I 990
DS10 DISK DRIVE
Student Guide

Digital Systems Group
EDUCATION & DEVELOPMENT CENTER

TEXAS INSTRUMENTS
INCORPORATED

CONTENTS

CONTENTS

DS-10 OUTLINE

DAY ONE AM MONDAY

1. INTRODUCTION
   A. HOURS, COURSE LENGTH,LAB AND LECTURE SCHEDULES.

   B. DISTRIBUTE AND EXPLAIN CLASS MATERIALS.

2. 990 TILINE CONCEPTS
   A. BLOCK OF 990 SYSTEM.
      1) DEFINE TILINE TERMS.

   B. HANDSHAKE OF TILINE SIGNALS.

3. DS10 CONTROLLER
   A. BLOCK DIAGRAM OF CONTROLLER.
      1) TILINE INTERFACE.
      2) MICROPROCESSOR PROTION.
      3) DISK INTERFACE.

DAY ONE PM MONDAY

4. DS10 DISK DRIVE
   A. BASIC DRIVE CONCEPTS.
      1) DEFINE TERMS AND INTERFACE SIGNALS.
      2) EXPLAIN BASIC SERVO OPERATION.
      3) EXPLAIN BASIC READ/WRITE OPERATION.
      4) DEFINE STATUS AND ERROR TERMS.

   B. SPECIAL TOOLS REQUIRED

   C. POWER SEQUENCE
      1) AC POWER ON AND DISTRIBUTION.
      2) BLOWER, CLOCKS, AND DC VOLTAGES.
      3) SEQUENCE LOGIC.
      4) SPEED DETECTION.

DAY TWO AM TUESDAY

D. SERVO SYSTEM
   1) BLOCK EXPLAINATION OF SERVO.
   2) FIRST SEEK LOGIC.
   3) D/A CONVERTER.
   4) SERVO CONTROL AND DIRVE.
   5) READY AND ATTENTION LOGIC.

E. PROGRAMED SEEK
   1) CA REGISTER AND CYLINDER COUNTER.
   2) SEEK CONTROL LOGIC.
   3) REPEAT ITEMS D3 THRU D5.
   4) CYLINDER POSITIONING SYSTEM.

F. RETURN TO ZERO SEEK

DAY TWO PM TUESDAY

LAB EXERCISE SCHEDULED

DAY THREE AM WEDNESDAY

G. READ/WRITE SYSTEM
   1) HEAD AND DISK SELECTION.
   2) WRITE DATA PATH.
   3) STRADDLE ERASE.
   4) SECTORING AND INDEX.
   5) RECORD FORMAT.
   6) WRITE PROTECTION.

H. READING DATA
   1) READ DATA PATH.
   2) CROSSOVER DETECTION AND DIGITIZER.

I. VCO AND DATA CLOCKS

J. SATUS AND FAULTS
   1) DAMAGIND AND NON-DAMAGING FAULTS.
   2) OUTPUT INTERFACE.

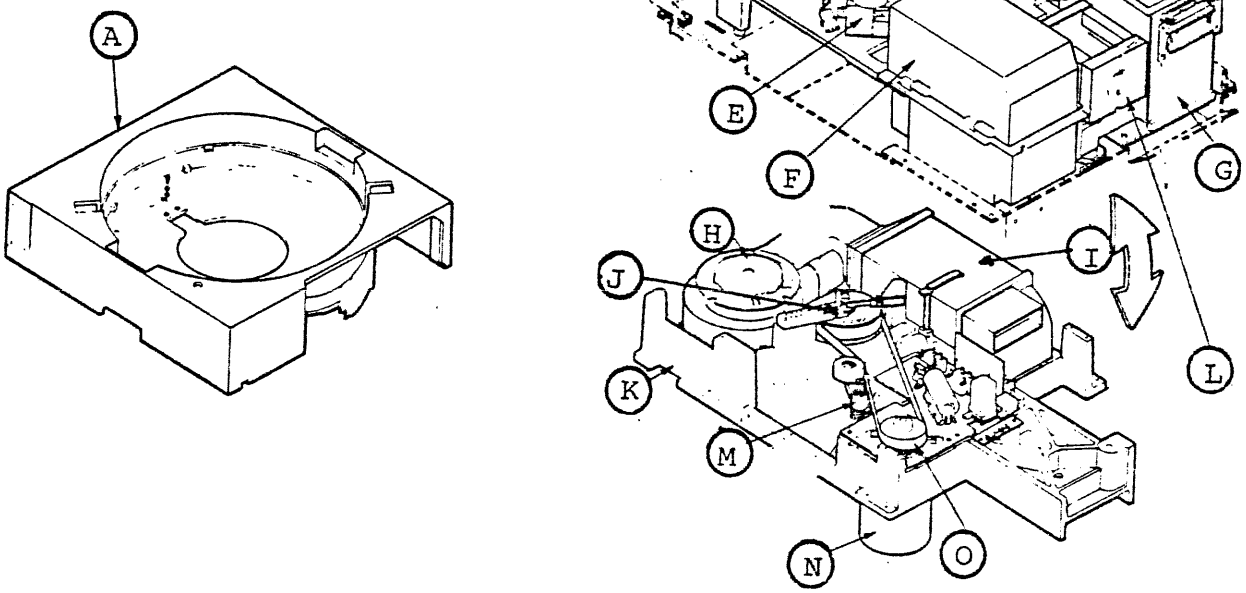
DAY THREE PM WEDNESDAY

LAB EXERCISE CONTINUED

EXERCISE 1

1. IN THIS EXERSISE YOR ARE TO IDENTIFY THE FOLLOWING LIST OF COMPONENTS AS SHOWN IN THE DIAGRAM BELOW.

AIR FILTER	_____	SPINDLE MOTOR	_____
BASE DECK	_____	ACTUATOR ASY	_____
SPINDLE	_____	POWER SUPPLY	_____
CARD CAGE	_____	PACK LOCK ASY	_____
BRUSH DRIVE	_____	BLOWER ASY	_____
FD SECTOR ASY	_____	HEADS ASY	_____
MAGNET ASY	_____	I.O. BOARD ASY	_____
IDLER ASY	_____	DRIVE PULLEY	_____
CARTRIGE RECEIVER ASY	_____		



EXERCISE 2

1. REMOVE COVERS TO EXPOSE THE CARD CAGE AND POWER SUPPLY.

2. SEQUENCE UP THE DRIVE ON THE SYSTEM.

3. LOAD DOCS AND PERFORM THE FOLLOWING CHECKS AND ADJUSTMENTS AS FOUND IN THE C.D.C. HARDWARE MAINTENANCE MANUAL.

* A. AGC SERVO PREAMP AND INDUCTOSYN CHECK AND ADJUSTMENT. PAGE 6-55.1 PARR 6.7.1

* B. FEDT CHECK AND ADJUSTMENT. THIS CHECK AND ADJUSTMENT MUST BE DONE IN THE FOLLOWING MANNER ON THE 990/10 UNLESS AN EXERCISER IS AVAILABLE.

   1. ON THE EXTENDER CARD INSTALL A .002 MICROFARAD CAP BETWEEN THE 15 PIN FROM THE RIGHT HAND SIDE AND GROUND. NOW PLACE THE SERVO CARD ON THE EXTENDER CARD AND PLACE THE EXTENDER IN THE SERVO CARD SLOT. NOW BRING UP THE DISK DRIVE AND WAIT FOR THE DRIVE TO COME READY. NOW PROCEED TO THE FOLLOWING STEPS.

   2. GROUND SKERR/ENABLE ON THE SERVO PWB. BY GROUNDING U25-13 OR U16-5 AND GROUND TEST POINTS 20 AND 21 ON THE SERVO CARD.

   3. ON THE SERVO CARD SET PENCIL SWITCHES S3-4 AND S2-10 TO THE OFF POSITION.

   4. SET UP THE FOLLOWING THREE COMMANDS BY USING DOCS:

MA	DATA	
8000	0000	
8002	0200	READ COMMAND
8004	0100	1S/R
8006	0198	CYL ADD 408
8008	0000	BYTE COUNT=0
800A	9000	
800C	0800	UNIT #0
800E	0000	

```
8010    0000
8012    0200  READ
8014    0100
8016    019A  CYL ADD 410
8018    0000
801A    9000
801C    0800
801E    0000

8020    0000
8022    0700  RESTORE
8024    0000
8026    0000
8028    0000
802A    0000
802C    0800
802E    0000
```

5. USING THE DOCS COMMAND LO LOOP ON ADDRESS 8000 FOR TWO COMMANDS AND DO NOT CHECK STATUS.

6. FOLLOW THE FEOT CHECK AND ADJUSTMENT PROCEDURES IN THE MAINTENANCE MANUAL TO CORRECTLY ADJUST THE FEOT SENSOR. THIS IS ON PAGE 6-63 PARR 6.7.3.

* C. STATIC ELIMINATOR CHECK. PAGE 6-71 PARR 6.7.3

4. ONLY CHECK THE FOLLOWING AND DO NOT ADJUST THEN AS THEY WILL BE ADJUSTED IN A LATER EXERCISE.

* A. HEAD ALIGNMENT CHECK. PAGE 6-64 PARR 6.7.4

* B. INDEX TO DATA BURST PERIOD CHECK. PAGE 6-66 PARR 6.7.5

EXERCISE 3

DISASSEMBLY AND REASSEMBLY

1. BEFORE PROCEEDING WITH THE FOLLOWING EXERCISE, PLEASE MAKE SURE YOUR INSTRUCTOR IS PRESENT.

2. REMOVE AND THEN REINSTALL THE FOLLOWING ASSEMBLIES:

TITLE	PARR NO.	PAGE NO.
ABSOLUTE FILTER	6.5.5	6-8
ACTUATOR ASSEMBLY	6.6.1	6-12
ALL FOUR HEADS	6.6.2	6-17
FIXED DISK	6.6.4	6-22
VELOCITY TRANSDUCER	6.6.6	6-28
VELOCITY TRANSDUCER MAGNET	6.6.7	6-31
POWER SUPPLY	6.6.18	6-49

3. AFTER REASSEMBLING THE ABOVE COMPONETS, RUN DIAGNOSTICS FROM THE SYSTEM TO CHECK THE ALIGNMENT OF THE DRIVE.

EXERCISE 4

1. PERFORM THE FOLLOWING SEEK OPERATIONS AS OUTLINED IN THE H.P.C. MANUAL.

   A. SELECT BITS 128, 16, AND 8 ON THE I.O. BOARD.

   B. OPERATE THE STROBE.

   C. WHAT ACTION TAKES PLACE?

      _____

   D. TURN OFF THE 128 BIT ON THE I.O. BOARD.

   E. AGAIN OPERATE THE STROBE.

   F. NOW WHAT ACTION TAKES PLACE?

      _____

   G. FOR WHAT PROCEDURE WOULD THIS METHOD OF MOVING THE HEADS BE USED?

      _____

   H. LOAD DOCS INTO THE SYSTEM AND DO A RTZS OPERATION.

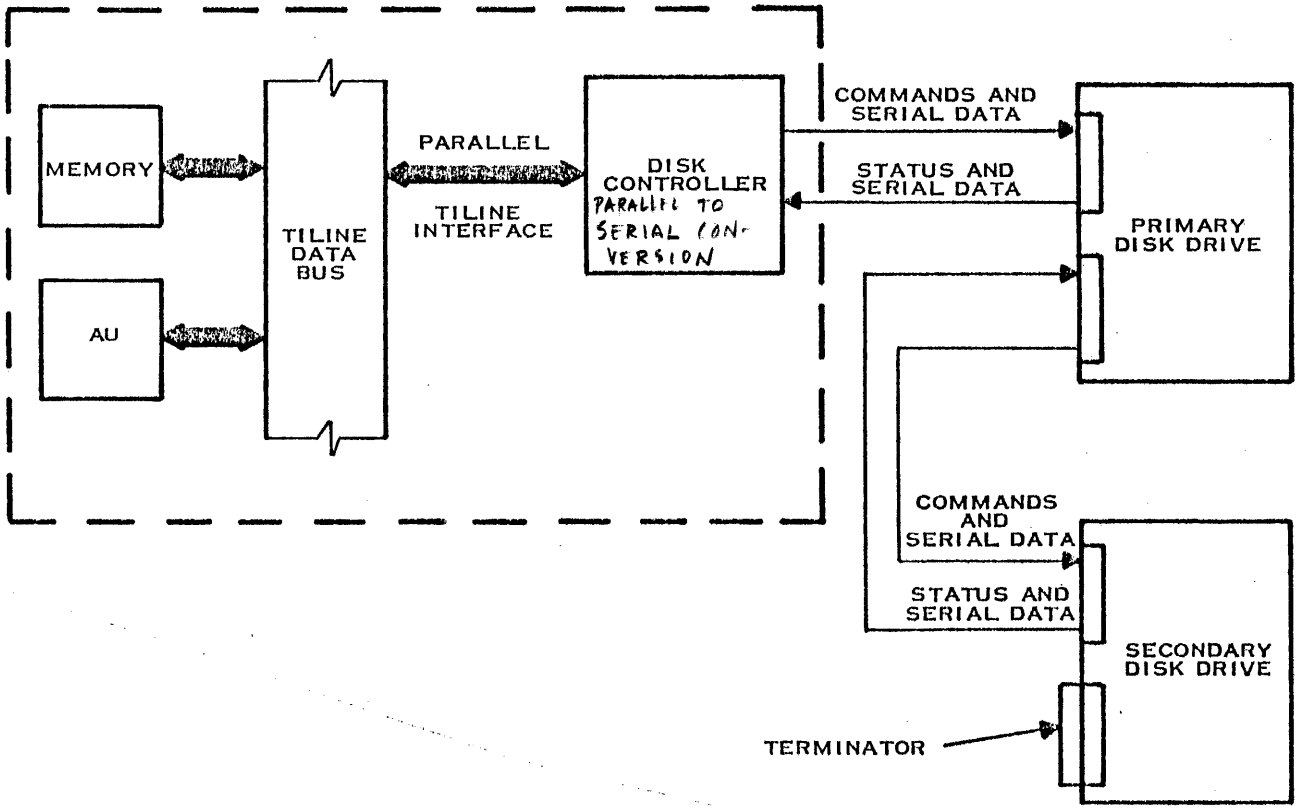
   I. WHAT OCCURS?_____

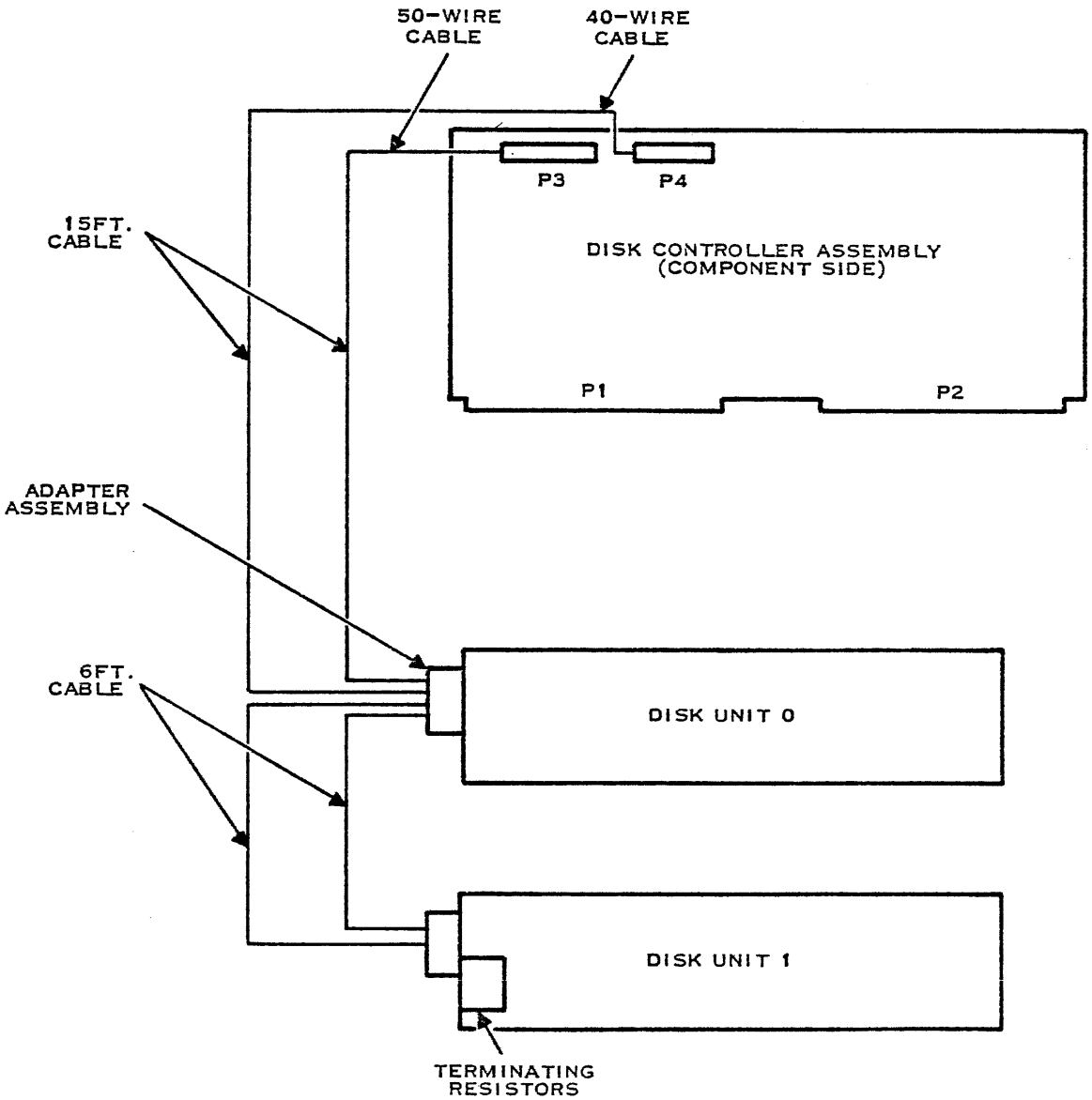
   J. AT WHAT CYLINDER NUMBER IS THE DRIVE IS SETTING?

      _____

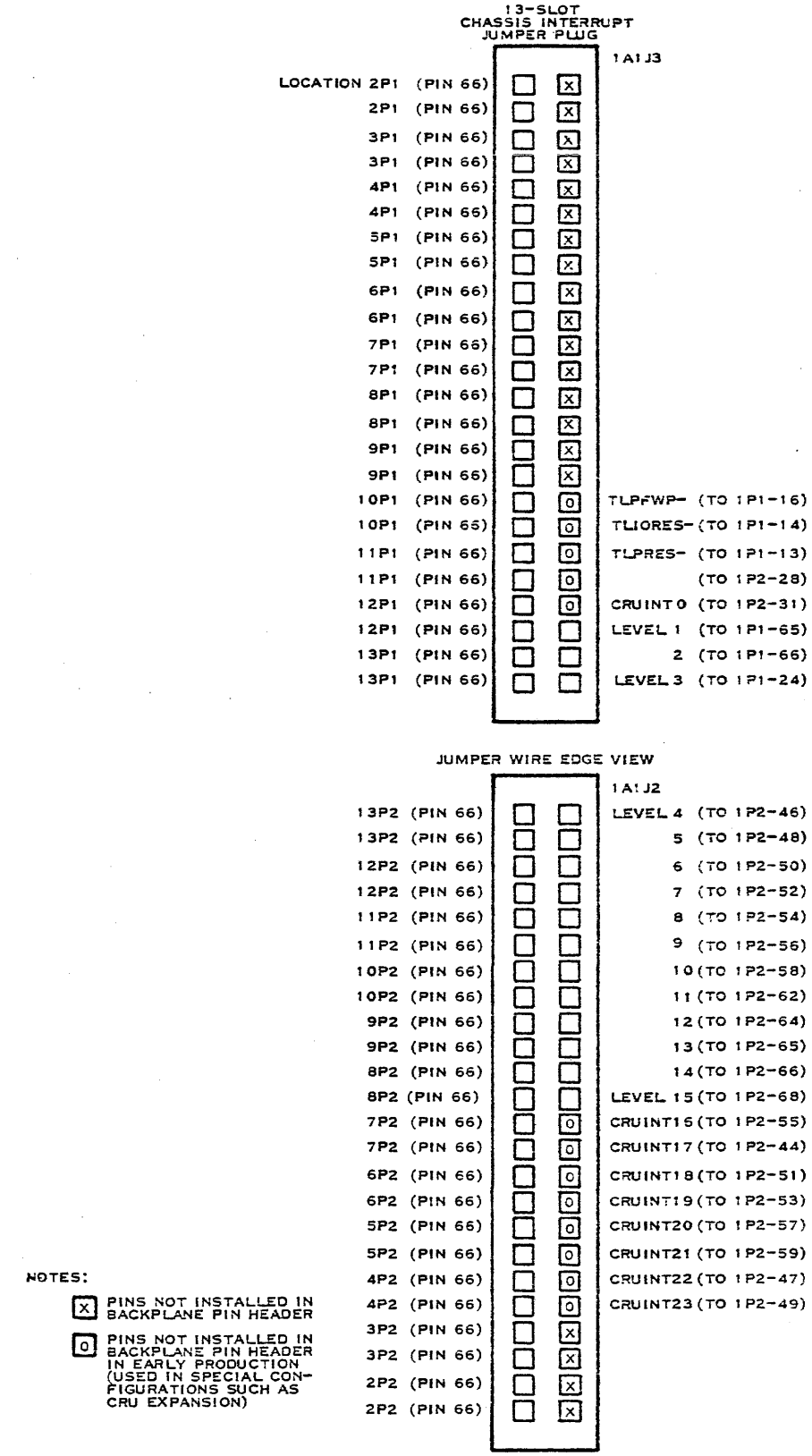
   K. FROM THE SYSTEM, PERFORM ALTERNATE SEEKS BETWEEN CTLINDERS 000 AND 400 AND RECORD THE STEPS BELOW.

1._____	6._____	11._____
2._____	7._____	12._____
3._____	8._____	13._____
4._____	9._____	14._____
5._____	10._____	15._____


MEMORY
AU
TILINE DATA BUS
PARALLEL
TILINE INTERFACE
DISK CONTROLLER
PARALLEL TO SERIAL CONVERSION
COMMANDS AND SERIAL DATA
STATUS AND SERIAL DATA
PRIMARY DISK DRIVE
COMMANDS AND SERIAL DATA
STATUS AND SERIAL DATA
SECONDARY DISK DRIVE
TERMINATOR

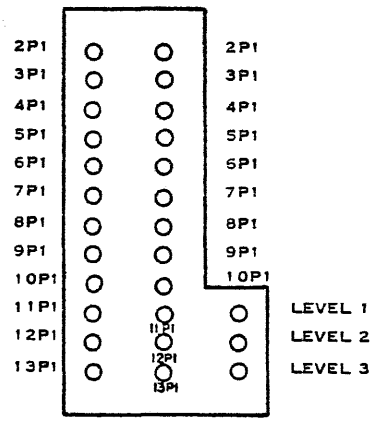


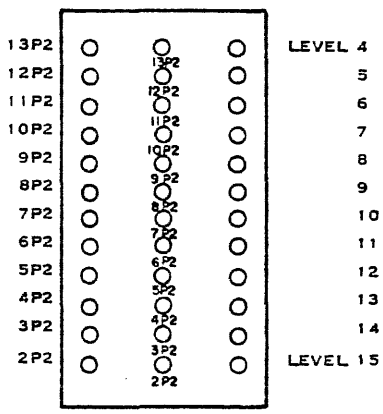
Logic voltages on DS10 is supplied on drive for TRIDENT, supplied from controller.

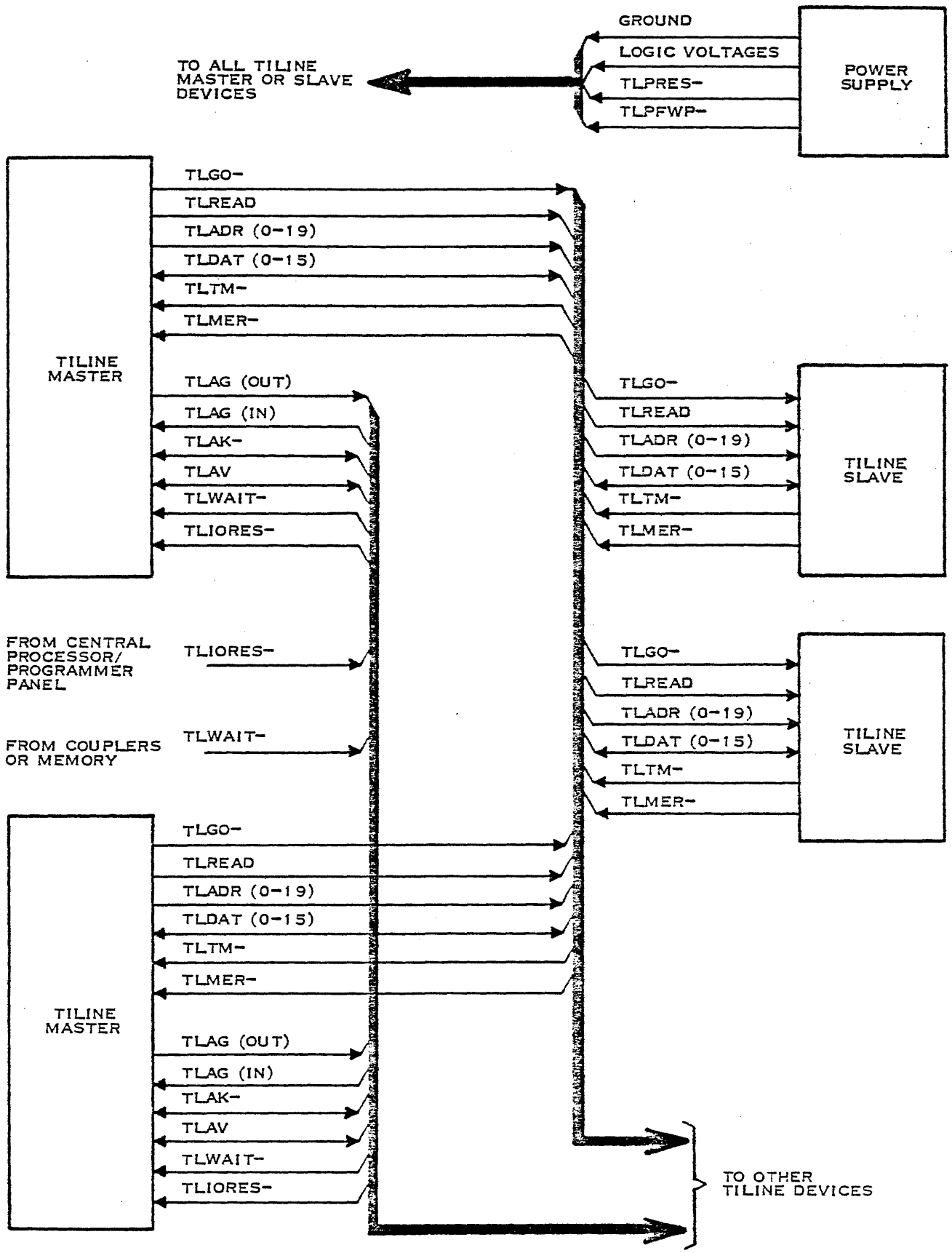


13-Slot Chassis Interrupt Jumper Plugs

ALTERNATE 13-SLOT
CHASSIS INTERRUPT
JUMPER PIN
CONFIGURATION







TILINE Interface Signals

TILINE Signal Definitions

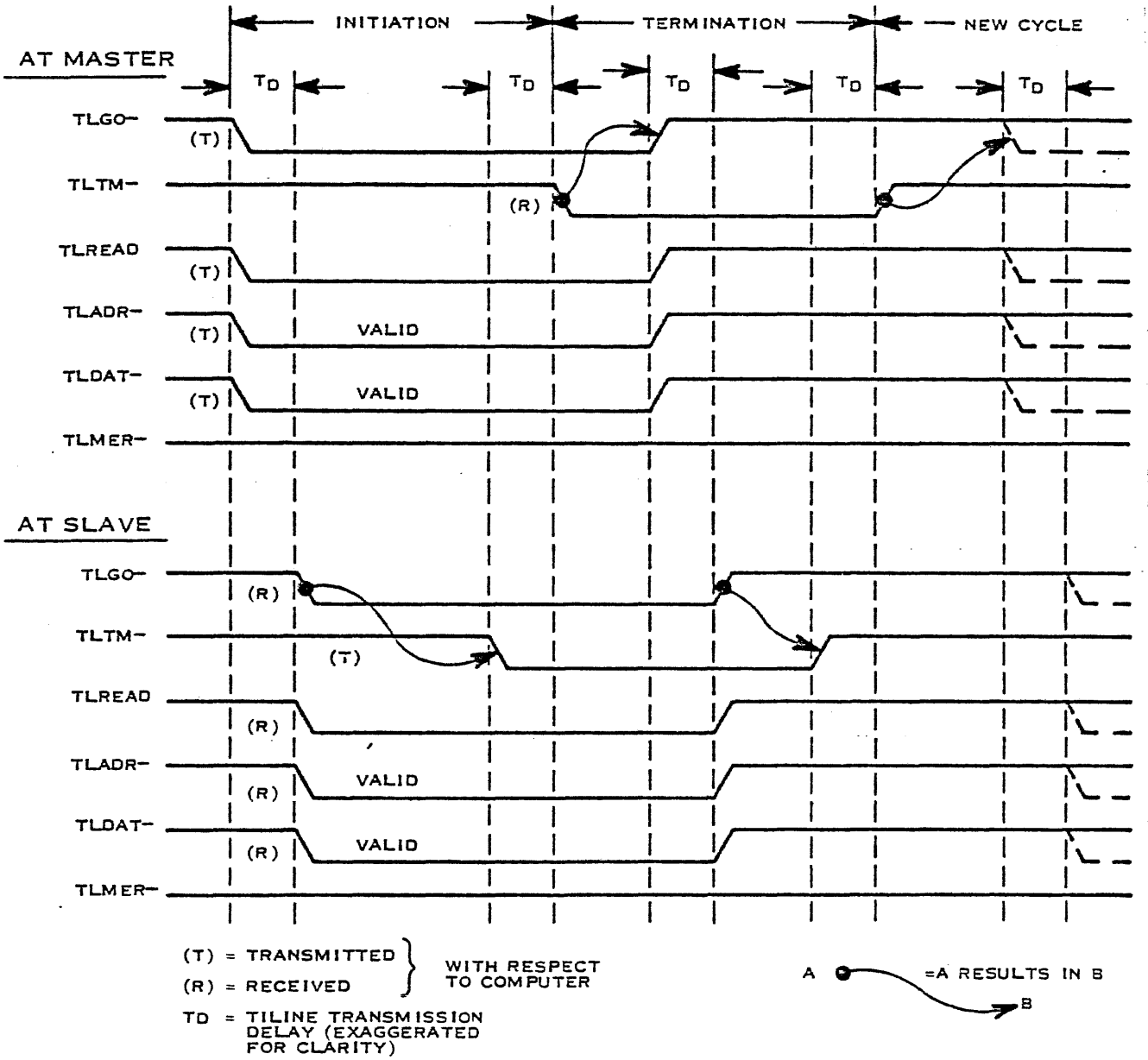
Signature	Pin No.	Definition
TLGO–	P1-25	TILINE Go: Initiates all data transfers when transition from high (3.0V) to low (1.0V) occurs. See note 1.
TLREAD	P1-11	TILINE Read: When high (3.0V) designates a read from SLAVE operation; when low (1.0V) designates a write to SLAVE operation.. See note 1.
TLADR00–	P2-55	TILINE Address to define the location of data during a fetch or store operation. When high (≥2.0V) the corresponding address bit is a zero; when low (≤0.8V) the corresponding address bit is a one. See note 2.
01–	P2-44	
02–	P2-51	
03–	P2-53	
04–	P2-57	
05–	P2-59	
06–	P2-47	
07–	P2-49	
08–	P2-17	
09–	P2-19	
10–	P2-10	
11–	P2-12	
12–	P2-11	
13–	P2-15	
14–	P2-8	
15–	P2-9	
16–	P2-29	
17–	P2-27	
18–	P2-25	
TLADR19–	P2-31	
TLDAT00–	P2-67	TILINE Data: Bidirectional data lines that when high (≥2.0V) represent zero data bits, and when low (≤0.8V) represent one data bit. See note 2.
01–	P2-69	
02–	P2-35	
03–	P2-37	
04–	P2-61	
05–	P2-63	
06–	P2-43	
07–	P2-45	
08–	P2-21	
09–	P2-33	
10–	P2-23	
11–	P2-20	
12–	P1-27	
13–	P1-28	
14–	P1-30	
TLDAT15–	P1-31	
TLTM–	P1-20	TILINE Terminate: When low (1.0V) indicates that the SLAVE device has completed the requested operation. See note 1.

Note 1: Received by SN75138; driven by 36 milliampere, minimum, open-collector driver.
Note 2: Received by one, maximum, standard SN74- load per card slot; driven by SN74LS367/8.

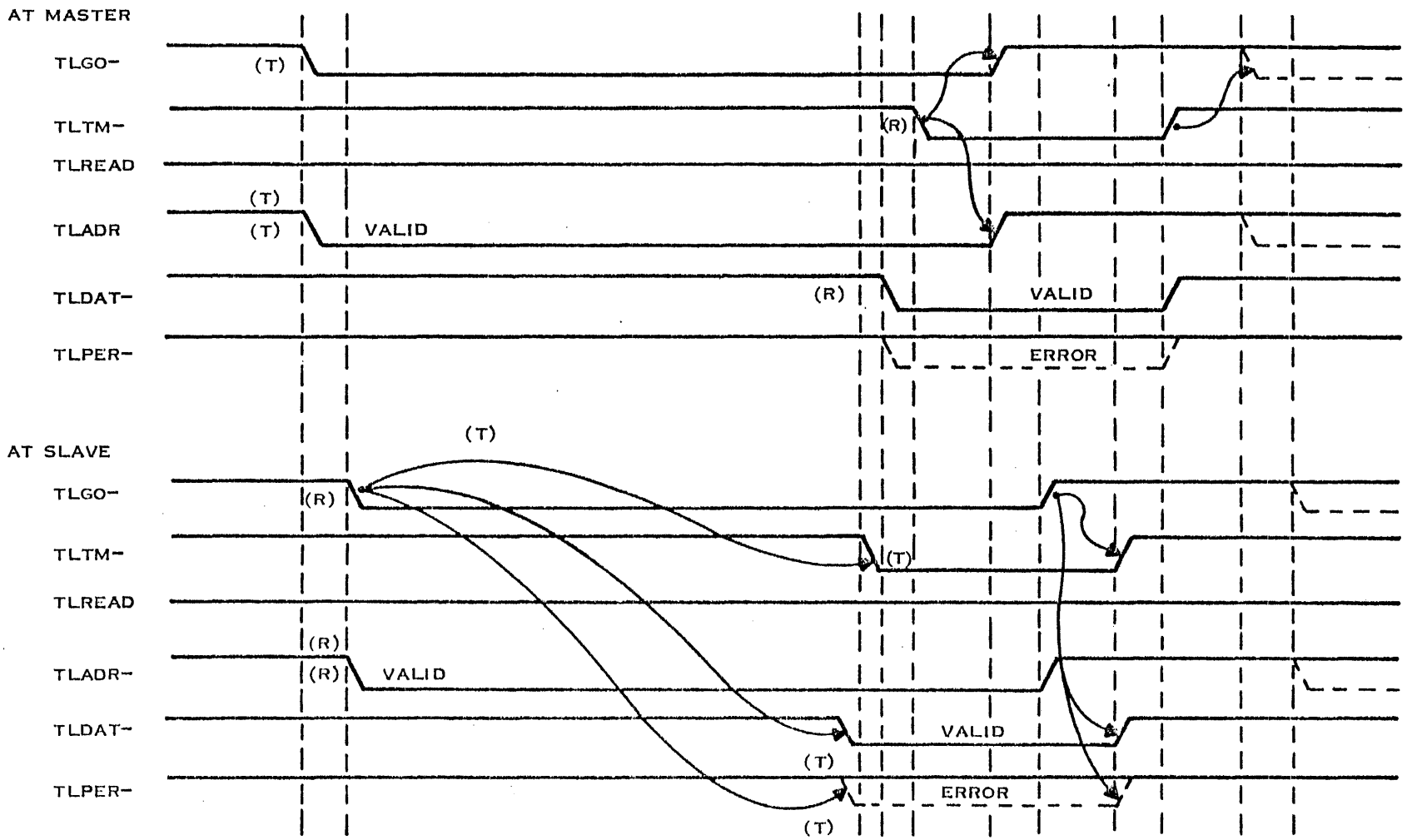
TILINE Signal Definitions (Continued)

Signature	Pin No.	Definition
TLMER–	P1-55	TILINE Memory Error: When low (≤0.8V) indicates that a nonrecoverable error has occurred during a memory read operation. See note 2.
TLAG (in)	P2-6	TILINE Access Granted: When high (≥2.0V), this signal indicates that no higher priority device has requested use of the TILINE. When low (≤0.8V), this signal prevents the receiving device from gaining access to the TILINE bus.
TLAG (out)	P2-5	TILINE Access Granted: When high (≥2.0V), this signal indicates that neither the sending device nor any higher priority device is requesting use of the TILINE. When low (≤0.8V), this signal indicates that either the sending device or some higher priority device is requesting use of the TILINE bus and prevents all lower priority devices from gaining access to the bus.
TLAK–	P1-71	TILINE Acknowledge: When high (3.0V), this signal indicates that no TILINE device has been recognized as the next device to use the TILINE. When low (1.0V), this signal indicates that some TILINE device has requested access, has been recognized, and is waiting for the bus to become available. See note 1.
TLAV	P1-58	TILINE Available: When high (3.0V), this signal indicates that no TILINE device is using the bus. When low (1.0V), this signal indicates that the TILINE bus is busy. See note 1.
TLWAIT–	P1-63	TILINE Wait: A normally high (3.0V) signal that when low (1.0V), temporarily suspends all TILINE MASTER devices from using the TILINE bus. This signal is generated by bus couplers to allow them to use the bus as the highest priority user. See note 1.
TLIORES–	P1-14 P2-14	TILINE I/O Reset. A normally high (≥2.0V) signal that when low (≥0.8V), halts and resets all TILINE I/O devices. This signal is a 100 to 500 nanosecond pulse generated by the RESET switch on the control console or by the execution of a Reset (RSET) instruction in the AU. Driven by SN7437; Received by 2 (maximum standard SN74- loads per slot).
TLPRES–	P1-13 P2-13	TILINE Power Reset: A normally high (≥2.0V) signal that goes low (≥0.8V) to reset all TILINE devices and inhibit critical lines to external equipment. The signal is generated by the power supply at least 10 microseconds before dc voltages begin to fail during power-down, and until dc voltages are stable during power-up. Driven by 80-milliampere open-collector driver (160 milliamperes with 40-ampere power supply).
TLPFWP–	P1-16 P2-16	TILINE Power Failure Warning Pulse: A 7.0 millisecond pulse preceding TLPRES–. When low (≤0.8V), this signal indicates that a power-down sequence is in progress, allowing the AU to perform its power failure interrupt subroutine. Driven by SN7437; received by two, maximum, standard SN74- loads per card slot.

