83322310

CONTROL DATA CORPORATION

CDC® STORAGE MODULE DRIVE

BK6XX

BK7XX

INSTALLATION AND CHECKOUT

GENERAL MAINTENANCE INFORMATION

PREVENTIVE MAINTENANCE

TESTS AND ADJUSTMENTS

TROUBLE ANALYSIS

REPAIR AND REPLACEMENT

Volume 1

HARDWARE MAINTENANCE MANUAL

REVISION RECORD

REVISION	DESCRIPTION
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REVISION LETTERS I, O, Q AND X ARE NOT USED.

Address comments concerning this manual to:

Control Data Corporation
Twin Cities Disk Division
Customer Documentation Dept.
5950 Clearwater Drive
Minnetonka, MN 55343

or use Comment Sheet in the back of this manual.

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PREFACE

This manual contains maintenance information applicable to Control Data® BK6XX and BK7XX Storage Module Drives (SMD's).

The specific types of drives covered and their configurations are listed in the configuration chart (refer to the next page).

Most of the information in this manual is applicable to all types of the above drives. However, where information is applicable only to specific types, this is noted in the text. Refer to hardware reference manual for more information on drive types.

References are made throughout this manual to the terms "VDE" and "NON-VDE." VDE units contain a VDE-approved power supply and have other associated electrical and mechanical differences. For explanation of Non-VDE and VDE refer to Symbology Table 3-1 located in the Parts Data section of the Maintenance Manual Vol. 2.

Maintenance information is divided into five sections. These sections and a brief description of their contents are as follows:

Section 1 - Installation. Provides information on installing the drive and preparing it for initial use.

Section 2 - General Maintenance Information. Provides general information relating to the maintenance of the drive.

Section 3 - Preventive Maintenance. Provides information regarding the preventive maintenance that must be performed on the drive to keep it operating properly.

Section 4 - Tests and Adjustments. Contains procedures describing drive electronic adjustments.

Section 5 - Trouble Analysis. Contains information on analyzing problems in the drive.

Section 6 - Repair and Replacement. Contains information concerning the mechanical replacement and adjustment of the drives field replaceable parts.

Other manuals, also applicable to the SMDs covered in this manual, are as follows:

Publication Number	Title
83322310	Hardware Maintenance Manual Vol. 1
83325380	Hardware Maintenance Manual Vol. 2 (Contains diagrams, wirelists, and parts data)
83322320	Hardware Reference Manual
83322440	CDC Microcircuits Manual, Volume 1: IC data sheets classified by CDC identifiers, logic families, and IC symbology.
83324440	CDC Microcircuits Manual, Volume 2: ICs identified by industry-recognized vendor type numbers.

A Guide for the Disk Drive Operator, Publication number 83323780 is also available. The guide, as well as any of the manuals listed above, may be ordered through Literature Distribution Services at the following address:

Control Data Corporation
Literature Distribution Services
308 North Dale St.
St. Paul, MN. 55103

WARNING

To ensure the integrity of safety features built into these drives, installation and maintenance must be performed only by qualified service personnel using designated CDC/MPI parts. Also, in case of fire or other emergency, isolate the drives from main power by disconnecting the drive power plugs from their site power receptacles. In situations where pulling the plugs is not possible or practical (such as in a rack mount installation), use the system main power disconnect to isolate the drives from main power.

WARNUNG

Um das einwandfreie Funktionieren der eingebauten Schutzvorrichtungen zu gewaehrleisten, darf die Installation und Wartung nur von qualifiziertem Service-Personal unter Verwendung von Original CDC/MPI Teilen durchgefuehrt werden. Beim Ausbrechen von Feuer oder in anderen Notfaellen ist die Verbindung zum Hauptstromnetz dadurch zu unterbrechen, dass die Stecker der Antriebe aus den Steckdosen gezogen werden. Sollte dies nicht moeglich oder unpraktisch sein (z. B. dann, wenn die Stationen uebereinander installiert sind), ist der Hauptstromunterbrecher des Systems zu bedienen, um die Antriebe vom Hauptstromnets su trennen.

CONTENTS

FIGURES

TABLES

IMPORTANT SAFETY INFORMATION AND PRECAUTIONS

Proper safety and repair is important to the safe, reliable operation of this unit. Service should be done by qualified personnel only. This maintenance manual describes procedures recommended by the manufacturer as effective methods of servicing the unit. Some of these procedures require the use of specially designed tools. For proper maintenance and safety, these specially designed tools should be used as recommended.

The procedures in this maintenance manual and labels on the unit contain warnings and cautions which must be carefully read and observed in order to minimize or eliminate the risk of personal injury. The warnings point out conditions or practices that are potentially hazardous to maintenance personnel. The cautions point out practices which, if disregarded, could damage the unit and make it unsafe for use.

For the safety of maintenance and operating personnel, the following precautions must be observed:

- Perform all maintenance in accordance with the procedures given in this manual.
- Read and observe all cautions and warnings provided in the procedures and labeled on the unit.
- Use the special tools called out in the maintenance procedure.
- Observe sound safety practices when performing maintenance.
- Use caution when troubleshooting a unit that has voltages present. Remove power from unit before servicing or replacing components.
- Wear safety glasses when servicing units.
- Wear safety shoes when removing or replacing heavy components.

It is also important to understand that these warnings and cautions are not exhaustive. The manufacturer could not possibly know, evaluate and advise maintenance personnel of all conceivable ways in which maintenance might be performed or the possible risk of each maintenance technique. Consequently, the manufacturer has not completed any such broad evaluation. Thus, any persons who use any non-approved maintenance procedure or tool must first satisfy themselves that neither their safety nor the unit performance will be jeopardized by the maintenance techniques they select.

ABBREVIATIONS

ABR	Absolute Reserve
ABV	Above
ADDR	Address
ADRS	Address
AGC	Automatic Gain Control
AM	Address Mark
AMPL	Amplifier
AMPTD	Amplitude
BLK	Black
BLW	Below
CAR	Cylinder Address Register
CH	Channel
CHAN	Channel
CKT	Circuit
CNTLGL	Centrifugal
CNTR	Counter
COMP	Compensation
CONFIG	Configuration
CONTD	Continued
CR REF	Cross Reference
CYL	Cylinder
DES	Desired
D/A	Digital to Analog
DCDR	Decoder
DIFF	Difference
DIR	Direction
DLY	Delay
DRV	Drive
DRVR	Driver
DSBL	Disable
ECL	Emitter Coupled Logic
ECO	Engineering Change Order
EMER	Emergency
EN	Enable
EOT	End of Travel
EQUIV	Equivalent
FCO	Field Change Order
FCTN	Function
FF	Flip Flop
FIG	Figure
FLT	Fault
FREQ	Frequency

ABBREVIATIONS (Contd)

FTU	Field Test Unit
FWD	Forward
GEN	Generator
GND	Ground
HD	Head
I/O	Input-Output
INTLK	Interlock
INTGTR	Integrator
LD	Load
MAINT	Maintenance
MAX	Maximum
MB	Megabyte
MFM	Modified Frequency Modulation
MK	Mark
MULT	Multiple
NC	No Connection
NEG	Negative
NOM	Nominal
NON-VDE	(See Preface)
NORM	Normal
NRM	Normal
NRZ	Nonreturn to Zero
PC PT	Piece Part
PLO	Phase Lock Oscillator
PN	Part Number
POS	Positive
PWR	Power
RCVRS	Receivers
RD	Read
RDY	Ready
REC	Receiver
REF	Reference
REG	Register
REV	Reverse
RGTR	Register
RTM	Reserve Timer
RTZ	Return to Zero
S&IO ABC	Sector & Index on A & B Cable
S&IOAC	Sector and Index on A Cable
S&IOBC	Sector & Index on B Cable
S/C	Series Code

ABBREVIATIONS (Contd)

SEC	Second
SEL	Select
SEQ	Sequence
SER	Servo
SH	Sheet
SOL	Solenoid
SR	Servo
SW	Switch
T	Track
TBS	To Be Supplied
TLA	Top Level Assembly
TP	Test Point
TRK	Track
TTL	Transistor Transistor Logic
UNREG	Unregulated
VCO	Voltage Controlled Oscillator
VDE	(See Preface)
W+R	Write or Read
W·R	Write and Read
W/	With
W/O	Without
WRT	Write
WT	White
XDUCER	Transducer
XMTR	Transmitter

SECTION 1

INSTALLATION AND CHECKOUT

INTRODUCTION

This section contains information concerning the initial installation and checkout of the drive. The person performing the installation and checkout should be familiar with operation of the drive and with all information in the discussions on General Maintenance (section 2 of this manual).

This section is divided into the following areas:

- Site Preparation - Describes requirements that must be met in preparing a site for installation of a drive.
- Packaging - Provides information regarding shipment of the drive.
- Installation Procedure - Contains instructions and procedures describing installation of the drive.
- Initial Checkout and Startup - Explains checks that must be made prior to putting the drive into normal online operation.

SITE PREPARATION

GENERAL

Site preparation information is provided to enable a user to lay out an installation site. Consideration is given to:

- Space and Clearances
- Environment
- Power (ac)
- Grounding
- I/O Cabling

The installation instructions provided later in this section are based on the assumption that all site preparation requirements have been met.

SPACE AND CLEARANCES

Position the drive either by itself or in line with other drives. In either case there must be enough clearance around the unit to permit access for maintenance. Space requirements are shown on figure 1-1.

ENVIRONMENT

The site location must present the proper environmental conditions for the drive. Environmental requirements are listed in table 1-1.

POWER REQUIREMENTS

An ac power source connection must be provided for each drive in the system. The drives connect to the power source via 3.05 metre (10-foot) long power cords.

Tables 1-2 and 1-3 list the drive input voltage tolerances and power consumption requirements. Figure 1-2 shows the drive startup current for each of the possible input voltages. The nominal voltage for each drive type is listed in the configuration chart in the front matter of this manual.

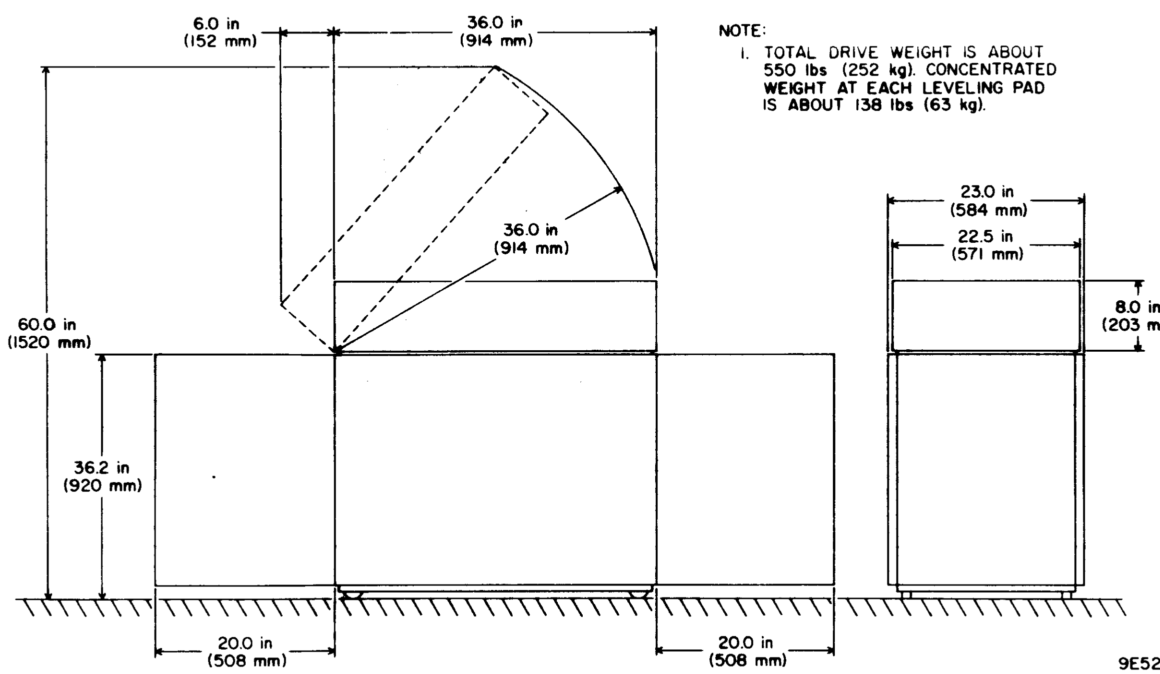


Figure 1-1. Space Requirements

It is important to note that drives come from the factory wired to accept input power of either 208 volts, 60 Hz or 220 volts, 50 Hz. If a different line voltage is required, rewire the drive as described in the Wiring and Power Cable Routing procedures. Converting Non-VDE drives from 50 to 60 Hz (or 60 Hz to 50 Hz) requires extensive reworking and is not recommended as a field procedure. If such a conversion is necessary, contact your factory representative.

TABLE 1-1. ENVIRONMENTAL REQUIREMENTS

Specification	Value
<u>Temperature</u>	
Operating	15.0°C (59°F) to 32°C (90°F)
Gradient	6.7°C (12°F) per hour
Transit (packed)	-40°C (-40°F) to 70°C (+158°F)
<u>Relative Humidity</u>	
Operating	20% to 80% (No condensation)
Transit (packed)	5% to 95% (No condensation)
<u>Altitude</u>	
Operating	-305 m (-1000 ft) to 2000 m (+6500 ft)
Transit (packed)	-305 m (-1000 ft) to 4572 m (+15 000 ft)

TABLE 1-2. DRIVE INPUT VOLTAGE

Voltage/Tolerance (ac Volts)	Frequency/Tolerance (Hz)	Phase
208 (+14.6, -29) 230 (+14.5, -32)	60 (+0.6, -1.0)	Single Phase
220 (+15.0, -25) 240 (+17.0, -27)	50 (+0.5, -1.0)	Single Phase

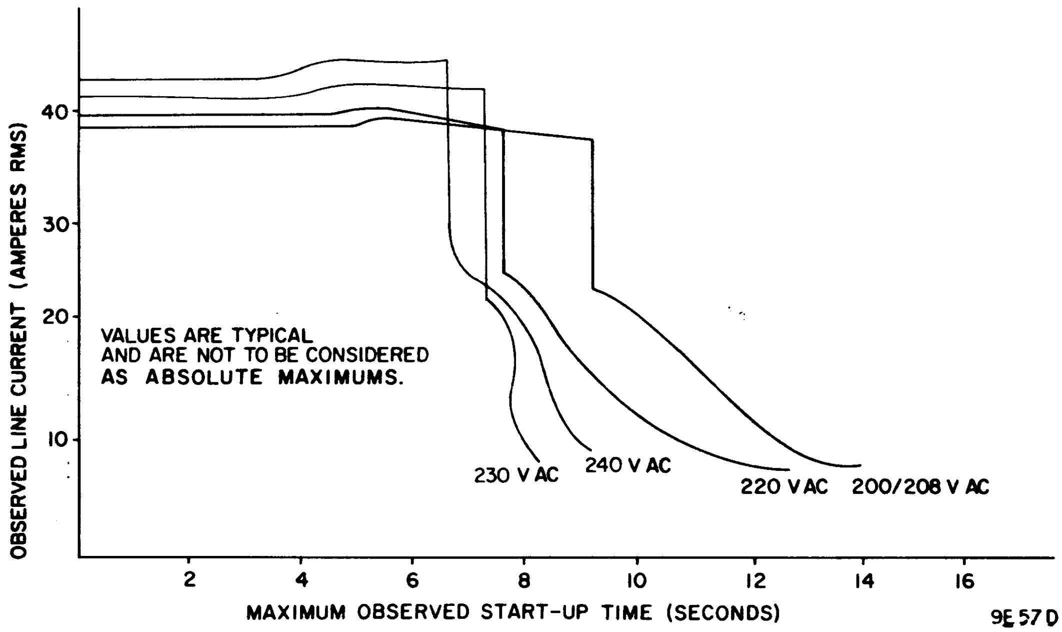


Figure 1-2. Startup Current

TABLE 1-3. DRIVE POWER CONSUMPTION REQUIREMENTS

Input Voltage	Unit Status	Line * Current	Consumption * KW	BTU/HR	Power Factor
208 V, 50/60 Hz	Disks and	8.60	1.40	4778	.78
208 V, 60 Hz	carriage	8.65	1.46	4983	.81
230 V, 60 Hz	in Motion	7.80	1.45	4949	.81
220 V, 50 Hz		9.18	1.50	5119	.74
240 V, 50 Hz		8.56	1.51	5153	.74
208 V, 50/60 Hz	Disks	1.77	0.367	1253	1.00
208 V, 60 Hz	Not	1.77	0.367	1253	1.00
230 V, 60 Hz	in	1.63	0.370	1263	.99
220 V, 50 hz	Motion	1.80	0.348	1188	.88
240 V, 50 Hz	(Standby)	1.79	0.349	1191	.81

* These are maximum values.

WARNING

Any 3 phase, 4 wire, wye circuit where over one half of the total load consists of electric discharge lighting, data processing (such as this unit), or similar equipment must meet the requirements given in the following topic. These requirements must be met in the United States, in order to comply with the National Electrical Code, and are recommended for installations in other countries. Failure to meet these requirements may result in hazardous conditions due to high currents (and heating) in the neutral conductors and transformers supplying the system.

SPECIAL REQUIREMENTS FOR 3 PHASE, 4 WIRE, WYE SITE POWER

General

This unit uses single phase power. If the power originates from a 3 phase, wye branch or feeder circuit with a load as defined in the above warning, ensure that the circuit meets following specifications.

Specifications for Neutral Conductor

Always consider the neutral in the 3-phase, wye circuit as a current carrying conductor and ensure that it is no smaller than the line conductors.

Limiting Branch and Feeder Circuit Load Currents

Limit the maximum load current in each 3-phase, wye conductor (lines and neutral) to the values shown in table 1-4.

GROUNDING

General

To ensure safe and satisfactory operation, each drive must be properly grounded. Properly grounded drives must have two ground connections: (1) site ac power system safety ground and (2) a system ground. Both of these are explained in the following discussions.

TABLE 1-4. CONDUCTOR LOAD CURRENT LIMITATIONS

Number of Conductors in Conduit, Cable, or Raceway	Limit to this Percentage of Value Specified by NEC* or Local or National Regulations
4 through 6	80%
7 through 24	70%
25 through 42	60%
43 and above	50%
* United States National Electrical Code.	

Site Power System Safety Ground

The site ac power system ground is provided by the green (or green with yellow stripe) wire in the ac power cord. This wire connects to the drive frame and goes through the ac power cord to earth ground, via the ac branch circuit supplying the drive. Also, all power receptacles in the vicinity of the drive must be at the same ground potential as the drive.

System Ground

The power system safety ground does not necessarily satisfy all system grounding requirements. Therefore, additional connections to earth ground are required to ensure proper drive and system operation. This is referred to as the system ground. The system ground can connect to earth using any of the following methods:

- Floor Grid (grounded) - Drives and controller are connected to a floor grid consisting of horizontal and vertical members that are mechanically secured and have ground straps or their equivalent joining them. The ground straps ensure a constant ground potential at all points on the grid. This grid is located under a false floor and connects directly to earth ground.

- Floor Grid (not grounded) - Drives and controller are connected to a floor grid that is isolated from earth ground. In this case, the controller is connected to earth ground to ground the grid.

NOTE

The daisy chain method of grounding the system is not recommended in systems containing more than ten separate equipments.

- Daisy Chain - Drives ground terminals are connected in a daisy chain to one another and then to the controller that connects to earth ground.

I/O CABLES

In laying out the site, consideration must be given to the routing of I/O cables. The drive connects to the controller via two I/O cables that are designated as the A cable and the B cable.

I/O cables connect to the controller in either a star or daisy chain configuration depending on the requirements of the specific installation. Both configurations are shown in figure 1-3.

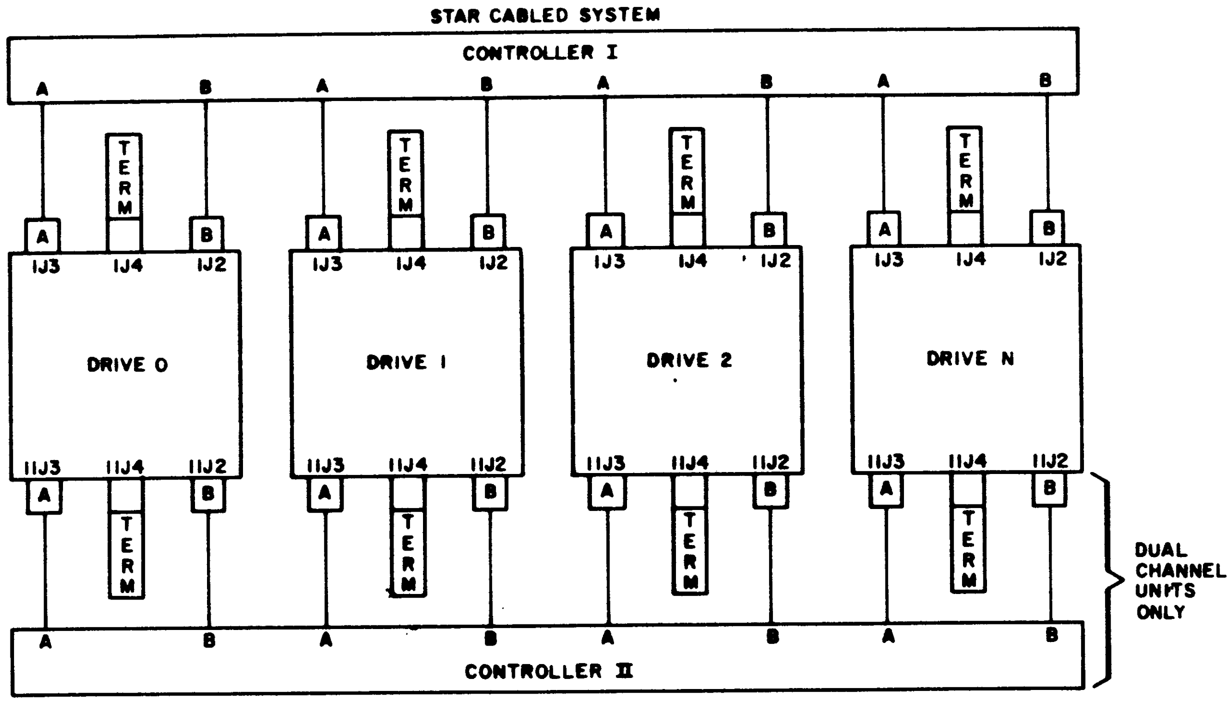
The star system requires that the A and B cables go directly from each drive to the controller. It also requires an A cable terminator assembly at each drive.

The daisy chain configuration also requires that the B cable go directly from each drive to the controller. However, only the first drive in the chain requires an A cable directly to the controller. The others are connected via the daisy chain. In the daisy chain configuration, only the last drive in the chain has an A cable terminator assembly.

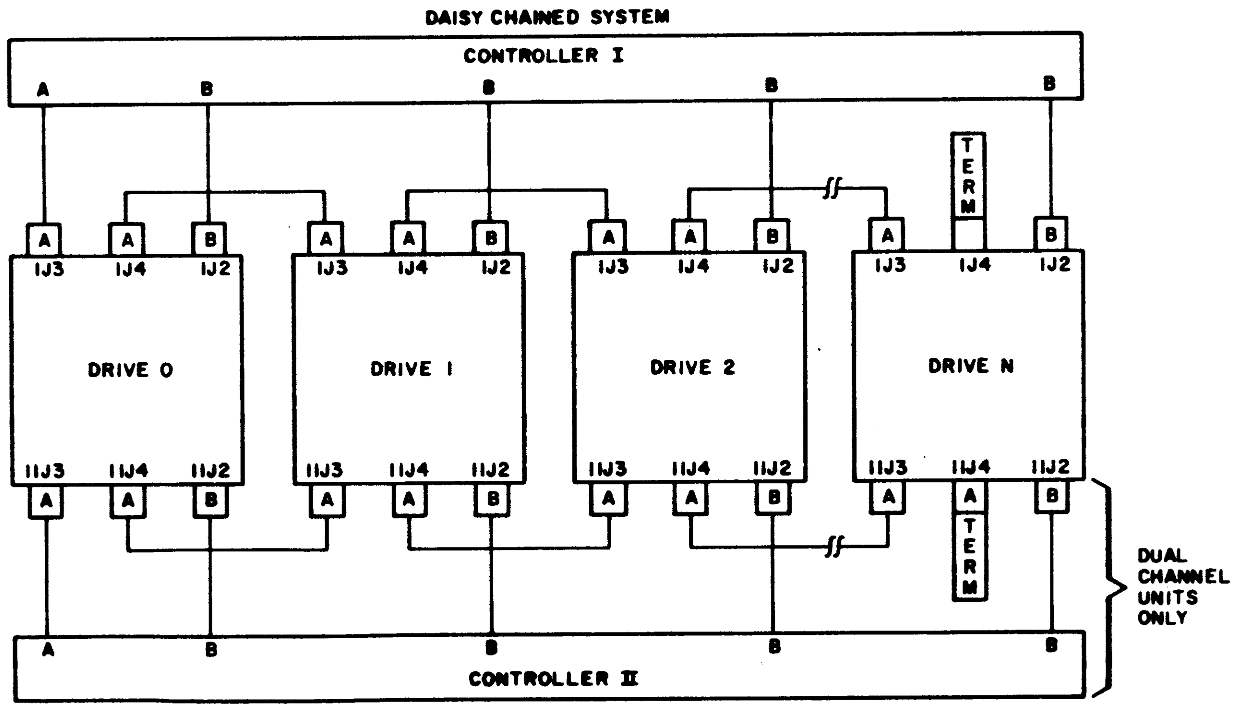
WARNING

When installing or replacing cables on a 60 Hz unit, S/C 34 with DJ13378-B and above, observe the following warning. To meet F.C.C. requirements for electromagnetic interference, it is mandatory that the round I/O cabling listed in table 1-5, is used for drive installation. If flat cabling listed in table 1-5 is used, it is the users responsibility to provide additional shielding, and obtain F.C.C. approval. Also, see warning in Preface of Hardware Reference manual.

Both the I/O cables and terminators are considered accessories and must be obtained separately from the drive. The part numbers of the terminators and the various available lengths of



NOTES:
1. MAXIMUM INDIVIDUAL A CABLE LENGTHS = 100 FEET
2. MAXIMUM INDIVIDUAL B CABLE LENGTHS = 50 FEET



NOTES:
1. MAXIMUM CUMULATIVE A CABLE LENGTH = 100 FEET
2. MAXIMUM INDIVIDUAL B CABLE LENGTH = 50 FEET

Figure 1-3. I/O Cable Configurations

TABLE 1-5. INSTALLATION ACCESSORIES

	CABLE LENGTH IN FEET/METRES											
	4	5	6	8	10	15	20	25	30	40	50	100
	1.2	1.5	1.8	2.4	3.0	4.5	6.1	7.6	9.1	12.2	15.3	30.5
A CABLE (60-Pin)												
775642XX (Unshielded)*	10	00	01	02	03	04	05	06	07	08	09	
815374XX (Shielded-FCC)	NA	00	NA	NA	01	02	03	04	05	06	07	08
A CABLE (Flat, 50-Pin)												
774594XX (Unshielded)	NA	00	01	02	03	04	05	06	07	08	09	
B CABLE (26-Pin)												
775643XX (Unshielded)*	NA	00	01	02	03	04	05	06	07	08	09	
927089XX (Shielded-FCC)	NA	00	NA	NA	01	02	03	04	05	06	07	

OTHER ACCESSORIES

A Cable Terminator (60-pin): 75841300
A Cable Terminator (50-pin): 75841301
Logic Plug: 943724XX

NOTES: NA = Not Available

* See warning in discussion on I/O cables

I/O cables are listed in table 1-5. The pin assignments and signal names may be found in the diagrams section of this manual.

PACKAGING

The drive must be properly packaged whenever it is shipped from one location to another.

Carefully remove the outer container. Set aside the packaging material used during shipment of the drive. Refer to the unpackaging instruction slip, which is shipped with the drive for instructions on removal of the internal blocking and holdown bolts.

If it is necessary to reorder packaging instructions, they may be obtained from:

Packaging Engineer, Material Services Dept.
Normandale Division, MPI
7801 Computer Avenue
Minneapolis, MN 55435
Telephone Number 612/830-5462

When ordering packaging instructions, specify the exact equipment number and series code of the drive as shown on the equipment identification plate.

INSTALLATION PROCEDURES

GENERAL

The procedures in this discussion describe the actual installation of the drive. These procedures are based on the assumption that the site meets all requirements discussed under Site Preparation.

All the procedures are listed below and generally speaking should be considered in the order they are presented. However, you may vary this order somewhat to meet requirements of specific installations.

- Preinstallation Inspection
- Grounding
- AC Power Wiring
- Power Cable Routing
- I/O Cable Installation
- Converting Sector and Index Signals
- Setting Sector Switches
- Cabinet Leveling

NOTE

Make sure temperature gradients are not exceeded during installation. Refer to the general description section in the hardware reference manual.

PREINSTALLATION INSPECTION

Perform the following inspection prior to installing the drive:

1. Inspect drive for possible shipping damage. File any claim for this type of damage promptly with the transporter involved. If a claim is filed, save the original shipping materials.

2. Verify that all logic cards are firmly seated in logic chassis and power supply.

3. Verify that all connectors are firmly seated, and check for loose hardware.

4. Verify that the control panel is firmly seated in shroud.

5. Verify that all cabling is intact and that there are no broken or damaged wires.

NOTE

Non-VDE: To gain access to the pack area while the drive is powered down, pull down on the solenoid latch and up on the pack access cover latch release.

VDE: To gain access to the pack area it is necessary to have the main circuit breaker on for at least 30 seconds.

6. Check entire drive for presence of foreign material that could cause an electrical short.

7. Check actuator and pack area for presence of material that could obstruct movement of carriage and heads.

8. Check Pack Access Cover for tight seal. (Refer to the Pack Access Cover Adjustment procedure in Section 2).

GROUNDING

The following procedures describe the methods of grounding the drive.

Drive to Floor Grid Grounding

If a floor grid is available (either grounded or ungrounded), connect each drive individually to the floor grid (refer to figure 1-4) according to the following procedures (refer to table 1-6 for grounding accessories).

1. Crimp and solder a terminal lug to one end of a length of flat braided shielding.
2. Connect terminal lug to ac terminal of grounding block (refer to figure 1-5).
3. Route free end of braided strap through I/O cable guide and into cutout in floor.
4. Cut strap to proper length and attach terminal lug to free end as done in step 2.
5. Drill 11/32 inch hole in floor grid.
6. Secure terminal lug to grid using 10x32x1/2 screw and #10 external tooth lockwasher.
7. If grid is not connected directly to earth ground, connect it to earth ground via the controller.

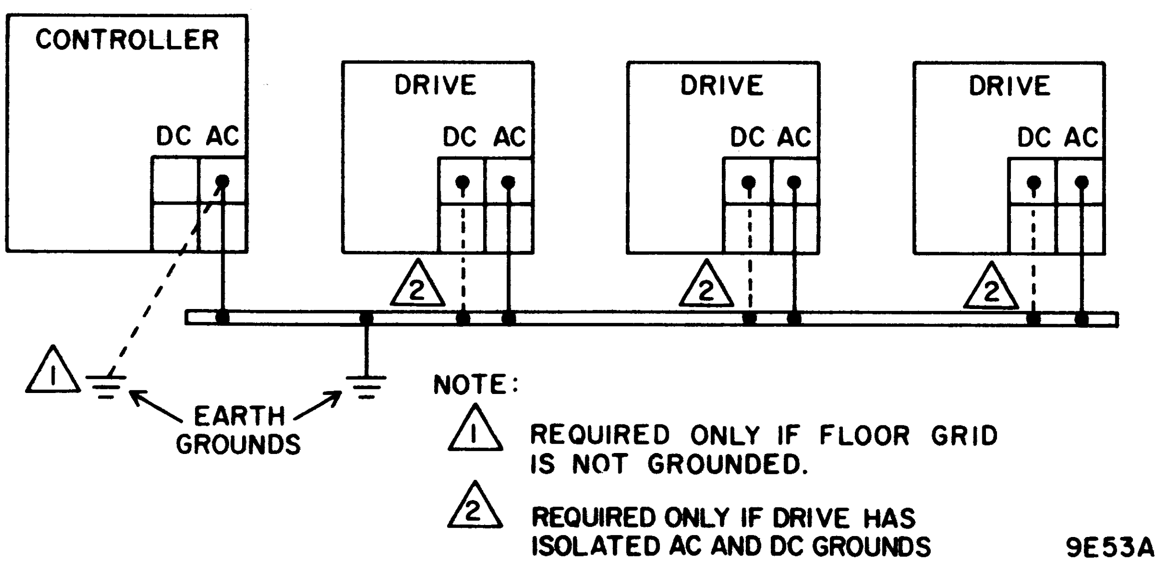


Figure 1-4. Floor Grid System Grounding

TABLE 1-6. GROUNDING ACCESSORIES

Part	CDC Part Number
Flat Braided Shielding	93267009 (Specify Length)
Terminal Lug	40125601
Lockwasher, external tooth, #10	10126403
Screw, Cross Recessed, Pan Head, 10x32x1/2	17901524

NOTE

The system ground must connect both the drive dc (logic) and ac (frame) ground to earth. The drive's ac and dc grounds are connected by four jumper wires and through the shielding of the drives internal I/O. One jumper wire is located on the grounding block (see figure 1-5) and three jumper wires connect the deck to the frame (one jumper wire across each of the three shock mounts). Therefore, only one system connection is required. It is recommended that these jumper wires remain connected to allow the drive to better withstand electrostatic discharge. However, some installations may require the isolation of ac ground from dc ground. In these cases, remove the four jumpers described above and isolate the main harness shielding from the deck. The main harness can be isolated from the deck by placing adequate electrical insulation between the main harness shielding and the cable clamp that secures the harness to the deck near the read/write chassis. Then connect both ac and dc grounds to earth via separate system ground connections. Perform steps 8 and 9 only if the drive is to have isolated ac and dc grounds.

8. Remove jumper wire between ac and dc portions of grounding block (refer to figure 1-5). Also, remove the three jumper wires across the deck shock mounts.

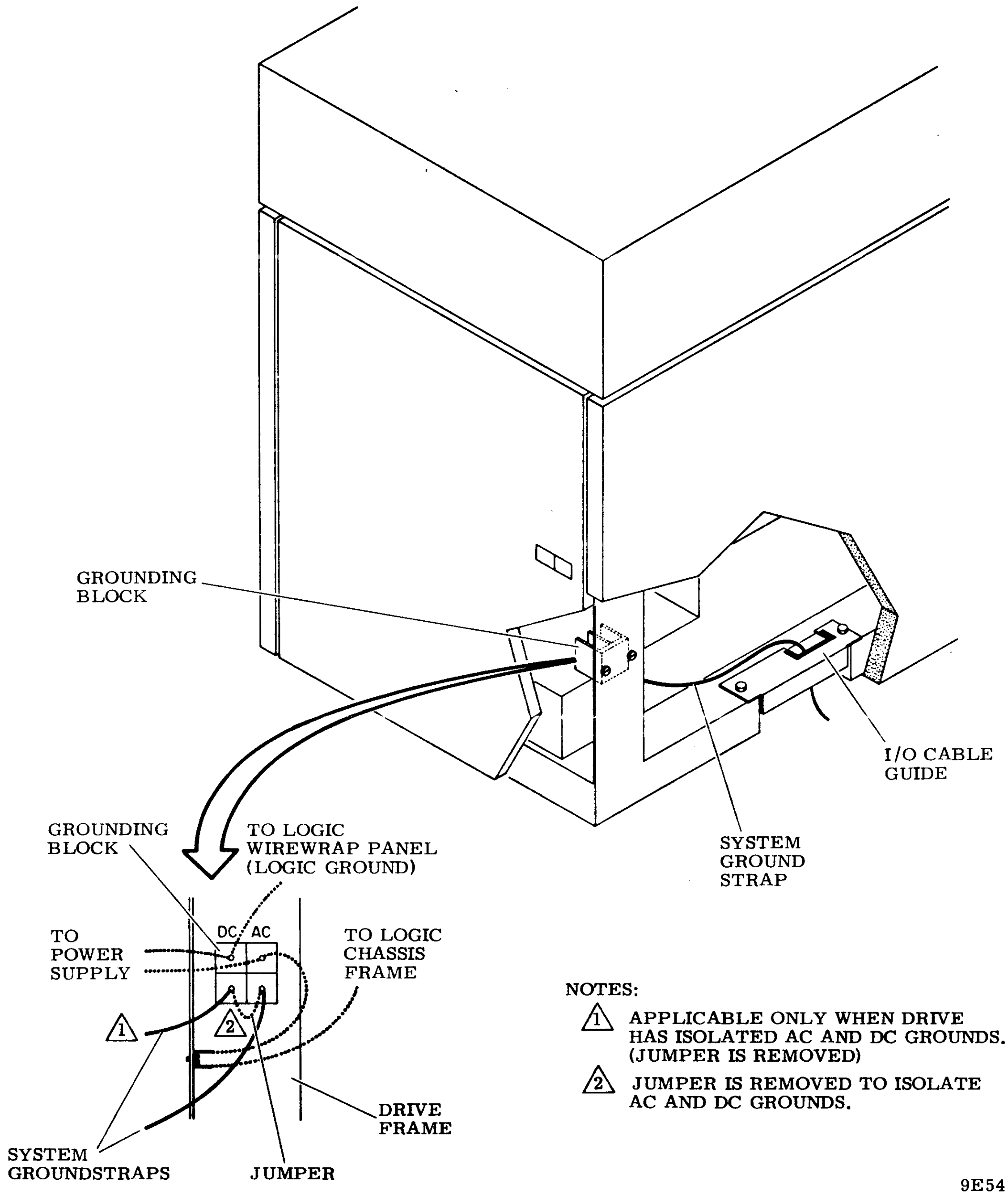


Figure 1-5. Drive Grounding Block

9. Perform steps 1 through 6 except, when performing step 2, connect ground strap to dc terminal of grounding block instead of ac terminal.

Daisy Chain Grounding

If a floor grid is not available, connect all drives to the controller in a daisy chain grounding configuration (refer to figure 1-6). Table 1-6 lists grounding accessories. Then connect the controller to earth ground. When connected in this manner, the drive must have a common ac and dc ground. Therefore, connect the jumper on the grounding block (figure 1-5) as follows:

1. Cut lengths of flat braided shielding to lengths required to go from drive to drive, from last drive in chain to controller and from controller to earth ground.
2. Crimp and solder a terminal lug to ends of each strap.
3. Connect two straps to ac terminal of grounding block, route straps through I/O cable guide, and connect to each of the two closest drives.

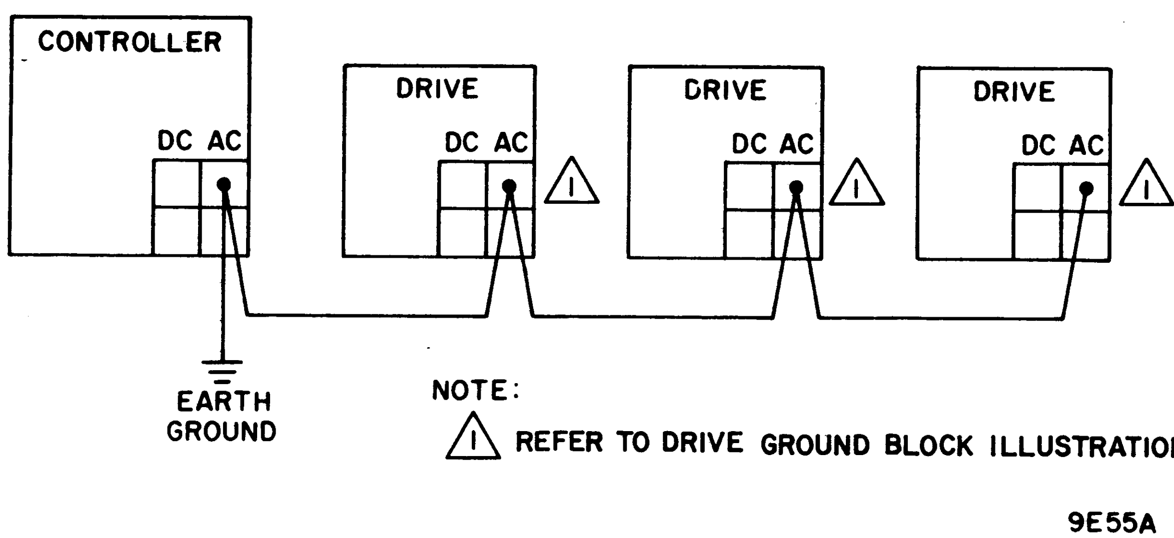


Figure 1-6. Daisy Chain System Grounding

4. Ensure that the following conditions exist:

- All drives and controller are connected in daisy chain.
- Drive closest to controller is connected to controller.
- Controller is connected to earth ground.

AC POWER WIRING

Two types of power supplies are used in the drive. Non-VDE units use the power supply shown on figure 1-7. The power supply shown on figure 1-8 is used on VDE drives. The two power supplies differ significantly and, as a result, ac power wiring is different. After examining figures 1-7 and 1-8 to determine which power supply is used, perform the appropriate power cable routing procedures.

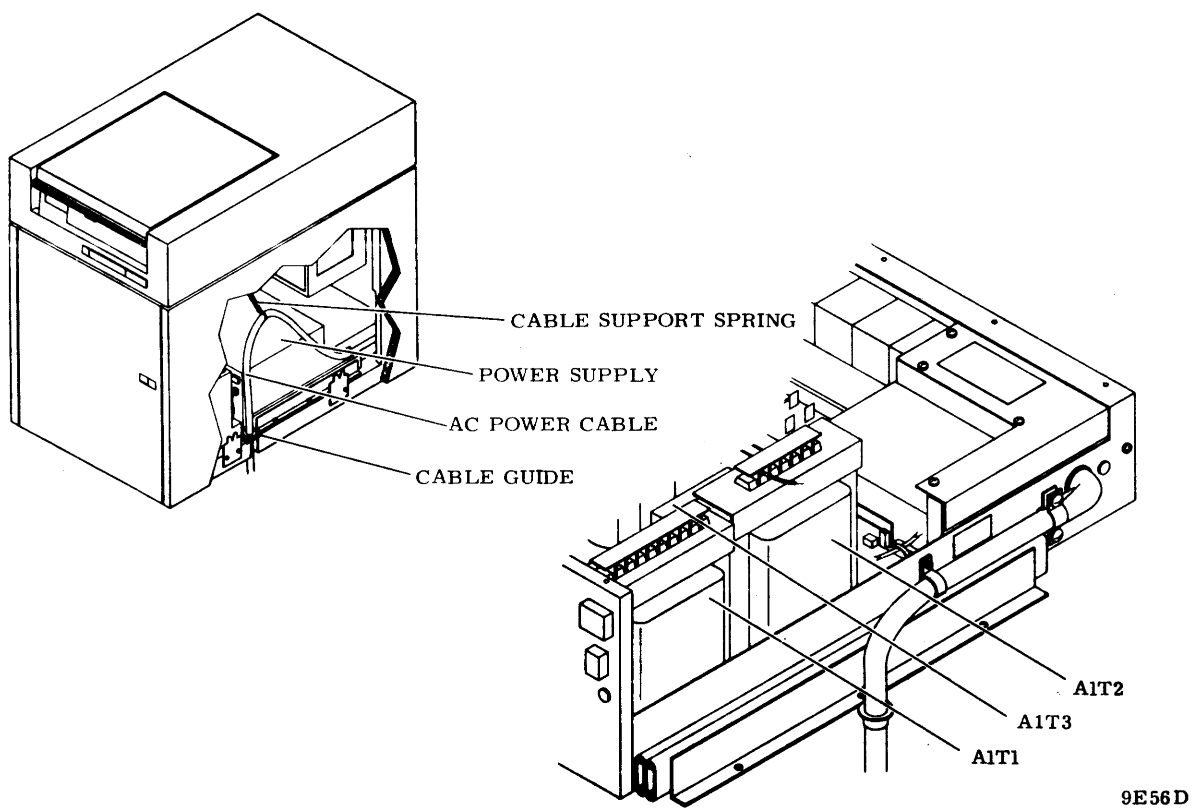


Figure 1-7. Power Cable Routing (Non-VDE)

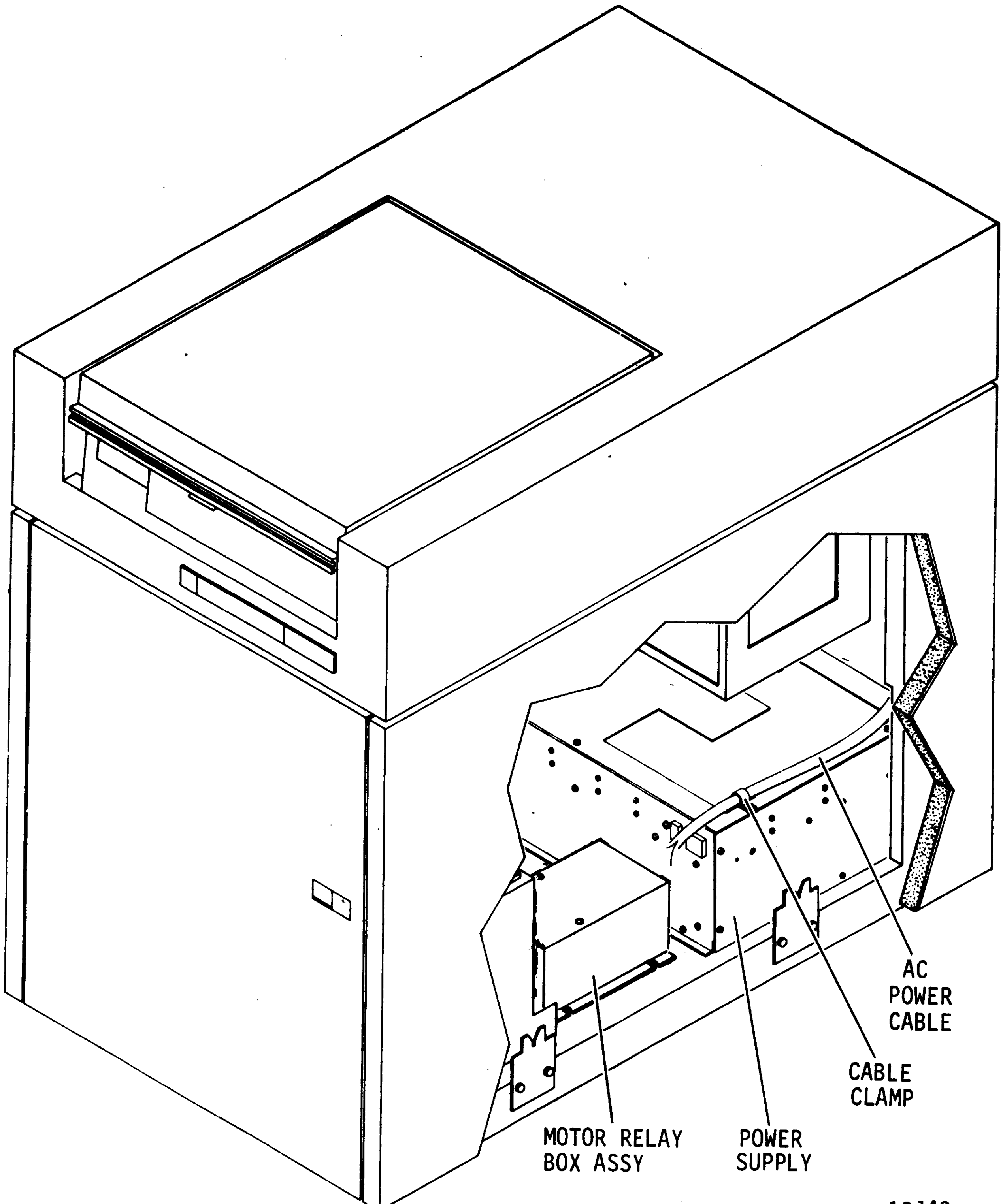


Figure 1-8. Power Cable Routing (VDE)

POWER CABLE ROUTING (NON-VDE)

The power supply shown in figure 1-7 is factory wired to accept 208 volts, 60 Hz, or 220 volts, 50 Hz input power. It is possible to rewire 60 Hz units to accept 230 volts, and 50 Hz units to accepts 240 volts by moving wires on transformers A1T1, A1T2, and A1T3. Refer to figure 1-7. The required transformer wiring for each input voltage is shown on cross reference number 803 in the logic diagrams.

CAUTION

> When changing input connections make certain that the blower motor lead remains connected to terminal 2 of transformer T2.

60 Hz drives cannot be converted to 50 Hz, and 50 Hz drives cannot be converted to 60 Hz without making transformer changes and additional wiring changes.

The drive power cable is connected and routed as follows:

1. Remove the screws securing the cable guide to the frame and remove the cable guide.
2. Route the power cable through the cable guide.
3. Position the cable guide on the frame and secure it with the mounting screws.
4. Connect the support spring to the power cable.
5. Do not connect the power cord to site power source at this time. All other cabling should be performed first.

POWER CABLE ROUTING (VDE)

The power supply shown in figure 1-8 is factory-wired for 208-V, 60 Hz or 220-V, 50 Hz. Wiring options are: 200-V, 50 or 60 Hz; 230-V, 60 Hz. Drive power wiring must match the site power source.

CAUTION

> When changing input connections make certain that blower motor lead remains connected to transformer T2 taps as follows: For 50 Hz: tap 4, for 60 Hz: tap 2.

If only a voltage change is required, refer to logic diagram cross reference numbers 803 and 804 for wiring information. If a change is required for 50 Hz to 60 Hz, or 60 Hz to 50 Hz, the drive motor, power cord, hour meter, and drive belt must be changed.

No special power cable routing is required. Check the power cord connection on the power supply control panel to ensure it is firmly seated. Ensure the cable is secured to the top of the power supply with a cable strap as shown in figure 1-8.

Do not connect the power cord to the site power source at this time. All other connections should be performed first.

I/O CABLE INSTALLATION

This procedure describes the installation of drive I/O cables and terminators. The person performing the installation should be familiar with the information under I/O cabling presented earlier in this section.

1. Remove power from drive by setting MAIN AC circuit breaker to off and ensure the power cord is disconnected from the site power source.

2. Remove left side panel.

CAUTION

Use care not to damage cables between I/O panel and logic chassis when performing the following steps.

3. Turn I/O panel fastener (refer to figure 1-9) counterclockwise and remove I/O panel from upright support. This will allow I/O panel to be positioned so cables can be easily installed.

4. Remove hardware securing I/O panel cover to I/O panel and remove cover.

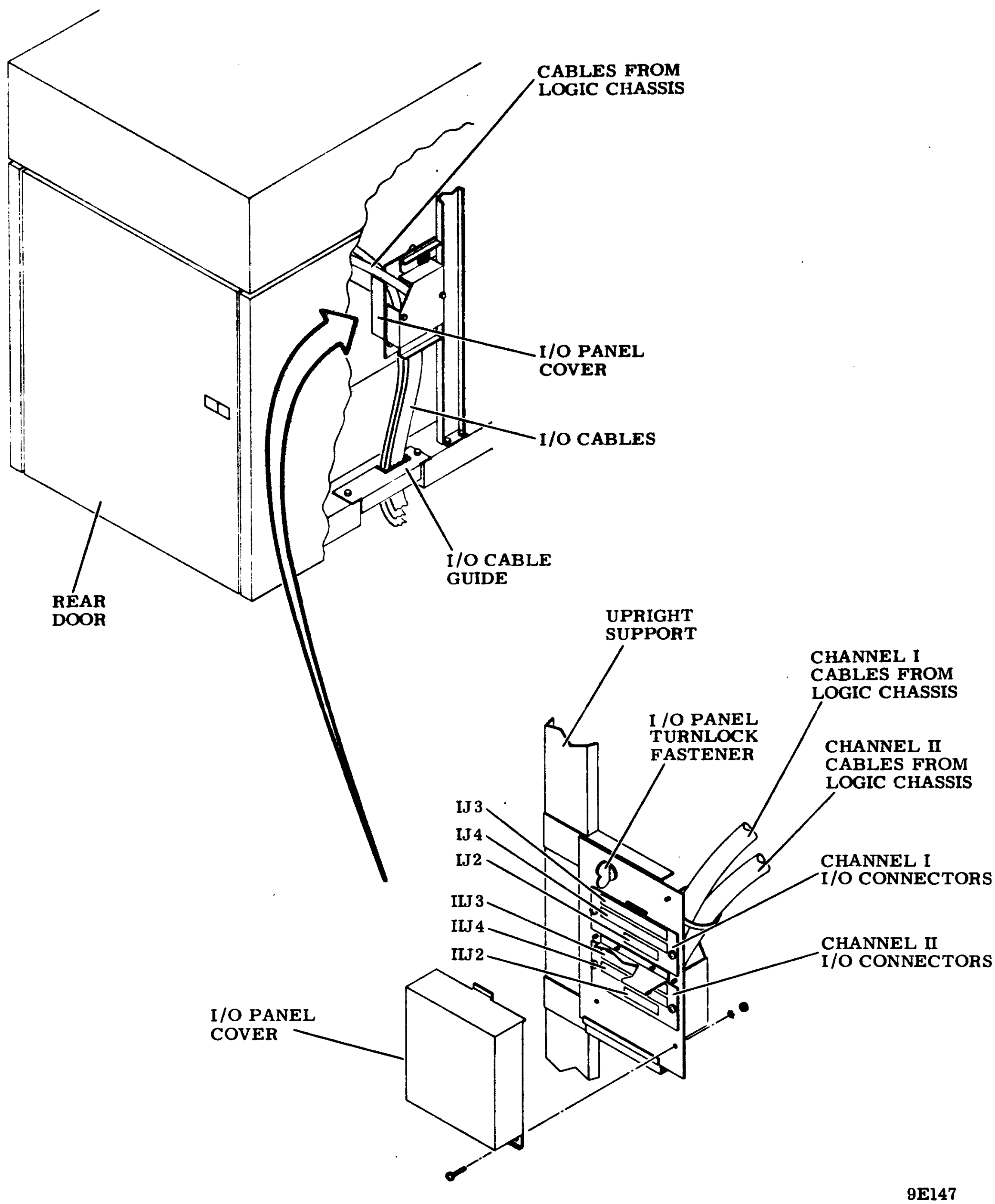


Figure 1-9. I/O Panel and I/O Cable Routing

NOTE

All cables installed in the following steps are routed through the I/O cable cutout. Also, some systems may require that specific connectors on the controller relate to specific physical drives. Consult controller manual for information relating to I/O connections. See figure 1-3 for a diagram of I/O cable connections.

5. Connect B cable between controller and drive connector IJ2. For dual channel drives connect a second B cable between channel II controller and drive connector IIJ2.

NOTE

Steps 6 and 7 apply only to systems using star I/O cabling configuration.

6. Connect A cable from controller to drive connector IJ3. For dual channel drives connect a second A cable from channel II controller to drive connector IIJ3.

7. Install terminator on IJ4. For dual channel drives install a second terminator on IIJ4. Proceed to step 12.

NOTE

Steps 8 through 10 apply only to system using daisy chain I/O cabling configuration.

8. Connect A cable from controller or connector IJ4 on upstream drive (drive closest to controller on daisy chain) to drive connector IJ3. For dual channel drives connect a second A cable from channel II controller or upstream drive to drive connector IIJ3.

NOTE

If drive is not last in daisy chain string, perform step 9. If drive is last in daisy chain string, perform step 10.

9. Connect another A cable from drive connector IJ4 to down stream drive connector IJ3. For dual channel drives connect another A cable from drive connector IIJ4 to down stream drive connector IIJ3.

10. Install terminator on IJ4. For dual channel drives install a second terminator on IIJ4.

11. Replace I/O panel cover on I/O panel and secure with hardware removed in step 4. Tighten cover so that cables are securely held but not so much as to damage them.

12. Position I/O panel on upright support and secure with I/O panel fastener.

13. Replace left side panel.

CONVERTING SECTOR AND INDEX SIGNALS

Series code 22 and below units may have Sector and Index on either the A or B cable. Units having Sector and Index on the A cable can be converted to Sector and Index on the B cable by installing a special option (SPO). Units having Sector and Index on the B cable cannot be converted.

Series code 23 and above units are shipped with Sector and Index on the A cable. Units can be converted to Sector and Index on the A or B cable by performing the following steps:

1. Open rear door and set MAIN AC circuit breaker to OFF.

2. Locate connector PD90. (PD90 is tied back into I/O cable).

CAUTION

Be careful not to cut or damage other wires when cutting cable tie.

3. Cut cable tie securing PD90 to I/O cable.

4. Plug PD90 into JD90 on logic backpanel (located in lower right corner of backpanel). Be sure connector is seated correctly.

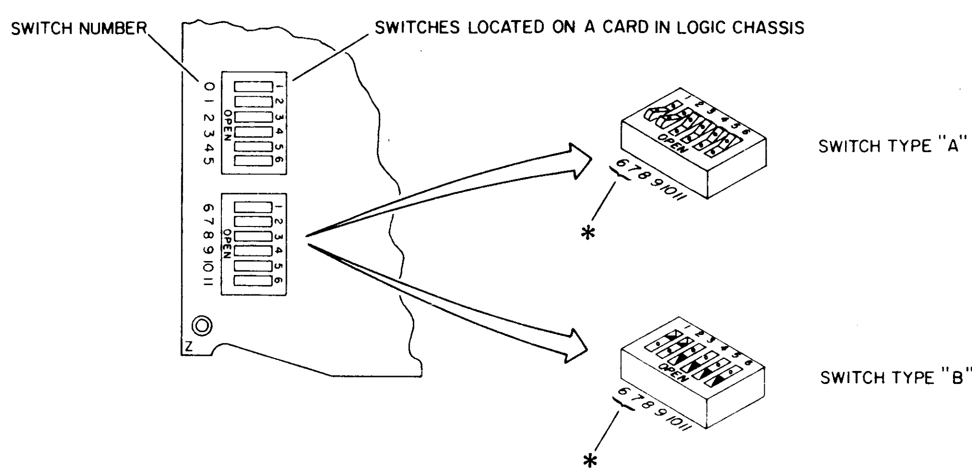
5. Set MAIN AC circuit breaker to ON.

6. Close rear door.

SETTING SECTOR SELECT SWITCHES

The number of sectors per revolution generated by the drive logic must be matched to that required by the controller. Therefore, sector select switches are provided in the drive logic to allow selection of different sector counts. These switches are located on logic card A2A06 and appear as shown in figure 1-10.

ROCKER-TYPE SWITCHES

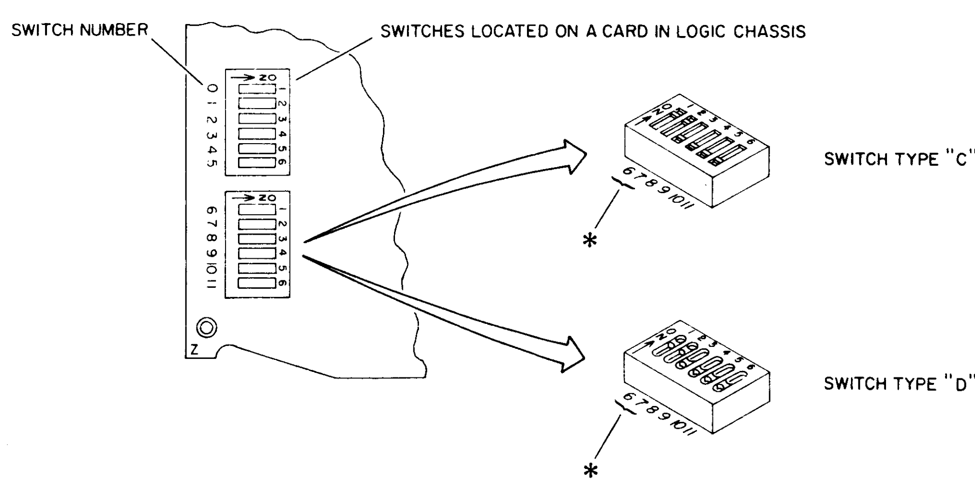


ROCKER-TYPE SWITCHES:

TO ACTUATE A SWITCH TO ITS CLOSED POSITION,
PRESS ON END OF SWITCH FARTHEST FROM "OPEN" LETTERING.

* SWITCHES 6 AND 7 SHOWN IN CLOSED POSITION.

SLIDE-TYPE SWITCHES



SLIDE-TYPE SWITCHES:

TO ACTUATE A SWITCH TO ITS ON POSITION,
SLIDE SWITCH IN DIRECTION OF ARROW SHOWN ON SWITCH.

* SWITCHES 6 AND 7 SHOWN IN ON POSITION.

9H10B

Figure 1-10. Sector Select Switches

Refer to the subsystem reference manual to determine the number of sectors required by the controller; and then locate that number in table 1-7. Across from the number of sectors listed in the table is a row of Cs and Os. C represents the Closed or On position of the sector switch. O represents the Open or Off position of the sector switch. Set the switches to the positions designated in the table while referring to figure 1-10 for an illustration of the switch positions.

