Rezero operation. The Ready lamp is off and a FSC of 1120 is generated. *See HDA 230, Entry A.*
- The Attention pushbutton initiates the Rezero operation. The drive Ready lamp is off, and pressing the Attention pushbutton appears to have no affect on the servo. *See ACC 638, (Attention Pushbutton Checkout procedure.)*
- The System Rezero command initiates the Rezero operation. The drive does not respond to the System Rezero command with an interrupt, and FSC 191B is generated. Sense Byte 8 is XXXX 1010. *See Microdiagnostic routine B8, test 3 and MICFL 630 and 637.*

FSC 1201 – ACCESS TIMEOUT CHECK IN STATE 01

This error is the result of a Seek Start command issued to a non-track following drive, or possibly the result of a defective Safety Timer circuit. *See ACC 110, Entry A (unable to reset Access Timeout Check), Microdiagnostic routine B8, test 2, and MICFL 630 and 633.*

FSC 1501 – OVERSHOOT CHECK IN STATE 01

This error could be the result of either defective velocity circuits or defective overshoot detection circuits. Check Sense Byte 11 for the following:

Bit 2 = 0 See ACC 334, Entry A
Bit 2 = 1 See ACC 120, Entry A

FSC 1601 – SERVO OFFTRACK ERROR IN STATE 01

This error could be the result of either a defective check circuit or a Set Read*Write command while the servo is in Reset State 01. *See ACC 130, Entry A (unable to reset Servo Offtrack error).*

FSC 900B – BUSY MISSING AFTER A SEEK OR REZERO OPERATION

This Fault Symptom Code applies to a Rezero operation failure if Sense Byte 16 is not equal to any of the following values:

'X8'
'XA'
'XC'
'XE'

See ACC 210, Entry C (no Busy response) if Sense Byte 16 equals any value other than above.

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SERVO REZERO OPERATION

REZERO STATE 00 (Rezero Start)

Fault Symptom Codes: 1200, 1500, or 1600

Purpose

Rezero State 00 tests the initial servo analog control conditions prior to starting carriage movement. The reset of the Wait latch in State 01 advances the sequencer to State 00 and starts the 180 millisecond Access Safety Timer for the Rezero operation. An Access Start signal is sent to the velocity control logic to condition the integrator controls for reverse direction movement to an even-numbered cylinder. If the Difference Counter is zero and the direction bit is set for reverse movement, Allow Rezero is sent back to the Access sequencer.

State Advance Conditions

The Access sequencer advances to State 10 (Rezero Mode latch is activated) when all of the following conditions are met:

- All Access Checks are inactive.
- Allow Rezero is active. This indicates that the velocity measurement control logic is conditioned to measure track-crossing frequency in the reverse direction.
- The Even Track latch is active *(see advance conditions for Rezero State 01 to 00).*
- Target Velocity is active. This indicates that the analog-measured velocity is null. The carriage may be moving but no VCM current is flowing and the track-crossing frequency circuits are reset.
- The Difference Counter is reset to zero. The DAC (digital to analog converter) input from the Difference Counter is zero during a Rezero operation.

For additional information see:
ALD page KE150 (KR150)
Microdiagnostic routine B8, test 3
MICFL 630 and 637

Possible Error Conditions

The 180 millisecond Access Safety Timer is started by Sequencer State 00. Overshoot detection circuits are not enabled during State 00.

FSC 1200 – ACCESS TIMEOUT CHECK IN STATE 00

Either a logic or an analog failure associated with the State Advance conditions occurred. Sense Byte 10, bit 7 (Odd Physical Track) should be inactive, indicating that the Even Track latch is active. Sense Byte 11, bit 2 (Target Velocity) should be active as one of the State Advance Conditions. *See ACC 320, Entry A (Access Timeout in State 00).*

FSC 1500 – OVERSHOOT CHECK IN STATE 00

This is an invalid condition indicating a checking circuit failure. *See ACC 120, Entry G (False Overshoot error).*

FSC 1600 – SERVO OFFTRACK ERROR IN STATE 00

This is an invalid error condition. Check Sense Byte 16 for the following:

Bit 0 = 1	See FSC 1200 above.
Bit 1 = 1	See FSC 1500 above.
Bits 0 and 1 = 0	The problem is associated with the Set Read*Write control logic. *See ACC 130, Entry D (invalid Servo Offtrack error).*

REZERO STATE 10 (Move Out)

Fault Symptom Codes: 1210, 1510, or 1610

Purpose

During State 10, the carriage is moved from the data area on the disk surface past track 0 to track –9 where the sequencer advances from State 10 to State 12 (turnaround).

Rezero State 10 starts carriage movement in the reverse direction (towards the OD). Velocity is controlled by the servo loop to approximately 15 in/sec. The actual carriage velocity is not critical unless it exceeds 20 in/sec, in which case the Overshoot Check is activated.

The carriage velocity is maintained until guardband pattern 1 is detected at track –2 *(see OPER 124 and 131).* When the guardband pattern 1 area (track –2 to track –9) is detected, the power amplifier drive voltage is reduced by the servo loop, slowing carriage movement to 2 in/sec.