Note 1: Received by SN75138; driven by 36 milliampere, minimum, open-collector driver.
Note 2: Received by one, maximum, standard SN74- load per card slot; driven by SN74LS367/8.



TILINE Write Cycle Timing

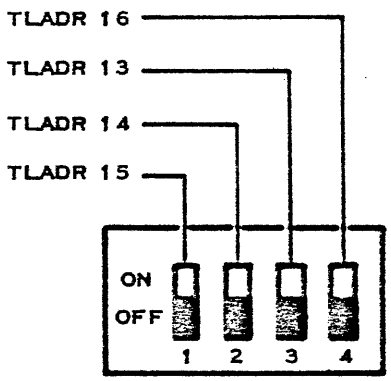


(T) = TRANSMITTED

(R) = RECEIVED

NOTE: TILINE DELAY IS EXAGGERATED FOR CLARITY

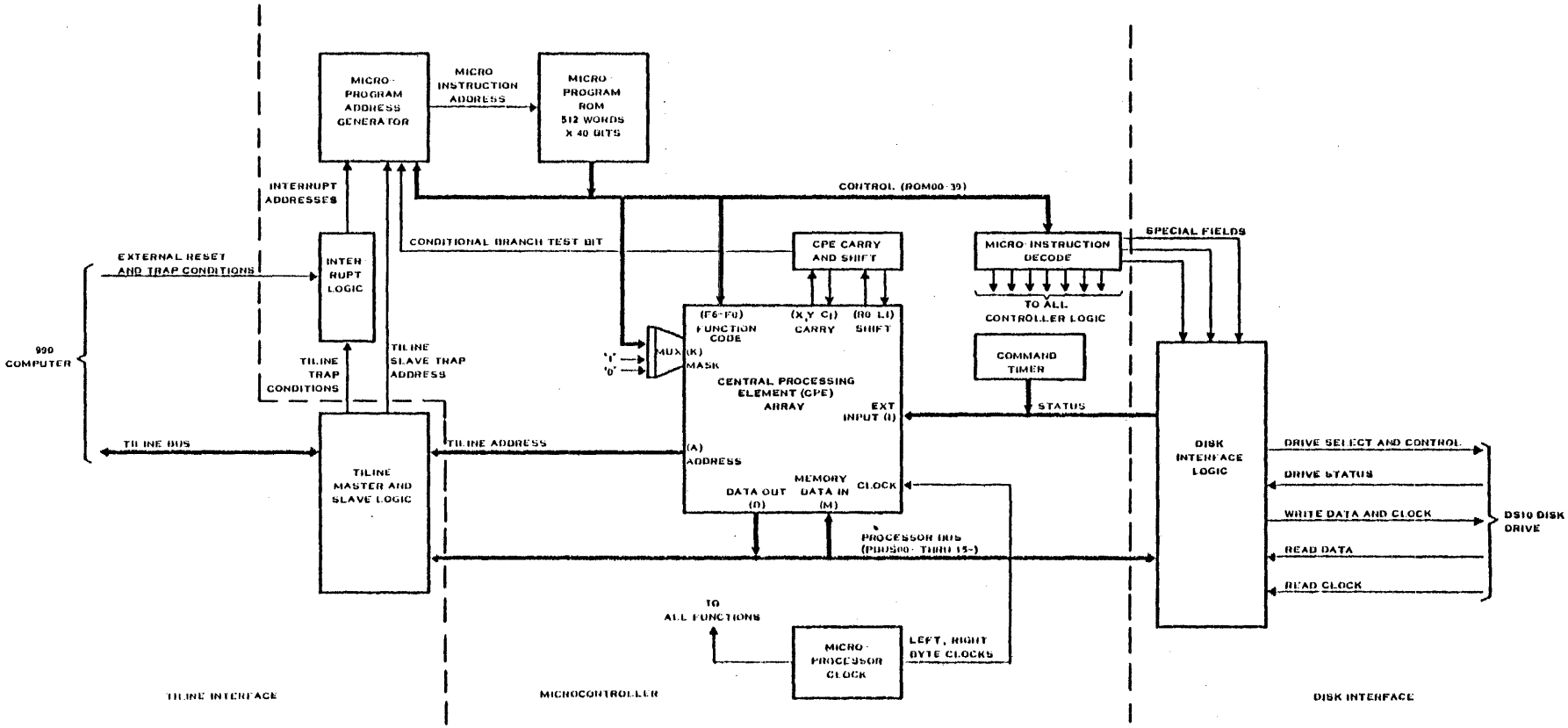
TILINE Master-to-Slave Read Cycle Timing



TILINE Slave Address Switches

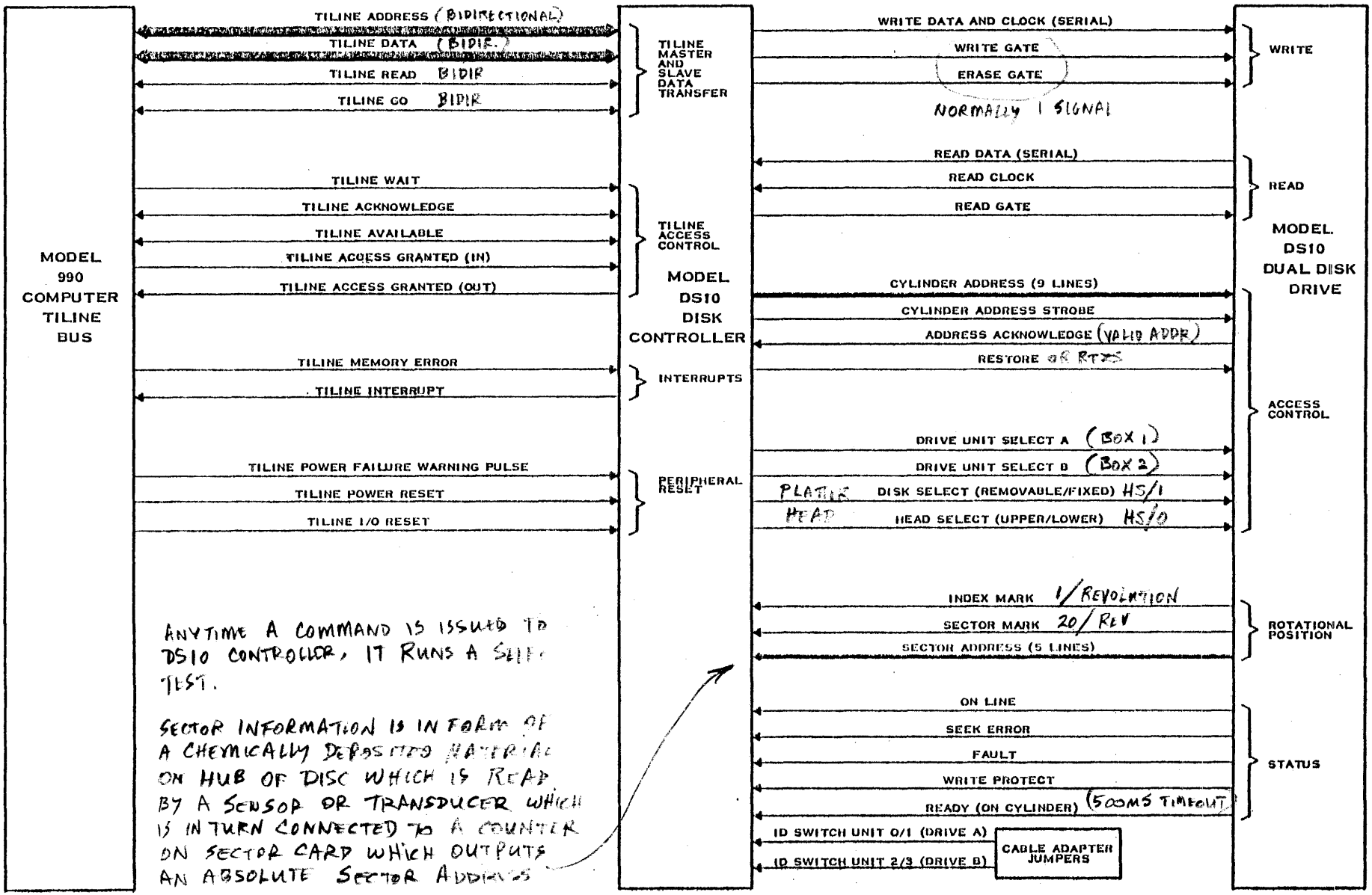
TILINE Slave Address Switch Settings and Addresses

TILINE Address (Hex)	CPU Address (Hex)	Switches 1	2	3	4
FFC00	F800	Off	Off	Off	Off
FFC08	F810	Off	Off	Off	On
FFC10	F820	On	Off	Off	Off
FFC18	F830	On	Off	Off	On
FFC20	F840	Off	On	Off	Off
FFC28	F850	Off	On	Off	On
FFC30	F860	On	On	Off	Off
FFC38	F870	On	On	Off	On
FFC40	F880	Off	Off	On	Off
FFC48	F890	Off	Off	On	On
FFC50	F8A0	On	Off	On	Off
FFC58	F8B0	On	Off	On	On
FFC60	F8C0	Off	On	On	Off
FFC68	F8D0	Off	On	On	On
FFC70	F8E0	On	On	On	Off
FFC78	F8F0	On	On	On	On

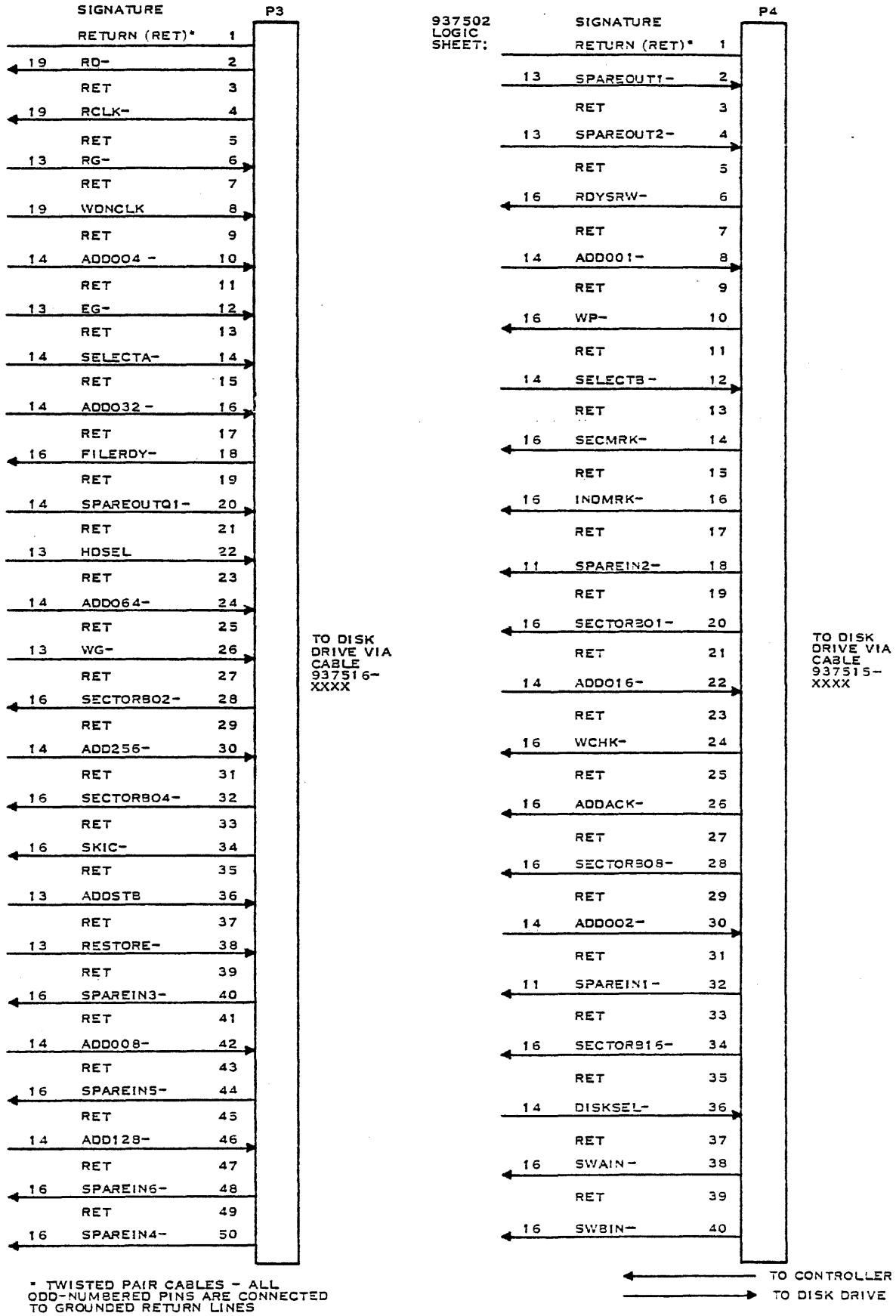


DS10 Disk Controller Simplified Block Diagram

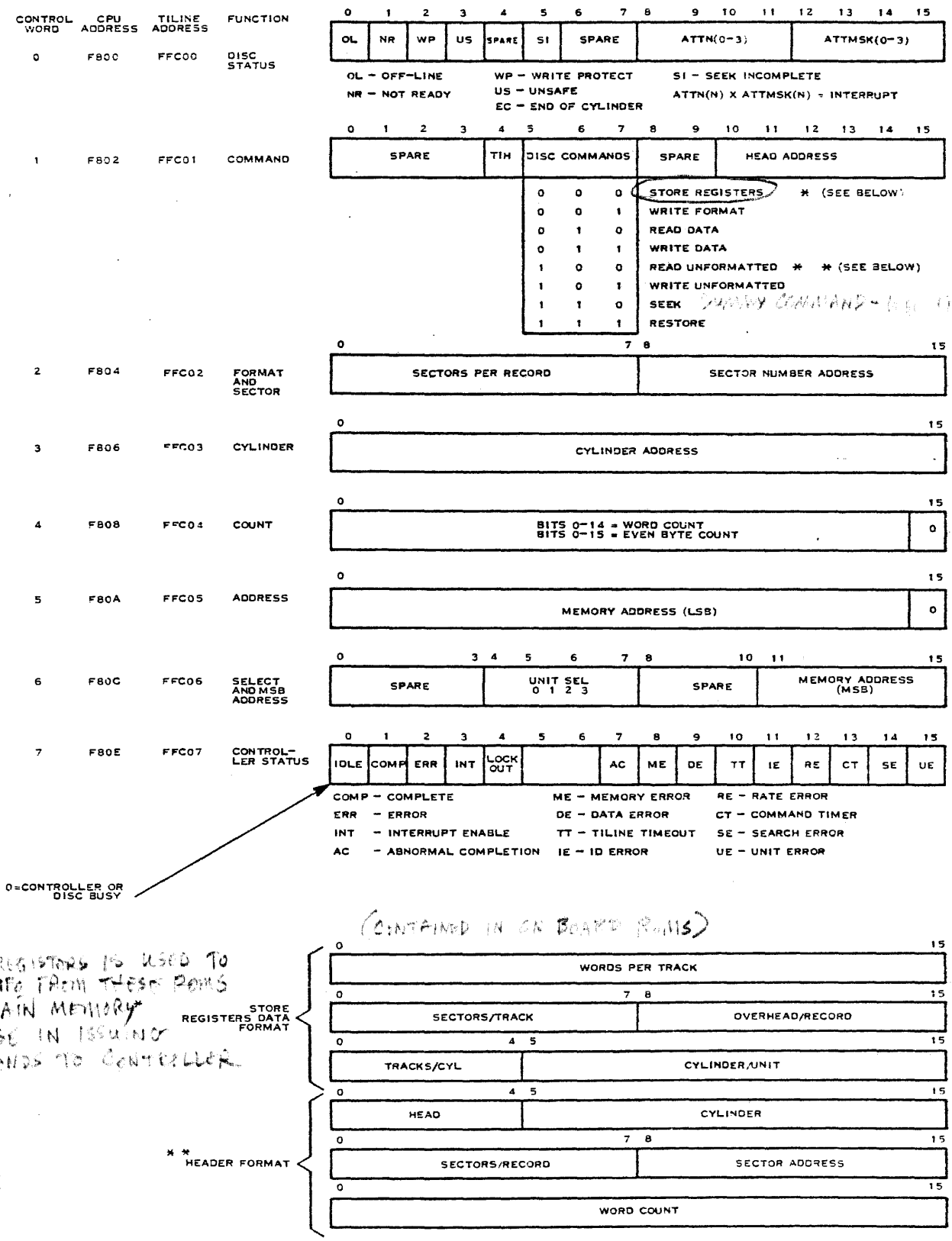
Disk Controller LED Configuration



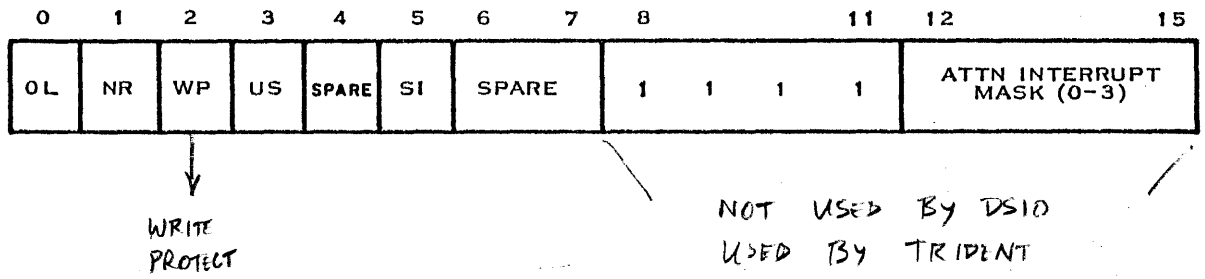
DS10 Disk Controller Interface Signals

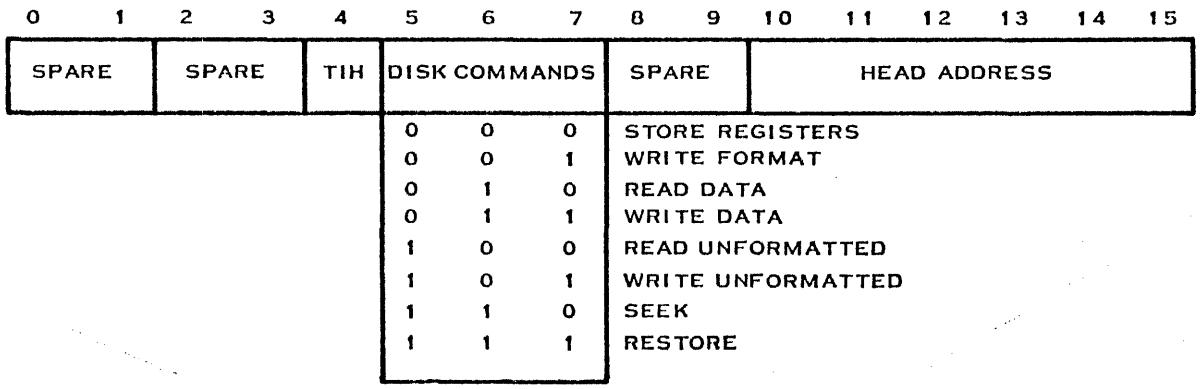


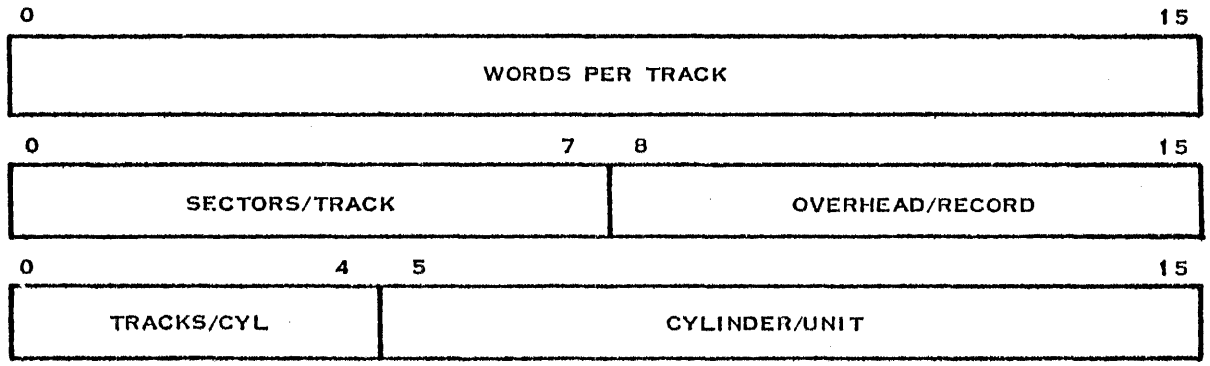
Controller I/O Connector P3 and P4 Pin Connection and Signal Flow



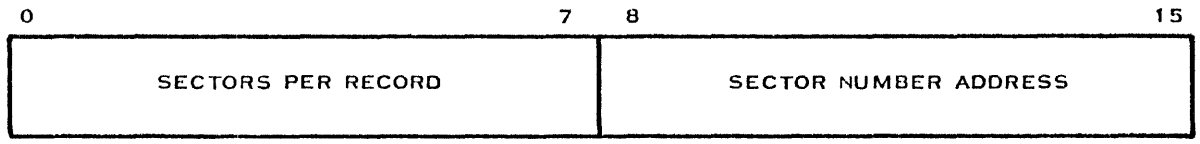
Model DS10 Disk System Control Word Formats

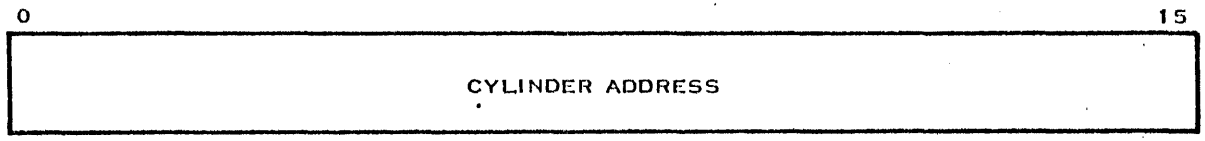

0
1
2
3
4
5
6
7
8
11
12
15
OL
NR
WP
US
SPARE
SI
SPARE
1
1
1
1
ATTN INTERRUPT MASK (0-3)
WRITE PROTECT
NOT USED BY DSIO
USED BY TRIDENT

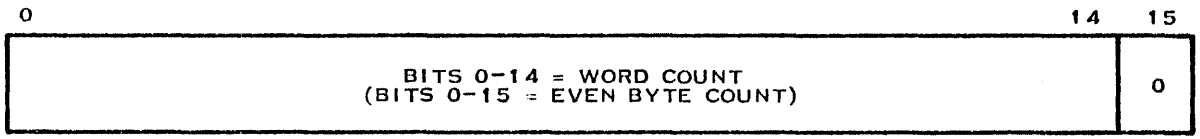

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
SPARE
SPARE
TIH
DISK COMMANDS
SPARE
HEAD ADDRESS
0 0 0 STORE REGISTERS
0 0 1 WRITE FORMAT
0 1 0 READ DATA
0 1 1 WRITE DATA
1 0 0 READ UNFORMATTED
1 0 1 WRITE UNFORMATTED
1 1 0 SEEK
1 1 1 RESTORE

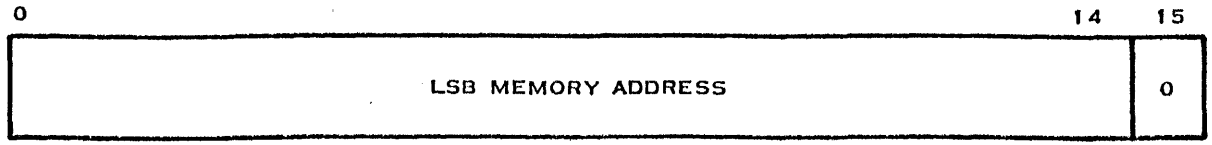


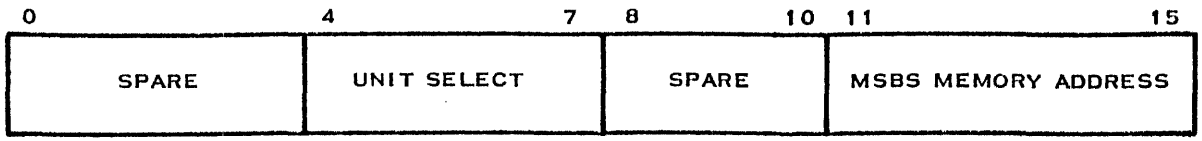
Store Registers Data Format

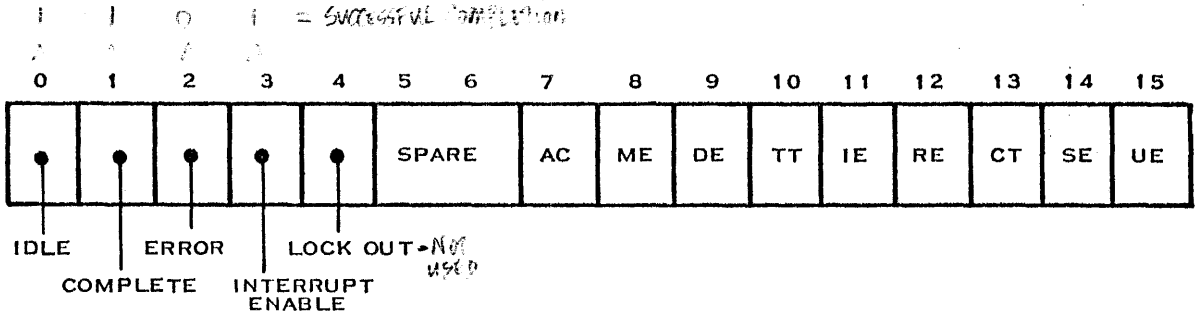

0
7
8
15
SECTORS PER RECORD
SECTOR NUMBER ADDRESS


0
15
CYLINDER ADDRESS


0
14
15
BITS 0-14 = WORD COUNT
(BITS 0-15 = EVEN BYTE COUNT)
0


0
14
15
LSB MEMORY ADDRESS
0

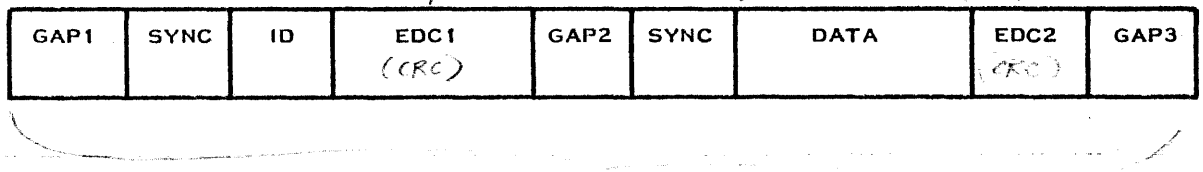

0
4
7
8
10
11
15
SPARE
UNIT SELECT
SPARE
MSBS MEMORY ADDRESS



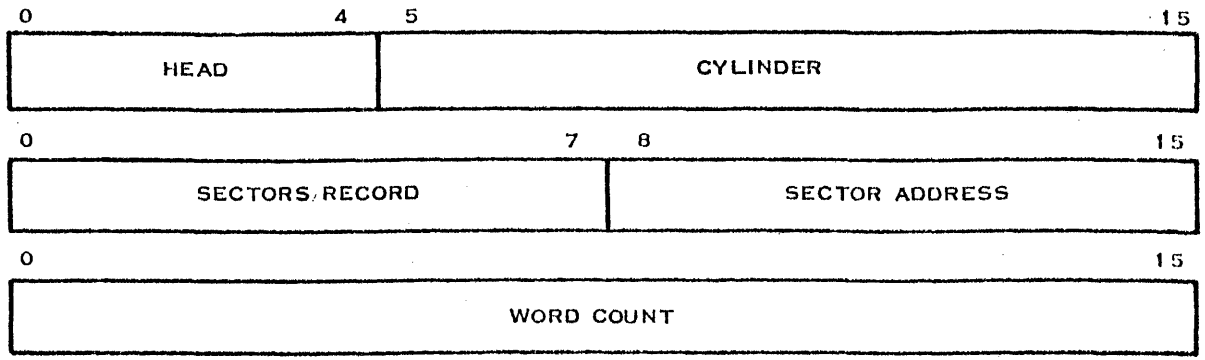
AC-ABNORMAL COMPLETION
ME-MEMORY ERROR
DE-DATA ERROR

TT-TILINE TIMEOUT 20mS
IE-ID ERROR
RE-RATE ERROR

CT-COMMAND TIMER 200 mS FOR D510
SE-SEARCH ERROR - IF A SYNC CHAR IS NOT DETECTED FOR EACH SECTOR
UE-UNIT ERROR - TRYING TO WRITE TO WRITE PROTECTED DISK.

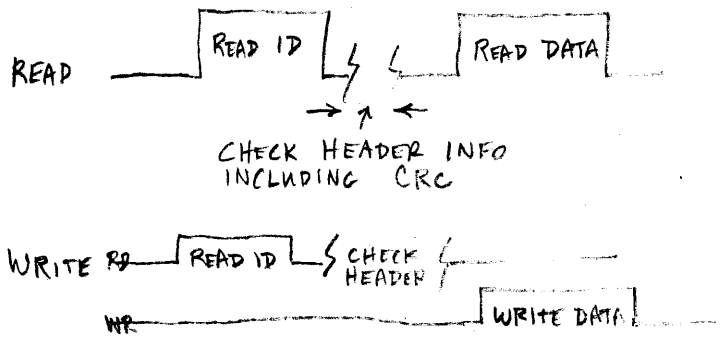


ONE SECTOR



Header Data Format

ONLY WRITTEN ON DISK DURING DISK FORMAT, NEVER CHANGED
SEQUENCE IN FORMAT - WRITE HEADER INFO TO HEADn, CYLn, SECTOR 0-20; HEAD n+1 CYLn, SECTOR 0-20;

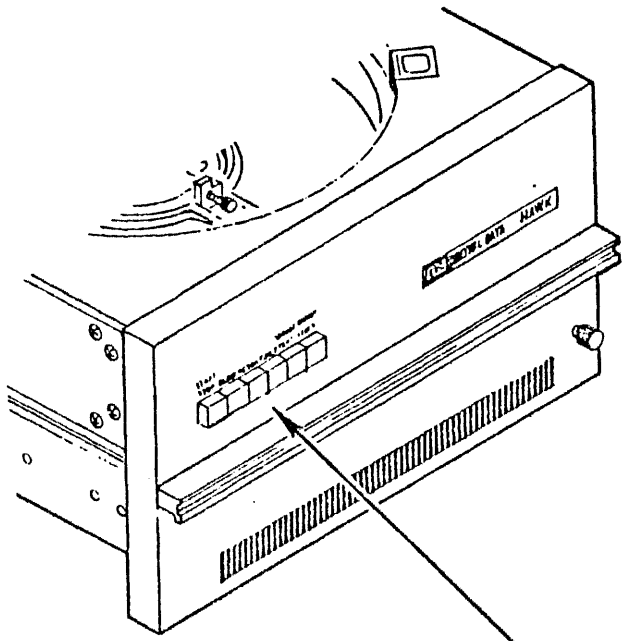


Disk I/F and Disk Drive Interface Signals

Signal Name in Controller	Description
Controller to Disk Signals:	(Active in the low voltage state unless otherwise specified.)
ADD001- ADD002- ADD004- ADD256-	Cylinder address. Valid when cylinder address strobe, ADDSTB, is high. A read or write operation need not load a new cylinder address unless the heads must seek to a new track.
ADDSTB-	Cylinder address strobe. Loads cylinder address into disk drive electronics when low. For read or write seeks, ADDSTB remains active until Address Acknowledge (ADDAK-) is issued. For Restore-, strobe remains active for at least one microsecond.
SELECTA-	Select disk drive A. When low, selects the dual disk drive which is designated "A". The select line must be active (low) to allow the drive unit to accept data or any other control signals, and to generate any control status signals except seek error and unit ready. This line selects a drive which contains two independent logical units. The select line and disk select signal are both required to uniquely specify logical unit 0 or 1.
SELECTB-	Select dial disk drive B. When low, selects the disk drive which is designated "B". The select line and the disk select signal are both required to uniquely specify logical unit 2 or 3. See SELECTA-, above.
DISKSEL-	Disk select. Selects one of the two platters within a disk drive. When low, DISKSEL- selects the fixed disk, when high selects the removable disk. The controller must check the position of the fixed/removable logical unit reversing jumper (SWAIN- or SWBIN-) before setting the polarity of DISKSEL-.
HDSEL-	Head Select. Selects the read/write head on the upper surface (HDSEL- low) or the lower surface (HDSEL- high) of the selected fixed or removable disk platter. HDSEL- is stable for at least 10 microseconds before the leading edge of a write gate, and remains stable for the duration of a read or write operation.
RG-	Read gate. Enables read data and clock through the disk drive electronics to the controller. Leading edge of read gate enables phase-lock circuitry in disk drive electronics clock/data separator.
WG-	Write gate. Enables write current during a write operation.
EG-	Erase gate. Enables erase current during a write operation, so the erase heads can "shear" flux splatter at the outer track edges (straddle erase).

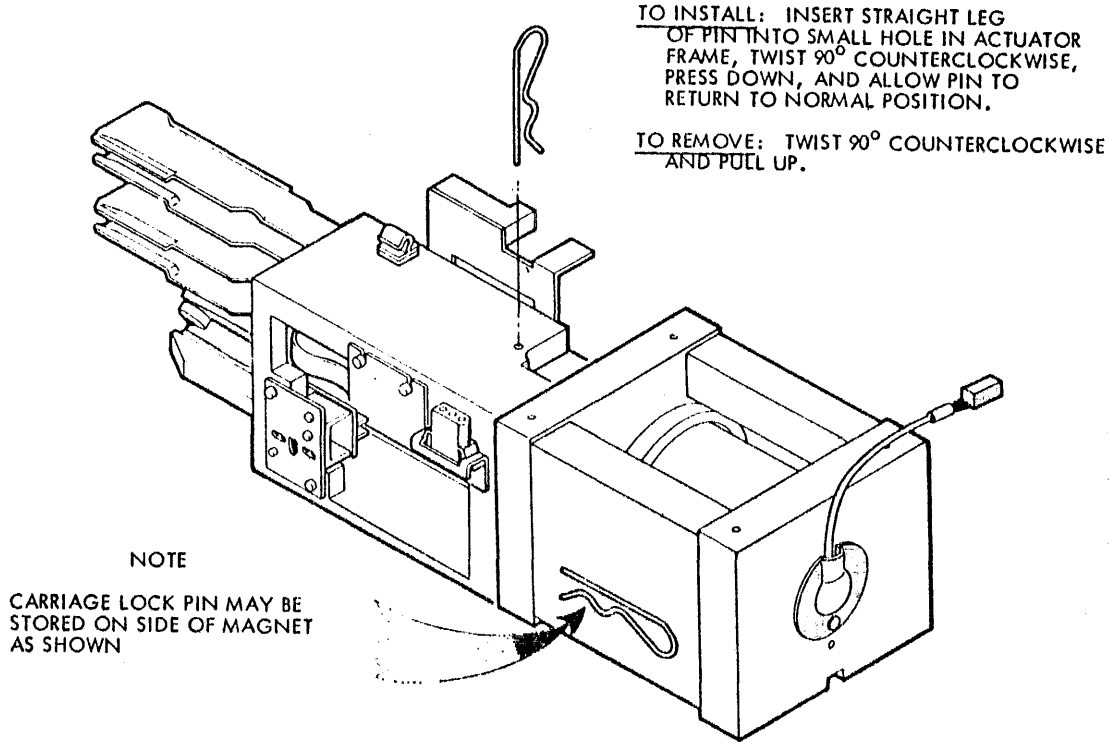
Signal Name in Controller	Description
WDNCLK-	Double-frequency encoded write data and clock to the disk unit. Minimum pulse width is 100 nanoseconds, with a rise/fall time less than 50 nanoseconds.
RESTORE-	Restore to Track Zero, also known as Return to Zero Seek (RTZS-). Causes the head carriage to advance to the forward limit of travel and then return to the home (track 000) position. Also clears disk cylinder address registers and counters, and clears disk unit fault latches. Essentially a master clear to the selected disk drive. Cylinder Address Strobe (ADDSTB-) must be low for the disk to accept the RESTORE command.
Disk to Controller Signals:	
ADDAK-	Address Acknowledge. Acknowledges acceptance and validity of cylinder address loaded into the disk drive electronics. Addresses greater than 407 are considered invalid.
FILERDY-	Disk File Ready. Active (low) if the disk cartridge is installed, disk spindle is up to speed, heads are loaded, dc voltages are within tolerance, unit selected, no fault latches set, terminator and terminator power present. Inverted within the disk controller as OFFLINE-.
RDYSRW-	Ready to start Read/Write (also called "on cylinder"). Indicates that the head carriage has reached the specified cylinder address, and the heads are stable. Also incorporates all file ready conditions. Inverted within the disk controller as NOTRDY-.
SKIC-	Seek Incomplete (also called seek error, Sker). Indicates that the disk drive failed to properly seek to the desired cylinder address. This condition may be cleared by a Restore operation.
INDMRK-	Index Mark. A reference pulse which occurs once every disk revolution when sector 0 rotates under the R/W heads. The controller has the logic to monitor INDMRK-, but the controller microprogram makes no use of it. The controller depends instead upon the sector address supplied by the selected disk unit. Generated separately for the fixed and removable disks.
SECMRK-	Sector Mark. A rotational position pulse (50 microseconds) which identifies the start of each disk sector. The reading edge is used as the timing reference for starting read or write operations. Generated separately for the fixed and removable disks.
SECTORB01- SECTORB02- SECTORB04- SECTORB16- SECTORB08- SECTORB32-	Sector Address. The disk drive electronics has a sector counter which uses the index and sector marks to keep track of the current rotational position of the selected disk. The disk controller compares this current sector address to the desired sector address to determine whether the desired sector is under the read/write heads. The sector address is updated at the end of a sector, about four microseconds before the next sector mark. It is stable when the sector mark occurs, and remains stable until four microseconds before the next sector mark.