TABLE 1-7. SECTOR SELECT SWITCH SETTINGS

Number of Sectors	Switch Number											
	0	1	2	3	4	5	6	7	8	9	10	11
4	C	C	C	C	C	O	O	O	C	O	C	C
5	C	C	C	C	C	C	C	O	O	C	O	C
6	C	C	C	C	C	C	O	C	O	O	O	C
7	C	C	C	C	C	C	C	O	C	C	C	O
8	C	C	C	C	O	O	O	C	O	C	C	O
9	O	O	C	O	C	O	C	C	C	O	C	O
10	C	C	C	C	C	C	O	O	C	O	C	O
11	O	O	C	O	O	O	C	C	O	O	C	O
12	C	C	C	C	C	O	C	O	O	O	C	O
13	O	O	O	C	O	O	O	O	O	O	C	O
14	C	C	C	C	C	C	O	C	C	C	O	O
15	C	C	C	C	C	C	C	O	C	C	O	O
16	C	C	C	O	O	O	C	O	C	C	O	O
17	C	O	C	O	C	O	O	O	C	C	O	O
18	C	O	O	C	O	C	C	C	O	C	O	O
19	O	C	O	O	O	O	C	C	O	C	O	O
20	C	C	C	C	C	O	O	C	O	C	O	O

Table Continued on Next Page

TABLE 1-7. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number 0	1	2	3	4	5	6	7	8	9	10	11
21	C	C	C	C	C	C	C	O	O	C	O	O
22	C	O	O	O	O	C	C	O	O	C	O	O
23	C	C	C	O	O	O	C	O	O	C	O	O
24	C	C	C	C	O	C	O	O	O	C	O	O
25	O	O	O	C	C	O	O	O	O	C	O	O
26	C	C	O	O	O	O	O	O	O	C	O	O
27	O	O	O	O	C	C	C	C	C	O	O	O
28	C	C	C	C	C	O	C	C	C	O	O	O
29	O	C	C	C	O	O	C	C	C	O	O	O
30	C	C	C	C	C	C	O	C	C	O	O	O
31	O	O	O	O	C	C	O	C	C	O	O	O
32	C	C	O	O	O	C	O	C	C	O	O	O
33	O	C	C	O	C	O	O	C	C	O	O	O
34	O	C	O	C	O	O	O	C	C	O	O	O
35	C	C	C	C	C	C	C	O	C	O	O	O
36	O	O	C	O	C	C	C	O	C	O	O	O
37	O	C	O	C	O	C	C	O	C	O	O	O
38	O	O	O	O	O	C	C	O	C	O	O	O
39	C	C	C	O	C	O	C	O	C	O	O	O
40	C	C	C	C	O	O	C	O	C	O	O	O
41	O	C	C	O	O	O	C	O	C	O	O	O
42	C	C	C	C	C	C	O	O	C	O	O	O
43	C	C	C	O	C	C	O	O	C	O	O	O
44	O	O	O	O	C	C	O	O	C	O	O	O
45	C	O	O	C	O	C	O	O	C	O	O	O

Table Continued on Next Page

TABLE 1-7. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number 0	1	2	3	4	5	6	7	8	9	10	11
46	C	C	O	O	O	C	O	O	C	O	O	O
47	O	O	C	C	C	O	O	O	C	O	O	O
48	C	C	C	O	C	O	O	O	C	O	O	O
49	C	O	O	O	C	O	O	O	C	O	O	O
50	C	C	O	C	O	O	O	O	C	O	O	O
51	O	C	C	O	O	O	O	O	C	O	O	O
52	C	O	O	O	O	O	O	O	C	O	O	O
53	O	O	C	C	C	C	C	C	O	O	O	O
54	C	C	C	O	C	C	C	C	O	O	O	O
55	C	C	O	O	C	C	C	C	O	O	O	O
56	C	C	C	C	O	C	C	C	O	O	O	O
57	O	C	O	C	O	C	C	C	O	O	O	O
58	O	C	C	O	O	C	C	C	O	O	O	O
59	O	C	O	O	O	C	C	C	O	O	O	O
60	C	C	C	C	C	O	C	C	O	O	O	O
61	C	C	O	C	C	O	C	C	O	O	O	O
62	C	C	C	O	C	O	C	C	O	O	O	O
63	O	O	C	O	C	O	C	C	O	O	O	O
64	C	O	O	O	C	O	C	C	O	O	O	O
65	C	O	C	C	O	O	C	C	O	O	O	O
66	O	C	O	C	O	O	C	C	O	O	O	O
67	C	C	C	O	O	O	C	C	O	O	O	O
68	O	O	C	O	O	O	C	C	O	O	O	O
69	C	O	O	O	O	O	C	C	O	O	O	O
70	C	C	C	C	C	C	O	C	O	O	O	O

Table Continued on Next Page

TABLE 1-7. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number											
	0	1	2	3	4	5	6	7	8	9	10	11
71	O	O	C	C	C	C	O	C	O	O	O	O
72	C	O	O	C	C	C	O	C	O	O	O	O
73	C	C	C	O	C	C	O	C	O	O	O	O
74	O	O	C	O	C	C	O	C	O	O	O	O
75	O	C	O	O	C	C	O	C	O	O	O	O
76	C	C	C	C	O	C	O	C	O	O	O	O
77	C	O	C	C	O	C	O	C	O	O	O	O
78	C	C	O	C	O	C	O	C	O	O	O	O
79	C	O	O	C	O	C	O	C	O	O	O	O
80	C	C	C	O	O	C	O	C	O	O	O	O
81	O	O	C	O	O	C	O	C	O	O	O	O
82	O	C	O	O	O	C	O	C	O	O	O	O
83	O	O	O	O	O	C	O	C	O	O	O	O
84	C	C	C	C	C	O	O	C	O	O	O	O
85	C	O	C	C	C	O	O	C	O	O	O	O
86	C	C	O	C	C	O	O	C	O	O	O	O
87	C	O	O	C	C	O	O	C	O	O	O	O
88	C	C	C	O	C	O	O	C	O	O	O	O
89	O	C	C	O	C	O	O	C	O	O	O	O
90	O	O	C	O	C	O	O	C	O	O	O	O
91	O	C	O	O	C	O	O	C	O	O	O	O
92	C	O	O	O	C	O	O	C	O	O	O	O
93	C	C	C	C	O	O	O	C	O	O	O	O
94	C	O	C	C	O	O	O	C	O	O	O	O
95	O	O	C	C	O	O	O	C	O	O	O	O

Table Continued on Next Page

TABLE 1-7. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number 0	1	2	3	4	5	6	7	8	9	10	11
96	C	C	O	C	O	O	O	C	O	O	O	O
97	C	O	O	C	O	O	O	C	O	O	O	O
98	O	O	O	C	O	O	O	C	O	O	O	O
99	O	C	C	O	O	O	O	C	O	O	O	O
100	C	O	C	O	O	O	O	C	O	O	O	O
101	O	O	C	O	O	O	O	C	O	O	O	O
102	O	C	O	O	O	O	O	C	O	O	O	O
103	C	O	O	O	O	O	O	C	O	O	O	O
104	O	O	O	O	O	O	O	C	O	O	O	O
105	C	C	C	C	C	C	C	O	O	O	O	O
106	C	O	C	C	C	C	C	O	O	O	O	O
107	O	O	C	C	C	C	C	O	O	O	O	O
108	C	C	O	C	C	C	C	O	O	O	O	O
109	O	C	O	C	C	C	C	O	O	O	O	O
110	C	O	O	C	C	C	C	O	O	O	O	O
111	O	O	O	C	C	C	C	O	O	O	O	O
112	C	C	C	O	C	C	C	O	O	O	O	O
113	C	O	C	O	C	C	C	O	O	O	O	O
114	O	O	C	O	C	C	C	O	O	O	O	O
115	C	C	O	O	C	C	C	O	O	O	O	O
116	O	C	O	O	C	C	C	O	O	O	O	O
117	C	O	O	O	C	C	C	O	O	O	O	O
118	O	O	O	O	C	C	C	O	O	O	O	O
119	C	C	C	C	O	C	C	O	O	O	O	O
120	C	C	C	C	O	C	C	O	O	O	O	O

Table Continued on Next Page

TABLE 1-7. SECTOR SELECT SWITCH SETTINGS (Contd)

Number of Sectors	Switch Number 0	1	2	3	4	5	6	7	8	9	10	11
121	O	C	C	C	O	C	C	O	O	O	O	O
122	C	O	C	C	O	C	C	O	O	O	O	O
123	O	O	C	C	O	C	C	O	O	O	O	O
124	C	C	O	C	O	C	C	O	O	O	O	O
125	O	C	O	C	O	C	C	O	O	O	O	O
126	C	O	O	C	O	C	C	O	O	O	O	O
127	O	O	O	C	O	C	C	O	O	O	O	O
128	O	O	O	C	O	C	C	O	O	O	O	O
Note: C = Closed or On position; O = Open or Off position.												

CABINET LEVELING

Cabinet leveling is not performed until the drive is in its final location and there is no further necessity to move it.

Cabinet leveling consists of installing leveling pads, placing drive in final location, screwing down leveling pads until drive is aligned with other equipments, and weight is off casters.

1. Install jam nut on each leveling pad and install a leveling pad at each corner of cabinet frame (see figure 1-11) by raising corner of cabinet and threading leveler into weldnut on frame.

2. Locate drive in final position.

3. Turn leveling pads down until they support drive's weight.

4. Adjust leveling pads until drive is aligned with adjacent equipment.

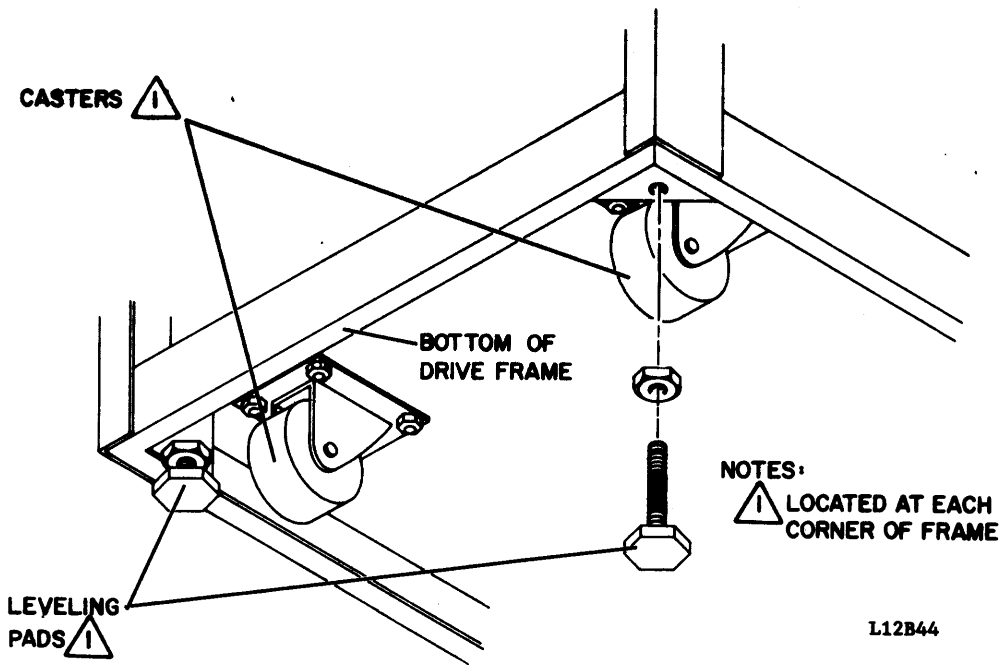


Figure 1-11. Leveling Procedure

5. Place spirit level on drive top cover and adjust leveling pads until drive is level within three angular degrees both front to back and side to side.

6. When drive is level in both directions, tighten jam nut against bottom of frame.

INITIAL CHECKOUT AND STARTUP

This procedure describes checks that must be performed on the drive prior to putting it online. Before starting make sure that the drive has been unpacked and installed in its normal operating position, all grounding power and I/O connections have been made, and sector switches have been set.

1. Set all circuit breakers to off.

NOTE

Non-VDE: To gain access to the pack area while the drive is powered down, pull down on the solenoid latch and up on the pack access cover latch release.

VDE: To gain access to the pack area it is necessary to have the main circuit breaker on for at least 30 seconds.

2. Perform Clean Shroud and Spindle procedure (refer to Preventive Maintenance section 3).

3. Open cabinet rear door, release logic chassis catch and swing logic chassis open.

4. Remove logic chassis card cover and verify that all cards are firmly seated in their connectors.

5. Verify that all connectors are firmly seated on the backpanel pins, and check for loose or broken wires.

6. Open top cover and remove deck cover.

7. Verify that all cards in the read/write chassis are firmly seated in their connectors.

8. Replace deck cover and close top cover.

9. Install logical address plug in operator control panel.

10. Set all circuit breakers to on, verify that blower starts, and allow it to operate for at least 10 minutes before proceeding to step 11.

11. Install scratch disk pack.

12. Press START switch and verify the following occurs:

    a. START indicator lights.

    b. Drive motor starts and pack comes up to speed in approximately 30 seconds.

    c. Heads load when pack comes up to speed.

13. Perform following procedures:

    a. Servo System Test and Adjustment (section 4).

    b. Head Alignment (section 4).

SECTION 2

GENERAL MAINTENANCE INFORMATION

INTRODUCTION

This section contains general information relating to maintenance of the drive. A person performing maintenance on the drive should be familiar with this information in addition to the operating principles and procedures described in the hardware reference manual.

The information in this section is divided into the following areas:

- Safety Precautions - Lists safety precautions that must be observed when working on the drive.
- Maintenance Tools and Materials - Lists tools and materials required to perform maintenance on the drive. This includes discussions on the types of disk packs used during maintenance procedures, the head alignment kit card which is used during head alignment, and the use of test software or field test unit for performing drive test and adjustments.
- Accessing Drive for Maintenance - Describes features of the drive which allow convenient access to its assemblies for maintenance.
- Maintenance Controls and Test Points - Describes location of test points (both on cards and backpanel) referred to in maintenance procedures.
- Manually Positioning Carriage - Describes how heads may be loaded and positioned manually.
- Special Maintenance Procedures and Practices - Describes certain procedures and practices that are important to proper maintenance of the drive.
- Head Crash Prevention - Describes the steps that should be taken to avoid head crashes.

SAFETY PRECAUTIONS

WARNING

> The following topic provides warnings and precautions that must be observed during maintenance. Refer also to Important Safety Information and Precautions located in the front of this manual following the table of contents. Failure to observe the warnings, precautions, and other safety information provided in this manual could result in personal injury.

Observe the following safety precautions at all times. Failure to do so may cause equipment damage and/or personal injury.

- Use care while working with power supply. Line voltages are present inside the ac power assembly.
- Keep hands away from actuator during seek operations and when reconnecting leads to voice coil. (Under certain conditions, emergency retract voltage may be present, causing sudden reverse motion and head unloading.)
- Use caution while working near heads. If heads are touched, fingerprints can damage them. Clean heads immediately if they are touched.
- Keep pack access cover closed unless it must be open for maintenance. This prevents entrance of dust into pack area.
- Keep all watches, disk packs, meters, and other test equipment at least two feet away from voice coil magnet when deck cover is off.
- Do not use customer disk pack; otherwise, customer data may be destroyed.
- Do not use CE alignment disk pack unless specifically directed to do so. These packs contain prerecorded alignment data that can be destroyed if test procedure requires drive to write. This alignment data cannot be generated in the field.
- If drive fails to power down when START switch is pressed (to turn off indicator) disconnect yellow leadwire to voice coil and manually retract heads before troubleshooting malfunction.

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- Make certain that heads are unloaded before turning off power.
- If power to drive motor is lost while heads are loaded and voice coil leadwire is disconnected, immediately retract carriage. Otherwise heads will crash when disk speed is insufficient to enable heads to fly.
- Observe safety precautions described in discussion on Handling Electrostatic Devices when working on _YFN card in power supply or this card may be damaged.

MAINTENANCE TOOLS AND MATERIALS

GENERAL

When performing preventive and corrective maintenance on the drive, certain special tools, test equipment and materials are required. These are listed in table 2-1 along with their CDC part numbers.

Most of these items require no special instructions for their use, and where special instructions are necessary, they are included in the maintenance procedures. However, several of the items in table 2-1 do require more explanation than is included in the maintenance procedures. These are the disk pack, head alignment kit, and field test unit which are described in the following discussions (note that these discussions also describe the use of test software which may be used instead of the field test unit).

DISK PACK

The maintenance procedures refer to three types of disk packs: (1) customer (2) scratch and (3) CE. All three are physically identical, but are used for different purposes.

A customer disk pack refers to a pack used by the customer for data storage during normal online operations.

The CE pack contains special prerecorded information used during maintenance; therefore, be careful that this data is not destroyed or altered.

A scratch pack is simply a disk pack that does not contain customer or other information that must not be destroyed. Therefore, a scratch pack can be used in maintenance procedures where a danger exists that the pack could be damaged or its information altered or destroyed.

Information regarding disk pack installation and removal is contained in the hardware reference manual.

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TABLE 2-1. MAINTENANCE TOOLS AND MATERIALS

Description	CDC Part Number
Adapter (3/16 Hex to 1/4 Sq)	CDC* 12262582
Adhesive, 3M FC1711 5 oz. tube (used to secure gasket to P.A. Cover Insert)	95017301
Adhesive, Sealant	CDC 95125321
Ball End Hex Driver (3/16 Hex)	CDC 12263201
Blank Tab Card (Computer Punch Card)	CDC 70631686
Bonding Agent (Fast Setting)	CDC 95033900
Bonding Agent	CDC 95033926
Card Extender (Full-Size)	CDC 54109701
Card Extraction Tool	CDC 87399200
Carriage Alignment Arm	CDC 75018400
Chip Extender (Chipclip)	CDC 12212196
Cloth, Lint Free	CDC 94211400
Disk Pack, CE (883-51)	CDC 70430003
Disk Pack, Regular *883-91	CDC 70430513
Dust Remover ***	CDC 95047800
Epoxy (Fast Cure)	CDC 12210960
Field Test Unit (TB216)	CDC 75144000
Gauze, Lint Free	CDC 12209713
Grease, Silicone	CDC 95109000

Table Continued on Next Page

TABLE 2-1. MAINTENANCE TOOLS AND MATERIALS (Contd)

Description	CDC Part Number
Head Adjustment Tool	CDC 75018803
Head Alignment Kit	CDC 77440503
Head Cleaning Solution	CDC 82365800
High Intensity Light****	CDC 12212038
Hose Assembly	CDC 82346500
I/O Pin Removal	CDC 12212759
Loctite, Grade C	Loctite Corp.
Loctite Primer, Grade N	Loctite Corp.
Lubricant Paste	CDC 95016101
Mirror	Commercially available
Non-Metallic Feeler Gage, 0.005 inch	CDC 12205633
Oscilloscope, Dual Trace	Tektronix 454 or equivalent
Oscilloscope Hood 016-0083-00	Tektronix
Pin Straightener	CDC 87369400
Pressure Gauge Kit, Differential (Optional)	CDC 73040100
Punch Card	NONE
Push-Pull Gage	CDC 12210797
Scope Probe Tip (Hatchet Type)	CDC 12212885

Table Continued on Next Page

TABLE 2-1. MAINTENANCE TOOLS AND MATERIALS (Contd)

Description	CDC Part Number
Sealant, Silicone, Rubber	CDC 95023500
Puller, Spring	CDC 84480900
Static Ground Wrist Strap	CDC 12263496
Static Shielding Bag	CDC 12263626
Thread Locking Compound, 50 ml bottle (Used to secure nuts to shroud window)	CDC 95059905
Torque Screwdriver **	CDC 92016400
Torque Screwdriver Bit **	CDC 87016701
Torque Wrench, 1/4 inch	CDC 92016400
Volt/ohmmeter	Ballantine 345 or equivalent digital voltmeter
Wire Wrap Bit, 30 Gage	CDC 12218402
Wire Wrap Gun, Electrical	CDC 12259111
Wire Wrap Removal Tool 20-30 Gage	CDC 12259183
Wire Wrap Sleeve, 30 Gage	CDC 12218403

* CDC is a registered trademark of Control Data Corporation.

** Torque Screwdriver and bit are used for tightening head clamping hardware.

*** Used for head cleaning.

**** Works only with 120 V, 60 Hz. For other voltages and frequencies, use commercially available 100 or 150 watt outdoor floodlight with suitable receptacle and extension cord. Note: Light must have hard safety glass bulb and all items must be rated for use with applicable source power.

HEAD ALIGNMENT KIT

The head alignment kit is used whenever the heads are aligned by the use of test software. The kit consists of a null meter which gives a visual indication of head alignment, a card which processes alignment information from the heads so it can be used by the meter, and a cable which carries alignment information from the heads to the card. Each of these are shown in figure 2-1 and explained in the following paragraphs.

The head alignment card develops an output voltage which is derived from the output of the servo and read/write preamplifiers. When a CE disk pack is installed on the drive, this output voltage is proportional to the distance a selected head is offset from the track centerline. The head alignment card plugs into card location A16 in the drive's logic chassis.

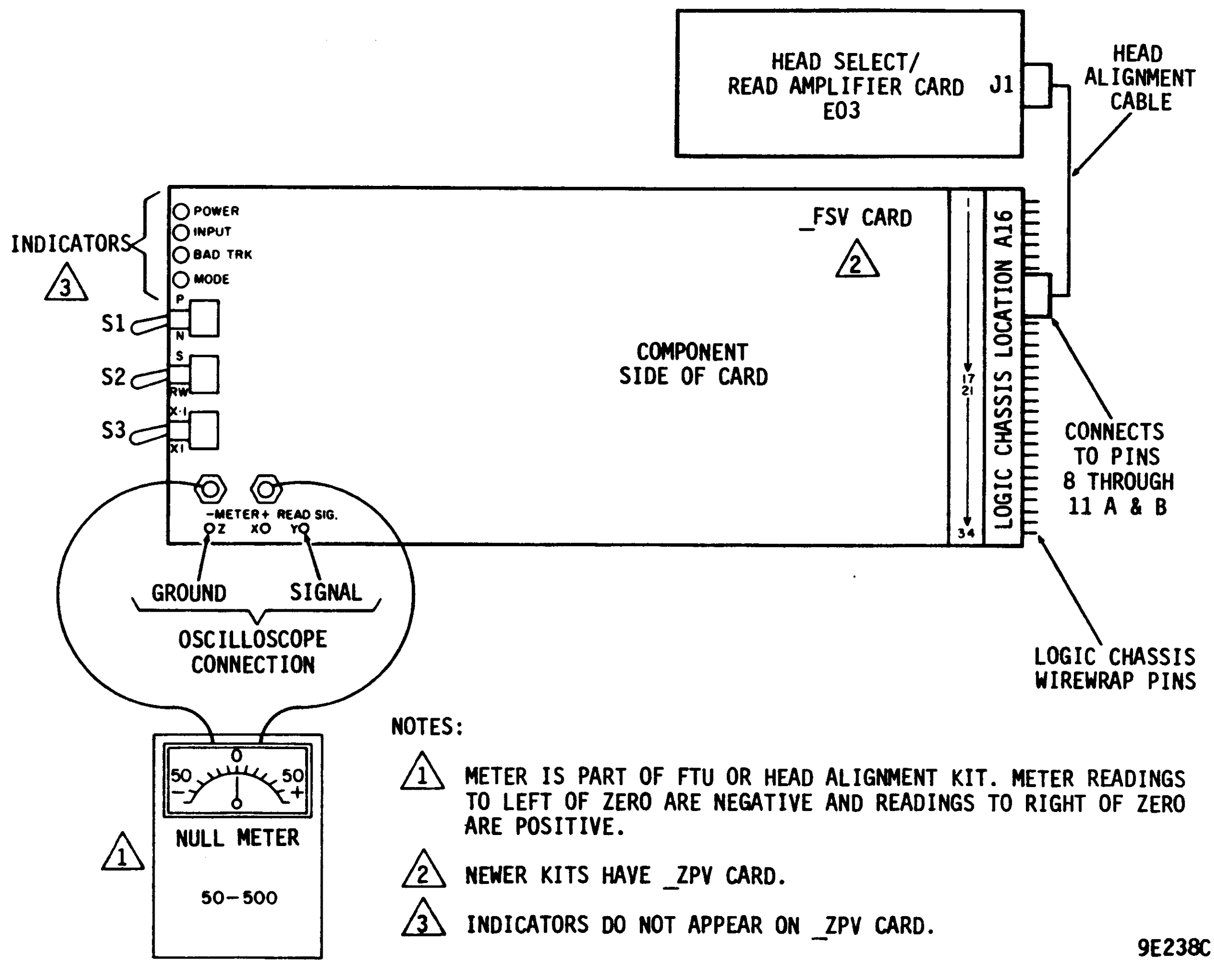


Figure 2-1. Head Alignment Kit

The head alignment card included in the kit is either the _FSV card or the _ZPV card. The only difference between the cards is that the _ZPV card does not have the four indicators found on the _FSV card (see figure 2-1).

The following toggle switches control the cards operation (refer to figure 2-1).

S1- Changes the polarity of the alignment signal and is used in aligning both servo and read/write heads. This is done as follows:

a. Note null meter reading or LED display when switch is in P position.

b. Note null meter reading or LED display when switch is in N position.

NOTE

Refer to FTU manual to determine how to decode the LED display readout.

c. Subtract N reading from P reading to determine alignment error. For example: If P=+30 mV and N=-40 mV then P - N = (+30) - (-40) = +70 mV.

S2- When switch is in S position, the card selects the servo head as an input to the card. When switch is in R/W position it selects a data head input to the card.

S3- Changes sensitivity of card. When in X.1 position, the cards sensitivity is reduced by a factor of 10. When in X1 position, the cards sensitivity is not reduced. This switch should be in X1 position when making measurements for use in calculating head alignment error.

Four indicators are provided on the _FSV card (but not on the _ZPV card) as monitors to ensure the card is operating properly and is receiving the proper data. These indicators are as follows:

Power - When lighted, it indicates power is applied to card.

Input - When lighted, it indicates the input signals are too low for the alignment card circuits to operate.

Bad Track - When lighted, it indicates a short duration loss of input. A one shot maintains the lighted condition for at least four seconds. Note that this indicator lights when switch S1 is operated.

Mode - When lighted, it indicates that either switch S2 is in the S (servo) position or switch S3 is in the X.1 position. When either of these conditions exists, read/write head alignment error cannot be measured.

The card receives its inputs via the head alignment cable that is a part of the head alignment kit. This cable connects between A16, pins 8 through 11, and J1 on the read amplifier board in read/write chassis location E03.

The cards output voltage is measured by a null meter or by the FTU LED display, depending on the type of FTU that is used. In either case, the voltage is connected to the alignment card via test leads from test points X and Z.

The null meter may be a part of the FTU or a separate unit if the head alignment kit is used.

The switch on the meters front panel changes the sensitivity of the meter. When the switch is in the 50 position, the meter reads up to $\pm$50 mV. When the switch is in the 500 position, the meter reads up to $\pm$500 mV. This switch should be in the 50 position when making measurements for use in calculating head alignment error.

TESTING DRIVE WITH FTU OR SOFTWARE

General

A field test unit (FTU) or test software is required to perform most of the electrical tests and adjustments described in this manual. The FTU or test software provides various functions (such as seeking) which are necessary to perform the test. The following discussion describes the use of both FTU and software in testing the drive.

Testing With FTU

The FTU is an offline tester. This means the drive cannot be selected or used by the controller while tests are performed with the FTU.

It connects to the drive using the standard I/O connection or by an I/O bypass connection.

The standard I/O connection requires disconnecting the system I/O cables and connecting the FTU I/O cables in their place.

The I/O bypass connection leaves the system I/O cables in place and connects a cable from the FTU to a connector on the drive backpanel.

Both types of connections are described in the Preparation of Drive for Testing procedure. Refer to the FTU manual for more information concerning its operation, installation, and use.

Testing With Software

The drive can also be tested using microdiagnostic test routines (test software). This requires use of the controller and the appropriate software. In this type of testing, the drive communicates with the controller as during normal online operations and no special I/O connections are necessary.

The procedure for preparing the drive is the same as that for using the FTU, except for the I/O connections and is described in the Preparation of Drive for Testing procedure.

Refer to manuals or other documentation applicable to the specific system or subsystem for information concerning the test software routines.

Preparation of Drive for Testing

The following procedure prepares the drive for testing with either the FTU or software.

1. Press START switch to stop drive motor and unload heads.

   NOTE

   Disable I/O by deselecting drive at controller before performing step 2.

2. Open rear door and set MAIN AC circuit breaker to OFF.

   NOTE

   All procedures other than head alignment require installation of a scratch pack; however, head alignment requires a CE pack.

3. Raise pack access cover, remove customer disk pack and replace with either scratch pack or CE pack.

4. Close pack access cover.

5. Release logic chassis latch and swing chassis open.

NOTE

If you are using the FTU and I/O bypass connection, proceed to step 6. If you are using the FTU and standard I/O connection, proceed to step 7. If you are using test software, proceed to step 8.

6. Connect FTU I/O bypass cable from FTU to A2JA84 on drive backpanel (refer to figure 2-2), then proceed to step 8.

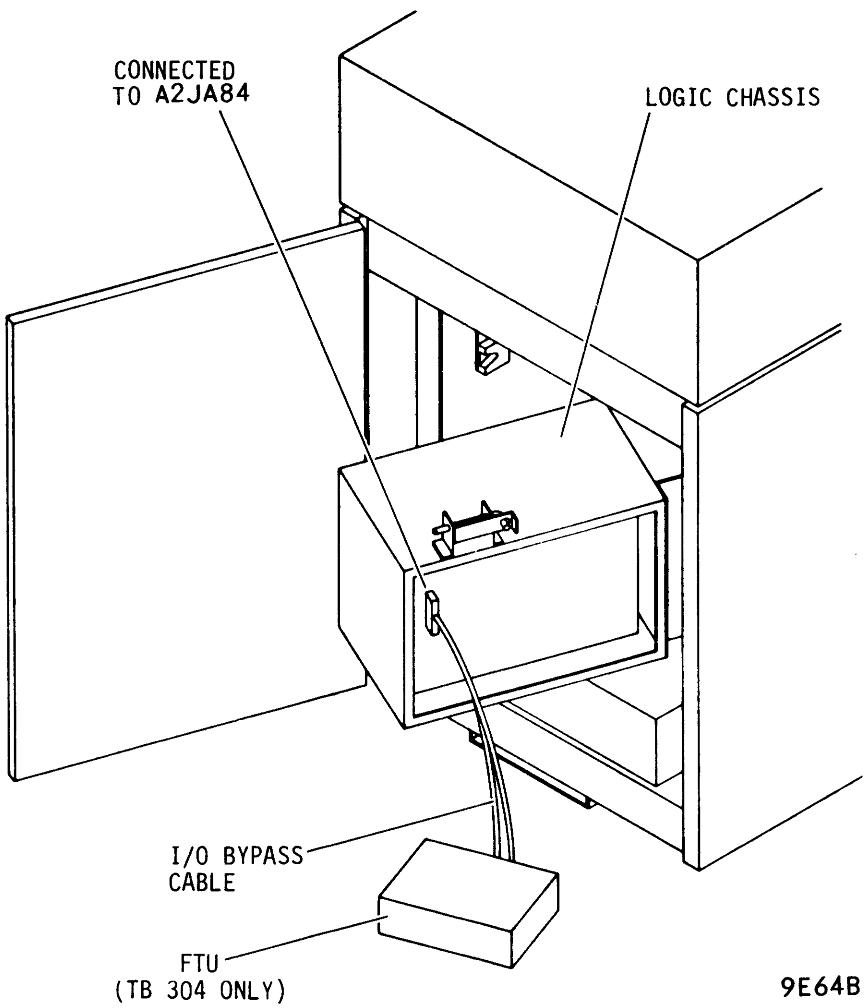


Figure 2-2. FTU to Drive I/O Bypass Connection

CAUTION

Use care not to damage cables between I/O panel and logic chassis or system I/O cables when performing step 7.

7. Connect FTU standard I/O cables to drive as follows (refer to figure 2-3 and 1-8):

   a. Turn I/O panel fastener counter-clockwise and remove panel from upright support. This will allow panel to be positioned so cables can be easily installed.

   b. Remove hardware securing I/O panel cover to I/O panel then remove cover and set it aside. Cover is not replaced until maintenance is complete.

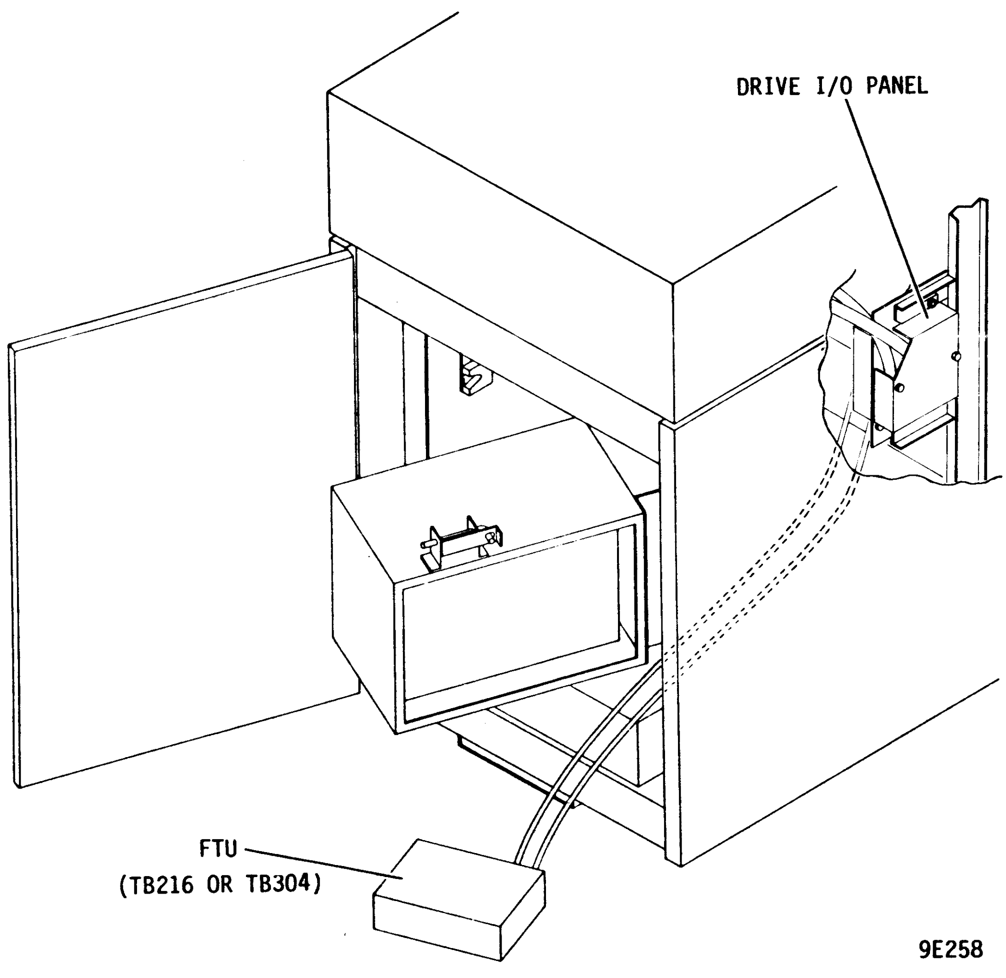


Figure 2-3. Standard I/O Connection

NOTE

Steps c through f refer to either Channel I or II connections, whichever is tested.

c. Disconnect I/O cables from J2, J3, and J4 on drive I/O panel.

d. Terminate J4.

e. Install tester A cable to J3 and B cable to J2.

f. Position I/O panel on upright support and secure with I/O panel fastener.

g. If drive is in system that is daisy chained, make necessary connections to ensure other drives remain under system control.

8. Loosen turn lock fastener securing card cage cover to logic chassis and remove cover.

9. Install card extender if test or adjustment procedure being performed requires it (this will be noted in that procedure).

10. If head alignment is being performed, proceed as follows (refer to figure 2-1):

    a. Install head alignment card in location A16.

    b. Connect head alignment cable from logic backpanel location A16 pins 8 through 11, to J1 on card E03 in read/write chassis (refer to discussion on head alignment for more information).

11. Set MAIN AC circuit breaker to on.

12. Press START switch to start drive motor and load heads.

13. Select drive (when drive is selected it is ready for tests and/or adjustments).

Preparation of Drive for Return Online After Testing

The following prepares the drive for return to normal online operation after completing tests with either FTU or software.

1. Remove power from drive as follows:

    a. Press START switch to stop drive motor and unload heads.

b. Set MAIN AC circuit breaker to off.

NOTE

If FTU with I/O bypass connection was used, proceed to step 2. If FTU with standard I/O connection was used, proceed to step 3. If test software was used, proceed to step 6.

2. Disconnect FTU I/O bypass cable from A2JA84 on drive backpanel and proceed to step 6.

3. Disconnect FTU standard I/O cables from J2 and J3 on drive I/O panel.

4. Disconnect terminator from J4 on drive I/O panel, if it was installed during testing with an FTU and is not required for normal online operation.

5. Reconnect system I/O cables to drive in same configuration as they were prior to installation of FTU.

6. If any cards were installed on card extender, remove card extender and replace card in logic chassis.

7. If head alignment was performed, remove head alignment card from location A16. Also remove head alignment cable which is connected from E03 on read/write chassis to A16 on drive backpanel.

8. Replace cover on card cage and secure with turnlock fastener.

9. Close logic chassis and rear door.

10. Close cabinet top cover (if it was open).

11. Remove scratch pack or CE pack (whichever was used).

ACCESSING DRIVE FOR MAINTENANCE

GENERAL

The drive has certain features such as doors and covers which provide easy access to its major assemblies. These features are useful when performing maintenance on the drive. Figure 2-4 shows all of these features and they are further described in the following discussions.

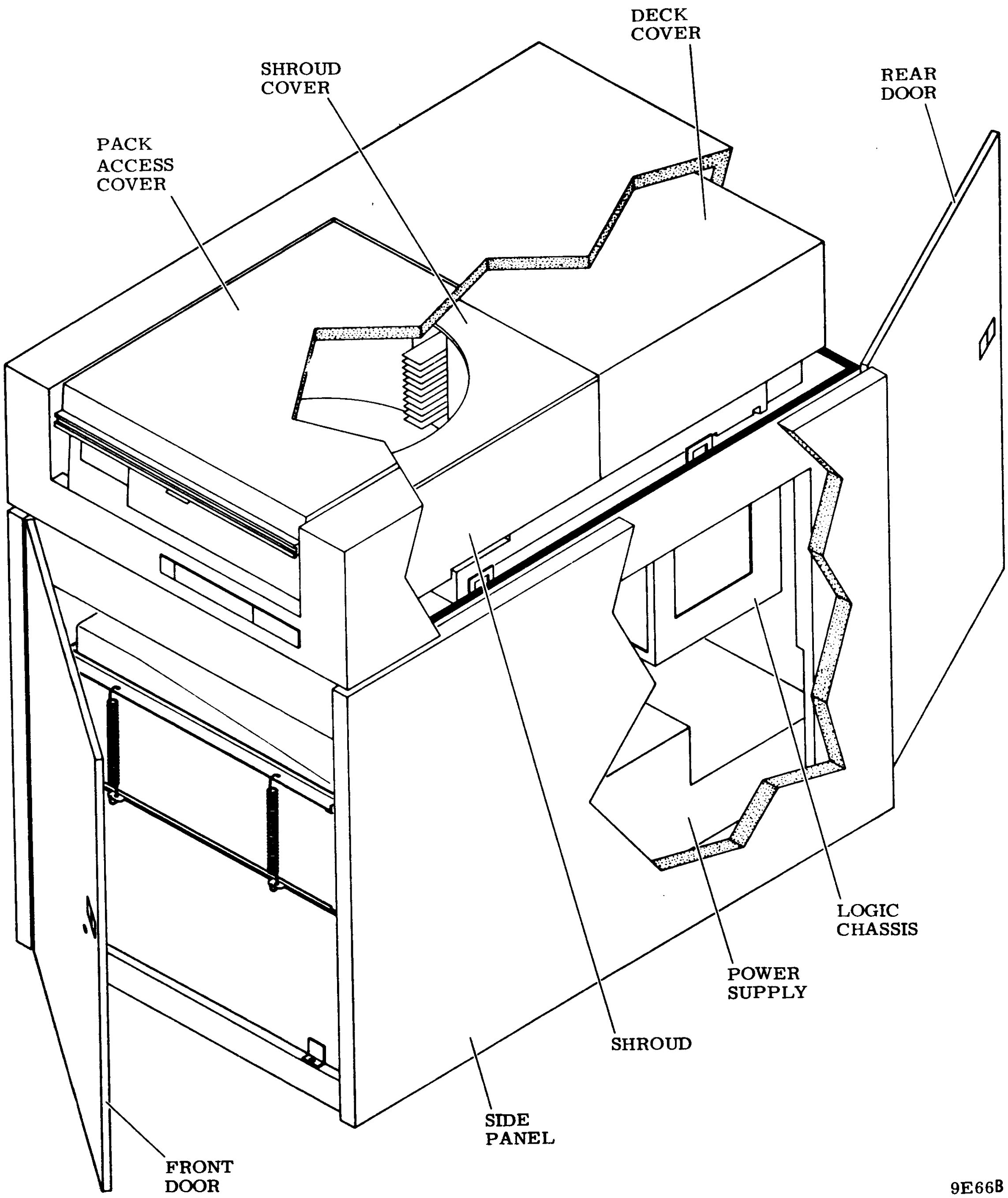


Figure 2-4. Access For Maintenance Features (NON-VDE)

CABINET DOORS

The drive has doors on both the front and rear of the cabinet (refer to figures 2-4 and 2-5). The front door provides access to the blower assembly. If the blower assembly is removed, the lower part of the spindle and its associated parts are also accessible. The rear door allows access to the logic chassis, power supply and drive motor.

The front door is opened by pushing the latch and swinging the door outward as shown in figures 2-4 and 2-5. The doors are removed by first removing the groundstrap, lifting out the pin securing the door to the lower hinge and slipping the door off the upper hinge. To replace the doors, reverse the removal procedure. The rear door on VDE units has an additional lock. To open it, insert a 6 mm hex wrench through the hole beneath the latch and turn it to release the lock.

CABINET TOP COVER

General

To gain access to the deck assemblies, raise the top cover. To remove the shroud cover, shroud or pack access cover, remove the top cover first.

Open latch (if installed) and raise top cover. The top cover is raised by lifting it from the rear and raising it until the support locks into place (refer to figure 2-6).

To raise the top cover, open the rear door first and then press the standoff fastened to the top cover latch which protrudes through the hole in the frame. While pushing on the standoff, push down on the top cover to release the latch. To lock the top cover, push it down until the latch catches.

The following procedure describes removal and replacement of the top cover. If the drive is installed inline with other drives, remove it from the inline position before removing or replacing the cover.

Top Cover Removal

1. Raise top cover until support locks it in upright position.

2. Remove groundstrap attached to side of top cover and remove nutplates from screws holding each side of top cover but do not remove screws. Cover should remain in raised position, supported by screws and support brackets.

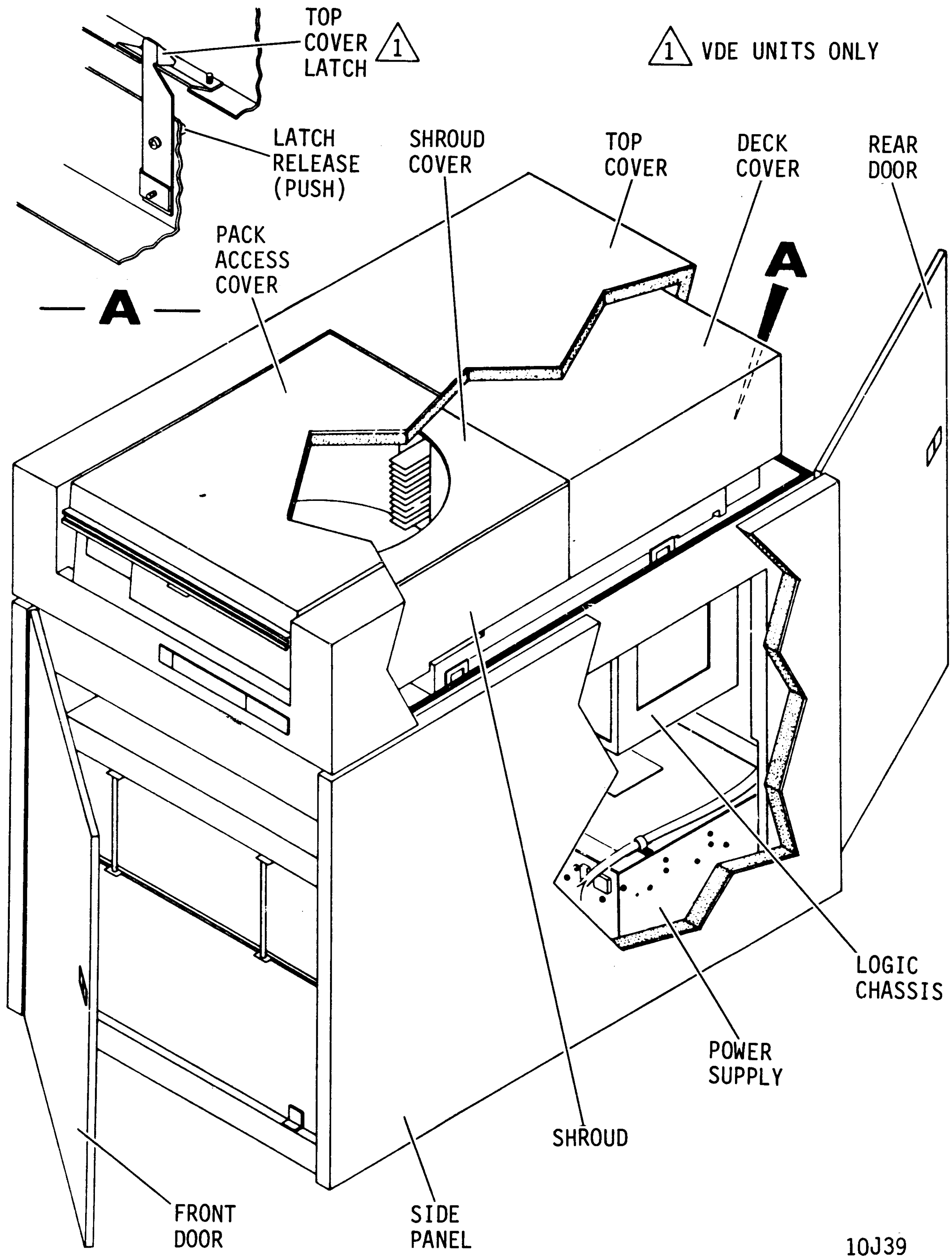


Figure 2-5. Access For Maintenance Features (VDE)

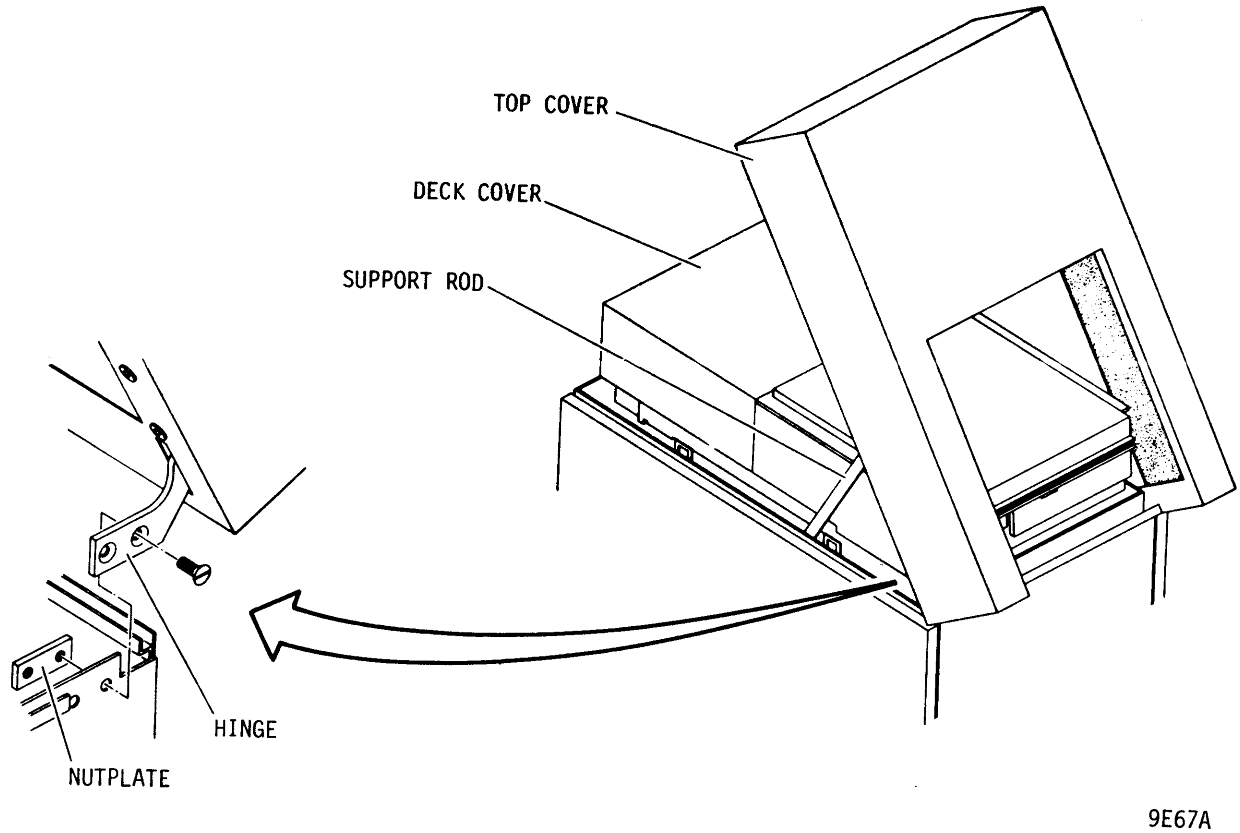


Figure 2-6. Top and Deck Cover

WARNING

When top cover is disconnected from support bracket, the possibility exists that the top cover may fall. Precautions must be taken when removing top cover to ensure that there is no injury to repair personnel or damage to the top cover.

3. Remove C clip securing support bracket to top cover, then lower support bracket and top cover to closed position.

4. Remove screws from top cover hinges and lift top cover off drive.

Top Cover Replacement

1. Set top cover on drive.

2. Insert screws through hinges and drive frame.

NOTE

> Cover should be supported by screws when it is raised in step 3.

3. Lift top cover to raised position and secure support bracket to top cover with C clip.

4. Install nutplates on screws securing hinges to frame and attach groundstrap to side of top cover.

DECK COVER

Remove the deck cover (refer to figure 2-6) to gain access to the rear half of the deck. This includes the actuator and magnet assemblies. The purpose of this cover is to provide an electromagnetic interference shield for the drive. Also, the cover is lined with acoustical foam to reduce machine noise.

Remove the cover by releasing the latches and lifting it off the deck.

LOGIC CHASSIS

To gain access to the logic chassis located at the rear of the drive, open the rear door. Releasing the catch on the logic chassis allows it to swing outward, thereby permitting access to the card cage (refer to figure 2-7). Remove the card cage cover in order to reach the logic cards. Use care when opening and closing the logic chassis not to damage the cables or air hose.

PACK ACCESS COVER

General

Raising the pack access cover allows access to the disk pack and shroud area of the drive. Once opened, the cover is held in place by a gas spring (refer to figure 2-8). A solenoid, located on the front of the shroud cover, prevents accidental opening of the pack access cover while the drive is in use or when the drive is completely powered down. In fact, the only time the cover can be opened (without overriding the solenoid) is when the MAIN AC circuit breaker is ON (providing all other

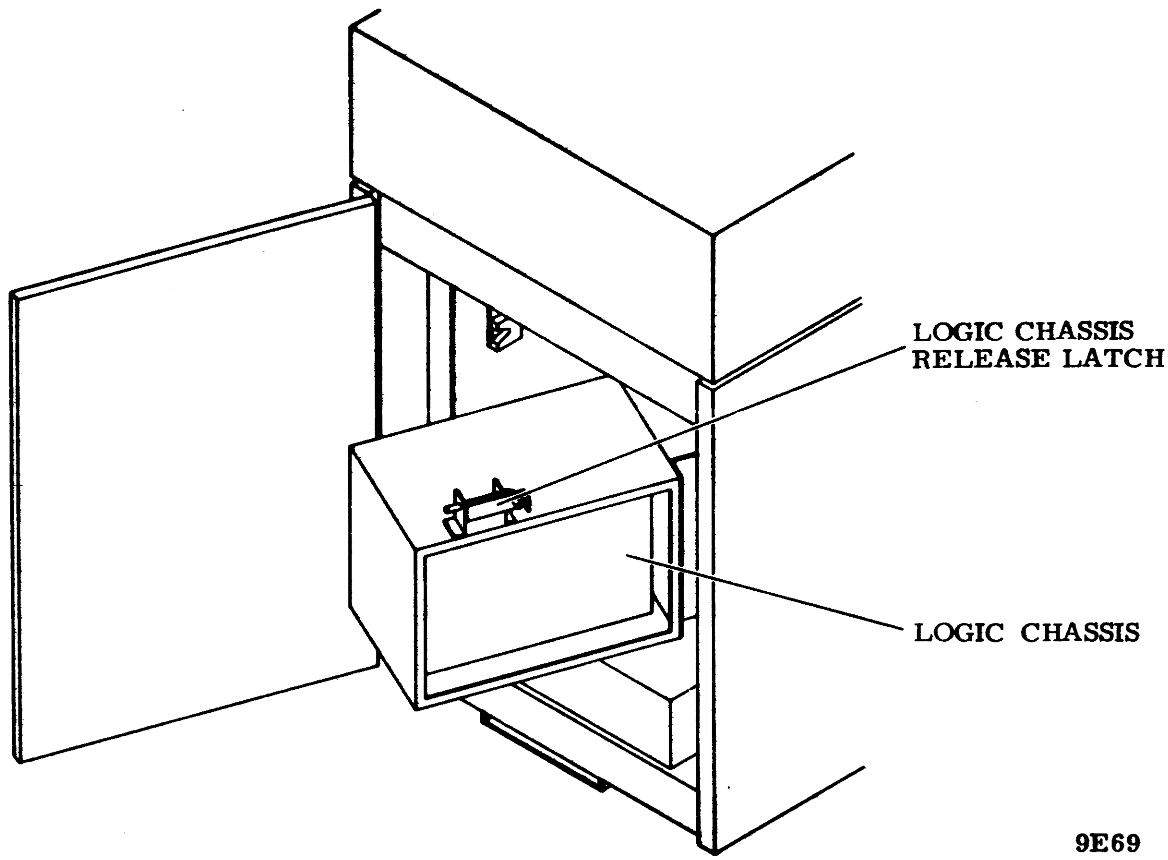


Figure 2-7. Logic Chassis

circuit breakers are on or active, or CB2 is on or active), but the START switch is Off.

The pack access cover solenoid can be manually actuated on Non-VDE units. Pull down on the solenoid latch while pulling up on the pack access cover latch release. On VDE units, the drive must be in the standby mode (power on, motor stopped) to open the cover. The pack access cover will remain locked for approximately 30 seconds after the MAIN AC circuit is turned on.

To remove and replace the pack access cover, perform the following procedures.

Pack Access Cover Removal

1. Remove cabinet top cover.

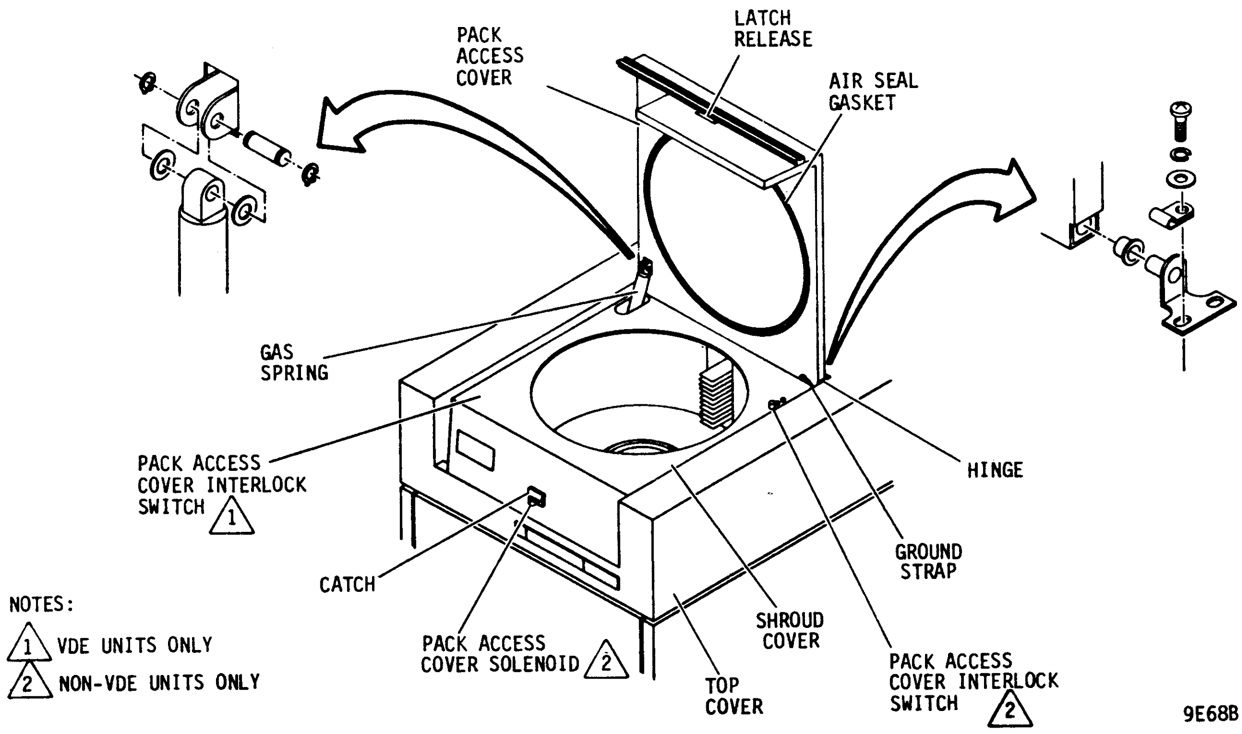


Figure 2-8. Pack Access Cover

2. Open pack access cover.

WARNING

When pack access cover is disconnected from gas spring, the possibility exists that the cover may fall. Precautions must be taken when raising the pack access cover to ensure that there is no injury to repair personnel or damage to the pack access cover.

NOTE

Use care when removing C clip to prevent loss of teflon washers.

3. Remove C clip securing gas spring to pack access cover.

4. Disconnect ground lead from pack access cover.

5. Remove hardware (on one side only) securing pack access cover hinge to shroud cover and slide pack access cover off existing secured hinge.

Pack Access Cover Replacement

1. Install pack access cover on shroud cover by securing removed hinge with nuts and screws. Before tightening screws ensure cover is approximately centered on shroud. Also ensure that clearance on front of shroud is such that the pack access cover solenoid (if installed) will engage.

2. Secure gas spring to pack access cover using pin, nylon spacers, and C clip (refer to figure 2-8).

3. Connect ground lead to pack access cover.

NOTE

> Adjustment of the solenoid is necessary if it is installed and if the catch on shroud cover is moved to ensure a proper air seal.

4. Close pack access cover.

5. Check to ensure that a tight air seal exists between pack access cover and shroud cover. Check this visually and also by noting the drag on a sheet of paper as it is pulled out from between closed pack access cover and shroud cover. Adjust if necessary by moving catch on shroud cover up or down until pack access cover latches tight enough to provide an air seal.

6. Install cabinet top cover.

POWER SUPPLY

Two types of power supplies are used in the drives. Their physical appearance and mounting methods differ significantly. The power supply shown in figure 2-9 is used on all Non-VDE units. The power supply shown in figure 2-10 is used on all VDE units.

Non-VDE Power Supply Access

The power supply is mounted on slides at the bottom rear of the drive cabinet. The slides allow the power supply to be slid out to a position convenient for maintenance. Put the supply in the maintenance position as follows:

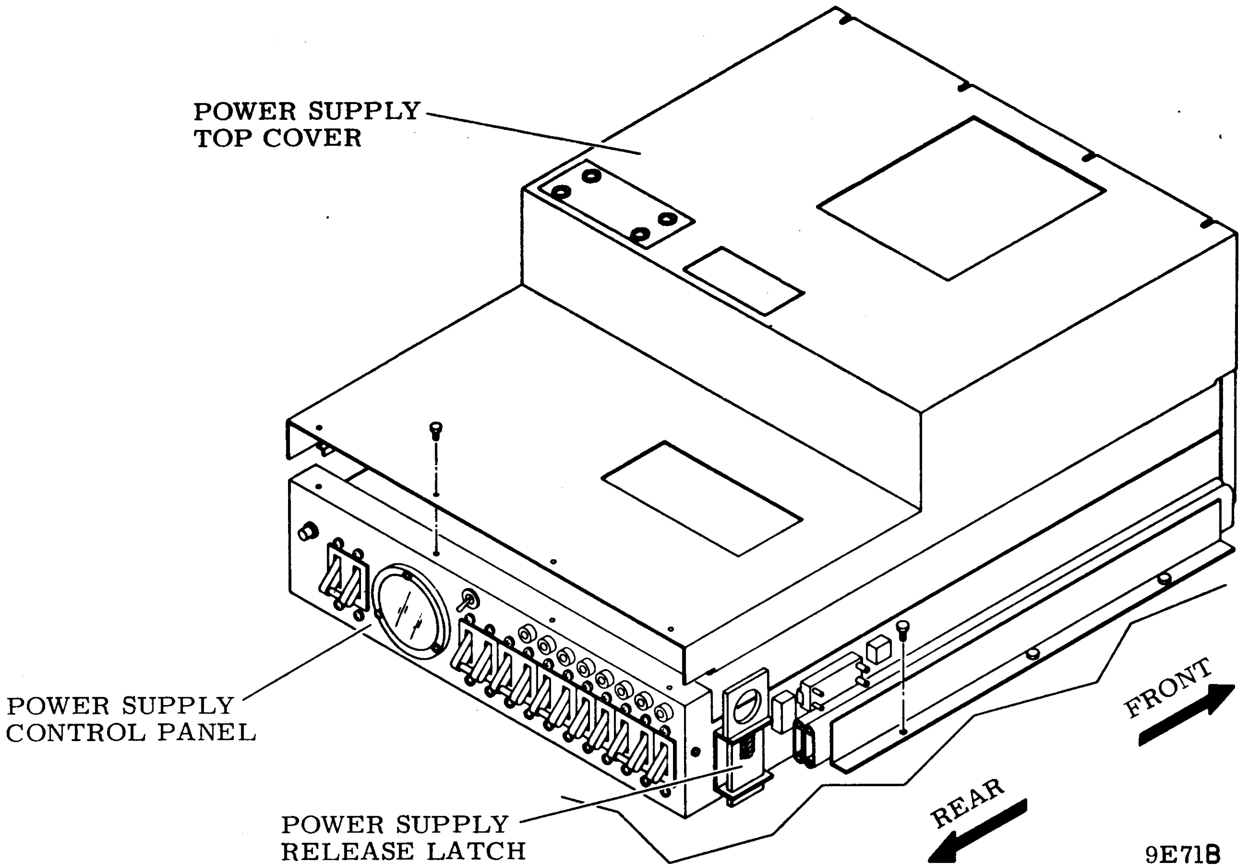


Figure 2-9. Power Supply (NON-VDE)

WARNING

Due to weight of power supply, use caution to prevent personal injury.

1. Swing logic chassis outward far enough so it is not damaged when power supply is slid out.

2. Lift power supply release latch (refer to figure 2-9) and pull power supply out to maintenance position.

When the power supply is in the maintenance position, the top cover can be removed to provide access to the inside of the supply. The top cover is removed by first removing the screws at the rear of the cover (refer to figure 2-9) then loosening the screws at the front of the cover and slipping the cover off.