At track –9, guardband pattern 2 (track –9 to OD) is detected; this advances the sequencer to State 12. State 12 activates Forward and moves the carriage toward track 0.

If the carriage is in the guardband pattern 2 area when the Rezero Mode latch is activated (State 10), the sequencer immediately advances to State 12 without any reverse carriage motion.

State Advance Conditions

The Access sequencer advances to State 12 (Control latch is activated) when the following conditions are met:

- All Access Checks are inactive.
- Guardband pattern 2 is detected.

For additional information see:
ALD page KE100 (KR100)
ACC 643 through ACC 646, Scoping procedures
Microdiagnostic routine B8, tests 4 and 5
MICFL 630, 639, and 641

Possible Error Conditions

The 180 millisecond Access Safety Timer is running during Access sequencer State 10. The greater than 20 in/sec Overshoot Detector monitors carriage velocity during the Rezero mode.

FSC 1210 – ACCESS TIMEOUT CHECK IN STATE 10

Either a logic or analog failure with the state advance condition occurred. Sense Byte 11, bit 1 (Guardband latch) should be active, indicating that either guardband pattern 1 or 2 was detected from the HDA. If the Guardband latch is active, the problem is in the sequencer logic controls. If the Guardband latch is inactive, one of the following could have occurred:

- The guardband pattern was not detected by the Index detection circuits.
- The carriage could have driven in the wrong direction (toward ID).
- The carriage was not in the guardband area when the Access Safety Timer reach 180 milliseconds either because of crash stop bounce or because of static carriage positioning. *See ACC 330, Entry A (Access Timeout in State 10).*

FSC 1510 – HIGH VELOCITY OVERSHOOT CHECK DURING REZERO STATE 10

This error is caused by either of the two following conditions:

- Excessive VCM current caused by a high-power amplifier drive signal, a defective velocity error signal summation circuit, or a high Rezero mode voltage output from DAC (digital to analog converter).
- Velocity detection circuit failure resulting in an erroneous high-velocity indication.

See ACC 334, Entry A (High Velocity Overshoot Check during Rezero mode).

FSC 1610 – SERVO OFFTRACK ERROR IN STATE 10

This is an invalid error condition. Check Sense Byte 16 for the following:

Bit 0 = 1	See FSC 1210 above.
Bit 1 = 1	See FSC 1510 above.
Bits 0 and 1 = 0	Problem is associated with the Set Read*Write control logic. *See ACC 130, Entry D (invalid Servo Offtrack error).*

REZERO STATE 12 (Turnaround)

Fault Symptom Codes: 1212, 1512, or 1612

Purpose

Rezero State 12 is the time the carriage is over the guardband pattern 2 area (track –9 to OD). Carriage motion is forward toward track 0 at high rezero velocity (approximately 15 in/sec.). When guardband pattern 1 is detected, the sequencer advances to State 16 (Linear Mode latch active).

State Advance Conditions

The Access sequencer is advanced to State 16 (Linear Mode latch active) when the following conditions are met:

- All Access Checks are inactive.
- Guardband pattern 1 is detected.
- Control latch is active (State 12).

For additional information see:
ALD page KE100 (KR100)
ACC 643 through ACC 647, Scoping procedure
Microdiagnostic routine B8, tests 4 and 5
MICFL 630, 639, and 641

Possible Error Conditions

The 180 millisecond Access Safety Timer is running during Access Sequencer State 12. If the timer expires, the Access Timeout Check is activated.

The greater than 20 in/sec Overshoot Detector monitors carriage velocity during Rezero mode.

FSC 1212 – ACCESS TIMEOUT IN STATE 12

This error could be caused by one of the following:

- Index detection circuit failure to detect guardband pattern 1. *See ACC 607, Step 8.*
- Linear Mode latch failure.
- Logic, analog, or power failure that results in no VCM current during the Rezero mode. The following are examples of this type of failure:
  - Open winding in the VCM.
  - Missing –36 Vdc to the power amplifier.
  - Missing the power amplifier drive signal.
  - Missing a rezero mode gate.
  - Missing a velocity error signal from summation amplifier.
  - Missing the rezero mode source voltage from DAC (digital to analog converter).
- Logic, analog, or power failure that results in reverse direction (toward OD) VCM current during Rezero mode. The following are examples of this type of failure:
  - Defective forward/reverse control logic.
  - An active Go Home condition from the HDA sequence.
  - A defective power amplifier drive control.
  - A defective power amplifier.
- Mechanical carriage binding.

See ACC 340, Entry A (Access Timeout in State 12).

FSC 1512 – HIGH VELOCITY OVERSHOOT CHECK DURING STATE 12

This error is caused by either of the two following conditions:

- Excessive VCM current caused by high power amplifier drive signal, defective velocity error signal summation circuit, or high Rezero mode voltage output from the DAC (digital to analog converter).
- Velocity detection circuit failure resulting in an erroneous high velocity indication.

See ACC 334, Entry A (High Velocity Overshoot Check during Rezero mode).

FSC 1612 – SERVO OFFTRACK ERROR IN STATE 12

This is an invalid error condition. Check Sense Byte 16 for the following:

Bit 0 = 1	See FSC 1212 above.
Bit 1 = 1	See FSC 1512 above.
Bits 0 and 1 = 0	Problem is associated with the Set Read*Write control logic. See ACC 130, Entry D (Invalid Servo Offtrack error).