Signal Name in Controller	Description
RD-	Read Data. A clock/data separator in the disk drive electronics uses phase-lock techniques to separate the double-frequency recorded clock and data stream into separate clock and data outputs to the controller. Nominal pulse width is 100 nanoseconds, with variations allowable from 50-150 nanoseconds. Leading edge is the reference.
RCLK-	Read Clock. Clock recovered from disk which is used as basic disk I/F clock for read operations. Recovered from recorded double-frequency clock data stream by phase lock techniques. Nominal pulse width is 100 nanoseconds, with allowable variations from 50-150 nanoseconds. Leading (falling) edge is the timing reference.
WP-	Write Protect. Indicates that data may not be written onto the the selected disk because the associated WRITE PROTECT switch on the disk drive control panel is on.
WCHK-	Write Check (also called Fault). Indicates that the disk drive electronics has detected a fault condition and inhibited the write and erase currents. Fault conditions which may be cleared by a Restore-signal, if temporary, include: 1. More than one head selected 2. Read and write gates simultaneously active (low) 3. Read and erase gates simultaneously 4. Erase gate active without write gate for more than 20 microseconds. 5. Write or erase gate on when not on cylinder (RDYSRW- high) 6. Low dc voltages in disk drive 7. Emergency retract condition, such as motor under speed.
Cable Adapter to Controller:	
SWAIN-	Position of fixed/removable disk logical unit number reversing jumper for 1st dual disk drive (disk drive A). SWAIN- high means that the reversing jumper is not installed, so that the removable disk cartridge is logical unit 1 and the fixed disk is logical unit 0. This is the normal situation. SWAIN- low means that the reversing jumper is installed, so that the removable disk is changed to logical unit 0 and the fixed disk is changed to logical unit 1.
SWBIN-	Position of fixed/removable disk logical unit number reversing jumper for the second dual disk drive (disk drive B). SWBIN- high means that the reversing jumper is not installed, so that the removable disk cartridge is logical unit 3 and the fixed disk is logical unit 2. This is the normal situation. SWBIN- low means that the reversing jumper is installed on the cable adapter, so that the removable disk is changed to logical unit 2 and the fixed disk is changed to logical unit 3. The disk controller senses the state of SWAIN- or SWBIN- before setting the DISKSEL- output level. The controller microprogram forces the DISKSEL- polarity to the correct level to select the disk specified in the logical unit select field of control word R6.



ITEM	FUNCTION
1.	START/STOP INDICATOR SWITCH
2.	UP TO SPEED & HEADS LOADED
3.	WRITE/READ OR SEEKING
4.	FAULT INDICATOR SWITCH NON-DAMAGING FAULT - WILL RESET DAMAGING FAULT - WILL NOT RESET
5.	WRITE PROTECT - REMOVABLE CARTRIDGE
6.	WRITE PROTECT - FIXED CARTRIDGE

START STOP	READY	ACTIVE	FAULT	W/PROT CART	W/PROT FIXED
1	2	3	4	5	6



Carriage Lock Pin Location

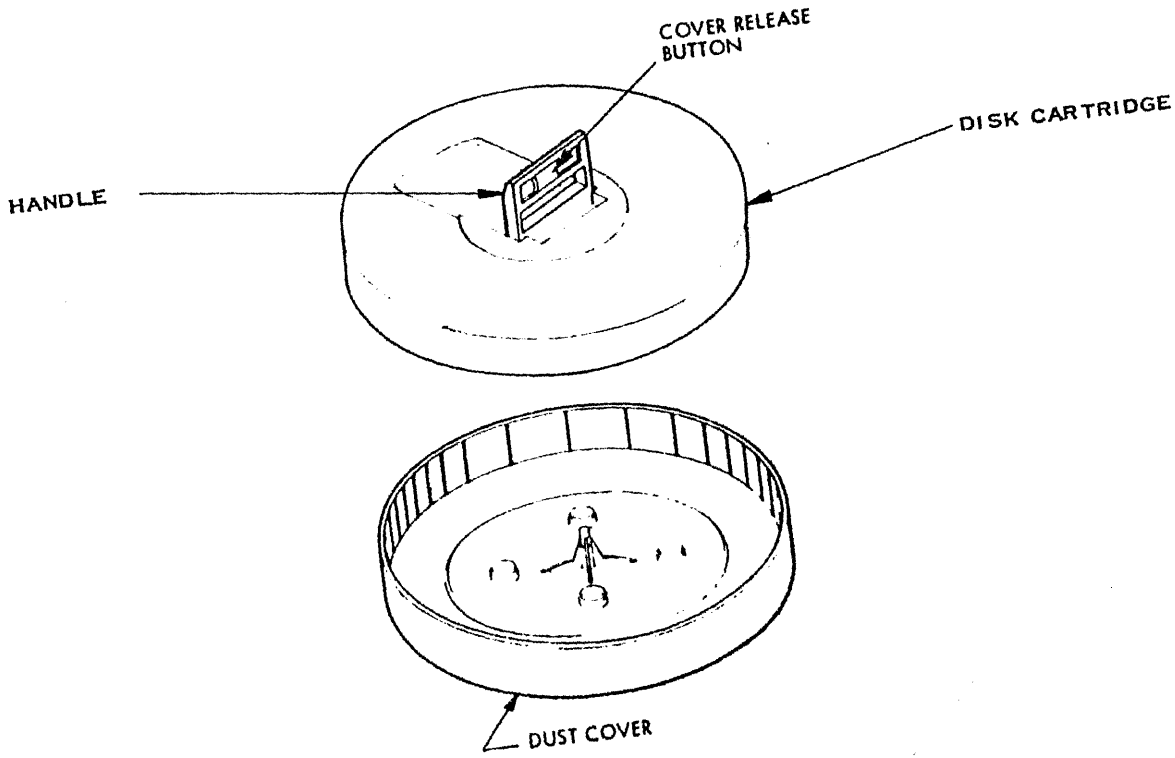
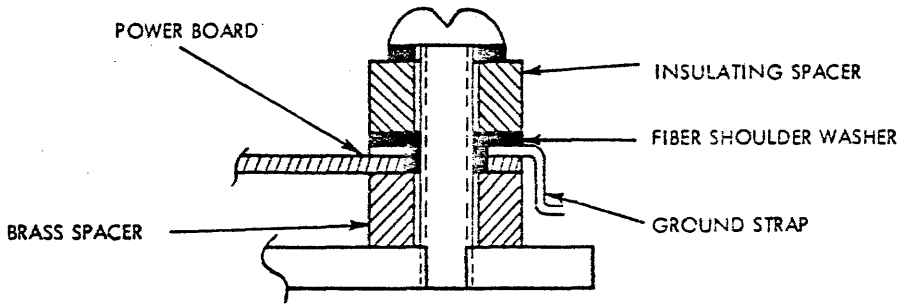


Figure 2-18. Disk Cartridge

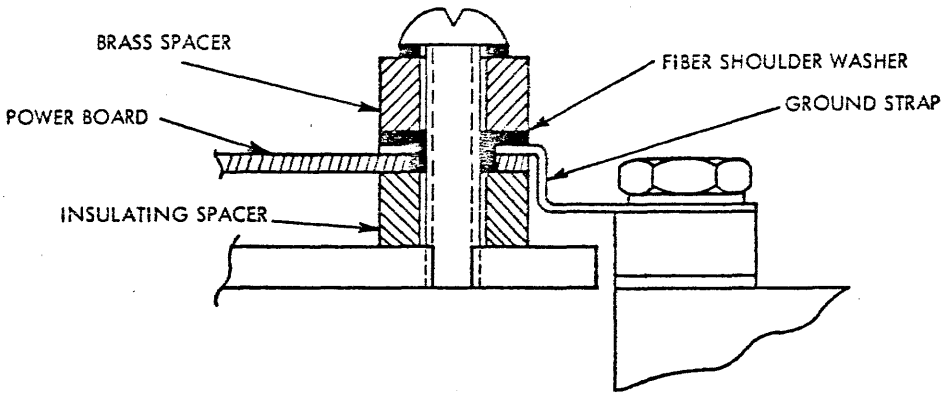
NOTE

GROUND MUST BE INSTALLED WHEN
DYNAMIC BRAKE OPTION IS INSTALLED.



(A)

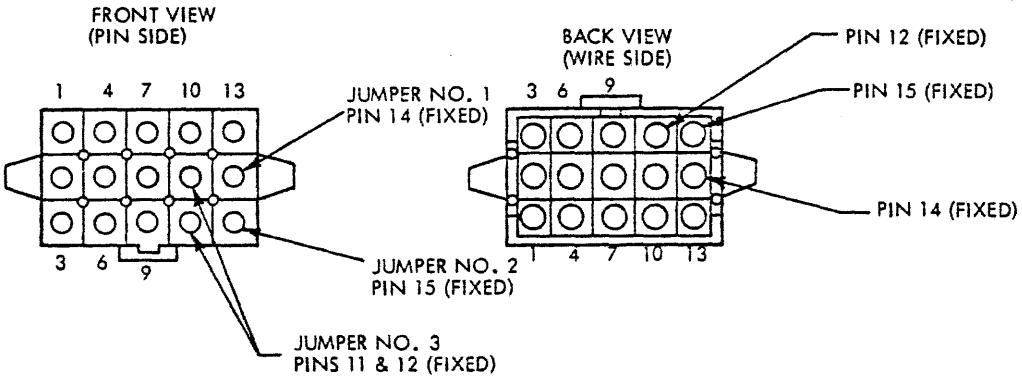
LOGIC (DC) GROUND CONNECTED TO CHASSIS (AC) GROUND



(B)

LOGIC (DC) GROUND ISOLATED FROM CHASSIS (AC) GROUND

Grounding Option



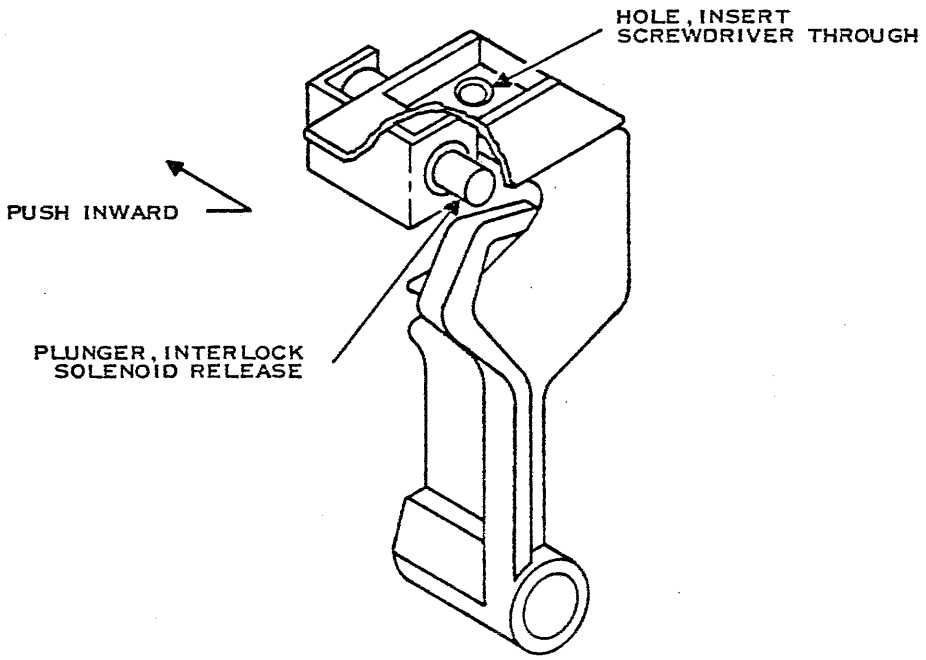
NOTE

For proper pin configuration use above illustration. Ignore pin numbering on connector.

	JUMPER #1		JUMPER #2	
VOLTAGE	FIXED PIN	MOVEABLE PIN	FIXED PIN	MOVEABLE PIN
100	14	4	15	7
110	14	3	15	7
120	14	2	15	7
130	14	1	15	7
140	14	6	15	8
150	14	5	15	8
160	14	4	15	8
170	14	3	15	8
180	14	2	15	8
190	14	1	15	8
200	14	6	15	9
210	14	5	15	9
220	14	4	15	9
230	14	3	15	9
240	14	2	15	9
250	14	1	15	9

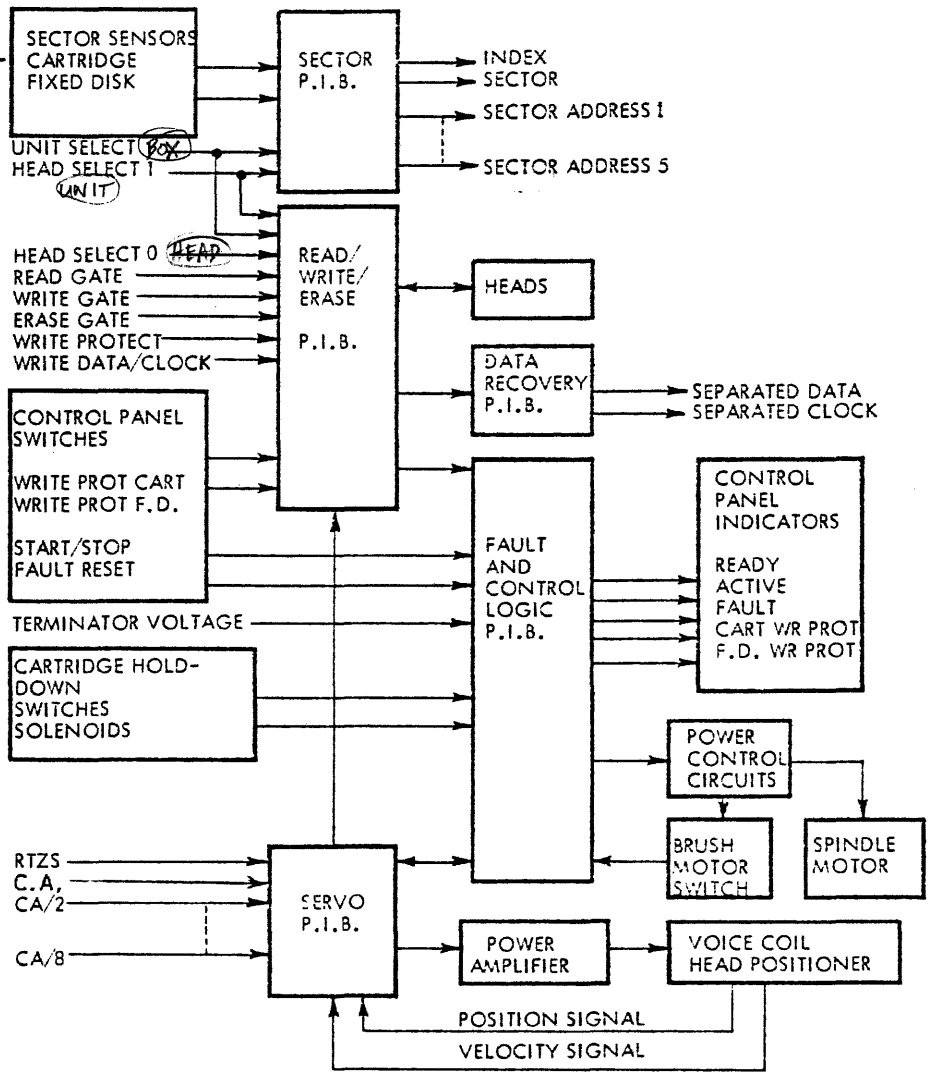
DRIVE MOTOR IS SYNCHRONOUS. DRIVE PULLEY AND BELT MUST BE CHANGED TO CONVERT FROM 50 TO 60 Hz OR VICE VERSA

Voltage Adjustment Plug P12 and Adjustment Table

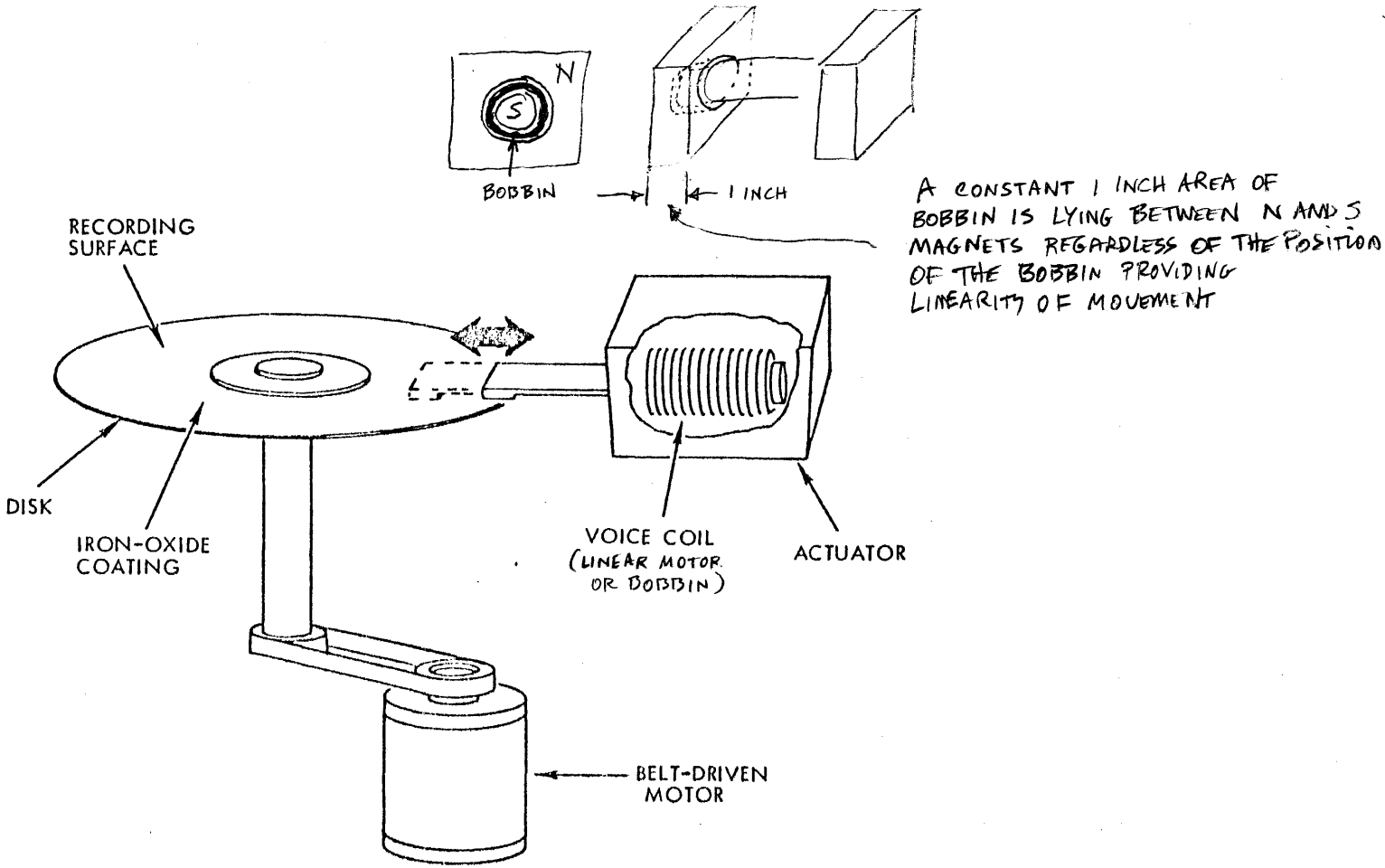


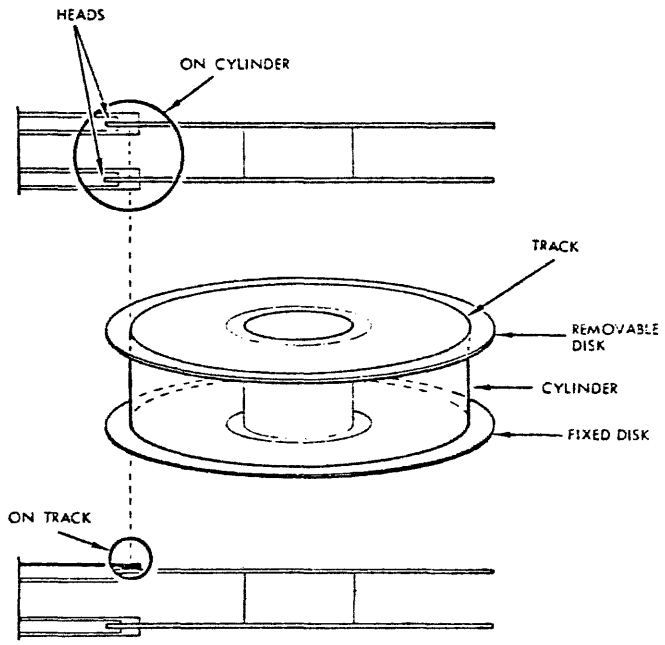
Cartridge Locks.

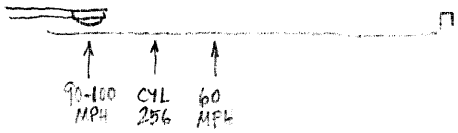
1. MAKE SURE A DISC PACK IS IN
2. MAKE SURE PACK IS SPINNING
3. SENDS OUT SECTOR INFO



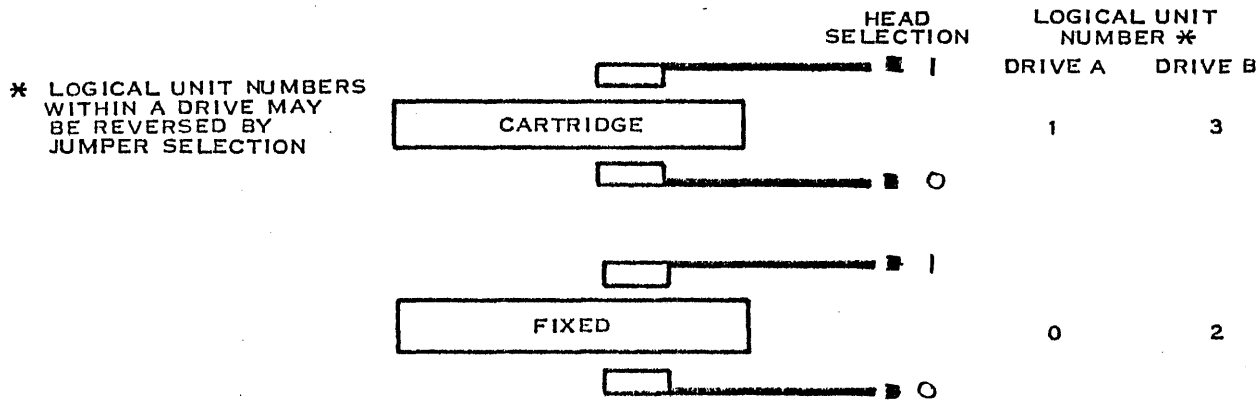
Model 9427H Block Diagram


N
S
BOBBIN
1 INCH
A CONSTANT 1 INCH AREA OF BOBBIN IS LYING BETWEEN N AND S MAGNETS REGARDLESS OF THE POSITION OF THE BOBBIN PROVIDING LINEARITY OF MOVEMENT
RECORDING SURFACE
DISK
IRON-OXIDE COATING
VOICE COIL (LINEAR MOTOR OR BOBBIN)
ACTUATOR
BELT-DRIVEN MOTOR

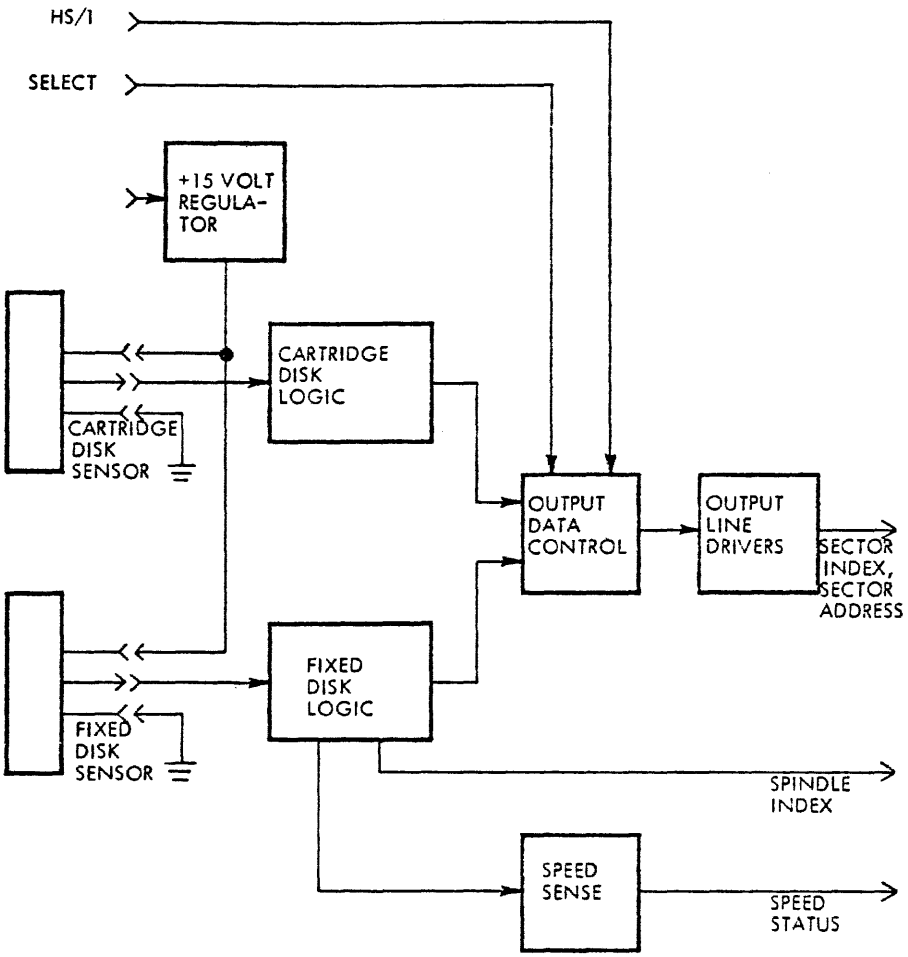


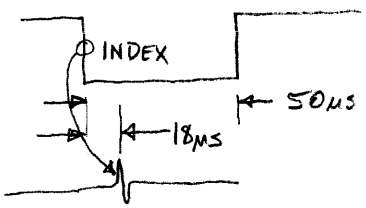


THE HEAD IS KEPT OFF THE DISC BY THE VELOCITY OF THE AIR PULLED BY THE SPINNING DISC. SINCE AT INNER POSITIONS THE DISC VELOCITY IS SLOWER THE AIR PRESSURE IS LESS AND THE HEAD IS CLOSER TO DISC. THERE IS CIRCUITRY TO REDUCE THE WRITE CURRENT AT TRACK 256



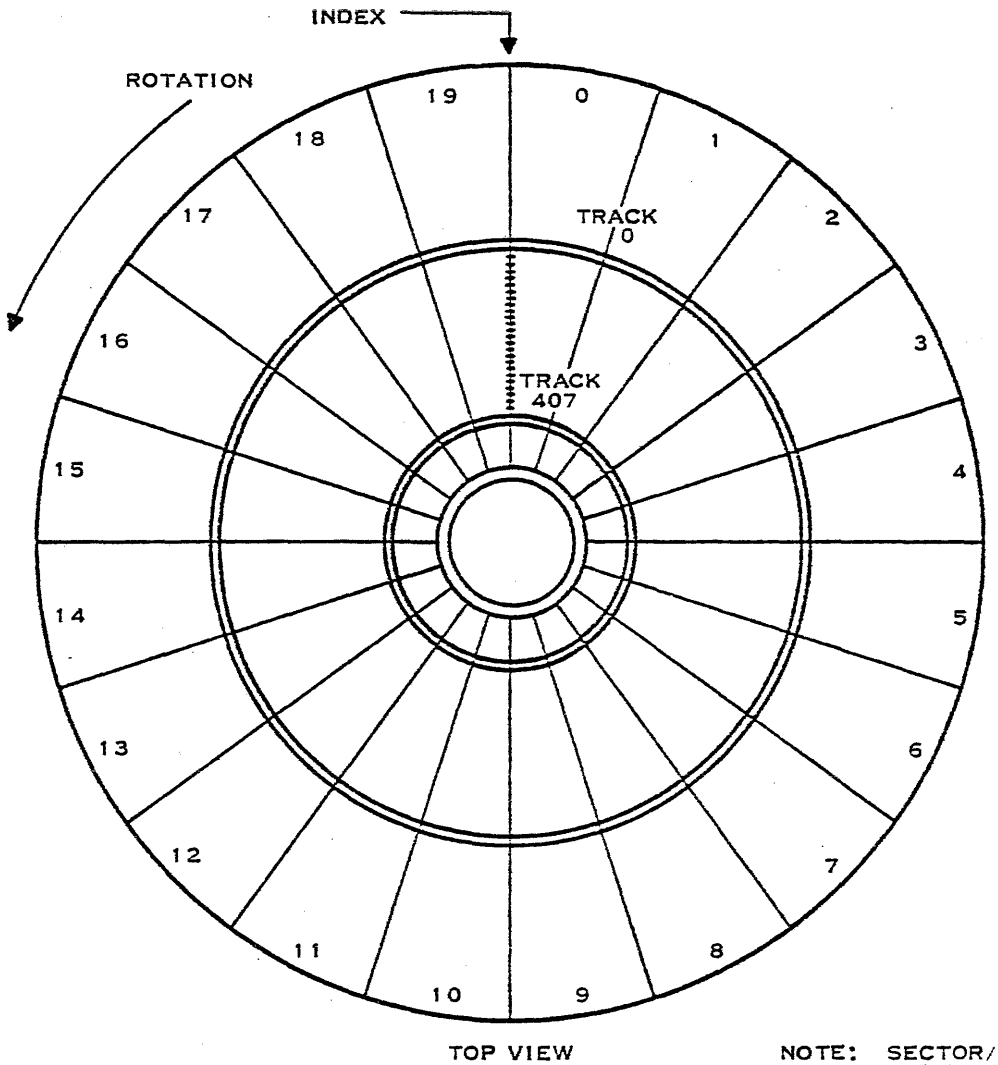
Disk Platter and Read/Write Head Organization





Sector System Block Diagram

BURST SIGNAL IS USED FOR TIMING THE ROTATIONAL TIME FROM THE FALLING EDGE OF INDEX TO THE TIME THAT INDEX MOVES UNDER HEAD ADJUSTMENT IS BY A POT ON SECTOR PCB.



NOTE: SECTOR/INDEX MARKS ARE DERIVED SEPARATELY FOR THE FIXED AND THE REMOVABLE DISK PLATTERS.

Sector and Track Organization

SEE P 33A

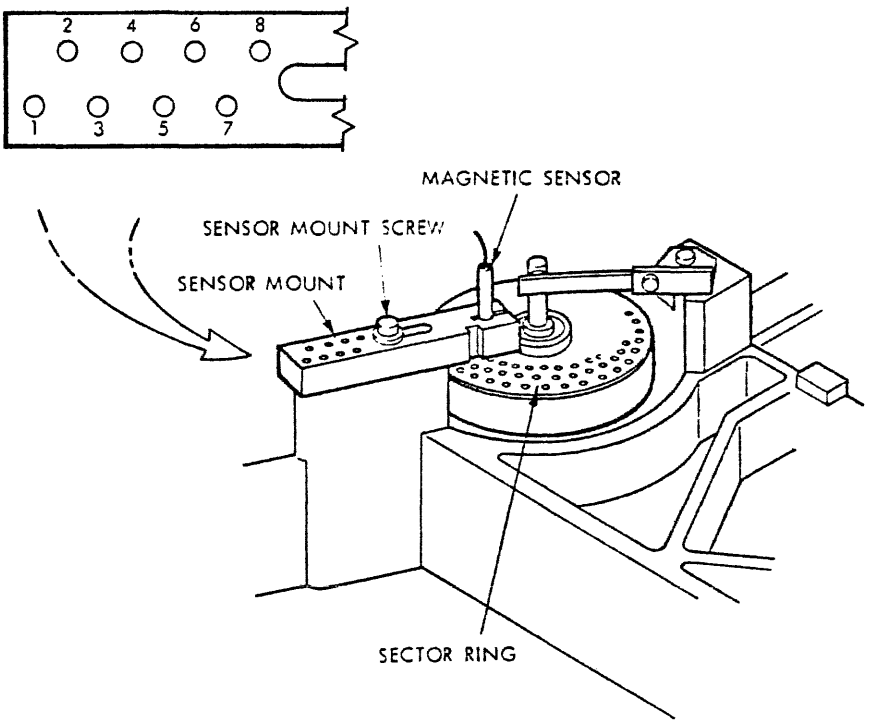
| GAP | SYNC | CRC | ID | DATA (256 WORDS MAX = 1 RECORD) | CRC |

| HEAD # | CYL # | SECTOR/RECORD | SECTOR ADDRESS | # OF WORDS IN SECTOR |

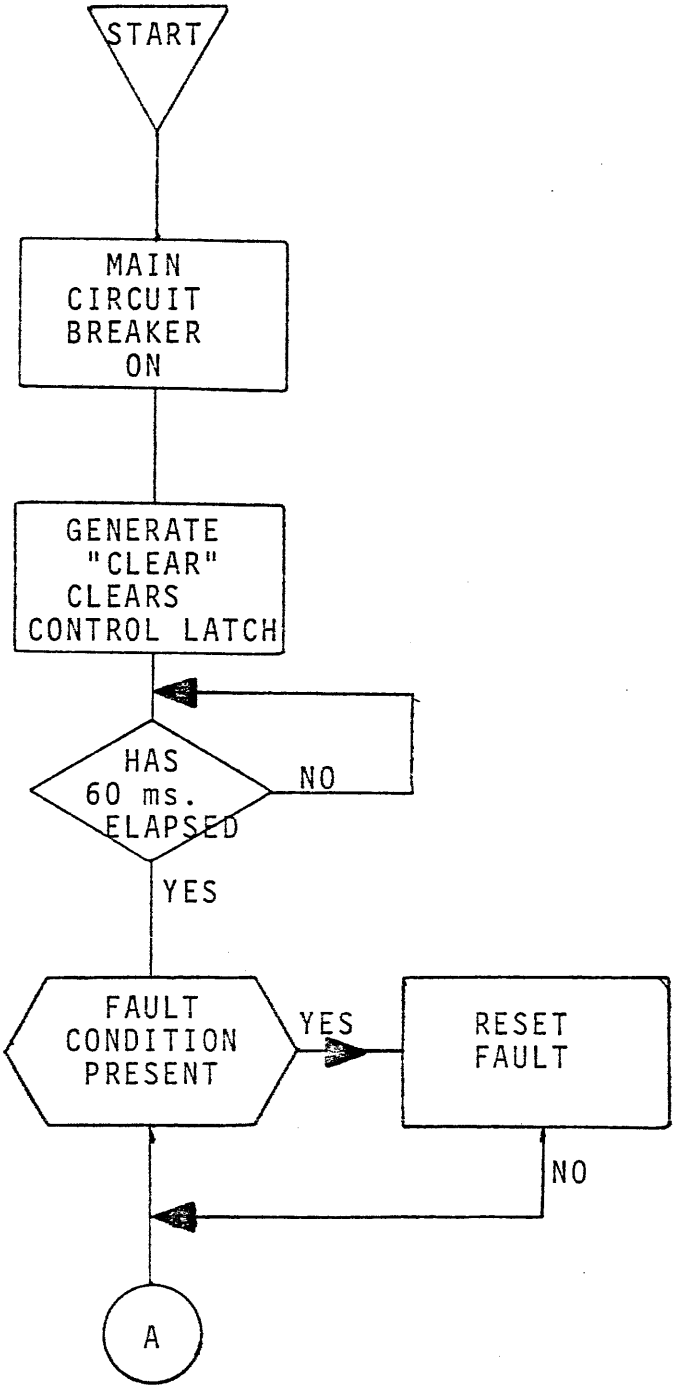
MAX = 1 SECTOR PER RECORD

Sector Option Conversion

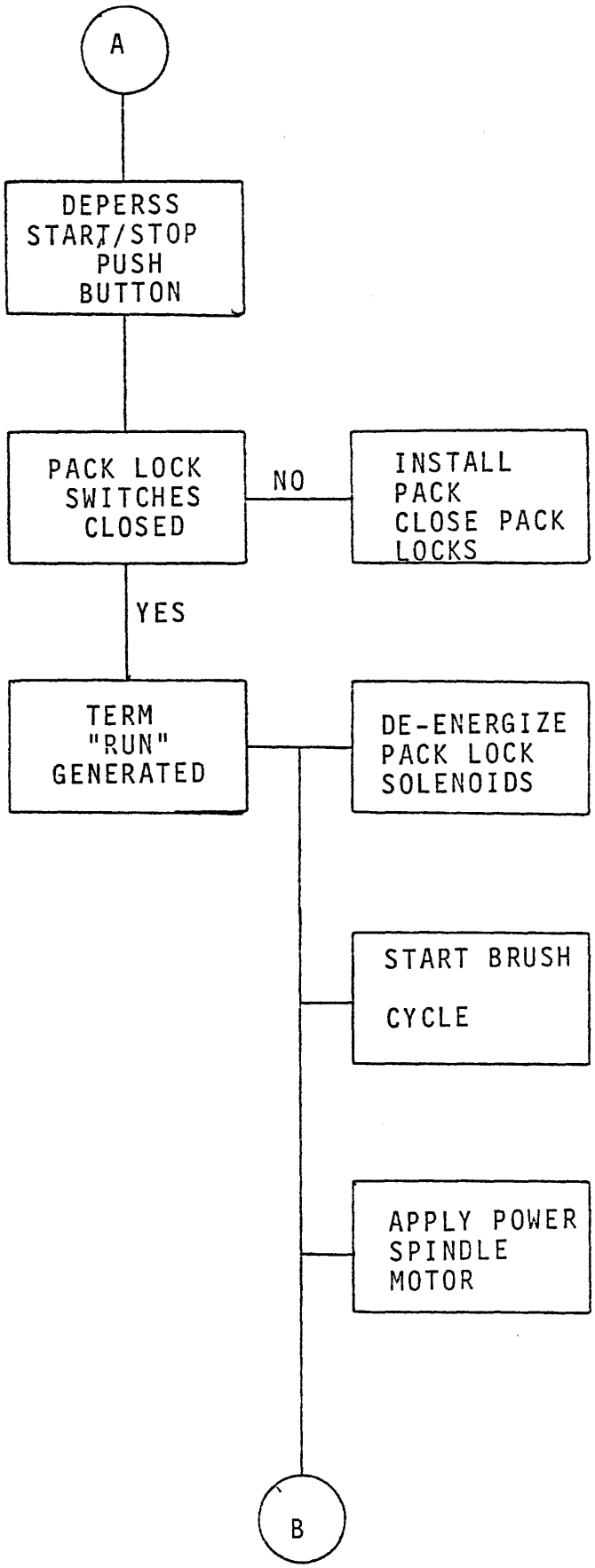
REQUIRED SECTOR (Switch setting for sector)	SENSOR MOUNT Hole #	RING Holes
29 or SOFT SECTOR	1	29
40, 20, 10, 5	2	40
48, 24, 12, 6, 3	3	48
50, 25	4	50
60, 30, 15	5	60
64, 32, 16, 8, 4, 2	6	64
56, 28, 14, 7 (8 ring)	7	56
72, 36, 18, 9 (8 ring)	8	72