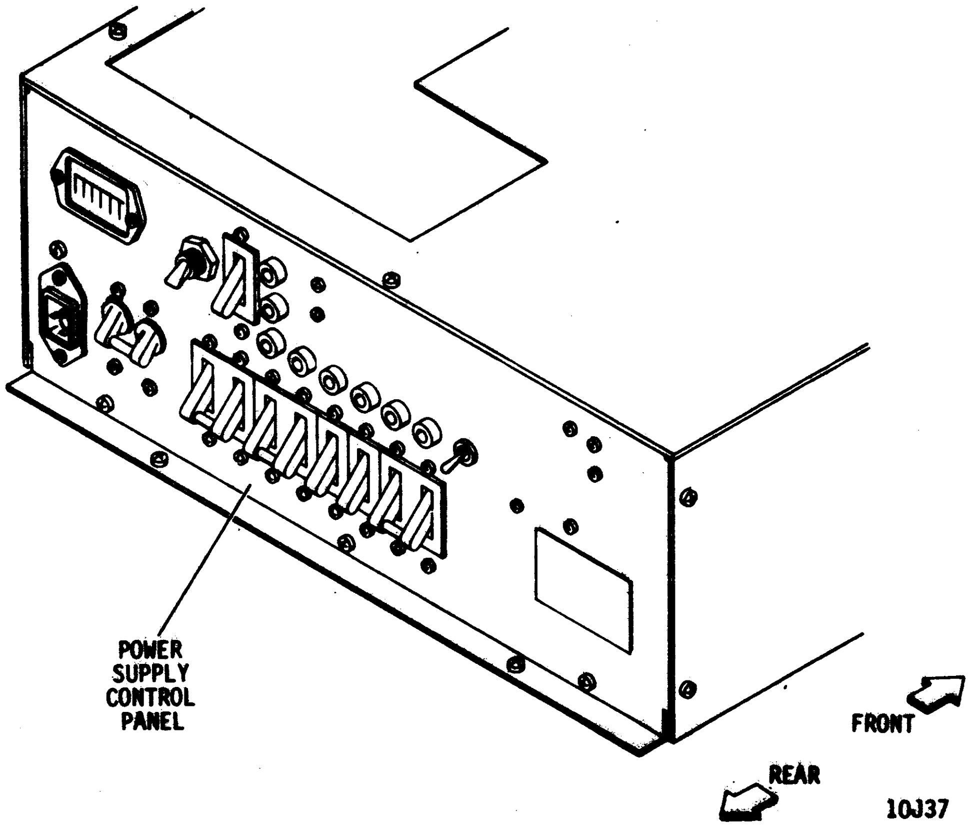


Figure 2-10. Power Supply (VDE)

The power supply control panel is hinged on its bottom edge so the panel may be opened to allow access to components on the back of the panel. To open the control panel, first remove the top cover, then remove the screws on each side of the panel and pull it open.

VDE Power Supply Access

The power supply, shown in figure 2-10, is mounted directly to the cabinet base. A lip at the back edge of the power supply slides under a bracket secured to the cabinet base. Two screws and lockwashers secure the front edge of the power supply to the cabinet base.

Removal of the mounting screws permits the power supply to be pulled backward within the limits of the free length of the cables and blower hose. Servicing of the power supply will generally require its removal from the cabinet. With the cover removed, the power supply can be repositioned in the cabinet if power on tests must be performed. Procedures for removal of the power supply and its cover are as follows:

WARNING

Due to weight of power supply, use caution to prevent personal injury.

1. Place the MAIN AC circuit breaker in the OFF position and disconnect the power cord from the site power source.

2. Disconnect the blower hose from the backpanel.

3. Disconnect the drive motor cable (A1P7), blower motor cable (P2), and brake cable (P8) from connectors J7, J2, and J8 respectively on the side panel of the power supply.

4. Disconnect the voice coil cable (A1P6), 5 volt regulator cable (A1P3), and external cable (A1P4) from connectors J6, J3, and J4 respectively.

5. Remove the two mounting screws that secure the control panel end of the power supply to the chassis.

6. Pull the power supply straight to the rear of the cabinet until the flange at the rear of the power supply clears the retaining bracket.

7. Remove the supply from the chassis.

8. Remove the screws that secure the cover to the power supply.

9. The power supply may be reinstalled in the cabinet and all cables connected to operate the drive with the cover removed. Check to ensure the blower hose is connected.

SIDE PANELS

The drive has both left and right side panels. To remove the panels, pull up on the release latches, swing the panels outward far enough to disconnect the ground straps, and then remove the panels from the drive (refer to figure 2-11). To replace the panels, reverse the removal procedure. If the

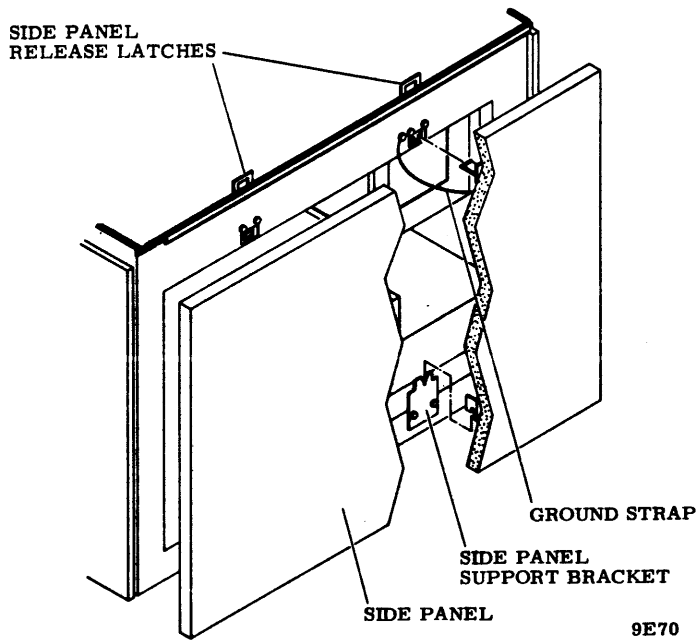


Figure 2-11. Side Panel

drive is installed in line with other drives, move it out of line to remove or replace the side panels.

SHROUD AND SHROUD COVER

General

The shroud and shroud cover enclose the pack area and the front portion of the deck. They must be removed to perform certain maintenance procedures; their removal and replacement is described in the following steps (refer to figure 2-12).

Shroud and Shroud Cover Removal

1. Remove cabinet top cover.
2. Remove pack access cover.
3. Remove pack access cover switch, if so equipped, by removing hardware securing it to shroud cover and letting it hang by leadwires.

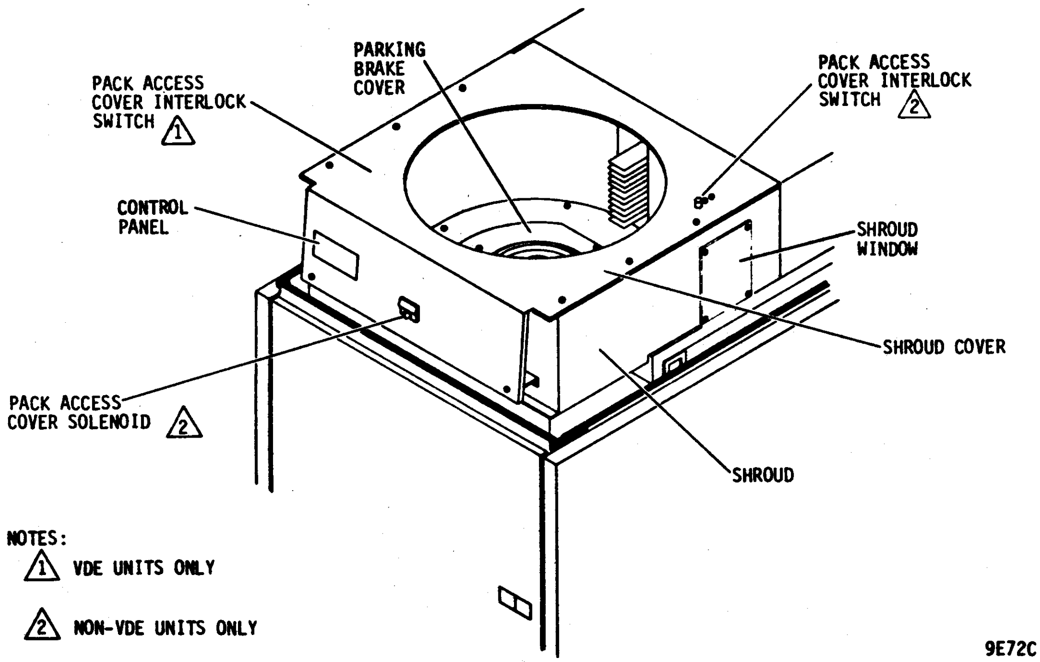


Figure 2-12. Shroud and Shroud Cover

4. Snap operator control panel out of its position in shroud cover, disconnect control panel cable plug P201 from control panel, then snap control panel back into place.

5. Remove hardware securing shroud cover to shroud and remove shroud cover.

6. Disconnect solenoid leadwires, and connector A3P9 on VDE units.

7. Remove hardware securing shroud to deck and remove shroud.

8. Remove hardware securing parking brake cover to shroud cover and remove parking brake cover.

Shroud and Shroud Cover Replacement

1. Position shroud on deck and secure.

CAUTION

> Ensure that the baffle seals are not damaged and that no interference exists between the baffle seals and the head arms.

2. Reconnect solenoid leadwires and connector A3P9 before securing shroud cover to shroud.
3. Position shroud cover on shroud and secure.
4. Secure parking brake cover to shroud.
5. Snap operator control panel out of its position in shroud cover, connect control panel cable plug to operator control panel, and snap control panel into its position in shroud cover.
6. Position pack access cover switch under shroud cover and secure.
7. Replace pack access cover.
8. Replace top cover.

MAINTENANCE CONTROLS AND TEST POINTS

GENERAL

The switches, indicators, and test points referenced throughout this manual are described in the following paragraphs.

MAINTENANCE CONTROLS

In addition to the operator panel and power supply control panel switches and indicators described in the operation section of the hardware reference manual, the drive has a number of controls and indicators used primarily for maintenance. All of these are located on the edges of cards in the logic chassis. Figure 2-13 shows these controls and indicators and table 2-2 defines their functions.

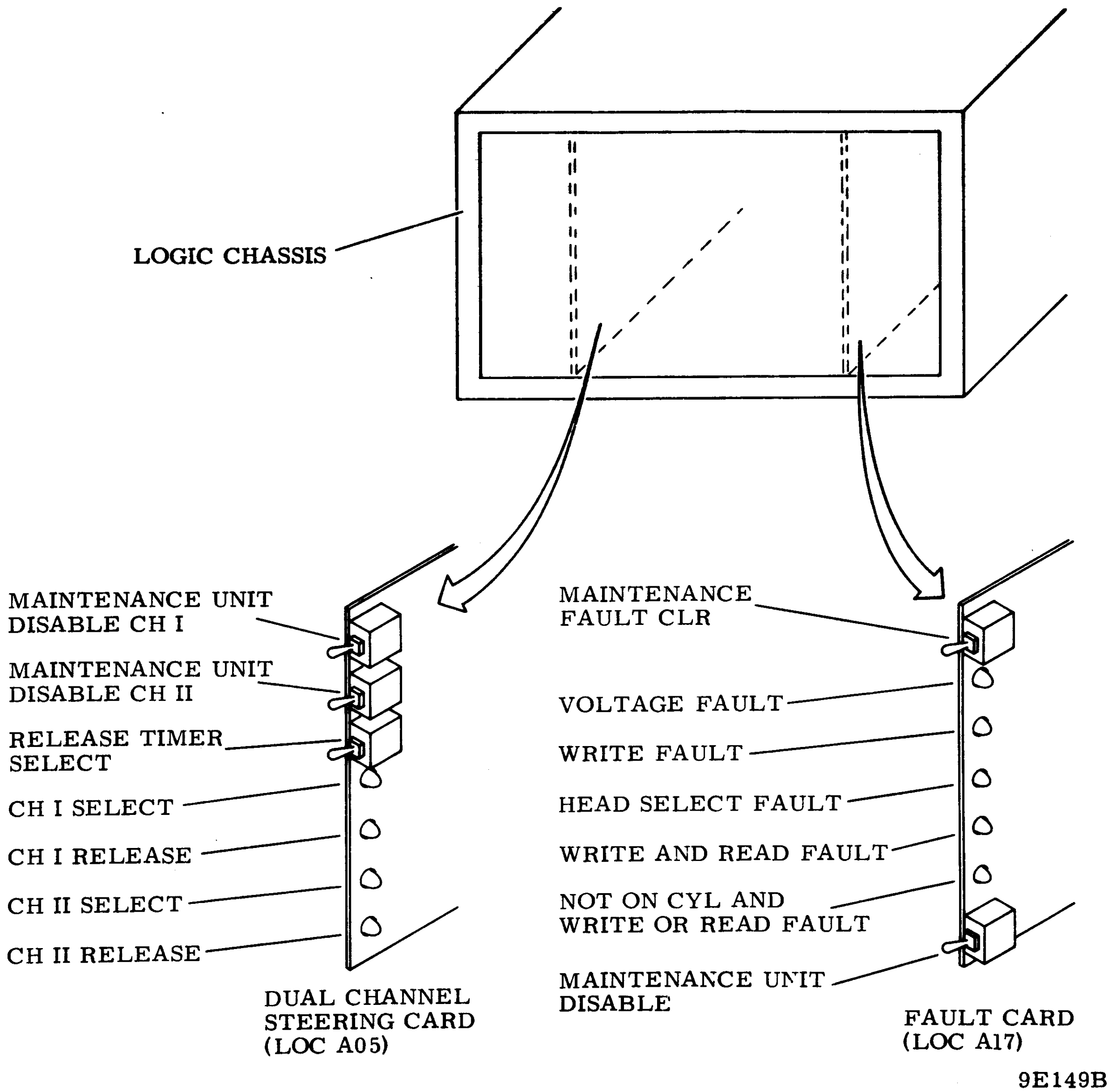


Figure 2-13. Maintenance Controls and Indicators

TABLE 2-2. MAINTENANCE CONTROLS AND INDICATORS

Control or Indicator	Function
Maintenance Fault Clear Switch	CLEAR position clears out Fault Latch and five Fault Status Latches. When switch is actuated, fault indicators on edge of Fault card go out and remain out unless condition causing fault still exists. NORM is normal operating position for switch and position to which it returns when released (spring loaded).
Maintenance Unit Disable Switch	Although switch exists on both single and dual channel drives, it is used only on single channel drives; dual channel units use the CH I/II Maintenance Unit Disable switches for the same purpose. DISABLE position prevents Unit Selected from being sent to controller and disables transmitters.
Voltage Fault Indicator	Lights to indicate a below normal voltage existed.
Write Fault Indicator	Lights to indicate a write fault existed.
Multiple Head Select Fault Indicator	Lights to indicate a multiple head select occurred.
Write and Read Fault Indicator	Lights to indicate that both write and read were commanded simultaneously.

Table Continued on Next Page

Control or Indicator	Function
Write or Read and Off Cyl Indicator	Lights to indicate that a write or read was selected during a seek operation (not on cylinder).
Channel I/II Maintenance Unit Disable Switches	Switches apply only to dual channel units. In DI position switch S1 disables Unit Selected signal and transmitters to channel I controller. Same is true for switch S2 when set to DII position. NORM is normal operating position for switches. When performing maintenance on drive both switches should be set to their disable position.
Release Timer Select Switch	Switch applies only to dual channel drives. Used to select between an absolute reserve and a reserve timer condition to control selection of drive by controller. In ABR (absolute reserve) position, channel selecting drive has uninterruptable control over drive until it issues a release command. During this time, opposite channel is unable to select drive. In RTM (Reserve Timer) position, channel selecting drive has nominally 500 ms (following selection) in which to use drive. Drive becomes available to opposite channel approximately 500 ms after the Select command.

Table Continued on Next Page

TABLE 2-2. MAINTENANCE CONTROLS AND INDICATORS (Contd)

Control or Indicator	Function
Channel I Selected Indicator	Lights to indicate channel I has selected drive.
Channel I Reserved Indictor	Lights to indicate channel I has drive reserved.
Channel II Selected Indicator	Lights to indicate channel II has selected drive.
Channel II Reserved Indicator	Lights to indicate channel II has drive reserved.

TEST POINTS

General

When performing the electrical checks and adjustments described in this manual, it is necessary to monitor signals at various points in the drives logic or other circuitry. These test points are in three categories: (1) Pins on logic chassis wirewrap panel (2) Test points located on a card in the logic or read/write chassis, (3) test points on the power supply control panel.

Wirewrap Pins

The procedures reference wirewrap pins by card location and pin number. For example, A08-05A refers to pin 05A at wirewrap panel location A08. The location and orientation of pins on the logic chassis wirewrap panel is explained in the Key to Diagrams in section 3 of this manual.

Card Test Points

The card test points (refer to figure 2-14) are located on logic cards located in either the logic or read/write chassis. These test points are located on the component side of the cards and consist of studs to which an oscilloscope probe can be attached.

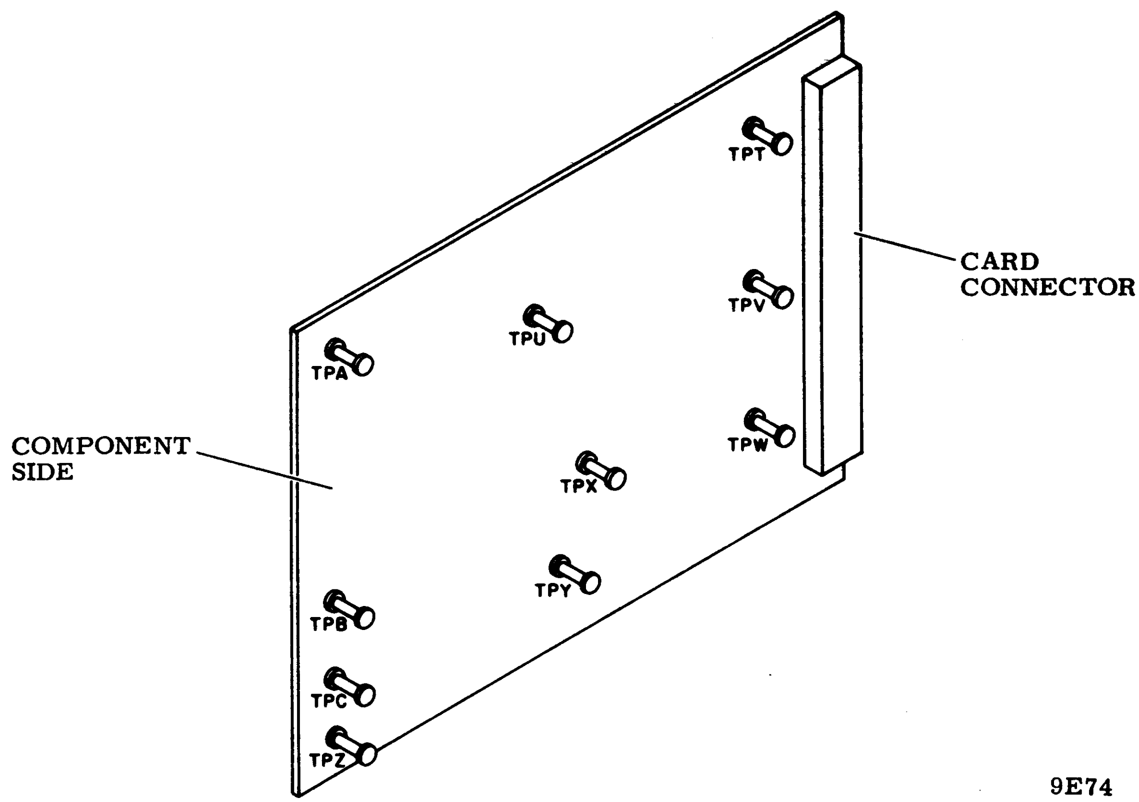


Figure 2-14. Card Test Points

The test points are located anywhere on the component side of a card and are lettered alphabetically (omitting letters I and O). When viewed from the component side with the connector at the right, the test points appear as follows (refer to figure 2-14):

- The test point in the lower left hand corner is always ground and labelled Z.
- The upper test point (on the left) is also ground and labelled A.
- Other test points on the card edge are labelled B, C, D, etc.

- All other test points are assigned in reverse order from the end of the alphabet (Y, X, W, etc). Y is nearest to the bottom right of the card and the letters progress (in reverse order) from right to left in successive rows from bottom to top (refer to figure 2-14).

The maintenance procedures reference test points by card location and test point letter. This means that test point A on card A02 in the logic chassis would be referenced as A02-TPA. Note that only the test points located on the outer edge of the cards are accessible without putting the card on an extender, and only those test points are called out in the procedures.

Power Supply Test Points

The power supply control panel (refer to figure 2-15) contains test points to measure certain voltage outputs from the power supply. These test points consist of jacks which are suitable for making measurements with a meter.

SPECIAL MAINTENANCE PROCEDURES AND PRACTICES

GENERAL

The following describes some procedures and practices that are both useful and important when performing maintenance on the drive.

MANUALLY POSITIONING CARRIAGE

Certain tests require manual operation of the positioner. Perform this procedure only if the drive will not respond or the desired results cannot be obtained with the servo under logic control. Note that improper positioning of the heads (for example, loading too slow, carriage hitting forward stop, or positioning heads in loading zone) will cause a servo fault condition. This could cause inaccurate results from any test in progress. If a servo fault occurs, unload the heads, clear the fault, and repeat the operation being performed.

1. Press START switch to stop drive motor and unload heads.

2. Remove yellow leadwire from voice coil.

3. Press START switch to start drive motor.

4. Remove plastic shield to expose voice coil.

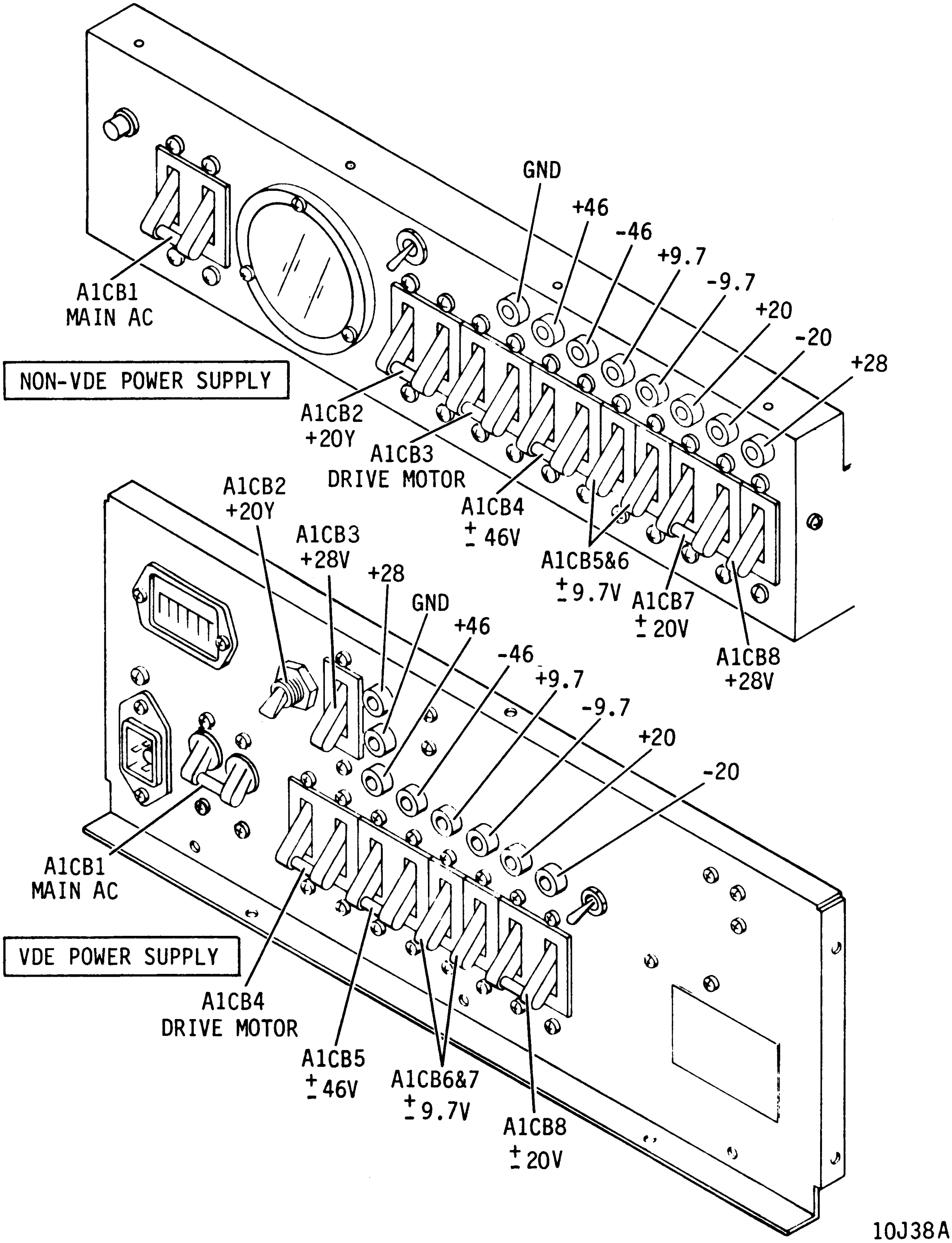


Figure 2-15. Power Supply Control Panel Test Points

CAUTION

Wait 30 seconds for drive motor to come up to speed and then load heads as fast as possible to avoid having the heads in a partially loaded position.

5. Carefully grasp voice coil and load heads.

CAUTION

Move coil as rapidly and as smoothly as possible. Do not apply a downward force. If spindle power is lost, immediately retract heads.

6. Move positioner as described by applying a lateral (parallel to coil movement) pressure to coil.

CAUTION

Unload heads as fast as possible to avoid having the heads in a partially loaded position.

7. When tests are completed, manually unload heads to fully retracted position.

8. Press START switch to stop drive motor.

WARNING

Before reconnecting yellow leadwire, make sure fingers are clear of positioner.

9. Reconnect yellow leadwire to voice coil.

10. Press START switch to start drive motor and load heads.

ELECTROSTATIC DISCHARGE PROTECTION

All drive electronic assemblies are sensitive to static electricity, due to the electrostatically sensitive devices used within the drive circuitry. Although some of these devices such as metal-oxide semiconductors are extremely sensitive, all semiconductors as well as some resistors and capacitors may be damaged or degraded by exposure to static electricity.

Electrostatic damage to electronic devices may be caused by a direct discharge of a charged conductor, or by exposure to the static fields which surround charged objects. To avoid damage to the drive electronic assemblies, service personnel must observe the following precautions when servicing the drive:

- Ground yourself to the drive whenever the drive electronics are or will be exposed. Connect yourself to ground with a wrist strap (see table 2-1 for part number). Connection may be made to the ground block at the rear of the drive. As a general rule, remember that you, the drive, and the circuit cards must all be at ground potential to avoid potentially damaging static discharges.

- Keep cards in conductive bags - when circuit cards are not installed in the drive, keep them in conductive static shielding bags (see table 2-1 for part number). These bags provide absolute protection from direct static discharge and from static fields surrounding charged objects. Remember that these bags are conductive and should not be placed where they might cause an electrical short circuit.

- Remove cards from bags only when you are grounded - all cards received from the factory are in static shielding bags, and should not be removed unless you are grounded.

- Turn off power to drive before removing or installing any circuit cards.

HEAD CRASH PREVENTION

There are five primary variables that cause the great majority of head crashes. These are 1) the disk drive, 2) the disk pack, 3) the environment, 4) the maintenance and 5) the operator of the disk drive. A list of precautions that can be taken to prevent head crashes will be given for each variable.

DISK DRIVE

1. Check the action of the pack access cover latch as it is closed. Latching should occur only after the cover seal has been compressed slightly. The pumping action of the spinning disk pack can cause dirt and dust particles to be drawn into the shroud if the cover is not sealed at all points.

2. Check for adequate positive pressure air flow of 0.15 inches of water using the pressure gauge kit (see table 2-1 for part number). This should be tested according to procedures in section 3 on absolute air filter replacement.

3. Make certain the wood shipping block is removed and the coarse filter is installed in its place. Make certain the coarse filter is not plugged.

4. Using a strip of paper (dollar bill size), check the pack access cover shroud seal by opening the pack access cover and laying the slip of paper on the shroud, then closing the cover (latched). Resistance should be felt while trying to withdraw the paper. Check at multiple places on each side of the shroud.

5. Make certain the shroud area is clean. If contaminants are present, look for the source and eliminate it.

6. If the unit goes into uncontrolled servo motion, check the heads and the disk pack for divots where oxide has been removed.

7. Examine the unit's air system to make certain air leaks do not exist. All hose clamps and fittings should be secure. The filter and plenum should be aligned with the gaskets to prevent leaks.

8. Hold the absolute filter up to a bright light to make certain it has no visible leaks. Minute leaks will allow contamination to enter the pack area. If any leaks are noted or suspected, replace the filter with a known good one.

DISK PACK

1. Do not use damaged disk packs. Inspect disk packs that arrive in damaged cartons to ensure that they are not bent.

2. Keep hands, pencils, or other objects off the disk pack surfaces. The disk pack surfaces can be contaminated, distorted, distorted, or damaged through impact or excessive pressure or abrasion.

3. Never lift or hold a disk pack by any of the recording disks. This causes permanent damage.

4. Clean the outside surfaces of the protective covers periodically to remove any build-up of dust that may occur (interiors should also be cleaned if contaminated). Use a lint free gauze pad dampened with head cleaning solution. If possible, use a vacuum cleaner to remove dust that accumulates on the cover lip.

5. If the disk drives are not in use and the blower is shut off, take the disk packs out of the drives and store them in their protective canisters.

6. Do not allow the pack to rest on or strike any other object when the bottom protective cover is removed for installation in the drive.

7. Re-assemble the disk pack bottom and top protective covers after the pack is mounted in the drive. This should be done even when no disk pack is contained in the cover to prevent dust and dirt from accumulating inside the covers.

8. Replace cracked, distorted or otherwise physically damaged pack covers.

9. Do not place disk pack identifying labels anywhere except outside the top protective cover assembly. The pack serial number may be used to maintain correct pack to canister identification.

10. The temperature of the disk pack must be stabilized to the temperature of the room in which the drive is operating.

11. Control Data does not recommend periodic field cleaning of disk packs. If field cleaning is employed, it is done at the risk of the user. Packs that are suspected for any reason should be returned to the vendor for inspection.

ENVIRONMENT

Install the drive in a room which is kept carefully dusted with particular attention given to maintaining a smooth floor mopped and a carpeted floor vacuumed. Carpeted floors can be particularly troublesome because of the dirt and dust they trap and the amount of lint they generate. Traffic in the room housing the disk drive should be kept to a minimum.

Maintain as much separation as possible between the disk drive and printers, tape, and card punch equipment. These machines can generate a lot of paper, carbon, and ink particulate matter. Do not store packs near this type of equipment.

Eliminate eating, drinking, or smoking in the disk drive area if at all possible. Particles of food and drink can be sucked into the shroud area when the pack access cover is opened and closed. Smoke particles have a sticky characteristic. The absolute filter on the disk drive can clog more rapidly in such an environment.

If at all possible, maintain the relative humidity in the disk drive operating room at 40 to 50%. Low relative humidity levels can lead to particle attraction and accumulation by static electricity.

Disk packs and disk drives must be stabilized to the same temperature.

Avoid building construction in the area of the drive or area used for pack storage. If construction is absolutely necessary make certain that protective steps are taken to avoid contamination in the area of the packs and drives.

One of the sources of head/disk contamination is the ambient air in the room in which the drive operates. Although the drive is designed to operated successfully over a wide range of ambient air conditions, it follows that the cleaner the room air can be maintained, the better and longer the drive air filtering and handling system can do its job of keeping potentially destructive particles out of the head/disk gap.

MAINTENANCE

1. Clean the primary air filter quarterly or at 1500 running hours whichever comes first. Make certain the primary air filter is not clogged.

2. Periodically wipe out the shroud cavity surfaces with a lint free gauze pad soaked in head cleaning solution. The recommended solution is a reagent grade hydrogenated hydrocarbon/alcohol mixture. Be sure, however, to keep the head cleaning solution from contacting the access cover seal. This can harden the seal material and reduce its effectiveness. (Head cleaning solution P/N 82365800).

3. Check the air pressure of the drive by using the pressure gauge kit (CDC 73040100). This should be tested according to the preventive maintenance procedure in section 3 of this manual. The filter should be replaced if the air pressure drops below 0.15 inches of water, or biennially, or at 9000 hours whichever occurs first.

4. Examine the unit's air system making certain to check all connections, hoses, and filters for possible leaks.

5. Do not under any circumstances clean the heads while they are in the unit. If head cleaning is required, remove the heads from the unit and clean according to the procedures in section 6 of this manual. This should be performed by trained personnel.

6. Control Data does not recommend periodic field cleaning of disk packs. If field cleaning is employed, it is done at the risk of the user. Packs that are suspected for any reason should be returned to the vendor for disposition.

7. Do not over lubricate the spindle lockshaft.

8. Do not use any type of oil or lubricant on the drive except for the very small amount used on the lockshaft.

OPERATOR

1. Keep the disk drive pack access cover closed and latched if at all possible, and keep the shroud blower energized at all times. This will help greatly in keeping contaminants out of the shroud cavity and away from the heads. Remove the pack and store it in its protective canister if the blower motor is not energized.

2. Do not store packs on top of drives - vibration will shake them off.

3. Never lift or hold a disk pack by any of the recording disks, as permanent damage and/or contamination will result.

4. Keep disk packs out of the drives and locked in their protective covers when not in use.

5. Do not allow the pack to rest on or strike any other object when its bottom protective cover is removed for installation in the drive.

6. Re-assemble the disk pack bottom and top protective covers. This should be done even when no disk pack is contained in the cover, to prevent dust and dirt from accumulating inside the covers.

7. Do not place disk pack identifying labels anywhere except outside the top protective cover assembly. The pack serial number may be used to maintain correct pack to canister identification.

8. Do not eat, smoke, or allow beverages near the drive or pack.

SECTION 3

PREVENTIVE MAINTENANCE

INTRODUCTION

This section describes the preventive maintenance procedures required to keep the drive operating properly. This maintenance is performed regularly on a schedule determined by the preventive maintenance index (see table 3-1).

The preventive maintenance index gives the procedure required for performing the maintenance, the estimated time to perform it, and the level which indicates how often to perform it.

The levels of preventive maintenance are based on a calendar period or hours of operation (whichever comes first). Table 3-2 lists the levels of preventive maintenance.

The person performing maintenance should be thoroughly familiar with operation of the drive and with all information in the general maintenance information section of this manual.

TABLE 3-1. PREVENTIVE MAINTENANCE INDEX

Level*	Est. Time (Minutes)	Procedure
1	10	Clean Primary Air Filter
1	2	Check +5 Volt and -5 Volt Outputs
2	1	Clean Shroud and Spindle
2	2	Clean and Lubricate Lockshaft
2	5	Clean Carriage Rails and Bearings
3	20	Absolute Air Filter Replacement

* Intervals are maximum times. Preventive maintenance may be required more often depending on level of dust contamination in operating area.

TABLE 3-2. PREVENTIVE MAINTENANCE LEVELS

Level	Time Schedule
Level 1	Quarterly or 1,500 hours.
Level 2	Semiannually or 3,000 hours.
Level 3	Biennially or 9,000 hours.

LEVEL 1 MAINTENANCE PROCEDURES

CLEAN PRIMARY AIR FILTER

This procedure describes cleaning the primary air filter. This filter is located in a bracket located at the bottom rear of the drive (refer to figure 3-1).

1. Press START switch to stop drive motor and unload heads.
2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.
3. Remove air filter by pulling it out of its bracket (refer to figure 3-1).
4. Clean filter by agitating in mild detergent solution. Rinse by thoroughly flushing filter with water from a low pressure nozzle.
5. Shake excess water from filter and allow to dry before proceeding.
6. Set MAIN AC circuit breaker to ON and allow blowers to purge unit for at least 2 minutes, then set MAIN AC circuit breaker to OFF.

CHECK +5 VOLT AND -5 VOLT OUTPUTS

Check these outputs by performing the +5 Volt and -5 Volt Test and Adjustment procedure (see section 4).

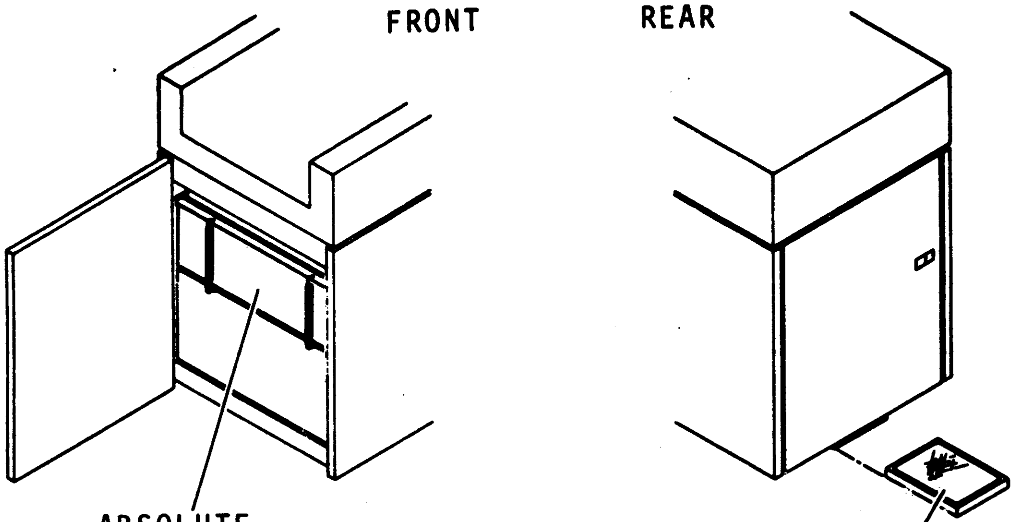


Figure 3-1. Air Filters

LEVEL 2 MAINTENANCE PROCEDURES

CLEAN SHROUD AND SPINDLE

This procedure describes cleaning of the inside shroud area and the top of the spindle upon which the pack rests.

1. Press START switch to stop drive motor and unload heads.
2. Open pack access cover and remove pack. Leaving cover open, set MAIN AC circuit breaker to OFF.

CAUTION

Do not allow head cleaning solution to run into spindle or bearing damage could occur.

3. Remove all dirt and smudges from shroud and top surface of spindle by using lint free gauze that is slightly dampened (not soaked) with head cleaning solution.

4. Inspect shroud and spindle for any particles that were not picked up with gauze in step 3. Pick up these particles using a wad of adhesive type tape.

5. Close pack access cover.

CLEAN AND LUBRICATE LOCKSHAFT

This procedure describes cleaning and lubrication of the threads on the top of the spindle lockshaft.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack. Leaving cover open set MAIN AC circuit breaker to OFF.

3. Use dry lint free gauze and a brush or sharp instrument to clean lockshaft threads.

4. Apply a thin coat of lubricant paste (see table 2-1) to lockshaft threads.

5. Check for free movement of lockshaft by depressing it and verifying that it returns to its original position. If lockshaft does not depress or stays depressed, replace lockshaft (refer to Spindle Lockshaft Replacement procedure). If lockshaft works satisfactorily, close pack access cover.

CLEAN CARRIAGE RAILS AND BEARINGS

This procedure describes cleaning of the rails and bearings on which the carriage rides (refer to figure 3-2).

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

3. Open cabinet top cover and remove deck cover.

4. Remove magnet cover by grasping edge of cover and snapping it out of place.

5. Grasp coil through opening in top of magnet assembly. Carefully and slowly push coil forward to extend heads.

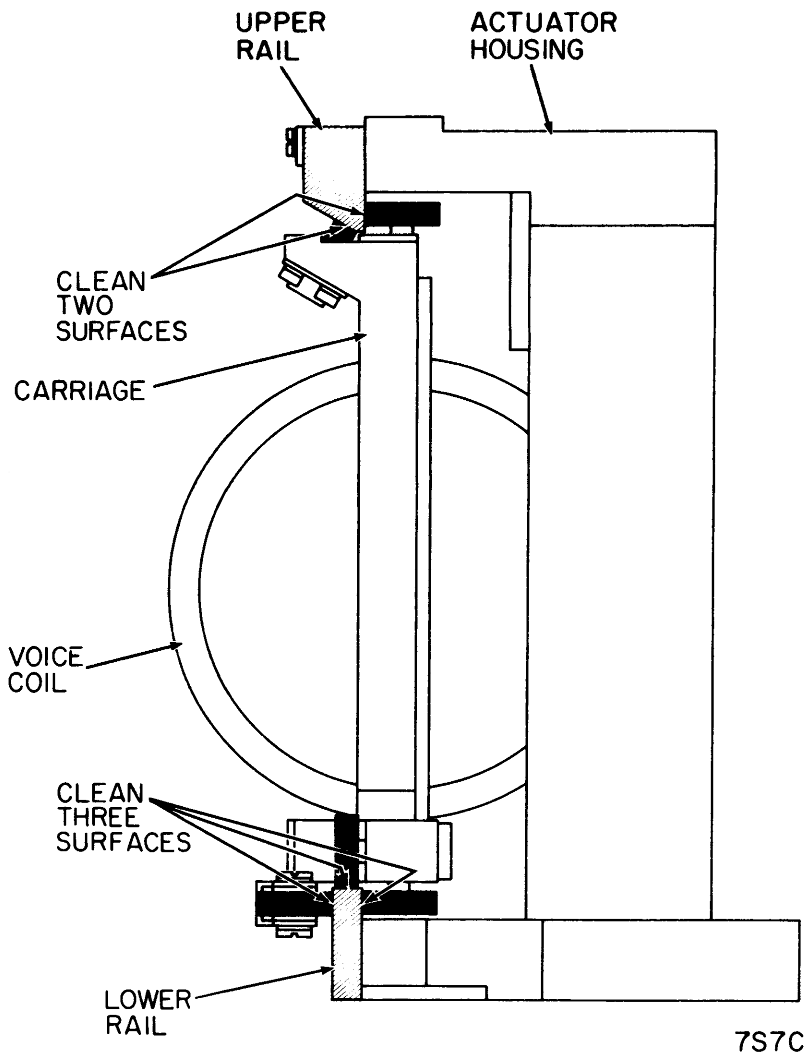


Figure 3-2. Clean Carriage Rails and Bearings

6. Once head arms have cleared cams, gently slide carriage and coil assembly back and forth along full length of rails. While moving coil, be aware of any possible irregularity (bumps or jerks) in movement. A sudden irregularity indicates dirt on rails and bearings. Do not confuse pressure of flex leads with a sudden irregularity in motion. Pressure from leads is a smooth change.

7. If a sudden irregularity in motion was noted in previous step, proceed to next step. If no sudden irregularity in motion was noted, cleaning is not required. Terminate procedure by returning carriage to heads unloaded position (fully retracted) and replace magnet cover.

CAUTION

Do not allow media solution to run into the bearings since it may remove some of the bearing lubricant.

8. Using a cotton swab dampened (not soaked) in head cleaning solution, clean rail and bearing surfaces. Access front portion of lower rail from interior of pack area. Access rear portion of lower rail and all of top rail from sides of actuator. Move carriage back and forth while cleaning in order to ensure all surfaces are reached.

9. When rail and bearing cleaning is completed, repeat step 6 to ensure that the carriage moves freely without sudden irregularities in its motion. If carriage now moves smoothly throughout its travel, proceed to step 10. If sudden irregularities persist, visually inspect rails and bearings using a strong light. Look for deterioration of rail or bearing surfaces. Surface deterioration requires replacement of defective parts. Since neither carriage nor rails are field replaceable, contact factory maintenance representative.

10. Return carriage to heads unloaded position (fully retracted) and replace magnet cover.

11. Replace deck cover and close cabinet top cover.

LEVEL 3 MAINTENANCE PROCEDURES

ABSOLUTE AIR FILTER REPLACEMENT

An adequate supply of clean air to the pack area is essential for proper operation of the drive. The absolute filter traps particles too small to be stopped by the primary filter. Eventually the filter becomes too clogged to yield a sufficient airflow, and it must be replaced. Its useful life depends on the drive's operating environment.

You have two options: 1. replace the absolute filter at fixed intervals depending on site environment, or 2. obtain a pressure gauge (see table 2-1) and replace the absolute filter when it fails the testing procedure given below.

With the first option, replacement of the absolute filter is required once every two years when the drive is operated in a computer room environment. If the drive is operated in something other than a computer room environment, absolute filter replacement is required more often. In a noncomputer room environment, replace the absolute filter every year or whenever there is doubt about the ability of the filter to pass air into the shroud area.

With the second option, periodically check the airflow through the absolute filter to determine the proper time for filter replacement. Regardless of a planned testing schedule, test whenever there is doubt about the ability of the filter to pass air into the shroud area.

Figure 3-3 is a flow chart showing the procedure included in this section and the available options. Use the flow chart to determine which of the following procedures are applicable.

Filter Replacement

CAUTION

Do not touch filter cells when handling replacement filter. They puncture and crush easily.

1. Examine replacement filter to determine if filter is usable. Do not use filter if cells are punctured, crushed, or otherwise damaged.

2. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Open pack access cover and remove pack, close cover.

   c. Open cabinet front door and set MAIN AC circuit breaker to OFF.

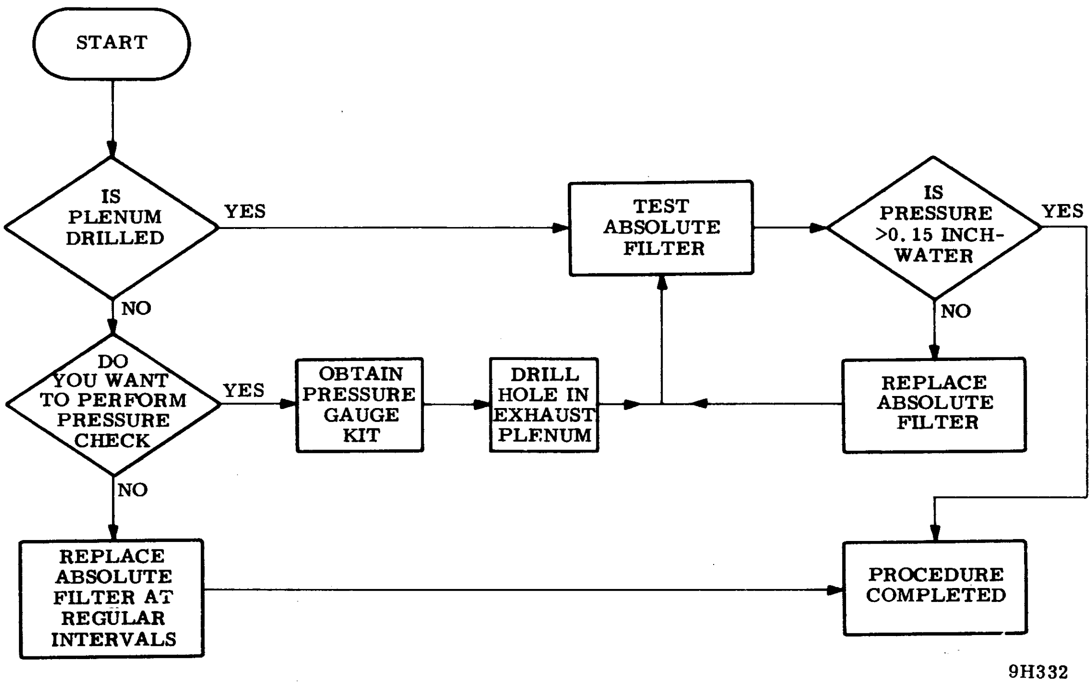


Figure 3-3. Filter Procedure Flow Chart

3. Remove blower assembly from drive as follows:

   a. Loosen clamp on large hose located on top of blower enclosure, then slide clamp up on hose and remove hose from blower enclosure.

   b. Remove two screws securing safety shield to frame.

WARNING

Springs are under tension. Wear safety glasses when performing this operation.

4. Refer to figure 3-4 and detach four springs (or posts in older units) securing exhaust plenum and absolute filter.

5. Lift plenum and remove filter from blower assembly.

6. Use a clean cloth to wipe inside of exhaust outlet, exhaust plenum, and portion of blower mount that touches filter.

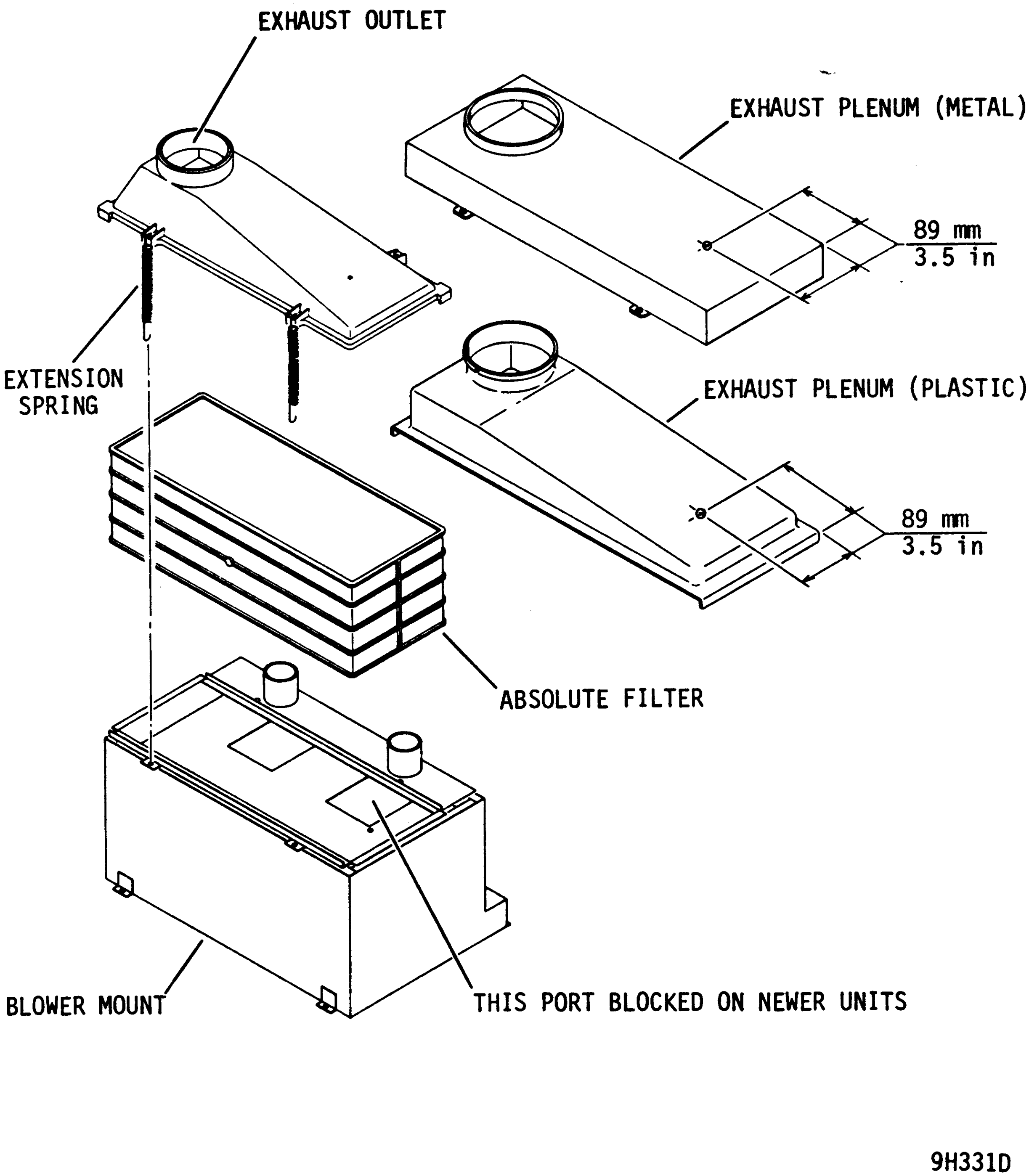


Figure 3-4. Plenum Removal and Drilling

NOTE

Before installing new air filter, record the date and hour meter reading on label located on the side of filter.

7. Set replacement filter, with arrows pointing up, on blower mount. Ensure the filter rests squarely on flanges of mount.

8. Set exhaust plenum on top of absolute filter.

9. Replace four springs (or posts in older units) securing exhaust plenum and absolute filter to blower mount.

   a. Slip large air hose over exhaust outlet on top of blower and secure with clamp.

CAUTION

Following reassembly of blower assembly, perform Shroud Cleaning procedure, then allow blower to purge system for at least two minutes before installing a disk pack.

   b. Replace safety shield and attach with two screws.

10. Close cabinet front door.

Drilling Hole in Exhaust Plenum

1. Perform steps 1 through 6 of Filter Replacement procedure.

2. Remove exhaust plenum from drive.

3. Drill a 6.35 mm (0.25 in) hole in exhaust plenum in location shown in figure 3-4.

4. Insert plastic plug in hole in exhaust plenum. (Spare plastic plugs are included in the gauge test kit.)

5. Set exhaust plenum on top of absolute filter.

6. Perform steps 11 through 13 of Filter Replacement procedure.

Testing Filter

1. Remove plastic plug and insert tubing attached to differential pressure gauge (refer to list of Maintenance Tools and Materials).

2. Apply power to drive as follows:

   a. Set MAIN AC circuit breaker to ON.

   b. Press START switch to start drive motor and load heads.

3. If pressure is 0.037 kPa (0.15 inch water) or less, filter should be replaced. If pressure is greater, filter need not be replaced at this time.

4. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Set MAIN AC circuit breaker to off.

5. Remove tubing and insert plastic plug. The plastic plug must be inserted at all times except when making pressure measurements.

SECTION 4

TESTS AND ADJUSTMENTS

TESTS AND ADJUSTMENTS 4

INTRODUCTION

This section contains procedures describing all drive electrical adjustments that may be performed in the field. Each of these procedures describes both the test and adjustments of a particular aspect of drive performance.

Before performing these procedures be thoroughly familiar with operation of the drive and with all information in the general maintenance information section of this manual.

Note that some of the following procedures differ slightly, depending upon whether they are performed on a 150 MB (BK6XX) or 300 MB (BK7XX) drive.

These differences are limited to seek length. In these cases, the 150 MB value is shown in parentheses as in the following example.

```
Example:     Command drive to perform a direct seek
             to Cylinder 491  (245).
                          |     |
                          |     |
    Applicable to         |     |     Applicable to
    300 MB Units ____|     |____  150 MB Units
    (BK7XX)                           (BK6XX)
```

Where a number is followed by a second number in parens, the first value applies to 300 MB drives, and the second value in parens applies to 150 MB drives. In instances where only one number is shown, the value applies to both types of drives.

+5 VOLT AND -5 VOLT TEST AND ADJUSTMENT

This procedure describes test and adjustment of the +5 and -5 volt outputs from the regulator board (refer of figure 4-1).

1. Prepare drive for use with test software or FTU.

2. Command continuous seeks between cylinders 000 and 256 (128).

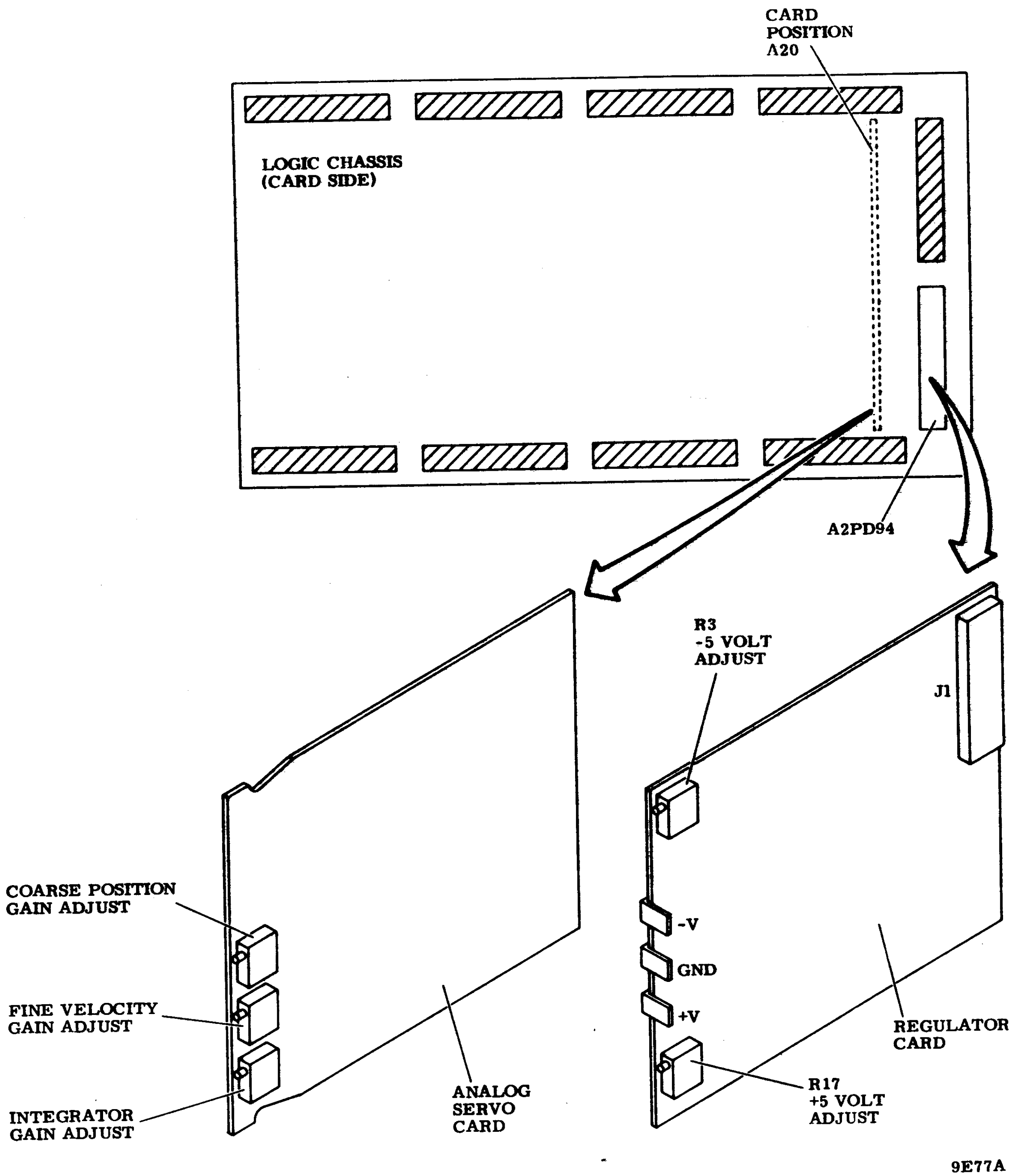


Figure 4-1. Voltage Regulator and Servo Adjustments

3. Check and adjust +5 volts as follows:

   a. Connect positive meter lead to A2JD94-04A on logic backpanel.

   b. Connect negative meter lead to terminal marked gnd on front edge of regulator card.

   c. Measured voltage should be +5.1 (±0.05) V. If it is not, adjust bottom pot on regulator card until voltage is within specified limits.

4. Check and adjust -5 volts as follows:

   a. Connect positive meter lead to terminal marked gnd on front edge of regulator board.

   b. Connect negative meter lead to wire wrap pin A2JD94-01B on logic backpanel.

   c. Measured voltage should be -5.1 (±0.05) V. If it is not, adjust top pot on regulator board until voltage is within specific limits.

5. Prepare drive for return to online operation.

HEAD ALIGNMENT

GENERAL

Check alignment of the heads under any of the following conditions:

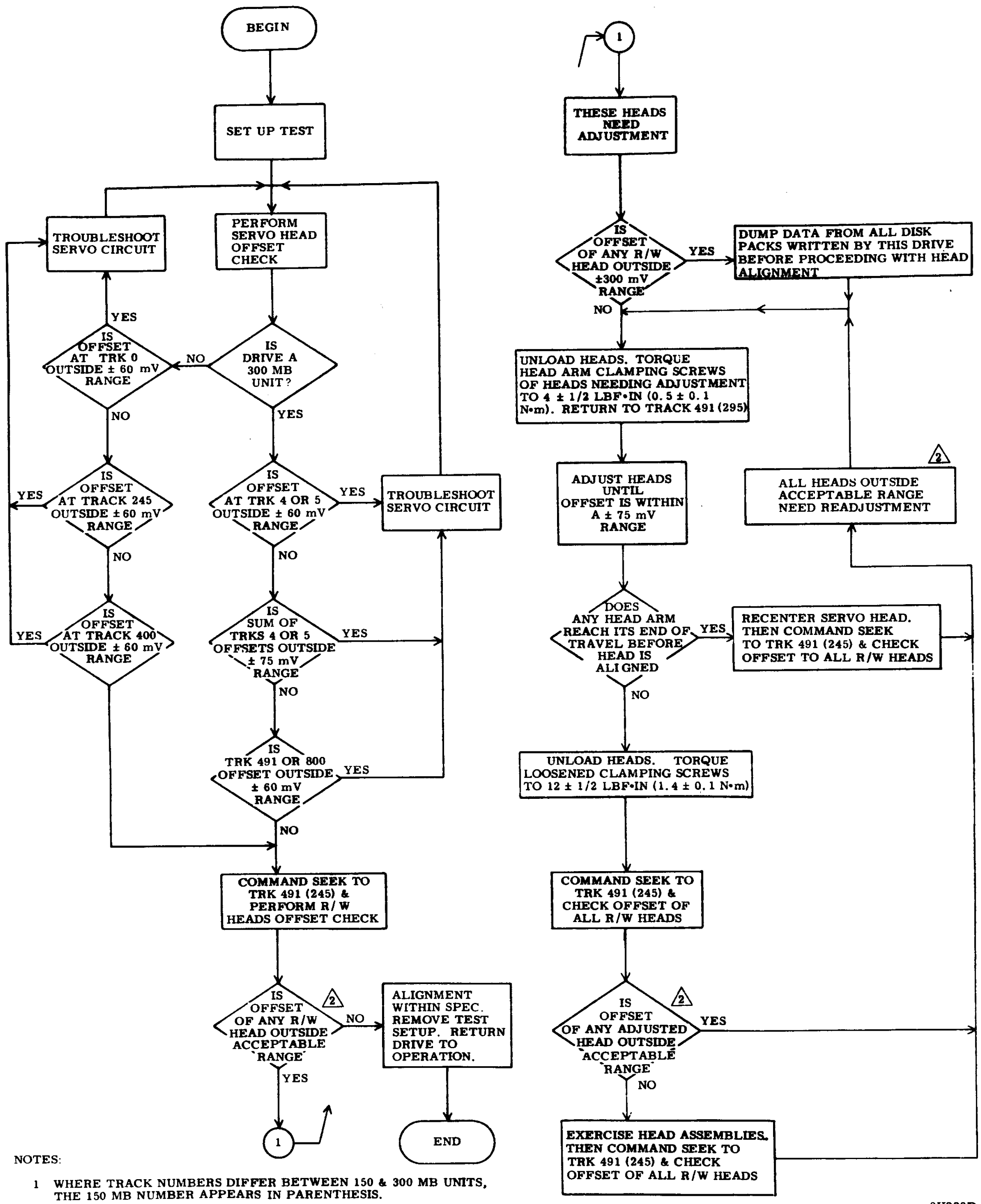
- During initial installation of the drive.