REZERO STATE 16 (Move Out)

Fault Symptom Codes: 1216, 1516, and 1616

During Rezero State 16, the carriage is moved in the forward direction across the guardband pattern 1 area (track –9 to track –2) to track 0. When State 16 is activated, the power amplifier drive voltage is reduced to control carriage velocity across the guardband pattern 1 area at 2 in/sec. When the carriage leaves the guardband pattern 1 area and approaches track 0, carriage velocity decelerates under the control of the position signal voltage. The End Decelerate Threshold detector is set to become active when the carriage is within one-half track of track 0 and moving at an approximate velocity of 0.5 in/sec. Detection of End Decelerate advances the Access State sequencer to State 06 (Linear mode) by resetting the Rezero Mode latch.

State Advance Conditions

The Access sequencer advances to State 06 (Rezero Mode latch is de-activated) when the following conditions are met:

- All Access Checks are inactive.
- The Linear Mode latch is active (State 16).
- Guardband pattern 1 is no longer being detected.
- End Decelerate is active.

For additional information see:
ALD page KE150 (KR150)
ACC 643 through ACC 647, scoping procedure
Microdiagnostic routine B8, tests 4 and 5
MICFL 630, 639, and 641

Possible Error Conditions

The 180 millisecond Access Safety Timer is running during Access sequencer State 16. If the timer expires, the Access Timeout Check is activated.

The greater than 20 in/sec Overshoot detector monitors carriage velocity during Rezero mode.

FSC 1216 – ACCESS TIMEOUT IN STATE 16

This error is probably caused by one of the following failures:

- End Decelerate Velocity Threshold detector failure.
- Guardband pattern 1 always decoded by the Index detection circuits.
- Any analog failure that prevents the servo from having enough power to move forward out of the guardband pattern 1 area.
- Carriage binding.
- Access Sequencer Rezero Mode latch failure.

See ACC 350, Entry B (Access Timeout in State 16).

FSC 1516 – HIGH VELOCITY OVERSHOOT CHECK DURING REZERO STATE

This error is caused by either of the two following conditions:

- Excessive VCM current caused by high power amplifier drive signal, defective velocity error signal summation circuit, or high Rezero mode voltage output from the DAC (digital to analog converter).
- Velocity detection circuit failure resulting in an erroneous high velocity indication. *See ACC 334, Entry A (High Velocity Overshoot Check during Rezero mode).*

FSC 1616 – SERVO OFFTRACK ERROR IN STATE 16

This is an invalid error condition. Check Sense Byte 16 for the following:

Bit 0 = 1	See FSC 1216 above.
Bit 1 = 1	See FSC 1516 above.
Bits 0 and 1 = 0	Problem is associated with the Set Read*Write control logic. See ACC 130, Entry D (Invalid Servo Offtrack error).

SERVO REZERO OPERATION

REZERO STATE 06 (Linear Mode)

Fault Symptom Codes: 1206, 1506, and 1606

Purpose

During Rezero State 06, the carriage is at track 0 and attempting to capture, then stabilize in a track following condition. *See OPER 123 through 125.*

When the sequencer advances from State 16 to State 06, the carriage should be approaching track 0 at a velocity of less than 0.5 in/sec and be within one-half track of the center of track 0. The Rezero mode servo is de-activated and the Track Following servo is activated. The Track Following servo holds the carriage at track center, enabling the data transfer operation. Track center is determined from Position Signal Level detectors which decode the On Track condition parameters. When the carriage enters the on track area, the 3.2 milliseconds track Following Delay Timer is started. If the servo holds the carriage within the on track area for 3.2 milliseconds, the timer expires and indicates Track Following to the Access sequencer. If the carriage moves out of the on track area, either before or after the timer expires, the timer resets and doesn't start again until the servo brings the carriage back to track center.

When Track Following is indicated to the Access sequencer and an Index Mark is detected, the sequencer advances to On Track State 0E (Servo latch active) and:

- Seek Complete is activated (Sense Byte 8, bit 7 = 1).
- Busy indication is blocked (Sense Byte 8, bit 6 = 0).
- Attention is sent to the attachment indicating the operation is complete.

The attachment responds with an Attention Reset command to reset the Busy latch.

State Advance Conditions

The Access sequencer advances to State 0E (Servo latch is activated) when the following conditions are met.

- All Access Checks are inactive.
- Access sequencer is in State 06.
- Track Following is indicated from the servo.
- Any Valid Index Mark is detected.

For additional information see:
ALD page KE100 (KR100)
ACC 643 through ACC 647, scoping procedure
Microdiagnostic routine B8, test 4 and 5.
MICRO 630, 639, and 641.

Possible Error Conditions

The 180 millisecond Access Safety Timer continues to run until the servo latch is activated (State 0E). In Sequence State 06, the greater than 20 in/sec Overshoot Detector is not active but an Overshoot Check is activated if three track-crossing pulses are counted while the servo is stabilizing on track 0. *See ACC 704 (Access Overshoot Check).*

FSC 1206 – ACCESS TIMEOUT IN STATE 06

This error can be caused by one of the following failures:

- Valid Index Mark detection failure.
- Track Following Timer circuit failure.
- Access sequencer servo latch failure.
- Analog failure in the Track Following servo can cause a Timeout Check if the servo cannot maintain the On Track condition. Generally, this type of failure causes loss of carraige control and results in an Overshoot Check.