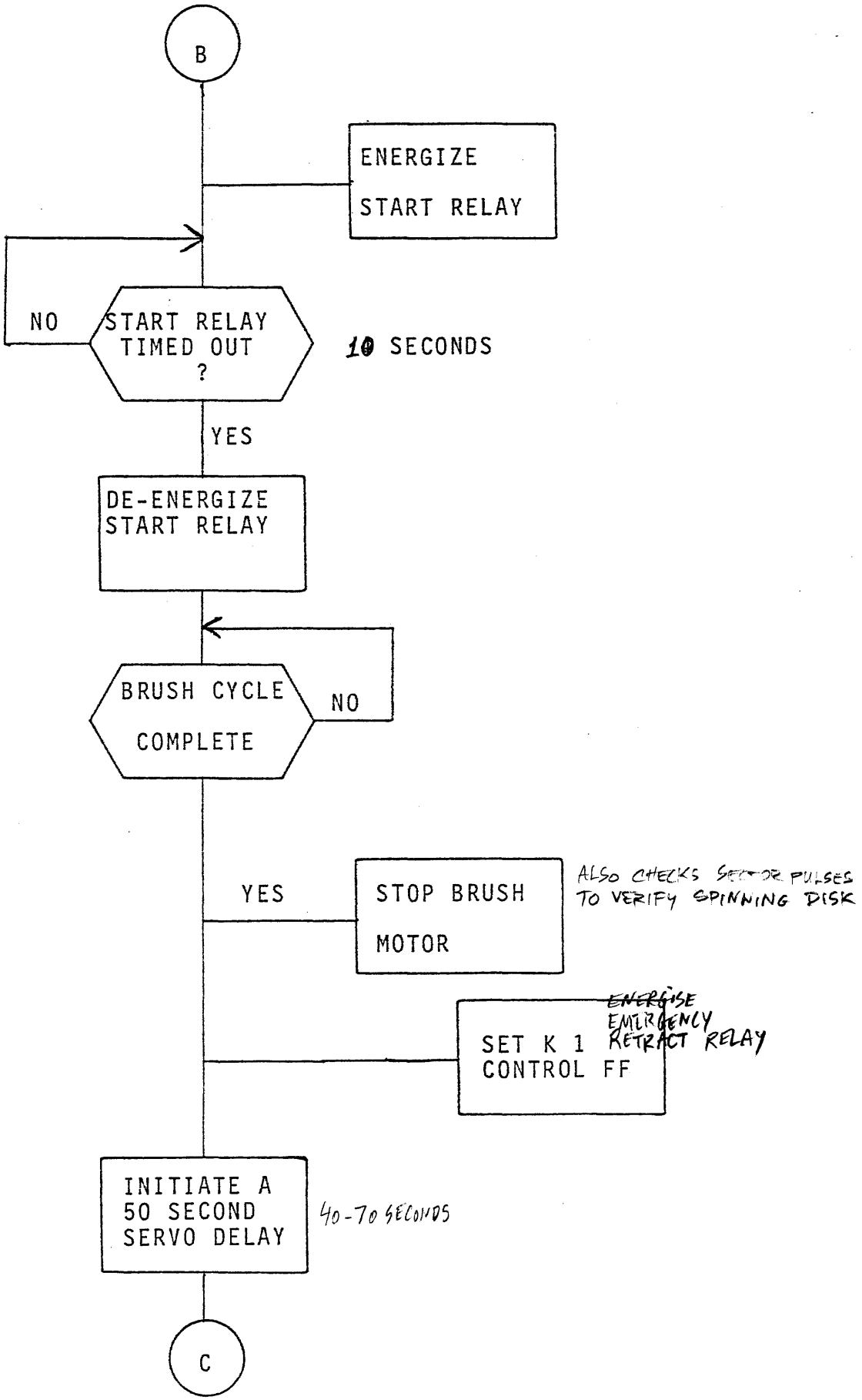


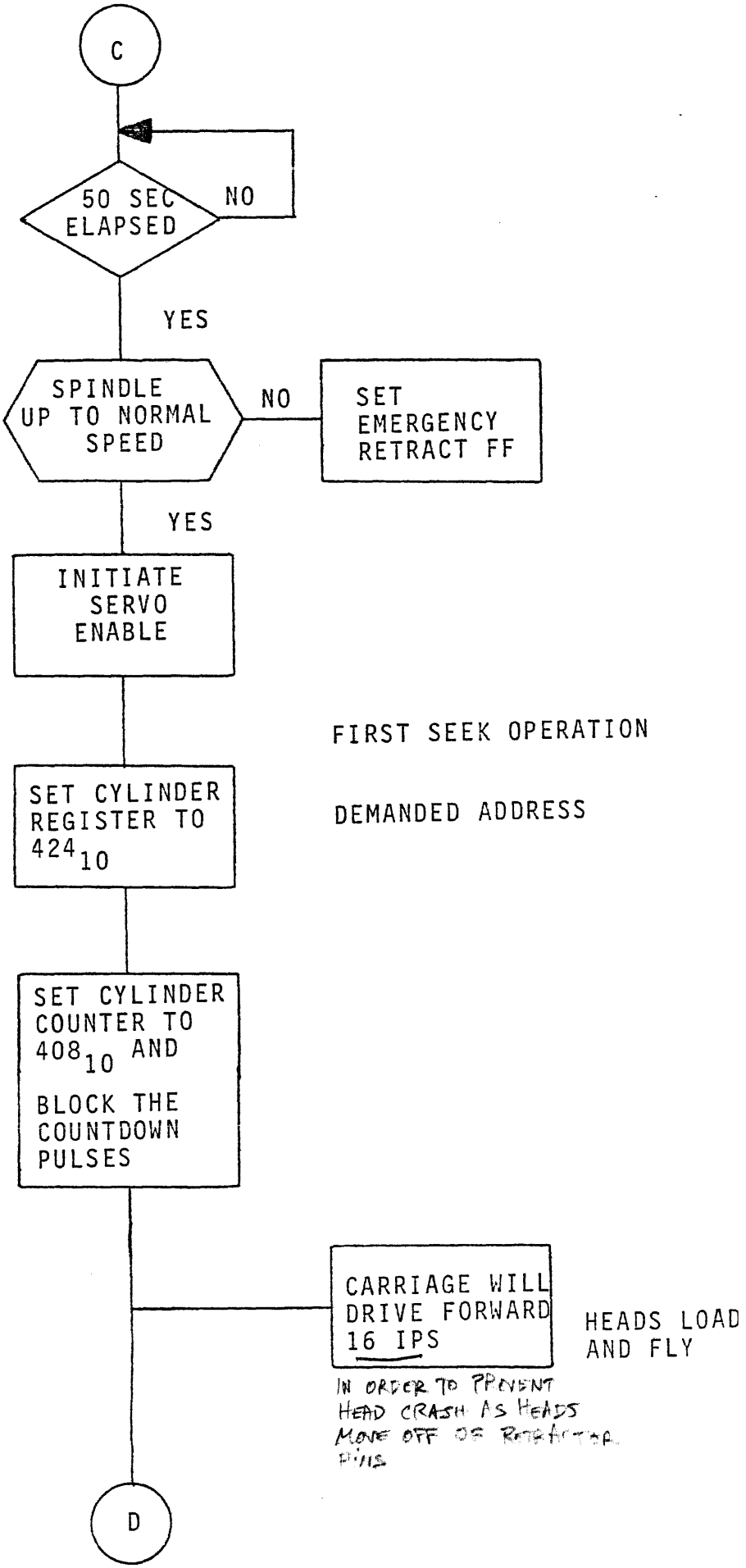
Sector Option Conversion

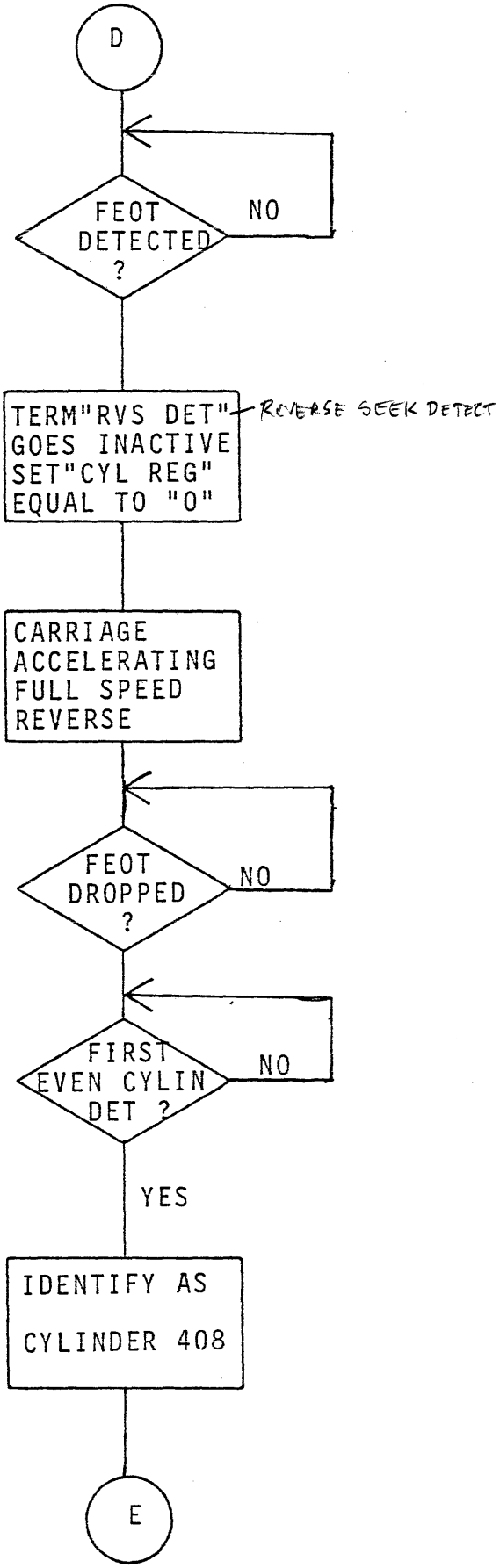


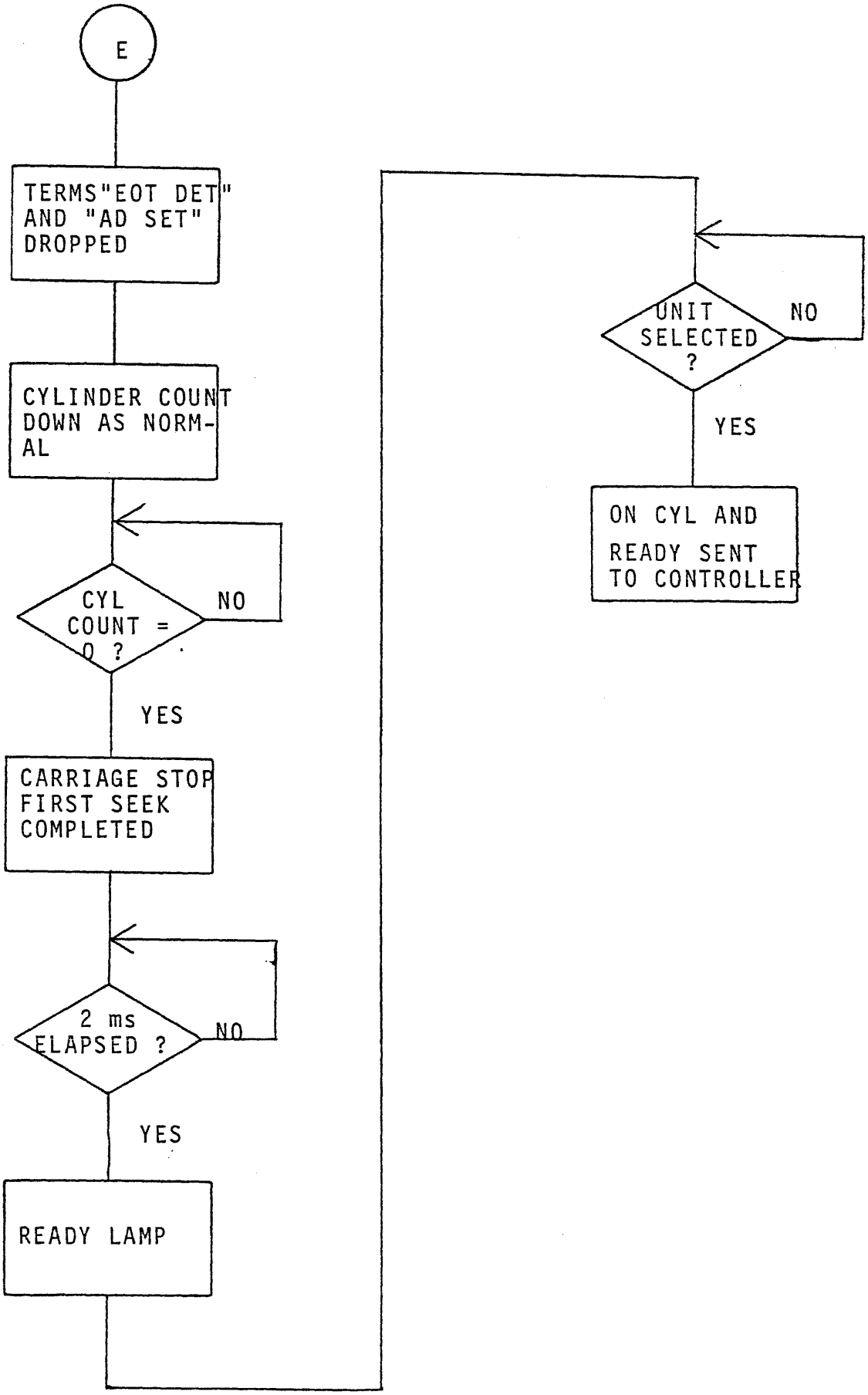
POWER UP AND
FIRST SEEK OPERATION

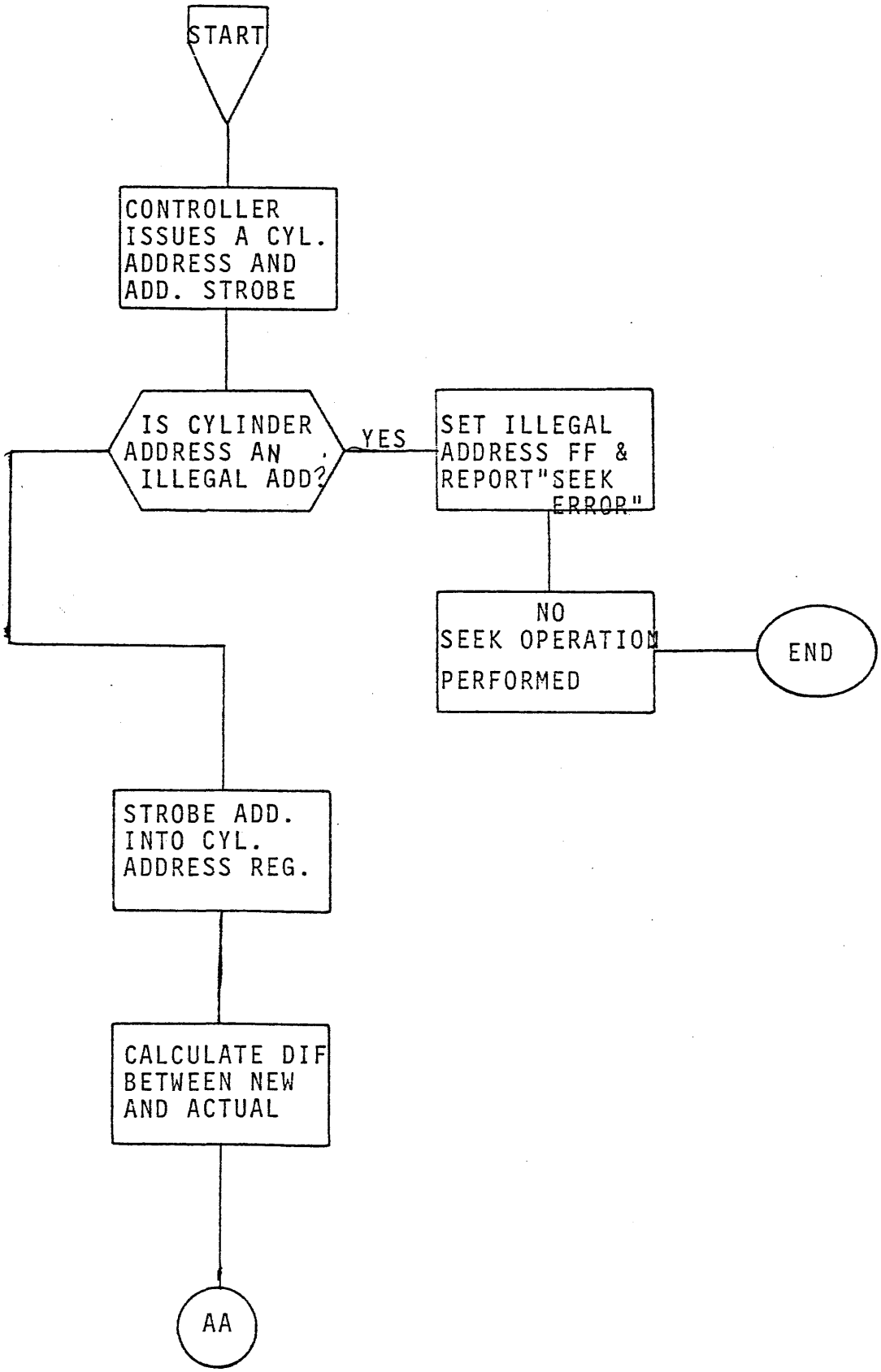

A
DEPERSS START/STOP PUSH BUTTON
PACK LOCK SWITCHES CLOSED
NO
INSTALL PACK CLOSE PACK LOCKS
YES
TERM "RUN" GENERATED
DE-ENERGIZE PACK LOCK SOLENOIDS
START BRUSH CYCLE
APPLY POWER SPINDLE MOTOR
B


B
ENERGIZE
START RELAY
NO
START RELAY
TIMED OUT
?
10 SECONDS
YES
DE-ENERGIZE
START RELAY
BRUSH CYCLE
COMPLETE
NO
YES
STOP BRUSH
MOTOR
ALSO CHECKS SECTOR PULSES
TO VERIFY SPINNING DISK
ENERGISE
EMERGENCY
RETRACT RELAY
SET K 1
CONTROL FF
INITIATE A
50 SECOND
SERVO DELAY
40-70 SECONDS
C

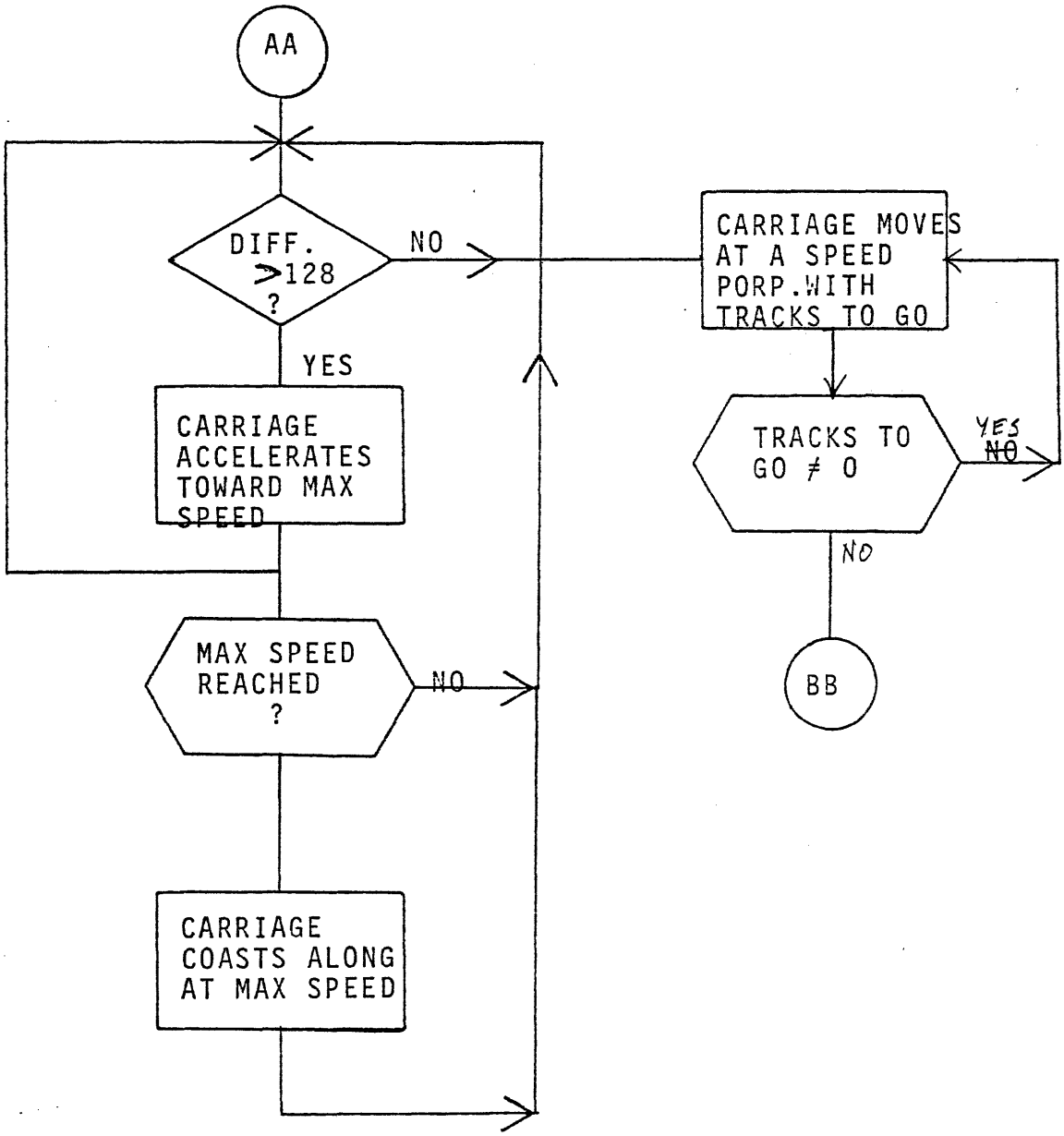

C
50 SEC ELAPSED
NO
YES
SPINDLE UP TO NORMAL SPEED
NO
SET EMERGENCY RETRACT FF
YES
INITIATE SERVO ENABLE
FIRST SEEK OPERATION
SET CYLINDER REGISTER TO 424_{10}
DEMANDED ADDRESS
SET CYLINDER COUNTER TO 408_{10} AND
BLOCK THE COUNTDOWN PULSES
CARRIAGE WILL DRIVE FORWARD 16 IPS
HEADS LOAD AND FLY
IN ORDER TO PREVENT HEAD CRASH AS HEADS MOVE OFF OF RETRACTOR PINS
D

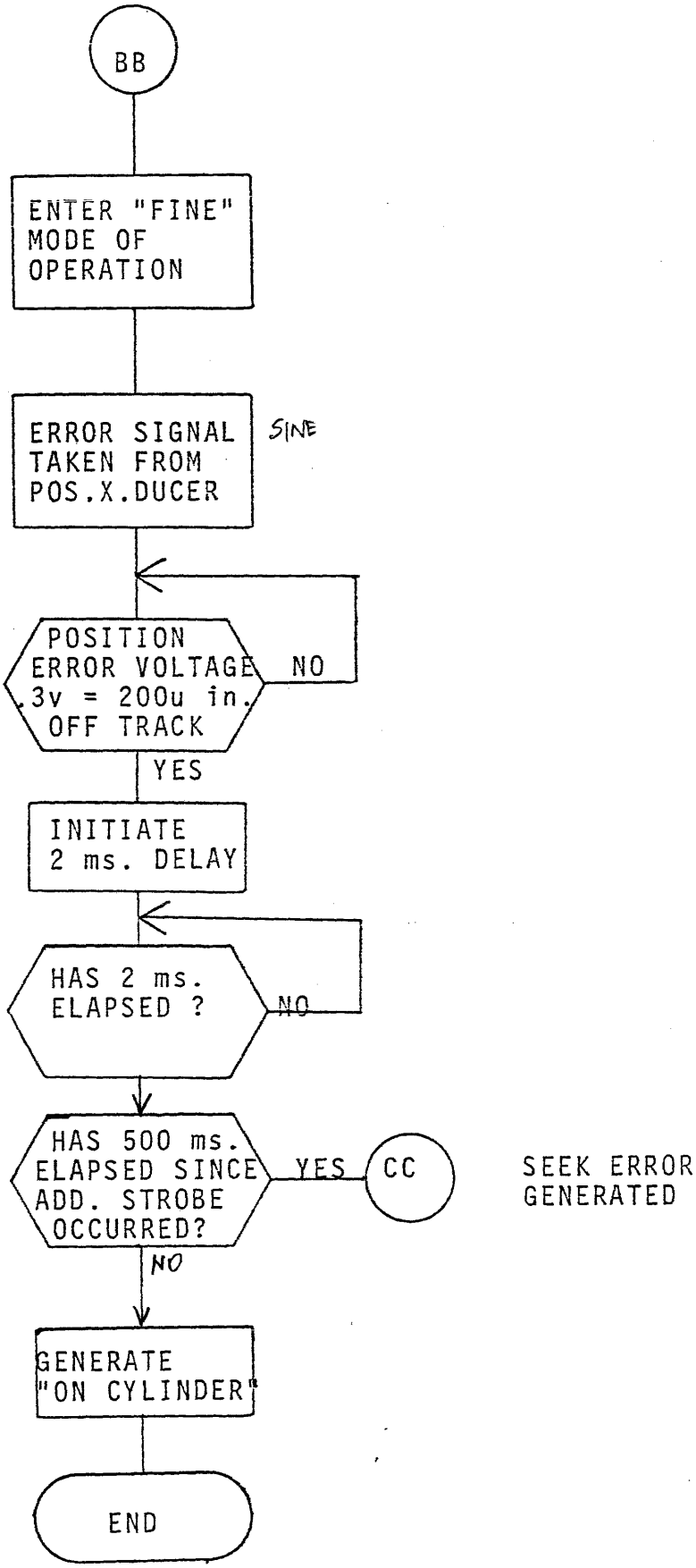

D
FEOT DETECTED ?
NO
TERM"RVS DET" GOES INACTIVE SET"CYL REG" EQUAL TO "0"
REVERSE SEEK DETECT
CARRIAGE ACCELERATING FULL SPEED REVERSE
FEOT DROPPED ?
NO
FIRST EVEN CYLIN DET ?
NO
YES
IDENTIFY AS CYLINDER 408
E

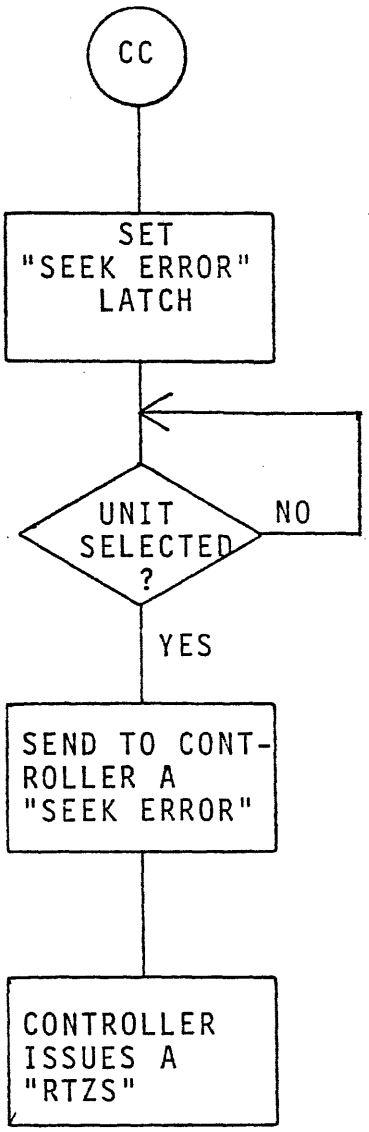

E
TERMS"EOT DET" AND "AD SET" DROPPED
CYLINDER COUNT DOWN AS NORM-AL
CYL COUNT = 0 ?
NO
YES
CARRIAGE STOP FIRST SEEK COMPLETED
2 ms ELAPSED ?
NO
YES
READY LAMP
UNIT SELECTED ?
NO
YES
ON CYL AND READY SENT TO CONTROLLER



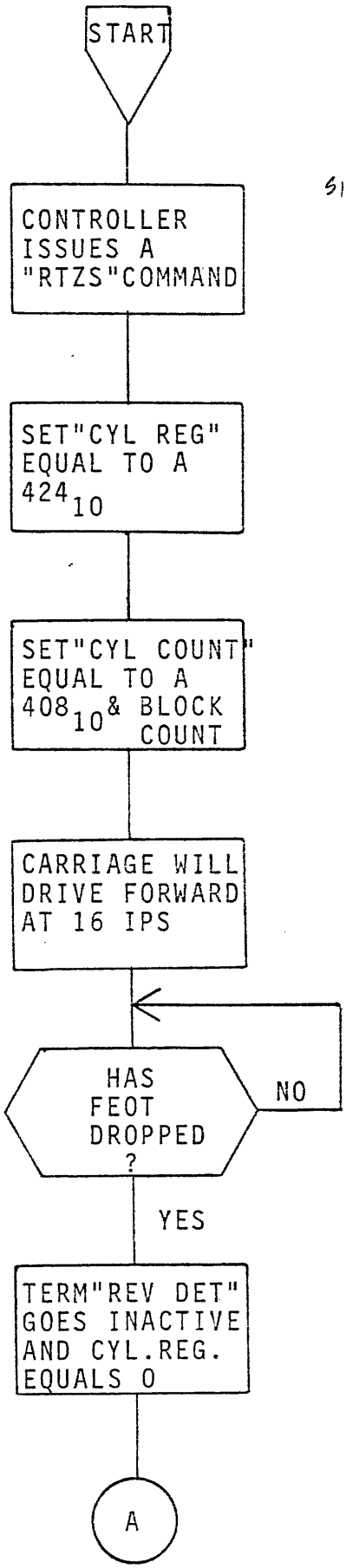
OPERATIONAL SEEK


AA
DIFF. >128 ?
NO
YES
CARRIAGE ACCELERATES TOWARD MAX SPEED
MAX SPEED REACHED ?
NO
CARRIAGE COASTS ALONG AT MAX SPEED
CARRIAGE MOVES AT A SPEED PORP.WITH TRACKS TO GO
TRACKS TO GO ≠ 0
YES
NO
NO
BB


BB
ENTER "FINE" MODE OF OPERATION
ERROR SIGNAL TAKEN FROM POS.X.DUCER
SINE
POSITION ERROR VOLTAGE .3v = 200u in. OFF TRACK
NO
YES
INITIATE 2 ms. DELAY
HAS 2 ms. ELAPSED ?
NO
HAS 500 ms. ELAPSED SINCE ADD. STROBE OCCURRED?
YES
CC
SEEK ERROR GENERATED
NO
GENERATE "ON CYLINDER"
END

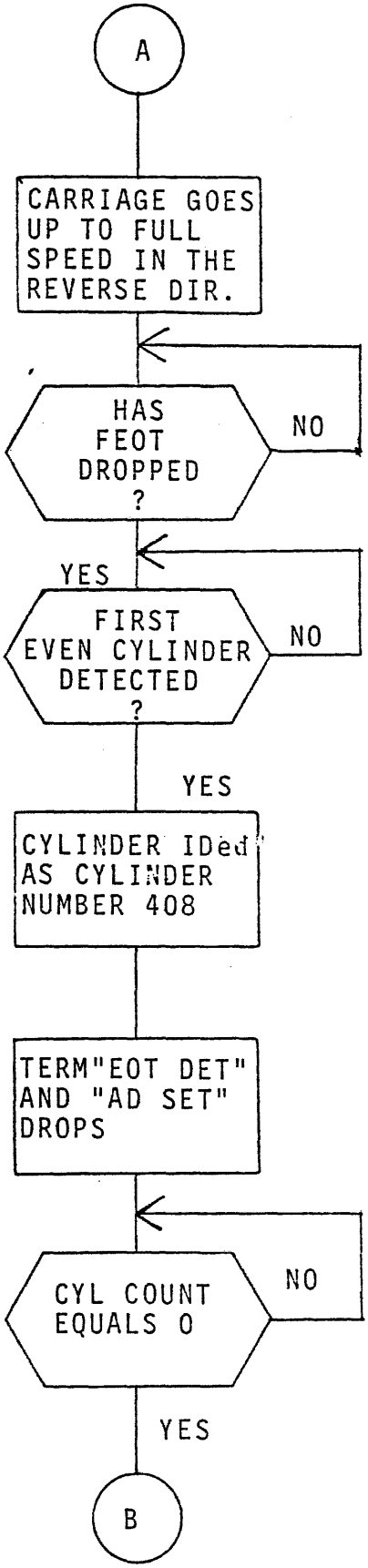


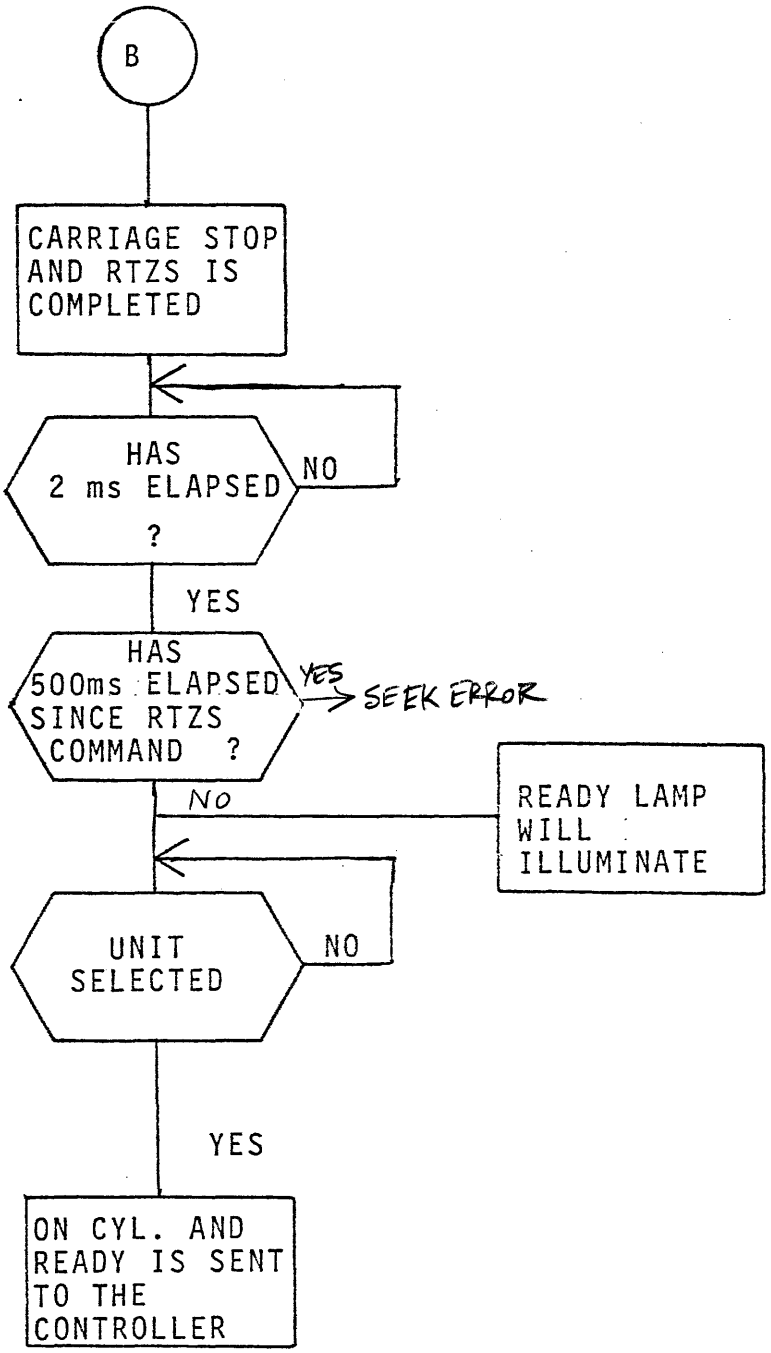
RTZS RESETS ERROR CIRCUITRY

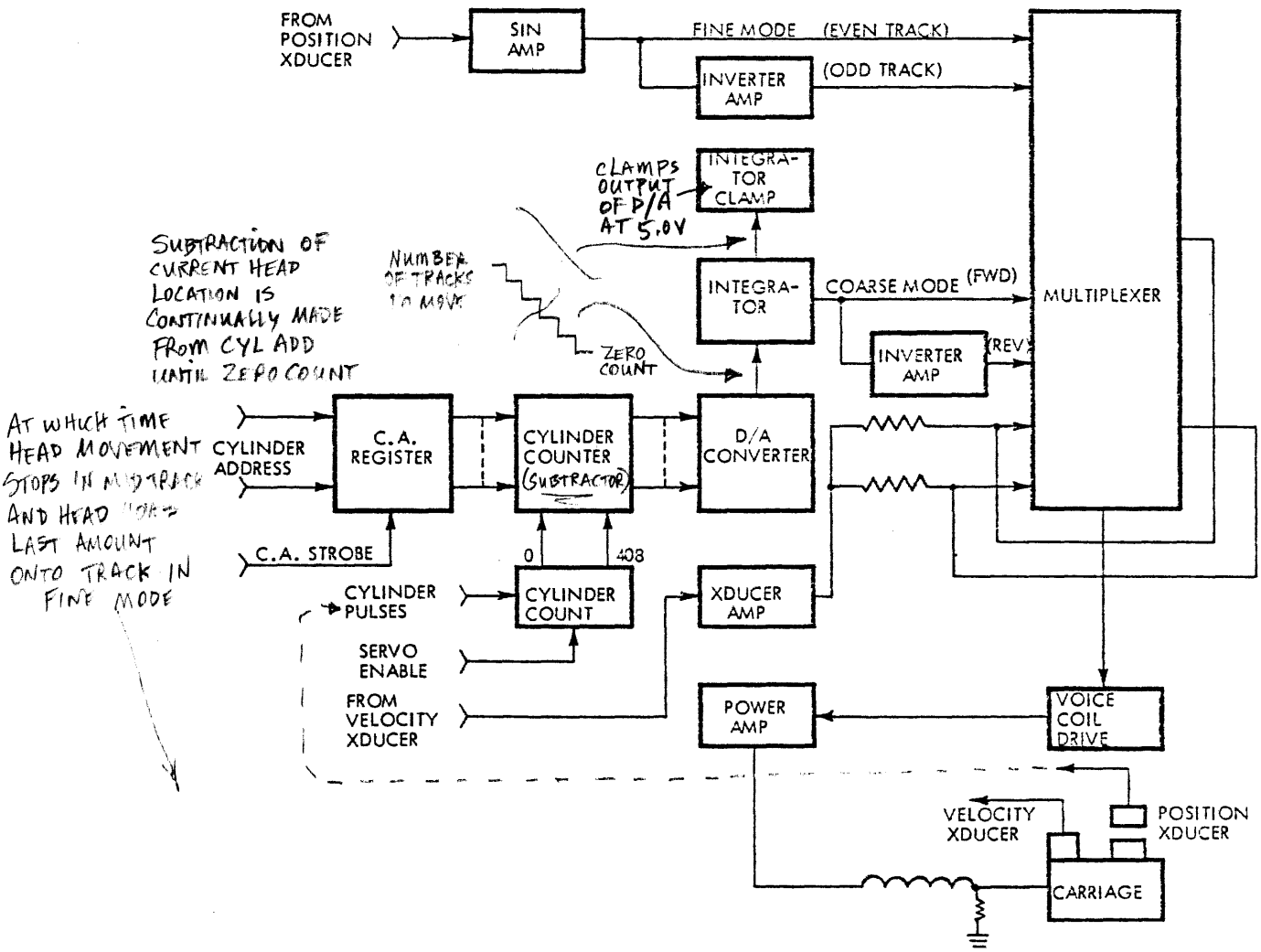


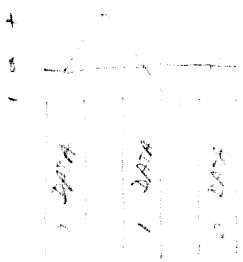
SIMILAR TO FIRST SEEK

RETURN TO ZERO SEEK OPERATION


A
CARRIAGE GOES UP TO FULL SPEED IN THE REVERSE DIR.
HAS FEOT DROPPED ?
NO
YES
FIRST EVEN CYLINDER DETECTED ?
NO
YES
CYLINDER IDed AS CYLINDER NUMBER 408
TERM"EOT DET" AND "AD SET" DROPS
CYL COUNT EQUALS 0
NO
YES
B