- After replacing one or more head arm assemblies.

- When misalignment of one or more heads is suspected. (For example, inability to read a pack written on another drive).

If it is determined that a head is misaligned, adjust the head arm to bring the alignment of the head within specifications. Figure 4-2 is a flowchart summarizing the basic functions of the head alignment check and adjustment procedure.

Head alignment is performed by using a Field Test Unit (FTU) or by using the controller, microprogram diagnostics, head alignment card and meter. This procedure applies only to the method using an FTU. Refer to the FTU maintenance manual for switch settings and functions called for in this procedure.



NOTES:

1 WHERE TRACK NUMBERS DIFFER BETWEEN 150 & 300 MB UNITS, THE 150 MB NUMBER APPEARS IN PARENTHESIS.

2 ACCEPTABLE RANGE DEPENDS ON CE PACK:
- IF PACK IS SAME ONE USED FOR LAST ALIGNMENT, RANGE IS 0 ±150 mV
- IF PACK IS NOT SAME ONE USED FOR LAST ALIGNMENT, RANGE IS 0 ±225 mV

Figure 4-2. Basic Head Alignment Check and Adjustment Procedure

When performing head alignment, give special consideration to the following:

Thermal Stabilization - In order to ensure accuracy during head alignment, it is important that the drive, CE pack, and FTU be at their normal operating temperature. This requires that all three be connected and allowed to operate (pack turning and heads loaded to cylinder zero) for a minimum of 60 minutes. If head alignment is being performed on more than one drive, and provided that the pack was taken immediately from a previous drive, and provided that the drive under test has been operating with heads loaded for a minimum of 60 minutes preceding tests; then the CE pack only requires a 15-minute stabilization time.

Alignment Tool - Use only the head alignment tool specified in the maintenance tools and materials table. Use of a different tool may cause damage to head arm or carriage. Always inspect the adjustment end of tool prior to use. Tool must be free of nicks and scratches and must have a polished surface where it enters the carriage alignment hole. If any aluminum deposits are present, polish tool surface with crocus cloth. Any other polishing medium will damage the tool. Do not use a defective tool; repair or replace tool if damage exists. When using tool, position it so that pin in end of tool engages alignment slot in head arm. The tool should slip easily through the alignment slot in the head arm. If anything more than a small amount of force is required to adjust the head, the tool is probably binding in the hole of the carriage. Ensure that alignment tool is kept perpendicular to hole in carriage at all times.

Carriage Locking - During the alignment procedure (when the heads are over the alignment track) the carriage locking pin and ring assembly must be installed in the ALIGN TRACK LOCK hole in the rail bracket assembly. This locks the carriage in one head alignment position. Failure to install the pin and ring assembly would allow the carriage to retract if any emergency retract signal were generated. Since your hands are in the actuator during the head alignment procedure, the retract could be dangerous.

CAUTION

Should an emergency retract condition be generated when the locking pin is in the ALIGN TRACK LOCK hole, the following results may occur:

- Blown fuses,
- Tripped dc circuit breaker

- Blown power amplifier transistors, and
- Unretracted heads on a stationary CE pack.

Carefully observe the instructions regarding the installation and removal of the carriage locking pin and ring assembly.

Cylinder Notation - In steps of this procedure that apply to both the 300 MB and 150 MB drives, a cylinder number for the 300 MB unit will be followed by a cylinder number in parenthesis for the 150 MB unit.

> Example: Command a direct seek to track 491 (245). If a 300 MB unit is being checked, this step requires a seek to track 491. A 150 MB requires a seek to track 245.

INITIAL SETUP

1. Prepare drive for use with FTU (refer to Preparation of Drive For Testing procedure).
2. Ensure that CE pack is thermally stabilized.
3. Connect oscilloscope to test points Z (ground) and Y (dibits) on head alignment card.
4. Connect test leads between head alignment card and FTU null meter.
5. Connect head alignment cable between connector J1 on E03 card in read/write logic chassis and backpanel pins 8 through 11 at card location A16.

SERVO HEAD OFFSET CHECK

1. Set head alignment card S/RW switch to S and X.1/X1 switch to X1.
2. Command continuous seeks between cylinders 240 and 245 for a minimum of 30 seconds.
3. Command direct seek to cylinder 004 (000).
4. Observe dibit pattern on oscilloscope. It should be similar to that shown on figure 4-3.
5. Toggle P/N switch to both P and N positions and record null meter readings. If both P and N readings are less than 50 mV, the X.1/X1 switch can be set to X.1 position for more accurate readings.

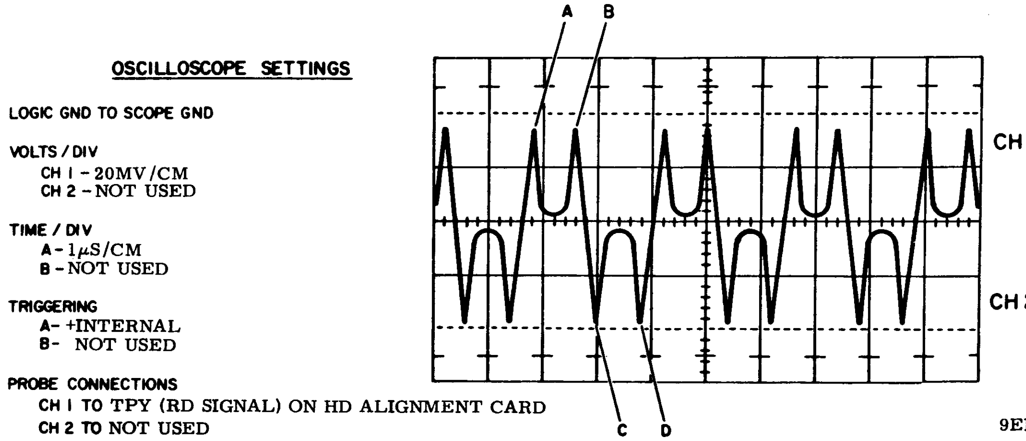


Figure 4-3. Head Alignment Waveform

6. Calculate head offset by using the following formula:

   (P) - (N) = OFFSET

   Where P is meter reading with P/N switch in P position and N is meter reading with switch in N position. Meter readings to right of zero are positive and meter readings to left of zero are negative.

   EXAMPLE 1: P = +20 N = +15
   (P) - (N) = (+20) - (+15) = +5

   EXAMPLE 2: P = +20 N = -15
   (P) - (N) = (+20) - (-15) = +35

   EXAMPLE 3: P = -20 N = +15
   (P) - (N) = (-20) - (+15) = -35

7. Record offset calculated in step 6.

8. Evaluate servo head offset as follows:

   - If offset ranges between +60 mV and -60 mV, it is acceptable so proceed with head alignment.

   - If offset is outside ±60 mV range, it is unacceptable. In this case, troubleshoot servo system before proceeding with head alignment.

9. Command direct seek to cylinder 005 and repeat steps 4 through 8.

10. Add offset readings from cylinders 004 and 005. This sum should range between +75 mV and -75 mV. If it does not, troubleshoot servo system.

EXAMPLE 1: $P_4 = -25$ $N_4 = -15$
(P) - (N) = (-25) - (-15) = -10 mV

$P_5 = +10$ $N_5 = -10$
(P) - (N) = (+10) - (-10) = +20 mV

(-10) + (+20) = +10 mV

Sum is within ±75 mV range
and is therefore acceptable.

EXAMPLE 2: $P_4 = +30$ $N_4 = -10$
(P) - (N) = (+30) - (-10) = +40 mV

$P_5 = +15$ $N_5 = -30$
(P) - (N) = (+15) - (-30) = +45 mV

(+40) + (+45) = +85 mV

Sum is outside ±75 mV range
and is therefore unacceptable.
Servo system troubleshooting
is required.

11. Command direct seek to cylinder 800 (400) and repeat steps 4 through 8.

12. Command direct seek to cylinder 491 (245).

13. Install carriage locking pin into track alignment hole (refer to figure 4-4) and repeat steps 4 through 8.

READ/WRITE HEADS CHECK AND ADJUSTMENT

1. Set S/RW switch to RW. Observe that dibit pattern is similar to that shown on figure 4-3.

2. Calculate offset of all read/write heads by using same method given in steps 5 and 6 of Servo Head Check.

3. Remove carriage locking pin from track alignment hole and place it in storage hole.

CAUTION

If any offset exceeds a 0 ±300 mV range, those heads are excessively misaligned. Therefore, to avoid possible loss of data, transfer data from packs written with those heads to other storage before proceeding with alignment.

4. Evaluate read/write head offset as follows:

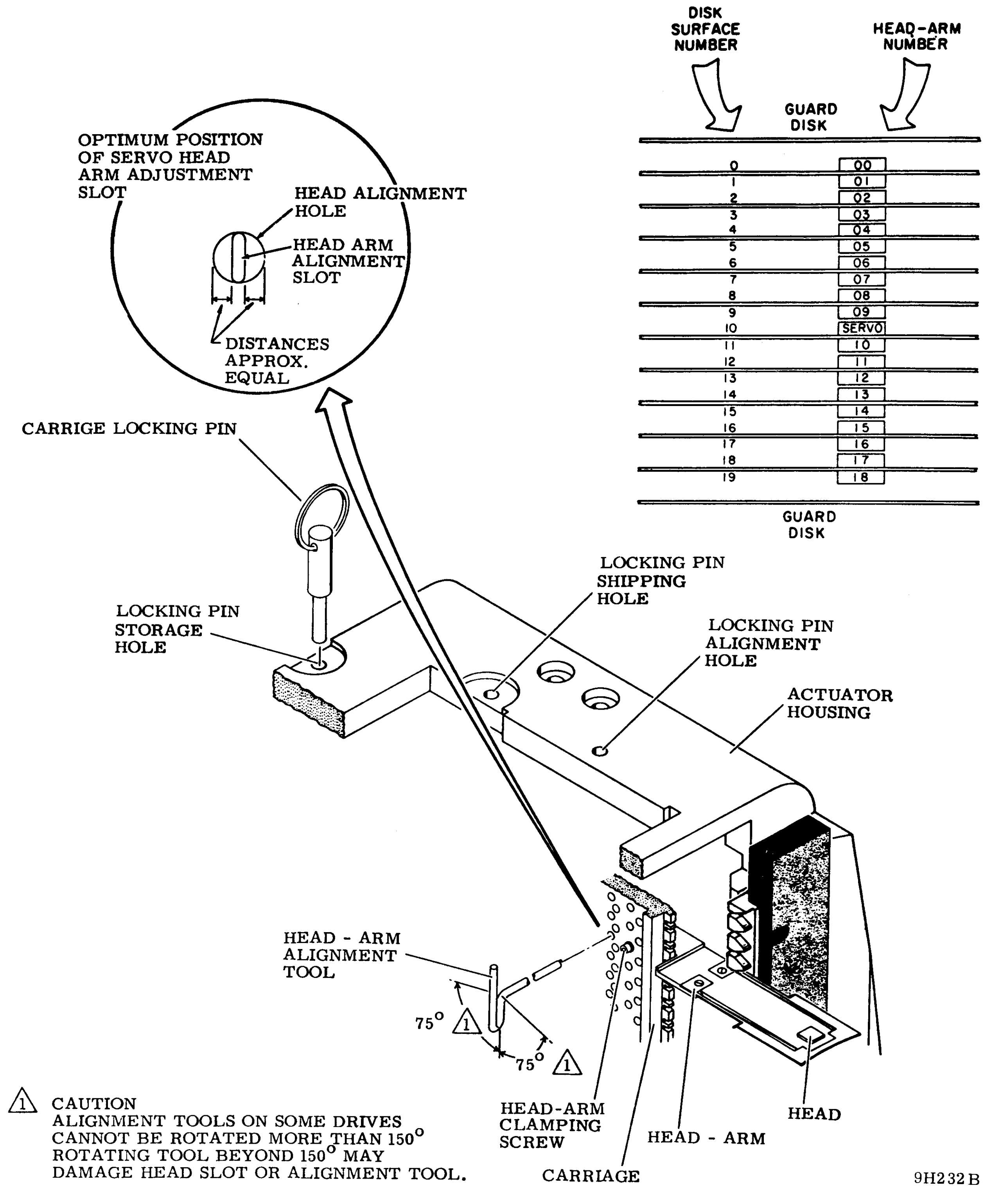


Figure 4-4. Head Arm Alignment

a. When using same CE pack as used for last alignment, offsets must range between +150 mV and -150 mV. If all offsets are within this range, alignment is satisfactory so proceed to step 15.

b. When using a different CE pack than the one used for last alignment, offsets must range between +225 mV and -225 mV. If all offsets are within this range, alignment is satisfactory so proceed to step 15.

c. In any offsets are outside acceptable range, as defined in steps a or b (whichever applies), these heads are misaligned. Proceed to step 5.

5. Press START switch to stop drive motor and unload heads.

NOTE

If heads 16, 17, or 18 require adjustment, remove power from drive, remove disk pack, and manually move carriage forward until mounting screws are accessible to torque wrench.

6. Manually return carriage to maximum retract position and install disk pack.

7. Loosen head-arm mounting screws securing heads requiring alignment and torque these screws to 0.5 +0.1 N·m (4 ±0.5 lbf·in).

8. Press START switch to start drive motor and load heads.

9. Command direct seek to cylinder 491 (245).

NOTE

The force exerted during adjustment can move the heads from the alignment cylinder to an adjacent cylinder. This will result in an improper alignment. Prevent this by connecting a jumper from A07-11A (Seek Error) to ground. However, be sure to remove the jumper before commanding the drive to perform another seek.

10. Install carriage locking pin in track alignment hole.

11. Select read/write head to be aligned.

WARNING

To prevent personal injury in case of an emergency retract, install carriage locking pin in head alignment hole prior to positioning head alignment tool. Be sure to remove pin before next seek is performed.

12. Install head alignment tool so that tool pin engages head-arm alignment slot (refer to figure 4-4).

13. Observe oscilloscope and adjust head to obtain balanced dibit pattern. Pattern is balanced when point A amplitude equals point B and point C equals point D (see figure 4-3).

14. Observe null meter and adjust head until offset ranges are adjusted to half of the maximum allowable range ($\pm$75 mV). Calculate offset as described in steps 5 and 7 of Servo Head Check. Occasionally, a head cannot be aligned because its adjustment slot is at its end of travel. If this occurs, check position of servo head-arm adjustment slot and, if necessary, recenter it. However, note that any slight adjustment of the servo head requires realignment of all read/write heads.

15. Repeat steps 11 through 14 for all heads to be aligned.

16. Remove carriage locking pin and also remove jumper from A07-11A (if it was installed).

17. Command an RTZ Seek.

18. Press START switch to stop drive motor and unload heads.

19. Torque head-arm clamp screws of each head adjusted to 1.4 $\pm$0.1 N·m (12 $\pm$0.5 lbf·in), refer to step 7. While tightening screws, use only straight arm allen wrench and keep it as perfectly aligned as possible with screws. Be careful during this operation to avoid pushing a head out of alignment.

20. Check each head adjusted to see if torqueing screws affected alignment. If any heads are outside acceptable range (as defined in step 4), readjust them as directed in steps 7 through 19.

21. Perform the following to ensure that heads will remain aligned under normal operating conditions.

a. Command continuous seeks between cylinders 240 and 245 for a minimum of 30 seconds.

b. Unload and load heads at least twice.

c. Command direct seek to cylinder 491 (245).

d. Check alignment of each head adjusted. If any heads are outside ±150 mV range, repeat this procedure starting with step 10.

22. Prepare drive for return to online operation.

SERVO SYSTEM TEST AND ADJUSTMENT

This procedure tests and adjusts the drives servo system. The servo system adjustments and their basic functions are as follows:

- Coarse Position Gain - Adjusts the gain of the velocity signal applied to the summing amplifier when the servo system is in coarse mode (cylinders to go equals more than one half track). This adjustment enables seek time to achieve a speed fast enough to meet the required specifications without causing excessive overshoot past the desired cylinder.

- Integrator Gain - Adjusts the gain of the velocity signal applied to the integrator. The integrator output is summed with the output from the D/A converter during the last 128 cylinders of a seek.

- Fine Velocity Gain - Adjusts the gain of the velocity signal applied to the summing amplifier when the servo system is in fine mode (cylinders to go equals less than one half track); this adjustment optimizes servo system response by minimizing overshoot without overdamping the system.

Since these adjustments are interactive, it is important to follow the proper sequence as shown on figure 4-5. The following procedures describe test and adjustment of the servo system.

1. Prepare drive for use with test software or FTU.

2. Test and adjust coarse position gain as follows:

   a. Command continuous seeks between cylinder 000 and 822 (410).

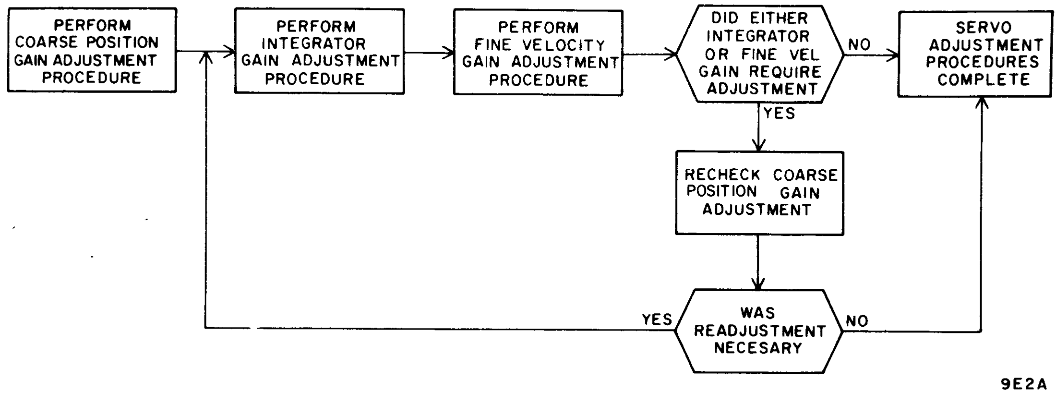


Figure 4-5. Servo System Adjustments Flow Chart

b. Connect oscilloscope channel 1 to A07-03A (+On Cylinder).

c. Trigger oscilloscope negative external on A07-07A (-Forward Seek).

d. Set other oscilloscope controls as necessary to make measurements required in step e.

e. Observe display (see figure 4-6). If distance from trailing edge of first on cylinder pulse to leading edge of second on cylinder pulse is not within 50 to 55 ms, adjust top potentiometer on card A20 until this requirement is met.

3. Test and adjust integrator gain as follows:

a. Command continuous seeks between cylinders 000 and 128.

b. Set up oscilloscope as indicated on figure 4-7 and adjust it until the two sloped curves are displayed.

NOTE

VOLT/CM and TIME/CM settings have to be changed to make measurement required in step c.

c. Observe the second to last discontinuity (indicated on figure 4-7) and note that it has a difference of $0\pm.03$ V or less (ignore the spike). If it exceeds this value, adjust bottom pot on A20 so that it meets these requirements.

OSCILLOSCOPE SETUP

INPUT:

CHANNEL	VOLTS/DIV	CONNECTION	SIGNAL NAME
CH 1	2V/CM	A07-03A	(+ ON CYLINDER)
CH 2	NOT USED		

TRIGGERING:

SLOPE/SOURCE	CONNECTION	SIGNAL NAME
NEG/EXT	A07-07A	(-FORWARD SEEK)

SCOPE GND TO GND ON LOGIC CARD.
USE XIO PROBES UNLESS OTHERWISE NOTED.

TIME/DIV: 10 MS/CM   MODE:

NOTES:

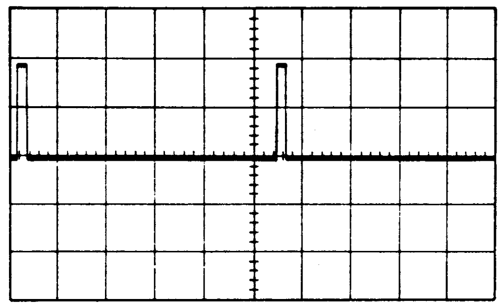


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Figure 4-6. Coarse Position Gain.

OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

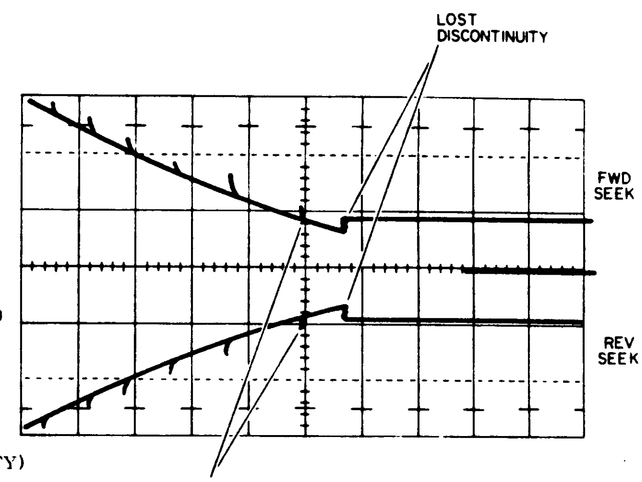
VOLTS / DIV
CH 1 - 0.5V/CM
CH 2 - NOT USED

TIME / DIV
A - 0.5MS/CM
B - NOT USED

NOTE:
HORIZ DISPLAY
SET TO MAG x 10

TRIGGERING
A - POSITIVE EXT ON A12-17B (+T ≤ 7)
B - NOT USED

PROBE CONNECTIONS
CH 1 TO A20-TPD (+ DESIRED VELOCITY)
CH 2 — NOT USED



NOTE:
IT IS NECESARY TO INCREASE VERTICAL SENSITIVITY TO MAKE THIS MEASUREMENT.

NOTE: IGNORE THE SPIKES.

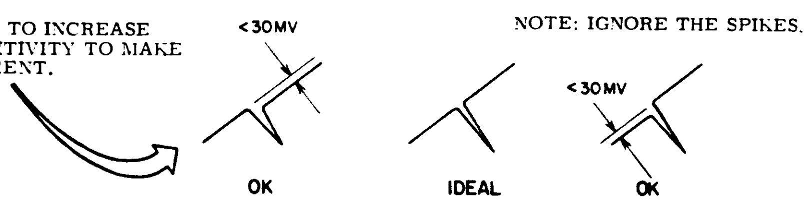


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Figure 4-7. Integrator Gain Waveform

NOTE

In step 4 the read operation is performed between seeks. This causes enough delay between seeks to provide the proper display.

4. Adjust fine velocity gain as follows:

   a. Command read operation to be performed in conjunction with continuous seeks between cylinders 000 and 001.

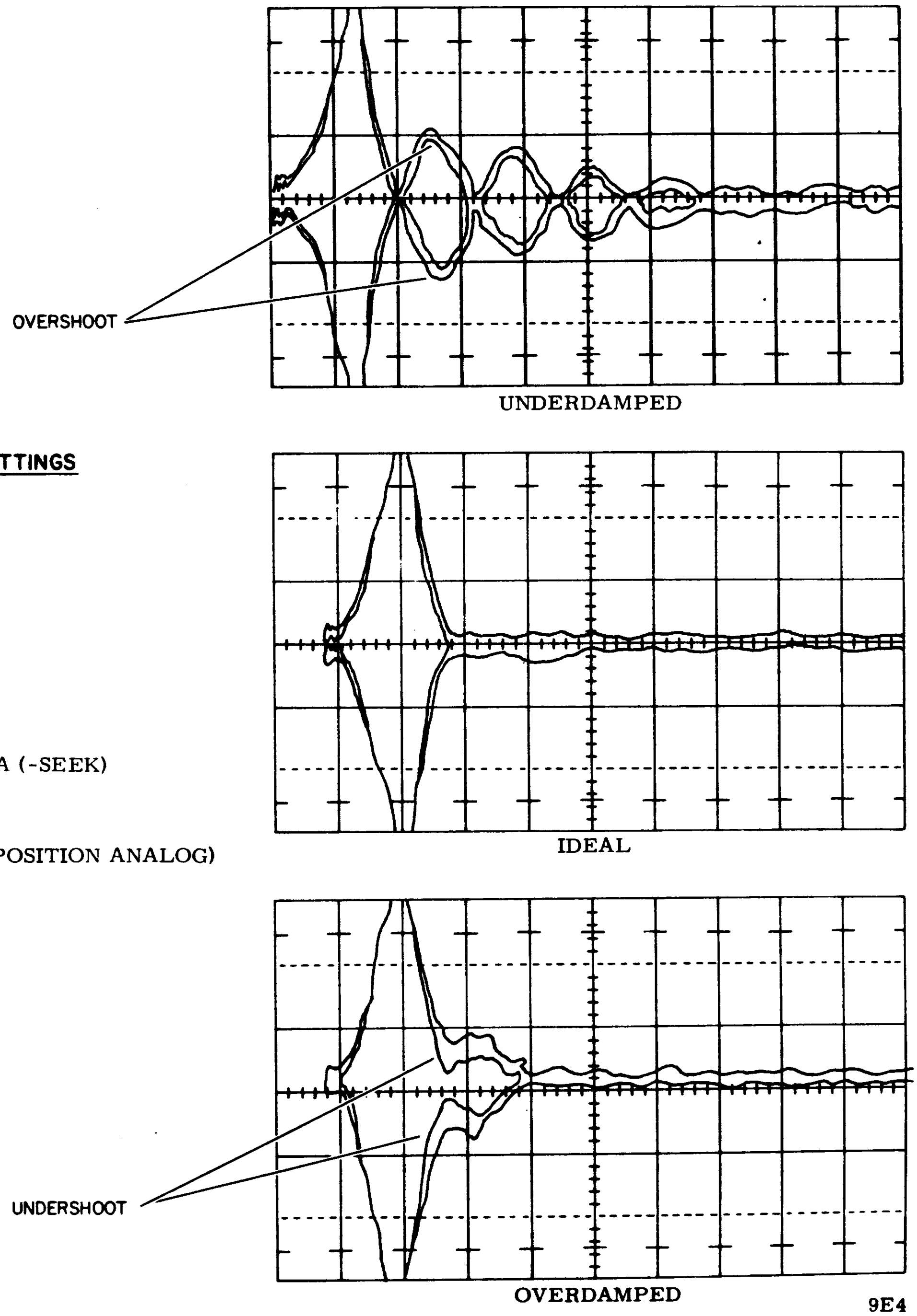
   b. Connect and set up oscilloscope as indicated in figure 4-8.

   c. Referring to figure 4-8, note that the displayed signal settles out with maximum overshoot of less than 0.5 V. If overshoot exceeds this value, adjust middle pot on card in A20. When adjustment is complete, the display should resemble the ideal waveform on figure 4-8.

   d. Command sequential forward seek from cylinder 000 through 822 (410) to be performed in conjunction with a read.

   e. Note that displayed signal is as shown on figure 4-9 at each cylinder. If overshoot exceeds 0.5 V at any cylinder adjust middle pot on card in A20 until this requirement is met.

5. Prepare drive for return to online operations.



OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV
- CH 1 - 0.5V/CM
- CH 2 - NOT USED

TIME / DIV
- A - 1MS/CM
- B - NOT USED

TRIGGERING
- A - NEGATIVE ON A07-30A (-SEEK)
- B - NOT USED

PROBE CONNECTIONS
- CH 1 TO A19-TPC (+FINE POSITION ANALOG)
- CH 2 — NOT USED

Figure 4-8. Fine Velocity Initial Check Waveform

OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 0.5V/CM
CH 2 - NOT USED

TIME / DIV
A - 0.1MS/CM
B - NOT USED

TRIGGERING
A - -EXT, A07-30A (-SEEK)
B - NOT USED

PROBE CONNECTIONS
CH 1 TO A19-TPC (+FINE POSITION ANALOG)
CH 2 - NOT USED

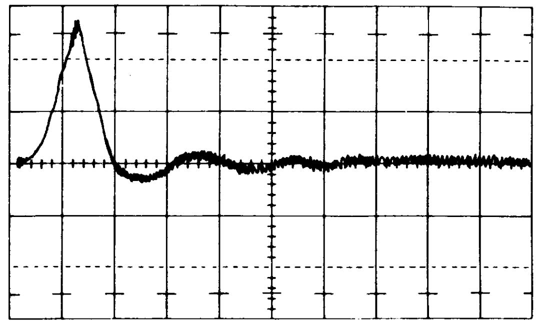


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Figure 4-9. Fine Velocity Gain Final Check Waveform

SECTION 5

TROUBLE ANALYSIS

INTRODUCTION

This section contains information on analyzing problems in the drive. The section is divided into three parts and they appear in the following order:

- Electrical Checks
- General Troubleshooting Procedures
- Structured Troubleshooting Procedures (TSPs)

The first part contains instructions on checking specific circuits or components. The last two parts describe procedures for localizing and correcting problems in the drive when their cause is not known.

The person performing these procedures should be thoroughly familiar with drive operation and with all information in the General Maintenance section of this manual.

ELECTRICAL CHECKS

GENERAL

The following procedures assist you in isolating problems causing improper drive operation. If the drive appears to be operating properly, failure to meet a specification given in these procedures does not in itself indicate improper drive operation.

The procedures are divided into the following major areas:

- Power Supply DC Voltage Output Checks
- Servo System Checks
- Read/Write System Checks
- Miscellaneous Logic Checks

Note that some of the following procedures differ slightly depending upon whether they are performed on a 150 MB (BK6XX) or 300 MB (BK7XX) drive.

These differences are limited to seek length. In these cases, the 150 MB value is shown in parentheses as in the following example.

Example: Command drive to perform a direct seek to cylinder 822 (410).

Applicable to 300 MB Units (BK7XX) — 822

Applicable to 150 MB Units (BK6XX) — (410)

Where a number is followed by a second number in parens, the first value applies to 300 MB drives, and the second value in parens applies to 150 MB drives. In instances where only one number is shown, the value applies to both types of drives.

POWER SUPPLY DC VOLTAGE OUTPUT CHECK

This procedure checks the dc power supply output voltages. This includes all voltages except +5 volts and -5 volts which are checked in the +5 Volt and -5 Volt Test and Adjustment procedure.

1. Prepare drive for use with test software or FTU.

2. Command continuous seeks between cylinders 000 and 128.

3. Connect voltmeter ground lead to ground test jack on power supply panel.

4. Measure between ground jack and appropriate test jacks on power supply control panel to check following voltages.

Nominal	Acceptable Range
+46 V	+44 to +51 V
-46 V	-44 to -51 V
+9.7 V	+8.7 to +10.7 V
-9.7 V	-8.7 to -10.7 V
+20 V	+18 to +22 V (Non-VDE) +19.5 to +24.5 V (VDE)
-20 V	-18 to -22 V (Non-VDE) -19.5 to -24.5 V (VDE)
+28 V	+26 to +30 V

5. Disconnect voltmeter, then set up and connect oscilloscope as appropriate to make measurements in step 6.

6. Measure between ground jack and appropriate test jack on power supply control panel and ensure that peak to peak voltage ripple at the following test jacks is within the following limits.

Test Jack	Ripple
+46	4.5 V
-46	4.5 V
+20	1.0 V
-20	1.0 V
+28	1.0 V

SERVO SYSTEM CHECK

The servo system checks consist of procedures that test various points in the drives servo logic. These procedures are divided into two categories: logic controlled checks and manually controlled checks.

The logic controlled checks use the FTU or test software to command the carriage movement required for testing the servo system.

The manually controlled checks provide various tests that can be performed by manually positioning the carriage. These tests may be necessary if problems exist such that satisfactory results cannot be obtained through the use of the FTU or test software.

Logic Controlled Servo Checks

The following procedures describe various tests that can be performed using the FTU or test software.

D/A Converter Output Check

This procedure checks the output of the D/A Converter. The D/A converter produces an output that begins at some maximum value and steps down as each track is crossed until the drive is on cylinder. When on cylinder the D/A output should be zero.

1. Prepare drive for use with test software or FTU.

2. Connect and set up oscilloscope as shown on figure 5-1.

3. Command continuous seeks between cylinders 000 and 128.

4. Check that the observed waveforms are as shown on figure 5-1. Note that by further expanding this waveform it is possible to see the individual steps produced as each track is crossed. The steps should be approximately equal and about 0.07 V in amplitude (refer to figure 5-2).

5. Prepare drive for return to online operation.

Cylinder Pulse Blanking Delay Check

This procedure checks the delay which prevents a cylinder pulse from being generated as the drive moves off cylinder.

1. Prepare drive for use with test software or FTU.

2. Command continuous seeks between cylinders 000 and 003.

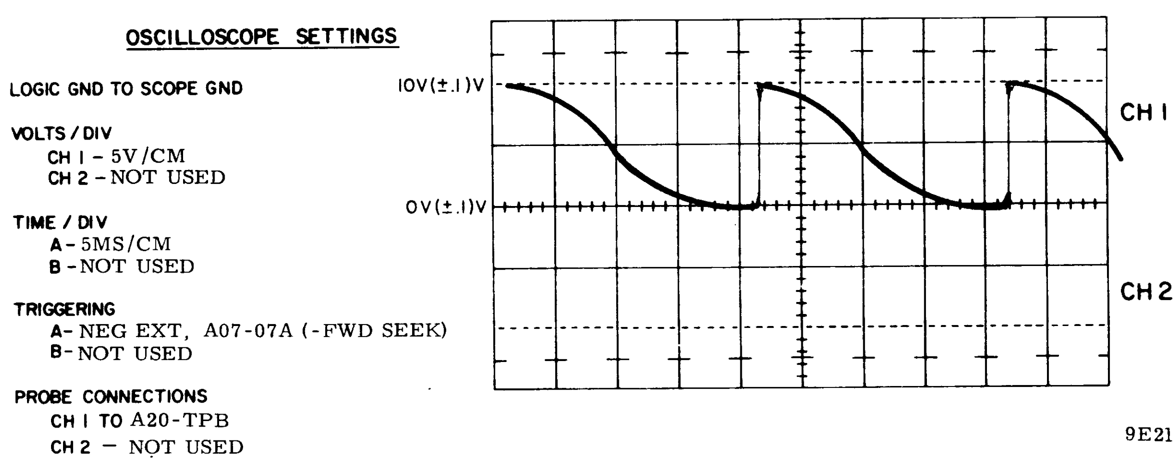


Figure 5-1. D/A Converter Output Waveform

OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 0.1V/CM
CH 2 - NOT USED

TIME / DIV
A - 5MS/CM
B - NOT USED

TRIGGERING
A - NEG EXT,A07-07A (-FWD SEEK)
B - NOT USED

PROBE CONNECTIONS
CH 1 TO A20-TPB
CH 2 — NOT USED

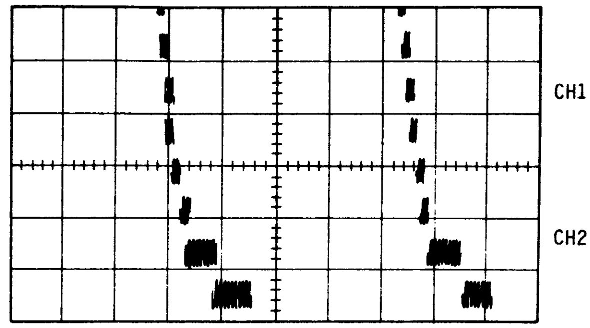


Figure 5-2. D/A Converter Output Waveform Expanded

3. Connect and setup oscilloscope as follows:

   a. Connect channel 1 to A07-30B (+Cylinder Pulse Blanking).

   b. Trigger positive internal.

   c. Set other controls as appropriate to make measurements required in step 4.

4. Observe that the Cylinder Pulse Blanking delay is a "1" for 950 (±50) us.

5. Prepare drive for return to online operation.

Cylinder Pulse One Shot Check

This procedure checks the duration of the cylinder pulses.

1. Prepare drive for use with test software or FTU.

2. Command continuous seeks between cylinders 000 and 003.

3. Connect and set up oscilloscope as follows:

   a. Connect channel 1 to A07-22A (+Cylinder Pulses).

   b. Trigger positive internal.

   c. Set other controls as appropriate to make measurements required in step 4.

4. Observe that Cylinder Pulse one shot is "1" for 7.5 to 12.5 us.

5. Prepare drive for return to online operation.

Cylinder Pulse Switching Level Check

This test checks the levels at which the track crossing detectors switch to cause generation of a cylinder pulse.

1. Prepare drive use with either test software or FTU.

2. Command 1 cylinder sequential forward seeks between cylinders 000 and 822 (410).

3. Connect and set up oscilloscope as indicated on figure 5-3. Note that this figure actually shows four different checks, each having a separate resulting waveform.

4. Evaluate results as shown on figure 5-3.

5. Prepare drive for return to online operation.

Fine Enable Switching Level Check

This procedure verifies that the Fine Enable signal switches at the proper time. The Fine Enable signal is turned on when Tracks to Go are less than one and Integrated Velocity reaches a certain point.

1. Prepare drive for use with test software or FTU.

2. Connect and set up oscilloscope as indicated on figure 5-4.

3. Command continuous seeks between cylinders 000 and 001.

4. Observe that the waveforms are as indicated on figure 5-4. Note that fine enable switches to a zero level when integrated velocity is between +0.82 and +0.98 V for forward seeks and -0.82 and -0.98 V for reverse seeks.

OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

TIME / DIV
A - 0.2 MS/CM
B - NOT USED

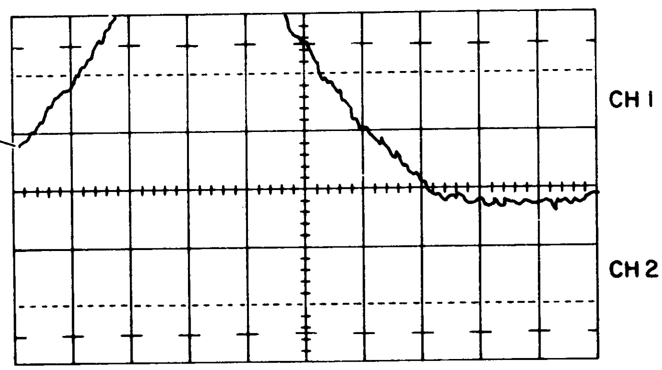
PROBE CONNECTIONS
CH 1 TO A18-09 B (+ TRACK SERVO SIGNAL)
CH 2 – NOT USED

NOTE:
TIME/DIV AND PROBE CONNECTIONS ARE COMMON TO ALL THE FOLLOWING WAVEFORMS.

VOLTS / DIV
CH 1 - 0.5V/CM
CH 2 - NOT USED

TRIGGERING
A - NEG EXT. A18-08B (+ CYL DET B)
B - NOT USED

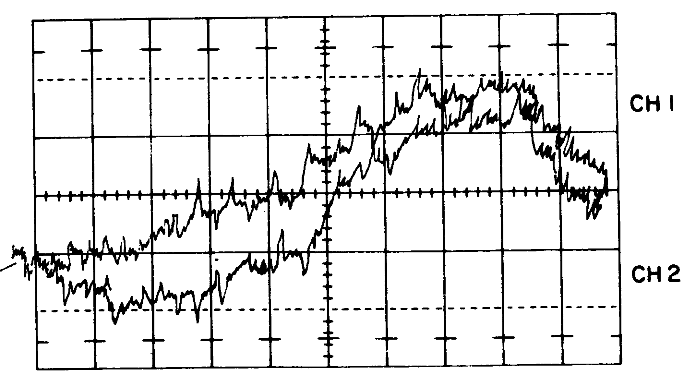
+0.4(±0.1)V



VOLTS / DIV
CH 1 - 0.1V/CM
CH 2 - NOT USED

TRIGGERING
A - POS EXT. A18-08B (+CYL DET B)
B - NOT USED

0(±0.1)V



9E16-1B

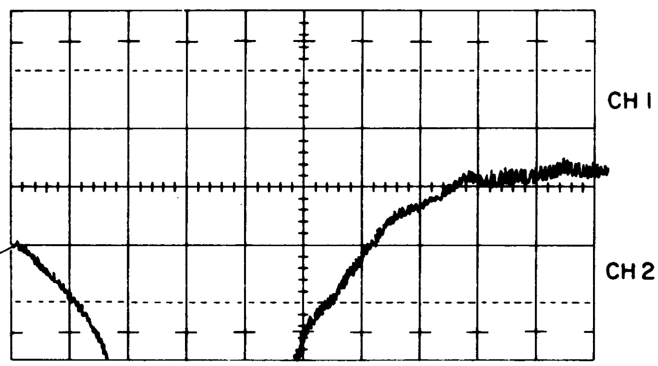
Figure 5-3. Cylinder Pulse Switching Level Waveform
(Sheet 1 of 2)

OSCILLOSCOPE SETTINGS

VOLTS / DIV
CH 1 - 0.5V/CM
CH 2 - NOT USED

TRIGGERING
A- NEG EXT. A18-07B (+CYL DET A)
B- NOT USED

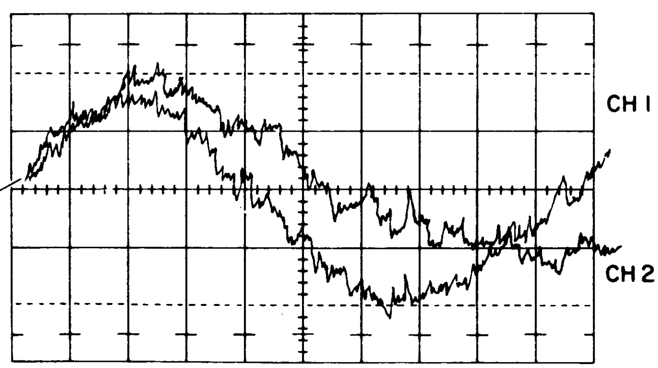
0.4(±0.1)V



VOLTS / DIV
CH 1 - 0.1V/CM
CH 2 - NOT USED

TRIGGERING
A- POS EXT. A18-07B (+ CYL DET A)
B- NOT USED

0(±0.1)V



9E16-2A

Figure 5-3. Cylinder Pulse Switching Level Waveform
(Sheet 2)

OSCILLOSCOPE SETUP

INPUT:

CHANNEL	VOLTS/DIV	CONNECTION	SIGNAL NAME
CH I	5V/CM	A20-10A	(-FINE ENABLE)
CH 2	0.5V/CM	A20-TPG	(+INTEGRATED VEL)

TRIGGERING:

SLOPE/SOURCE	CONNECTION	SIGNAL NAME
NEG/INT	A20-12A	(-FWD SEEK)

SCOPE GND TO GND ON LOGIC CARD.
USE XIO PROBES UNLESS OTHERWISE NOTED.

TIME/DIV: 2 MS/CM MODE: ALTERNATIVE

NOTES:

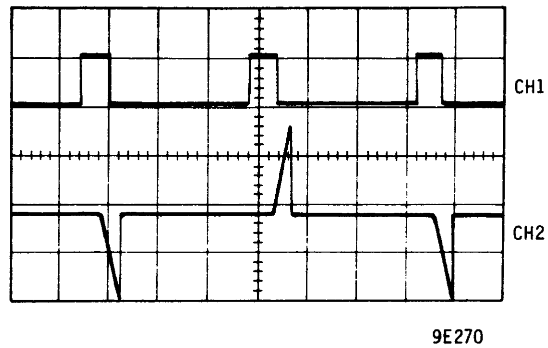


Figure 5-4. Fine Enable Switching Level Waveform

5. Prepare drive for return to online operation.

On Cylinder Delay Check

This procedure checks the delay between the time the drive is on cylinder and the On Cylinder pulse is generated.

1. Prepare drive for use with test software or FTU.

2. Command continuous seeks between cylinder 000 and 003.

3. Connect and set up oscilloscope as follows:

   a. Connect channel I to A07-03B (-On Cylinder).

   b. Trigger positive on A07-15A (+On Cylinder Sense).

   c. Set other controls as appropriate to make measurement required in step 4.

4. Observe that On Cylinder is a "1" for 1.40 to 2.1 ms.

5. Prepare drive for return to online operation.

On Cylinder Dropout Delay Check

This procedure checks the delay between the time the drive goes off cylinder and when the On Cylinder signal drops.

NOTE

> Place card A07 on card extender during drive preparation procedure. Also place chip clip on IC in position A3.

1. Prepare drive for use with test software or FTU.
2. Command continuous seeks between cylinders 000 and 003.
3. Connect and setup oscilloscope as follows:
   a. Connect channel 1 to pin 3 of chip in position A3.
   b. Trigger negative internal.
   c. Set other controls as appropriate to make measurements required in step 4 of this procedure.
4. Observe that On Cylinder Dropout delay is zero for 500 to 1100 us.
5. Prepare drive for return to online operation.

On Cylinder Pulse Check

This procedure measures duration of On Cylinder pulse.

1. Prepare drive for use with test software or FTU.
2. Command continuous seeks between cylinders 000 and 001.
3. Connect and setup oscilloscope as follows:
   a. Connect channel 1 to A07-22A (+Cylinder Pulses).
   b. Trigger positive internal.
   c. Set other controls as appropriate to make measurement required in step 4.
4. Observe that On Cylinder pulse is one for 0.25 to 0.35 us.
5. Prepare drive for return to online operation.

On Cylinder Switching Level Check

This procedure checks the level at which the On Cylinder Sense signal goes true. This should occur at each zero (track) crossing.

1. Prepare drive for use with either test software or FTU.

2. Set up and connect oscilloscope as shown on figure 5-5.

3. Command continuous 2-track seeks between cylinder 000 to 002 (001).

4. Check that resulting waveforms agree with those shown on figure 5-5.

5. Set up and connect oscilloscope as shown on figure 5-6.

OSCILLOSCOPE SETTINGS

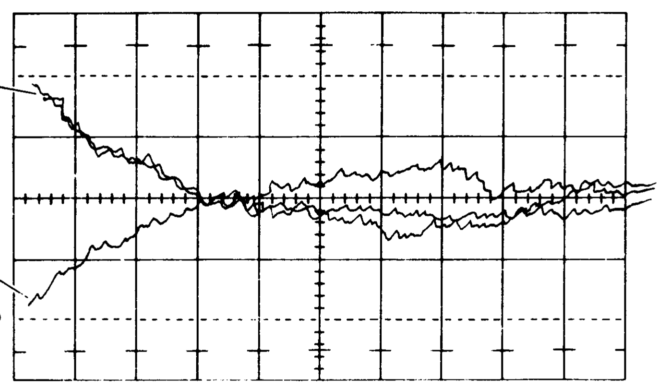
LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 0.2V/CM
CH 2 - NOT USED

TIME / DIV
A - 0.1MS/CM
B - NOT USED

TRIGGERING
A - POS EXT, A08-31B (+ON CYL SENSE)
B - NOT USED

PROBE CONNECTIONS
CH 1 TO A18-09B (+TRACK SERVO SIGNAL)
CH 2 TO NOT USED



9E17A

Figure 5-5. On Cylinder Switching Level - Waveform I

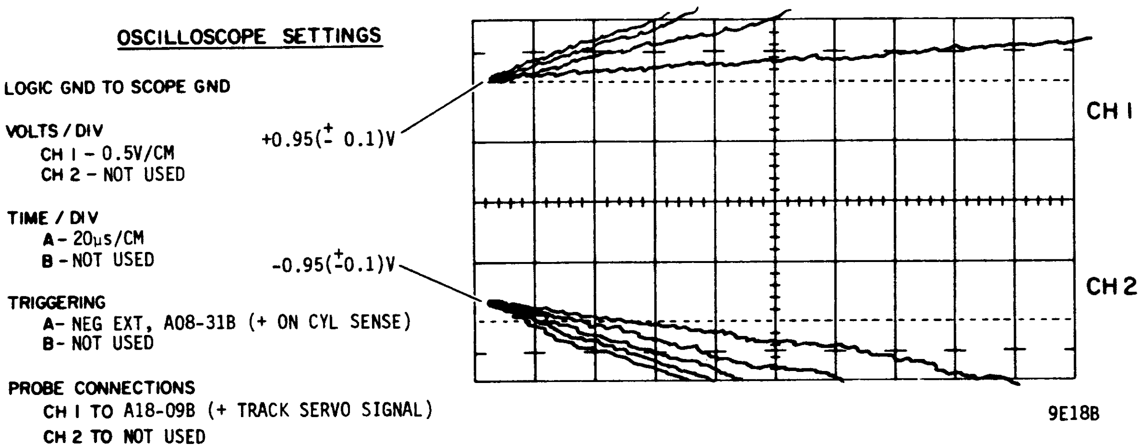


Figure 5-6. On Cylinder Switching Level - Waveform II

CAUTION

While performing step 6, refer to Manually Positioning Carriage procedure and perform that entire procedure before proceeding to step 7.

6. Observe display while manually moving carriage in forward and reverse directions. Check that resulting waveforms agree with those on figure 5-6. Check to ensure that a fault did not occur as the result of manually moving the heads.

7. Prepare drive for return to online operation.

One Track Seek Time Check

This procedure checks the time it takes for the positioner to move from one track to another.

1. Prepare drive for use with test software or FTU.

2. Command drive to perform one cylinder sequential forward seeks, starting at cylinder 000 and ending at 822 (410). Perform a read operation between each seek.

3. Connect and set up oscilloscope as follows:

   a. Connect channel 1 to A07-03A (+On Cylinder).

   b. Trigger negative internal on A07-07A (-Forward Seek).

   c. Set other oscilloscope controls as appropriate for making measurements required in step 4.

4. Observe that signal is low for 8 ms or less.

5. Prepare drive for return to online operation.

Positioner Offset Voltage Check

This checks the offset level produced by a servo offset command. The measurement is made on the Track Servo signal which normally has an average dc level of zero when the drive is on cylinder.

1. Prepare drive for use with either test software or FTU.

2. Command direct seek to cylinder 400 (200).

3. Connect and set up oscilloscope as follows:

   a. Connect channel 1 to A18-09B (+Track Servo Signal).

   b. Set channel A sweep trigger mode to AUTO.

   c. Set other controls as appropriate to make measurement required in step 4.

NOTE

Measure average dc level in steps 4 and 5.

4. Command carriage offset plus (forward offset) and observe that the scope indicates +0.5 to +0.7.

5. Command carriage offset minus (reverse offset) and observe that the scope indicates -0.5 to -0.7.

6. Prepare drive for return to online operation.

Track Following Check

This procedure checks the ability of the heads to accurately follow the track. Inability to stay on track may be caused by excessive runout of the disk pack or spindle assembly. Runout is the degree to which a rotating object wobbles off its center of rotation.

Inability to stay on track is also caused by the servo logic being unable to respond to allowable runout.

If the heads do not accurately follow the track, read errors may occur and the drive may also intermittently drop on cylinder.

1. Prepare drive for use with test software or FTU.

2. Command direct seek to cylinder 400 (200).

3. Connect and set up oscilloscope as follows:

   a. Connect channel 1 to A19-TPC (Fine Position Analog).

   b. Trigger positive external on A06-TPC (Index).

   c. Set other controls as appropriate to make observations required in remainder of this procedure.

4. Observe display and refer to figure 5-7. As runout increases, waveform sinusoidal amplitude increases.

5. Interpret display as follows:

   a. If amplitude of 60 Hz sinusoidal component of waveform exceeds 400 mV peak-to-peak, it is excessive and a problem exists with either drive or disk pack. In this case, note point at which waveform syncs with Index and proceed to step 6.

   b. If waveform sinusoidal amplitude does not exceed 400 mV, the drive or disk pack does not have excessive runout. In this case, proceed to step 11.

6. Press START switch to stop drive motor and unload heads.

7. Note position of disk pack on spindle, remove disk pack, rotate in 90 degrees (1/4 turn) in either direction and reinstall it on the spindle.

8. Press START switch to start drive motor and load heads.

OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 0.1V/CM (READ SCALE AS 100MV)
CH 2 - NOT USED

TIME / DIV
A - 2MS/CM
B - NOT USED

TRIGGERING (POSITIVE /EXTERNAL)
A - INDEX
B - NOT USED

PROBE CONNECTIONS
CH 1 TO A19-TPC (FINE POS ANALOG)
CH 2 - NOT USED

NOTES:

1 MORE THAN NORMAL RUNOUT RESULTS IN THE WAVEFORM HAVING A 60Hz SINUSOIDAL COMPONENT AS SHOWN ON WAVEFORM A. AS AMOUNT OF RUNOUT INCREASES, THE PEAK TO PEAK AMPLITUDE OF THE 60Hz COMPONENT INCREASES.

2 NORMAL RUNOUT IS SHOWN ON WAVEFORM B. IN THIS CASE, THE AMPLITUDE OF THE 60Hz SINUSOIDAL COMPONENT IS LESS THAN 400MV PEAK TO PEAK.

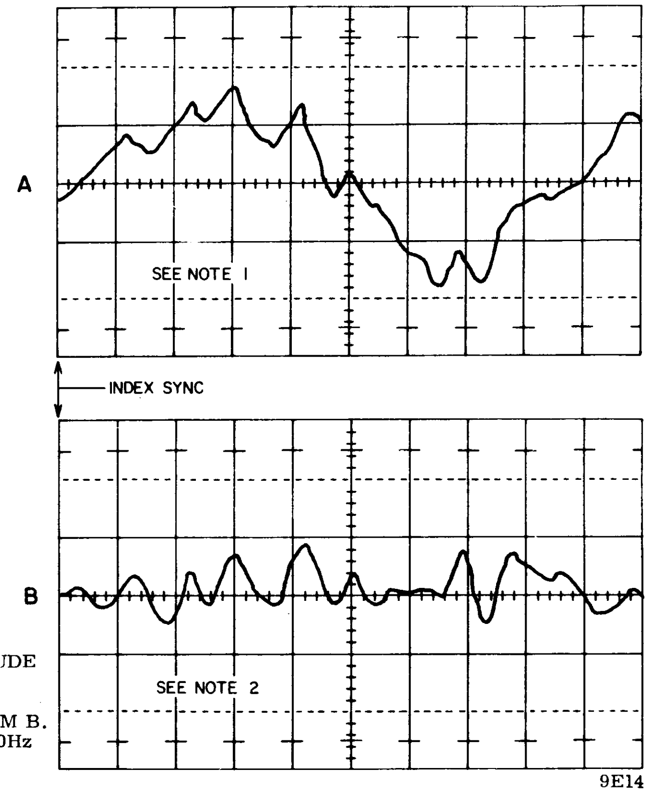


Figure 5-7. Track Following Check Waveform

NOTE

Because Index and Fine Position signals are both derived from servo dibit tracks on disk pack, there should be no phase shift between these signals when disk pack is rotated with respect to spindle if there is no spindle run-out.

9. Command direct seek to cylinder 400 (200).

10. Compare phase position of waveform displayed with phase position of waveform observed in step 5. Interpret results as follows:

    a. If phase relationship of both waveforms coincide, disk pack or servo system is cause of excessive runout.

b. If phase relationship of both waveforms do not coincide, spindle or servo system is causing excessive runout.

11. Prepare drive for return to online operation.

Track Servo Amplitude Check

This procedure checks the amplitude of the track servo dibits signal that is an input to the track servo circuit.

1. Prepare the drive for use with test software or FTU.

2. Connect and set up oscilloscope as indicated on figure 5-8.

3. Command direct seek to cylinder 000 and observe peak to peak amplitude of waveform.

4. Command direct seek to cylinder 822 (410) and observe peak to peak amplitude of waveform.

5. Check that waveforms observed in steps 3 and 4 is between 0.3 and 1.5 V peak-to-peak. Also note that waveform of step 3 has the largest amplitude.

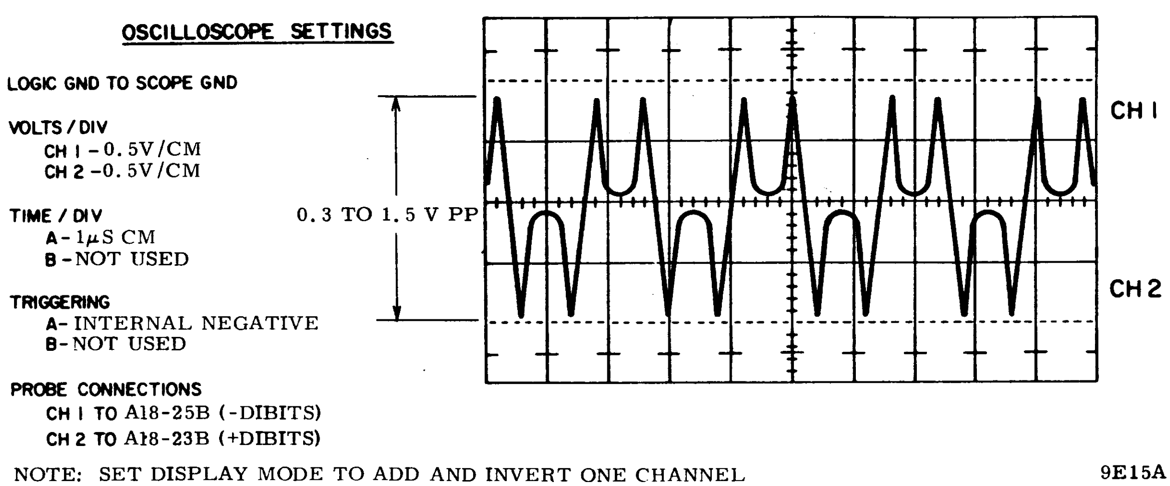


Figure 5-8. Track Servo Amplitude Waveform

6. Prepare drive for return to online operation.

Velocity Transducer Gain Uniformity Check

This checks the output of the velocity transducer by monitoring the sawtooth output of the velocity integrator. Note that the positive sawtooth waveforms are produced during forward seeks and the negative waveforms during reverse seeks.

1. Prepare drive for use with test software or FTU.

2. Connect and setup oscilloscope as indicated on figure 5-9.

3. Command continuous seeks between cylinders 000 and 822 (410).

4. Observe waveforms as shown on figure 5-9, check to ensure that the amplitude of the second to last positive and negative ramps are each in the range from 1.8 to 2.2 V and the difference between the two is 0.3 V maximum. Note that the positive ramps are produced during forward seeks and negative during reverse seeks.

OSCILLOSCOPE SETTINGS

LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 1V/CM
CH 2 - NOT USED

TIME / DIV
A - 0.5MS/CM
B - NOT USED

TRIGGERING
A - EXT POS, A12-17B (T ≤ 7)
B - NOT USED

PROBE CONNECTIONS
CH 1 TO A20-TPG (+INTEGRATED VELOCITY)
CH 2 — NOT USED

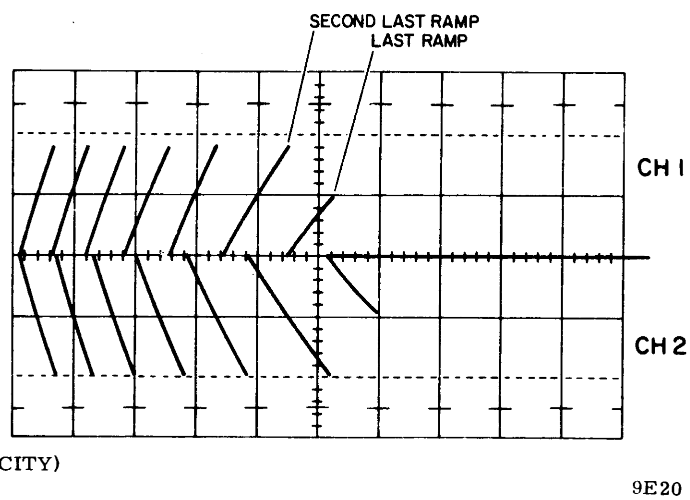


Figure 5-9. Integrated Velocity Waveform

Manually Controlled Servo Checks

This procedure describes testing the servo system while manually positioning the carriage.

1. Prepare drive as follows:

   a. Press START switch to stop drive motor.

   b. Set MAIN AC circuit breaker to off.

   c. Raise top cover.

   d. Put logic chassis in maintenance position.

   e. Remove logic control of voice coil by disconnecting yellow lead wire at voice coil.

CAUTION

> Make sure carriage is fully retracted (refer to procedure for manually positioning carriage).

2. Check that output of summing amplifier is at 0 volts before drive motor is energized by performing the following procedure.

   a. Set oscilloscope vertical sensitivity control to 5V/CM.

   b. Set oscilloscope horizontal sweep control to .01 MS/CM.

   c. Set oscilloscope trigger control to AUTO (free running).

   d. Connect oscilloscope channel A to A20-25A (+Summing Amp Output).

   e. Set MAIN AC circuit breaker to on and observe that voltage remains at 0 volts.

3. Check that output of summing amplifier goes to -10 V when drive motor gets up to speed by performing the following procedure.

   a. Connect and set up oscilloscope as in step 2.

b. Press START switch to start drive motor and observe that summing amplifier output drops to -10 volts when drive motor gets up to speed (approximately 30 seconds).

CAUTION

Refer to discussion on manually positioning carriage before loading and positioning heads as described in the following steps.

4. Manually load heads.

5. Check velocity transducer and amplifier as described in the following. If signals observed are as specified.

   a. Set up oscilloscope as follows:

      - Vertical sensitivity to .05V/CM.
      - Horizontal sweep to 10MS/CM.
      - Trigger control to AUTO (free running).
      - Connect channel A to A20-TPE (+Velocity).

   b. Manually move carriage toward cylinder 822 (forward direction). Signal should go negative and amplitude should increase as speed of carriage increases.

   c. Manually move carriage toward cylinder 000 (reverse direction). Signal should go positive and amplitude should increase as speed of carriage increases.

6. Check Fine Position Analog signal. If signal is observed as specified in step b below, track servo and servo head are functioning properly.

   a. Set up and connect oscilloscope as follows:

      - Set Vertical sensitivity control to 1V/CM.
      - Set Horizontal sweep control to 10MS/CM.
      - Set trigger control to AUTO (free running).
      - Connect channel A to A19-TPC (Fine Position Analog).

b. Observe an approximate 3.8 volts peak-to-peak signal when moving carriage in either forward or reverse direction. When signal is at 0 volts, drive is on cylinder.

7. Check polarity of Fine Positioning Analog signal. If observed signals are as specified, it ensures that the Fine Position Analog signal has the proper polarity when it is applied to the fine gate.

   a. Oscilloscope settings and connections are same as in previous step.

   b. Move positioner back until heads contact head cams (do not unload heads).

   c. Observe that Fine Position Analog signal is at zero volts.

   d. Manually move carriage slowly forward and observe that signal first goes positive (as it crosses reverse end of travel area) then alternately positive and negative as servo head starts crossing tracks.