See ACC 630, Entry B (Access Timeout in State 06).

FSC 1506 – OVERSHOOT CHECK IN STATE 06

This is a common type of failure that can be caused by any of the following:

- An analog failure in the Track Following servo loop, such as a missing current sense feedback from the power amplifier or a defective error signal summation circuit.
- Missing servo forward drive current. This can cause the carriage to bounce off the outer crash stop and advance the sequencer to State 06 by its return momentum. The Track Following servo may or may not lock on to track 0 if this happens. If it does not lock on to track 0, an Overshoot error occurs.
- Mechanical Carriage binding.
- Mechanical vibrations induced into the HDA either from an internal or external source.
- An Analog failure, during State 16, that causes the carriage velocity to be too high at the approach to track 0.
- End Decelerate circuit failure that advances the servo to State 06 early while the carriage velocity is too high for the Track Following servo to control.

Note: *There are circuits in the servo that are critical and others that are not. The circuits that are not critical can be defective and still not cause a failure or only cause an intermittent failure. Intermittent servo errors, especially FSC 1506, have a high probability of being caused by a solid analog failure.*

See ACC 364, Entry A (Access Overshoot Error in Rezero Operation).

FSC 1606 – SERVO OFFTRACK ERROR IN STATE 06

This is an invalid error condition. Check Sense Byte 16 for the following:

Bit 0 = 1	See FSC 1206 above.
Bit 1 = 1	See FSC 1506 above.
Bits 0 and 1 = 0	Problem is associated with the Set Read*Write control logic. See ACC 130, Entry D (Invalid Servo Offtrack error).

Rezero Operations Failure Fault Symptom Codes

1208	1508	1608	900B
120A	150A	160A	
120C	150C	160C	
120E			

For additional information see:
ACC 5XX, Seek failure MAPs and diagrams
ACC 648 and 649, Scoping procedure
ACC 665 through 673, Scoping procedure
OPER 119 and 120, Access State sequence
OPER 139 through 142, Seek operation description

A Seek operation is initiated only by a command from the attachment system. Tag '8F' Bus '08' initiates a Seek operation through the channel.

PREREQUISITES FOR A SEEK OPERATION

1. The access mechanism is in the Track Following State (Sense Byte 16 = '0E') with all access errors inactive. The Ready lamp on is the visual indication. FSC 120E results if the servo is not track following when the Seek Start command is issued.
2. The Difference Counter is loaded to a nonzero value by Tag '8C', Bus 'XX' (Set Difference Counter Low) and Tag '8F'. Bus 'XE' (Set Difference High and Set Direction). *See OPER 101.*
3. The Read/Write or Pad operation is not in progress. If a Seek command is issued during a Data Transfer operation, FSC 900B (Missing Busy after Seek Start) is generated.

SEEK STATE 0A (Accelerate)

Fault Symptom Codes: 120A, 150A, and 160A

Purpose

If the prerequisites are met, a Seek Start command resets the Track Following Timer and then activates the Busy latch (Sense Byte 8, bit 6 = 1). When the servo indicates that the Track Following Timer is reset, the sequencer advances to State 0A (Accelerate). Any logic failure prior to advancing to State 0A generates FSC 900B (Missing Busy after a Seek Start).

State 0A starts the 180 millisecond Access Safety Timer, activates the Servo Access mode, and starts carriage motion. Track-crossing pulses, generated by the carriage movement, are used to decrement the Difference Counter. The Difference Counter sends a signal to DAC (digital to analog converter) which produces an analog voltage level used by the servo to determine the carriage velocity necessary to reach the target track. The carriage velocity is measured, as it moves, and fed back to the servo to indicate this velocity. When the carriage velocity is the same as the velocity required by the DAC input to the servo, End Accelerate is activated, which advances the sequencer to State 08 (Decelerate).

State Advance Conditions

The Access sequencer advances to State 08 (Control latch de-activated) when the following conditions are met:

- All Access Checks are inactive.
- End Accelerate is detected.

For additional information see:
ALD page KE110 (KR110)
ACC 648 and 649, Scoping procedure
Microdiagnostic routine B8, tests 7 and A
MICFL 630, 645, and 653

Possible Error Conditions

The 180 millisecond Access Safety Timer is running during State 0A. If the timer expires, the Access Timeout Check is activated.