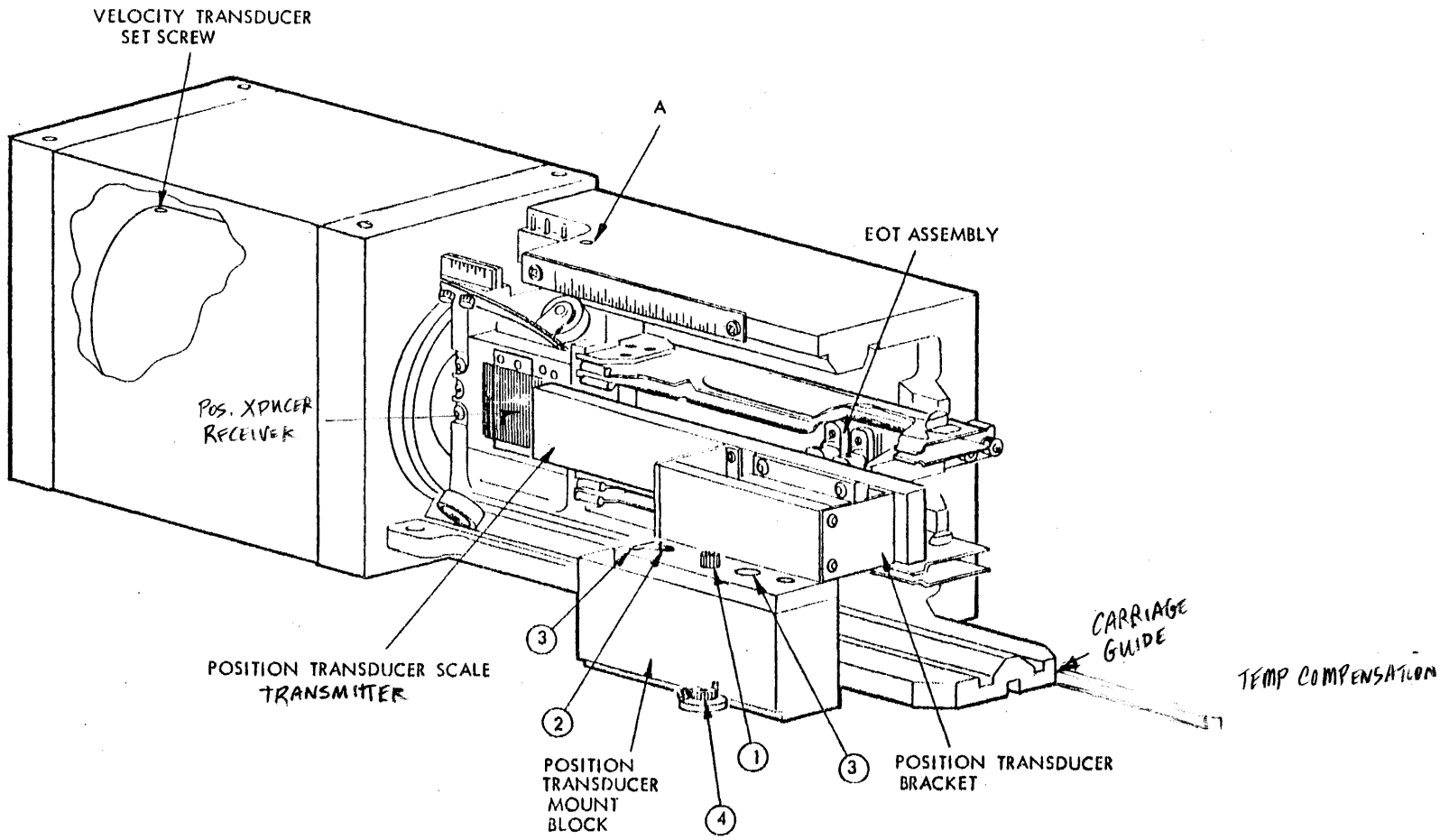

B
CARRIAGE STOP AND RTZS IS COMPLETED
HAS 2 ms ELAPSED ?
NO
YES
HAS 500ms ELAPSED SINCE RTZS COMMAND ?
YES
SEEK ERROR
NO
READY LAMP WILL ILLUMINATE
UNIT SELECTED
NO
YES
ON CYL. AND READY IS SENT TO THE CONTROLLER



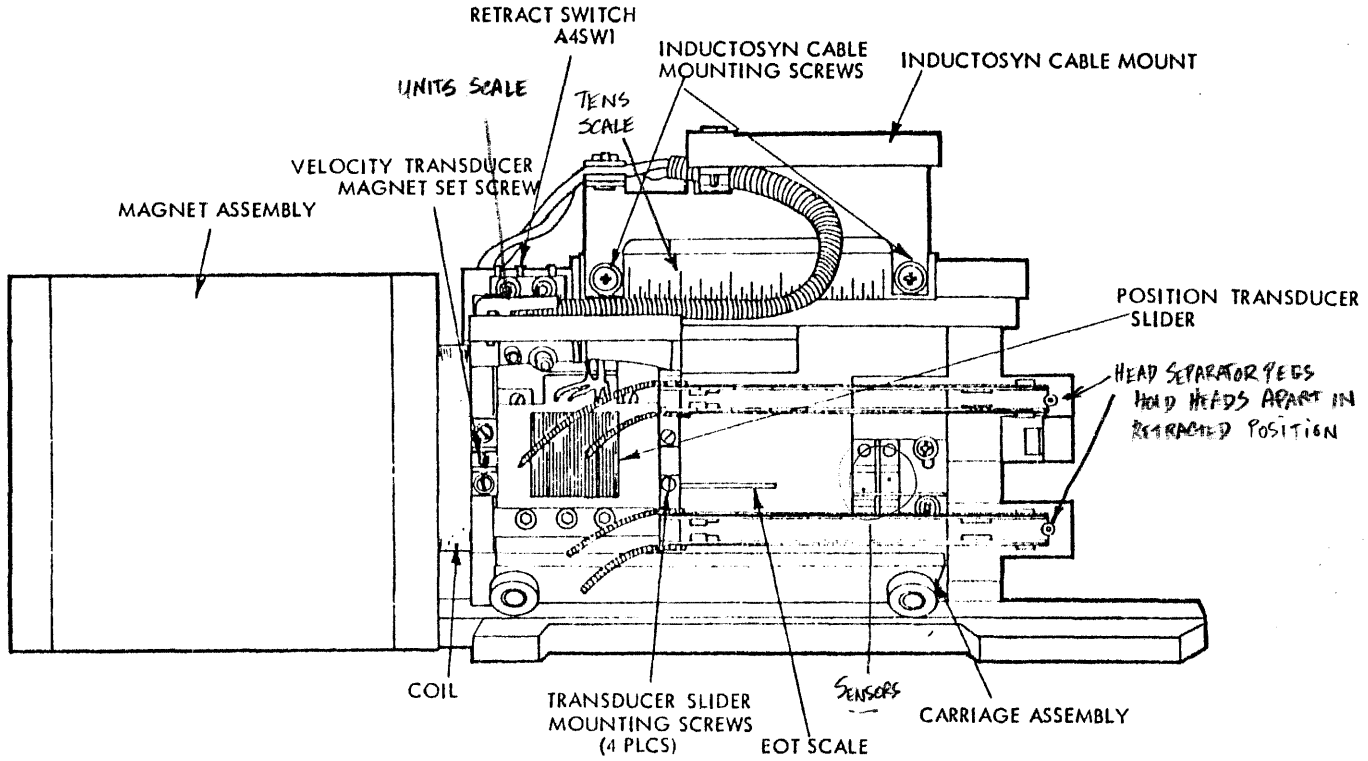


USES POLARITY OF SIGNAL PICKED UP BY POSITION XDUCER TO DETERMINE EVEN/ODD TRACK. USES AMPLITUDE TO STEP FROM IN-BETWEEN TO ON TRACK

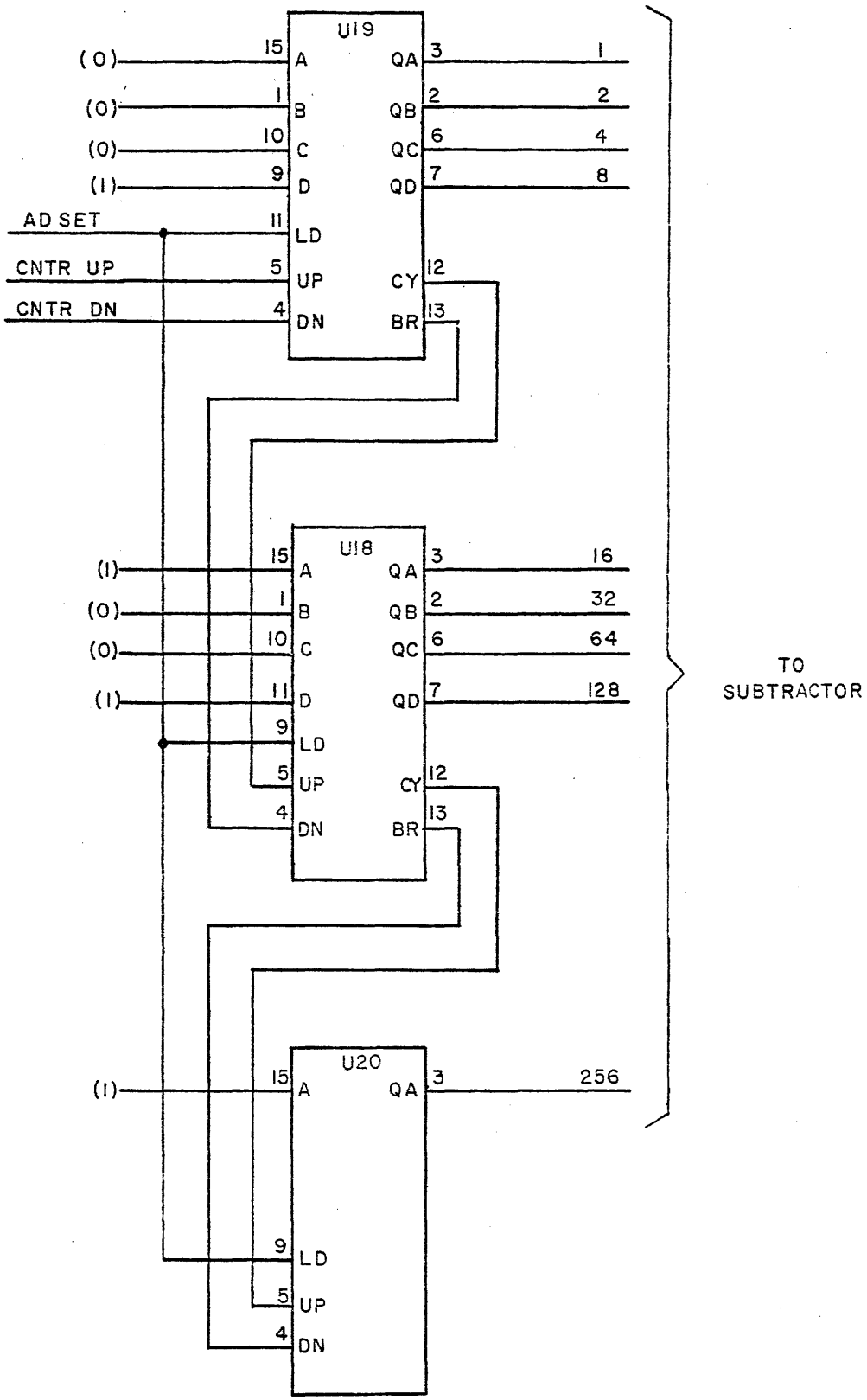
Servo System Block Diagram



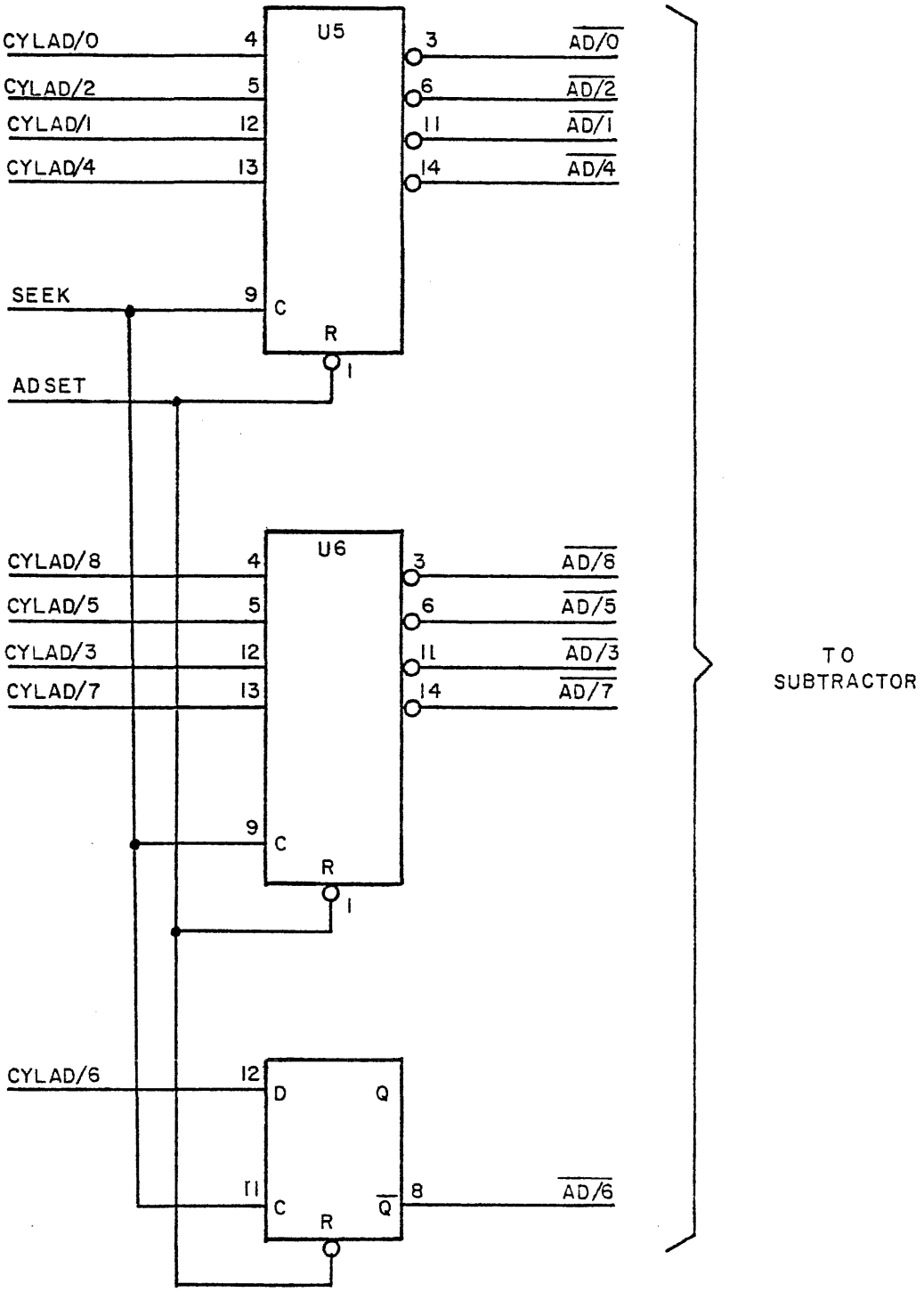
Actuator Assembly



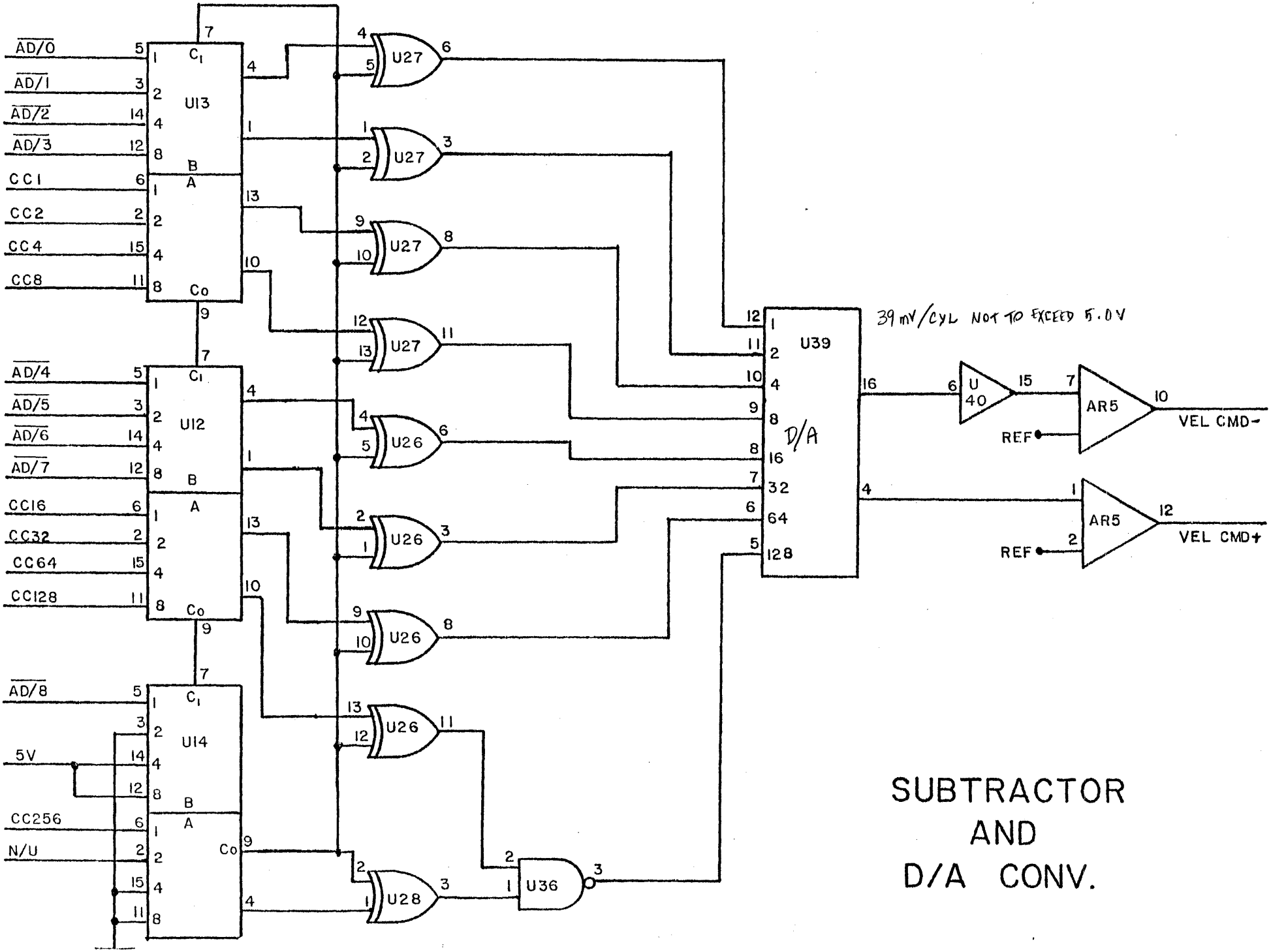
FIRST SHUTS DOWN BOTH SENSORS (MOVING OUT)
WHEN FIRST SENSOR COMES ON AFTER EOT SCALE
HAS COMPLETELY PASSED, IT THEN BACKS UP. FIRST
TRACK FOUND ON BACKING UP IS 468 (FIRST SEEK.)
BACKS UP 408 TRACKS AND DENOTES THIS AS
TRACK ZERO. THEN AN ALIGNMENT DISK IS INSTALLED
TRACK 146 IS SEEKED, IF CATS EYE APPEARS, DISK IS
PROPERLY ALIGNED. THIS CAN BE USED TO CALIBRATE
SENSOR AND SCALE POSITIONS

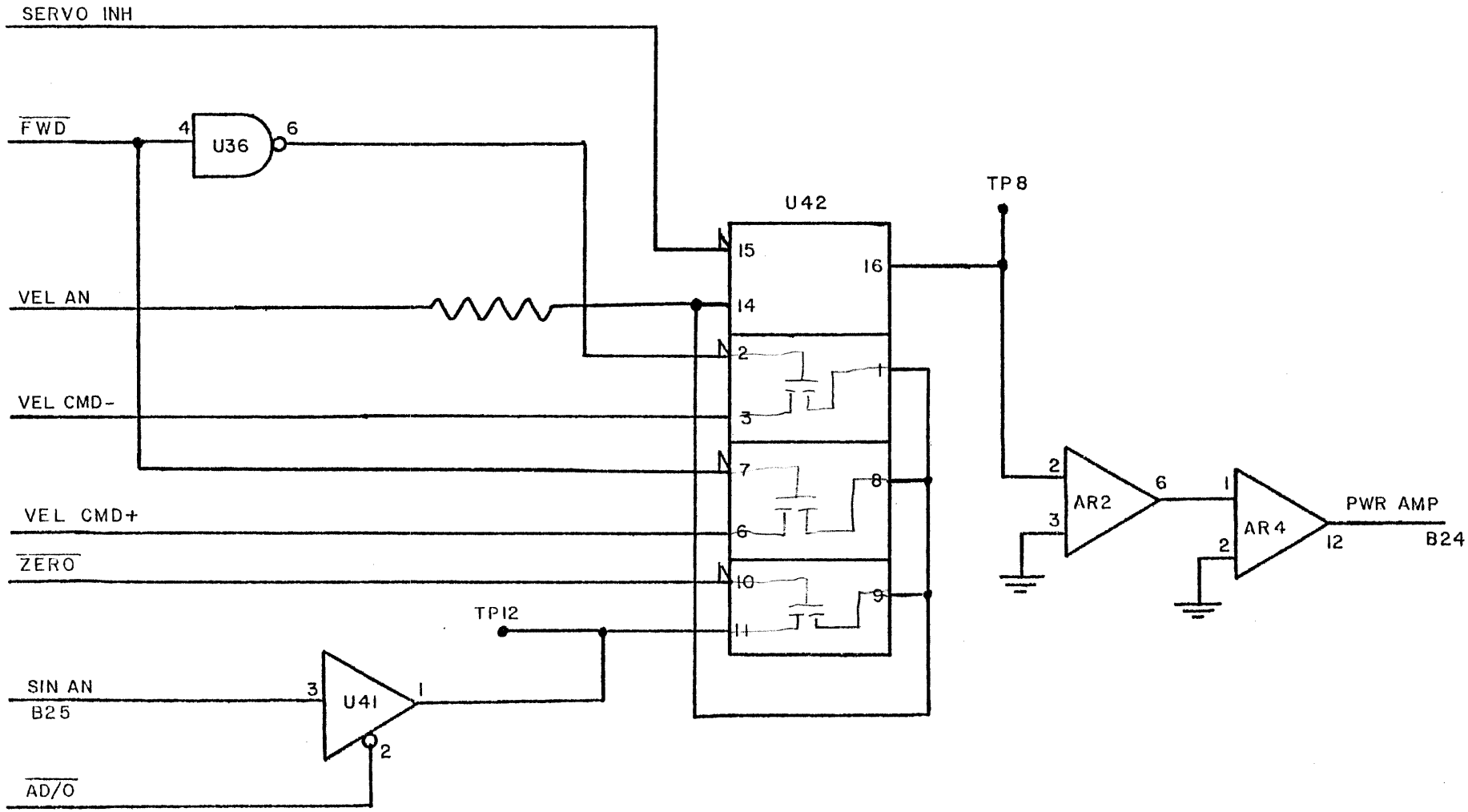


CYLINDER COUNTER

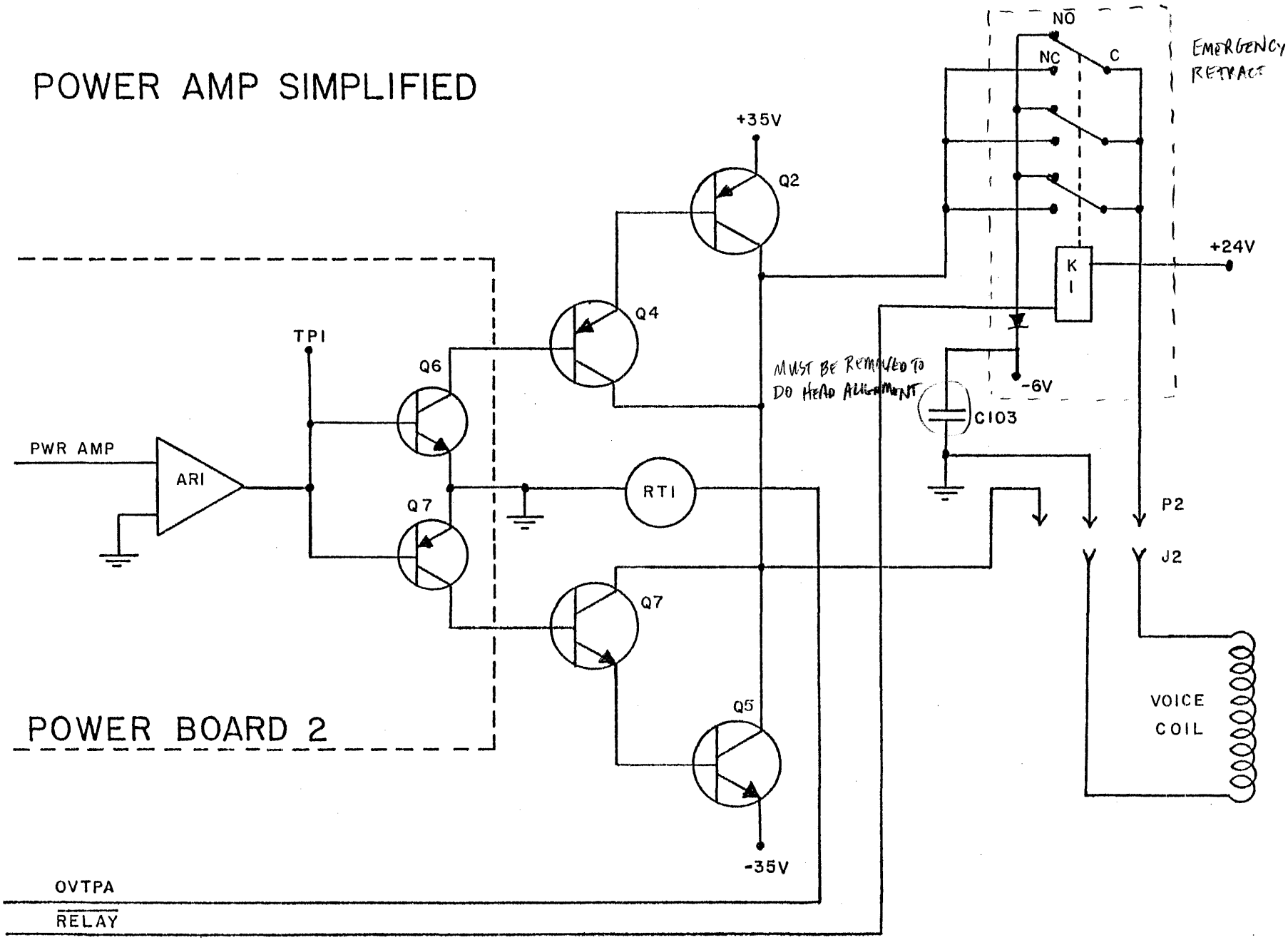


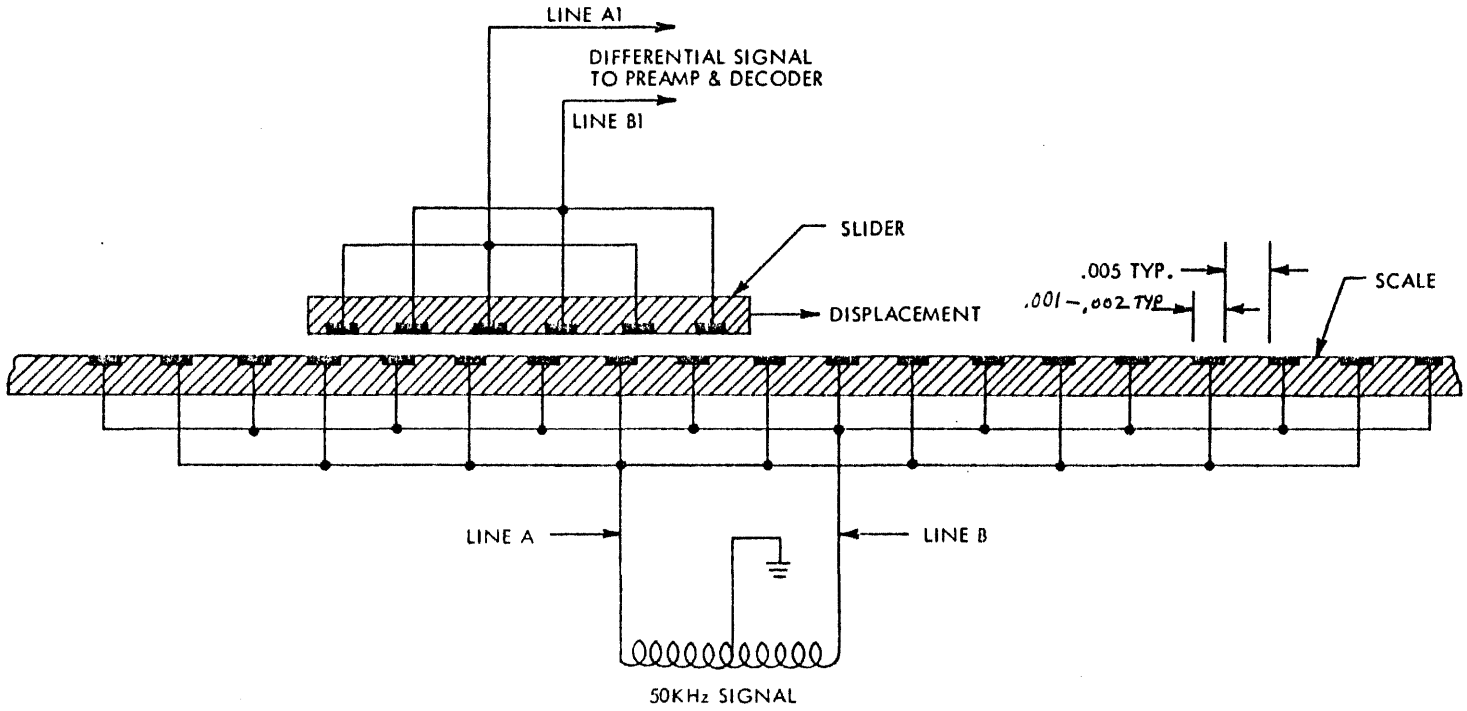
CYLINDER REGISTER


AD/0
AD/1
AD/2
AD/3
CC1
CC2
CC4
CC8
U13
AD/4
AD/5
AD/6
AD/7
CC16
CC32
CC64
CC128
U12
AD/8
5V
CC256
N/U
U14
U27
U26
U28
U36
U39
D/A
39 mV/cyL NOT TO EXCEED 5.0V
U 40
AR5
REF
VEL CMD-
VEL CMD+
SUBTRACTOR
AND
D/A CONV.



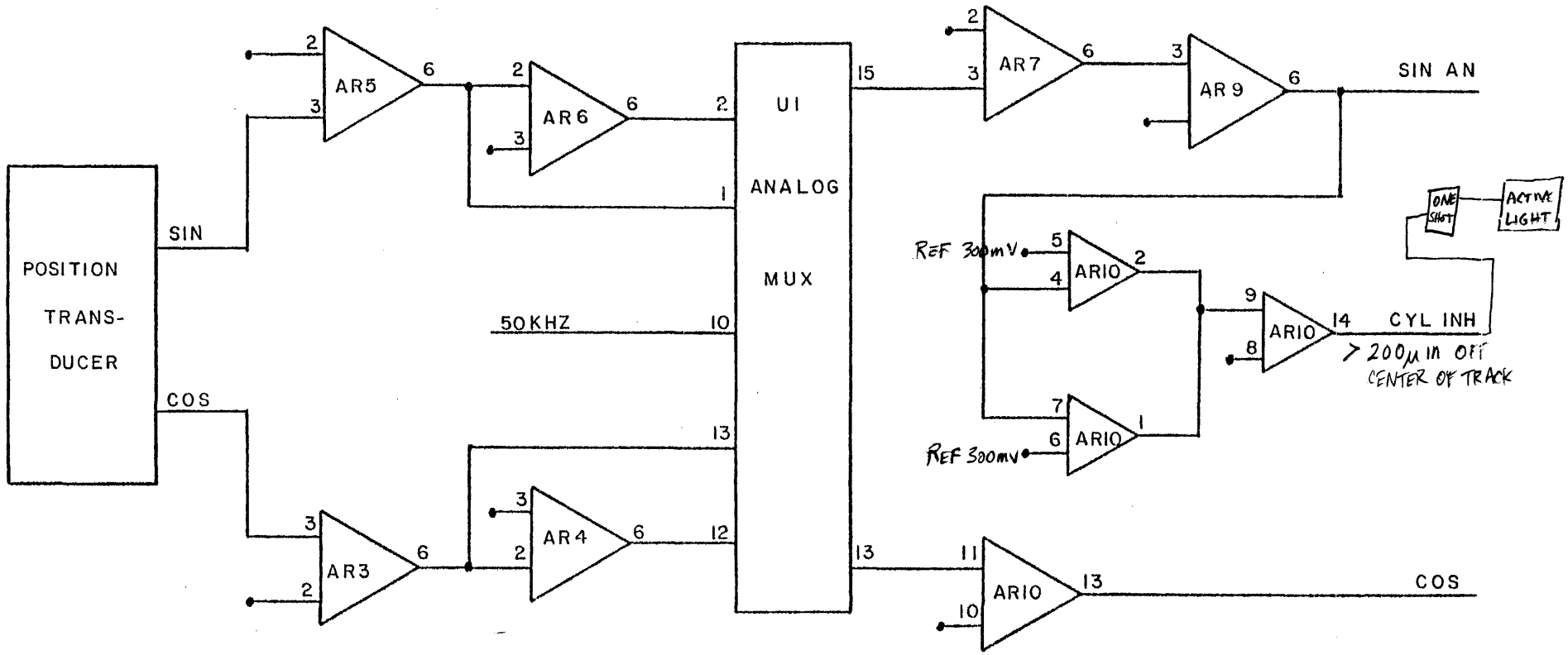
SERVO PROCESSING SIMPLIFIED


POWER AMP SIMPLIFIED
+35V
Q2
NO
NC
C
EMERGENCY RETRACT
+24V
K
Q4
TPI
Q6
MUST BE REMOVED TO DO HEAD ALIGNMENT
-6V
C103
PWR AMP
ARI
Q7
RTI
P2
J2
Q7
VOICE COIL
POWER BOARD 2
Q5
-35V
OVTPA
RELAY

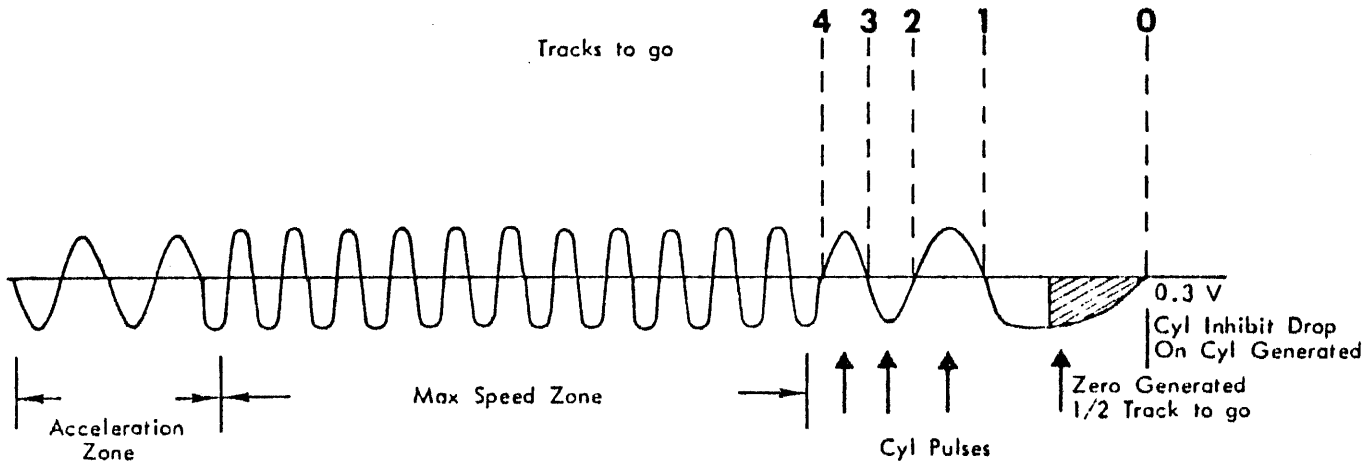


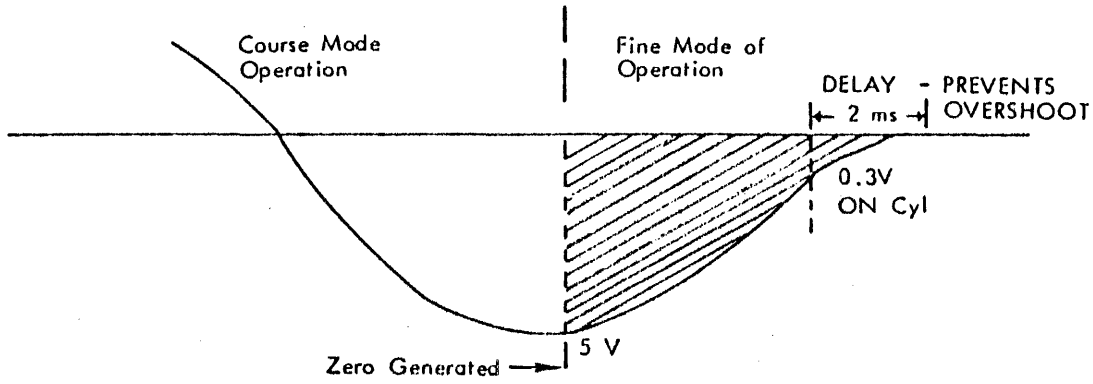
Capacitively Coupled Linear Displacement Transducer