8. Check summing amplifier output. If signals observed in the following are as specified, it indicates that proper signal is being gated to summing amplifier, fine mode is enabled, and Velocity and Fine Position Analog signals are properly summed together.

   a. Connect and set up oscilloscope as follows:

      - Set Vertical sensitivity control to 5V/CM.

      - Set Horizontal sweep control to 20MS/CM.

      - Set trigger control to AUTO (free running).

      - Connect channel A to A20-25A (+Summing Amp Outlet).

   b. Move carriage in forward then reverse direction.

9. Check Power Amplifier output. If signal observed are as specified in following, power amplifier is functioning properly.

   a. Connect and set up oscilloscope as follows:

      - Set Vertical sensitivity control to 2V/CM (use 10X probe).

- Set Horizontal sweep control to 10MS/CM.
- Set trigger control to AUTO (free running).
- Connect channel A to yellow leadwire that was disconnected from voice coil.

b. Move carriage forward, then reverse direction, and observe signal switching from +46 and -46 volts.

CAUTION

Refer to discussion on manually positioning carriage before manually unloading heads.

10. Manually unload heads.
11. Press START switch to stop drive motor.
12. Set MAIN AC circuit breaker to off.
13. Reconnect yellow lead wire to voice coil.
14. Prepare drive to online operation.

READ/WRITE SYSTEM CHECKS

The read/write system checks consist of procedures checking the basic read/write capability of the drive.

Write Circuit Checks

This procedure checks three points in the write circuits (refer to figure 5-10). If the signals at these points are correct, the write circuits are performing their basic function.

1. Prepare the drive for use with test software or FTU.
2. Command drive to write a 1010 bit pattern on the disk.
3. Check inputs to NRZ to MFM converter and write compensation circuits. Timing relationships between NRZ data and 9.67 MHz Enable signals must be correct if NRZ to MFM conversion and write compensation circuits are to operate properly.

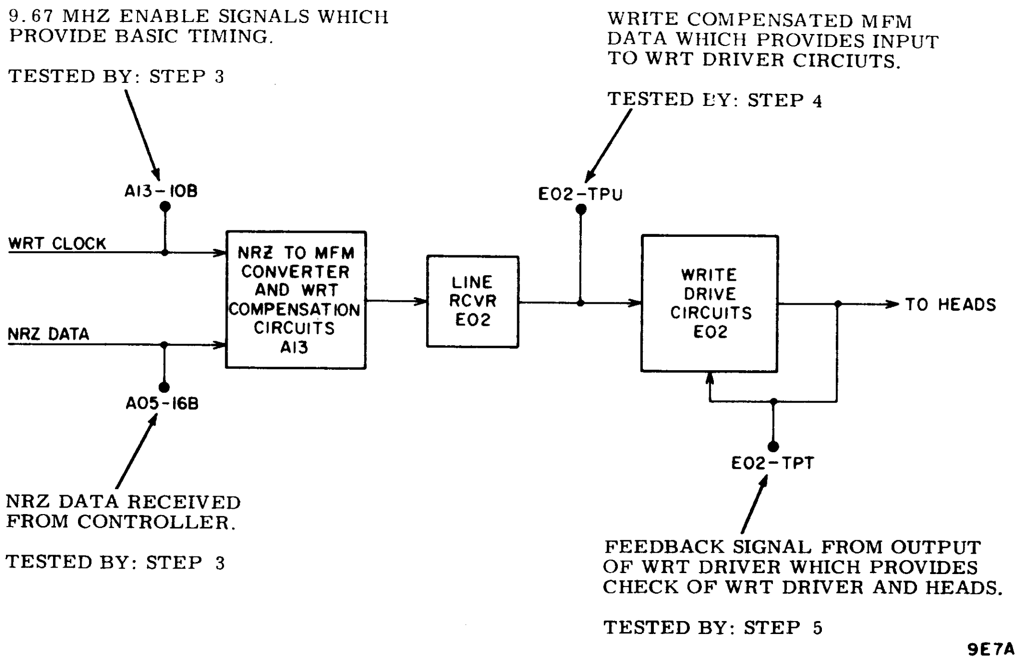


Figure 5-10. Write Circuits Test Points

a. Connect and set up oscilloscope as shown in figure 5-11.

b. Observe that signals have timing relationships as shown in figure 5-11.

4. Check input to write driver circuits. This checks compensated MFM data input to Write Toggle FF.

   a. Move oscilloscope channel 2 probe to E02-TPU.

   b. Observe that signals have approximately the relationship shown in figure 5-12 and that channel 2 signal has proper polarity.

5. Check output of write driver circuits. This ensures that write driver is sending data and that head is functioning.

   a. Move oscilloscope channel 2 probe to E02-TPT.

   b. Observe that signals are approximately as shown in figure 5-13.

6. Prepare drive for return to online operation.

OSCILLOSCOPE SETTINGS

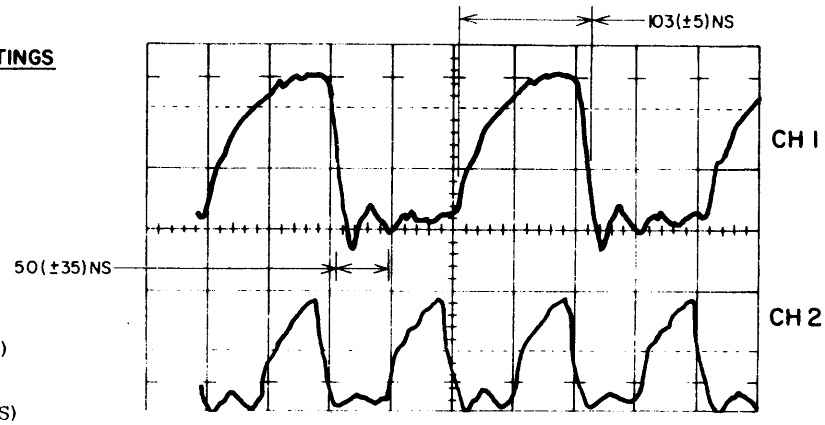
LOGIC GND TO SCOPE GND

VOLTS / DIV
- CH I - 0.2V/CM
- CH 2 - 0.2V/CM

TIME / DIV
- A - 2MS/CM
- B - 0.05μS/CM

TRIGGERING
- A- +EXT, A06-TPC (INDEX)
- B- -INT

PROBE CONNECTIONS (10X PROBES)
- CH I TO A05-16B (NRZ DATA)
- CH 2 TO A13-10B (WRT CLOCK)



NOTE: SET TO DISPLAY MODE TO ALT AND TRIGGER MODE TO CH 1 ONLY.
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)

9E11 A

Figure 5-11. NRZ Write Data Input Waveform

OSCILLOSCOPE SETTINGS

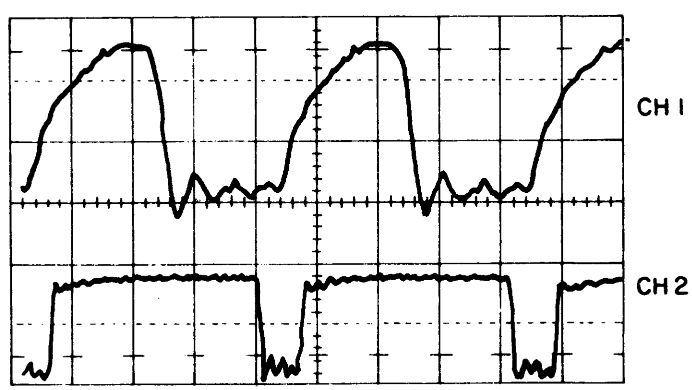
LOGIC GND TO SCOPE GND

VOLTS / DIV
- CH I - 0.2V/CM
- CH 2 - 0.2V/CM

TIME / DIV
- A - 2MS/CM
- B - 0.05μS/CM

TRIGGERING
- A- +EXT, A06-TPC (+ INDEX)
- B- -INT

PROBE CONNECTIONS (10X PROBES)
- CH I TO A05-16B (NRZ DATA)
- CH 2 TO EO2-TPU



NOTE: SET DISPLAY MODE TO ALT AND TRIGGER MODE TO CH 1 ONLY.
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)

9E12 A

Figure 5-12. Write Driver Input Waveform

OSCILLOSCOPE SETTINGS

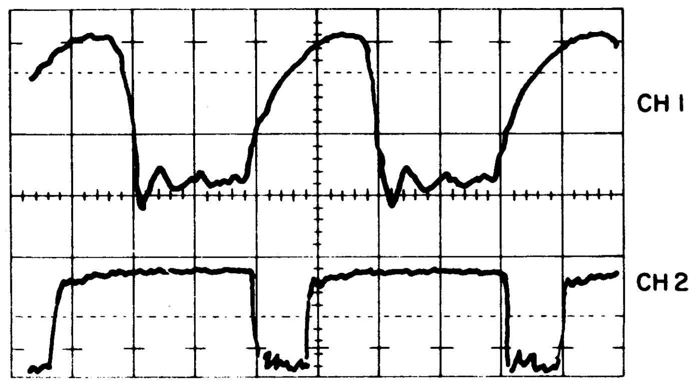
LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 0.2V/CM
CH 2 - 0.2V/CM

TIME / DIV
A - 2MS/CM
B - 0.05μS/CM

TRIGGERING
A - +EXT, A06-TPC (+ INDEX)
B - - INT

PROBE CONNECTIONS (10X PROBES)
CH 1 TO A05-16B (NRZ DATA)
CH 2 TO EO2-TPT



NOTE: SET DISPLAY MODE TO ALT AND TRIGGER MODE TO CH 1 ONLY
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)

9E13 A

Figure 5-13. Write Driver Output Waveform

Read Circuit Checks

This procedure checks the basic operation of the read circuits (refer of figure 5-14). If the observed signals are correct, these circuits are performing their basic functions.

1. Prepare drive for use with test software or FTU.

2. Command drive to write 1010 bit pattern on disk.

3. Command drive to read 1010 bit pattern.

4. Check Analog Data input to the analog to digital converter circuits. If signals are correct, the analog data detection circuits are functioning.

   a. Connect and set up oscilloscope as indicated in figure 5-15.

   b. Observe that signal is approximately as shown on figure 5-15 with approximately 200 ns between zero crossings.

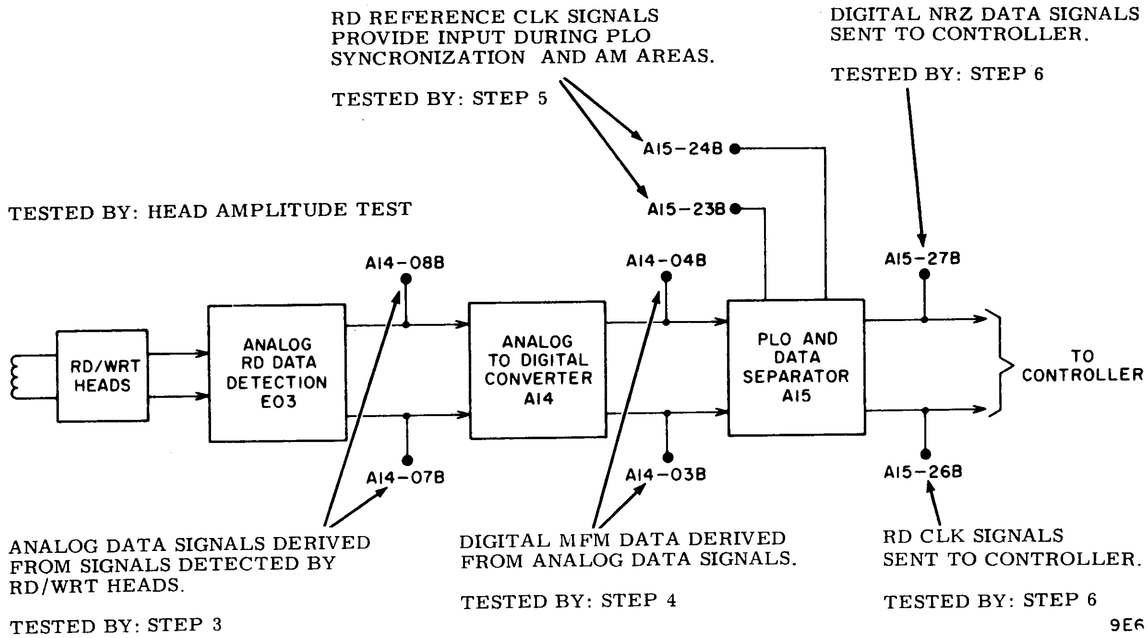


Figure 5-14. Read Circuits Test Points

OSCILLOSCOPE SETTINGS

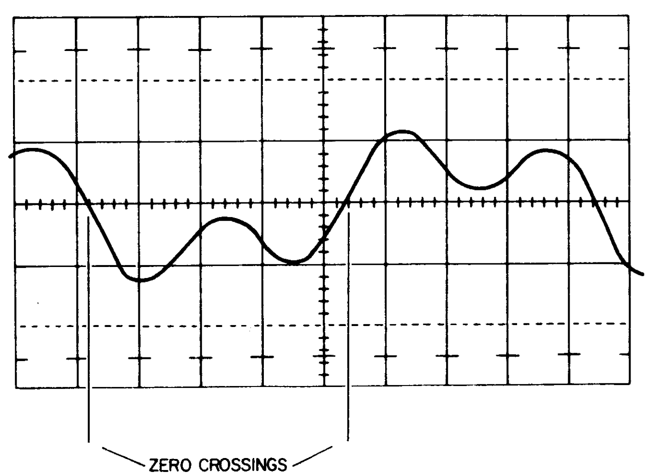
LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 0.1V/CM
CH 2 - 0.1V/CM

TIME / DIV
A - 2MS/CM
B - 0.05μS/CM

TRIGGERING
A - +EXT, A06-TPC (+INDEX)
B - -INT

PROBE CONNECTIONS (10x PROBES)
CH 1 TO A14-08B (-ANALOG DATA)
CH 2 TO A14-07B (+ANALOG DATA)



9E8

NOTE: SET DISPLAY MODE TO ADD AND INVERT ONE CHANNEL.
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)

Figure 5-15. Analog Read Data Waveform

5. Check output of Data latch. If observed signals are correct, the high and low resolution channels and Data latch are functioning.

   a. Connect and set up oscilloscope as shown on figure 5-16.

   b. Observe that signal is approximately as shown in figure 5-16.

6. Check frequency of Read Reference Clock signals.

   a. Connect and set up oscilloscope as shown on figure 5-15 except move Channel 1 probe to A15-24B (+Read Reference Clock) and Channel 2 probe to A15-23B (-Read Reference Clock).

   b. Observe that the displayed signal has a frequency of approximately 4.84 MHz.

7. Check the Read data to Read clock timing relationship. If signals are correct, the read circuits are generating the proper Read data and Read clock signals.

OSCILLOSCOPE SETTINGS

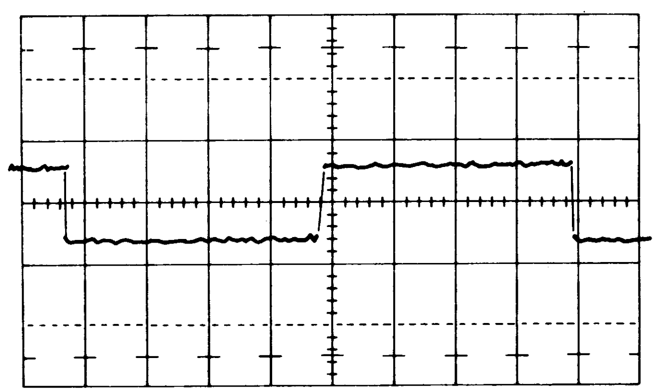
LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 0.1V/CM
CH 2 - 0.1V/CM

TIME / DIV
A - 2MS/CM
B - 0.05 S/CM

TRIGGERING
A - +EXT, A06-TPC (+INDEX)
B - -INT

PROBE CONNECTIONS (10x PROBES)
CH 1 TO A14-03B (+RD DATA)
CH 2 TO A14-04B (-RD DATA)



9E9

NOTE: SET DISPLAY MODE TO ADD AND INVERT ONE CHANNEL.
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)

Figure 5-16. Data Latch Output Waveform

a. Connect and set up oscilloscope as shown on figure 5-17.

b. Observe that displayed signals have timing relationships as shown on figure 5-17.

8. Prepare drive for return to online operation.

Head Amplitude Check

This procedure verifies that the read signal has sufficient amplitude to be reliably processed by the read logic. Since amplitude decreases as recording frequency increases, the minimum amplitude, in MFM recording, is obtained when an all "0s" or all "1s" pattern is being read. The minimum amplitude is tested first. Minimum recording frequency, and therefore, the greatest amplitude is obtained by a pattern of alternate "1010..." pattern. This amplitude is also tested.

1. Prepare the drive for use with test software or FTU.

2. Command direct seek to cylinder 822 (410) and write an all ones pattern.

OSCILLOSCOPE SETTINGS

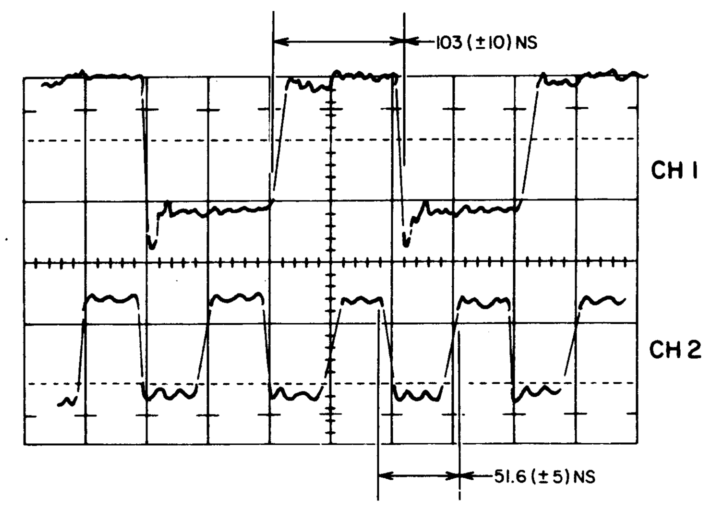
LOGIC GND TO SCOPE GND

VOLTS / DIV
CH 1 - 0.2V/CM
CH 2 - 0.2V/CM

TIME / DIV
A - 2MS/CM
B - 0.05μS/CM

TRIGGERING
A--EXT, A15-12B (-READ GATE)
B--INT

PROBE CONNECTIONS (X10 PROBES)
CH 1 TO A15-27B
CH 2 TO A15-26B



NOTE: SET DISPLAY MODE TO ALT AND TRIGGER MODE TO CH 1 ONLY.
ALSO SET HORIZONTAL DISPLAY TO B (DELAYED SWEEP)

9E10

Figure 5-17. Read Data To Read Clock Timing

3. Connect and set up oscilloscope as follows:

   a. Trigger negative external on A06-TPC (Index).

   b. Connect channel 1 to E03-TPB.

   c. Connect channel 2 to E03-TPC.

   d. Set DISPLAY MODE to ADD and invert one channel.

   e. Set VOLTS/CM and TIME/CM controls to values appropriate for making measurements required in remainder of this procedure.

4. Command drive to read, select each head in turn and measure amplitude of read signal for each head. This amplitude should be a minimum of 130 mV peak-to-peak.

5. Command direct seek to cylinder 001 and write a 101010... pattern with all heads.

6. Command drive to read, select each head in turn, and measure amplitude of read signal for each head. This amplitude should be a maximum of 1100 mV peak-to-peak.

7. Prepare drive for return to online operation.

MISCELLANEOUS LOGIC CHECKS

Index Timing Check

This procedure ensures that Index is present and has the proper pulse width. It also checks the time between successive Index pulses which is an indication of disk pack rotational speed.

1. Prepare drive for use with test software or FTU.

2. Connect and setup oscilloscope as follows:

   a. Connect channel 1 to A06-TPC (+Index).

   b. Trigger internal positive.

   c. Set other controls as appropriate to make measurements required in steps 3 and 4.

3. Observe that Index is a logic "1" for 2.5 ($\pm$.03) us.

4. Observe that time between Indexes is approximately 16.7 ms.

5. Prepare drive for return to online operation.

Speed Sensor Output Check

This procedure checks the output of the speed sensor to ensure that is has the proper polarity and is of sufficient amplitude.

1. Prepare drive for use with test software or FTU.

2. Connect and setup oscilloscope as follows:

   a. Connect channel 1 to A17-17A (speed sensor output)

   b. Trigger positive internal.

   c. Set other controls as necessary to make measurement in step 3.

3. Check oscilloscope waveform for the following:

   a. Scope trace should first go positive and then negative with respect to ground. If not, wiring to speed sensor is reversed. Correct wiring to speed sensor and recheck polarity of signal. If waveform is correct, go to step 3b.

   b. Observe amplitude of waveform on oscilloscope. Signal should have positive and negative amplitudes of at least 0.6 volt. If not, recheck speed sensor gap.

4. Prepare drive for return to online operation.

GENERAL TROUBLESHOOTING PROCEDURES

The following procedures specify how to check ac inputs to the power supplies, pinpoint voltage faults in the logic chassis and read/write chassis, troubleshoot heat-generated problems in the drive, and troubleshoot head crashes. They are identified as Procedures A, B, C, and D and are referenced as such in the structured troubleshooting procedures.

PROCEDURE A: CHECKING AC INPUTS TO POWER SUPPLIES

Procedure A verifies that a given secondary winding of a ferroresonant or standard transformer provides the required voltage to drive the associated power supply. This procedure should be followed whenever a transformer is suspected as the reason for a dc voltage problem. It should also be performed after repairing or replacing the rectifier/filter circuits. This ensures the previously malfunctioning supply did not damage the transformer.

Two unique power supplies are used in the drive. Non-VDE units use a power supply with two ferroresonant and one standard transformer. VDE units use a smaller power supply that has one ferroresonant transformer and one standard transformer. Table 5-1 shows some common failure symptoms for power supplies.

NOTE

> To prevent the ferroresonant transformer from oscillating, never disconnect more than one set of secondary leads from the rectifier/-filter circuits at any given time. Such oscillation, although not dangerous, would make voltage measurement meaningless. This does not apply to standard transformers that have sine-wave outputs.

Procedure:

1. Turn off the MAIN AC breaker (CB1).

2. Determine which transformer secondary you want to check, and set the breakers as follows:

   a. Non-VDE

      T3 - CB2 (+20Y) ON. All others OFF.
      T1 or T2 - CB2, CB5(+9.7 V), CB6(-9.7 V) ON, all others OFF.

   b. VDE

      T1 - CB2(+20Y) ON. All others OFF.
      T2 - CB2, CB3(+28 V), CB6(+9.7 V), CB7(-9.7 V) and CB8 ($\pm$20 V) ON. All others OFF.

NOTE

Power to transformer T1 and T2 (step 2a above) is interrupted by auxiliary contacts on CB5 and CB6. Power to transformer T2 (step 2b above) is interrupted by CB3, CB6, CB7, and CB8. If any of these breakers trip, logic voltages are dropped to prevent possible voice coil damage.

3. Refer to table 5-2 and determine the terminals that receive the input from the transformer winding being tested. The winding is disconnected by removing Fastons (Non-VDE), or by removing fuses (VDE). It is not necessary to disconnect the center tap.

4. Plug in the test scope and set the Trigger control to LINE. Turn on the scope and when the horizontal track becomes visible, center it on the graticule.

5. Connect the scope's ground (-) probe to the appropriate terminal indicated in table 5-2.

6. Turn on the MAIN AC breaker (CB1).

7. Connect the scope's +Probe (CH1 or CH2, depending upon scope set-up) to either of the input leads removed in step 3.

8. Adjust scope's TIME/DIV control to secure a stable square-wave trace (ref: figure 5-18).

9. Adjust scope's VOLTS/DIV control to allow easy mental reckoning of the voltage represented by the trace, as shown against the graticule lines.

10. Record the voltage from the ground reference line on the graticule to the top and bottom of the trace (two readings) as indicated by "E" in figure 5-18.

11. Repeat step 10 with the +probe connected to the other input lead.

12. If both steps 10 and 11 show a symmetrical waveshape about the ground reference line (that is, all four voltage readings are the same), and are within the tolerance specified in table 5-2, the winding for that particular supply is good.

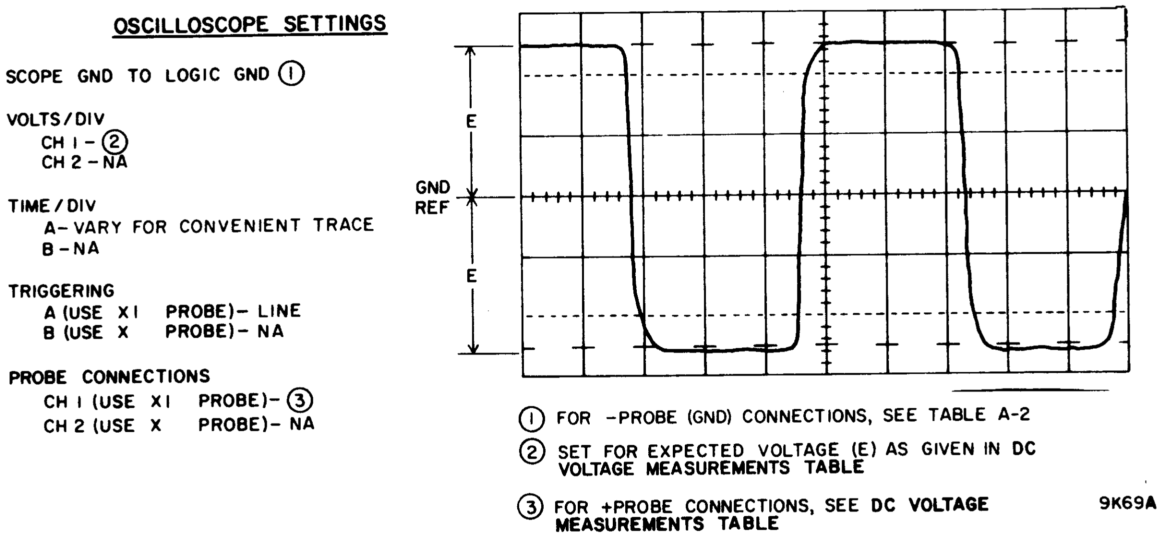


Figure 5-18. AC Input (Ferroresonant) to Power Supply Rectifiers

TABLE 5-1. FAILURE SYMPTOMS IN POWER SUPPLIES

Symptom	Probable Cause
1. Noticeable ripple at output. (checked with oscilloscope)	Open diode or open filter capacitor
2. Less then specified output. (ac input good)	Shorted diode or shorted filter capacitor
3. Output decreases significantly when load is connected.	Open bleeder resistor

TABLE 5-2. AC INPUT TO RECTIFIERS

Xfmr	To Recti- fier	+Probe Terminals (Check Both)	-Probe Terminal (GND)	Acceptable Range ±5%	Condition Remarks
Non-VDE					
T1 (1)	±16 V -16 V	A1TB1-4 A1TB1-5	A1TB1-3	16.0 FL 17.0 NL	Min DC load condition as indicated in DLT.
T1	±46 V	A1TB1-7 A1TB1-8	A1TB1-3	44.0 FL 46.5 NL	No Load = CB4 OFF
T2 (1)	±9.7 V	A1TB1-7 A1TB1-18	A1TB1-14	10.3 FL 11.1 NL	Min DC load condition as indicated in DLT.
T2 (1)	±20 V	A1TB1-15 A1TB1-16	A1TB1-14	21.0 FL 22.7 NL	No Load = CB7 OFF
T2	±28 V	A1TB1-19 A1TB1-20	A1TB1-14	27.3 FL 29.4 NL	No Load = CB8 OFF
T3	+20 Y	A1TB2-9 A1TB2-10	A1TB1-12	25.0	Secondary dis- connected. Sine wave output. Volt- ages peak to ground
(1) Do not measure square-wave output, as shown in figure 5-18, unless tuning capacitor is connected.					

Table Continued on Next Page

TABLE 5-2. AC INPUT TO RECTIFIERS (Contd)

Xfmr	To Rectifier	+Probe Terminals (Check Both)	-Probe Terminal (GND)	Acceptable Range ±5%	Condition Remarks
	VDE				
T1	±20Y	A1P2-1 A1P2-3	A1P2-2	19.5 FL 20.6 NL	P2/J2 disconnected on control board - CFN. Sinewave output. Voltage is peak to ground.
T2	±9.7 V	A1F1 A1F2 (Line Side)	T2J3 - 1	9.36 FL 10.66 NL	Fuse removed = No Load. Fuse In = Full Load
T2	±28 V	A1F3 A1F4 (Line Side)	T2J3 - 3	27.0 FL 30.5 NL	Fuse removed = No Load. Fuse In = Full Load
T2	±20 V	A1F7 A1F8 (Line Side)	T2J3 - 3	19.0 FL 22.1 NL	Fuse Removed = No Load. Fuse In = Full Load
T2	+46 V	A1F5 A1F6 (Line Side)	J2J3 - 2	45.83 FL 49.60 NL	Fuse Removed = No Load. Fuse In = Full Load

13. If the voltage readings are not the same, or if they are the same but not within the tolerance specified in table 5-3, the problem is a shorted winding. You may be able to confirm this by sniffing the transformer for evidence of burned insulation, although this is not a definitive test.

Procedures for removal and replacement of transformers are:

- Non-VDE

  a. T1 - Steps 14 & 15.

  b. T2 - Steps 14 & 15.

  c. T3 - Step 16.

- VDE

  a. T1 - Step 18

  b. T2 - Step 19

WARNING

Tuning capacitors A1C1 and A1C2 are charged with 500 volts or higher. Treat them with respect.

14. Remove and replace transformer T1 or T2:

    a. Turn off CB1.

    b. Remove the fiber insulator from the terminal strip mounted on top of the transformer.

    c. With insulated long-nosed pliers, short terminals 4 and 5 (yellow wires) to discharge the tuning capacitor.

    d. Remove the two yellow wires and the orange and black power wires from the left side of terminals 2 through 5. There is no harness wire on terminal 1. (See figure 5-19).

    e. Referring to CR803 of the diagrams, remove the transformer lead wires (Fastons) from A1TB1. (Check colors with figure 5-20).

TABLE 5-3. DC VOLTAGE MEASUREMENTS

DC Voltage to be Measured	Probe Connection for Scope or VOM: Full Load △1 +Probe	No Load △2 +Probe	GND Probe	Acceptable DC Voltage Range	
+46	+46 TP	A1TB2-8	↑	+44	+51
-46	-46 TP	A1TB2-7		-44	-51
+28	+28 TP	A1TB2-1		+26	+30
+20Y	--	A1TB2-11	Use terminals 1, 2, 3, 14 of A1TB1	+18	+22
+20	+20 TP	A1TB2-5		+18	+24
-20	-20 TP	A1TB2-4		-18	-24
-16 (E.R. Pwr)	--	A1TB2-6		-14	-20
+9.7	+9.7TP	A1TB2-3		+8.7	+10.7
-9.7	-9.7TP	A1TB2-2	↓	-8.7	-10.7
+5	A2JD94-04A	Use GND Faston on regulator card for Load or No Load condition		+5.05	+5.15
-5	A2JD94-01A			-5.05	-5.15
+16 △2 -16 △2	K8-3	Brake power bridge rectifier is not grounded. Measure full voltage as given at right		28	45

△1 Measure to GND test point on power supply panel. The corresponding dc breaker must be ON.

△2 Non-VDE only

f. Remove the nuts securing the transformer to the base and lift out the transformer.

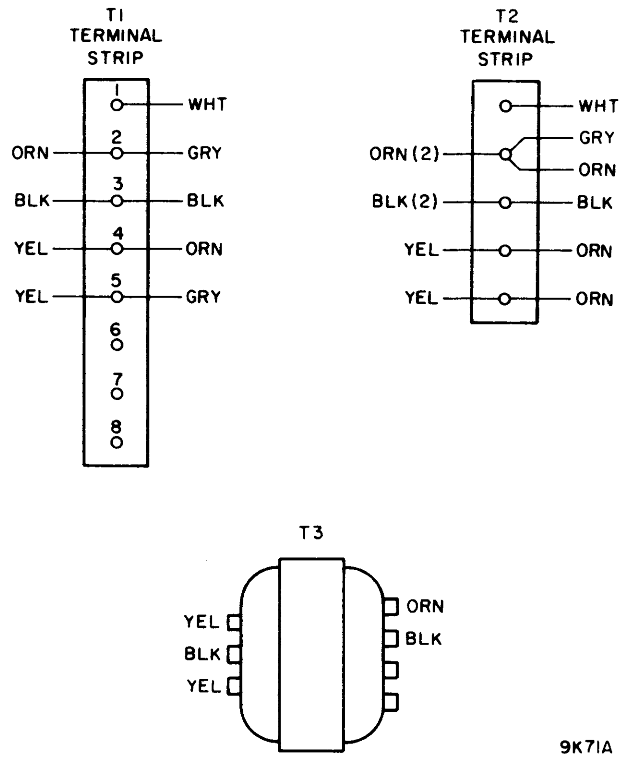


Figure 5-19. Non-VDE Transformer Connections

Reverse the order of these steps to install the new transformer.

NOTE

To prevent the ferroresonant transformer from oscillating, never disconnect more than one set of secondary leads from the rectifier/filter circuits at any given time. Such oscillation, although not dangerous, would make voltage measurement meaningless. This does not apply to standard transformers that have sine-wave outputs.

15. Be sure to connect at least one secondary winding, as advised in the SPECIAL NOTE at the beginning of this procedure, then check out the newly installed transformer by repeating steps 2 through 11.

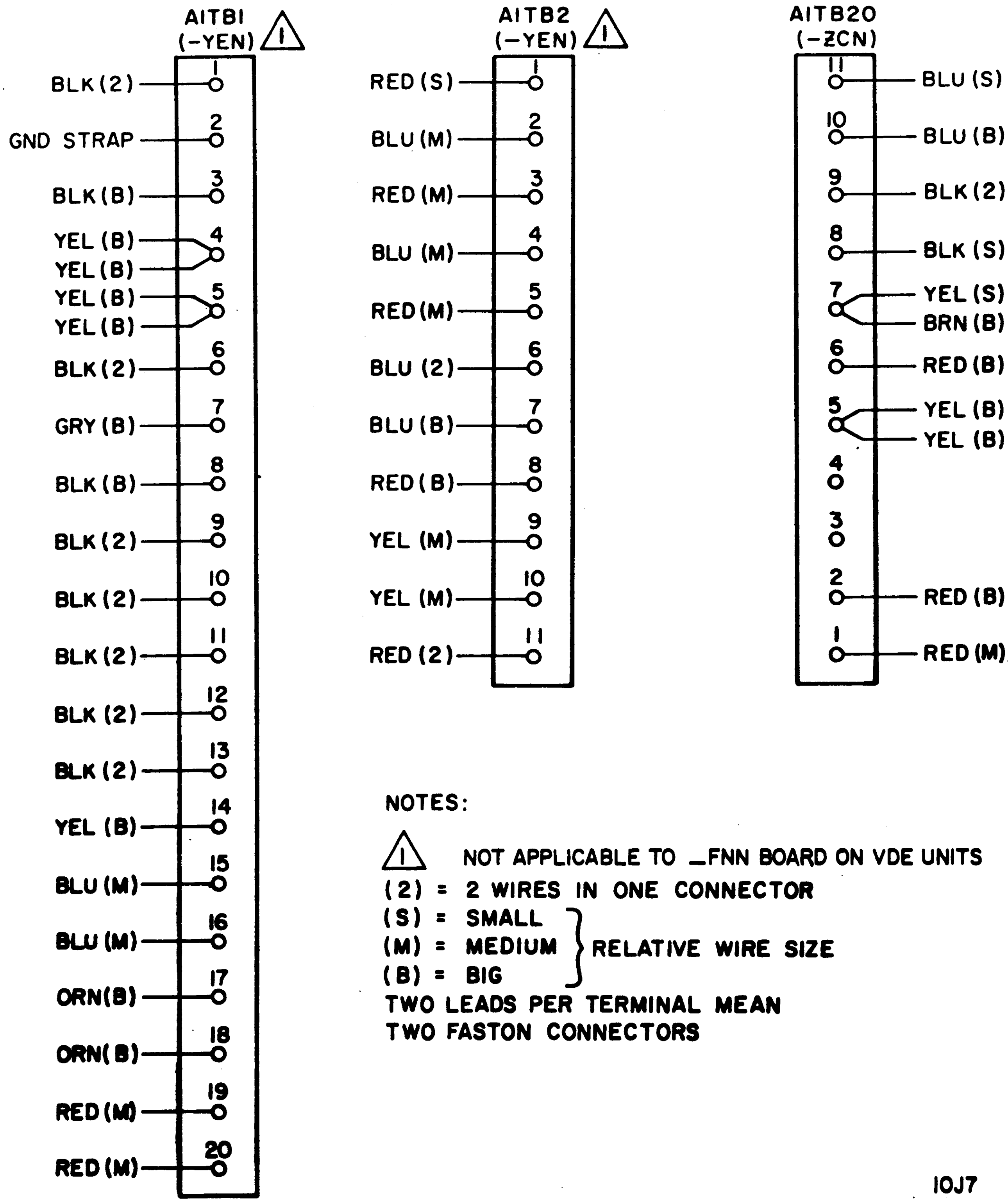


Figure 5-20. Terminal Board Connections

16. To remove and replace T3, proceed as follows:

    a. Turn off CB1.

    b. Remove rectifier/capacitor board as described in the "_YEN Replacement" procedure of section 6.

    c. Remove the five Fastons from the clips protruding from the windings of T3. See figure 5-20 for color coding.

    d. Remove the nuts securing T3 to the power supply base and lift out the transformer.

    Reverse the order of these steps to install the new transformer.

17. After securing all Fastons secured to the proper terminals, turn on CB1. Check for +20 V (+20Y) at A1TB2-11 to verify proper operation of T3 and the +20Y rectifier.

18. To remove and replace transformer T1 on VDE units proceed as follows:

    a. Turn off CB1.

    b. Disconnect P2/J2 on the control board (_CFN).

    c. Disconnect the primary leads. Note or tag lead position.

    d. Remove the hardware securing the transformer to the chassis and remove the transformer.

    e. Reverse the procedure to install the replacement transformer.

    f. Check operation of the newly installed transformer.

19. To remove and replace transformer T2 on VDE units proceed as follows:

    a. Turn off MAIN AC breaker CB1.

    b. Short tuning capacitor C1 to discharge it.

    c. Disconnect the primary winding leads. Tag them or note position.

    d. Disconnect P2 and P3. P1 cable is not used.

    e. Remove the mounting hardware and remove the transformer.

f. Reverse the procedures to install the replacement transformer.

g. Check operation of the newly installed transformer.

PROCEDURE B: PINPOINTING VOLTAGE FAULTS IN THE LOGIC AND READ/WRITE CHASSIS

This procedure locates ±5 V, ±20 V, and +28 V faults on cards in either the logic or read/write chassis, or in the backpanel wiring of the logic chassis. Conduct the test in either of two ways. The first method is to check each voltage individually by entering the procedure from the applicable TSP.

The second method is to check all voltages on a given card at the same time. Since the test for each voltage fault is made by adding cards one at a time, this second method is more efficient, and is the one described. As shown in table 5-4, not all cards will require all voltage checks.

NOTE

> From table 5-4, notice that cards in the logic chassis use both ±5 V and ±20 V (with the exception of Fault card A17, which also monitors ±46V). Cards in the R/W chassis use ±5 V, ±20 V, and +28 V.

It would be a good idea to have table 5-4 available for ready reference when performing this procedure.

1. Turn off CB2 (+20Y), keeping CB1 (MAIN AC) ON. This removes all logic voltages while permitting the blower to operate.

2. Turn off ±46 V breaker (CB4 or CB5 depending on power supply type). ±46 V is not tested in this procedure.

3. All other breakers must be ON, except as noted in the procedural steps. The logic chassis test begins at step 4, the test for the R/W chassis at step 14.

4. Turn off +28 V breaker, if unit has a VDE power supply, the ±20 V breaker CB3 must be ON.

5. Remove A3PE1 from the R/W control card (E01). This removes the ±5 V, ±20 V voltages from the R/W chassis.

6. Remove all logic cards from the logic chassis. Be sure not to remove the ±5 V regulator card from A2PD94.

7. Turn on CB2. Power-wiring errors in (or damage to) the logic backpanel will trip the corresponding breaker. If a breaker trips, turn off CB2 and raise the logic chassis to the maintenance position. Then carefully examine the backpanel for grounds or shorts, most usually the product of bent pins or dangling wires. After clearing the fault, lower the logic chassis to its normal position and turn on CB2 to check.

8. Turn off CB2. You are now ready to start putting the cards back in the logic chassis one at a time, checking for faults after each card has been inserted.

9. Before inserting the selected card, examine both sides for evidence of arcing across the foil. Often the carbon residue around an arc area can be removed with an alcohol swab and the card won't give any more trouble.

10. Insert the selected card in its proper slot. Use the CARD TYPE column in table 5-4 to ensure accuracy here.

11. Turn on CB2.

12. If a breaker trips, turn off CB2 and replace the card just installed with a fresh one. Then turn on CB2 to test the new card. (Don't forget to reset the tripped breaker).

13. If the card has no faults, turn off the CB2 and, selecting another card, repeat steps 9 through 13 until all cards have been inserted and found good.

The following steps check out the read/write chassis.

14. Turn off CB2 and turn on CB8 (+28 V) or CB3 depending on power supply type.

15. Remove the small cables from cards E02, E03, and E05. Also remove cable A3PE1 from card E01 if this was not done when checking out the logic chassis (see step 5).

TABLE 5-4. VOLTAGE USAGE

	+5V -5V	+9.7V -9.7V	+10.5V -10.5V	-16V	+20Y	+20V -20V	+22	+28	+46 -46	Card Type
A4 Operator Panel	+									-ZYN
Control Board	+	+			+			+		-CFN △2
Rectifier/Filter		X				X		+	X	-CBN △2
Rectifier/Cap		X		-	+	X		+	X	-YEN △1
Relay Board					+				-	-FNN △2
Relay Board		+		-	+					-YFN △1
Power Amp									X	-ZCN △1 △2
E01	X					X		+		-PKV
E02	X		X				+			-PJV

Table Continued on Next Page

TABLE 5-4. VOLTAGE USAGE (Contd)

	+5V -5V	+9.7V -9.7V	+10.5V -10.5V	-16V	+20Y	+20V -20V	+22	+28	+46 -46	Card Type
E03	X		X				+			-PHV
E04	X									-XFN
E05	+									-XGN
Servo Preamp		X								-ZQN
Voice Coil				-					-	
Pack Cover Sol					+					
5 V Reg		X								--
A01/ A03	X									-TVV
A02/ A04	X									-RVV
A05										-KHV
A06	X									-LTV

Table Continued on Next Page

TABLE 5-4. VOLTAGE USAGE (Contd)

	+5V -5V	+9.7V -9.7V	+10.5V -10.5V	-16V	+20Y	+20V -20V	+22	+28	+46 -46	Card Type
A07	+									-LVV
A08	X									-QPV
A09	X	X								-SMV
A10	X					X				-LSV
A12	+									-LWV
A13	X									-LXV
A14/ A15/ A16	X X X					X X X				-LRV -LZV HD Align
A17	X							+		-KFV
A18/	X					X				-FRV
A19/	X					X				-KGV
A20	X					X				-MSV

NOTES

An "X" in a column indicates all voltages at top of column apply.

A "-" in a column indicates only negative voltages at top of column apply.

A "+" in a column indicates only positive voltages at top of column apply.

△1 Non-VDE

△2 VDE

16. Remove cards E01, E02, E03, and E05 from their pin connections on card E04.

17. Examine E04 for bent or broken pins where the other cards plug into (or onto) it. Also examine the foil for signs of arcing. E04 uses no power voltages, but acts as a distributor for the power voltages brought into it by E01.

18. Examine E01 for foil arcing (see step 9), then insert it into its connector on card E04.

19. Reconnect cable A3PE1 to card E01.

20. Turn on CB2.

21. If a breaker trips, turn off CB2 and replace the E01 card with a fresh one. Then reset the tripped breaker(s) and turn on CB2 to check the new card.

22. If a breaker trips after the new E01 card has been inserted, replace the E04 card. Then try the original E01 card again.

23. Turn off CB4 and, selecting another of the removed cards, examine it for foil arcing and insert it into E04.

24. Turn on CB2. If a breaker trips, turn off CB2 and try a fresh card.

25. Repeat steps 23 and 24 until all cards in the R/W chassis have been inserted and found good.

26. Reconnect the three cables to E02, E03, and E05.

PROCEDURE C: TROUBLESHOOTING HEAT-GENERATED PROBLEMS

CAUTION

> If the heads perform an unscheduled retract and the START and FAULT lights are both off, immediately turn off the +20Y breaker; you have dropped +5 V and run the risk of burning up the voice coil. Only after you've thus disabled dc power should you check to see if the power-down resulted from a failure on the ac line. (Hint: Is the blower still on?)

If you commit the above CAUTION to memory and act instinctively upon it, you may one day save yourself a lot of trouble; failure of the +5 V supply is a common cause for abnormal shutdowns.

Heat-related problems are easy to diagnose: they occur only when the drive gets hot, and they disappear when the drive has had a chance to cool off. If you suspect a problem is heat-related, let the drive cool down, then note the failure (or more accurately, the absence of the failure) when the drive is started up again. Often the troubleshooting period can be shortened by applying artificial heat to the suspected area (a hair dryer is useful here). Once you've diagnosed the problem, correct it as you would any other malfunction.

Heat problems are of two types -- those originating in the power supplies and those developing in the various loads. Should a load fault trip a dc breaker, the course is clear: simply refer to the applicable "load" TSP. But if the fault merely brings up a FAULT light (on the edge of card A17), the table below should offer a starting point for correcting the problem. (If the +5 V supply goes, of course, the fault lights won't work).

FAULT	PROBLEM RELATED TO
Voltage (except +5 V)	A17
On Cyl· (W+R)	A17, A07, A02, A08, A12, A20
Write	A17, A01, E02 (Write Driver board)
W·R	A17, A02
Hd Sel	A17, E01 (Hd Sel/Rd Amp board)

PROCEDURE D: HEAD CRASHES

The following paragraphs provide the information required to determine whether a head crash has occurred, how to troubleshoot the cause of the crash, and perform recovery procedures.

Detection

It is important that the drive operator be aware of a number of head crash warnings and/or indications provided by the drive itself.

Advanced Warning

Warnings of impending head crashes are very often provided by the data signals picked up by the heads. Under conditions of increasing contamination in the air cushion on which the head flies, variations in flying height can become a significant proportion of the nominal height. These variations in flying height can result in the generation of data errors. Continuous monitoring of the data error rate is strongly recommended. A significant increase in the data error rate on the order of five to ten times normal should be heeded as a definite warning signal.

Crash In Progress

Head to disk contact may be occurring if an audible "ping" (scratching noise), or a burning odor is detected when the heads are over the disk.

After a Crash

Head-to-disk contact has occurred if concentric rings or divots are observed on the disk surface.

CAUTION

> If any of the above are detected, shut down the drive at once. Do not move the pack to another drive without first checking to see if it has been damaged or contaminated. Do not attempt to operate the drive with another disk pack until full assurance is made that no damage or contamination has occurred to the drive heads or shroud area.

Determining the Cause of a Head Crash

If the drive has been shut down because of a suspected head crash, the following steps should be taken to determine the cause of the head crash.

1. Reconstruct the operating history of the drive and pack.

2. Evaluate drive failures that have occurred on the unit prior to the one in question.

3. Check to determine if the failure was propagated by moving the pack from one drive to another.

4. Check to determine whether anything unusual happened prior to the failure.

5. Try to reconstruct the mode of operation prior to the failure.

6. How long had the pack been on the drive before the crash occurred? Was the pack new? Was the drive new? Any shipping damage?

Reconstruct the pre-crash conditions of the drive, drive heads and pack.

1. Open the circuit breaker - disconnect the power cord

2. Remove the top cover

3. Reinstall the crashed disk pack if it has been removed.

4. Manually position the head arm assemblies toward the spindle to the point at which the head arms slide off the head cam towers.

5. Looking through the shroud observation window with a high intensity lamp, check to see if the heads appear to be equidistant with respect to the disk surfaces. Under no circumstances should any part of the head be in contact with a disk prior to sliding off the cam surface.

6. With the heads still resting on the head cam towers, manually turn the pack (by rotating the top trim shield) and verify that the head to disk spacing remains constant.

7. Look at the recording surfaces and make note of which disk pack surfaces and heads have had contact.

8. With the disk pack stationary, slide the head arms off the head cam towers onto the disks but do not push the heads forward. Check the head assemblies (particularly those that have not crashed) to see if any part of the head load spring is relatively close to or touching the disk. If closeness is noted, further inspection, once the heads are removed from the drive, is required.

9. Retract the carriage and remove the pack.

Evaluating the Drive

1. With the disk pack removed, manually position the carriage so that the heads are in a loaded position. Traverse the carriage repeatedly between the front stops and where the heads contact the head cams. If resistance is found, check for the following possible causes: bound velocity transducer; flex head retainer mispositioned and striking the rail bracket; worn rail; bad carriage bearing; obstruction caught on magnet; and foreign material on the rails. Retract the carriage to the fully retracted position.

2. Connect the power cord and turn on the breaker. Check for adequate air flow entering the shroud area. If questionable, either compare with another drive in the area or replace absolute filter with another filter as described in the Corrective Maintenance section.

3. Using a strip of paper (dollar bill size), check the pack access cover-shroud seal. Open the pack access cover and lay the slip of paper on the shroud. After closing the cover (latched), resistance should be felt while trying to withdraw the paper. Check several places on each side of the shroud.

4. Clean the shroud area and look for possible foreign material (paper, plastic, etc.). If contamination exists, try to determine the type and its possible source.

5. Note head positions, then remove all heads for evaluation and cleaning.

Evaluating the Heads

1. If any part of the head load spring appears to be close to a disk, the possibility exists that the fixed arm (part attached to the carriage) may be bent. Look at the subject head for evidence of burnishing on the head arm assembly where it might possibly have struck the disk.

2. Compare crashed heads to non-crashed heads and look for possible mechanical failure differences such as bent gimbal springs, etc.

3. Dispose of heads as described in this maintenance manual and return non-recoverable head assemblies to the manufacturer for further analysis.

Evaluating Disk Pack

1. Install the crashed pack back on the drive (use a pack inspector if available) and try to determine if pack has been damaged in any way. Using observation window in shroud and high intensity light, rotate pack and note any concentric scratches or disk fluctuations (up and down). No fluctuation should be in evidence including upper and lower cover disks.

2. Look on pack trim shield (top of pack) for any evidence of adhesive. A pack identification label might have been applied.

3. Look for an unusually high amount of "dings" or divots (chipping) at the outer area of the data disks. If found, these may be due to carriage slams - a drive malfunction.

Recovery

Use the following procedure to insure that all contamination is removed from a unit after a head crash. This is essential to eliminate propagation to other packs and drives. Consult the repair and replacement section of this manual for details on these steps.

1. Remove all power from the drive.

2. Remove the top cover assembly by backing out the two screws on each side of the unit frame and removing the C clip holding the top cover latch rod.

3. Remove the deck cover assembly by unsnapping the four spring clips.

4. Remove the heads and shroud/pack access cover assembly performing the following steps;

   a. Remove the screws on the inside of the pack well.

   b. Remove the screws holding the panel located on the left side of the shroud. Behind this plate remove the screws holding down the shroud.

   c. Remove one C clip from the shroud gas spring and slide out the holding pin to free the spring.

   d. Remove the operator panel.

e. Remove the faston and P-clamp to free the pack access cover ground strap.

f. Remove the screws on the pack access cover interlock to free the switch.

g. Remove the two wires from the pack access solenoid.

h. Remove the shroud/pack access cover assembly from the drive.

i. Clean the deck and exposed air system with head cleaning solution.

j. Clean the pack well area making certain to reach behind the perforated area to remove all contamination. Use lint free cloth and head cleaning solution.

k. Remove all twenty heads from the unit.

l. Reinstall the shroud/pack access cover by reversing steps a-g.

m. Clean the inside of the pack access cover and shroud with lint free cloths and head cleaning solution. Do not let any solution contact the rubber gasket in the pack access cover.

n. Consult the section in this maintenance manual for Repair and Replacement - Head Arm Replacement Criteria. Replace any heads that are defective per this criteria. Replacement heads should be new heads or those that are cleaned by properly trained personnel only.

5. Reinstall the top cover.

6. Do a head alignment per the procedure called out in the Test and Adjustment section of this manual.

7. Reinstall the deck cover assembly.

STRUCTURED TROUBLESHOOTING PROCEDURES (TSPs)

The structured troubleshooting procedures describe how to isolate and correct common drive problems. Figure 5-21 is an example of a troubleshooting procedure and explains the format. The following paragraphs explain how to use the structured troubleshooting procedures.

Before starting a procedure, check to ensure that all assumptions have been satisfied. The assumptions are provided in the introductory paragraph to the procedure and describe conditions that must exist for the procedure to be valid.

When the assumptions are satisfied, proceed to the first step of the procedure. After performing the action or answering the question, follow the line down to the next step. For a question, follow the line beneath the appropriate Y (yes) or N (no) response. Continue until a corrective action is reached.

After taking the first recommended action, retest the unit. If the test results do not change, try recommended action 2, and so on, being sure to retest after each action. The corrective actions which are easier to perform (checking a signal or changing a circuit board, for example) are listed before the more difficult tasks. If the corrective actions do not solve the problem, call field support.

Two sets of structured troubleshooting procedures are provided. The first set applies to all Non-VDE units. The second set applies to all VDE units.

Two sets of TSPs are provided. The first set applies to all Non-VDE units. The second set applies to all VDE units. They are described in the following paragraphs.

- TSP1-lists the most likely causes of a failure to power up.
- TSP2-lists the probable causes of an inability to maintain power up after a successful power up.
- TSP3-describes the causes of a lack of +20Y power used to sequence the power supplies.
- TSP4-examines the power and logic problems associated with the drive motor.
- TSP5 through TSP9 (Non-VDE) or TSP5 through 7 (VDE) diagnoses problems involving dc logic voltages.
- TSP10 through TSP13 (Non-VDE) or TSP8 through TSP11 (VDE) diagnoses various seek and read/write errors.
- TSP14 (Non-VDE) or TSP12 (VDE) describes what to do when a drive does not power down correctly.

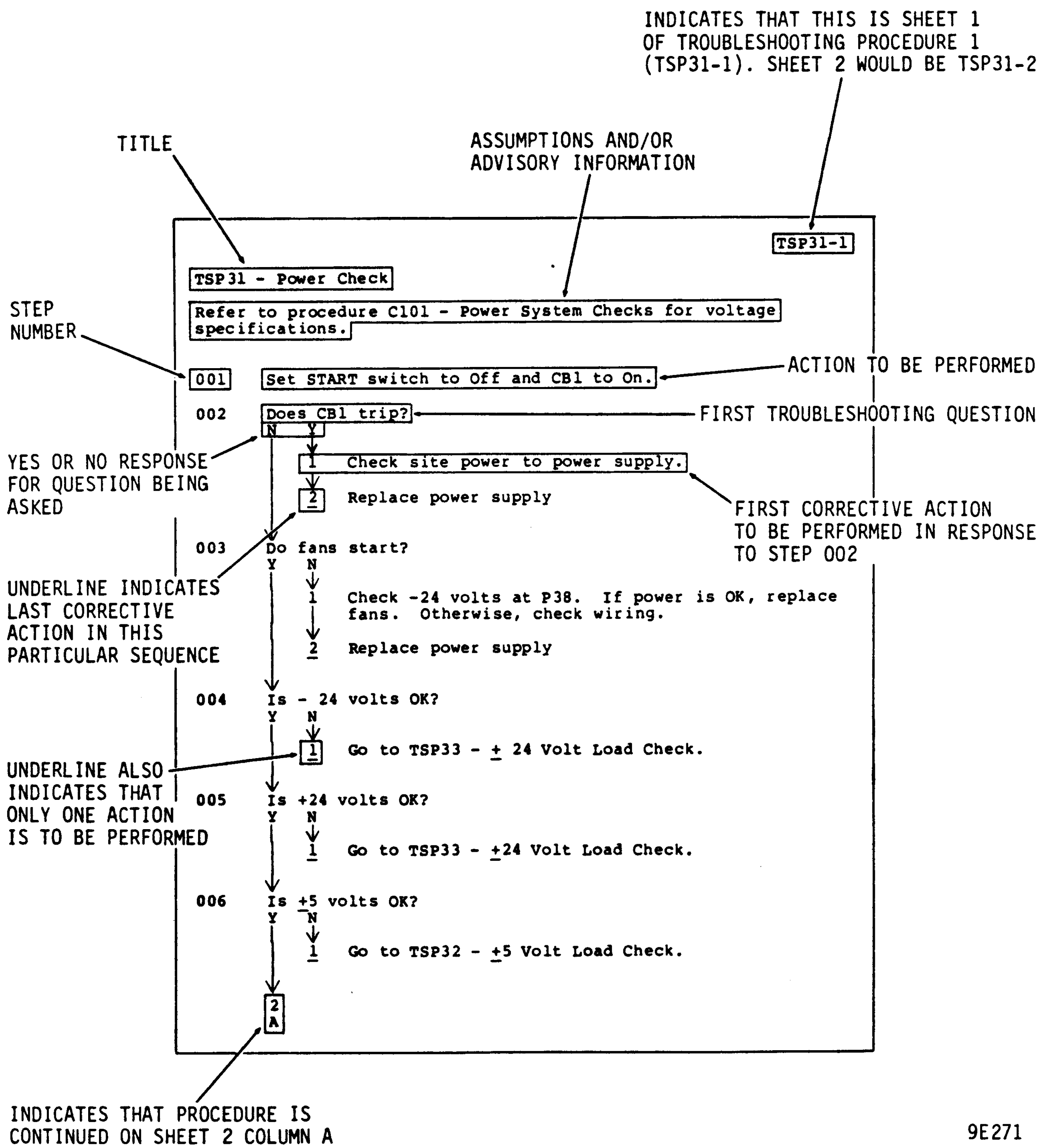


Figure 5-21. Example of Structured Troubleshooting Procedure

TSP1 - Failure to Power up (Non-VDE)

Assumptions:
1. Drive connected to site Power
2. Disk installed and all covers closed
3. Main AC circuit breaker (CB1) off, all other circuit breakers on

```
001     Turn on CB1.
        ↓
002     Does blower motor start?
        Y   N
        |   ↓
003     |   Does elapsed time meter start?
        |   Y   N
        |   |   ↓
004     |   |   AC present at CB1 with correct phasing?
        |   |   Y   N
        |   |   |   ↓
        |   |   |   1   Call Field Support
        |   |   ↓
        |   |   1   Replace CB1
        |   ↓
        |   1   Check line filters and blower cable connector
        ↓
005     Do any breakers trip?
        N   Y
        |   ↓
        |   1   Check to determine which breaker tripped and go
        |       to corresponding TSP.

        |       •   CB1 - TSP2
        |       •   CB2 - TSP3
        |       •   CB3 - TSP4
        |       •   CB4 - TSP9
        |       •   CB5, CB6 - TSP7
        |       •   CB7, CB8 - TSP8
        ↓
006     Press START switch.  Does START indicator come on and
        READY LIGHT flash at 1-second intervals?
        Y   N
        |   1   Check to ensure that all circuit breakers are on.
        |   |
        ↓   ↓
        2   2
        A   B
```

A B
1 2

2 Check dc test jacks on power supply panel. If all dc voltages are missing, go to TSP3. If some dc voltages are missing, go to appropriate TSP (2,3,4,7, 8, 9) for missing voltage.

3 Check to ensure that A1P/J4 is properly mated (START indicator)

4 Check P/JD90, P/JA80, P/J201 for proper mating (START indicator).

5 Replace Logic cards at A08, A17 (READY flasher).

007 Does drive motor start?
Y N

1 Go to TSP4.

008 Does drive motor come up to speed
Y N

1 Go To TSP4

009 Does drive motor cut out after 10 second timeout expires?
N Y

1 Check speed sensor and Logic cards at A08, A17

2 Call Field Support.

010 Do heads Load?
Y N

1 Go To TSP10.

3
A

A
2
↓
011 Is first seek successful?
Y N
↓
1 Go To TSP10.

012 Problem is not in power up logic.
Go To TSP11

TSP2 - Unable To Maintain Power up (Non-VDE)

Assumptions: 1. CB1 trips after power up.
2. All other breakers remain on.

001 Turn off CB2 and CB3. Reset CB1 and try again. Does CB1 still trip?

N Y

1 Disconnect blower and try again. If trouble persists (blower OK), reconnect blower.

2 Disconnect time meter and try again. If trouble persists (meter OK), reconnect time meter.

3 Check for shorts and/or grounds in wiring to Line side of CB2 and CB3.

4 Call Field Support.

002 Turn off CB1 and Turn on CB3. Turn on CB1. Does either CB3 or CB1 Trip?

N Y

1 Drive motor at fault. Go to TSP4.

003 Turn off CB1. Disconnect wire from A1Q1-2 (AC power triac) to interrupt power to T1 and T2. Reset CB1. Does CB1 still trip?

N Y

1 Replace AC triac A1Q1.

2 Call Field Support.

2
A

A
1

004 Turn off CB1. Replace wire on A1Q1-2; remove wire from A1Q5-1 (disable T2). Turn on CB1. Does CB1 still trip?

N Y

Y: 1 Check wiring to T2 for shorts and/or grounds.

2 Check for shorted tuning capacitor A1C1. Warning - tuning capacitors A1C1 and A1C2 are charged to 500 Volts.

3 Go to TSP5

N:

005 Turn off CB1. Replace wire on A1Q5-1; remove wire from A1Q5-2 (check for grounded LOAD contacts on A1Q5). Turn on CB1. Does CB1 still Trip?

N Y

Y: 1 Replace T1 ENABLE triac A1Q5.

N:

1 Check wiring to T1 for shorts and/or grounds.

2 Check for shorted tuning capacitor A1C2. Warning - Tuning capacitors A1C1 and A1C2 are charged to 500 Volts.

3 Go to TSP6.

TSP3 - +20Y Power Missing (Non-VDE)

Assumptions: 1. +20y drops out during power up or
2. +20y drops out after power up (drive motor stops, blower motor still on, all indicators out).