The Overshoot Check detection circuits monitor carriage movement for either three track-crossing pulses after the Difference Counter has decremented to zero or for detection of the Guardband latch or ID position. *See ACC 704, Overshoot Check.*

FSC 120A – ACCESS TIMEOUT IN STATE 0A

This error is the result of a servo failure which prevents the carriage from accelerating to the velocity that is indicated by the Difference Counter and not reaching the target track within 180 milliseconds. Normally, this means no carriage movement at all because any low-velocity movement eventually decrements the Difference Counter to where End Accelerate is activated. Any low seek velocity problem either causes intermittent Overshoot Checks or no failure at all. An Overshoot Check is caused by a logic failure in the Access State sequencer circuits which causes the carriage to hit the crash stop. *See ACC 540, Entry B (Access error in State 0A).*

FSC 150A – OVERSHOOT CHECK IN STATE 0A

This error can result from one of the following:

- A State Advance sequencer logic failure.
- An End Accelerate detector circuit failure.
- The detection of a guradband pattern during State 0A. This may be caused by carriage movement in the wrong direction or by a Difference Counter failure, such that it is at a greater value than that required to move to the target track. *See ACC 540, Entry B (Access errors in Seek State 0A).*

FSC 160A – SERVO OFFTRACK ERROR IN STATE 0A

This is an invalid error condition. Check Sense Byte 16 for the following:

Bit 0 = 1	See FSC 120A above.
Bit 1 = 1	See FSC 150A above.
Bits 0 and 1 = 0	Problem is associated with the Set Read*Write control logic. See ACC 130, Entry D (Invalid Servo Offtrack error).

SEEK STATE 08 (Decelerate)

Fault Symptom Codes: 1208, 1508, and 1608

Purpose

During Seek State 08 (Decelerate), the carriage continues moving at its maximum velocity until the Difference Coutner has decremented to within 127 cylinders of the target track. The servo then starts slowing the carriage in relation to a controlled-function curve (servo decelerate curve). The decelerate curve slows the carriage velocity to 0.5 in/sec when the carriage is 0.5 cylinders from the target cylinder. At 0.5 in/sec and 0.5 cylinder from the target cylinder, a Velocity Threshold detector (called End Decelerate) is activated advancing the sequencer to Seek State 0C. Advancing to State 0C de-activates the Access Mode servo and activates the Track Following servo to capture the target track.

State Advance Conditions

The Access sequencer advances to State 0C (Linear Mode latch is activated) when the following conditions are met:

- All Access Checks are inactive.
- End Decelerate is detected.

For additional information see:
ALD page KE100 (KR100)
ACC 648 and 649, Scoping procedure
ACC 665 through 673, Scoping procedure
Microdiagnostic routine B8, tests 7 and A
MICFL 630, 645, and 653

Possible Error Conditions

The 180 millisecond Access Safety Timer is running during State 08. If the timer expires, the Access Timeout Check is activated.

The Overshoot Check detection circuits are active for either three track-crossing pulses after the Difference Counter has decremented to zero or for detection of the Guardband or ID position. *See ACC 704, Overshoot Check.*

FSC 1208 – ACCESS TIMEOUT CHECK IN STATE 08

This error is the result of a servo failure that causes very slow carriage movement. It is an unlikely condition and no specific circuit failure can be defined as causing the failure symptom. Usually, a low-velocity problem causes either an Overshoot Check or no failure. *See ACC 550, Entry A (Access error in State 08).*

FSC 1508 – OVERSHOOT CHECK IN STATE 08

This error can be caused by one of the following failures:

- A State Advance sequencer logic failure.
- An End Decelerate detector circuit failure.
- The detection of a Guardband pattern in State 08. This can be caused by carriage movement in the wrong direction or by a Difference Counter value that is greater than expected.
- Servo failure resulting in uncontrolled carriage movement during the Seek Access mode. This can cause the Difference Counter to decrement to zero before detecting end decelerate velocity. *See ACC 550, Entry A (Access error in Seek State 08).*

FSC 1608 – SERVO OFFTRACK ERROR IN STATE 08

This is an invalid error condition. Check Sense Byte 16 for the following:

Bit 0 = 1	See FSC 1208 above.
Bit 1 = 1	See FSC 1508 above.
Bits 0 and 1 = 0	Probelm is associated with the Set Read*Write control logic. See ACC 130, Entry D (Invalid Servo Offtrack error).

SERVO SEEK OPERATION

SEEK STATE 0C (Linear Mode)

Fault Symptom Codes: 120C, 150C, and 160C

Purpose

During Seek State 0C, the carriage is at the target cylinder and attempting to lock into a track following condition. *See OPER 123 through 125.*

When the sequencer advances from Seek State 08 to 0C, the carriage should be approaching the target cylinder at less than 0.5 in/sec and be within one-half track of the center of the target track. The Access mode servo is de-activated and the Track Following servo is activated. The Track Following servo holds the carriage at track center, enabling data transfer operations.

The track center is determined from the Position Signal Level detectors which decode the on track condition parameters. When the carriage enters the on track area, a 3.2 millisecond Track Following Delay Timer is started. If the servo holds the carriage within the on track area of 3.2 milliseconds, the timer expires and indicates Track Following to the Access sequencer. If the carriage moves out of the track following area, either before or after the timer expires, the timer is reset and is not re-started until the servo brings the carriage back to the track center.

When Track Following is indicated to the Access sequencer, the sequence advances to the On Track State 0E (Control latch is activated) and:

- Seek Complete is activated (Sense Byte 8, bit 7 = 1).
- Busy indication is blocked (Sense Byte 8, bit 6 = 0).
- Attention is sent to the attachment indicating the Servo operation is complete.