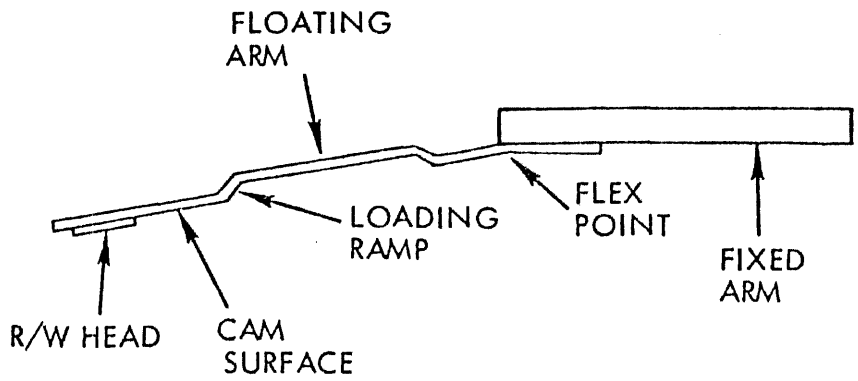
(INDUCTOSYN)



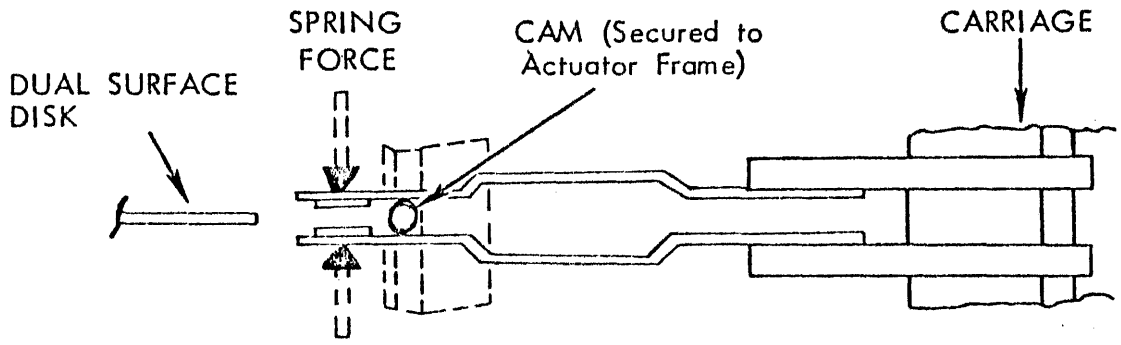
SIN AND COS DEVELOPMENT


Tracks to go
4
3
2
1
0
0.3 V
Cyl Inhibit Drop
On Cyl Generated
Acceleration
Zone
Max Speed Zone
Cyl Pulses
Zero Generated
1/2 Track to go

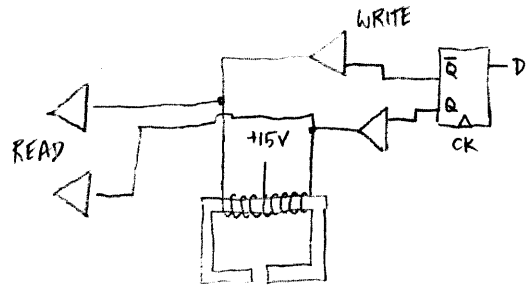

Course Mode
Operation
Fine Mode of
Operation
DELAY - PREVENTS
← 2 ms → OVERSHOOT
0.3V
ON Cyl
5 V
Zero Generated



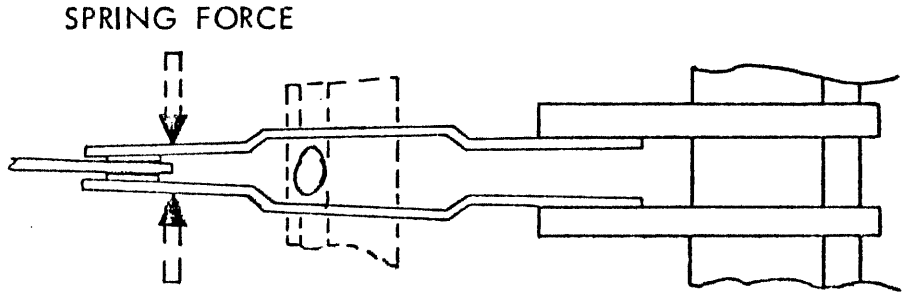
HEAD ASSEMBLY - UNFLEXED PROFILE



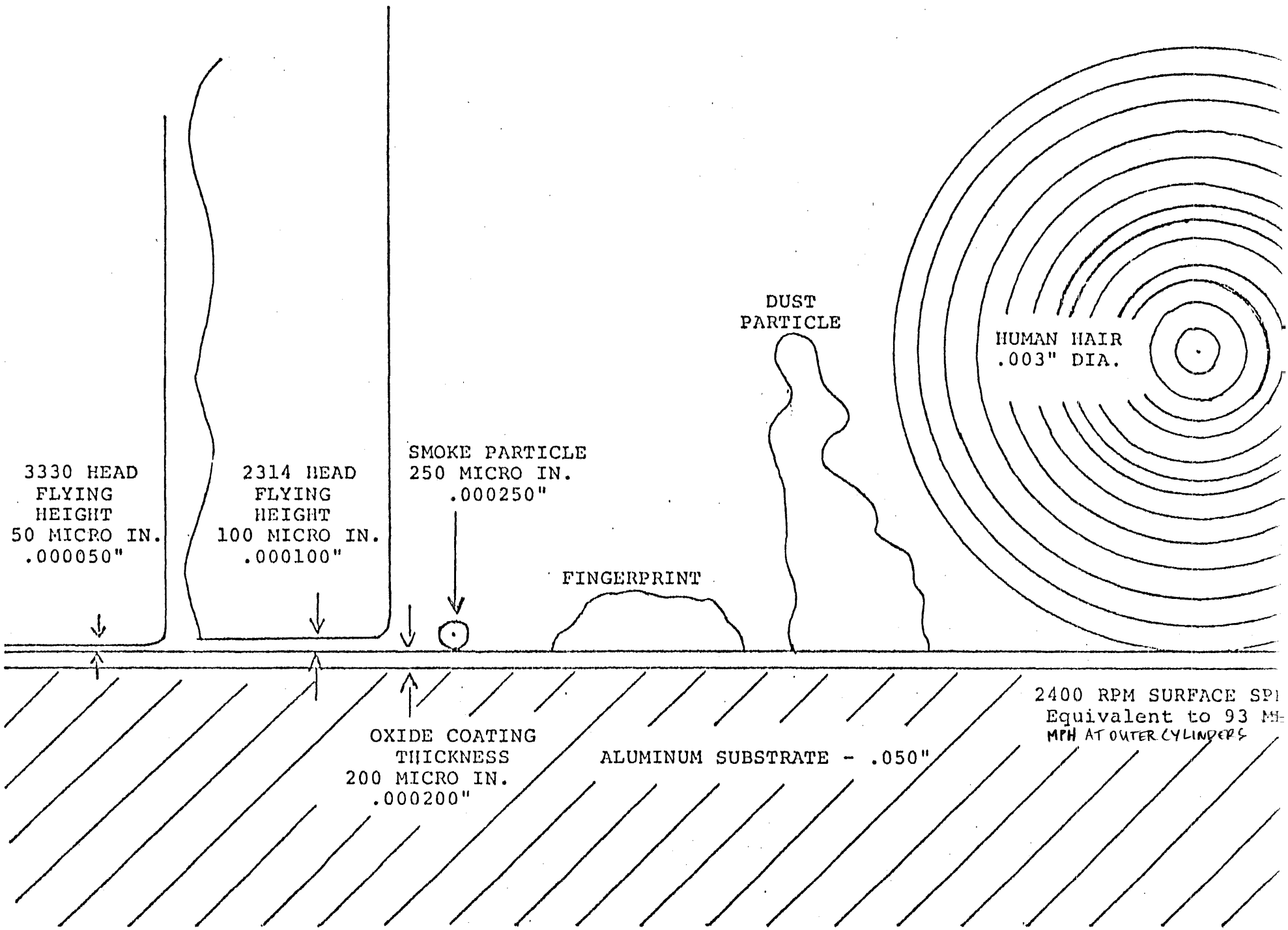
HEAD ASSEMBLY - RETRACTED POSITION

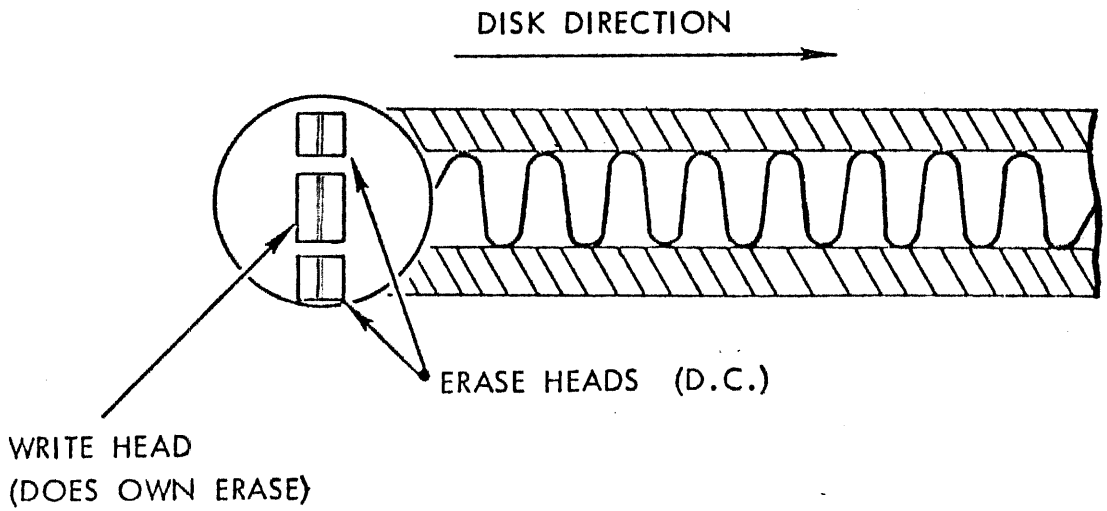


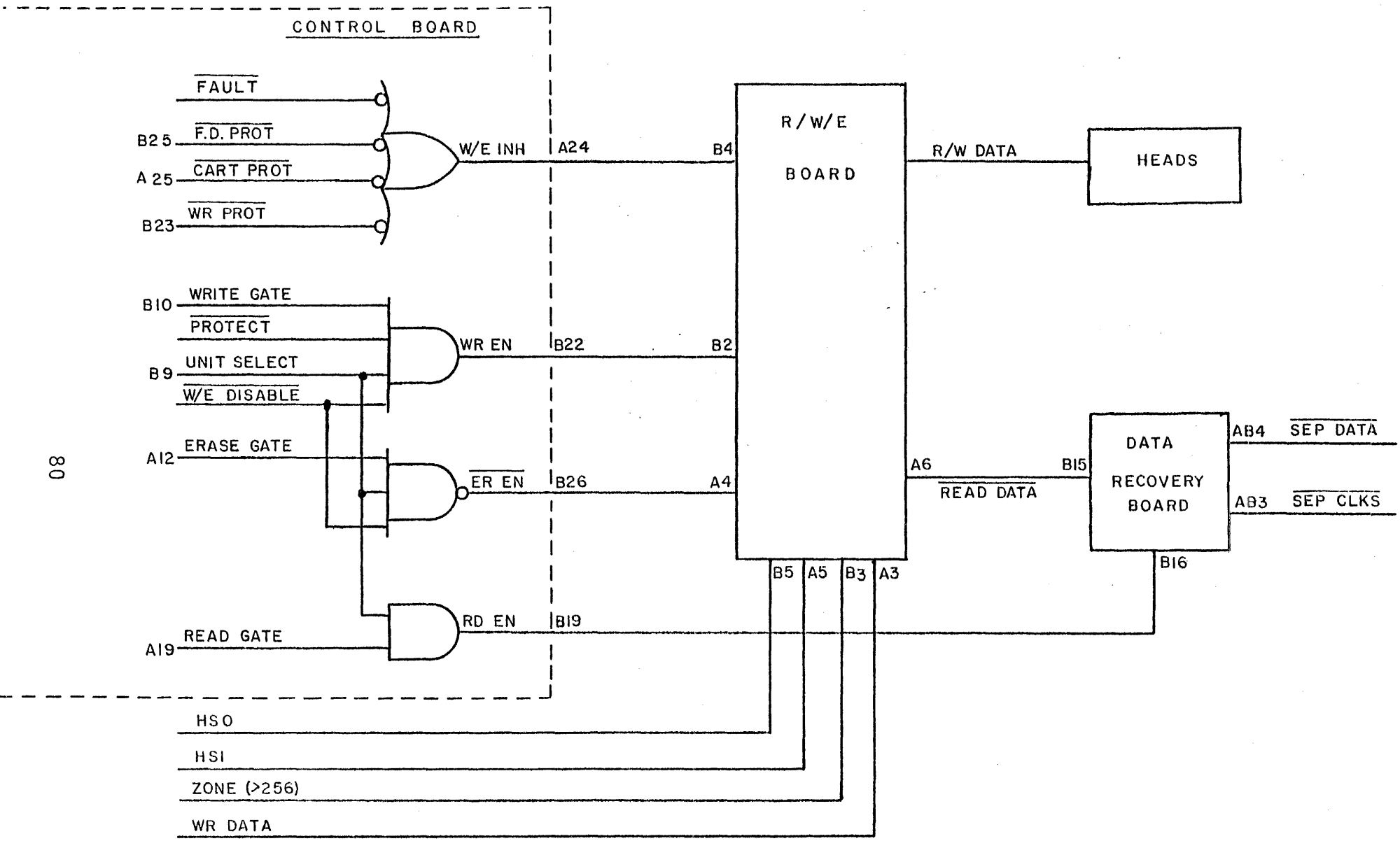
DATA IS REPRESENTED BY TRANSITIONS IN FLUX DIRECTION AND NOT BY FLUX DIRECTION ITSELF



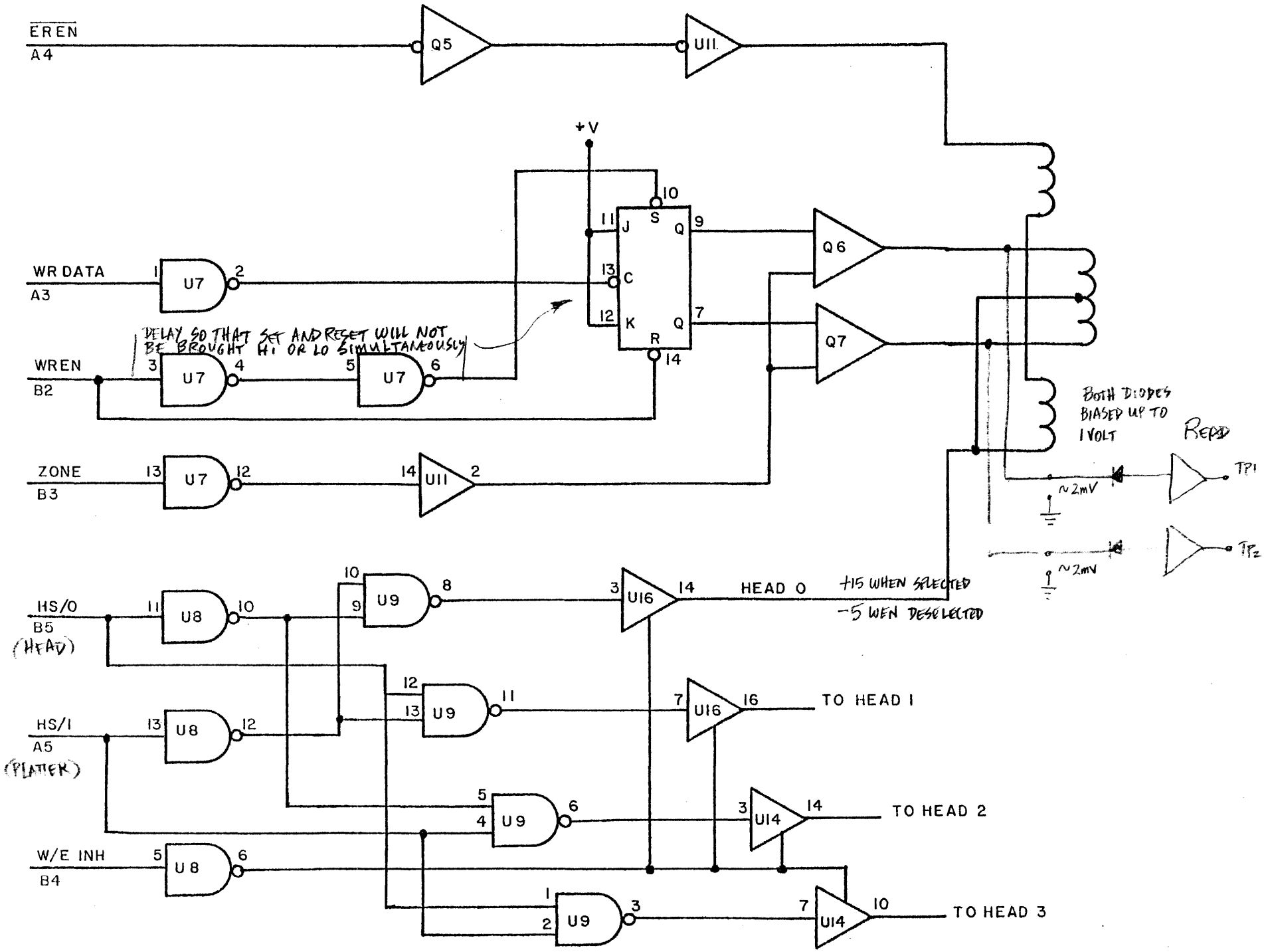
HEAD ASSEMBLY - LOADED POSITION


3330 HEAD
FLYING
HEIGHT
50 MICRO IN.
.000050"
2314 HEAD
FLYING
HEIGHT
100 MICRO IN.
.000100"
SMOKE PARTICLE
250 MICRO IN.
.000250"
FINGERPRINT
DUST
PARTICLE
HUMAN HAIR
.003" DIA.
OXIDE COATING
THICKNESS
200 MICRO IN.
.000200"
ALUMINUM SUBSTRATE - .050"
2400 RPM SURFACE SP
Equivalent to 93 M
MPH AT OUTER CYLINDER

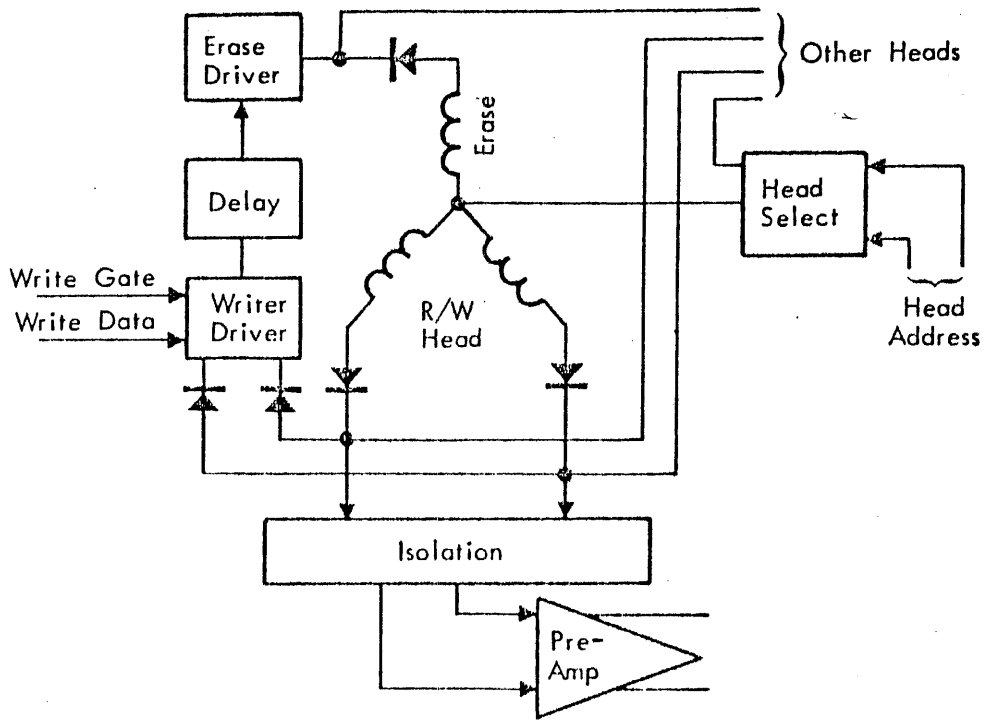

DISK DIRECTION
ERASE HEADS (D.C.)
WRITE HEAD
(DOES OWN ERASE)



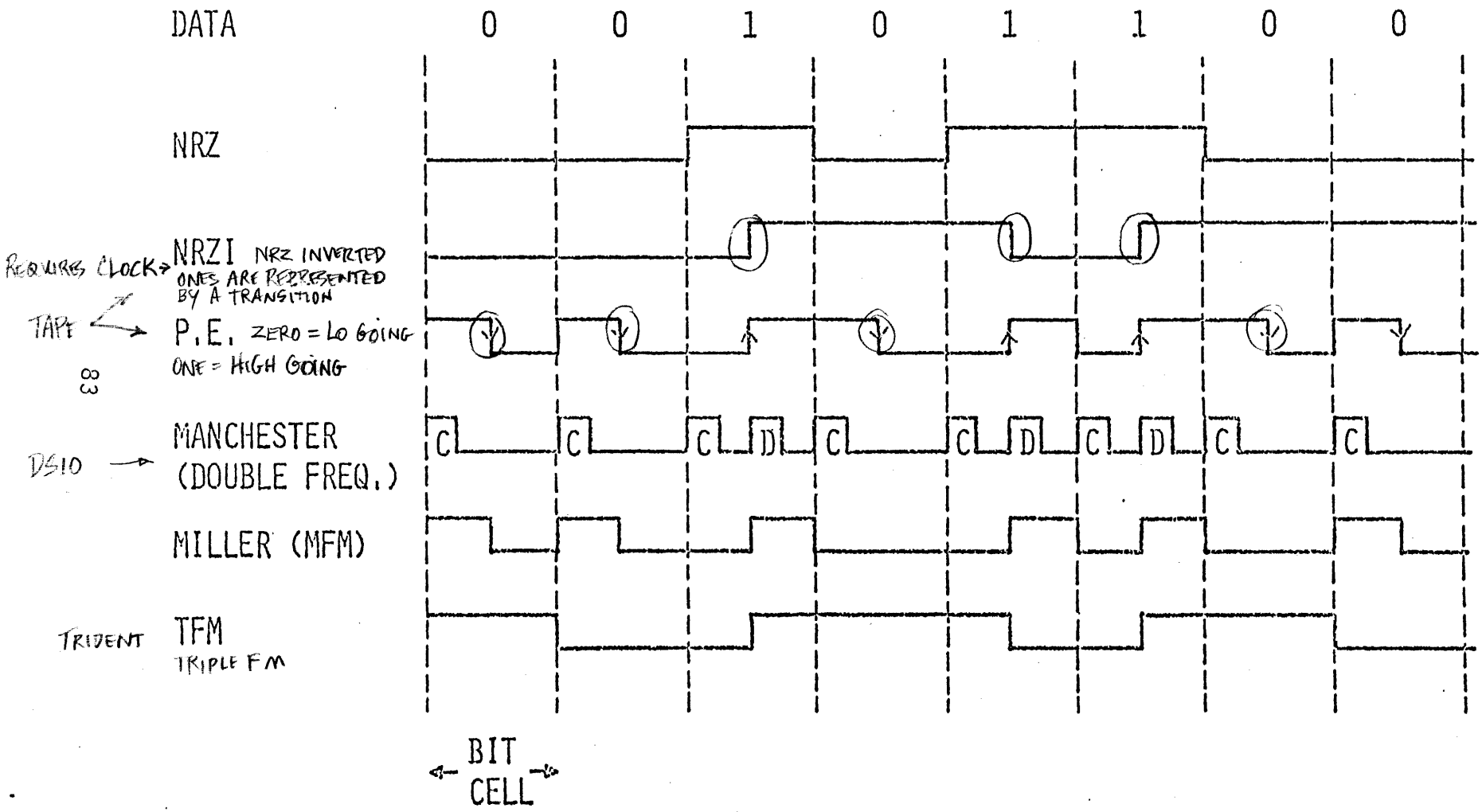
READ WRITE CONTROL

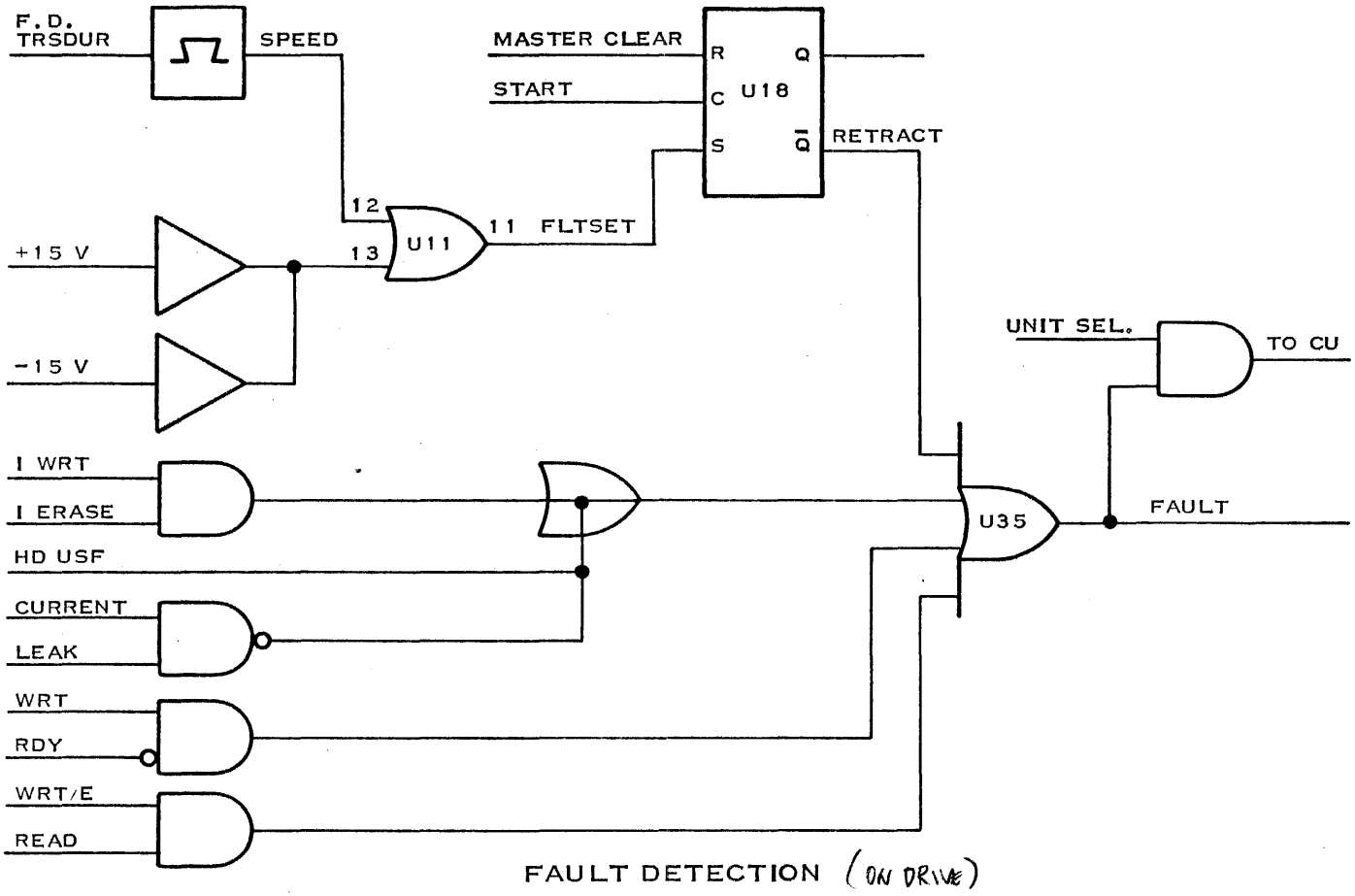


HEAD SELECTION & WRITE DATA

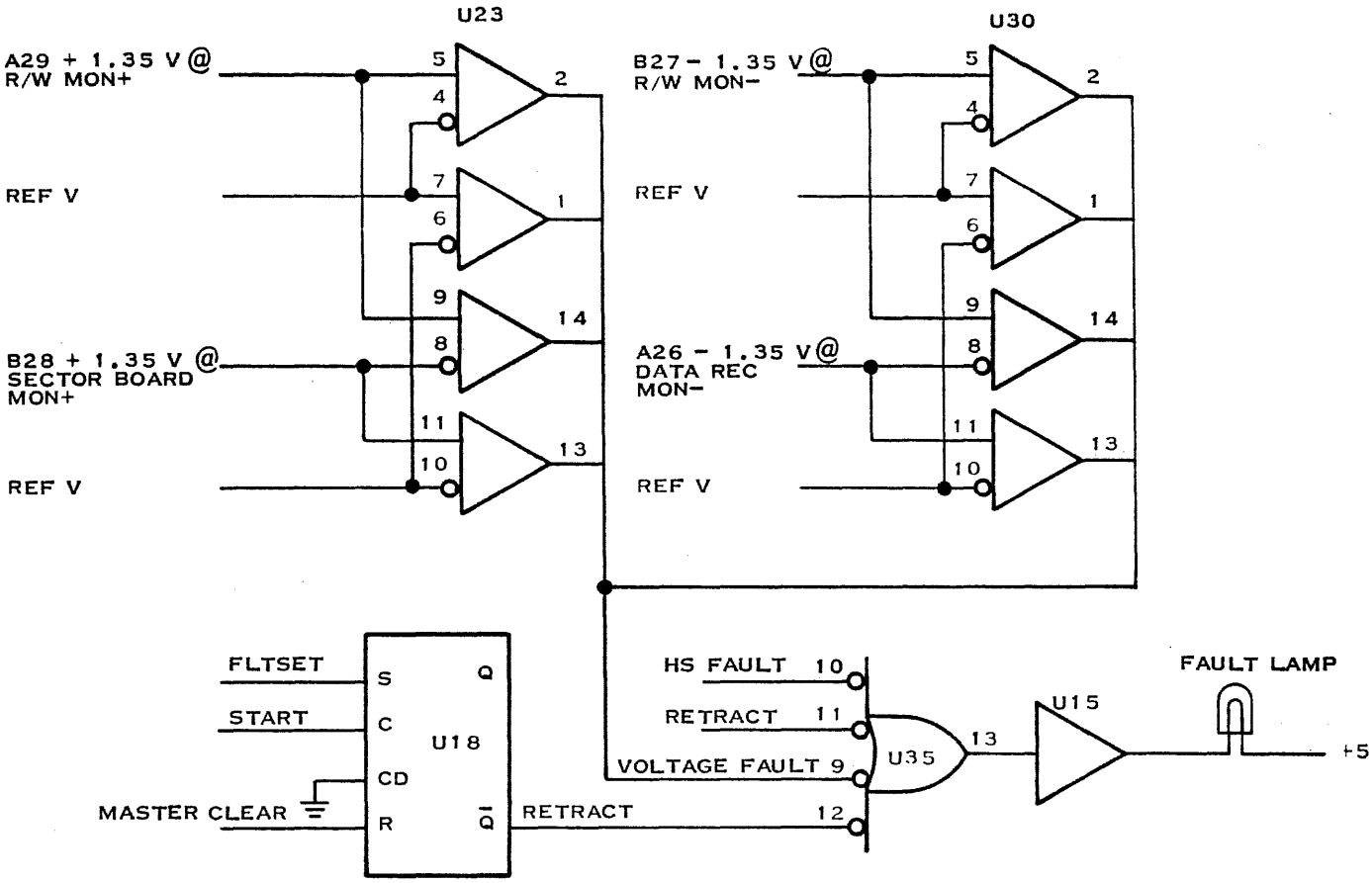

Erase Driver
Other Heads
Erase
Delay
Head Select
Write Gate
Write Data
Writer Driver
R/W Head
Head Address
Isolation
Pre-Amp

PERIPHERAL RECORDING CODES

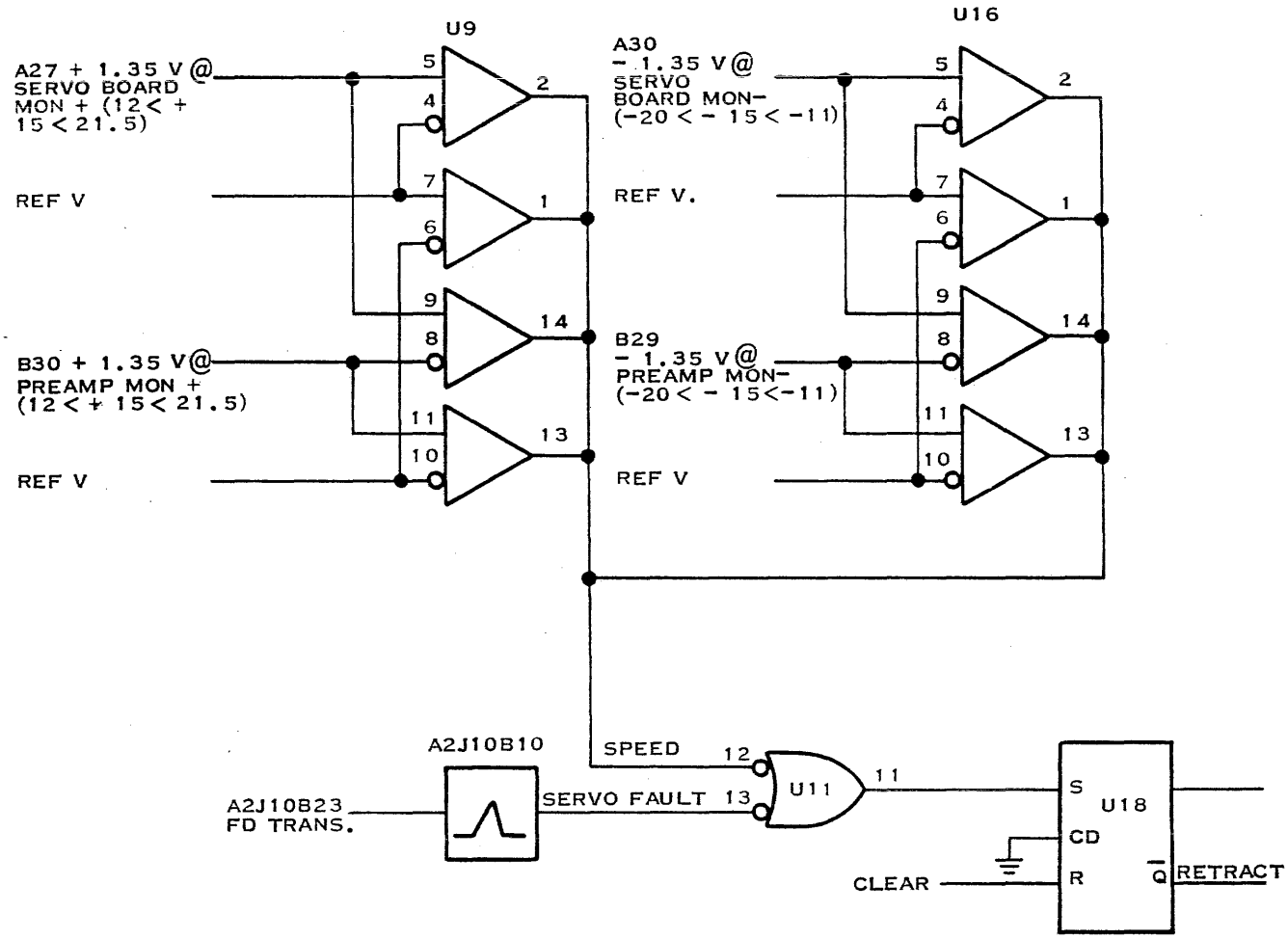




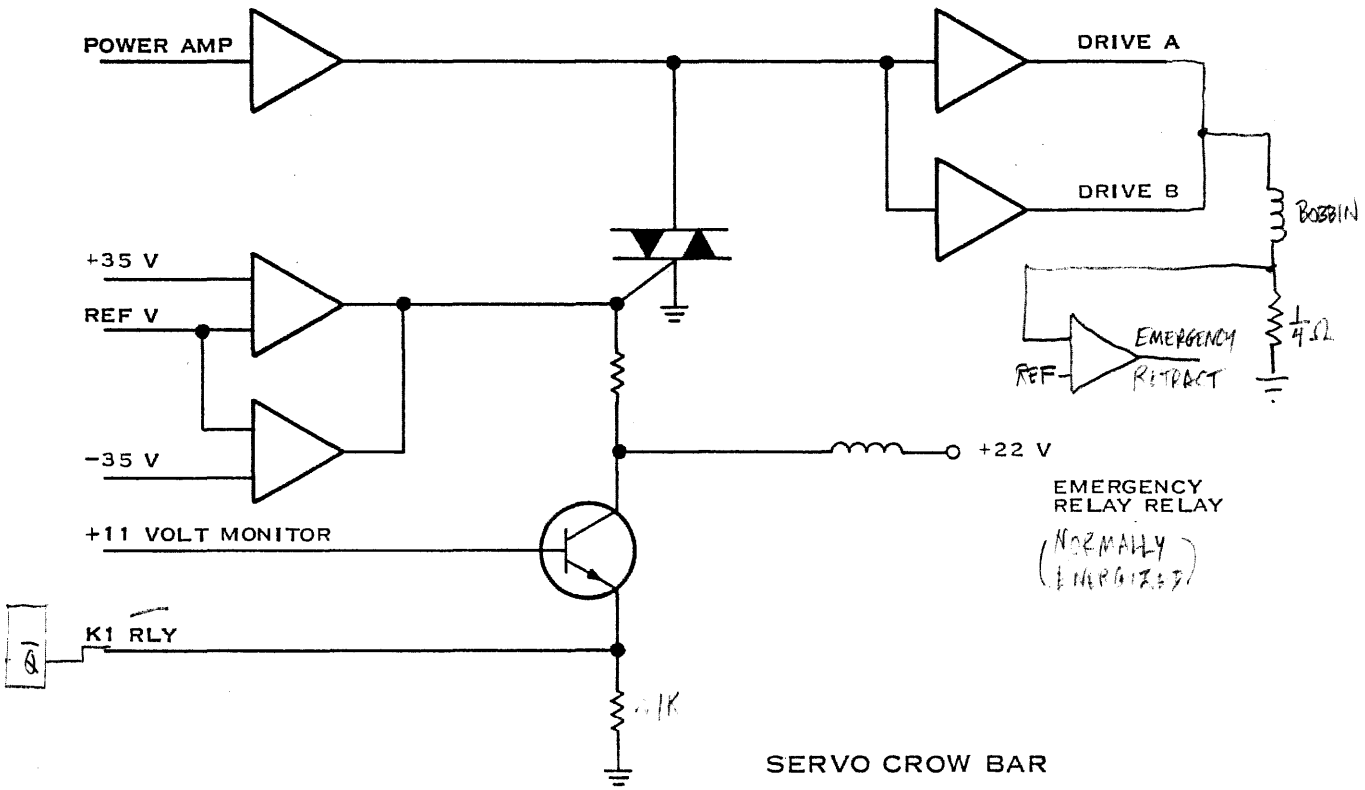
FAULT DETECTION (ON DRIVE)



NONDAMAGE FAULT
(CONTROL BOARD)



DAMAGING FAULT
(CONTROL BOARD)



SERVO CROW BAR

Part	Verb	Test	Description
Part 1	E1		Three subtests comprise part 1 testing:
		Test 1	Writes and reads slave bits back
		Test 2	Reads after all unit select lines are deselected. An I/O Reset is issued and the controller status is checked for proper value (A100).
		Test 3	Performs a store register command to address 57FE. The status of the controller is checked and the values written out to memory are compared against a look-up table of values.
Part 2	E2		Sixteen subtests comprise part 2.
		Test 4	Does seeks followed by restores and checks disk status.
		Test 5	Does unformatted writes followed by unformatted reads and a restore command.
		Test 6	Formats entire disk and then does unformatted read, checking for proper header information
		Test 7	Formats a cylinder, writes data and reads data back. Also the reentry capability is tested to insure that controller is not always retrying.
		Test 8	The transfer inhibit is tested to insure it works.
		Test 9	Forces bad ID and CRC words and detects that the controller responds properly.
		Test 10	Forces search errors and checks that controller responds properly.
		Test 11	Forces a CRC error to occur and checks that the controller responds properly to this error.
		Test 12	Tries to read from an illegal sector address, which causes timeout error status and checks that the controller reported this.
		Test 13	Causes the controller to go to illegal cylinder and checks that unit error is reported in controller status (W7) and seek incomplete is reported in the disk status (W0).
		Test 14	Checks to see that no information is written on disk when word count of 0 is specified.
		Test 15	Tested busy circuitry by having the controller write to itself and then test the MSB of data (idle bit) that was stored for each transfer.