001 Has +20Y circuit breaker (CB2) tripped?
Y N
1 Go to step 008

002 Check for short in control circuit of A1Q5 by removing faston from A1Q5-3. Reset CB2 and try again. Does CB2 still trip?
Y N
1 Replace A1Q5

003 Reconnect faston to A1Q5-3. Check for short in control circuit of A1Q1 by removing faston from A1Q1-3. Reset CB2 and try again. Does CB2 still trip?
Y N
1 Replace A1Q1
2 Call Field Support

004 Reconnect faston to A1Q1-3. Check for shorted T3: remove fastons from A1TB2-9 and A1TB2-10 (isolate T3 from +20Y rectifier). Reset CB2 and try again. Does CB2 still trip?
Y N
1 Replace capacitor board _YEN.
2 Go to Step 007.

2
A

A
1

005 Check for shorts in wiring to/from T3.

006 Replace T3.

007 Reconnect fastons removed in step 004

008 Turn on (or reset) CB2 and check for +20 volts at A1TB2-11 (+20Y output). Is +20Y present?

Y N

Check T3 input to +20Y rectifier; test for approximately 20 V ac between A1TB1-11 (ground) and A1TB2, pins 9 and 10. Is 20 Vac present?

Y N

1 Check wiring from T3. Replace T3 if necessary.

1 Replace capacitor board _YEN.

2 Call Field Support.

009 Was TSP entered because of assumption 1?

N Y

1 Problem is solved

010 Check for the presence of +20Y at A1P5-12, A1P5-13 and A1Q1-3. Is +20Y present?

Y N

Is CB5 tripped?

N Y

1 Go To TSP5.

1 Replace A1Q1.

2 Call Field Support.

011 Problem solved.

TSP4 - Drive Motor Fails (Non-VDE)

Assumptions: 1. Drive motor fails to start, starts prematurely, or does not come up to speed. All circuit breakers are on initially.
2. Drive motor shuts down after it has been running properly.

001 Does drive motor start as soon as CB1 is actuated?

N Y

1 Replace card in slot A08.

2 Replace relay board _YFN.

3 Call Field Support.

002 Does CB3 or motor thermal switch trip as soon as CB1 is actuated?

N Y

1 Check for short on LOAD side of CB3. Replace CB3 if needed.

2 Call Field Support.

003 Does drive motor start as soon as START switch is present?

Y N

004 Is +20Y present at pin 3 of A1Q2, A1Q3, A1Q4 after pressing START switch?

Y N

005 One or more fault Lights Lit?

Y N

+9.7 V at test jack on panel?

Y N

1 Go To TSP5.

2A 2B 2C 2D

A B C D
1 1 1 1

1 Replace card in slot A08.

2 Replace relay board (_YFN).

3 Call Field Support

1 Troubleshoot faults.

2 Replace card in slot A08.

3 Replace relay board (_YFN).

4 Call Field Support

007 Is one phase of AC power present (measured with respect to ground) at pin 2 of A1Q2, A1Q3, A1Q4 upon pressing START switch?

Y N

+9.7 V at test jack on panel?

Y N

1 Go to TSP5.

1 Replace suspected triacs.

2 Call Field Support.

1 Check integrity of power wiring P/J7 to drive motor.

2 Replace drive motor.

3
A

A
2

009 Does CB3 or motor thermal switch trip as soon as START switch is pressed?

N Y

1 Check to ensure that parking brake has released drive spindle.

2 Call Field Support.

010 Does CB3 or thermal switch trip before motor gets up to speed?

N Y

011 Is squealing heard when motor starts to run?

N Y

1 Check to ensure that parking brake has released drive spindle.

2 Check drive belt and tension.

3 Call Field Support.

1 Check drive belt and tension.

2 Call Field Support

012 No problem. If READY light comes on steady, proceed to TSP10, otherwise return to TSP2 to check cause.

TSP5 - Fault In T2 Network (Non-VDE)

Assumptions: Circuit breaker CB1 trips. Problem has been narrowed to transformer A1T2 (source of ±9.7, ±20, and +28 voltages) or to the generation or distribution of these voltages, or to an open rectifier Load fault.

001 Check out A1T2. Remove faston from A1Q5-1, or A1Q5-2 (deenergize T1), disconnect A1C2 (warning - A1C2 is charged to 500 volts), disconnect fastons from A1TB1 pins 14 through 20. Turn on CB1. Doe CB1 trip?

N Y

1 Replace A1T2. Restore all connections and try again.

2 Call Field Support

002 Check out ±9.7 V rectifier. Turn off CB1 and reconnect A1C2. Separate connector A1P/J3 (removes load from rectifier). Reconnect fastons to Terminals 14, 17 and 18 of A1TB1. Turn on CB1. Does CB1 trip?

N Y

1 Replace capacitor board, then restore all connections and try again.

2 Call Field Support.

003 Check out ±20 V rectifier. Turn off CB1 and CB7 (±20 V breaker). Reconnect fastons to Terminals 15 and 16 of A1TB1. Turn on CB1. Does CB1 trip?

N Y

1 Replace capacitor board, then restore all connections and try again.

2 Call Field Support

2
A

A
1

004 Check out +28 V rectifier. Turn off CB1 and CB8 (+20 breaker). Reconnect fastons to terminals 19 and 20 of A1TB1. Turn on CB1. Does CB1 trip?

N Y

1 Replace capacitor board, then restore all connections and try again.

2 Call Field Support

005 Check ±9.7 voltages. Turn off CB1. Ensure that CB5 and CB6 are ON, and that A1P/J3 is separated. Turn on CB1. Are ±9.7 V present at panel test jacks?

Y N

1 Inoperative rectifier. Replace capacitor board.

2 Call Field Support

006 Check ±9.7 V loads. Turn off CB1 and CB7 (±20 V breakers). Reconnect A1P/J3 to restore ±9.7 V load. Turn on CB1. Does either CB5 or CB6 trip?

N Y

Go to TSP7.

007 With CB1 ON and CB7 still OFF, check for no-load ±20 V at terminals 5 and 6 of A1TB2 (ground probe on A1TB1-14). Are voltages present?

Y N

1 Inoperative rectifier - replace capacitor board.

2 Call Field Support

3
A

A
2

008 Check ±20 V loads by turning on CB7. Does CB7 trip?
N Y

1 Go to TSP8.

009 With CB1 ON and CB8 (+28 V breaker) OFF, check for no-load +28 V at A1TB2-1 (ground probe on A1TB2-14). Is +28 V present?
Y N

1 Inoperative rectifier - replace capacitor board.

2 Call Field Support.

010 Check +28 V load by Turning CB8 ON. Does CB8 trip?
N Y

1 Go to TSP8.

011 Go To TSP6.

TSP6 - Fault in T1 Network (Non-VDE)

Assumptions: Circuit breaker CB1 trips - Problem has been narrowed to transformer A1T1 (source of ±16 and ±46 voltages), or to the generation or distribution of these voltages.

000 Check out A1T1. Turn off CB1 and disconnect A1C1 (Warning - tuning capacitor A1C1 is charged to 500 volts). Reconnect fastons to A1Q5 if entering test from TSP2 step 005. Disconnect fastons from terminals 4, 5 (2 fastons each), and 3, 6, 7, 8 (one faston each) of A1TB1. Turn on CB1. Does CB1 trip?

N Y

1 Replace A1T1. Restore all connections and try again.

2 Call Field Support

002 Check out ±46 V rectifier. Turn off CB1 and CB4 (±46 V breaker). Reconnect A1C1. Reconnect fastons to terminals 3, 7, 8 of A1TB1. Turn on CB1. Does CB1 trip?

N Y

1 Replace capacitor board. Restore all connections and try again.

2 Call Field Support

003 Turn on CB4. Does CB4 trip?

N Y

1 Go to TSP9.

2
A

A
1

004 Is ±46 V present at panel test jacks?

Y N

1 Replace capacitor board. Then restore all connections and try again.

2 Call Field Support.

005 Check out -16 V retract power rectifier. Turn off CB1. Reconnect the two yellow-wire fastons coming from A1T1 to terminals 4 and 5 of A1TB1. Turn on CB1. Is -16 V present at A1TB1-6 (A1TB1-3 is ground)?

Y N

1 Replace capacitor board, then restore all connections and try again.

2 Call Field Support.

006 Check out the brake - current rectifier. Turn off CB1. Reconnect the two remaining yellow wires to the second pair of fastons on terminals 4 and 5 of A1TB1. Turn on CB1. Does CB1 trip?

N Y

1 Replace bridge rectifier (located on front wall of power supply).

2 Call Field Support.

007 Is 32 V dc present between terminals 3 and 10 of brake relay K8 (connect minus VOM probe to terminal 3)?

Y N

1 Replace bridge rectifier (located on front wall of power supply).

2 Call Field Support.

008 Go to TSP8.

TSP7 - Fault in ±9.7 V Loads (Non-VDE)

Assumptions: CB5 (+9.7V) and/or CB6 (-9.7 V) trip when CB1 (MAIN AC) is actuated. A1P/J3 and A1P/J5 are connected to provide loads to the ±9.7 V power supplies.

001 Limit load to +9.7 V on relay board. Turn off CB1 and CB4 (±46 V). Separate A2P/J3 (on side of power supply cabinet). Reset (or turn on) CB5 and CB6, then turn on CB1. Does either CB5 or CB6 trip?

N Y

↓

1 Check to ensure that A1P5 is properly mated to A1J5 on relay board.

↓

2 Check A1P5 cable for shorts/grounds (+9.7 V wire is on pin 15).

↓

3 Replace relay board.

↓

4 Call Field Support.

↓

002 Limit ±9.7 V loads to servo preamp. Turn off CB1 (CB4 still off). Reconnect A1P/J3. Remove the three fastons from the ±5 V regulator card in the logic chassis. Be sure the fastons don't touch each other. Turn on CB1. Does either CB5 or CB6 trip?

N Y

↓

1 Check wires from regulator - card fastons to preamp for shorts/grounds.

↓

2 Replace servo preamp.

↓

3 Call Field Support

↓

003 Add regulator card to ±9.7 V loads. Turn off CB1 (CB4 still off). Reconnect fastons to regulator card, then remove card from Logic Chassis. Lay card on insulated surface (a folded dry rag for example). Turn on CB1. Does either CB5 or CB6 trip?

N Y

↓

1 Replace regulator card.

↓

2 Call Field Support.

↓

2
A

A
1

004 Add logic chassis to ±9.7 V loads. Turn off CB1. Reinstall regulator card (with fastons connected) in logic chassis. Separate A1J/PA82 (on logic chassis backpanel). Turn on CB1. Does either CB5 or CB6 trip?

N Y

1 Problem is in the Logic chassis. Go to General Troubleshooting Procedure B.

005 Check for +5 V at A2JD94-04 (A or B), then for -5 V at A2JD94-01 (A or B). Voltages should be 5.1 ± 0.05 V. Adjust potentiometer(s) on regulator card if voltages are out of specification.

006 Add R/W chassis to complete the ±9.7 V load. Turn off CB1. CB4 (±46 V) may be turned on now if desired. Reconnect A2P/JA82. Turn on CB1. Does either CB5 or CB6 trip?

N Y

1 Problem is in the R/W chassis. Go to General Troubleshooting Procedure B.

007 Problem has been eliminated.

TSP8 - Fault in ±20 and/or +28 V Loads (Non-VDE)

Assumptions: None

001 Has CB7 tripped (±20 V load fault)?
Y N
↓
Has CB8 tripped (+28 V lod fault)?
Y N
↓
No problem

003 Check for +28 V short/ground in Logic chassis back-panel wiring from PD93 to JA82. Turn off CB8.
↓
004 Add R/W chassis to ±20 V Load. Turn off CB1 (CB7 still on). Reconnect P/JA82 (if separated in step 007). Turn on CB1. Does CB7 trip?
N Y
↓
1 Go to General Troubleshooting Procedure B to pinpoint ±20 V fault in R/W chassis.

005 Has +28 V fault occured?
N Y
↓
006 Turn on CB8 to odd +28 V to R/W chassis. Does CB8 trip?
N Y
↓
1 Go to General Troubleshooting Procedure B to pinpoint +28 V fault in R/W chassis.

1 Go to TSP-1

1 Go to TSP-1

2
A

A
1

007 Restrict ±20 V Load to Logic Chassis. separate P/JA82. Reset CB7, then turn on CB1. Does CB7 still trip?

N Y

1 Go to General Troubleshooting Procedure B to pinpoint ±20 V fault in logic chassis.

008 Has +28 V fault occured?

N Y

009 Turn on (or reset) CB8. Does CB8 trip?

Y N

1 Go to step 003

1 Turn off CB8

2 Go to step 004

010 Go to step 004

TSP9 - Fault In ±46 V Loads (Non-VDE)

Assumptions: None

001 Limit ±46 V to power amplifier. Turn off CB1, then reset CB4 (±46 V). Separate A1P/J4 (on side of power supply). Ensure breakers CB2-CB8 are ON, then turn on CB1. Does CB4 trip?

N Y

- Y:
  1 Replace power amplifier.
  2 Call Field Support.
- N: go to 002

002 Add Logic Chassis to ±46 V load. Turn off CB1. Reconnect A1P/J4. Turn on CB1. Does CB4 still trip?

Y N

- N: 003 Problem no longer exists
- Y: go to 004

004 Restrict ±46 V load in logic chassis to backpanel wiring. Turn off CB1. Remove card from location A17. Reset CB4, then turn on CB1. Does CB4 still trip?

Y N

- N:
  1 Install new card in location A17
  2 Call Field Support
- Y:
  1 Check logic chassis backpanel wiring between JD93-12A and A17-32B (+46 V), and between JD93-12B and A17-03B (-46 V).
  2 Call Field Support

TSP10 - First Seek (Non-VDE)

Assumptions: START light is on,drive is up to speed, First seek not complete (READY light blinking).

001 READY light glows continuously, signifying successful first seek?
N Y
- Y: No problem - Go to TSP11.

002 First seek attempted?
N Y

003 Drive seeks to forward mechanical stop, FAULT Light comes on (+42 V fuse blows), but heads don't unload and unit cannot power down?
N Y
- Y:
  1 Check fine enable Logic on cards in slots A06, A19.
  2 Check velocity transducer and attendant logic on cards in slots A20, A19.
  3 Replace power amplifier.
  4 Call Field Support.

004 Drive seeks to forward mechanical stop, waits for FAULT Light (+42 V fuse blows, then retracts?
N Y
- Y:
  1 Replace power amplifier.
  2 Call Field Support.

005 Drive Loads heads, hesitates, then creeps to forward EOT?
Y N
- N:
  1 Call Field Support.
- Y:
  1 Check fine enable Logic on cards in slots A06, A19.
  2 Check cards in slots A17, A20.

2A 2B

A B
1 1

3 Call Field Support.

006 Check to ensure that heads loaded switch is transfering. Press START switch to stop disk. Do not turn off breakers. Manually push voice coil forward to move heads off unloading ramps. Does coil resist forward movement?

Y N

1 Check loads to (or contacts in) emergency retract relay.

2 Check for open voice coil

3 Replace heads loaded switch.

4 Replace power amplifier.

5 Call Field Support.

007 Check for forward drive to voice coil. Disconnect wire from terminal 2 of voice coil (one closest to magnet assembly). Attach + lead of VOM to this wire, - lead to logic ground. Press START switch. Wait 15-20 seconds for up-to-speed timeout to expire, then check voltage. Does VOM read approximately +40 V?

Y N

1 Check card in slot A20

2 Check card in slot A07

3 Check card in slot A12

4 Check cards in slots A08, A17

5 Replace power amplifier

6 Call Field Support

3
A

A
2

008 Drive attempts first seek and then unloads?

Y N

N: Problem resolved

009 Check servo preamplifier input to card in slot A18 (Track Servo Amplifier Check). Servo preamplifier input to card in slot A18 OK?

Y N

N:

1 Check for continuity/ground in servo preamplifier cable (input to A18).

2 Replace servo preamplifier.

3 Replace and align servo head.

4 Replace relay board _YFN.

5 Call Field Support.

010 Track servo signal present at A18 - 09B?

Y N

N:

1 Check card in slot A18.

2 Call Field Support.

Y:

1 Suspect propagation of Track Servo signal through cards at slots A19, A20.

2 Call Field Support.

TSP11 - RTZ, Continous seeks (Non-VDE)

Assumptions:
1. FTU connected to drive
2. Local/Remote switch set to Remote
3. LAP installed and drive selected

001 Actuate RTZ switch on FTU panel. Was RTZ successful?

Y N

- N:
  1 Replace card in slot A06
  2 Replace card in slot A07
  3 Replace card in slot A19
  4 Replace card in slot A20
  5 Replace card(s) in slot(s) A02 (A04)
  6 Call Field Support
- Y: continue to 002

002 Set up and perform continuous seeks. Were continuous seeks successful?

Y N

- N:
  1 Replace card in slot A06
  2 Replace card in slot A12
  3 Replace card in slot A20
  4 Replace card(s) in slot(s) A02 (A04)
  5 Call Field Support
- Y: 2 A

A
1
↓

003 Select maximum cylinder address (822 for BK7XX or 410 for BK6XX) and seek to this address. Was seek successful?

Y N

1 Replace card in slot A06.

2 Replace card in slot A12.

3 Replace card in slot A20.

4 Replace card(s) in slot(s) A02 (A04).

5 Call Field Support.

004 Select illegal cylinder address (823 for BK7XX or 411 for BK6XX). Does seek error result?

Y N

1 Replace card in slot A06.

2 Replace card in slot A12.

3 Replace card in slot A20.

4 Replace card(s) in slot(s) A02 (A04).

5 Call Field Support.

005 No Problem. Go to TSP-12.

TSP12 - Write/Write Format (Non-VDE)

Assumptions: FTU connected to drive and set up for Write or Write Format operation.

001 FAULT indicators on both FTU and drive come on?

N Y

↓

Go to step 004.

002 FAULT indicator on FTU comes on?

N Y

↓

1 Check to ensure that +5 V is present at operator panel (_ZYN board). If present, replace _ZYN board (see cross reference 772 in diagrams).

003 FAULT indicator on drive comes on?

Y N

↓

No problem. Go to TSP13.

004 Is fault limited to groups of contiguous addresses?

N Y

↓

1 Replace card in slot A12.

↓

2 Replace card in slot E02.

↓

3 Call Field Support.

005 Does fault appear only on Write Format operations?

Y N

↓

Go to step 007.

006 Set FTU address mark/sector mark switch to sector mark position and try again. Does FAULT light still come on?

Y N

↓

1 Check cards in slots A01, A02, A17.

↓

2 Replace card in slot E02.

↓

3 Call Field Support.

2

A

A
1
↓
007 Restore switch to address mark position and repeat test.
↓
008 Check LEDs on edge of Fault card (A17). Is Write Fault on?
N Y
↓
1 Check to ensure that FTU Servo offset switch is off.
↓
2 Replace card in slot A10.
↓
3 Replace card in slot A13.
↓
4 Replace card(s) in slot(s) A02 (A04).
↓
5 Replace card in slot A19.
↓
6 Replace card in slot E02.
↓
7 Call Field Support.

009 Is head select fault on?
N Y
↓
1 Check to ensure that FTU Servo offset switch is off.
↓
2 Replace card(s) in slot(s) A02 (A04).
↓
3 Replace card in slot E03.
↓
4 Call Field Support.

010 Is Write and Read Fault on?
N Y
↓
1 Check to ensure that FTU Servo offset switch is off.
↓
3 3
A B

A B
2 2

2 Replace card(s) in slot(s) A02 (A04).

3 Replace card in slot A19.

4 Replace card in slot E02.

5 Call Field Support.

011 Is Write or Read and Not on cylinder Fault on?

N Y

1 Check to ensure that FTU Servo offset switch is off.

2 Replace card in slot A19.

3 Replace card in slot A20.

4 Replace card in slot E02.

5 Call Field Support.

012 No Problem.

TSP13 - Read (Non-VDE)

Assumptions: FTU set up to perform a read operation.

```
001    Was address read properly?
       Y   N
       |   |
001    |   Are errors head related?
       |   Y   N
       |   |   |
       |   |   1   Reformat disk using write format procedure in
       |   |   |   FTU manual.
       |   |   |
       |   |   2   Replace card in slot A15.
       |   |   |
       |   |   3   Replace card in slot A14.
       |   |   |
       |   |   4   Replace card in slot A19.
       |   |   |
       |   |   5   Replace card(s) in slot(s) A02 (A04).
       |   |   |
       |   |   6   Replace card(s) in slot(s) A01 (A03).
       |   |   |
       |   |   7   Check head alignment.
       |   |   |
       |   |   8   Replace card in slot E03.
       |   |   |
       |   |   9   Call Field Support.
       |   |
       |   1   Replace card(s) in slot(s) A01 (A03).
       |   |
       |   2   Check head alignment.
       |   |
       |   3   Replace and align faulty heads.
       |   |
       |   4   Call field Support.
       |
       2
       A
```

A
1
↓
003 Was data read properly?
N Y
↓ No problem. Go to TSP-14.

004 Are errors head related?
N Y

Y:
1. Replace card(s) in slot(s) A01 (A03).
2. Check head alignment.
3. Replace and align faulty heads
4. Call Field Support

N:
1. Check to ensure that FTU data switches are set to read the pattern previously written on the disk.
2. Replace card in slot A15.
3. Replace card in slot A14.
4. Replace card in slot A19.
5. Replace card(s) in slot(s) A02 (A04).
6. Replace card(s) in slot(s) A01 (A03).
7. Check head alignment.
8. Replace read amplifier board (E03).
9. Call Field Support.

TSP14 - Power Down (Non-VDE)

Assumptions:
1. Remote mode - an attempt was made to power down the drive from a remote location.
2. Local mode - an attempt was made to power down the drive by pressing the START switch.

001 START light on drive panel goes out (Local Mode only)?

Y N

N:
1 Cathode of START LED grounded. See cross reference 773 in diagrams.
2 Call Field Support.

Y ↓

002 Do the heads unload?

Y N

N:
1 Replace card in slot A07.
2 Replace card in slot A20.
3 Call Field Support

Y ↓

003 Does drive motor brake to a stop?

N Y

Y: No problem

N ↓

004 Does drive motor coast to a stop?

Y N

N:
1 Check deck interlock switch (or wiring) for grounds.
3|
2 Check to ensure that heads loaded switch has transferred.
3 Replace card in slot A08.

2A 2B

A B
1 1

4 Replace relay board _YFN.

5 Call Field Support.

1 Check for open thermal resistor in CB3 (terminals C, D).

2 Check brake relay K8 and connections. If pressing START switch still does not pull K8, replace relay board (_YFN).

3 Check for 32 V dc between terminals 10 and 3 of K8. If absent, replace ±16 V bridge rectifier. If 32 V dc is present, check for broken wires to motor connector P/J7.

4 Call Field Support.

TSP1 - Failure to Power Up (VDE)

Assumptions:
1. Drive connected to site power
2. Disk pack installed and all covers closed
3. Main AC circuit breaker (CB1) off, all other circuit breakers on

```
001    Turn on circuit breaker CB1.  Does blower motor start?
       Y   N
       |   |
       |   Elapsed time meter running?
       |   Y   N
       |   |   |
       |   |   1   Check power input to power panel and CB1.
       |   |   |
       |   |   2   Check for correct power phasing at power
       |   |   |   plug.
       |   |   |
       |   |   3   Call Field Support.
       |   |
       |   1   Check line filter and blower cable connecter.
       |
002    Do any breakers trip or fuses open?
       N   Y
       |   |
003    |   Check to determine which breaker or fuse opened
       |   and go to indicated TSP:
       |   •  CB1:  TSP2
       |   •  CB2:  TSP3
       |   •  CB4:  TSP4
       |   •  CB5, F5, F6:  TSP7
       |   •  CB6, CB7, F1, F2:  TSP5
       |   •  CB8, F7, F8, CB3:  TSP8
       |
       2
       A
```

A
1

004 Press START switch. Does indicator come on and READY light flash at 1-second intervals?

Y N

1 Check to ensure that all circuit breakers are on.

2 Check dc test jacks on power supply panel. All voltages present?

Y N

No voltages present?

Y N

Go to appropriate TSP listed in step 003.

Go to TSP3.

1 Check to ensure that A1P/J4, is properly mated (START light).

2 Check to ensure that P/JD93, P/JA80, P/201, are properly mated (START light).

3 Replace logic cards at location A08, A17 (READY flasher).

4 Call Field Support.

3
A

A
2
↓
005 Does drive motor start?
Y N
| ↓
| Go to TSP4.
↓
006 Does drive motor come up to speed?
Y N
| ↓
| Go to TSP4.
↓
007 Does drive motor cut out after 10-second timeout expires?
N Y
| 1 Check speed sensor and logic cards A17, A08.
| ↓
| 2 Call Field Support.
↓
008 Do heads load?
Y N
| ↓
| Go to TSP 8.
| ↓
↓
009 Is first seek successful?
Y N
| ↓
| Go to TSP 8.
↓
010 No problem. Go to TSP9.

TSP2 - Unable To Maintain Power UP (VDE)

Assumptions: 1. CB1 trips during power up. All other circuit breakers are on.

001 Turn off CB3 and CB4. Reset CB1 and try again. Does CB1 still trip?

N Y

- Y:
  1 Disconnect blower and retry. If trouble persists, blower is OK.
  2 Reconnect blower. Disconnect time meter and retry.
  3 Reconnect time meter. Check wiring in line side of CB2 and CB4.
  4 Call Field Support.
- N: go to 002

002 Turn off CB1, turn on CB4 and then turn on CB1. Does either CB1 or CB4 trip?

N Y

- Y:
  1 Disconnect J/P1 on _CFN and retry. If trouble persists, check wiring on load side of CB4. Does CB4 stay on?

  Y N

  - N:
    1 Check wiring on load side of CB4.
  - Y:
    1 Replace _CFN
    2 Call Field Support
- N: go to 003

003 Disconnect P/J2 and C1 on T2. Turn on CB1. Does CB1 trip?

N Y

- Y:
  1 Replace transformer T2 and reconnect P/J2.
- N: go to 004

004 Problem has been corrected.

TSP3 - +20Y (+20 Volt Relay Power) Missing (VDE)

Assumptions: 1. Lack of +20Y noticed upon failure to power up.

2. Drive motor stops; all indicator lights out, blower still on.

001 Has +20Y breaker (CB2) tripped?

N Y

1 Disconnect P/J2 on _CFN and retry. If CB2 still trips, check wiring to/from T1 for shorts or grounds, and if necessary, replace T1.

002 Check for +20Y at rectifier CR1/CR2 on _CFN. Is +20Y present?

N Y

1 Check continuity of +20Y and, if necessary, replace the _CFN.

003 Disconnect P/J2 and check for raw ac at P2. Is 20 V ac present at P2?

N Y

1 Replace _CFN board. Reconnect P/J2. Go to TSP1.

004 Check for raw 20 V ac at T1. Is 20 V ac present?

N Y

1 Check wiring from T1 to P2 for opens.

1 Check wiring from CB2 to T1.

TSP4 - Drive Motor Fails (VDE)

Assumptions:

1. Drive motor fails to start, starts prematurely, or fails to come up to speed (CB2 - CB8 on). Conditions below are initiated by actuating CB1.
2. Drive motor shuts down after a period of proper operations.

```
001    Does CB4 (motor) trip when CB1 (MAIN AC) is actuated?
       N   Y
       |   ↓
       |   1   Check for shorts or grounds in wiring on load
       |   |   side of CB4.  Replace CB4 if necessary.
       |   ↓
       |   2   Call Field Support.
       ↓
002    Does drive motor start when CB1 is actuated?
       N   Y
       |   ↓
       |   1   Replace _CFN card (control).
       |   ↓
       |   2   Replace _FNN card (relay).
       |   ↓
       |   3   Call Field Support.
       ↓
003    Does drive motor start when START switch is pressed?
       Y   N
       |   ↓
004    |   Is motor power present at J/P7 (motor) when START
       |   switch is pressed?
       |   N   Y
       |   |   ↓
       |   |   1   Check wiring between P/J2 and motor.
       |   |   ↓
       |   |   2   Replace motor.
       |   |   ↓
       |   |   3   Call Field Support.
       |   ↓
005    |   Check for +9.7 V at test jack.  Is 9.7 V power
       |   present?
       |   Y   N
       |   |   ↓
       |   |   1   Go to TSP5.
       ↓   ↓
       2   2
       A   B
```

A B
1 1

1 Check wiring between P/J7 and _CFN card.

2 Replace _CFN card.

006 Is lack of motor power accompanied by one or more FAULT indications?

N Y

1 Troubleshoot faults.

2 Call Field Support.

007 Check for +9.7 V power at test jack. Is +9.7 V power present?

Y N

1 Go to TSP5.

1 Replace card at location A08.

2 Replace _FNN card.

3 Replace _CFN card.

4 Call Field Support.

008 Does CB4 or thermal breaker trip when START switch is pressed?

N Y

1 Check to ensure that parking brake has released spindle.

2 Check for tight or seized motor and/or spindle bearing.

3 Call Field Support.

3
A

A
2

009 Does CB4 or thermal breaker trip before motor is up to speed?

Y N

N: If READY light flashes after motor starts, go to TSP8. If READY light is on steady (successful first seek), go to TSP9.

Y:

011 Is squealing heard when motor starts?

N Y

Y:

1 Check to ensure that parking brake has released spindle.

2 Check drive belt and tension.

3 Call Field Support.

N:

1 Check drive belt and tension.

2 Check brake and associated wiring.

3 Call Field Support.

TSP5 - Fault in ±9.7 V Loads (VDE)

Assumptions:
1. Circuit breaker CB6 and/or CB7 trips when attempting to power up and/or.
2. Fuses F1 and F2 open and/or.
3. ± 9.7 V dc missing at test jacks.

001 Did fuse F1 or F2 open?
N Y

002 Turn off CB1 and replace open fuses. Did CB6 or CB7 trip?
Y N

1 Check rectifier/filter circuits on _CBN. Replace board if necessary.

2 Replace control board _CFN.

3 Call Field Support.

003 Turn off CB1. Disconnect J/P3 on power supply. Turn on CB6 and CB7. Did CB6 or CB7 trip?
N Y

1 Check wiring between load side of breakers and J3 on power supply.

004 Turn off CB1. Disconnect A3P8 on servo preamplifier. Connect J/P3 on power supply. Turn on CB5 and CB6, then CB1. Did CB5 or CB6 trip?
N Y

1 Replace ±5 V regulator board.

1 Replace servo preamplifier.

005 Did CB6 or CB7 trip?
N Y

Go to step 003.

2
A

A
1

006 Is ± 9.7 V present at test jacks?

Y N

1 Check rectifier/filter circuits on _CBN. Replace board if necessary.

2 Check for ac to transformer T2. Is ac power present?

Y N

1 Replace control board _CFN.

1 Check transformer T2 and replace if necessary.

2 Call Field Support.

007 No problem.

TSP6 - Fault In ± 20 and/or + 28 V Loads (VDE)

Assumptions:

1. Circuit breaker CB3 (+28 V) and/or CB8 (-20 V) tripped when powering up and/or
2. Fuses F7 and/or F8 (20 V) and/or F3 and/or F3 and/or F4 (28 V) open when powering up and/or
3. ±20 V and/or +28 V missing at test jacks.

001 Are fuses F3, F4, F7 and/or F8 open?
N Y

002 Turn off CB1 and replace open fuse(s). Did CB3 or CB8 trip?
Y N
1 Troubleshoot rectifier/filter board _CBN or replace it if necessary.

003 Turn off CB1 and disconnect J/P4 and J/P3 on power supply. Turn on CB3, CB8 and then CB1. Did CB3 or CB8 trip?
N Y
1 Check wiring between load side of CB3/CB8 for shorts and/or grounds.
2 Call Field Support.

004 Are dc voltages present at test jacks?
Y N
1 Troubleshoot rectifier/filter board _CBN or replace it if necessary.
2 Check for ac to T2. Is ac present at T2?
Y N
1 Troubleshoot control board _CFN and replace if necessary.
1 Check transformer T2 and replace it if necessary.
2 Call Field Support.

2 2
A B

A B
1 1

005 Turn off CB1 and connect J/P3 on power supply. Leave J/P4 disconnected. Turn on CB3, CB8 and then CB1. Did CB8 trip?

N Y

1 Troubleshoot ±20 V circuits between logic chassis and J/P3 on power supply.

2 Call Field Support.

006 Turn off CB1 and connect J/P4. Turn off CB8. Turn on CB3 and then CB1. Did CB3 trip?

N Y

1 Troubleshoot +28 V circuits beyond J/P4 on power supply.

2 Call Field Support.

1 Troubleshoot ±20 V circuits beyond J/P4 on power supply.

2 Call Field Support.

007 Did CB3 or CB8 trip?

N Y

1 Go to step 003.

008 Are dc voltages present at test jacks?

N Y

No Problem. Go to TSP1.

1 Troubleshoot rectifier/filter board _CBN, or replace it if necessary.

2 Check transformer T2 and replace it if necessary.

3
A

A
2
↓
3 Check for ac to T2. Is ac present at T2?
Y N
↓
1 Troubleshoot control board _CFN and replace it if necessary.
↓
1 Call Field Support.

TSP7 - Fault In ±46 V Loads (VDE)

Assumptions:
1. Circuit breaker CB5 trips when attempting to power up and/or
2. Fuses F5 and/or F6 open when attempting to power up and/or
3. ±46 V dc missing when measuring at test jacks.

```
001     Did fuse F5 and/or F6 open?
        N    Y
        |    ↓
        |    Turn off CB1 and replace open fuse(s).  Did CB5 trip?
        |    Y    N
        |    |    ↓
        |    |    1    Troubleshoot rectifier/filter board _CBN and
        |    |    |    replace it if necessary.
        |    |    ↓
        |    |    2    Replace control board _CFN
        |    |    ↓
        |    |    3    Call Field Support.
        |    ↓
003     |    Turn off CB1.  Limit load to power amplifier by dis-
        |    connecting J/P4 on power supply and J/P1 on _FNN
        |    card.  Turn on CB5 and then CB1.  Did CB5 trip?
        |    N    Y
        |    |    ↓
        |    |    1    Replace power amplifier.
        |    ↓
004     |    Turn off CB1.  Connect J/P4 on logic chassis.  Turn
        |    on CB5 and then CB1.  Did CB5 trip?
        |    N    Y
        |    |    ↓
        |    |    1    Troubleshooting ±46 V distribution beyond
        |    |    ↓    P/J4 on power supply.
        |    |    2    Call Field Support.
        ↓    ↓
        2    2
        A    B
```

```
        A   B
        1   1
        |   ↓
005     |   Turn off CB1.  Connect J/P1 on relay board _FNN.
        |   Turn on CB5 and then CB1.  Did CB5 trip?
        |   N   Y
        |   |   ↓
        |   |   1   Replace relay board _FNN
        |   |   ↓
        |   |   2   Call Field Support.
        |   ↓
        |   Problem no longer exists.  Go to TSP1.
        ↓
006     Did CB5 trip?
        N   Y
        |   ↓
        |   Go to step 003.
        ↓
007     Is ±46 V present at test jacks?
        N   Y
        |   ↓
        |   No problem.
        ↓
        1   Troubleshoot rectifier/filter board _CBN and replace
        |   it if necessary.
        ↓
        2   Check -46 V distribution beyond P/J3 on _CBN.
        ↓
        3   Replace _CFN board.
        ↓
        4   Check for ac to transformer T2.  Is ac present at
            transformer T2?
            Y   N
            |   ↓
            |   1   Troubleshoot control board _CFN and replace
            |       if necessary.
            ↓
            1   Check transformer T2 and replace it if necessary.
            ↓
            2   Call Field Support.
```

TSP8 - First Seek (VDE)

Assumptions: Start light is on drive is up to speed. First seek not yet completed (READY light blinking).

```
001     READY light glows continuously, signifying successful
        first seek?
        N   Y
        |   ↓
        |   No problem.  Go to TSP9.
        ↓
002     First seek attempted?
        Y   N
        |   ↓
003     |   Check to ensure that Heads Loaded switch is trans-
        |   ferring.  Press START switch to stop disk.  Do not
        |   turn off breakers.  Manually push voice coil forward
        |   to move heads off unloading ramp.  Does voice coil
        |   resist forward movement?
        |   Y   N
        |   |   ↓
        |   |   1   Check leads to (or contacts in) emergency
        |   |   |   retract relay.
        |   |   ↓
        |   |   2   Check for open voice coil.
        |   |   ↓
        |   |   3   Replace heads loaded switch.
        |   |   ↓
        |   |   4   Replace power amplifier.
        |   |   ↓
        |   |   5   Call Field Support.
        |   ↓
004     |   Check for forward drive to voice coil.  Disconnect
        |   wire from terminal 2 of voice coil (one closest to
        |   magnet assembly).  Attach + lead of VOM to this wire,
        |   - lead to logic ground.  Press START switch.  Wait
        |   15-20 seconds for up-to-speed timeout to expire, then
        |   check voltage.  Does VOM read approximately +40 V?
        |   Y   N
        |   |   ↓
        |   |   1   Check card in slot A20.
        |   |   ↓
        |   |   2   Check card in slot A07.
        |   |   |
        ↓   ↓   ↓
        2   2   2
        A   B   C
```

A B C
1 1 1

3 Check card in slot A12.

4 Check cards in slots A08, A17.

5 Replace power amplifier board.

6 Call Field Support.

Go to step 006.

006 Drive attempts first seek, then unloads?
Y N

007 Drive seeks to forward mechanical stop, FAULT light comes on (CB5 trips), but heads don't unload (unit cannot power down)?
N Y

1 Check Fine Enable logic on cards in slots A06, A19.

2 Check velocity transducer and attendant logic on card in slot A20.

3 Replace power amplifier board.

4 Call Field Support.

008 Drive seeks to forward mechanical stop, wait for FAULT light (CB5 trips) then retracts?
Y N

Drive loads heads, hesitates, then creeps to forward EOT.
N Y

1 Check Fine Enable logic on cards in slots A06, A19.

2 Check cards in slots A17, A20.

3 Call Field Support.

Go to step 010.

3 3
A B

A B
2 2

1 Replace power amplifier board.

2 Call Field Support.

010 Check servo preamp input to card in slot A18. Servo preamplifier input to card in slot A18 OK?

Y N

1 Check for continuity/grounds in servo preamplifier cable (input to card in slot A18).

2 Replace servo preamplifier board.

3 Replace and align servo head.

4 Call Field Support.

011 Track servo signal present at A18-09B (output pin).

Y N

1 Check card in slot A18.

2 Call Field Support.

1 Check propagation of Track Servo signal through cards in slots A19, A20.

2 Call Field Support.

TSP9 - RTZ, Continous seeks (VDE)

Assumptions:
1. FTU connected to drive
2. Local/Remote switch set to Remote
3. LAP installed and drive selected

001 Actuate RTZ switch on FTU panel. Was RTZ successful?

Y N

1 Replace card in slot A06

2 Replace card in slot A07

3 Replace card in slot A19

4 Replace card in slot A20

5 Replace card(s) in slot(s) A02 (A04)

6 Call Field Support

002 Set up and perform continuous seeks. Were continuous seeks successful?

Y N

1 Replace card in slot A06

2 Replace card in slot A12

3 Replace card in slot A20

4 Replace card(s) in slot(s) A02(A04)

5 Call Field Support

2
A

A
1
↓

003 Select maximum cylinder address (822 for BK7XX or 410 for BK6XX) and seek to this address. Was seek successful?

Y N

- 1 Replace card in slot A06.
- 2 Replace card in slot A12.
- 3 Replace card in slot A20.
- 4 Replace card(s) in slot(s) A02(A04).
- 5 Call Field Support.

004 Select illegal cylinder address (823 for BK7XX or 411 for BK6XX). Does seek error result?

Y N

- 1 Replace card in slot A06.
- 2 Replace card in slot A12.
- 3 Replace card in slot A20.
- 4 Replace card(s) in slot(s) A02(A04).
- 5 Call Field Support.

005 No Problem. Go to TSP-10.

TSP10 - Write/Write Format (VDE)

Assumptions: FTU connected to drive and set up for Write or Write Format operation.

001 FAULT indicators on both FTU and drive come on?
N Y
↓
Go to step 004.

002 FAULT indicator on FTU comes on?
N Y
↓
1 Check to ensure that +5 V is present at operator panel (_ZYN board). If present, replace _ZYN board (see cross reference 772 in diagrams).

003 FAULT indicator on drive comes on?
Y N
↓
No problem. Go to TSP11.

004 Is fault limited to groups of contiguous addresses?
N Y
↓
1 Replace card in slot A12.
↓
2 Replace card in slot E02.
↓
3 Call Field Support.

005 Does fault appear only on Write Format operations?
Y N
↓
Go to step 007.

006 Set FTU address mark/sector mark switch to sector mark position and try again. Does FAULT light still come on?
Y N
↓
1 Check cards in slots A01, A02, A17.
↓
2 Replace card in slot E02.
↓
3 Call Field Support.

2
A

A
1
↓

007 Restore switch to address mark position and repeat test.
↓

008 Check LEDs on edge of Fault card (A17). Is Write Fault on?

N Y
↓
1 Check to ensure that FTU Servo offset switch is off.
↓
2 Replace card in slot A10.
↓
3 Replace card in slot A13.
↓
4 Replace card(s) in slot(s) A02(A04).
↓
5 Replace card in slot A19.
↓
6 Replace card in slot E02.
↓
7 Call Field Support.

↓ (N)

009 Is head select fault on?

N Y
↓
1 Check to ensure that FTU Servo offset switch is off.
↓
2 Replace card(s) in slot(s) A02 (A04).
↓
3 Replace card in slot E03.
↓
4 Call Field Support.

↓ (N)

010 Is Write and Read Fault on?

N Y
↓
1 Check to ensure that FTU Servo offset switch is off.
↓

3 3
A B

A B
2 2

2 Replace card(s) in slot(s) A02(A04).
↓
3 Replace card in slot A19.
↓
4 Replace card in slot E02.
↓
5 Call Field Support.

011 Is Write or Read and Not on cylinder Fault on?
N Y
↓
1 Check to ensure that FTU Servo offset switch is off.
↓
2 Replace card in slot A19.
↓
3 Replace card in slot A20.
↓
4 Replace card in slot E02.
↓
5 Call Field Support.

012 No Problem.

TSP11 - Read (VDE)

Assumptions: FTU set up to perform a read operation.

001 Was address read properly?
Y N

001 Are errors head related?
Y N

1 Reformat disk using write format procedure in FTU manual.

2 Replace card in slot A15.

3 Replace card in slot A14.

4 Replace card in slot A19.

5 Replace card(s) in slot(s) A02(A04).

6 Replace card(s) in slot(s) A01(A03).

7 Check head alignment.

8 Replace card in slot E03.

9 Call Field Support.

1 Replace card(s) in slot(s) A01(A03).

2 Check head alignment.

3 Replace and align faulty heads.

4 Call field Support.

2
A

A
1
↓

003 Was data read properly?

N Y

Y → No problem. Go to TSP12.

004 Are errors head related?

N Y

Y:

1 Replace card(s) in slot(s) A01(A03).
↓
2 Check head alignment.
↓
3 Replace and align faulty heads
↓
4 Call Field Support

N:

1 Check to ensure that FTU data switches are set to read the pattern previously written on the disk.
↓
2 Replace card in slot A15.
↓
3 Replace card in slot A14.
↓
4 Replace card in slot A19.
↓
5 Replace card(s) in slot(s) A02(A04).
↓
6 Replace card(s) in slot(s) A01(A03).
↓
7 Check head alignment.
↓
8 Replace read amplifier board (E03).
↓
9 Call Field Support.

TSP12 - Power Down (VDE)

Assumptions:
1. Remote operation - Attempt to power down drive from remote location.
2. Local operation - Press START switch to turn off START indicator and power down drive.

```
001    START light on control panel goes off (local mode).
       Y   N
       |   |
       |   1   Cathode of START LED grounded.
       |
002    Heads unload?
       Y   N
       |   |
       |   1   Replace card in slot A07.
       |   |
       |   2   Replace card in slot A20.
       |
003    Drive motor brakes to a stop?
       Y   N
       |   |
004    |   Drive motor coasts to a stop.
       |   Y   N
       |   |   |
       |   |   1   Check that Heads Loaded switch has trans-
       |   |       ferred (A07-24B to ground).
       |   |
005    |   Check for +20Y at brake connector J/P8.  Is 20Y
       |   present?
       |   Y   N
       |   |   |
       |   |   1   Replace control board _CFN.
       |   |
       |   1   Check brake assembly and replace if necessary.
       |
006    Diagnostics completed satisfactorily.
```

SECTION 6

REPAIR AND REPLACEMENT

INTRODUCTION

This section contains information concerning the mechanical replacement and adjustment of the drive field replacement parts. It describes the replacement of all major field replaceable assemblies and those components having critical or complex replacement procedures. It also includes associated mechanical adjustments that may be performed in the field.

The section is divided into procedures each describing either the replacement or adjustment of a particular assembly or component. These procedures are arranged alphabetically according to the assembly or component associated with the procedure.

Note that all procedures in this section are based on the assumption that the drive is installed inline with other drives and can be accessed only from front and rear.

If it is not installed in the inline position, certain procedures are more easily performed by removing side panels to gain access to the drive from the side.

Figures 6-1 and 6-2 locate the assemblies and components having a replacement and/or adjustment procedure. The theory concerning the operation of these parts is described in the hardware reference manual. Additional parts information, including illustrations and part numbers are included in the Parts Data section of this manual.

Before performing maintenance, be thoroughly familiar with operation of the drive and with all information in the General Maintenance section of this manual.

ACTUATOR ASSEMBLY REPLACEMENT

The actuator is located on the deck assembly (refer to figures 6-1 and 6-2).

The following describes the entire procedure for replacing the actuator assembly. Figure 6-2 is an exploded view of the deck assemblies involved in actuator replacement.

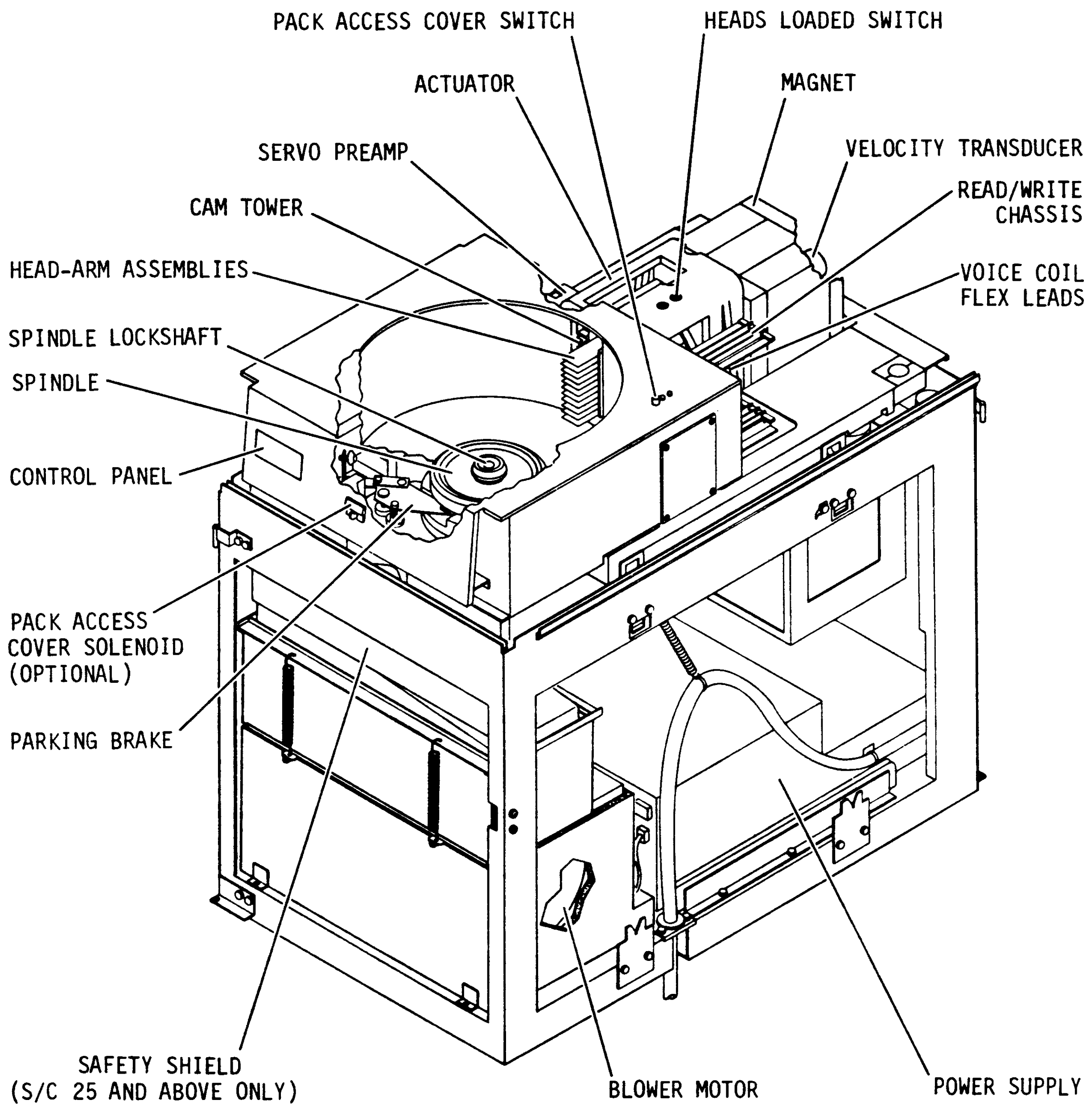
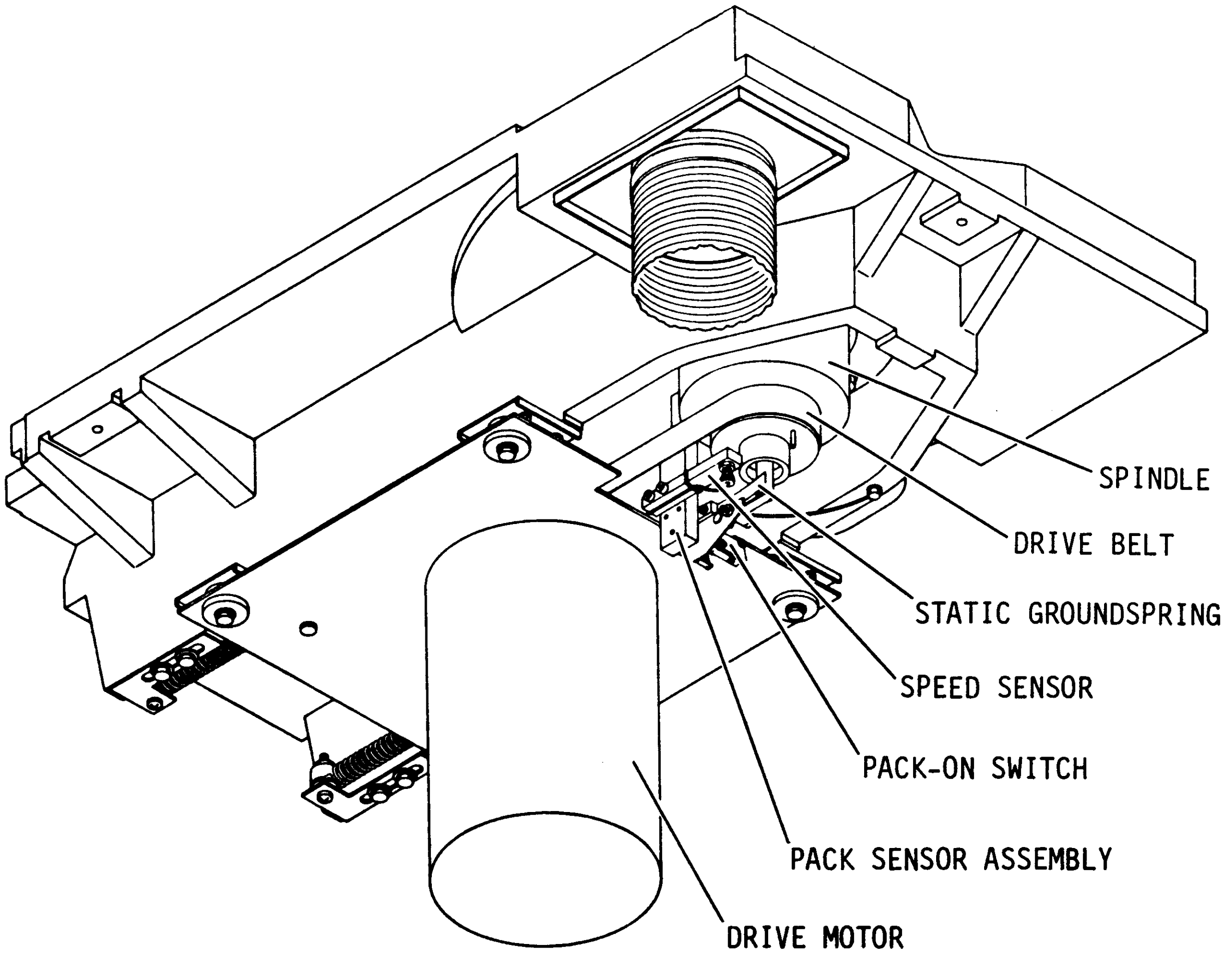


Figure 6-1. Assembly Locator (NON-VDE) (Sheet 1 of 2)



NOTE:

1. ILLUSTRATION SHOWS UNDERSIDE OF DECK VIEWED FROM LOWER LEFT. IRRELEVANT PARTS ARE NOT SHOWN.

9E23-2C

Figure 6-1. Assembly Locator (NON-VDE) (Sheet 2 of 2)

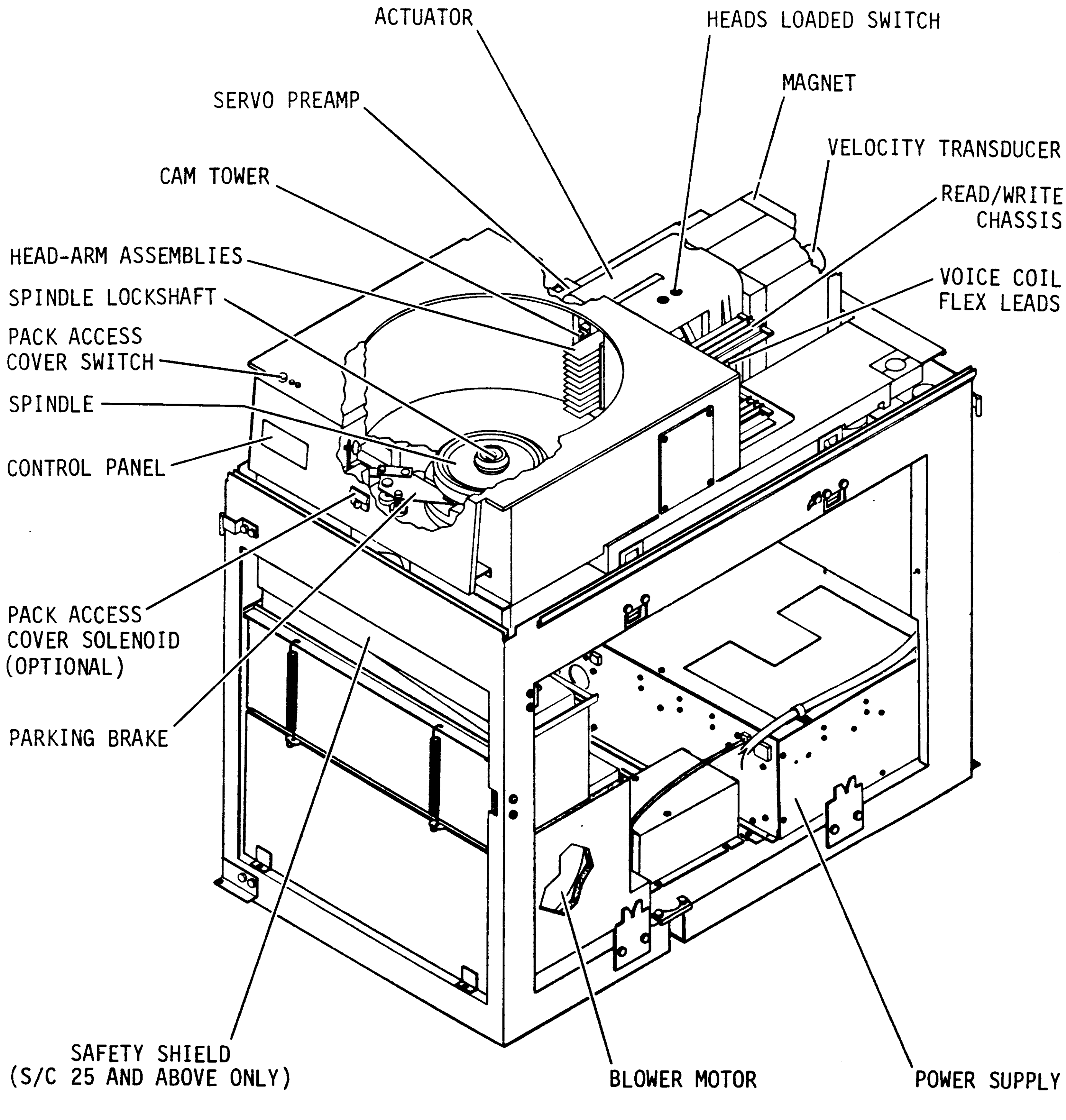


Figure 6-2. Assembly Locator (VDE) (Sheet 1 of 2)

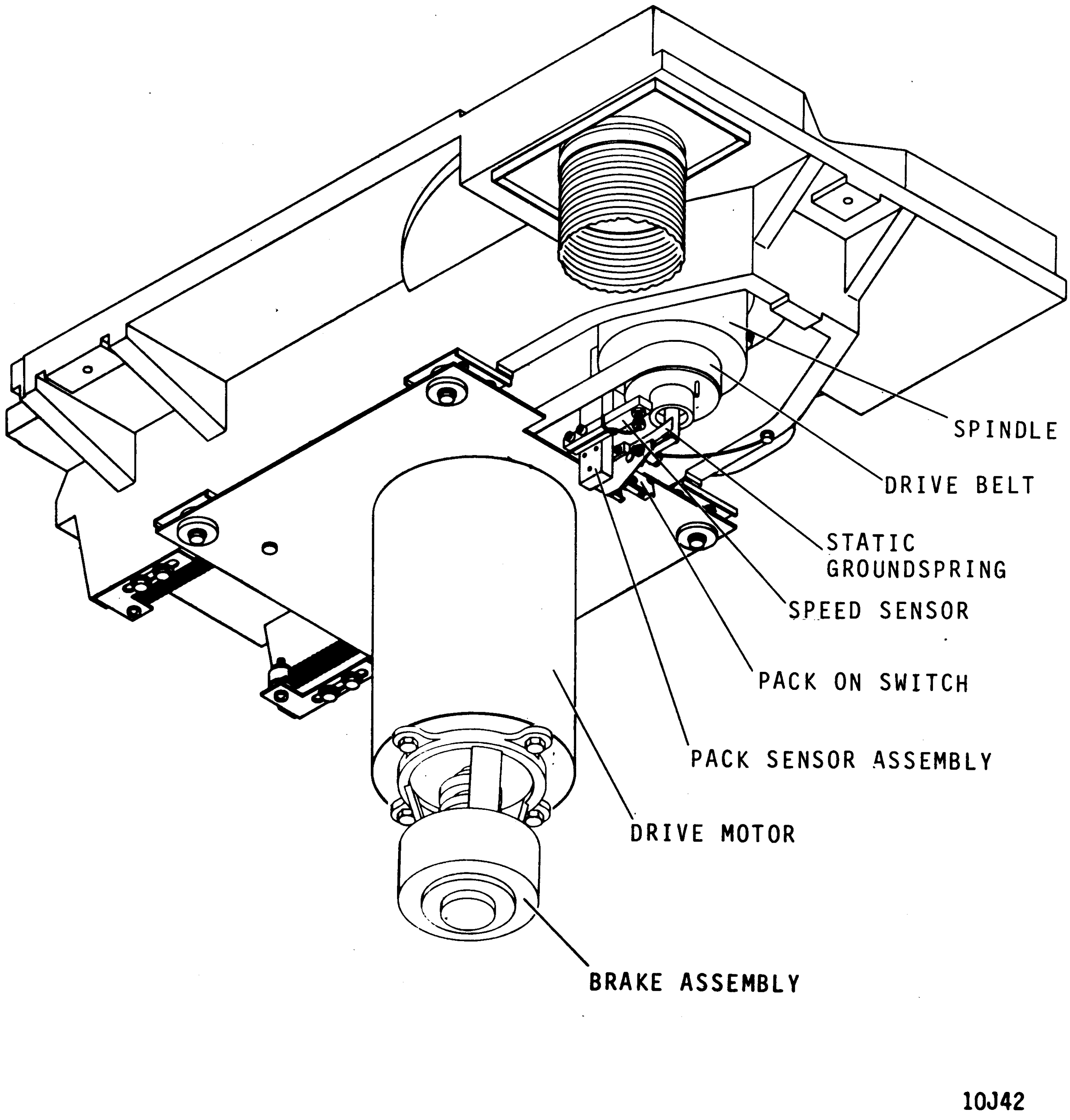


Figure 6-2. Assembly Locator (VDE) (Sheet 2 of 2)

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

NOTE

If drive is installed inline with other drives, it may be necessary to move drive out of line to remove the top cover.

3. Remove cabinet top cover.

4. Remove deck cover.

5. Remove pack access cover.

6. Remove shroud and shroud cover.

7. Remove pack access cover switch (Non-VDE:A3S1, VDE:A3S9) and pack access cover solenoid (Non-VDE:A3L1, VDE:A3L2) if installed. Disconnect connector A3P9 on VDE units.

CAUTION

The magnetic field generated by the magnet is very strong. Permanent watch damage will occur if it is brought near magnet.

8. Make note of voice coil leadwire connections and disconnect leadwires.

9. Disconnect velocity transducer cable plug P4.

10. Cut cable ties securing voice coil and heads loaded switch A3S6 leadwires to side of actuator housing.

11. Remove hardware securing heads loaded switch A3S6 to actuator housing then remove switch and set it aside leaving leadwires connected.

12. Move servo preamp housing as follows:

    a. Remove hardware securing cover to preamp housing and remove cover.

    b. Disconnect servo head cable plug from servo preamp board.

    c. Remove hardware securing servo preamp housing to deck.

    d. Move housing to one side leaving leadwires connected.

CAUTION

Remove only one head-arm assembly at a time. As each head-arm assembly is removed, observe order in which it is removed and lay out in order of removal. Lay each head (face up) on a clean surface. Each head-arm assembly must be installed in the same slot it was removed from.

13. Remove head-arm assemblies starting with head 00. Refer to Head-Arm Assembly Replacement procedure step 8.

14. Remove read/write logic chassis as follows:

    a. Remove connectors from cards.

    b. Remove hardware securing read/write logic chassis to deck and remove chassis.