The attachment responds with an Attention Reset command to reset the Busy latch.

State Advance Conditions

The Access sequencer advances to State 0E (Control latch is activated) when the following conditions are met:

- All Access Checks are inactive.
- The sequencer is in State 0C.
- The servo is Track Following.

For additional information see:
ALD page KE100 (KR100)
ACC 648 and 649, Scoping procedure
ACC 665 through 673, Scoping procedure
Microdiagnostic routine test 7 and A
MICFL 630, 645, and 653

Possible Error Conditions

The 180 millisecond Access Safety Timer is running during State 0C. If the timer expires, the Access Timeout Check is activated.

The Overshoot Check detection circuits monitor carriage movement for either three track-crossing pulses after the Difference Counter has decremented to zero or for detection of the Guardband latch or ID position. *See ACC 704, Overshoot Check.*

FSC 120C – ACCESS TIMEOUT ERROR IN STATE 0C

This error can be caused by one of the following failures:

- A State Advance sequencer logic failure.
- An analog failure in the Track Following servo which can cause a Timeout Check if the servo cannot maintain the On Track condition. This type of failure is more likely to cause loss of carriage control and result in an Overshoot Check.

Basic track following circuits have been verified by the successful completion of a Rezero operation before the Seek operation. A track following circuit failure after a Seek operation has to be due to marginal conditions. *See ACC 560, Entry A (Access Timeout Check in State 0C).*

FSC 150C – OVERSHOOT CHECK IN STATE 0C

This error is a common intermittent type of failure and can be caused by any of the following failures:

- A marginal analog circuit causing Track Following servo failures.
- Incorrect power supply voltage levels or voltage noise levels.
- Mechanical binding in the HDA.
- Mechanical vibration induced into the HDA either from an internal or external source.
- Access mode servo failure that cause carriage velocity to be too high at the approach to the target cylinder.
- Access mode servo failure that causes the carriage velocity to be too slow at the approach to the target cylinder.

Note: *There are circuits in the servo design that are critical and others that are not. The circuits that are not critical can be defective and still not cause a failure or only cause an intermittent failure. Intermittent servo failures have a high probability of being caused by a solid analog failure in a non-critical circuit.*

See ACC 562, Entry A (Overshoot Check in State 0C).

FSC 160C SERVO OFFTRACK ERROR IN STATE 0C

This is an invalid error condition. Check Sense Byte 16 for the following:

Bit 0 = 1	See FSC 120C above.
Bit 1 = 1	See FSC 150C above.
Bits 0 and 1 = 0	Problem is associated with the Set Read*Write control logic. See ACC 130, Entry D (Invalid Servo Offtrack error).

SERVO TRACK FOLLOWING OPERATION

Track Following Operation Failure Fault Symptom Codes

120E 150E 160E

Visual Indication – Loss of Ready light

For additional information see:
ACC 560, Track Following MAPs
ACC 665 through ACC 673, Seek Operation Scoping Checkout procedure
OPER 123 through 125, Track Following description

Purpose

The Servo Track Following State is the Access Sequencer State 0E (Sense Byte 16 = '0E'). Track Following State 0E follows the successful completion of either a Rezero or Seek operation. All data transfer operations take place during State 0E. A Seek operation can be initiated only while the servo is track following (State 0E). The Ready lamp is usually on when the servo is in State 0E.

The servo can loose track following and recover itself without causing an error unless a data transfer operation is in progress. When the servo is not track following, the Track Following Timer is reset and the Ready lamp is off. Track following is not indicated until the servo repositions the carriage at track center and holds it for 3.2 milliseconds.

An error occurs when the drive is not track following and a Seek operation is initiated or if the carriage is so far off track that the servo cannot return it to track following. Loss of track following during a data transfer operation also causes an error. If an error occurs, the VCM drive current is de-activated and the Ready lamp stays off.

Possible Error Conditions

The following Fault Symptom Codes are generated by errors during Sequencer State 0E.

FSC 120E – TIMEOUT CHECK DURING STATE 0E

This error occurs when the servo is not track following when a Seek Start command is issued.

FSC 150E – OVERSHOOT CHECK DURING STATE 0E

One of the following conditions can cause an Overshoot Check:

- Detection of the guardband pattern either at ID or OD while in State 0E activates the Overshoot Check.
- Counting the third track-crossing pulse after the servo has locked on to the target track activates an Overshoot Check.

FSC 160E – SERVO OFFTRACK CHECK DURING STATE 0E

This error is activated if the servo looses track following during a data transfer operation. The data transfer operation is terminated.

Possible Causes for Servo Failures in State 0E

Servo failures in State 0E can be caused by one of the following:

- Marginal performance in the track following analog circuits.
- Incorrect power supply voltage amplitude or noise levels.
- Mechanical vibration induced into the carriage assembly by carriage movement during Seek operations or by patterns of repetitive Seek operations.
- Mechanical vibrations induced into the HDA from an external source.
- Carriage binding caused by misalignment between the VCM and HDA.
- Electrical noise in the servo feedback circuits from the HDA servo head input or from the VCM current sense feedback.