Diagnostic Test Sequences

(Part 2, E2 Continued)		Test 16	Test TILINE timeout by doing a store register to an illegal address. The controller status is checked to assure that the error was detected properly.
		Test 17	Tests rate error logic in the controller by giving the drive a write operation while keeping the TILINE busy. The controller status is checked to assure that the rate error was detected and reported properly.
		Test 18	Tests the drives ability to handle write amplifier recovery when switching from one head to the other. A read across head boundaries is forced and the controller is checked for read CRC errors.
		Test 19	Tests the ability of the controller and drive to auto-increment across cylinder boundaries.
Part 3	E3	Test 20	Verifies that the controller can address all of the sectors on one track correctly.
		Test 21	Verifies that all tracks on the disk can all be addressed. Also, 1000 (hex) random seeks are performed on each head.
Part 4	E4	Test 25	Memory addressing test. This test verifies the disk controller ability to read from and write to all available memory.
Part 5	E5	Test 23	Does a verification of the media. The entire disk is formatted at 20 sectors per record with the maximum word count selected. A read is performed on each track, and if an error is encountered, the track is read 10 times and the number of failures found is added to the error count. This procedure is repeated four times with a different data pattern verified each time. Patterns of 0000, FFFF, AAAA, and 5555 are used for this test.
Part 6	E6	Test 24	This test is an interactive test which requires operator intervention; thus, no looping capability on this test is possible. After answering the questions with a YES (1) or NO (0), the test will do a read of the data written in test 23 and assure that no data was lost during the power cycling.

Diagnostic Test Sequences (Continued)

SUBASSEMBLY	TI P/N	ASSOCIATED ADJUSTMENTS	CDC MAN. SECT.
CONTROL CARD	943848-0003	NO ADJUSTMENTS	N/A
SERVO CARD	943848-0007	1) TEMPERATURE STABILIZATION CHECKS.	6.7.1
		2) STEPS 19-27 OF AGC SERVO PREAMPLIFIER AND INDUCTOSYN CHECK AND ADJUSTMENT.	6.7.2
AGC SERVO PREAMP CARD	943848-0004	1) TEMPERATURE STABILIZATION CHECKS.	6.7.1
		2) AGC SERVO PREAMP & INDUCTOSYN CHECK & ADJUSTMENT.	6.7.2
		3) FEDT CHECK & ADJUSTMENT.	6.7.3
		4) HEAD ALIGNMENT IF STEP 2 REQUIRED ADJUSTMENT.	6.7.4
R/W/E BOARD	943848-0008	NO ADJUSTMENTS	N/A
POWER SUPPLY CARD (PIGGYBACK)	943848-0005	1) STEPS 19-27 OF AGC SERVO PREAMP & INDUCTOSYN CHECK & ADJUSTMENT.	6.7.2
		CAUTION BE SURE THE POWER SUPPLY TO CHASSIS GROUND STRAP IS SECURE BEFORE MAKING ANY ADJUSTMENTS.	
SECTOR CARD	943848-0010	1) INDEX TO DATA BURST CHECK AND ADJUSTMENT.	6.7.5
SM I/O CARD	943848-0011	1) CHECK ALL SWITCH SETTINGS.	N/A
WINCHESTER I/O CARD	943848-0012	1) CHECK ALL SWITCH SETTINGS.	N/A
R/W/E HEADS	943848-0014 OR 0015	IF ACTUATOR ASSEMBLY IS NOT REMOVED:	
		1) INDEX TO BURST ADJUSTMENT.	6.7.5
		2) HEAD ALIGNMENT.	6.7.4
		IF ACTUATOR ASSEMBLY IS REMOVED.	
		1) AGC SERVO PREAMP & INDUCTOSYN CHECK & ADJUSTMENT.	6.7.2
		2) FEDT CHECK & ADJUSTMENT.	6.7.3
		3) HEAD ALIGNMENT.	6.7.4
		4) INDEX TO BURST CHECK & ADJUSTMENT.	6.7.5
		5) TRACK INDICATOR ADJUSTMENT.	6.7.6

SUBASSEMBLY	TI P/N	ASSOCIATED ADJUSTMENTS	
VELOCITY TRANSDUCER	943848-0025	STEPS 19-27 OF ADC SERVO PREAMP & INDUCTOSYN CHECK & ADJUSTMENT.	6.7.2
VELOCITY TRANSDUCER MAGNET	943848-0026	SAME AS ABOVE.	6.7.2
TRANSDUCER, PAB, SCALE, OR SLIDER	943848-0027	1) ADC SREVO PREAMP & INDUCTOSYN CHECK & ADJUSTMENT. 2) FEOT ADJUSTMENT. 3) HEAD ALIGNMENT. 4) INDEX TO BURST ADJUSTMENT. 5) TRACK INDICATOR ADJUSTMENT.	6.7.2 6.7.3 6.7.4 6.7.5 6.7.6
BRUSH MOTOR ASSEMBLY	943848-0031	1) CHECK BRUSH SWITCH ACTUATION WITH A VOM. 2) CHECK BRUSH INDICATOR TO SLOT ALIGNMENT AFTER ONE FULL BRUSH CYCLE. 3) INDEX TO BURST ADJUSTMENT.	6.6.14 N/A 6.7.5
FIXED DISK	943848-0007	1) INDEX TO BURST ADJUSTMENT.	6.7.5
SECTOR TRANSDUCER (BOTH)	943848-UPPER 0030 LOWER 0044	1) SECTOR TRANSDUCER ADJUSTMENT. 2) INDEX TO BURST ADJUSTMENT.	6.7.10 & 6.7.11 6.7.5
STATIC ELIMINATOR	943848-0037	CHECK SPINDLE SHAFT TO BASE PLATE. THE RESISTANCE SHOULD BE ONE OHM OR LESS	N/A
CARTRIDGE ON SWITCH	943848-0063	1) CHECK MECHANICAL ALIGNMENT. THE PLASTIC ARM SHOULD REST ON THE CARTRIDGE DUST COVER. 2) CHECK SWITCH WITH VOM. STEPS 3-6 3) INDEX TO BURST ADJUSTMENT.	N/A 6.6.13 6.7.5
EOT DETECTOR	943848-0017	1) FEOT CHECK & ADJUSTMENT. 2) HEAD ALIGNMENT. 3) INDEX TO BURST ADJUSTMENT. 4) TRACK INDICATOR ADJUSTMENT.	6.7.3 6.7.4 6.7.5 6.7.6

SUBASSEMBLY	TI P/N	ASSOCIATED ADJUSTMENTS	CDC MAN.SECT.
MOTOR AND BRAKE ASSEMBLY	940848-0047	1) DRIVE BELT TENSION ADJUSTMENT. (SEE SPINDLE ASSEMBLY ITEM 1)	N/A
		2) AGC SERVO PREAMP & INDUCTOSYN ADJUSTMENT STPS 19-27	6.7.2
		3) INDEX TO BURST ADJUSTMENT.	6.7.5
SPINDLE ASSEMBLY	940848-0036	1) CHECK IDLER PULLEY CONTACT WITH DRIVE BELT. IF BELT SLIPS OFF OF DRIVE OR SPINDLE PULLEY, ADJUST SNUBBING CLUTCH SCREW TO PLACE MORE PULLEY TENSION ON DRIVE BELT	N/A
		2) STATIC ELIMINATOR CHECK.	6.7.8
		3) SECTOR TRANSDUCER ADJUSTMENTS.	6.7.10 & 6.7.11
		4) AGC SERVO PREAMP & INDUCTOSYN CHECK & ADJUSTMENT.	6.7.2
		5) FEDT ADJUSTMENT.	6.7.3
		6) HEAD ALIGNMENT.	6.7.4
		7) INDEX TO BURST ADJUSTMENT.	6.7.5

SIGNAL NAME	BOARD	ORIGIN	1ST DESTINATION
+11 MONITOR	POW.SUP.	J4-2	J6-11
+22 VDC	POW.SUP.	Q3 EMITTER	J6-43
+22VDC	POW.SUP 2	P6-43	J1-29
+5VDC	POW.SUP 2	P6-5	J1-3
-22 VDC	POW.SUP.	Q6 EMITTER	J6-35
-22VDC	POW.SUP 2	P6-35	J1-33
-7.5 VDC	POW.SUP 2	VR 6	J1-22
ACT. DRIVE	POW.SUP.	K1 P7	P2-2
AD. SET	SERVO	U35 P6	U19 P11
AD. ACK*	SERVO	U8 P10	B14
AD.INT*	SERVO	U8 P5	B15
AD/0*	SERVO	U5 P3	U13 P5 U41 P2
AD/1*	SERVO	U5 P11	U13 P3
AD/2*	SERVO	U5 P6	U13 P14
AD/3*	SERVO	U4 P8	U13 P12
AD/4*	SERVO	U5 P14	U12 P5
AD/5*	SERVO	U4 P6	U12 P3
AD/6 SK*	SERVO	U15 P8	U12 P14
AD/7*	SERVO	U4 P11	U12 P12
AD/8*	SERVO	U4 P3	U14 P5
ADD.16	SECTOR	U18 P10	U9 P11
ADDR CK	SERVO	U7 P12	U33 P5 U25 P9
AMP. FD. BK	POW.SUP.	Q5,Q2 COLL.	J6-33
AMP. MON. B	POW.SUP.	Q5, EMITTER	J6-23
AMPA	R/W/E	AR2 P5	AR1 P15
AMPB	R/W/E	AR2 P6	AR1 P10
AP CLK*	DATA RCVY	U25 P11	U27 P5
BRAKE*	MOTBRKASY	U1 P10	P1-15
BRUSH RETURN	POW.SUP 2	Q10	P6-45
C.SEL	SECTOR	U15 P13	U11 P14
C/A/0	SECTOR	U12 P6	U11 P7
C/A/1	SECTOR	U12 P11	U11 P5
C/A/2	SECTOR	U12 P11	U11 P5
C/A/3	SECTOR	U12 P2	U11 P1
C/A/4	SECTOR	U7 P6	U8 P4
C/A/5	SECTOR	U7 P11	U8 P5
C/A/6	SECTOR	U7 P14	U18 P13
C/IND.SW	SECTOR	U24 P10	U8 P3
C/INDX*	SECTOR	U23 P15	U20 P11
C/SECT*	SECTOR	U23 P12	U20 P3
C/SECT.SW	SECTOR	U22 P10	U8 P1
C/SIG.2	SECTOR	U34 P6	U15 P11
C/SIG.2*	SECTOR	U34 P7	U25 P12
CART PROT*	SW BD ASY	SW5 P1-2	J1-5
CLK	DATA RCVY	U17 P12	U4 P13
CLK	R/W/E	U17 P12	U16 P8
CLK*	R/W/E	U17 P10	U8 P12
CLK*	DATA RCVY	U17 P11	U16 P9
CNTR DN	SERVO	U32 P6	U19 P4
CNTR UP	SERVO	U32 P11	U19 P5
COS	AGC PA	AR10 P13	J2-11
CR.FLT*	R/W/E	U6 P6	B7
CYL INH	AGC PA	AR10 P14	J2-20

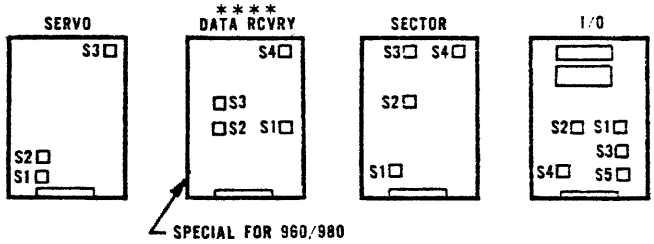
SIGNAL NAME	BOARD	ORIGIN	1ST DESTINATION
DIFF.ZERO*	SERVO	U30 P2	A21
DN PLS	SERVO	U24 P7	U31 P11
DR. MON-	DATA RCVY	AR1 P2	B22
DRIVE A	POW.SUP 2	Q6 COLLECTOR	P6-4
DRIVE B	POW.SUP 2	Q7 COLLECTOR	P6-2
DWA*	DATA RCVY	U26 P8	U19 P2
DWB*	DATA RCVY	SW2 P1	U19 P3
DWC*	DATA RCVY	SW3 P4	U22 P2
DWD*	DATA RCVY	U24 P6	U22 P4
DWE*	DATA RCVY	SW2 P3	U18 P2
EOT.DET*	SERVO	U16 P8	U35 P4
ER.IND	SERVO	U17 P12	U33 P11
F.SEL	SECTOR	AR9 P6 TP3	U8 P9
F/A/0	SECTOR	U17 P6	U11 P6
F/A/1	SECTOR	U17 P11	U11 P4
F/A/2	SECTOR	U17 P14	U11 P2
F/A/3	SECTOR	U17 P2	U11 P3
F/A/4	SECTOR	U13 P6	U8 P6
F/A/5	SECTOR	U13 P11	U8 P4
F/DIRECT	SECTOR	U26 P4	U26 P12
F/IND	SECTOR	U29 P11	U8 P2
F/IND.*	SECTOR	U30 P15	U27 P11
F/IND.EN*	SECTOR	U30 P4	U29 P13
F/RESET	SECTOR	U30 P2	U33 P2
F/SEC.CLK.*	SECTOR	U21 P4	U33 P1
F/SEC.EN.*	SECTOR	U27 P13	U29 P8
F/SECT	SECTOR	U29 P10	U8 P15
F/SECT*	SECTOR	U30 P12	U27 P3
F/STD2	SECTOR	U25 P6	U15 P3
FAST	R/W/E	U25 P3	U2 P1
FAST	DATA RCVY	U25 P3	U7 P12
FAST*	DATA RCVY	U26 P12	U6 P12
FAST*	R/W/E	U26 P12	U6 P12
FAULT RST*	SW BD ASY	SW4 P1-2	J1-13
FEOT	AGC PA	AR11 P2	J2-3
FIXED PROT*	SW BD ASY	SW5 P1-2	J1-3
FT. CLK*	DATA RCVY	U7 P8	U8 P5
FT. CUPR	DATA RCVY	U6 P9	BASE Q1
FT.CLK*	R/W/E	U7 P3	U8 P5
FT.TRK*	R/W/E	U4 P6	B23
FT.TRK*	DATA RCVY	U4 P6	B23
FWD	SERVO	U23 P11	U30 P11
GAP.CLK*	DATA RCVY	U4 P8	B25
GAP.CLK*SPARE	DATA RCVY	U4 P8	B25
INDEX*	SECTOR	U2 P10	B17
INH	R/W/E	U8 P4	U2 P6
INH*	R/W/E	U8 P6	BASE Q11
INT SK	SERVO	U25 P6	U22 P12
INV.AD.*	SERVO	U27 P5	A15
LED-I	AGC PA	AR16 P3	J1-5
LOCK PWR	POW.SUP.	CR2 CAT.	J3-3
LOCK RET	POW.SUP.	Q1 COLLECTOR	J3-1
LOCK RLY*	POW.SUP 2	J1-1	P6-47
LOGIC GND	POW.SUP 2	P6-27	J1-24
MCP	DATA RCVY	U17 P6	U8 P2
MCP	R/W/E	U17 P6	U8 P2
O.V.DET	POW.SUP.	R 11	J4-1
ON. CYL1*	SERVO	U29 P8	U37 P13
ON. CYL2	SERVO	U2 P1	B20
OVT +5V.	POW.SUP.	RT2	J4-42

SIGNAL NAME	BOARD	ORIGIN	1ST DESTINATION
OVT PA	POW.SUP.	RT1	J6-39
P2*	DATA RCVY	U8 P8	U24 P10
P2EN	DATA RCVY	U22 P7	U8 P9
P4 EN	DATA RCVY	U22 P9	U8 P1
P4*	DATA RCVY	U8 P6	U24 P11
PDA*	DATA RCVY	U21 P6	U22 P1
PDB*	DATA RCVY	U21 P10	U19 P13
PDC*	DATA RCVY	SW3 P9	U18 P11
PHASE 1*	DATA RCVY	U15 P6	U13 P14
PHASE 2*	DATA RCVY	U15 P8	U9 P1
PHASE 3*	DATA RCVY	U15 P3	U13 P15
PHASE 4*	DATA RCVY	U15 P11	U18 P13
PRE:MON+	AGC PA	AR15-P2	J2-13
PRE:MON-	AGC PA	AR14	J2-15
PWR AMP	SERVO	AR4 P12	B24
PWR BRUSH	POW.SUP.	R2	J7-1
R.D.SIGB	R/W/E	Q12 EMIT	B 26
R/W.MON-	R/W/E	U4 P11	A18
R/W.MONT	R/W/E	U4 P4	A15
RD DATA	DATA RCVY	U7 P3	U26 P1
RD SYNC SPARE	DATA RCVY	U6 P5	B11
RD SYNC*	DATA RCVY	U6 P5	B10
RD.DATA	R/W/E	U7 P3	U26 P1
RD.DATA*	R/W/E	U1 P6	A6
RD.SIGA	R/W/E	Q13 EMIT	B 27
RELAY BYPASS	POW.SUP.	K1 P4	P2-4
RELAY*	POW.SUP 2	Q2 COLLECTOR	P6-49
REMOTE TRIP BKR	POW.SUP 2	Q3	P6-17
REMOTE TRIP BKR.	POW.SUP.	J6-18	J8-2
RECT	AGC PA	AR11 P1	J2-5
RET BRUSH	POW.SUP.	J6-45	J7-2
REV STOP	AGC PA	J3-3 J3-1	J2-1 J2-2
STR CAP	POW.SUP.	VR CATHODE	J6-13
STR OUT	POW.SUP 2	Q1 P3	P6-51
RUN*	MOTBRKASY	U1 P5	P1-16
RVS.DET*	SERVO	U31 P6	U35 P9
SA/0	SECTOR	U5 P5	B2
SA/1	SECTOR	U5 P10	B3
SA/2*	SECTOR	U4 P5	B6
SA/3*	SECTOR	U4 P10	B8
SA/4*	SECTOR	U3 P5	B11
SA/5*	SECTOR	U3 P10	B14
SA/6	SECTOR	U6 P10	B26
SC RET (GND)	DATA RCVY	U1 P6	A2, B2
SCALE	AGC PA	AR8 P2	J6-2
SCALE	AGC PA	AR8 P6	J6-1
SD RET (GND)	DATA RCVY	U1 P9	A5, B5
SEC.MON+	SECTOR	RN3 P10	B27
SECTOR*	SECTOR	U2 P5	B18
SEEK*	SERVO	U3 P6	U21 P12
SEP CLK*	DATA RCVY	U1 P5	A3, B3
SEP DATA*	DATA RCVY	U1 P10	A4, B4
SERVO EN*	SERVO	U3 P2	U15 P1
SERVO INH	SERVO	U29 P12	U42 P15
SERVO MONT+	SERVO	AR1 P4	A26 B26
SERVO MONT-	SERVO	AR1 P11	A27 B27
SERVO OUTPUT RET.	SERVO	U23 P10	U37 P12

SIGNAL NAME	BOARD	ORIGIN	DESTINATION
SIN	AGC PA	AR9 P6 TP3	J2-7
SKER*	SERVO	U25 P11	B16
SKIP*	DATA RCVY	U16 P11	U3 P3
SPD.REF	SECTOR	U29 P11	B13
SPEED	SECTOR	U32 P6	B10
SPND.STAT*	SECTOR	U1 P3	B12
START*	CM BD ASY	SW1 P1-2	J1-10
STROBE	SERVO	U2 P4	A02
STROBE *	SERVO	SW3 P1	
TERM SK	SERVO	U30 P12	U18 P1
TERM SK*	SERVO	U15 P6	U17 P5 U25 P1
TERM. POWER	PCM.SUP.	Q8 COLLECTOR	J6-4
VEL	AGC PA	AR17 P6	J2-14
VEL.CMD.(+)	SERVO	AR5 P12	U42 P6
VEL.CMD.(-)	SERVO	AR5 P10	U42 P3
WR.MON.A	R/W/E	COL 06	U13 P1
WR.MON.B	R/W/E	COL 07	U13 P16
ZERO	SERVO	U36 P11	U29 P4
ZONE	SERVO	U20 P3	A20

SWITCH DESIGNATOR	CONTROL BOARD	SERVO BOARD			DATA RCVRY **** BOARD				SECTOR BOARD				I/O BOARD				
*** SWITCH POSITION	S1	S1	S2	S3	S1	S2	S3	S4	S1	S2	S3	S4	* S1	* S2	S3	S4	S5
1	0	1	0	** 0	0	0	1	0	1	1	0	0	UN1	INT1	0	0	0
2	1	1	0	** 1	1	0	0	0	1	0	0	0	UN2	INT2	1	1	0
3	1	1	0	1	0	1	0	1	0	0	0	0	UN3	INT3	0	** 1	0
4	0	1	0	1	0	** 1	1	1	1	0	1	0	UN4	INT4	0	1	0
5	0	1	0		** 0	** 1	1	0		0	1	0	0	0		0	0
6	0	1	0		** 0	** 0	0	0		0	0	1		0		0	0
7	1	1	0		1	** 1	1	1		1	0	1		1		0	0
8	0	1	0							0	1	0		0		1	0
9		1	0											0			
10		0	1											1			

* S1 AND S2 – UN AND INT SWITCHES MUST HAVE SAME UNIT SELECTED
** SWITCHES ARE REVERSED FOR 960/980 APPLICATIONS
*** 1=ON, 0=OFF
**** CDC PN 75886537 OR 75297105 FOR 990, CDC PN 75881050 FOR 960/980



DS10 SWITCH SETTINGS
THIS UNIT SET FOR 990 [X] 960/980 [ ]

NOTE THE SWITCH SETTING FOR THE DATA RECOVERY BOARD. SWITCH S2-4 HAS BEEN CORRECTED FROM A "0" TO A "1".

THE SWITCH SETTING FOR THE I/O BOARD SWITCH S2-5 HAS BEEN CORRECTED FROM A "1"TO A "0".

CDC HAWK DISK DS10

FIELD REPLACEABLE SUBASSEMBLIES AND PARTS

TI P/N	VENDOR P/N	DESCRIPTION
943848-0003	75297507	Card Control **
-0004	77831200	Card Servo AGC **
-0005	83476105	Card PWR Piggyback **
-0006	22940804	Relay
-0008	75296311	Card R/W/E (Special Note) **
-0009	77831400	Card Servo **
-0010	75883201	Card Sector **
-0011	74848205	Card I/O 3M Rack **
-0012	75857706	Card I/O Winch. Rack **
-0013	74866206	Card Brake **
-0014	75037504	Head ASM 200/SE/24
-0015	75037505	Head ASM 200/SE/24
-0017	83447301	EOT Detector
-0018	75885250	Switch Solid State 600V
-0020	75870203	Card Mother Board
-0025	75317102	Vel Xducer Conn Ass'y
-0026	75319802	Vel Xducer MAG
-0027	75315404	Xducer Scale PWB Ass'y
-0030	75793802	Sensor Cable Upper
-0031	75740701	Brush Motor Assy
-0032	40024501	Brush Disk
-0033	40024502	Brush Disk
-0034	83437400	Filter Air
-0036	75286701	Spindle Assy
-0041	83457100	Blower
-0044	75793803	Sensor Cable Lower
-0047	83467401	Motor and Brake Assy
-0051	83475106	PWR Supply Bd ASM Piggyback
-0052	75299103	Switch ASM
No TI P/N Assigned	83475401	Pos Xducer SL-CC
	92054227	CR Bearing Ball
	75305002	Transformer
	75318901	Card End Travel
-0016	75886537	Data Recovery

** Spares also used as Tools

SPECIAL NOTE:

The R/W/E Card has two Resistor Networks, RM1 and RM2, mounted on it. These Resistor Networks must be transferred from the old card to the new card when changing out the board with special attention to the locations of the Pin 1. (As per Manual)

CDC HAWK DISK DS10

FIELD REPLACEABLE EXPENSED ITEMS

TI P/N	VENDOR P/N	DESCRIPTION
943848-0019	75300200	Resistor Module
-0021	77832393	Lamp
-0023	75774466	Capacitor
-0035	75794902	Gasket Supply/Divert
-0037	40054700	Spring Static Guard
-0038	70308502	Spring Ideler
-0039	83443301	Clutch Snubber
-0042	94357803	Solenoid
-0043	77499600	Gasket Blower
-0046	94255105	Capacitor Motor
-0048	95582004	Bridge Rectifier
-0049	75805800	Air Filter Cab
-0053	77604000	Pre Filter Filter
-0054	75722930	Drive Belt
-0055	75738604	Resistor Module
-0056	75738607	Resistor Module
No TI P/N Assigned	75774466	Capacitor
	75779867	Spring
	75300200	Resistor Module
	92549007	Switch Sub Miniature
	77598501	Switch Sub Miniature
	36159806	Switch Pivot Lever 1
	75774406	Capacitor
	40054700	Spring Static Guard

SPECIAL TOOLS AND TEST EQUIPMENT

TI P/N	VENDOR P/N	DESCRIPTION
943850-0201	89296000	CE Pack
-0202		Scratch Pack 960/980
-0203		Scratch Pack 990
-0204	75861504	Extender Board
-0205	83485801	Card Extractor
-0206	75797900	Head Alignment Tool
-0207	83455500	Armature Plate Simulator
-0208		.010" Thick Plastic Feeler Gage
-0209		Torque Screw Driver 1-30 In/Lbs Wt. Hex & Phillips Adapters

THIS PROGRAM COMES TO YOU COMPLIMENTS OF
RAMON O'CALLAGHAN
T.I. SPAIN

THIS IS A PROGRAM TO ISSUE A SEQUENCE OF COMMANDS TO A TILINE CONTROLLER AND LOOP ON IT.

THE COMMANDS TO BE ISSUED ARE AS MANY AS REQUIRED. EACH COMMAND TAKES EIGHT SEQUENTIAL WORDS IN MEMORY AS REQUIRED FOR T.P.C.S. PARAMETERS.

THE COMMANDS MUST BE PLACED SEQUENTIALLY IN MEMORY IN ORDER TO BE READ AND ISSUED TO THE CONTROLLER.

THE RESULT IS THAT A LIST OF ALL PARAMETERS (EIGHT PER COMMAND) IS NEEDED.

WORKSPACE REGISTERS R1,R2,R3 THAT ARE LOADED AT THE BEGINNING OF PROGRAM EXECUTION HOLD THE FOLLOWING DATA.

REG 1= NUMBER OF COMMANDS TO BE ISSUED.
REG 2= STARTING MEMORY ADDRESS FOR THE COMMAND LIST.
REG 3= CONTROLLER TILINE ADDRESS

FOR CONVENIENCE PLACE THE COMMAND LIST AT MEMORY ADDRESS 7000

```
7000  02E0     .    LWPI >7100      WP DEFINITION
7002  7100
7004  0201    LI1   LI   1,>0002    SET NUMBER OF COMMANDS
7006  0002
7008  0202    LI2   LI   2,>8000    PARAMETER LIST STARTING ADDRESS
700A  8000
700C  0203    LI3   LI   3,>F800    TILINE DISK CONTROLLER ADDRESS
700E  F800
7010  C103          MOV  3,4        BUILD CONTROLLER STATUS ADDRESS
7012  0224          AI   4,>000E    FROM TILINE CONTROLLER ADDRESS (R3)
7014  000E
7016  C154    M045  MOV  *4,5       WAIT UNTIL CONTROLLER IS NOT BUSY.
7018  0245          ANDI 5,>8000    ( IDLE WHEN BIT 0=1 WORD 7 )
701A  8000                          *NOTE* COMPARE COMMAND DO NOT CHANGE
701C  13FC          JEQ  M045
701E  C193    M036  MOV  *3,6       WAIT UNTIL DISK READY
7020  0246          ANDI 6,>4000     (READY WHEN BIT 1=0 WORD 0)
7022  4000
7024  16FC          JNE  M036
7026  CCF2    M023  MOV  *2+,*3+    TRANSFER PARAMETERS FROM MOMORY TO
7028  8103          C    3,4        THE CONTROLLER VIA T.P.C.S.
702A  16FD          JNE  M023
702C  C4F2          MOV  *2+,*3     TRANSFER WORD 7 (CONTROL WORD)
702E  0601          DEC  1
7030  0281          CI   1,0000     LAST COMMAND IN THE SEQUENCE?
7032  0000
7034  16EB          JNE  LI3
7036  10E6          JMP  LI1        START AGAIN TO LOOP ON THE SEQUENCE
                                    OF COMMANDS.
```

THE FOLLOWING IS AN EXAMPLE OF THE REQUIRED COMMANDS TO ACCOMPLISH AN UNFORMATED READ ON A DS10 ON CYLINDER 0 AND CYLINDER 190.

CYL ADDRESS
146_{10} = 0092 HEX
408_{10} = 0198 HEX
410_{10} = 019A HEX

MEMORY ADDRESS 8000 IS USED FOR THIS LIST.

8000	0000	CLEAR DISK STATUS [ZEROED OUT]
8002	0400	COMMAND FOR AN UNFORMATED READ
8004	0100	SECTORS PER RECORD & SECTOR ADDRESS
8006	0000	CYLINDER ADDREDSS IN HEX
8008	0002	WORD COUNT
800A	9000	MEMORY ADDRESS FOR DATA TO BE PLACED 9000
800C	0400	UNIT SELECT UNIT 1
800E	0000	CONTROLLER STATUS [ZEROED OUT]
8010	0000	CLEAR DISK STATUS [ZEROED OUT]
8012	0400	COMMAND FOR AN UNFORMATED READ
8014	0100	SECTORS PER RECORD & SECTOR ADDRESS
8016	0190	CYLINDER ADDRESS IN HEX
8018	0002	WORD COUNT
801A	9000	MEMORY ADDRESS FOR DATA TO BE PLACED
801C	0400	UNIT SELECT UNIT 1
801E	0000	CONTROLLER STATUS [ZEROED OUT]

MAKE SURE THAT F800 AND F80E ARE ZEROED BEFORE ATTEMPTING TO EXECUTE THIS PROGRAM.

CLEAR THE STATUS REGISTER.

SET THE PC TO 7000 AND HIT THE RUN BUTTON. THE DISK SHOULD NOW LOOP ON THE TWO ABOVE COMMANDS.

THE PROGRAM IS ABLE TO CARRY OUT THE SAME FUNCTIONS AS THE DIAGNOSTIC TEST VERBS : IC, IM, LO.

TO SELECT ONE OF THE ABOVE FUNCTIONS, ONE OF THE FOLLOWING CHANGE GROUPS MUST BE MADE.

VERB	LOCATION	CONTENTS CHANGED TO	DESCRIPTION
IC	7006	0001	JUST ONE COMMAND
	7036	0340	END WITH IDLE
IM	7006	NNNN	N BEING NUMBER OF DESIRED COMMANDS
	7036	0340	END WITH IDLE
LO	7006	NNNN	N BEING NUMBER OF DESIRED COMMANDS
	7036	10E6	LOOP ON COMMAND OR COMMANDS

CONTENTS

INITIALIZING SYSTEM LOG

.S#SLG1 = 0

.S#SLG2

DURING SYSGEN

INITIALIZE TO 100

WHEN SLG1 FILLS UP SLG2 STARTS BEING FILLED. WHEN SLG2 GETS FILLED SLG1 STARTS BEING OVER-WRITTEN.

FIRM BOARD

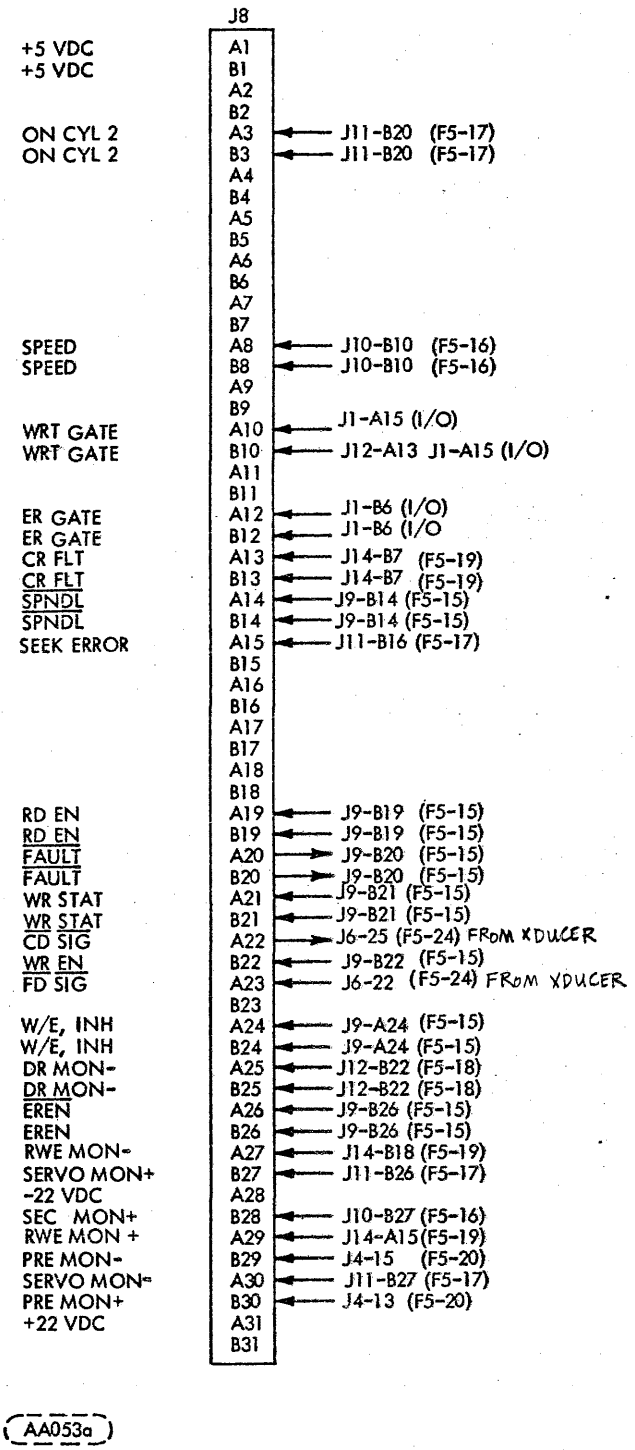


Figure 5-1. Detailed Intracabling Diagram (Sheet 1 of 2)

FIRM BOARD

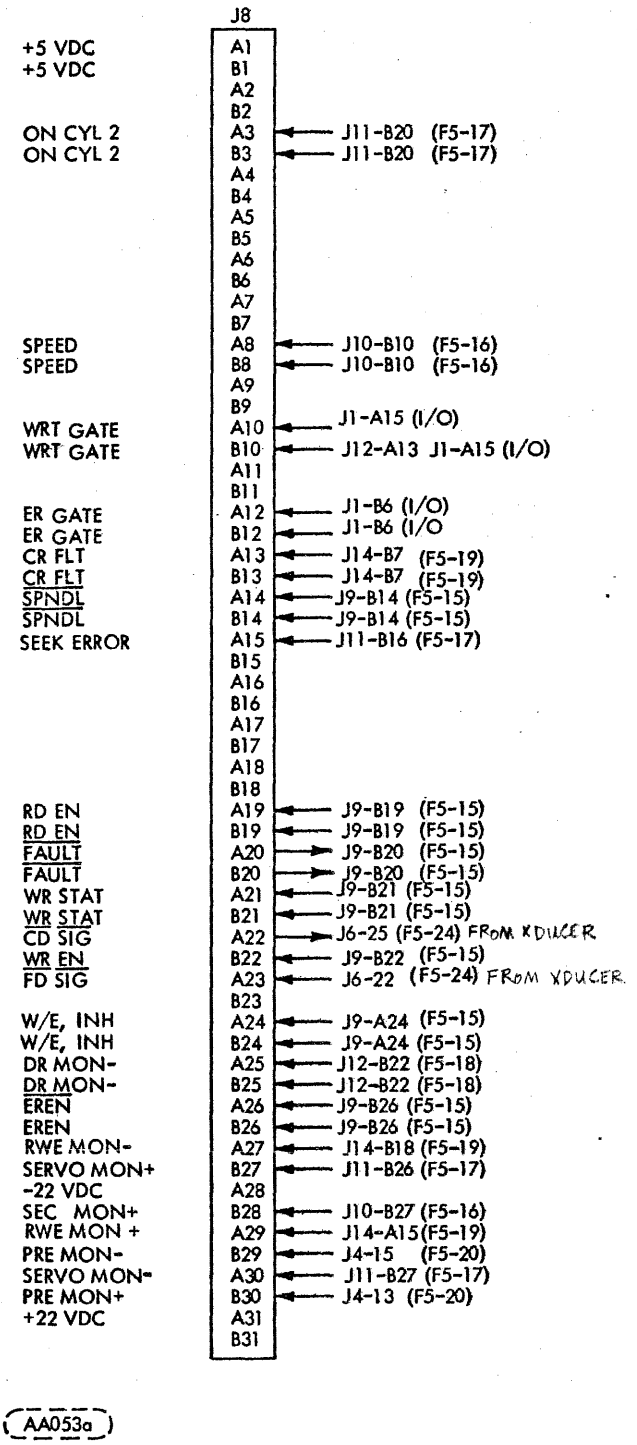


Figure 5-1. Detailed Intracabling Diagram (Sheet 1 of 2)

ALERT MEMO NO. 43-79-0012

DATE: 23 March 1979 EXPIRATION DATE: 30 June 1979

TO: ALL BRANCH MANAGERS
ALL CE'S
ALL DISTRICT MANAGERS
ALL TECH SPECIALISTS

FROM: MIKE THOMPSON

SUBJECT: DS10PD DIAGNOSTIC, MARCH '79 VERSION

The following two errors were found in the March, 1979 release of DS10PD diagnostic. The messages generated by these errors should be ignored:

Part 2 - Subtest 16

An incorrect error bit is being tested causing the following error message to be displayed -

```
ERROR IN TEST 0016
TILINE TIMEOUT ERROR
R7 STATUS EXP A820 REC XXXX
```

Part 2 - Subtest 18

During this test, an error condition is expected and tested for. An error message print flag is erroneously set, causing the following message to be displayed.

```
ERROR IN TEST 0018

*STATUS ERROR
CONTROLLER STATUS COMP=X ERR=X IDLE=X
U.T.C. REG
DISK STAT COMM SA S/R R A CYL A BYTE C MEM AD SEL CONT STATUS
 XXXX     XXXX XX  XX X X  XXXX  XXXX  XXXXXX  XX   XXXX
COMMAND ISSUED
DISK STAT COMM SA S/R R A CYL A BYTE C MEM AD SEL CONT STATUS
 XXXX     XXXX XX  XX X X  XXXX  XXXX  XXXXXX  XX   XXXX
```

Software Control will release a corrected version of DS10PD in April, 1979. An errata sheet has been sent to those customers who received the March '79 version.