15. Refer to Velocity Transducer Replacement procedure step 5, and remove velocity transducer from magnet assembly.

16. Remove magnet assembly as follows (refer to figure 6-3):

    a. Loosen hardware securing rear deck seal to frame and remove.

    b. Loosen hardware securing rear deck plate to deck and remove.

    c. Remove top cover latch from frame.

    d. Remove plastic magnet cover by prying cover from magnet assembly.

CAUTION

The screw removed in next step goes through the actuator housing and threads into the magnet assembly. The magnet will have a strong pull on the wrench used to remove this screw so use care not to damage actuator components.

    e. Remove screw securing actuator housing to magnet assembly. This screw is located at top inside surface of actuator housing next to magnet.

    f. Move carriage as far forward as possible.

    g. Remove hardware securing stop plates to stop mount on magnet.

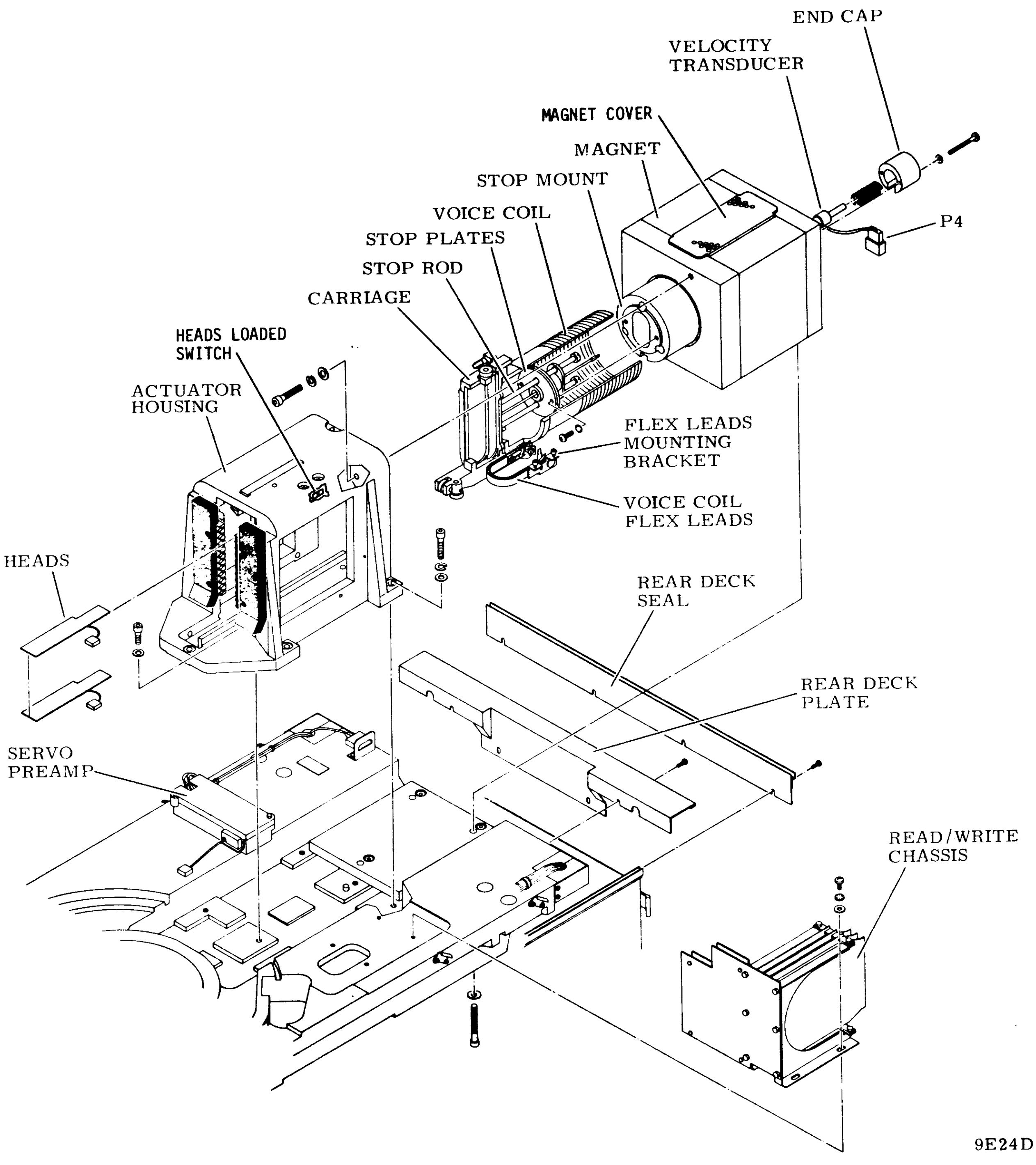


Figure 6-3. Actuator Replacement

h. Remove hardware (under deck) securing magnet assembly to deck.

CAUTION

When removing magnet assembly use care not to damage voice coil. Also, use care to place magnet away from metal filings or other metallic objects.

i. Remove magnet from deck by sliding straight back from voice coil (ensuring that voice coil is pushed forward).

17. Remove hardware securing actuator housing to deck, then lift actuator housing straight up off pin and deck.

NOTE

The defective actuator assembly has now been completely removed. The following steps describe installation of the replacement actuator assembly.

18. Prepare replacement actuator for installation as follows:

    a. Remove hardware securing voice coil flex lead adjustment bracket to actuator housing. This frees the flex leads and bracket from the housing.

    b. Back carriage out of actuator housing, using care not to damage voice coil flex leads.

    c. Check to see that there are no burrs or foreign particles on mounting surfaces of deck or actuator housing. If necessary clean these surfaces.

NOTE

When installing actuator housing leave screws loose enough to perform carriage to spindle alignment.

19. Mount actuator housing on deck.

20. Slide carriage into actuator housing taking care not to damage voice coil flex leads.

21. Align carriage to spindle as follows:

    a. Install and position carriage alignment arm as instructed in step 5 (a, b and c) of Spindle to Carriage Alignment procedure.

b. Check to see that clearance between carriage alignment arm and spindle hub is between 0.05 and 0.10 mm (0.002 and 0.004 in) (refer to figure 6-4).

c. If requirements of step b are not met, gently tap actuator on one side or the other to move it in the proper direction.

NOTE

Do not disturb actuator position when removing carriage alignment arm and carriage.

d. Remove carriage alignment arm from carriage.

e. Remove carriage from actuator housing.

NOTE

Start with center screws when securing actuator housing to deck and use care not to disturb actuator position.

f. Tighten screws securing actuator housing to deck. Torque each bolt to 6.8 $\pm$0.4 N·m (60 $\pm$5 lbf·in).

g. Slide carriage into actuator housing.

h. Check to ensure alignment was not disturbed during torquing of actuator housing screws, by repeating steps a and b. If requirements of step b are not met proceed to step i, otherwise proceed to step m.

i. Remove carriage alignment arm.

j. Back carriage out of actuator housing.

k. Loosen screws securing actuator housing, sufficiently to permit carriage to spindle alignment.

l. Realign as instructed in steps a through h.

m. Remove carriage alignment arm.

22. Apply Loctite, Grade C to threads of screw and attach voice coil flex lead mounting bracket to actuator housing.

23. Move carriage and check to see that voice coil flex leads do not bind and ride approximately parallel to deck. If necessary adjust flex lead mounting bracket until this is the case.

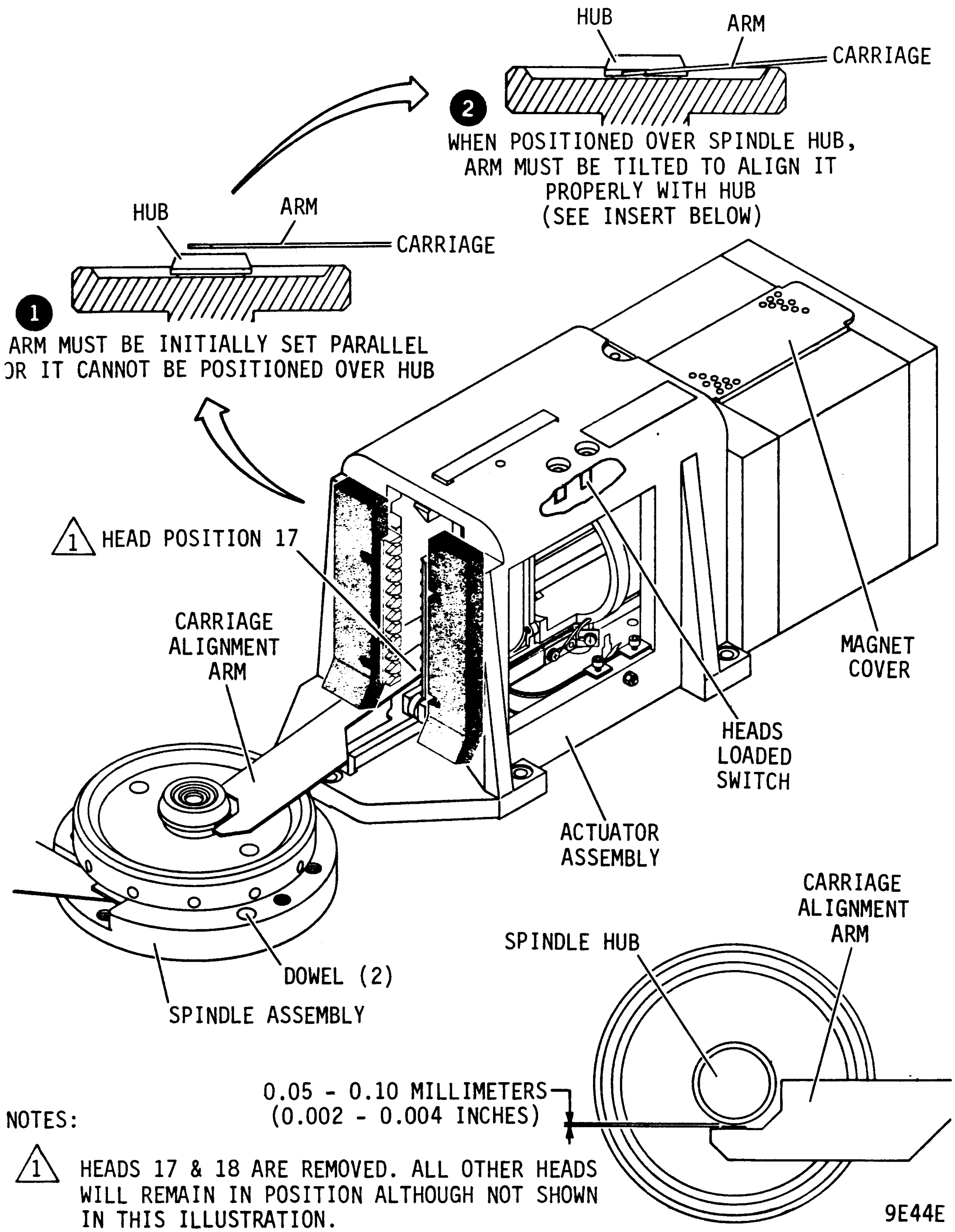


Figure 6-4. Spindle-to-Carriage Alignment

CAUTION

While performing next step use care not to damage voice coil windings.

24. Install magnet assembly as follows:

    a. Move carriage forward as far as possible without unloading bearings from rails.

    b. Carefully slide magnet into position and loosely secure it to deck.

CAUTION

While performing following step use caution not to damage voice coil.

25. Align magnet and voice coil as follows:

    a. Loosely install hardware through top of actuator into magnet assembly.

    b. Slowly move voice coil in and out of magnet assembly while moving magnet assembly as necessary to ensure voice coil is not making contact with it.

    c. While moving coil in and out of magnet, insert a 0.15 mm (0.005 in) non-metallic feeler gauge between coil and magnet to ensure that the coil is centered within 0.25 mm (0.010 in) inside the magnet.

    d. Secure screw through top of actuator to 6.8 ±0.2 N·m (60 ±2 lbf·in).

    e. Recheck gap (step c) and if required, loosen screw, and repeat steps b through d until proper gap is obtained.

    f. Secure magnet to deck using a torque of 3.4 ±0.1 N·m (30 ±1 lbf·in).

    g. Recheck gap (step c) and if required, loosen all magnet screws and repeat steps b through f until proper gap is obtained.

26. Secure stop plates to magnet assembly with two screws and washers. Ensure that stop rods do not rub on stop plates during carriage movement.

27. Replace plastic magnet shield.

28. Replace velocity transducer assembly (refer to figure 6-5) as follows:

    a. Insert coil housing, containing transducer core and extension rod, into rear of magnet.

    b. Position end cap and spring on magnet, then secure with screws and washers.

    c. Apply one drop of Loctite, Grade C to extension rod threads, then thread extension rod into carriage and tighten.

    d. Connect velocity transducer cable plug P4.

29. Replace heads loaded switch on actuator housing.

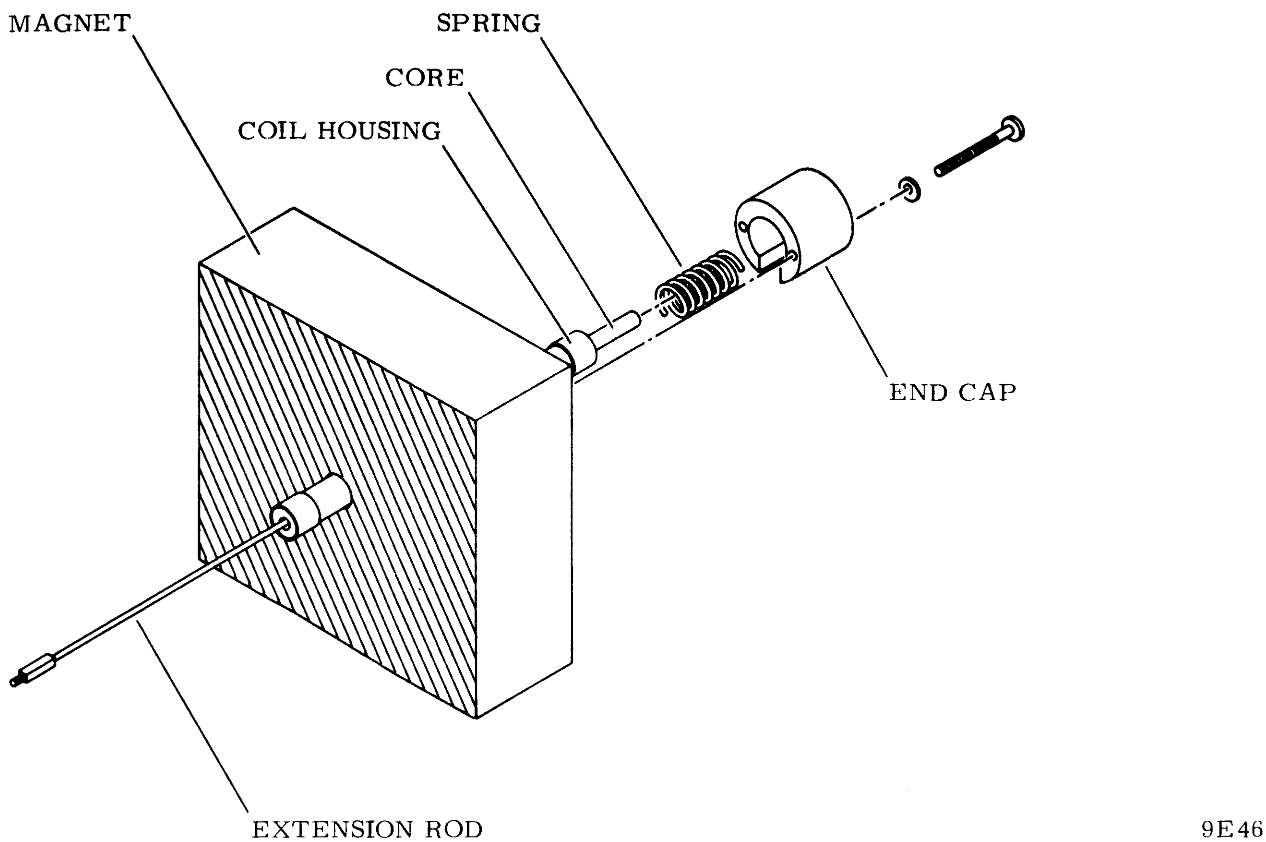


Figure 6-5. Velocity Transducer Replacement

30. Perform Heads Loaded Switch Adjustment procedure steps 5 through 16.

31. Position read/write chassis on deck and secure.

32. Replace cable connectors on read/write chassis cards.

NOTE

Inspect heads before installing them and clean if necessary (refer to head inspection and cleaning procedure).

33. Replace head-arm assemblies (starting at bottom) as follows:

CAUTION

Ensure that head cable and plug do not contact head pad on adjacent heads or those heads may be damaged.

a. Install head-arm, plug and cable carefully between existing heads until head-arm is in proper position.

b. Install head-arm clamp screw and torque to 0.45 N·m (4 lbf·in).

c. When installing read/write head-arm, connect head cable plug to _XGN card in read/write chassis location E05. When installing servo head, connect servo cable jumper plug to connector card on actuator housing.

d. Install each remaining head by repeating steps a through c.

34. Replace voice coil leadwires.

35. Secure heads loaded switch and voice coil leadwires to side of actuator housing with cable ties.

36. Replace servo preamp assembly as follows:

a. Position servo preamp housing on deck and secure.

b. Connect servo head plug and plug A3P8 to servo preamp board.

c. Secure cover to servo preamp housing.

37. Position rear deck plate on deck and secure (refer to figure 6-3).

38. Position rear deck seal on frame and secure (refer to figure 6-3).

39. Replace shroud and shroud cover.

40. Reinstall pack access cover switch (Non-VDE:A3S1, VDE:A3S9) and pack access cover solenoid (Non-VDE:A3L1, VDE:A3L2) if present. Reinstall connector A3S9 on VDE units.

41. Replace pack access cover.

NOTE

If it was necessary to move drive from the inline position to remove top cover, reinstall drive inline after replacing top cover.

42. Replace cabinet top cover.

CAUTION

Before installing a disk pack, allow blower to operate for at least two minutes. This is necessary to purge shroud area of foreign particles that may have accumulated during actuator replacement.

43. Perform following procedures:

    a. Head Alignment

    b. Servo System Adjustment

BLOWER MOTOR REPLACEMENT

The blower motor is located within the blower assembly as shown in figure 6-6. Replacing the motor requires removing the entire blower assembly from the drive. The following describes removal and replacement of the blower motor.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

3. Open cabinet front door.

4. Remove blower assembly (containing blower motor) from drive as follows:

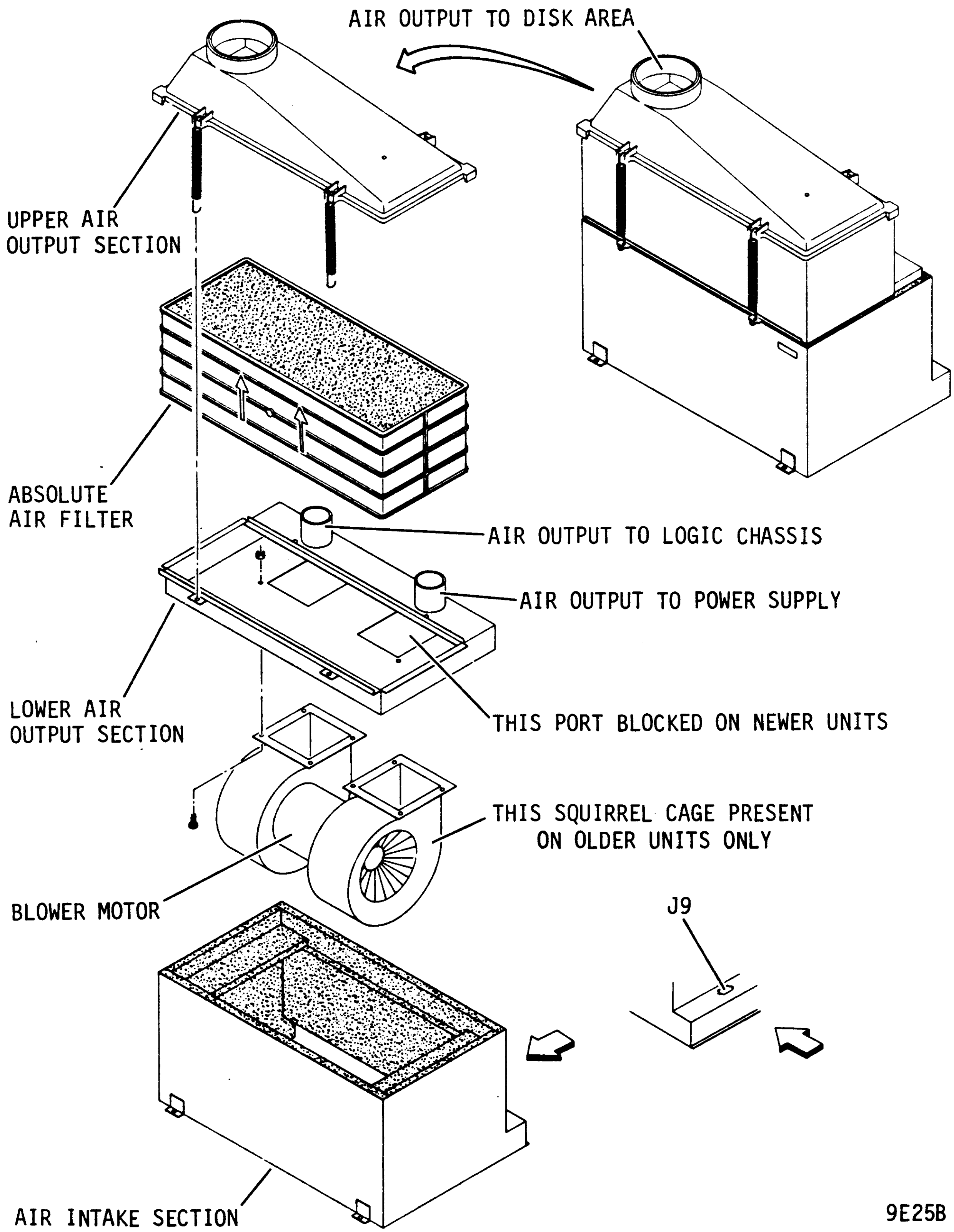


Figure 6-6. Blower Motor Replacement

a. Remove two screws securing safety shield to frame. Refer to figures 6-1 and 6-2.

b. Loosen clamp on large hose located on top of blower enclosure, then slide clamp up on hose and remove hose from blower enclosure.

c. Remove hardware securing bottom front of blower enclosure to frame.

CAUTION

Do not stretch plastic hoses when sliding blower out of frame. Over stretching will tear hoses.

d. Slide blower enclosure out of front of drive and set on floor.

CAUTION

Use care not to exert too much upward force or hoses will tear.

e. Remove smaller hoses from blower enclosure by turning in a clockwise direction until they come free.

f. Disconnect blower motor cable plug P9 from its connector on blower enclosure.

5. Snap J9 out of its position on air intake section of blower enclosure and allow it to hang from its leadwire.

6. Disconnect groundstrap (on older units with metal housing) from terminal on air intake section of blower enclosure.

WARNING

Springs are under tension. Wear safety glasses.

7. Detach springs (or posts in older units) securing upper air output section and absolute air filter and set aside.

8. Lift lower air output section, containing blower motor, off the air intake section.

9. Remove hardware securing blower motor to lower air output section and remove motor.

NOTE

Before beginning reassembly, wipe off disassembled parts with a clean cloth.

NOTE

Before replacing new blower motor, ensure that speed nut is attached to blower motor assembly.

10. Position replacement blower motor on lower air output section and secure.

11. Set lower air output section (with motor mounted) on air intake section.

12. Snap J9 into its position on air intake section of blower enclosure and reconnect groundstrap (on older units with metal blower housing)

13. Observing arrows indicating air flow, set absolute air filter on lower air output section.

WARNING

Springs are under tension. Wear safety glasses.

14. Secure upper air output section with four springs (or four posts in older units); insert rear springs in blower assembly first.

CAUTION

Following replacement of blower assembly, perform Shroud Cleaning procedure (section 3), and then allow the blower to purge the system for at least two minutes before installing a disk pack.

15. Replace blower enclosure in drive as follows:

    a. Connect blower motor cable plug P9 to J9 on rear of air intake section.

    b. Connect small air hoses to rear of lower air output section by screwing them counterclockwise into holes (refer to figure 6-6 for proper orientation).

CAUTION

Ensure that air hoses or blower motor cable are not pinched.

c. Slide blower into drive until flange on rear lower edge of blower enclosure slips into channel on cabinet frame.

d. Secure front of blower enclosure to cabinet.

e Position safety shield on frame and secure with two screws. Refer to figures 6-1 and 6-2.

f. Slip large air hose over output hole on top of blower enclosure and secure with clamp.

16. Close cabinet front door.

DRIVE BELT REPLACEMENT

The drive belt (refer to figures 6-7 and 6-8) transfers drive motor power to the spindle. It is removed by first removing the idler springs, which keep tension on the belt, then slipping it off the pulleys. When the belt is replaced the drive belt tension should be checked and adjusted if necessary. This adjustment is covered in the Drive Belt Adjustment procedure. The following describes removal and replacement of the drive belt.

CAUTION

A drive belt should only be removed by first removing the idler springs as directed in the replacement procedure. Never remove a drive belt by rolling the belt off the pulleys or damage to the drive motor shaft or belt will result.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

3. Open cabinet rear door and swing logic chassis open.

4. Remove static groundspring leadwire from static ground spring.

5. Disconnect speed sensor cable plug A3P3.

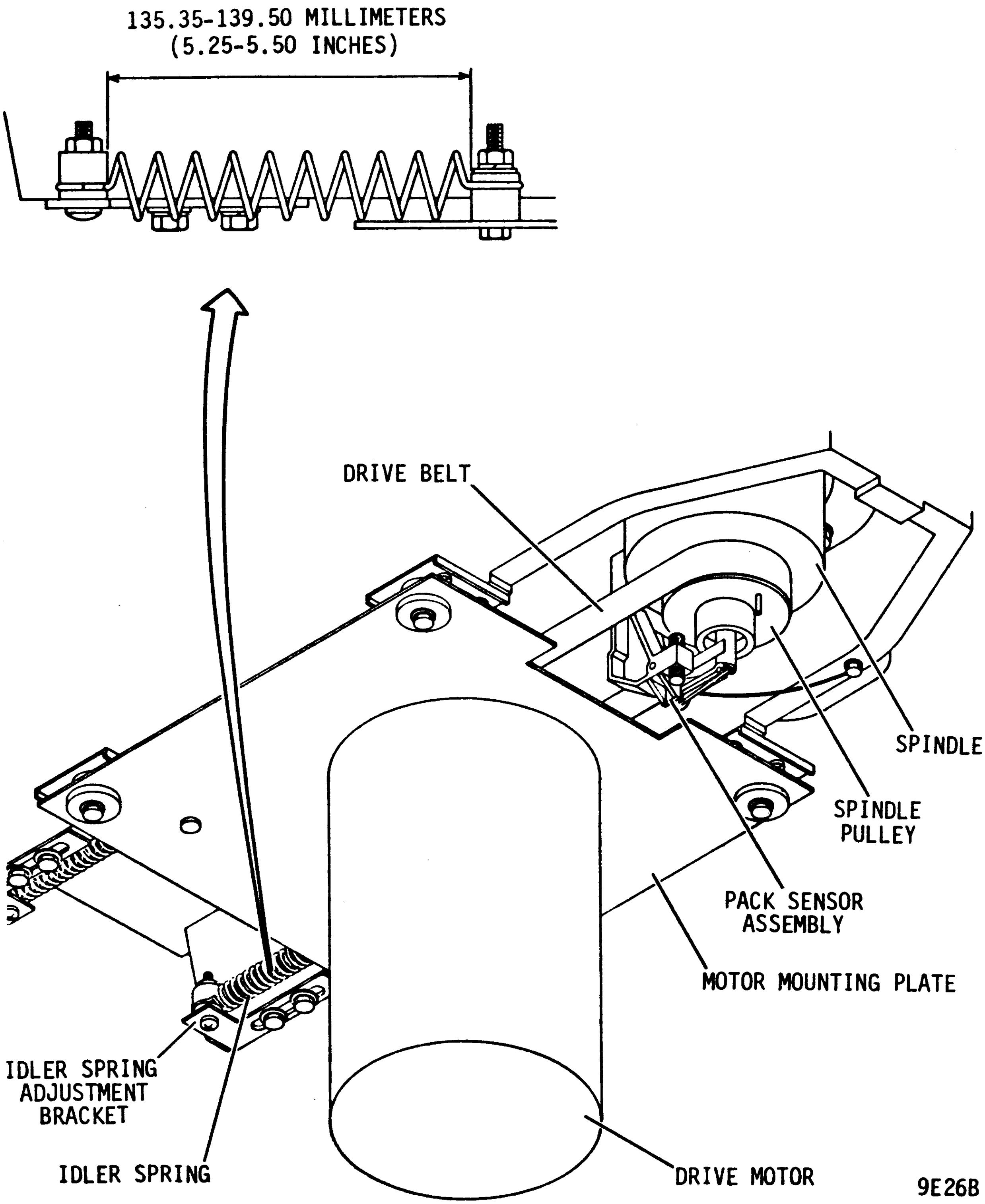


Figure 6-7. Drive Belt Replacement/Adjustment (NON-VDE)

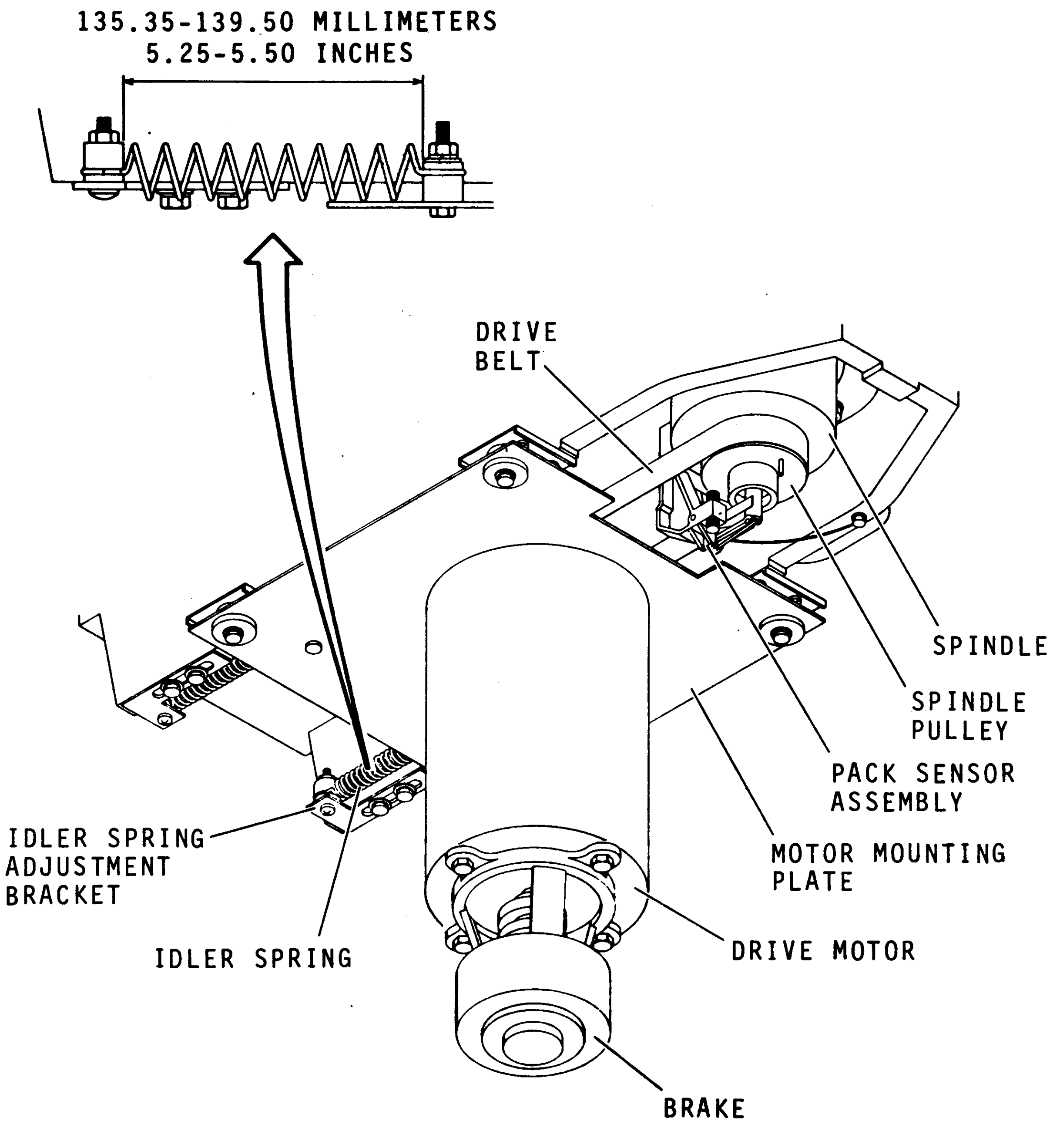


Figure 6-8. Drive Belt Replacement/Adjustment (VDE)

6. Note leadwire connections and disconnect leadwires from pack on switch.

CAUTION

Use care not to damage the pack sensor assembly when removing drive belt.

7. Remove drive belt as follows (refer to figures 6-7 and 6-8).

WARNING

To prevent possible eye injury, safety glasses must be worn when removing or replacing idler springs.

   a. Attach spring puller (refer to list of maintenance tools in section 2) to spring. Check to ensure that spring is inserted into spring puller groove and end of spring is seated in the round hole at the outer end of the tool (see figure 6-9).

   b. Exert a force on the spring sufficient to remove it from the spring bracket standoff.

   c. Slowly release the tension on the spring and remove it from the motor mounting plate standoff.

   d. Twist the spring puller to remove it from the spring.

   e. Remove the other spring using the same procedure.

   f. Move motor mounting plate toward spindle to relieve tension on drive belt then slip belt off pulleys and set aside.

8. Install replacement belt as follows:

   a. Move drive motor and mounting plate back and forth several times to ensure the mounting plate is free to move.

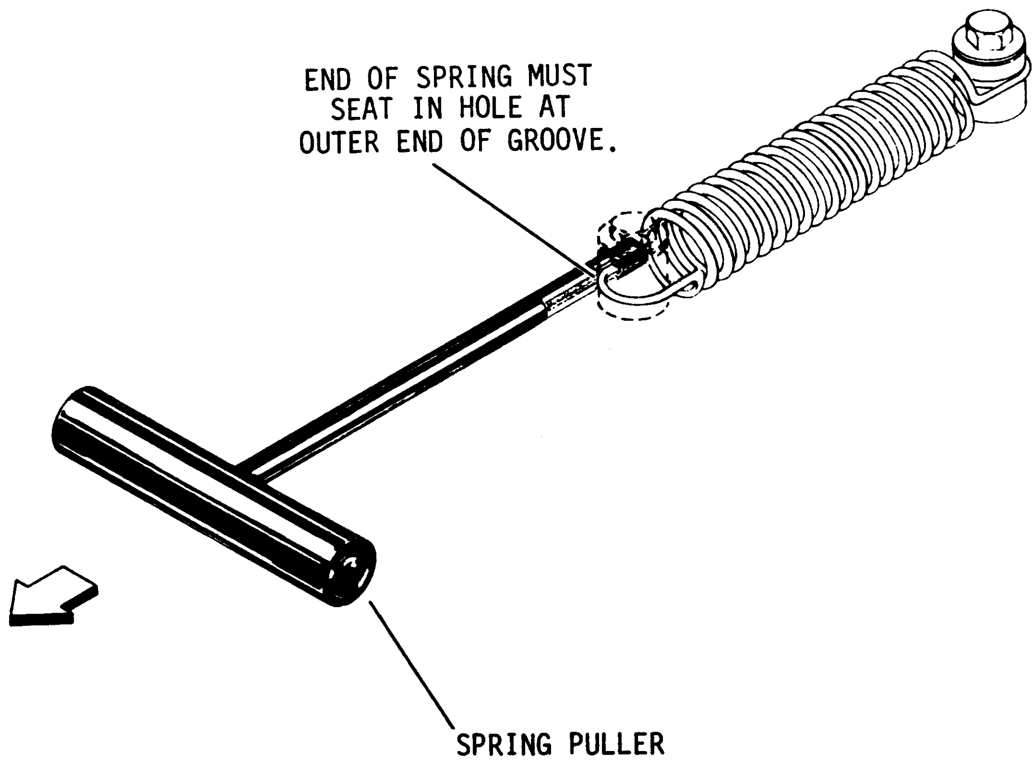


Figure 6-9. Spring Puller Usage

WARNING

To prevent possible eye injury, safety glasses must be worn when removing or replacing idler springs.

b. Fit one end of spring over the motor mounting plate standoff.

c. Attach spring puller (refer to list of maintenance tools in section 2) to spring. Check to ensure that spring is inserted into the spring puller groove and the end of the spring is seated in the round hole at the outer end of the tool (see figure 6-9).

d. Install the belt (smooth side against pulleys) on both pulleys and exert a sufficient force on the motor mounting plate to maintain the belt in this position.

e. Exert a force on the spring sufficient to allow the end of the spring to be placed over the spring bracket standoff. Check to ensure that the curved ends of the spring are seated in the groove of each standoff.

f. Remove the spring puller from the spring by twisting and pushing at the same time.

g. Install the other spring using the same procedure.

h. Manually rotate spindle to align drive belt on pulleys.

9. Connect speed sensor plug A3P3 and static groundspring leadwire.

10. Connect pack on switch leadwires to switch terminals.

11. Close cabinet front door.

12. Perform Drive Belt Adjustment procedure starting with step 4.

DRIVE BELT ADJUSTMENT

The drive belt adjustment consists of changing the belt tension which is maintained by the two idler springs. These springs are mounted between posts mounted on adjustable brackets on the deck casting and fixed posts mounted on the motor mounting plate (refer to figures 6-7 and 6-8). The drive motor mounting plate is moved by the springs to exert tension on the belt. The springs are adjusted by removing them from the brackets, repositioning the adjustable brackets and then replacing the springs.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

3. Open rear door of cabinet and swing logic chassis open.

4. Inspect drive belt for cracks or worn spots. If required, replace belt by performing Drive Belt Replacement procedure starting with step 4.

5. Check drive belt adjustment by measuring distance between idler spring posts (refer to figures 6-7 and 6-8).

   This distance should be from 133 to 140 mm (5.25 to 5.5 in). If distance is not within these limits, adjustment is required, so go to step 6. If distance is within these limits, no adjustment is required; go to step 7.

6. Adjust idler spring tension (and therefore drive belt tension) as follows:

   WARNING

   To prevent possible eye injury, safety glasses must be worn when removing or replacing idler springs.

   a. Attach spring puller (refer to list of maintenance tools in section 2) to spring. Check to ensure that spring is inserted into the spring puller groove and the end of the spring is seated in the round hole at the outer end of the tool (see figure 6-9).

   b. Exert a force on the spring sufficient to remove it from the spring bracket standoff.

   c. Slowly release the tension on the spring and remove it from the motor mounting standoff.

   d. Twist the spring puller to remove it from the spring.

   e. Remove the other spring using the same procedure.

   f. Loosen screws securing adjustment bracket and reposition bracket to bring distance checked in step 5 within specified limits.

g. Tighten screws securing adjustment bracket.

h. Fit one end of spring over the motor mounting plate standoff.

i. Attach spring puller (refer to list of maintenance tools in section 2) to spring. Check to ensure that spring is inserted into the spring puller groove and the end of the spring is seated in the round hole at the outer end of the tool (see figure 6-9).

j Install the belt (smooth side against pulleys) on both pulleys and exert a sufficient force on the motor mounting plate to maintain the belt in this position.

k Exert a force on the spring sufficient to allow the end of the spring to be placed over the spring bracket standoff. Check to ensure that the curved ends of the spring are seated in the groove of each standoff.

l. Remove the spring puller from the spring by twisting and pushing at the same time.

m. Install the other spring using the same procedure.

NOTE

Tension between idler springs is interacting; therefore, when adjusting one spring always recheck both springs.

n. Recheck spring distance requirements by repeating procedure starting with step 5.

7. Close logic chassis and rear door of cabinet.

DRIVE MOTOR REPLACEMENT

The replacement motor assembly includes the motor, pulley, and cable with attached plug. Replacing the drive motor assembly involves removing the motor mounting plate with motor attached. The old motor is then removed from the mounting plate and the replacement motor mounted in its place. This assembly is then replaced in the drive cabinet.

If the drive motor includes an externally mounted brake assembly, it must be removed from the old motor and installed on the replacement motor.

CAUTION

When replacing the drive motor on 50 Hz NonVDE drives (except BK6A1D and BK7A1D), it may also be necessary to replace the start triac, run triac, and _YFN card. If these parts are defective and not replaced it can cause premature failure of the new motor.

1. Remove power from the drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Set MAIN AC circuit breaker to OFF.

   NOTE

   If drive is installed inline with other drives, take it out of line to remove side panels.

2. Remove cabinet side panels.

3. Open cabinet rear door (6 mm hex wrench needed) and swing logic chassis open.

CAUTION

Use care not to damage pack sensor assembly when removing drive belt.

4. Remove drive belt by performing steps 4 through 7 of Drive Belt Replacement procedure.

5. Remove drive motor and motor mounting plate as follows (refer to figures 6-10 and 6-11):

   a. Disconnect drive motor cable plug A1P7 from rear of power supply. If the motor includes an externally mounted brake, disconnect A1P8 on the power supply.

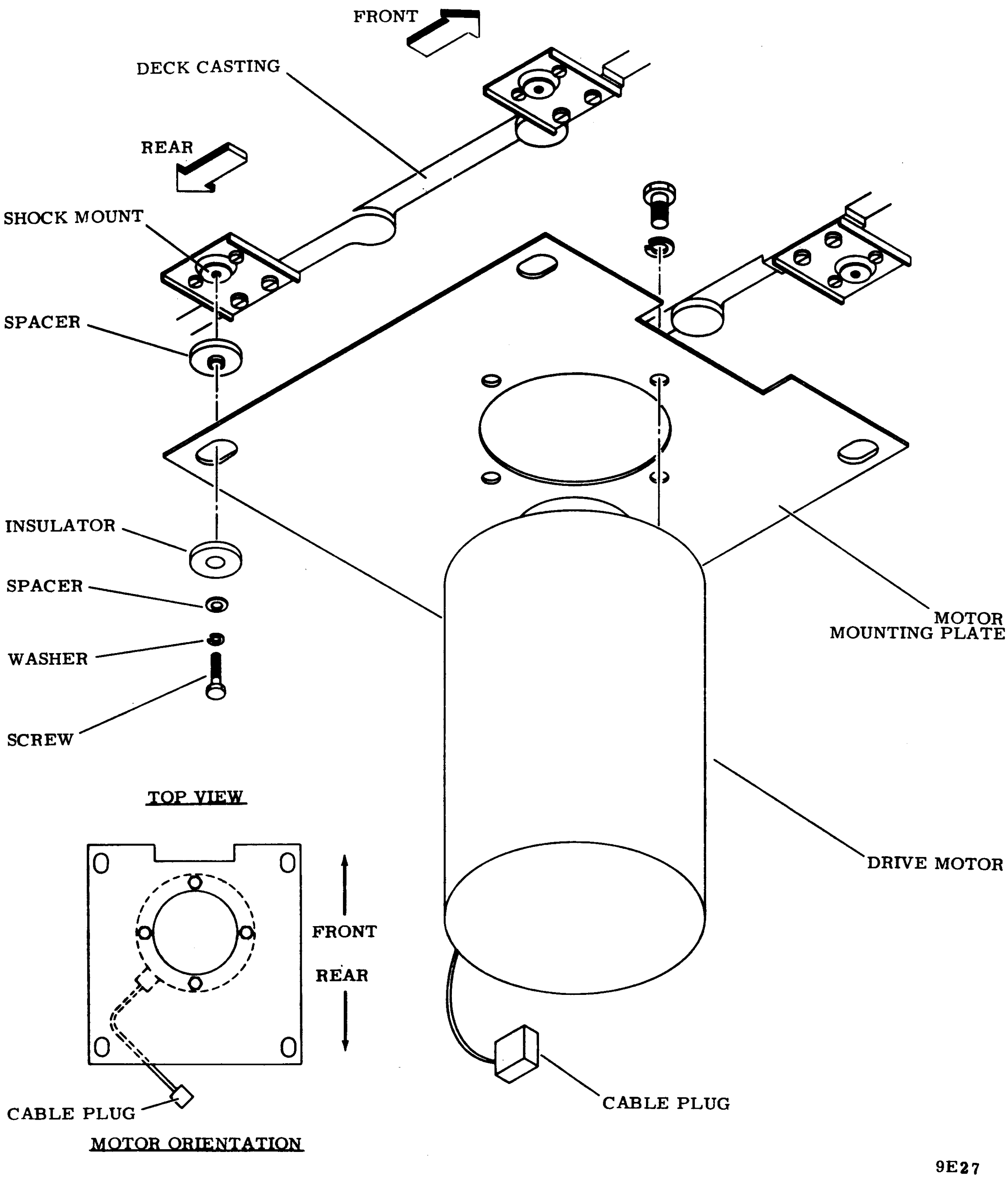


Figure 6-10. Drive Motor Replacement (NON-VDE)

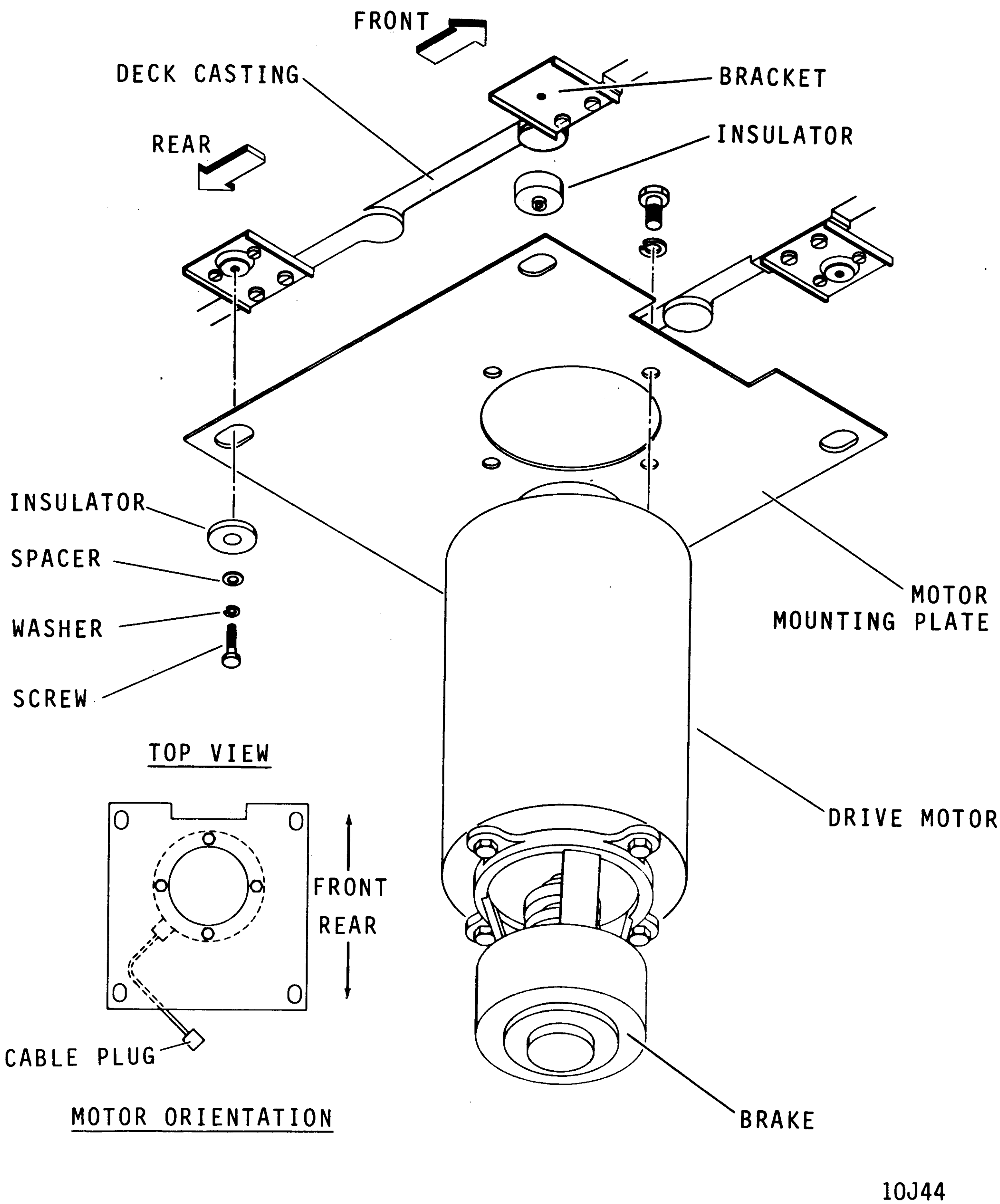


Figure 6-11. Drive Motor Replacement (VDE)

CAUTION

Drive motor is heavy and difficult to handle. Therefore, it is advisable to have some sort of support beneath drive motor when the securing hardware is removed to prevent it from being dropped to the floor of the drive cabinet.

NOTE

Use care when removing hardware securing motor mounting plate to deck to prevent hardware from falling into power supply.

b. Remove hardware securing motor mounting plate to deck casting and remove drive motor and motor mounting plate from drive cabinet.

6. Remove screws securing drive motor to motor mounting plate, remove drive motor and pulley from plate and set aside. Remove the externally mounted brake (VDE units only) using the brake replacement procedure, and install it on the replacement motor.

7. Replace drive motor and motor mounting plate as follows:

   a. Orient replacement drive motor and pulley as shown on figures 6-10 and 6-11 and secure it to mounting plate.

CAUTION

Drive motor and mounting plate require support from beneath (such as block of wood on floor of cabinet) to prevent them from being dropped during installation.

NOTE

Apply one drop of Loctite, Grade C, to threads of each screw installed in step b. Also, do not over tighten screws or motor mounting plate will not be free to move between spacers.

   b. Position motor mounting plate and drive motor as shown on figures 6-10 and 6-11 and secure with hardware removed in step 5.

   c. Check that motor mounting plate is free to move forward and backward between motor mount spacers. If not, loosen screws and retighten so that mounting plate is free to move.

8. Replace drive belt as follows:

   a. Move drive motor and mounting plate back and forth several times to ensure the mounting plate is free to move.

WARNING

To prevent possible eye injury, safety glasses must be worn when removing or replacing idler springs.

   b. Fit one end of spring over the motor mounting plate standoff.

   c. Attach spring puller (refer to list of maintenance tools in section 2) to spring. Check to ensure that spring is inserted into the spring puller groove and the end of the spring is seated in the round hole at the outer end of the tool (see figure 6-9).

   d. Install the belt (smooth side against pulleys) on both pulleys and exert a sufficient force on the motor mounting plate to maintain the belt in this position.

   e. Exert a force on the spring sufficient to allow the end of the spring to be placed over the spring bracket standoff. Check to ensure that the curved ends of the spring are seated in the groove of each standoff.

   f. Remove the spring puller from the spring by twisting and pushing at the same time.

   g. Install the other spring using the same procedure.

   h. Manually rotate spindle to align drive belt on pulleys.

   i. Connect speed sensor plug A3P3 and static ground spring leadwire.

   j. Connect pack on switch leadwires to switch terminals.

9. Connect drive motor cable plug A1P7 to J7 (and A1P8 to J8 on units equipped with external brake) on rear of power supply.

10. Close logic chassis then close cabinet rear door.

NOTE

If drive was moved from inline position prior to removing side panels, reinstall drive in line after replacing side panels.

11. Replace side panels.

BRAKE REPLACEMENT (VDE ONLY)

The brake assembly, on units so equipped, is mounted on a bracket attached to the bottom of the drive motor. The brake applies its braking force to the motor through a flexible coupling connecting the motor and brake shafts.

When replacing a drive motor the brake assembly must be transferred to the replacement motor. Use the following procedure to transfer the assembly, or to replace the brake.

1. Remove the drive motor using the Drive Motor Replacement procedure. It is not necessary to remove the motor from the mounting plate if the motor is not being replaced.

2. Remove the hardware securing the brake mounting bracket to the bottom of the motor. See figure 6-11.

3. Separate the brake and bracket assembly from the motor.

NOTE

If the brake is being transferred to a replacement motor, go to step 4. If the brake is being replaced, go to step 9.

4. Loosen the setscrews in the flexible coupling on the motor shaft and slip the coupling off the motor shaft.

5. Install the coupling on the replacement motor, lightly tighten the setscrews.

6. Assemble the brake and bracket to the motor using the hardware removed in step 2. Ensure the flexible coupling components engage properly.

7. Slide the flexible coupling on the motor shaft downward. Ensure all coupling components engage properly and tighten all setscrews.

8. Skip steps 9-16 and install the drive motor using the Drive Motor Replacement procedure, beginning with step 8.

9. Loosen the setscrew that secures the flexible coupling to the brake shaft.

10. Slip the coupling off the brake shaft.

11. Remove the screws that secure the brake to the mounting bracket.

12. Assemble the replacement brake to the mounting bracket using the hardware removed in step 11.

13. Slip the flexible coupling onto the brake shaft. Leave the setscrews in the coupling loose.

14. Position the brake and bracket assembly on the motor and secure it with the hardware removed in step 2.

15. Raise the flexible coupling on the brake shaft so it engages the coupling components. Tighten all setscrews securely.

16. Install the drive motor using the Drive Motor Replacement procedure beginning with step 8.

HEAD-ARM ASSEMBLY REPAIR

GENERAL

The following describes head inspection, head cleaning and gives criteria for determining if a head-arm assembly should be replaced. A procedure for replacing one or more of the headarm assemblies is also included.

HEAD ARM ASSEMBLIES

CAUTION

> If any of the following conditions exist, do not attempt to operate the media on another drive until full assurance is made that no damage or contamination has occurred to the media.
>
> Do not attempt to operate the drive with another media until full assurance is made that no damage or contamination has occurred to the drive heads or to the shroud area.

The drive has a positive pressure filtration system that eliminates the need for periodic inspection and cleaning of heads. The heads should be inspected for the following reasons only:

1. A problem is tracked to a specific head or heads; for example, excessive data errors.

2. Head to disk contact is suspected. This may be indicated by an audible ping, scratching noise, or a burning odor when the heads are over the disk area.

3. Concentric scratches are observed on the disk surface.

4. Contamination of pack is suspected (possibly due to improper storage of the pack).

5. The pack has been physically damaged (possibly due to dropping or bumping).

Head Inspection

CAUTION

> Do not smoke when inspecting or cleaning heads. Use extreme care not to damage the head.
>
> Do not touch the head pad or gimbal spring with fingers or tools.
>
> If head must be laid down, do not allow the head pad or gimbal spring to touch anything.

Remove suspected head as described in the read/write or servo head arm replacement procedure. Refer to figure 6-12, observe the head arm assembly, and perform the suggested remedy as follows:

1. If reddish-brown oxide deposits exist on the head, replace or clean the head arm assembly.

2. If head appears scratched, replace or clean the head arm assembly.

3. If head appears damaged, replace the head arm assembly.

4. If the gimbal spring (it holds the head pad to the arm) is bent or damaged, replace the head arm assembly.

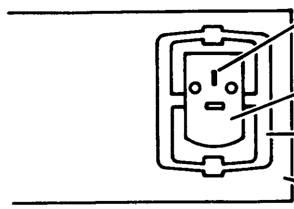


Figure 6-12. Typical Head Arm Components

Head Cleaning

CAUTION

> Head cleaning is a delicate procedure that is not recommended. It should not be undertaken unless it is absolutely necessary, and then it should be performed only by properly trained personnel.

Refer to figure 6-13 if head cleaning is required and perform the following procedure. Use care not to damage any part of the head arm assembly.

CAUTION

> In the following step, hold the can of dust remover upright (vertical). If the can is not held upright, liquid propellant will be sprayed on the head.

1. Use super dry dust remover (see list of Maintenance Tools and Materials) to blow off all loose particles from the head pad (flying surface), from the edge of the head pad, and from the holes in the head pad. Hold the nozzle 6 to 13 mm (0.25 to 0.5 in) from the head pad. Spray with a back and forth motion across the head pad, making certain to hold the can only in a vertical position.

2. Use a clean, flat working surface, for example, a glass or formica table top.

3. Place a new, unpunched, clean computer card with the back side up (printing down) on the clean flat working surface as shown in figure 6-13.

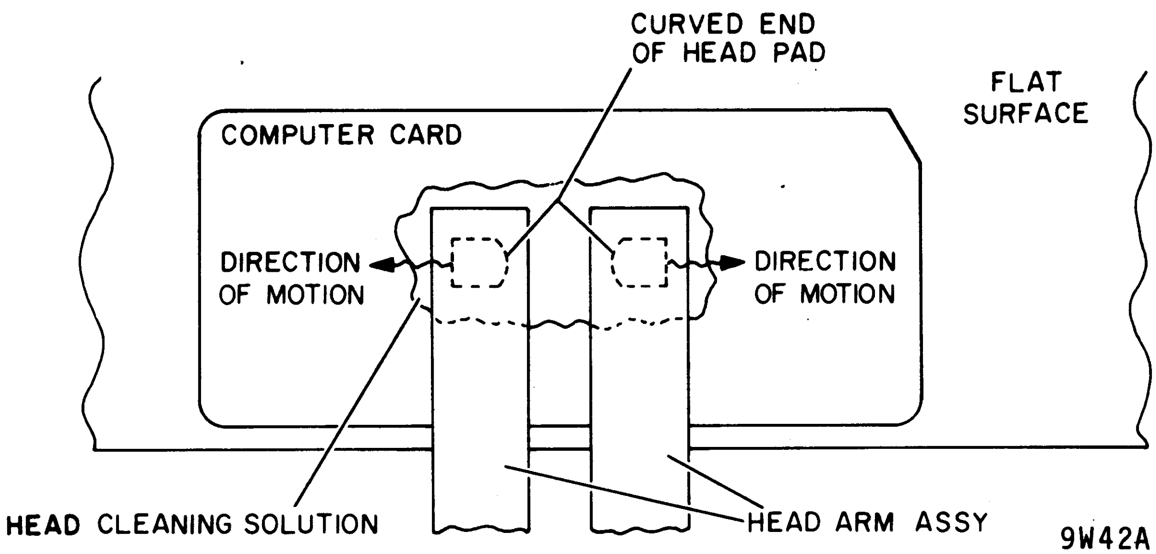


Figure 6-13. Head Cleaning Motion

CAUTION

Take care to avoid using excess cleaning solution. Excess solution on the head cable may remove the plasticizer and make the cable stiff. A stiff cable reduces the flexibility of the head pad and could cause broken wires.

4. Moisten a small area in the center of the card with head cleaning solution. (Refer to the list of Maintenance Tools and Materials).

CAUTION

Inspect the head cleaning solution for contamination, rust, dirt, etc. Do not use contaminated solution.

5. Very carefully place the head pad flying surface on moistened area and move head pad from moistened area to dry area in a zig-zag motion as shown in figure 6-13. Move head in a direction away from curved end of head pad. If it is moved in the opposite direction, the sharp edge of the curved end will cut into the computer card and prevent movement and proper cleaning.

6. Blow off the head again using the Super Dry Dust Remover as in step 1.

NOTE

> Discoloration of head cleaning solution and computer card indicate that oxide particles are being removed from head pad flying surface.

7. Repeat steps 3, 4, 5 and 6 using a clean computer card and clean head cleaning solution each time until no discoloration on card is present.

8. After discoloration has ceased, inspect head to determine that oxide deposits were removed. If deposits remain but show signs of being removed, repeat cleaning procedure until deposits are removed.

9. If oxide deposits cannot be removed, replace head arm assembly.

10. If oxide deposits were removed and head passes inspection according to the Head Arm Replacement Criteria, reinstall head.

11. Follow read/write or servo head arm replacement procedure to install cleaned head or a replacement head as required.

Head Arm Replacement Criteria

A head arm assembly requires replacement if any of the following conditions exist:

1. Consistent oxide buildup on the same head, indicating repeated head to disk contact.

2. Appreciable oxide buildup which cannot be removed.

3. Scratches on the head flying surface.

4. Imbedded particles in the head pad flying surface.

5. Bent or damaged gimbal spring.

6. Any apparent physical damage to head arm assembly.

HEAD ARM ASSEMBLY REPLACEMENT

The following describes replacement of read/write and/or the servo head-arm assemblies. Head alignment must be performed on any head-arm assembly replaced. Replacing the servo head-arm assembly requires alignment of all heads. Head alignment is covered in a separate procedure.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to off.

3. Open cabinet top cover and remove deck cover.

4. Open pack access cover as far as possible.

NOTE

Perform step 5 if any of the following apply:

- If removing all heads.
- If removing any of the heads in surface positions 15 through 19.
- If removing the servo head. In this case perform only a and b under step 5.

If none of these apply, proceed to step 6.

5. Move servo preamp housing as follows:

   a. Remove hardware securing cover to housing and remove cover.

   b. Disconnect servo head cable plug from servo preamp board.

   c. Remove hardware securing preamp housing to deck, then move preamp housing as required to provide access to head clamp screws for head surface positions 15 through 19.

6. Determine surface location of head (or heads) to be replaced by referring to head identification label on actuator housing or to figure 6-14.