SEEK VERIFICATION ERROR

Microcode detected error:
FSC 191A

PURPOSE

Seek Verification is a command sequence executed by the storage control or host attachment. This command sequence verifies that the carriage is positioned over the correct cylinder and the correct head is selected before any customer data operation begins. If a Seek Verification error occurs, the physical Home Address read did not compare to the expected value.

ADDRESSING

Sense Bytes 5 and 6 contain the expected logical cylinder and head address. *See R/W 400 to convert the logical addresses to physical addresses.*

Sense Bytes 20 and 21 contain the physical head and cylinder address that were read from the disk.

Sense Bytes 13 and 14 contain the physical head and cylinder addresses of the previous position of the Access.

ERROR RETRY

If a Seek Verification error occurs, the storage control performs ten successive retries in an attempt to position the carriage correctly. A retry consists of a Rezero operation followed by a Seek operation to the expected cylinder. If the retry is successful, the Seek Verification error is soft and the contents of Sense Bytes 5, 6, 13, 14, 20, and 21 reflect the original seek failure. If all retries are unsuccessful, the error is hard and the contents of Sense Bytes 5, 6, 13, 14, 20, and 21 reflect the last retry sequence.

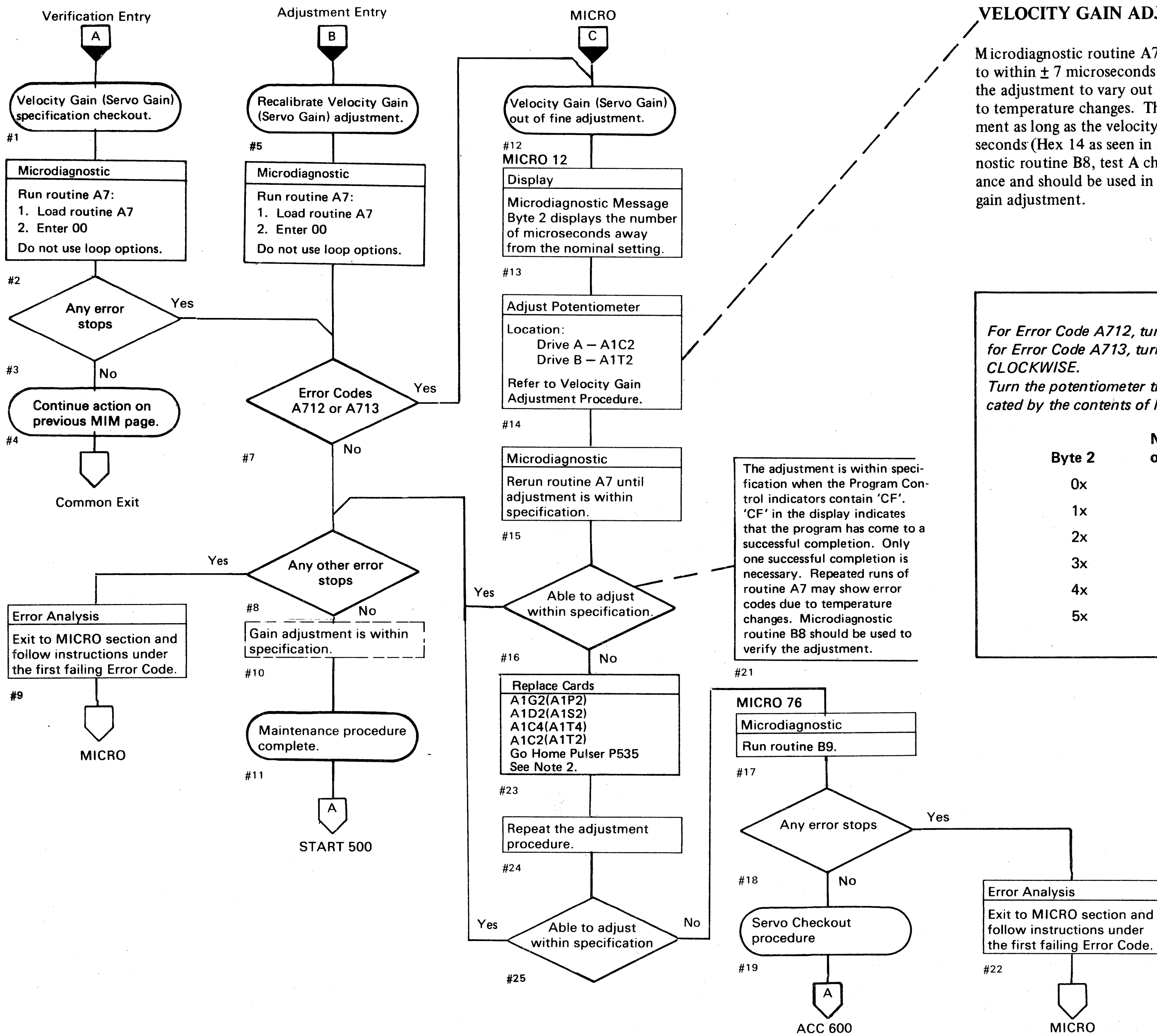
CORRECTING SEEK VERIFICATION ERRORS

Examine the Sense Bytes and try to isolate the problem to the following conditions:

- A movable head select failure.
- A fixed head select failure.
- A cylinder seek problem.
- Failures common to single address or random addresses.
- A failure caused by an overshoot or undershoot of the expected cylinder.
- The difference between expected and received cylinder is greater than two or a binary unit that would indicate a logic failure.
- A drive that is failing in other modes indicating a possible marginal analog failure.
- Failures coincident with external mechanical influences or power surges.
- A failure that can be reproduced with microdiagnostic routines.
- A failure that can be isolated to either the HDA or card logic.