An FSB will be forthcoming describing the software patch which must be implemented to allow the March '79 version to properly execute. Any questions regarding the execution of the March '79 version should be directed to Bob Adams, TI Austin, Ext. 7948.

APPROVED BY: M. A. Thompson
MIKE THOMPSON

ALERT MEMO NO. 43-79-0014

DATE: 03 April 1979 EXPIRATION DATE: 30 June 1979

TO: ALL BRANCH MANAGERS
ALL CE'S
ALL DISTRICT MANAGERS
ALL TECH SPECIALISTS

FROM: DALE RITZEN

SUBJECT: CARTRIDGE DISK SECTOR TRANSDUCER ANGULAR ADJUSTMENT ON CDC HAWK MHD DRIVE

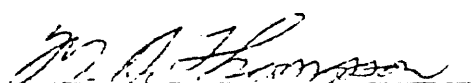
Angular variations away from the center of the pack area (spindle cone) are to be expected for the Cartridge Disk Sector Transducer.

Per CDC, these angular variations to the left or right of center (viewed from Front Panel) are made to accomodate use of either the Straddle-erase or Pre-erase type R/W/E head, respectively. The angular variation is to be considered as a coarse transducer adjustment for either type head.

The coarse adjustment should be followed with the Index-to-Burst Period check and adjustment once the CE has observed a clean, well defined signal from the transducer at pin A22 on the Sector Board. To obtain the clean, well defined signal from the transducer, a compromise somewhere between the coarse angular setting and the spindle center may be needed. Subsequent adjustments during Index-to-Burst Period alignment may also be needed due to the limited range of R29 on the Sector Board (see CDC Hawk Hardware Maintenance Manual, P/N 77834675, Section 6.7.5).

TI does not buy or use Pre-erase type R/W/E heads, therefore CE should not normally observe a transducer aimed to the right of spindle center. The off-right position may indeed cause sectoring problems and will definitely affect the Index-to-Burst period adjustment on R29 of the Sector Board.

An FSB further defining this "offset" transducer adjustment will be forthcoming.

APPROVED BY: 
MIKE THOMPSON

FIELD SERVICE BULLETIN

COMPUTER SERVICE

CDC 10 MBYTE MHD DRIVE

DATE: 14 February 1979 **NUMBER:** 02208FB005

SUBJECT: CDC Hawk disk drive critical adjustments

REFERENCE: Control Data Cartridge Disk Drive Model 9427H Hardware Maintenance Manual, CDC P/N 77834675.

AFFECTS: All CDC Hawk disk drive units, TI P/N 937513-1, 937513-4, 937513-5, 937513-8.

PROBLEM: There have been many problems encountered while servicing the CDC Hawk disk drive (DS44H, DS10) in the field, that have appeared to be not easily resolvable. It has been noted recently that there exists inherent interaction between the Hawk disk drive's PCB'S and other electro-mechanical assemblies. It is quite likely that many of these problems could possibly have been serviced in a more timely manner if these interactions were established and appropriate adjustments were made relative to the replacement of a particular PCB or assembly. This FSB is to address these interactions and the associated Hawk disk-adjustments which must be made due to the interactions.

SOLUTION: The troubleshooting table included in this FSB was generated as an aid for the CE/Tech Specialists to help determine which critical Hawk disk adjustments are needed after certain PCB or electro-mechanical assembly removal and replacement.

ACTION REQUIRED: CE/Tech Specialists should reference the attached troubleshooting/adjustment aid whenever a CDC Hawk disk PCB or electro-mechanical subassembly is removed and replaced during normal troubleshooting processes.

COST DISTRIBUTION: None. This FSB is for information only.

SPECIAL TOOLS REQUIRED: None

PARTS REQUIRED: None

EFFECTIVITY: February 5, 1979

ORIGINATOR: Dale Ritzen/Ron Bratt

APPROVAL: M. A. Thompson

MIKE THOMPSON

TEXAS INSTRUMENTS
INCORPORATED
P.O. Box 2909 M/S 2212
Austin, Texas 78769

CDC 9427H HAWK DISK
TROUBLESHOOTING/ADJUSTMENT AID

The purpose of this table is to provide the CE/Tech Specialists with a reference to aid in determining which critical Hawk disk drive adjustments should be made or could at least be affected by the removal and replacement of each PCB or an electro-mechanical subassembly of the disk drive unit.

The table is divided into two elements. The first element is a listing of those adjustments which should be performed during the disk unit installation operation. The second element is a troubleshooting aid table which should be referenced during service calls on the Hawk disk drive.

Any questions concerning the information contained in the table or the use of the table should be directed to Ron Bratt, TI Austin, M/S 2212.

I. Installation of CDC 9427H Hawk disk drive unit.

It is service policy to verify all system/unit adjustments during initial installation. Verification of all Hawk disk drive adjustments should only occur after the disk drive unit has been powered on and has reached environmental stabilization (approximately 15 to 30 minutes exercising warm up). The adjustments listed below should be checked and if not within CDC specification, adjusted to conform to those specifications. Remember, one incorrect adjustment may affect the adjustments on other PCB's or assemblies. Therefore, all adjustments should be checked prior to initiating corrective action such as PCB or subassembly replacement, and section II of this aid should be referenced for subsequent adjustment interactions.

Installation Adjustments (after environmental stabilization)

1- AGC Servo Preamplifier and Inductosyn Check and Adjustment
2- FEOT Adjustment
3- R/W/E Head Alignment
4- Index to Burst Period Adjustment (*see below)
5- Track Indicator Adjustment
6- Cartridge - On Switch Adjustment
7- Static Eliminator Check
8- Disk Brush Sweep Adjustment
9- Cartridge Index/Sector Transducer Adjustment
10- Fixed Disk Index/Sector Transducer Adjustment

* CDC offers two different types of R/W/E heads for use on the Hawk disk drive. The standard type head (which TI buys and stocks) is the "straddle erase" head. A "pre-erase" head is also offered, by CDC, as an option to CDC Hawk customers. These two types of heads each have different Index to Burst period specifications. The "straddle-erase" head has a period of 18.75 $\pm$ 3 usec. The "pre-erase" head has a period of 100 $\pm$ 5 usec. A head may be identified as either "pre-erase" or "straddle-erase" by viewing the head assembly and observing the last three digits of the CDC part number (excluding dash numbers) which is stamped on the assembly. The last three digits of the CDC

part numbers (listed below) are easily visible with the top cover removed. The possibility exists that the CE may be called to service a CDC Hawk drive which has been purchased directly from CDC or another OEM outlet which may contain the "pre-erase" R/W/E heads. Therefore, it is essential to note the type of head before checking or making the Index to Burst adjustment on a Hawk disk.

Pre-Erase Head (2400 RPM, 200 TPI)

70590208-8	Lower Head
70590209-6	Upper Head

Straddle-Erase Head (2400 RPM, 200 TPI)

75037504-0	Lower Head
75037505-0	Upper Head

II. Service calls on CDC 9427H Hawk disk drive unit.

Before initiating corrective action such as PCB or electro-mechanical subassembly replacement to correct a Hawk malfunction, the following actions should be accomplished after the disk has become environmentally stable:

1- The Velocity Offset and Gain adjustment on the Preamplifier PCB should be verified (reference CDC Hawk Maintenance Manual, CDC P/N 77834675, section 6.7.2).
2- The Index to Sector Burst period (reference installation section, item 4) should be verified per type of R/W/E head used.

If either of these adjustments cannot be made to conform to CDC specification, and PCB or electro-mechanical subassembly replacement is indicated, please refer to the table listing below for field adjustments associated with the removal and replacement of these items.

CAUTION

Removal of more than one field replaceable item at a time will be on an exception basis only. The removal of more than one item at a time will greatly increase the chances of adjustment interactions and may lead to performing all or at least a great part of the adjustments shown in the following table.

All CDC Maintenance Manual references in this table are taken from Control Data Cartridge Disk Drive Model 9427H Hardware Maintenance Manual, CDC P/N 77834675, revised to Rev. J on 3/28/78.

NOTE: R/W/E head alignment (CDC Maintenance Manual section 6.7.4) requires the use of three oscilloscope probes.

FIELD REPLACEABLE SUBASSEMBLY	TI PART NUMBER	ASSOCIATED ADJUSTMENTS	CDC MAINTENANCE MANUAL SECTION
CONTROL CARD	943848-0003	NONE	N/A
SERVO CARD	943848-0009	1 - Temperature Stabilization Checks	6.7.1
		2 - Steps 19-27 of AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
AGC SERVO PREAMPLIFIER CARD	943848-0004	1 - Temperature Stabilization Checks	6.7.1
		2 - AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		3 - FEOT Check and Adjustment	6.7.3
		4 - Head Alignment	6.7.4
		5 - Index to Burst Period Check and Adjustment	6.7.5
R/W/E CARD	943848-0008	NONE	N/A
POWER SUPPLY CARD (PIGGYBACK)	943848-0005	Check Velocity Offset Voltage and Gain per steps 19-27 of AGC Servo Preamplifier and Inductosyn Check and Adjustment (NOTE: If Preamplifier Card is replaced to correct Velocity Offset or Gain Adjustment problems, all steps of section 6.7.2 must be performed). *CAUTION* Be sure power supply to chassis ground strap is tight before making Velocity Offset and Gain Adjustment.	6.7.2
SECTOR CARD	943848-0010	Index to Burst Period Check and Adjustment	6.7.5
3M RACK I/O CARD	943848-0011	Check switch settings	N/A
WINCHESTER I/O CARD	943848-0012	Check switch settings	N/A

STATIC ELIMINATOR	943848-0037	1 - Check Spindle Shaft to Base resistance.	N/A

FIELD REPLACEABLE SUBASSEMBLY	TI PART NUMBER	ASSOCIATED ADJUSTMENTS	CDC MAINTENANCE MANUAL SECTION
R/W/E HEADS	943848-0014 -0015	If Actuator Assembly is not removed:	
		1 - Index to Burst Period Adjustment	6.7.5
		2 - Head Alignment	6.7.4
		If Actuator Assembly is removed:	
		1 - AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		2 - FEOT Check and Adjustment	6.7.3
		3 - Head Alignment	6.7.4
		4 - Index to Burst Period Check and Adjustment	6.7.5
		5 - Track Indicator Check and Adjustment	6.7.6
EOT DETECTOR	943848-0017	1 - FEOT Check and Adjustment	6.7.3
		2 - Head Alignment	6.7.4
		3 - Index to Burst Period Check and Adjustment	6.7.5
		4 - Track Indicator Check and Adjustment	6.7.6
VELOCITY TRANSDUCER	943848-0025	Steps 19-27 of AGC Servo Preamplifier and Inductosyn Check and Adjustment	6.7.2
VELOCITY TRANSDUCER MAGNET	943848-0026	Steps 19-27 of AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
TRANSDUCER SCALE PWB	943848-0027	1 - Track Indicator Check and Adjustment	6.7.6
		2 - AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		3 - FEOT Check and Adjustment	6.7.3
		4 - Head Alignment	6.7.4
		5 - Index to Burst Period Check and Adjustment	6.7.5

CDC HAWK TROUBLESHOOTING AID (CONT)

FIELD REPLACEABLE SUBASSEMBLY	TI PART NUMBER	ASSOCIATED ADJUSTMENTS	CDC MAINTENANCE MANUAL SECTION
SPINDLE ASSEMBLY	943848-0036	1 - Check Idler pulley contact with drive belt. If belt slips off of drive or spindle pulley, adjust snubbing clutch screw to place more Idler pulley tension on drive belt.	N/A
		2 - Static Eliminator Check	6.7.8
		3 - Fixed Disk Index/Sector Transducer Check and Adjustment.	6.7.11
		4 - AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		5 - FEOT Check and Adjustment	6.7.3
		6 - Cartridge Index/Sector Transducer Check and Adjustment.	6.7.10
		7 - Head Alignment	6.7.4
		8 - Index to Sector Burst Period Check and Adjustment	6.7.5

FIELD S
BULL

DATE: 13 February 197

SUBJECT: Incorrect switc

REFERENCE: Service Proble
ECN No. 449602

AFFECTS: All DS10 Cartr
Manuals, TI P/N

PROBLEM: The switch sett
PWB, TI P/N 943
Computer Model
Operation" manu
of the manual
timing is requi

SOLUTION: ECN No. 449602
the switch sett
in the DS10 Ins
9701. A docume
coming.

As an interim a
modified to ret
FSB. All furth
data timing swi

Figure 2-14 (pa
S2 should be:

1 - OFF
2 - OFF
3 - ON
4 - OFF
5 - ON
6 - OFF
7 - ON

ACTION REQUIRED: CE and all Tech
tion and Operat
diately upon r

COST
DISTRIBUTION: None. This FS

FIELD REPLACEABLE SUBASSEMBLY	TI PART NUMBER	ASSOCIATED ADJUSTMENTS	CDC MAINTENANCE MANUAL SECTION
R/W/E HEADS	943848-0014 -0015	If Actuator Assembly is not removed:	
		1 - Index to Burst Period Adjustment	6.7.5
		2 - Head Alignment	6.7.4
		If Actuator Assembly is removed:	
		1 - AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		2 - FEOT Check and Adjustment	6.7.3
		3 - Head Alignment	6.7.4
		4 - Index to Burst Period Check and Adjustment	6.7.5
		5 - Track Indicator Check and Adjustment	6.7.6
EOT DETECTOR	943848-0017	1 - FEOT Check and Adjustment	6.7.3
		2 - Head Alignment	6.7.4
		3 - Index to Burst Period Check and Adjustment	6.7.5
		4 - Track Indicator Check and Adjustment	6.7.6
VELOCITY TRANSDUCER	943848-0025	Steps 19-27 of AGC Servo Preamplifier and Inductosyn Check and Adjustment	6.7.2
VELOCITY TRANSDUCER MAGNET	943848-0026	Steps 19-27 of AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
TRANSDUCER SCALE PWB	943848-0027	1 - Track Indicator Check and Adjustment	6.7.6
		2 - AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		3 - FEOT Check and Adjustment	6.7.3
		4 - Head Alignment	6.7.4
		5 - Index to Burst Period Check and Adjustment	6.7.5

CDC HAWK TROUBLESHOOTING AID (CONT)

FIELD REPLACEABLE SUBASSEMBLY	TI PART NUMBER	ASSOCIATED ADJUSTMENTS	CDC MAINTENANCE MANUAL SECTION
SPINDLE ASSEMBLY	943848-0036	1 - Check Idler pulley contact with drive belt. If belt slips off of drive or spindle pulley, adjust snubbing clutch screw to place more Idler pulley tension on drive belt.	N/A
		2 - Static Eliminator Check	6.7.8
		3 - Fixed Disk Index/Sector Transducer Check and Adjustment.	6.7.11
		4 - AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		5 - FEOT Check and Adjustment	6.7.3
		6 - Cartridge Index/Sector Transducer Check and Adjustment.	6.7.10
		7 - Head Alignment	6.7.4
		8 - Index to Sector Burst Period Check and Adjustment	6.7.5
MOTOR AND BRAKE ASSEMBLY	943848-0047	1 - Drive Belt Tension Adjustment (see Spindle Assembly, item 1)	N/A
		2 - Index to Sector Burst Period Check and Adjustment	6.7.5
		3 - Steps 19-27 of AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		4 - Cartridge Index/Sector Transducer Check and Adjustment.	6.7.10
		5 - Fixed Disk Index/Sector Transducer Check and Adjustment.	6.7.11
POSITION TRANSDUCER	CDC P/N 83475401	1 - AGC Servo Preamplifier and Inductosyn Check and Adjustment.	6.7.2
		2 - FEOT Check and Adjustment	6.7.3

FIELD REPLACEABLE SUBASSEMBLY	TI PART NUMBER	ASSOCIATED ADJUSTMENTS	CDC MAINTENANCE MANUAL SECTION
POSITION TRANSDUCER (CONTINUED)	CDC P/N 83475401	3 - Head Alignment	6.7.4
		4 - Index to Sector Burst Period Check and Adjustment.	6.7.5
		5 - Track Indicator Check and Adjustment	6.7.6
BRUSH MOTOR ASSEMBLY	943848-0031	1 - Check Brush Switch actuation with ohmmeter (Step 2 of Maint. Manual section 6.6.14)	6.6.14
		2 - Check Brush Indicator to Slot alignment after one full brush cycle.	N/A
		3 - Index to Sector Burst Period Check and Adjustment.	6.7.5
FIXED RECORDING DISK	943848-0007	Index to Sector Burst Period Check and Adjustment.	6.7.5
SECTOR TRANSDUCERS	943848-0030 Upper 943848-0044 Lower	1 - Cartridge and/or Fixed Disk Index/Sector Transducer Check and Adjustment	6.7.10 6.7.11
		2 - Index to Sector Burst Period Check and Adjustment.	6.7.5
STATIC ELIMINATOR	943848-0037	1 - Check Spindle Shaft to Base resistance. Should be less than 1 ohm.	N/A
		2 - Index to Sector Burst Period Check and Adjustment.	6.7.5
CARTRIDGE "ON" SWITCH	943848-0063	1 - Check mechanical alignment. Plastic arm should rest on cartridge dust cover.	N/A
		2 - Check switch actuation with ohmmeter (steps 3-6 of CDC Maint. Manual. Section 6.6.13)	6.6.13
		3 - Index to Sector Burst Period Check and Adjustment.	6.7.5

FIELD SERVICE BULLETIN

COMPUTER SERVICE

CDC 10 MBYTE HAWK MHD

DATE: 13 February 1979 **NUMBER:** 02208FB006

SUBJECT: Incorrect switch settings on CDC Hawk disk Data Recovery PWB.

REFERENCE: Service Problem Notification No. 85134, dated 1/19/79. TI ECN No. 449602, dated 1/24/79.

AFFECTS: All DS10 Cartridge Disk System Installation and Operation Manuals, TI P/N 946261-9701.

PROBLEM: The switch settings for Switch 2 (S2) on the Data Recovery PWB, TI P/N 943848-0016, are incorrect in the "Model 990 Computer Model DS10 Cartridge Disk System Installation and Operation" manual. The switch settings as shown in Figure 2-14 of the manual reflect ¼ cell data timing, whereas ½ cell data timing is required for normal operation.

SOLUTION: ECN No. 449602 was generated on January 24, 1979, to cover the switch setting corrections as well as several other errors in the DS10 Installation and Operation manual, TI P/N 946261-9701. A document change package covering this ECN is forthcoming.

As an interim action, Figure 2-14 (page 2-17) should be modified to reflect ½ cell data timing upon receipt of this FSB. All further DS10 installations should use the ½ cell data timing switch settings for switch S2.

Figure 2-14 (page 2-17) Data Recovery PWB Switch Settings for S2 should be:

1 - OFF
2 - OFF
3 - ON
4 - OFF
5 - ON
6 - OFF
7 - ON

ACTION REQUIRED: CE and all Tech Specialists should modify their DS10 "Installation and Operation" manuals to reflect ½ cell data timing immediately upon receipt of this FSB.

COST DISTRIBUTION: None. This FSB is for information only.

TEXAS INSTRUMENTS
INCORPORATED
P.O. Box 2909 M/S 2212
Austin, Texas 78769

IS:

	OFF	S2	ON	
HARD SECTOR	X	1		SOFT SECTOR
HARD SECTOR	X	2		SOFT SECTOR
SOFT SECTOR		3	X	HARD SECTOR
½ CELL DATA	X	4		¼ CELL DATA
¼ CELL DATA	X	5		½ CELL DATA
½ CELL DATA		6	X	¼ CELL DATA
¼ CELL DATA	X	7		½ CELL DATA

SHOULD BE:

	OFF	S2	ON	
HARD SECTOR	X	1		SOFT SECTOR
HARD SECTOR	X	2		SOFT SECTOR
SOFT SECTOR		3	X	HARD SECTOR
½ CELL DATA	X	4		¼ CELL DATA
¼ CELL DATA		5	X	½ CELL DATA
½ CELL DATA	X	6		¼ CELL DATA
¼ CELL DATA		7	X	½ CELL DATA

FIGURE 1

DATA RECOVERY PWB SWITCH SETTINGS

FIELD SERVICE BULLETIN

COMPUTER SERVICE

CDC 10 MBYTE HAWK DRIVE

DATE: 13 February 1979 **NUMBER:** 02208FB008

SUBJECT: CDC Hawk Disk Drive I/O Board Switch Setting

REFERENCE: ECN No. 448417(E) and 448418(C).

AFFECTS: All CDC 10 MBYTE Hawk Disk Drives.

PROBLEM: R and M experienced intermittent problems with a CDC 10 MBYTE Hawk disk drive failing PDT, Part 2. The disk command was a RESTORE and the status returned was "04F0", seek incomplete. The failure would not occur if switch 2, position 5, R.T.Z.S., on the I/O Board was changed from "on" to "OFF". Replacing the I/O Board, TI P/N 943981, would not solve the problem.

Engineering investigation determined there was a timing problem with the R.T.Z.S. strobed signal, switch 2, position 5 in the "ON" position. The problem does not exist with the R.T.Z.S. unstrobed signal, switch 2, position 5 in the "OFF" position.

SOLUTION: Change the switch setting on the I/O Board, switch 2, position 5, R.T.Z.S., from "ON" to "OFF", so that RESTORE does not require a strobe.

ECN 448418(C) changes the Incoming Test Procedure for CDC 10 MBYTE Hawk Disk Drives such that switch 2, position 5, R.T.Z.S, is set to "OFF" instead of "ON". Consequently, future shipments of Hawk Drives will reflect this change.

ECN 448417(E) changes the DS10 Switch Setting Label, TI P/N 945180, to reflect the different switch setting for switch 2, position 5.

ACTION REQUIRED: If a CDC 10 MBYTE Hawk Disk Drive is exhibiting the above symptoms, changing the switch setting for switch 2, position 5 on the I/O Board from "ON" to "OFF" may solve the problem.

COST DISTRIBUTION: None. This FSB is for information only.

SPECIAL TOOLS REQUIRED: None

PARTS REQUIRED: None

EFFECTIVITY: 29 January 1979

ORIGINATOR: Walt Rutherford WR

APPROVAL: M. A. Thompson
MIKE THOMPSON

TEXAS INSTRUMENTS
INCORPORATED
P.O. Box 2909 M/S 2212
Austin, Texas 78769

FIELD SERVICE BULLETIN

COMPUTER SERVICE

CDC 10 MBYTE MHD DRIVE

DATE: March 5, 1979 **NUMBER:** 02208FB009

SUBJECT: CDC 9427H Hawk Disk Drive on 960/980 and 990 Systems.

REFERENCE: TI Dwgs. 943981, 937514, 937508, 973689 and 945180. This FSB references and supplements FSB 02208FB006, dated 2/13/79.

AFFECTS: All CDC Hawk disk units used with TI 960/980 or 990 computer systems.

PROBLEM: The CDC Hawk disk is used as a peripheral device for both 960/980 computer systems and 990 computer systems. Due to the fact that the Hawk disk is a multiple use peripheral, there exist inherent internal differences in switch settings, PWB assemblies, sector adjustment, etc. for each system application.

This FSB will try to address several of the distinctive differences between Hawk disks used on both types of computer systems. It will also try to address some possible problem areas which may be encountered while servicing or installing the Hawk disk unit due to these inherent differences in system application.

SOLUTION: The CDC 9427H "Hawk" disk drive is a 10 megabyte disk unit containing one "fixed" disk platter and one removable disk platter cartridge. When used as a peripheral component of a 960/980 computer system, the Hawk disk is identified as a DS44H disk unit. When used in conjunction with a 990 computer system, the Hawk disk is identified as a DS10 disk unit. The Hawk disk is also used as a peripheral component on TI distributed processing systems. However, this FSB will not cover this application.

The names DS44H (960/980) and DS10 (990) should not be used indiscriminantly or interchangeably when discussing a Hawk problem over the phone or especially when requesting replacement parts or replacement whole blood units. The DS44H Hawk and the DS10 Hawk are each a separate and distinct disk unit.

The Hawk disk is set up for and tested as a DS10 disk (990 configuration) when it is received from the vendor, during incoming QC testing (TI Dwg. 937514). The Hawk remains set up as a DS10 (990 configuration) disk drive until it reaches final Systems Test, prior to being shipped to the customer as a system component. In Systems Test, the Hawk disk itself is configured for the appropriate computer system application (960/980 or 990).

TEXAS INSTRUMENTS
INCORPORATED
P.O. Box 2909 M/S 2212
Austin, Texas 78769

In Systems Test, if the Hawk disk is to be used in a DS44H configuration (960/980 only) it is converted from the DS10 configuration (990 configuration) by performing the following conversion procedures:

1. A special Data Recovery PWB (TI P/N 943982-0001) with a fast phase locked loop (modified by TI Dwg. 943981-0001) must replace the standard 990 Data Recovery PWB (TI P/N 943848-0016) located internally to the Hawk disk unit.

2. Switch settings on the Hawk disk internal PWB's must be changed to the 960/980 settings, per TI Dwg. 945180.

   a. I/O PWB (TI P/N 943848-0011, -0012) switches S1, S2, S4

   b. Servo PWB (TI P/N 943848-0004) switch S3

   c. Data Recovery PWB (TI P/N 943982-0001) switches S1, S2*
   *Data Recovery PWB switch S2 should be set to reflect 1/4 Cell Data clock in the 960/980 configuration as opposed to 1/2 Cell Data clock in the 990 configuration (refer to FSB 02208FB006 for 990 settings only).

3. The "fixed" disk sector counter must be changed from a 20 sector per revolution count (990 DS10 setting) to a 24 sector per revolution count (960/980 DS44H setting). This is accomplished by physically changing the fixed disk sector sensor mount to the appropriate sector ring setting (guide pin No.3).

   NOTE: Precaution is taken at the factory to insure that during the sector sensor mount change, the sector sensor itself does <u>not</u> come into contact with the sector ring. Damage to the sector sensor and/or sector ring will result if contact is made while the sector ring is allowed to turn.

4. A label (TI P/N 940042-0001) must be affixed to the Hawk disk front panel to identify the switch/indicator functions and locations.

Once these modifications have been accomplished, the Hawk disk, now DS44H, is tested in the 960/980 configuration in Systems Test prior to shipment and installation at customer site.

If the Hawk disk is to be used in 990 customer configuration, Systems Test does not normally have to perform any conversion procedures as the disk unit should be set up for use in a 990 configuration when it is tested at incoming QC and also again at factory Unit Test.

ACTION REQUIRED:

CE should be aware of the DS44H modifications which allow the Hawk disk to interface with the 960/980 computer systems. It is possible that a CE may receive a Hawk disk which is set-up incorrectly for a particular application (either 960/980 or 990), especially when a Hawk disk is sent as a whole blood replacement.

CE should inspect the Hawk disk for correct configuration prior to unit installation and verify all pertinent switch settings, Data Recovery PWB type, and sector ring alignment.

If Data Recovery PWB is wrong type, contact your local Inventory Spares personnel to obtain the correct type:

Data Recovery PWB (990)	TI P/N 943848-0016
Data Recovery PWB (960/980)	TI P/N 943982-0001

COST DISTRIBUTION: None. This FSB is for information only.

SPECIAL TOOLS REQUIRED: None

PARTS REQUIRED: None

EFFECTIVITY: February 22, 1979

ORIGINATOR: Dale Ritzen

APPROVALS:

M. B. Thompson
MIKE THOMPSON

Jim Strong
JIM STRONG

FIELD SERVICE
BULLETIN

COMPUTER SERVICE

CDC
10 MBYTE
MHD DRIVE

DATE: 28 March 1979 **NUMBER:** 02208FB011

SUBJECT: "Unit Select" signal causing erroneous Hawk disk faults.

REFERENCE: CDC Field Change Order No. 19578, dated 3/17/78.

AFFECTS: CDC 9427H "Hawk" MHD units, CDC S/N 350-19974.

PROBLEM: An erroneous fault can occur when either or both of the disk unit "Write Protect" switches are enabled and the signal "Unit Select" is toggled by the disk controller. The fault condition is due to ground noise generated by the peripheral drivers which drive the "Unit Select" signal line when the disk unit is selected for a disk operation by the controller. A spike on the "Write Enable" caused by ground noise toggles "Write Data" signal and sets the fault latch.

This condition will not effect previously written data even though the fault condition occurs.

SOLUTION: CDC has modified the 9427H MHD Control PWA, TI P/N 943848-0003 (CDC P/N 75891657) to separate the logic grounds of the write protect circuits from the "Write Enable" circuits. This modification consists of cutting a circuit etch run and adding a wire jumper between two sections of ground circuit etch. This provides IC's U1 to U14 with a separate ground from U15 to U44.

This modification raises the revision level of the Control PWA to revision level "C", (or 75891657C as stamped on the PWA).

ACTION REQUIRED: If CE encounters a CDC 9427H "Hawk" MHD drive which exhibits a tendency to latch up a disk unit fault when selected while the "Write Protect" switches are enabled, he should check the revision level of the Control PWA. The revision level should be revision C or later.

If it is not at the correct revision level, a Control PWA (CDC P/N 75891657, TI P/N 943848-0003) revision C or later, should first be obtained through the local Inventory Spares office before initiating further corrective action.

COST DISTRIBUTION: If warranty, charge to 0711-0043-9XX.

If contract or billable, charge to 1764-XXXX-901.

TEXAS INSTRUMENTS
INCORPORATED
P.O. Box 2909 M/S 2212
Austin, Texas 78769

FIELD SERVICE BULLETIN

COMPUTER SERVICE

CDC 10 MBYTE MHD DRIVE

DATE: 28 March 1979 **NUMBER:** 02208FB012

SUBJECT: Redesign of the Hawk MHD Idler assembly.

REFERENCE: CDC Notification of Engineering Change No. 1066, dated 1/25/79.

AFFECTS: All CDC 9427H Hawk MHD drives.

PROBLEM: CDC has recently redesigned the Hawk MHD Idler assembly (CDC P/N 74793103, TI P/N 943848-0040) to reduce bearing induced noise and wear between the idler arm and stub stud. The new Idler assembly has been designated CDC P/N 75895411. CDC will not stock the old Idler assemblies once the new Idler assemblies are put into production.

SOLUTION: The new idler assembly is functionally and physically interchangeable with the previous idler assembly. The changes to the Idler assembly consist of:

1 - Material that Idler is made of was Aluminum, is now Steel.

2 - Improved Idler spring.

3 - Use of Roulon J bushing in Idler assembly.

The new Idler assembly will have the same TI P/N as the previous Idler assembly since they are directly compatible.

ACTION REQUIRED: Inventory Spares personnel should note the change in the CDC part number. They should also note that the TI P/N will remain the same as the new Idler assemblies are substituted for the old.

CE's should note the design change and be aware of the possible change in Idler assembly material and components, bearing in mind the complete interchangeability between the old and new Idler assemblies.

COST DISTRIBUTION: None. This FSB is for information only.

SPECIAL TOOLS REQUIRED: None

EFFECTIVITY: March 19, 1979

ORIGINATOR: Dale Ritzen

PARTS REQUIRED: None

APPROVALS: MIKE THOMPSON JIM STRONG

TEXAS INSTRUMENTS
INCORPORATED
P.O. Box 2909 M/S 2212
Austin, Texas 78769

FIELD SERVICE
BULLETIN

COMPUTER SERVICE

990 COMPUTERS

DATE: 27 February 1979 **NUMBER:** 02940FB033

SUBJECT: 990 TILINE device priority

REFERENCE: Memo from Mike Choate, dated 1/11/79, concerning TILINE device configurations. ECN No. 448751 and 442592.

AFFECTS: All 990 computer systems using TILINE devices.

PROBLEM: TILINE transfer rate errors can be caused by improper TILINE device configuration resulting in inefficient use of the TILINE, unexplainable system crashes and reduced throughput rate. DX10 crashes "20", "80", and "100" (illegal ops) are exhibited during high CPU and TILINE activity when using DS10 with a DS25 or DS200 controller in the same chassis and user memory in an expansion chassis. DS200 controllers with higher TILINE priority than the DS10 will cause the DS10 to get rate errors which would not be reported on a "READ" because of a microcode problem with the control ROM on the DS10 controller. In addition, rate errors can occur in the expansion chassis TILINE master during high activity if the controller is accessing main chassis memory across TILINE couplers and the TILINE coupler cable vector is pointing to the expansion chassis. This problem occurs when a controller without buffering capability accesses memory across couplers and is locked out by successive TILINE accesses by master devices in the main chassis.

SOLUTION: To prevent rate errors, correct the master priority by reconfiguring the TILINE master devices according to the type of TILINE controller and the data transfer rates. Listed below are the data transfer rates and buffering capability for TILINE controllers used in 990 systems. Buffering the data from the disk allows the controller to transfer data to the TILINE during high CPU activity, exclusive of transfer rate errors and data losses. The system software should "retry" controller errors such as rate and/or data errors.

TILINE DEVICE	TRANSFER RATE	BUFFER SIZE
DS 31	1 WORD EVERY 10.66 US	NO BUFFER
FLOPPY	32 US	2 WORDS
DS 10	1 WORD EVERY 6.4 US	16 WORDS
979 TMTC, 1600 BPI	33.33 US	NO BUFFER
979 TMTC, 800 BPI	66.66 US	NO BUFFER
DS25, 50, 200	2.48 US	128 WORDS

TEXAS INSTRUMENTS
INCORPORATED
P.O. Box 2909 M/S 2212
Austin, Texas 78769

SOLUTION: (CONT) ECN No. 448751 changed the microcode in the control ROM on the DS10 controller to allow the reporting of rate errors on a "read". The controller assembly, TI P/N 937505-0001, was upgraded to "Revision R".

To prevent a non-buffered controller from being "locked out", resulting in rate errors, the TILINE cable vector can be changed to point towards the CPU chassis. However, if this is done, the CPU will be unable to issue the TIOLRESET signal to the expansion chassis unless CRU expansion is used in the same chassis. For systems not having CRU expansion, ECN No. 442592 upgrades the control cable assembly, TI P/N 945089 to "Revision C" to allow the CPU to reset the expansion chassis when the cable vector points toward the CPU.

ACTION REQUIRED: If a system is configured such that a DS200 has higher priority than a DS10 and the system is exhibiting unexplained crashes such as the ones described above, replace the DS10 controller with a REV. "R" assembly or later and reconfigure the system TILINE devices to reflect the proper TILINE priority based on transfer rates and buffer capability. The system interrupt configuration also would have to be changed or the system would have to be "Resysgened". The system configuration label should be updated to indicate the new configuration.

If a system has a non-buffered controller in an expansion chassis and it accesses main memory often and there is CRU expansion in the same chassis, the control cable vector should be changed to point towards the CPU chassis. If there is not CRU expansion in that chassis, the control cable should be replaced with Assembly Rev. "C" or later and point the vector towards the CPU.

Figures 1 and 2 should be used as guidelines when reconfiguring the devices to the proper TILINE priority.

In the event that memory is divided into two chassis, it is advantageous to have only two controllers in the main since most of the transfers (except for system disc) would be to user memory in the expansion chassis. In addition, the TLC must be considered as a controller if there is a controller present in the expansion chassis. This would speed up the system operation and decrease the possibility of rate errors.

COST DISTRIBUTION: If warranty call, charge labor to 0711-0043-9XX.

If contract or billable, charge labor to 1764-XXXX-901.

If billable and assembly is replaced, charge customer fixed price repair.

SLOT #	CHASSIS DEVICE	TLAG PRIORITY
1	SMI	* LOWEST *
2	AU	
3	MEM	
4	MEM	
5	MEM	
6	MEM	
7	DS25, 50, 200	6TH
8	DS10	5TH
9	911 CRT	
10	979 TMTC	4TH
11	TL FLOPPY	3RD
12	DS31	2ND
13	TL COUPLER	* HIGHEST *

FIGURE 1 EXAMPLE CONFIGURATION MAIN CHASSIS

SLOT #	CHASSIS DEVICE	TLAG PRIORITY
1	CRU BUFFER	* LOWEST *
2	TL COUPLER	
3	MEM	
4	MEM	
5	MEM	
6	MEM	
7	DS25, 50, 200	5TH
8	DS10	4TH
9	911	
10	911	
11	979 TMTC	3RD
12	TL FLOPPY	2ND
13	DS31	* HIGHEST *

FIGURE 2 EXAMPLE CONFIGURATION EXPANSION CHASSIS

(1) I/O CARD B10 DIP - ALIGNMENT PACK
TOGGLE DIFFERSEL (* STAR SEL)

(2) STROBE IN HEAD ADDR 146
SYNC FROM B10 (SECTOR)
MONITOR TEST POINTS ON RIGHT SIDE OF I/O

(3) STROBE IN HEAD ADDR 10
SCOPE AS (2) SHOULD SEE
INDEX TO BURST

(4) MONITOR A5 & B 15 WITH SCRATCH DK
SYNC ON A 31 (INDEX)
READ DATA TRY SECTOR 0 CHECK CHANGE IN POS OF SECTOR PULSES
WRITE DATA THEN SECTOR 15

HEAD ALIGN

1. REMOVE EMERG RETRACT RELAY
2. TURN MOLEX CONNECTOR AROUND
3