Any failures that cannot be attributed to the HDA or repaired by card replacement have to be left to the discretion of the Customer Engineer for further isolation.

VELOCITY GAIN CALIBRATION



VELOCITY GAIN ADJUSTMENT PROCEDURE

Microdiagnostic routine A7 is used to adjust the velocity gain to within ± 7 microseconds (MICFL 180). It is not unusal for the adjustment to vary out of the ± 7 microsecond range due to temperature changes. This should not be cause for re-adjustment as long as the velocity gain remains within ± 20 microseconds (Hex 14 as seen in A7, message byte 2). Micro diagnostic routine B8, test A checks for a ± 20 microsecond tolerance and should be used in place of A7 to verify the velocity gain adjustment.

For Error Code A712, turn the potentiometer CLOCKWISE; for Error Code A713, turn the potentiometer COUNTER-CLOCKWISE.
Turn the potentiometer the correct number of turns as indicated by the contents of Message Byte 2.

Byte 2	Number of turns
0x	1/2 (or less) (See Note 1)
1x	1
2x	2
3x	3
4x	4
5x	5

Note 1: *A potentiometer that is set at the extreme upper or lower end will, with very little adjustment, sometimes cause erratic low to high readings (message byte 2) with the same error code. Continue to turn the potentiometer in the direction indicated by the error code until the readings are in the correct range. This may require 8 to 12 turns. Replacement cards may be received with the potentiometer set at either the upper or lower limit.*

Note 2: *The connector on top of the Pulser card is split (one side for Drive A and one side for Drive B). Reversing the connector will swap the A and B drive pulse circuits. See LOC 4 and 14.*

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TROUBLE NOT FOUND

This page contains aids for problem resolution where insufficient error information is available to follow the maintenance analysis procedure. It may also be used as an aid in analyzing intermittent errors.

CHECK DEVICE ADDRESS

Is the failing device the only one that fails?

Check EREP printouts to determine if more than one device is failing.

CHECK MICRODIAGNOSTIC DISK

If the microdiagnostics failed, verify that the disk used is the proper level for the device that failed.

EC INSTALLATION

Has an engineering change been recently installed?

Check the EC installation instructions and determine where the change was made.

Inspect the backpanel for tight wire wraps.

VISUAL CHECKS

Circuit Breakers

Verify that all Circuit Breakers (CBs) and Circuit protectors (CPs) are set.

Cables/Wiring

- Verify that all cables are seated properly.
- Check for pinched or damaged wires or cables.
- Check for loose wires on terminal strips.

Voltage Jumpers

Verify that the voltage jumpers to A–A1 and A–A2 are plugged correctly (See power logic page YB 090).

VCM Terminals

Verify that the voice coil motor terminals are secure (see Figure 1, ACC 600). See HDA 708 for voice coil replacement procedure.

CHECKOUT PROCEDURES

If any of the following checkout procedures have not yet been used to isolate the problem, they may be used now.

Static Servo Checkout – ACC 600

The Static Servo Checkout procedure contains the following:

- Voltage specification chart
- Card and cable possible cause list
- Servo input scope procedures
- Servo analog functions – static scoping procedures
- Servo cards – I/O pin static condition chart

Dynamic Servo Checkout – ACC 630

The Dynamic Servo Checkout procedure contains the following:

- Symptom/recommended action chart
- Attention pushbutton diagram and checkout procedure.
- Rezero and Seek operations scope checkout procedure – program setup, scope setup, and sample scope figures.
- Servo block diagram and test point and ALD cross-reference charts.

HDA Checkout Procedure – ACC 660

- Symptom/recommended action chart.
- HDA cable diagram with sample scope figures.
- HDA grounding diagram and checkout procedure.
- Servo Seek operation – settling time scope checkout procedure, program setup, scope setup, and sample scope figures.

REFERENCES

Access Theory

Access mechanism theory of operation and description– OPER 116 through OPER 142.

Microdiagnostics

The following references point to individual microdiagnostic routines that test the Access mechanism. The MICFL reference is a reference to the flowchart of the routine and the routine description; the MICRO reference is a reference to the operating instructions for the routine.

Routine B8 – Basic Servo diagnostic
MICFL 633
MICRO 74

Routine B9 – Advanced Servo diagnostic
MICFL 683
MICRO 76

Routine A7 – Velocity Gain Adjustment
MICFL 181
(See ACC 800 for instructions)

Routine A9 – Incremental Seek exerciser
MICFL 201
MICRO 24

Routine AA – Cylinder Seek exerciser
MICFL 211
MICRO 28

Routine AB – Random Seek exerciser
MICFL 221
MICRO 28

Routine BD – HDA Vibration Tolerance test
MICFL 813
MICRO 84

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