7. Lock carriage in place by inserting carriage locking pin into shipping hole.

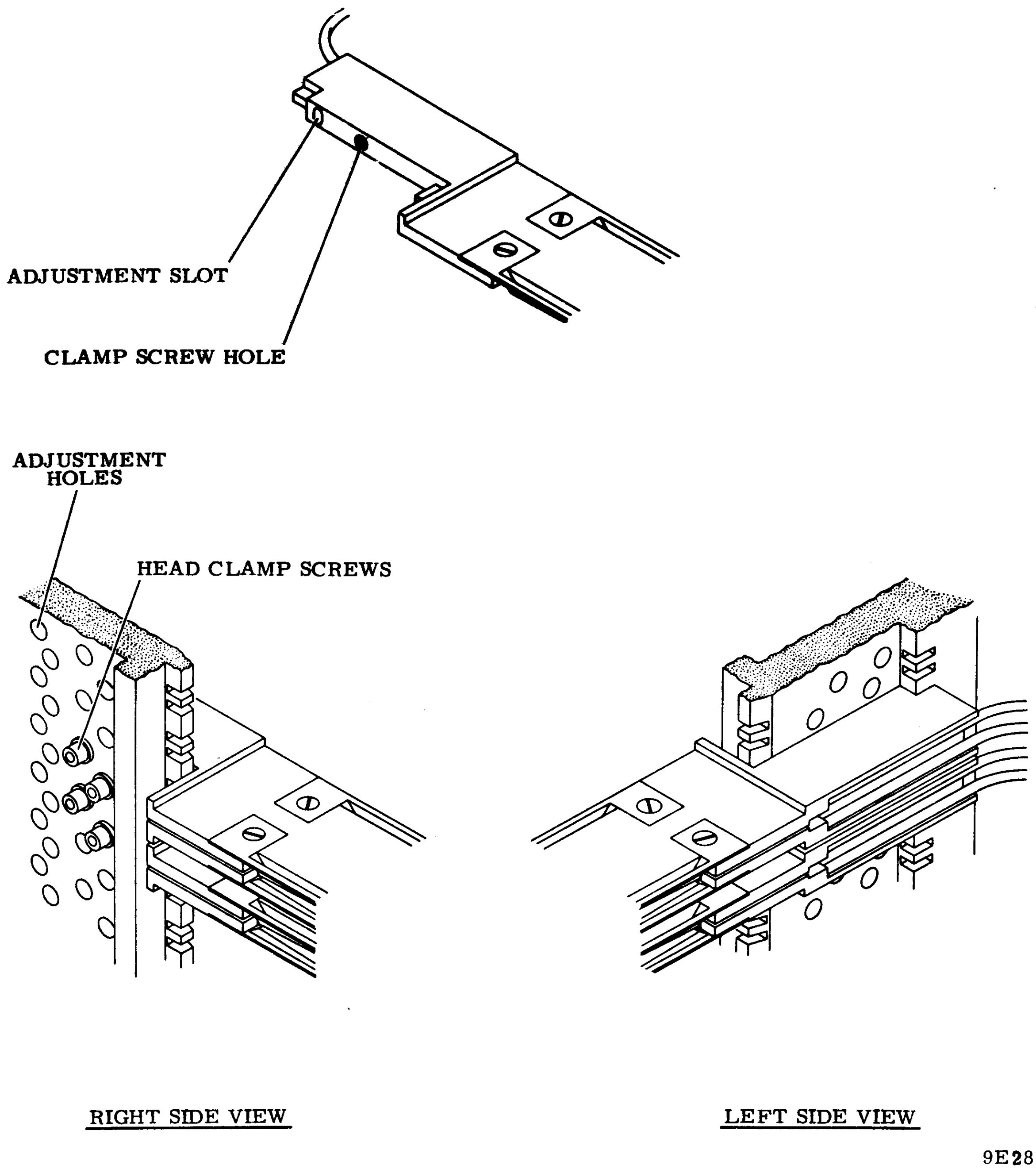


Figure 6-14. Head-Arm Assembly Replacement

8. Remove heads as follows:

NOTE

If more than one head is to be removed, disconnect head cables one at a time as the heads are removed.

a. If removing read/write head, disconnect head cable plug of head to be removed from _XGN card in read/write chassis location E05. If removing servo head, disconnect servo cable jumper plug from connector card on actuator housing.

CAUTION

When head-arm clamping screw is removed, use care not to dislodge head from its position in carriage. This may allow head to contact an adjacent head thus causing damage to itself or that head. Also, if more than one head is to be removed, remove clamping screws one at a time as heads are removed.

b. Remove clamping screw securing head-arm to be removed.

c. Slide head-arm assembly forward from its position in carriage until it can be grasped from front, then carefully remove head arm, cable and plug from carriage assembly.

d. Repeat steps a through c for all heads to be removed.

NOTE

Inspect heads before installing them and clean if necessary (refer to Head Inspection and Cleaning procedure).

9. Install heads as follows:

CAUTION

Ensure that head plug and cable do not contact head pad on adjacent heads or these heads may be damaged.

a. Slide head-arm, plug and cable carefully between existing heads until head-arm is in proper position.

b. Install head-arm clamp screw and torque to 0.45 N·m (4 lbf·in).

c. If installing read/write head, connect head cable plug to _XGN card in read/write chassis location E05. If installing servo head, connect servo cable jumper plug to connector card on actuator housing.

d. Repeat steps a through c for all heads to be installed.

10. Remove carriage locking pin from shipping hole.

NOTE

Step 11 is applicable only if step 5 was performed.

11. Reinstall servo preamp housing as follows:

a. Place it in its proper position on deck and secure it.

b. Reconnect servo head cable plug to preamp board.

c. Replace servo preamp housing cover.

NOTE

Do not adjust servo head arm if it was not replaced because all read/write heads must be realigned whenever this adjustment is disturbed.

12. If servo head-arm was replaced, adjust it as follows, otherwise proceed to step 13.

a. Using head-arm adjustment tool, center servo head-arm adjustment slot in the head adjustment hole (refer to figure 6-14).

b. Torque head-arm clamp screw to 1.35 $\pm$0.1 N·m (12 $\pm$0.5 lbf·in).

13. Check alignment of all heads and adjust as necessary (refer to Head Alignment procedure).

CAM TOWER REPLACEMENT

This procedure describes removal and replacement of the cam towers, baffles, and baffle seals. The top cover, pack access cover, shroud, and shroud cover must be removed to gain access to the cam towers. The cam towers snap onto dowel pins on the actuator housing and require no adjustment after installation.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

NOTE

If drive is installed inline with other drives, it may be necessary to move the drive out of line to remove the top cover.

3. Remove cabinet top cover.

4. Remove pack access cover.

5. Remove shroud and shroud cover.

6. Manually load heads.

7. Remove two screws securing each cam tower, baffle, and baffle seal to actuator housing. (Refer to figure 6-15).

CAUTION

Before replacing cam towers ensure that mating surfaces of actuator housing and cam towers are clean.

8. Remove baffle and baffle seal by pulling straight off from the cam tower.

9. Remove cam towers from dowel pins on actuator housing.

CAUTION

Before replacing cam towers ensure that mating surfaces of actuator housing and cam towers are clean. Also clean residual foam particles from actuator housing located along sides of cam towers before installing replacement baffles and baffle seals.

10. Install replacement cam towers as follows (refer to figure 6-15):

    a. Snap the cam towers onto the three dowel pins located on the actuator housing so they are flush against housing.

    b. Ensure baffle is free of foam particles or other contaminants, then attach the baffle seals to the baffles by removing the adhesive strip.

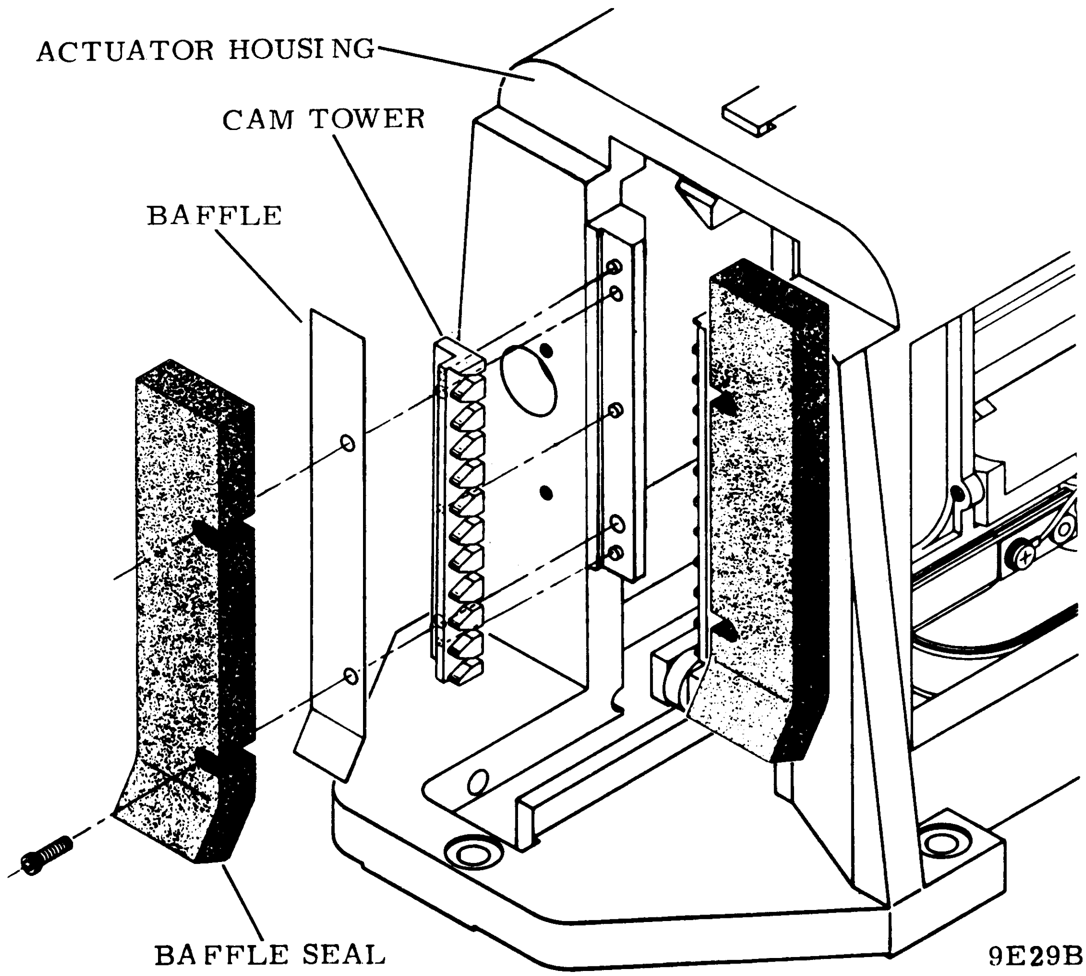


Figure 6-15. Cam Towers

c. Align the baffles to fit flush against the shoulder of the cam tower. Slots cut in the baffle seals must be aligned over the holes in the baffles (curved end toward base of actuator housing).

d. Install screws and torque to 0.45 N·m (4 lbf·in).

11. Manually unload heads.

12. Replace shroud and shroud cover.

CAUTION

Ensure that the baffle seals are not damaged and that no interference exists between the baffle seals and the head arms.

13. Replace pack access cover.

NOTE

If it was necessary to move drive from inline position to remove top cover, reinstall drive inline after replacing top cover.

14. Replace cabinet top cover.

15. Replace disk pack.

HEADS LOADED SWITCH REPLACEMENT

This switch is mounted on the actuator housing (refer to figure 6-12) and indicates to the drive logic whether or not the heads are loaded. The following describes the removal and replacement of this switch. This switch also requires adjustment, which is explained in the Heads Loaded Switch Adjustment procedure.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

3. Open cabinet top cover and remove deck cover.

4. Move carriage back to retracted stop.

5. Remove heads loaded switch from actuator housing as follows (refer to figure 6-16):

   a. Cut cable tie securing heads loaded switch leadwires to actuator housing.

   b. Remove hardware securing heads loaded switch mounting block to actuator housing, then remove mounting block and switch from actuator housing.

   c. Note leadwire connections and remove leadwires from switch.

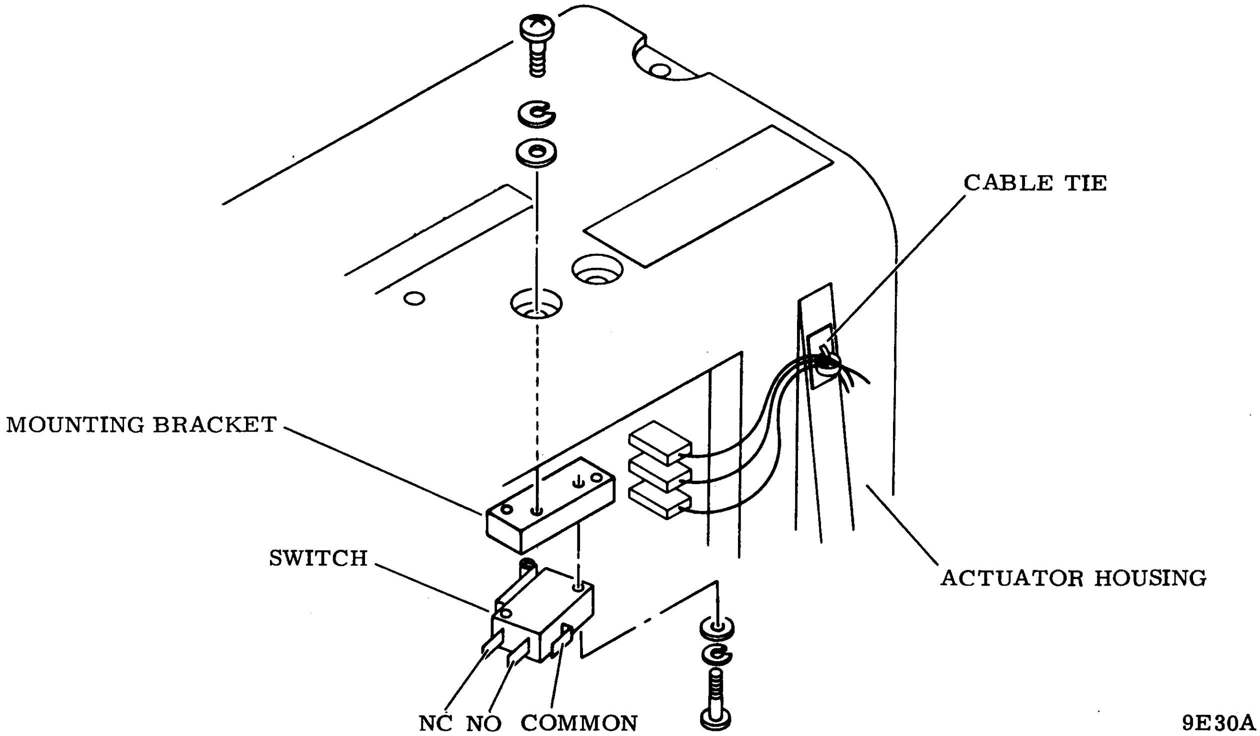


Figure 6-16. Heads Loaded Switch Replacement

d. Remove hardware securing switch to block and remove switch.

6. Install replacement switch on mounting block.

7. Install replacement switch and mounting block on actuator housing leaving screws loose enough to perform adjustments in step 9.

8. Secure leadwires to side of actuator housing with cable tie.

9. Perform Heads Loaded Switch Adjustment procedure starting with step 6.

HEADS LOADED SWITCH ADJUSTMENT

The following describes adjusting the heads loaded switch so it actuates when the carriage is forward far enough so that the heads are loaded.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

3. Open cabinet top cover and remove deck cover.

4. Move carriage back to retracted stop.

5. Note heads loaded switch leadwire connection and disconnect leadwires.

6. Connect an ohmmeter (set to Rx1 scale) across common and normally closed (NC) terminals of the switch (refer to figure 6-16).

7. Check heads loaded switch operation as follows:

   a. With carriage at retracted stop, meter should read zero. If it does not, proceed to step 8. If it does, proceed to b.

   b. Move carriage forward until switch transfers (meter indicates infinity) and measure distance traveled. If distance is between 2.5 and 5.0 mm (0.1 to 0.2 in), proceed to step 17. If distance is not between these limits, proceed to step 8.

8. Loosen hardware securing switch mounting block to actuator housing then move block and switch as far back as possible toward magnet. Meter should now indicate infinity.

9. Disconnect one of meter leads at meter.

NOTE

> In next step, a suitable shim is constructed by taping a number of feeler gauges together until their combined thickness is from 2.5 to 4.5 mm (0.1 to 0.18 in). Check their thickness with a steel rule.

10. Insert 3.8 mm (0.15 ±0.05 in) shim between stop on magnet and shock stop on carriage assembly (refer to figure 6-17).

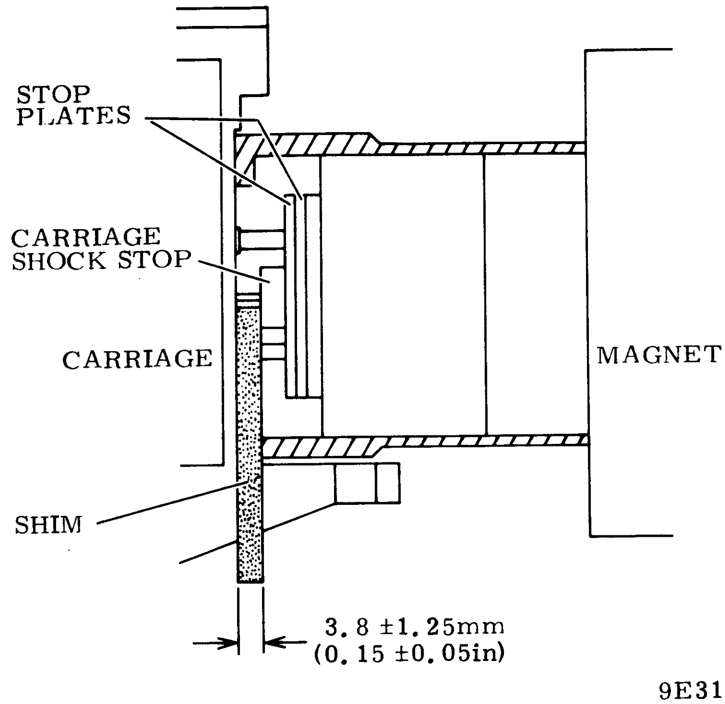


Figure 6-17. Heads Loaded Switch Adjustment

11. Reconnect meter lead and note that meter still indicates infinity when carriage is moved back against shim.

12. Hold carriage against shim then move heads loaded switch towards spindle until switch transfer occurs (meter indicates zero). Tighten screws securing switch and mounting block to actuator housing taking care not to disturb their position.

13. Remove shim and move carriage back to retracted stop.

14. Move carriage forward and check with shim or steel rule to ensure switch transfer occurs between 2.5 and 5.0 mm (0.1 and 0.2 in) of retracted stop.

15. If requirements of step 14 are not met, repeat steps 7 through 14 until the adjustment is correct and then proceed to step 16.

16. Disconnect meter from switch terminals and reconnect heads loaded switch leadwires.

17. Replace deck cover and close top cover.

LOGIC CHASSIS BACKPANEL REPAIR

GENERAL

Backpanel repair is limited to replacing damaged wires and bent or broken pins. Both procedures are described in the following paragraphs.

WIREWRAP PIN REPLACEMENT

This procedure describes removing a damaged pin from the backpanel and replacing it with a new one.

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

   NOTE

   Use care not to damage wires when removing them from pin. Also note level of wires so they are placed in the same position as they were removed.

2. Open cabinet rear door and remove cover from logic chassis card cage.

3. Remove all wires from pin (refer to wirewrap replacement procedure step 3.

4. Remove card associated with pin to be replaced.

5. Slide post removal tool over pin and apply pressure toward backpanel until bond breaks between pin and collar (refer to figure 6-18).

6. Grasp shank of pin (with long nose pliers or similar tool) and pull it out of backpanel. If collar comes out with pin, proceed to step 7. If collar remains secure in backpanel, proceed to step 8.

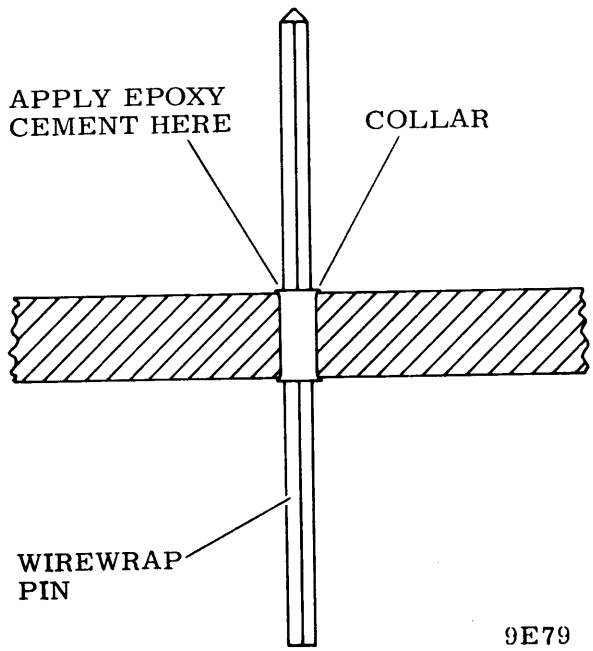


Figure 6-18. Wirewrap Pin Replacement

7. Coat collar of replacement pin (not hole) with epoxy and insert it into backpanel from wirewrap side. Proceed to step 9.

8. Insert replacement pin with collar removed from wirewrap side of backpanel. Push it into collar in backpanel hole until it is same length as adjacent pins.

CAUTION

Any cement left on shaft of pin will prevent an electrical connection.

9. Apply fast cure epoxy cement around pin on wirewrap side of backpanel to ensure tightness of pin (refer to figure 6-18).

10. Replace wires removed in step 3 (refer to wirewrap replacement procedure steps 5 through 9).

11. Replace cover on logic chassis card cage and close cabinet rear door.

WIREWRAP REPLACEMENT

This procedures describes removal and replacement of backpanel wirewrap connections.

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

2. Open cabinet rear door.

NOTE

> If pin has two wires and wire to be replaced is closest to backpanel, it is necessary to remove the top wire too. In this case, use care not to damage the top wire.

3. Unwrap each end of wire as follows. Using end of wirewrap tool with notch opposing direction of wrap, slide tool over pin and carefully turn tool to unwrap wire.

4. Cut replacement wire to proper length and strip approximately 30 mm (1.125 in) of insulation from each end of wire.

5. Insert one end of wire into wirewrap tool until insulation rests against stop.

6. Slide tool over backpanel, leaving a small gap between bottom of post or lower pin wrap level and new wire.

7. Hold wire securely (allow small amount of slack to assure one turn of insulation) and twist tool to wrap wire around pin. As tool is twisted, wire wrapping around pin forces tool up and off wire.

8. When wire is completely wrapped, remove tool and proceed to wrap other end of wire to its pin.

9. Ensure that each connection has one turn of insulation and six to seven turns of bare wire around pin.

10. Close cabinet rear door.

OPERATOR CONTROL PANEL REPLACEMENT

The operator control panel is replaced by snapping it out of the shroud cover, removing it from the connector and replacing it with a new control panel assembly.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack. Leaving cover open, set MAIN AC circuit breaker to OFF.

3. Open cabinet top cover.

4. Remove plastic plug from access hole in shroud cover (refer to figure 6-19).

5. Snap operator control panel out of its position in shroud cover (refer to figure 6-19).

NOTE

Use care not to bend pins in next step.

6. Remove control panel cable plug P201 from control assembly card and set assembly aside.

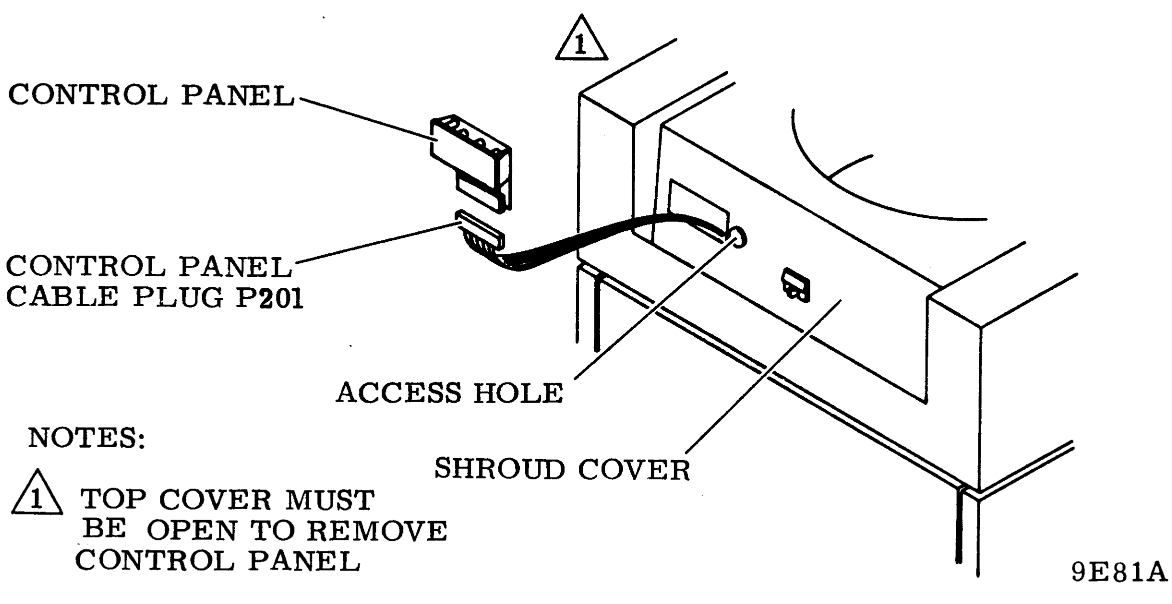


Figure 6-19. Operator Control Panel Replacement

7. Install control panel connector plug P201 on replacement operator control panel, then snap replacement control panel into its position in shroud cover.

8. Reinstall pack and close pack access cover.

PACK ACCESS COVER SOLENOID REPLACEMENT

The solenoid is mounted on the front of the shroud cover (refer to figure 6-20) and prevents the pack access cover from being opened while the spindle is turning. The following steps describe replacement, and adjustment is covered in the Pack Access Cover Solenoid Adjustment procedure.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack. Leaving cover open, set MAIN AC circuit breaker to OFF.

NOTE

> If drive is installed inline with other drives, it will be necessary to pull drive out of line to remove top cover.

3. Remove cabinet top cover.

4. Remove pack access cover.

5. Snap operator control panel out of its position in shroud cover and let it hang by control panel cable wires.

6. Remove hardware securing shroud cover to shroud and move shroud cover forward far enough to allow access to pack access cover solenoid assembly.

7. Remove hardware securing solenoid assembly and slip it out from beneath shroud cover.

8. Note solenoid leadwire connections, disconnect leadwires and set solenoid aside.

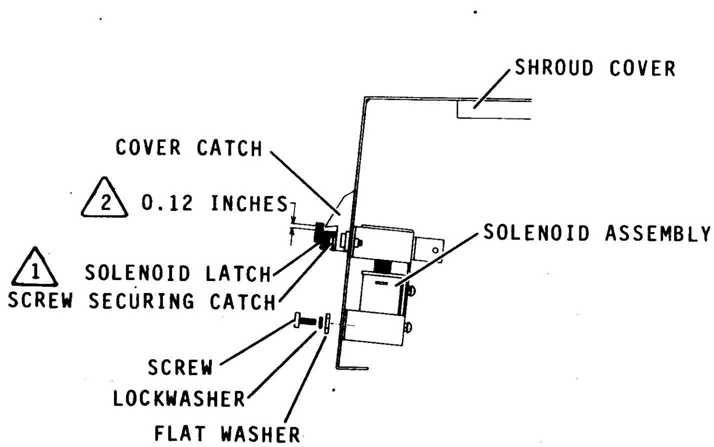
9. Install replacement solenoid to shroud cover.

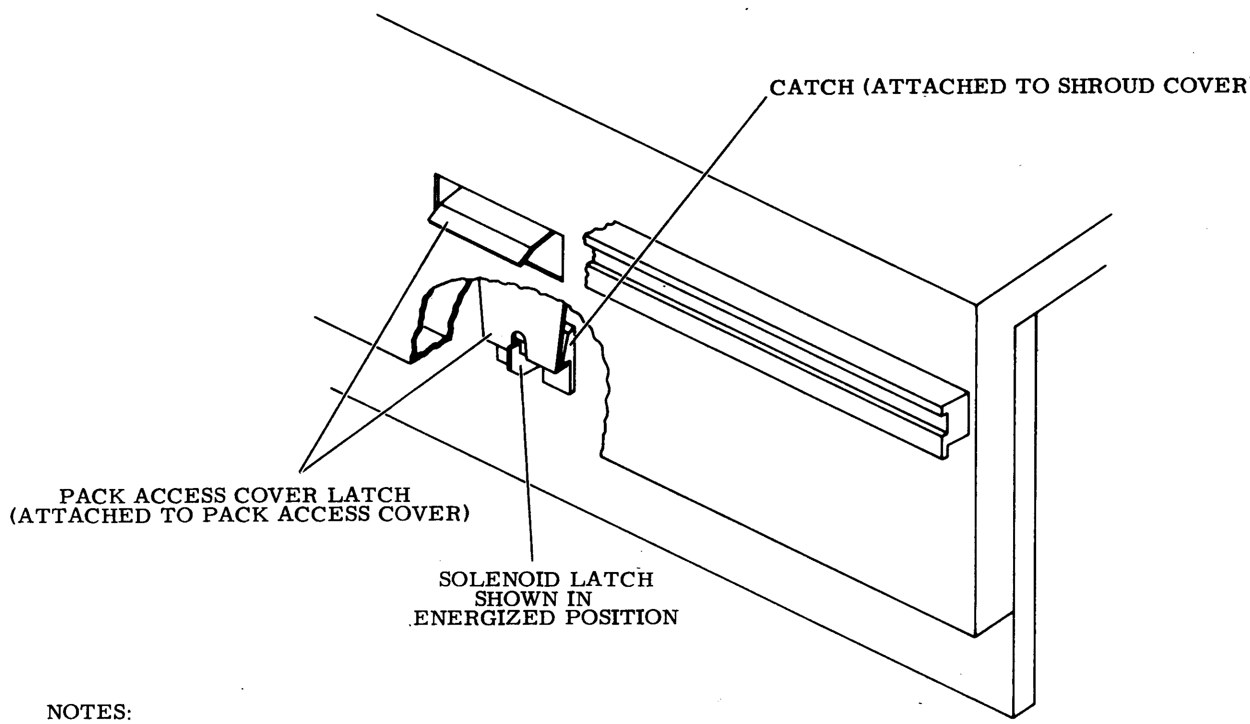
10. Connect leadwires to solenoid.

11. Move shroud cover back into position and secure.

12. Replace pack access cover.

13. Replace operator control panel in shroud cover.





NOTES:

1. SHOWN IN ENERGIZED POSITION
2. NOT CRITICAL HOWEVER DISTANCE MUST ENSURE PACK ACCESS COVER WILL BE LOCKED SHUT BY SOLENOID LATCH

9E32 C

Figure 6-20. Pack Access Cover Solenoid Replacement/Adjustment

NOTE

If is was necessary to move drive from inline position to remove top cover, reinstall drive inline after replacing top cover.

14. Replace cabinet top cover.

15. Perform Pack Access Cover Solenoid Adjustment procedure.

PACK ACCESS COVER SOLENOID ADJUSTMENT

This adjustment consists of moving the solenoid assembly (installed on the shroud cover) up or down until the clearance between it and the cover catch is correct. When this is accomplished, the solenoid should prevent the cover from opening when the drive is powered down or while the spindle is turning.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack. Leaving cover open, set MAIN AC circuit breaker to OFF.

3. Carefully raise cabinet top cover so that it clears pack access cover.

4. Raise pack access cover as far as possible.

5. Check adjustment with solenoid deenergized (solenoid latch up). Measure distance between it and catch on shroud cover (refer to figure 6-20).

6. If distance measured in step 5 is as indicated on figure 6-20 proceed to step 7; otherwise, adjust as follows:

   a. Loosen screws securing solenoid assembly to shroud cover.

   b. Adjust solenoid assembly until proper clearance is obtained.

   c. Tighten screws securing solenoid assembly to shroud cover.

7. Perform final check as follows:

   a. Close top cover allowing pack access cover to fully open.

   b. Install scratch disk pack and close pack access cover. Solenoid should engage and prevent cover from opening.

c. Set MAIN AC circuit breaker to ON. Solenoid energizes and cover should open.

d. Press START switch to start drive motor and load heads.

e. Solenoid should deenergize and prevent pack access cover from being opened. If it operates properly, proceed to step 8.

   However, if cover can be opened, repeat steps 1 through 6 and also check catch, latch, and solenoid for proper operation.

8. Press START switch to stop drive motor and unload heads.

9. Remove disk pack.

10. Set MAIN AC circuit breaker to OFF.

11. Close pack access cover.

PACK ACCESS COVER SWITCH REPLACEMENT

This switch prevents the drive motor from starting when the pack access cover is open. It is located under the shroud cover as shown in figure 6-21. The following procedure describes its removal and replacement. This switch requires no adjustments.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack. Leaving cover open, set MAIN AC circuit breaker to OFF.

3. Carefully raise cabinet top cover so that it clears the pack access cover and remove deck cover.

4. Open pack access cover as far as possible.

5. Remove pack access cover switch assembly as follows (refer to figure 6-21):

   a. Remove hardware securing pack access cover switch assembly to shroud cover and remove switch assembly from beneath shroud cover.

   b. Note leadwire connections and remove leadwires from switch.

   c. Remove hardware securing switch to its mounting bracket, then remove switch from bracket and set aside.

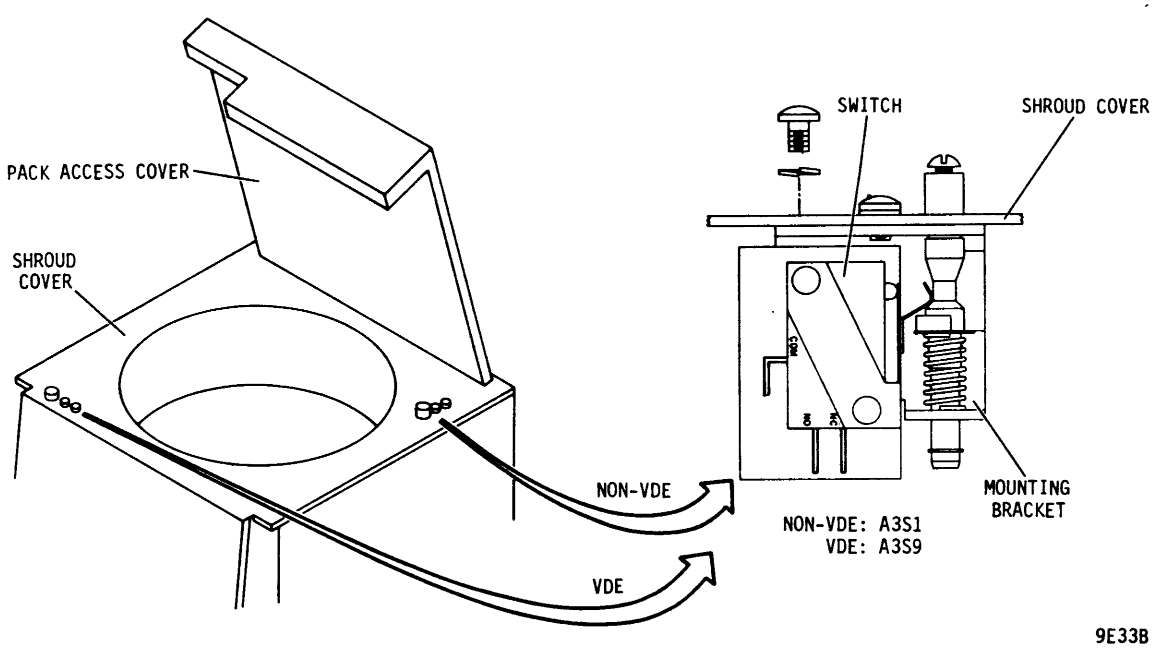


Figure 6-21. Pack Access Cover Switch Replacement

6. Replace pack access cover switch assembly as follows:

   a. Position replacement switch on mounting bracket and secure.

   b. Connect leadwires to switch terminals.

   c. Position switch under shroud cover and secure.

7. Close pack access cover.

8. Replace deck cover and close cabinet top cover.

INTERLOCK SOLENOID AND SWITCH REPLACEMENT (VDE)

The interlock assembly shown in figure 6-22 is used on VDE units. Its purpose is to lock the pack access cover so it can only be opened when the drive is in the standby mode (MAIN AC breaker ON and drive motor stopped). It also prevents the drive motor from starting if the pack access cover is open. The following procedure describes removal and replacement of the interlock assembly.

1. Press the START switch to stop the drive.

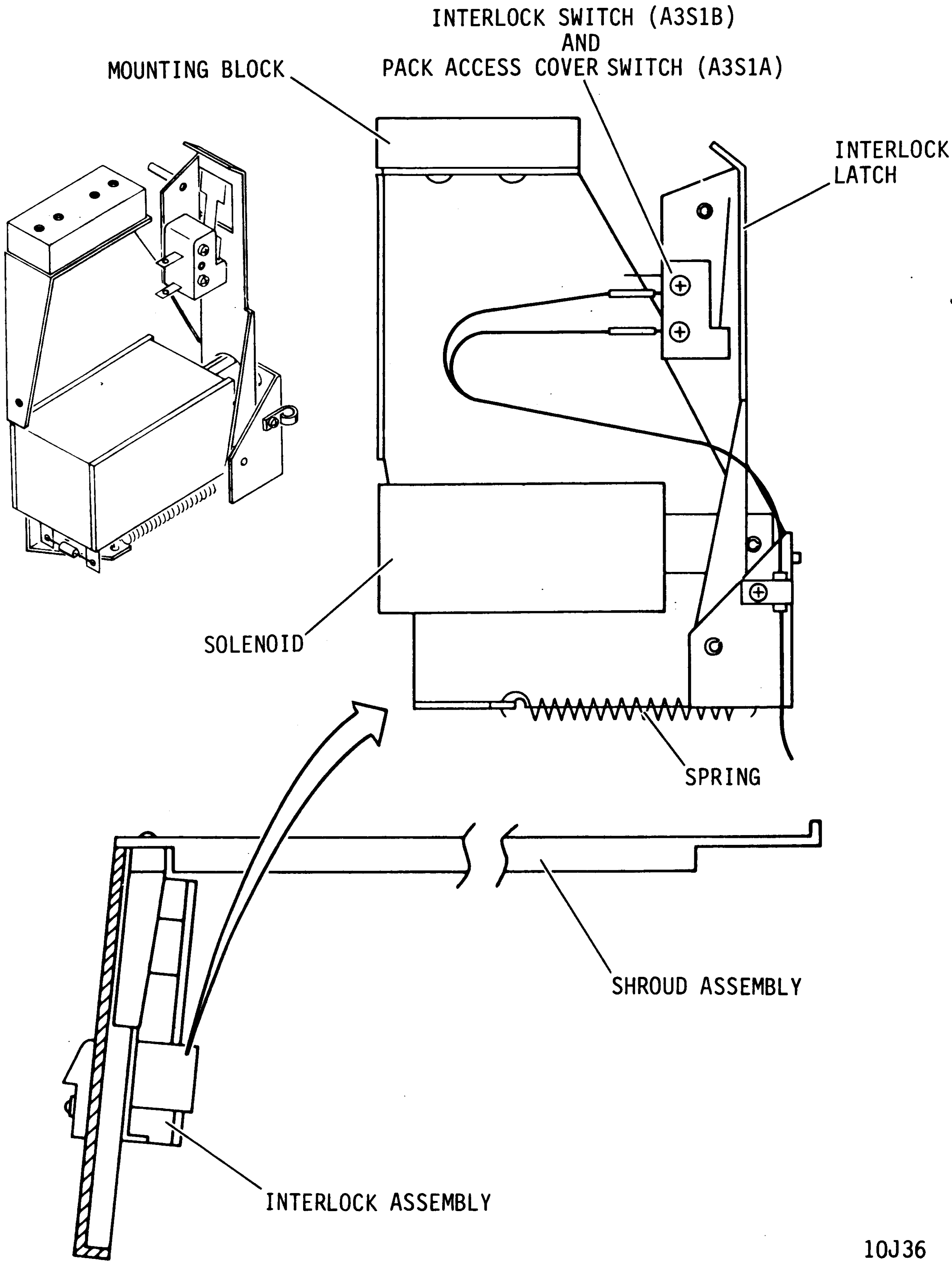


Figure 6-22. Interlock Assembly (VDE)

2. Open the pack access cover, remove the disk pack and then turn off the MAIN AC circuit breaker.

3. Remove the cabinet top cover.

4. Remove the pack access cover.

5. Remove the shroud cover attaching hardware and slide the cover forward far enough to allow access to the interlock assembly.

6. Disconnect interlock connector A3P9.

7. Note the lead positions on the solenoid and disconnect the leads.

8. Remove the hardware securing the interlock assembly to the shroud. Slip the assembly out of the drive.

   - If the solenoid is being replaced, proceed with step 9.

   - If the interlock switch is being replaced, go to step 14.

   - If the entire interlock assembly is being replaced, reverse steps 1-8 to install the new assembly.

9. Remove the hardware that secures the solenoid to the bracket.

10. Remove the solenoid and plunger.

11. Install the solenoid plunger and solenoid on the bracket and secure it with the hardware removed in step 9.

12. Manually operate the solenoid and check for freedom of movement. The solenoid body can be repositioned within limits of the attaching hardware to eliminate slight binding.

13. Reverse steps 1-8 to install the interlock assembly.

14. Note lead positions on the interlock switch and disconnect the leads.

15. Remove the hardware that secures the switch to the latch.

16. Install the new switch with the hardware removed in step 15.

17. Attach the leads to the switch.

18. Reverse steps 1-8 to install the interlock assembly.

With the interlock assembly installed, the pack access cover should lock when the drive motor is running, or when the MAIN AC breaker is OFF.

NOTE

> The interlock solenoid will not release the latch (energize) for 30 seconds after the MAIN AC breaker is turned ON.

The interlock hook on the pack access cover must actuate the interlock switch when the cover is closed. If this does not occur, the drive motor will fail to start when the START switch is pressed.

PACK ON SWITCH REPLACEMENT

This switch is located on the pack sensor assembly. The following describes replacement of the pack on switch. The switch must be adjusted following replacement and this is covered in the Pack On Switch Adjustment procedure.

REPLACEMENT (S/C 08 AND BELOW)

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

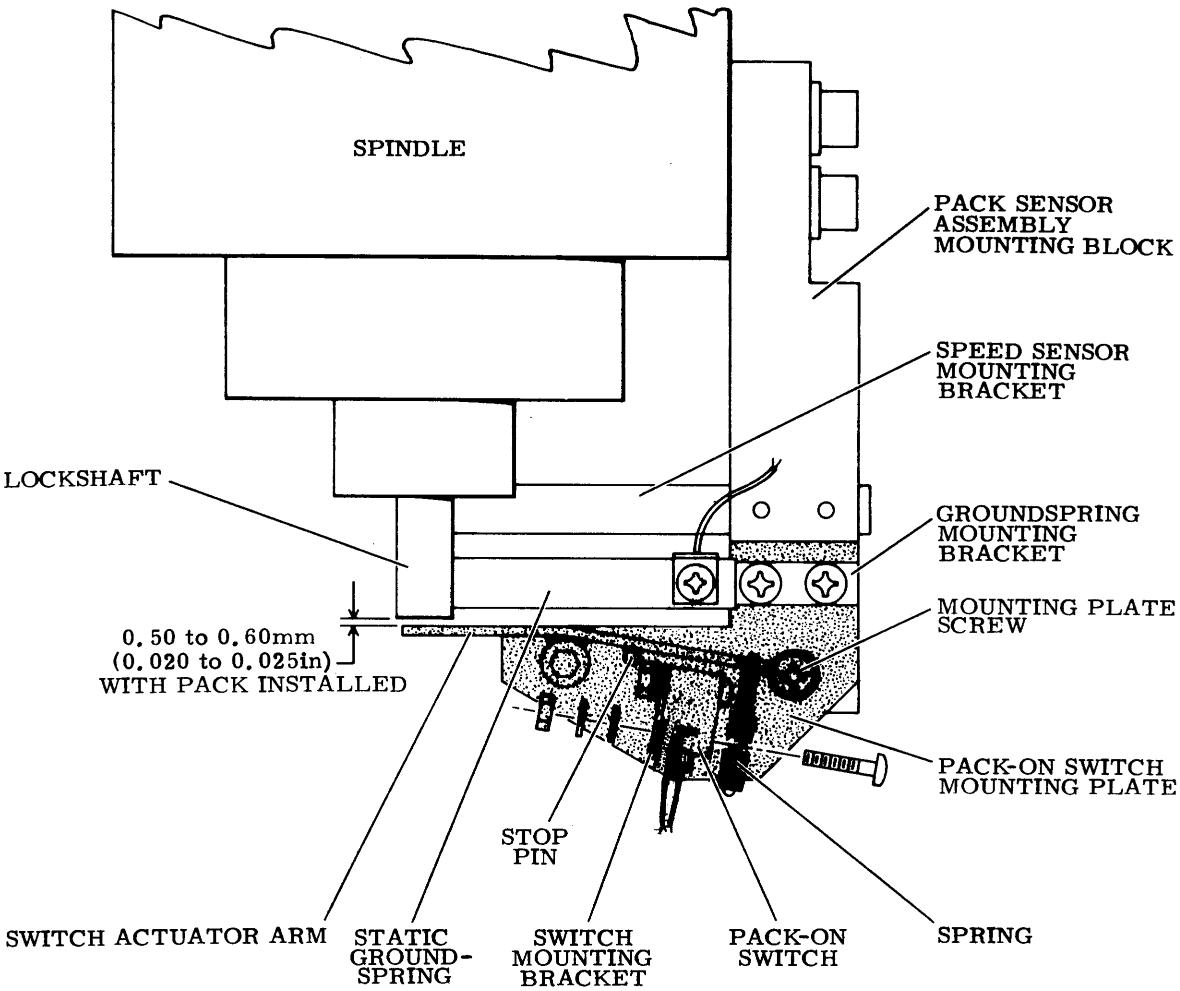
2. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

3. Note leadwire connections and disconnect leadwires at pack on switch terminals (refer to figure 6-23).

4. Remove small spring located behind pack on switch.

5. Remove hardware securing switch to mounting bracket then remove switch.

6. Install replacement switch on mounting bracket, then replace small spring.



NOTES:

1 SHADED AREAS INDICATE PARTS RELEVANT TO PACK ON SWITCH ADJUSTMENT AND REPLACEMENT

9E34B

Figure 6-23. Pack On Switch Replacement/Adjustment (S/C 08 and Below)

7 Reinstall blower assembly (refer to Blower Motor Replacement step 15).

8. Perform Pack On Switch Adjustment procedure.

REPLACEMENT (S/C 09 AND ABOVE)

1. Stop spindle motor.
2. Remove disk pack.
3. Set MAIN AC circuit breaker to OFF.
4. Refer to Side Panel Removal/Installation procedure and remove right (viewed from front) side panel.
5. Identify pack on switch leadwires. Disconnect wires at switch (figure 6-24).
6. Remove hardware securing switch to switch base bracket. Remove faulty switch.
7. Install replacement switch to switch base bracket using two screws, washer, and nut. Do not tighten screws.
8. Perform Pack On Switch Adjustment procedure.

PACK ON SWITCH ADJUSTMENT

This procedure describes adjustment of the pack on switch so it opens and closes at the proper points. The switch should close when a pack is installed and open when the pack is removed.

ADJUSTMENT (S/C 08 AND BELOW)

1. Remove power from drive as follows:
   a. Press START switch to stop drive motor and unload heads.
   b. Remove customer disk pack and install a scratch pack.
   c. Leaving cover open, set MAIN AC circuit breaker to OFF.
2. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).
3. Note leadwire connections, then remove leadwires from pack on switch.

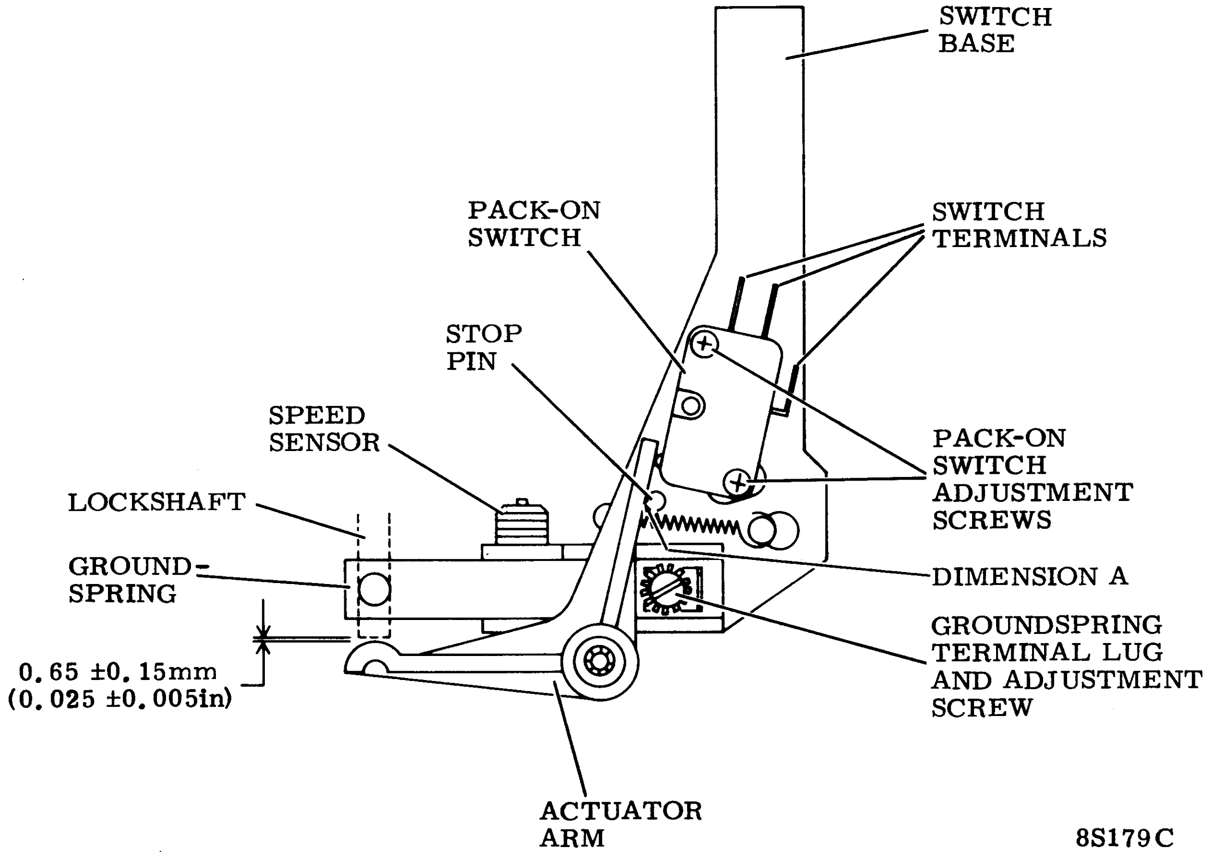


Figure 6-24. Pack On Switch Replacement/Adjustment (S/C 09 and Above)

4. Check to ensure that gap between actuator arm and lockshaft is as specified in figure 6-23. If gap is not as specified, proceed to step 5. If it is as specified, proceed to step 6.

5. Adjust mounting plate as follows to obtain clearance specified in figure 6-23.

   a. Loosen hardware securing static groundspring mounting bracket to mounting plate.

   b. Loosen mounting plate adjustment screw.

   c. Position switch mounting plate until gap between actuator arm lockshaft is as specified in figure 6-23.

d. Tighten mounting adjustment screw and hardware securing static ground spring mounting bracket to mounting plate.

e. Recheck gap and readjust if necessary.

6. Check as follows to ensure that pack on switch is closed.

   a. Connect multimeter (set to Rx1) across pack sensor terminals as follows:

      - Black (ground) lead to pack on switch terminal C.

      - Red (positive) lead to pack on switch terminal NO.

   b. Observe that meter indicates zero ohms. If it does, go to step 8. If it does not, go to step 7.

7. Adjust pack on switch to close at proper point as follows:

   a. Loosen hardware securing switch to mounting bracket.

   b. Position switch until meter just indicates zero ohms.

   c. Tighten hardware securing switch to mounting bracket.

8. Check as follows to see that switch opens at the proper point:

   a. Insert 0.3 mm (0.011 inch) feeler gauge between actuator arm and stop pin (refer to figure 6-23).

   b. Meter should indicate infinity. If not, go to step 9; if correct remove feeler gauge and go to step 10.

9. Adjust pack on switch to open at proper point as follows:

   a. Loosen hardware securing pack on switch to mounting bracket.

   b. Position switch until meter just indicates infinity.

   c. Tighten screws.

   d. Remove feeler gauge and note that meter goes to zero. If meter does not go to zero, repeat procedure starting with step 8. If meter does go to zero, proceed to step 10.

10. Remove multimeter probes from pack on switch terminals.

11. Reconnect pack on switch leadwires to switch terminals.

12. If mounting plate was adjusted (step 6), perform Static Groundspring Adjustment procedure steps 3 and 4.

13. Install blower assembly (refer to Blower Motor Replacement procedure step 15).

14. Remove scratch disk pack.

15. Close cabinet front door.

ADJUSTMENT (S/C 09 AND ABOVE)

NOTE

The following adjustment procedure applies to units with S/C 09 and above. The new pack sensor assembly is interchangeable, but the adjustment varies.

1. Stop spindle motor.

2. Install a disk pack.

3. Leaving cover open, set MAIN AC circuit breaker to OFF.

4. Refer to Side Panel Removal/Installation procedure and remove right (viewed from front) side panel.

5. Identify pack on switch leadwires (figure 6-24). Disconnect wires at switch terminals.

6. Dimension between actuator arm and lockshaft must be as specified in figure 6-24. If dimension is as specified, go to step 9. If adjustment is required, go to step 7.

7. Loosen hardware on switch base (figure 6-24).

8. Position switch base until dimension between actuator arm and lockshaft is as specified in figure 6-24. Tighten screws.

9. Connect a multimeter (set to Rx1) to pack sensor switch terminals (figure 6-24). Meter must indicate 0 ohms. If correct go to step 11, if not go to step 10.

10. Loosen pack sensor switch adjustment screws and position switch until multimeter just indicates 0 ohms. Tighten screws.

11. Insert 0.3 mm (0.011 in.) thick feeler gauge between actuator arm and stop pin (dimension A of figure 6-24).

12. Multimeter must indicate infinity. If not, go to step 13. If correct, remove feeler gauge and go to step 16.

13. Loosen pack sensor switch adjustment screws and position switch until multimeter just indicates infinity. Tighten screws.

14. Remove feeler gauge. Multimeter must indicate 0 ohms. If correct, go to step 15. If not, repeat procedure starting at step 10.

15. If requirements of step 14 are met, go to step 16. If not, and further adjustments are required, repeat the entire adjustment procedure.

16. Disconnect multimeter from switch terminals.

17. Connect pack sensor switch leadwires to switch terminals.

18. Perform Groundspring Adjustment procedure if mounting plate screws were loosened.

19. Remove scratch disk pack.

20. Install side panel.

PACK SENSOR ASSEMBLY REPLACEMENT

This assembly is mounted beneath the deck on the rear of the spindle. The two main elements of the pack sensor assembly are the static groundspring and pack on switch. The procedure for individually replacing each of these are contained elsewhere in this section. The following describes replacement of the entire pack sensor assembly.

REPLACEMENT (S/C 08 AND BELOW)

1. Remove power from drive as follows:

    a. Press START to stop drive motor and unload heads.

    b. Remove disk pack.

    c. Set MAIN AC circuit breaker to OFF.

2. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

3. Remove pack sensor assembly (figure 6-25) as follows:

   a. Disconnect static groundspring leadwire from terminal on groundspring.

   b. Note leadwire connections and disconnect leadwires from pack on switch.

   c. Disconnect speed sensor cable plug (A3P3).

   d. Remove hardware securing pack sensor assembly to spindle assembly then remove pack sensor assembly and set aside.

4. Remove speed sensor assembly from old pack sensor assembly by removing hardware. Install speed sensor assembly on replacement pack sensor assembly.

5. Install replacement pack sensor assembly as follows:

   a. Position replacement pack sensor assembly on rear of spindle assembly and secure.

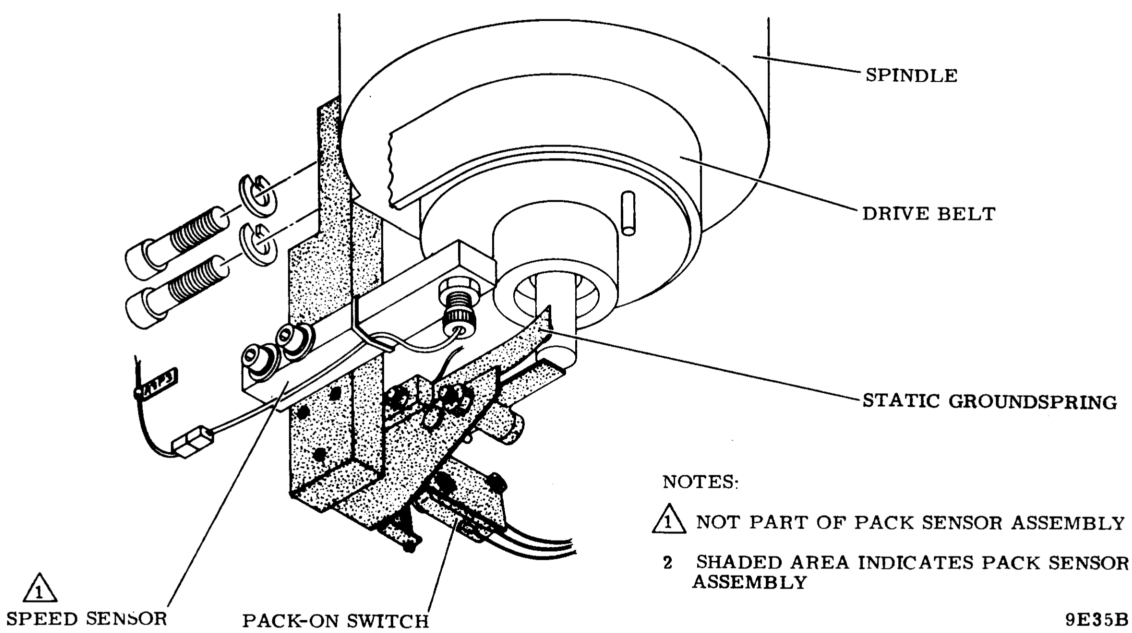


Figure 6-25. Pack Sensor Assembly Replacement (S/C 08 and Below)

b. Connect speed sensor cable plug A3P3.

c. Connect leadwires to pack on switch and static groundspring.

6. Perform the following procedures:

   a. Pack On Switch Adjustment.

   b. Static Groundspring Adjustment.

   c. Speed Sensor Adjustment.

7. Install blower assembly (refer to Blower Motor Replacement procedure step 15).

8. Perform Speed Sensor Output Check procedure.

REPLACEMENT (S/C 09 AND ABOVE)

1. Remove power from drive as follows:

   a. Press START to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

2. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

3. Remove pack sensor assembly (figure 6-26) as follows:

   a. Disconnect static groundstrap connected to terminal on groundspring.

   b. Cut tie wrap on leadwires.

   c. Note leadwire connections and disconnect leadwires from pack on switch.

   d. Disconnect speed sensor cable plug.

   e. Remove drive belt (refer to Drive Belt Replacement procedure steps 3 through 7).

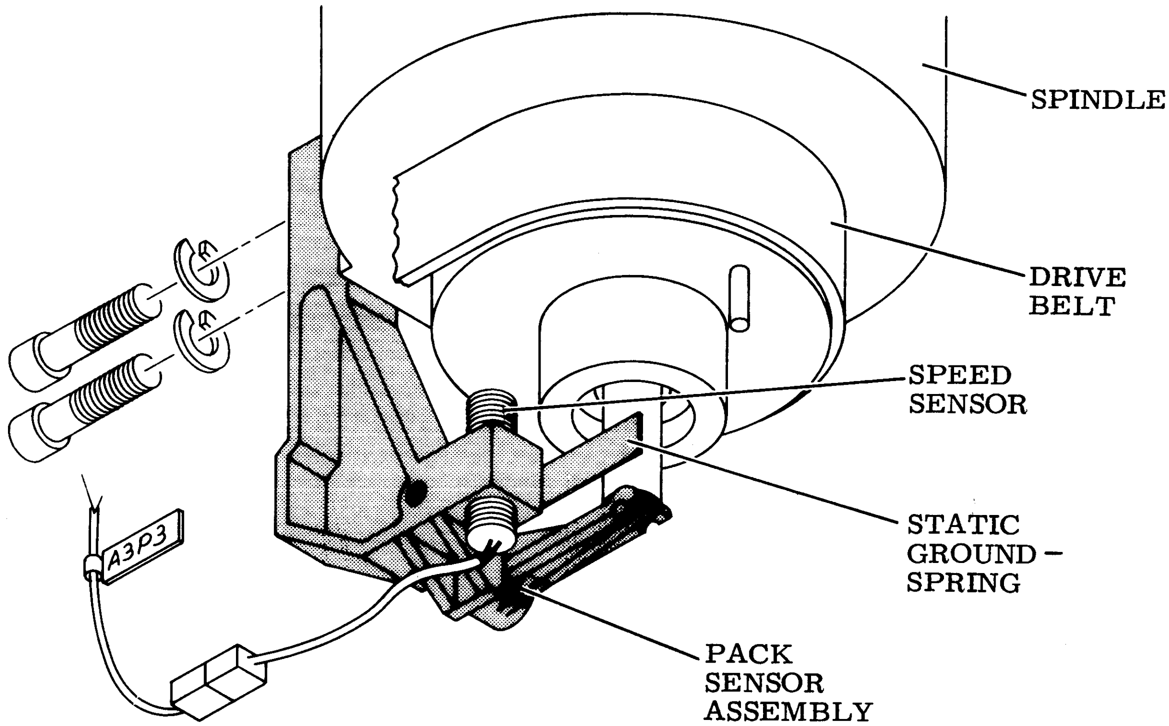


Figure 6-26. Pack Sensor Assembly Replacement (S/C 09 and Above)

f. Remove hardware securing pack sensor assembly to spindle assembly.

g. Remove pack sensor assembly and set aside.

4. Install replacement pack sensor assembly as follows:

a. Position replacement pack sensor assembly on rear of spindle assembly.

b. Perform Pack On Switch Adjustment procedure and secure.

c. Replace drive belt (refer to figures 6-7 and 6-8 and Drive Belt Replacement procedure steps 8 through 11).

d. Connect speed sensor cable plug A3P3.

e. Connect leadwires to pack on switch and static groundspring leadwire.

5. Perform the following procedures:

   a. Pack On Switch Adjustment

   b. Static Groundspring Adjustment

   c. Speed Sensor Adjustment

6. Install blower assembly (refer to Blower Motor Replacement procedure step 15).

7. Perform Speed Sensor Output Check procedure.

PARKING BRAKE REPLACEMENT

The parking brake is located on the deck near the spindle (refer to figure 6-27). It is necessary to remove only the brake cover plate to access the parking brake for removal and replacement. Adjustment is covered in the Parking Brake Adjustment procedure.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack. Leaving cover open, set MAIN AC circuit breaker to OFF.

3. Remove hardware securing brake plate cover to deck then remove cover.

4. Remove hardware securing parking brake assembly to deck (refer to figure 6-27) then remove assembly and set aside.

NOTE

Apply Loctite Primer Grade N and Loctite Grade C to screws used in step 5.

5. Install parking brake assembly to deck.

6. Perform Parking Brake Adjustment procedure starting with step 4.

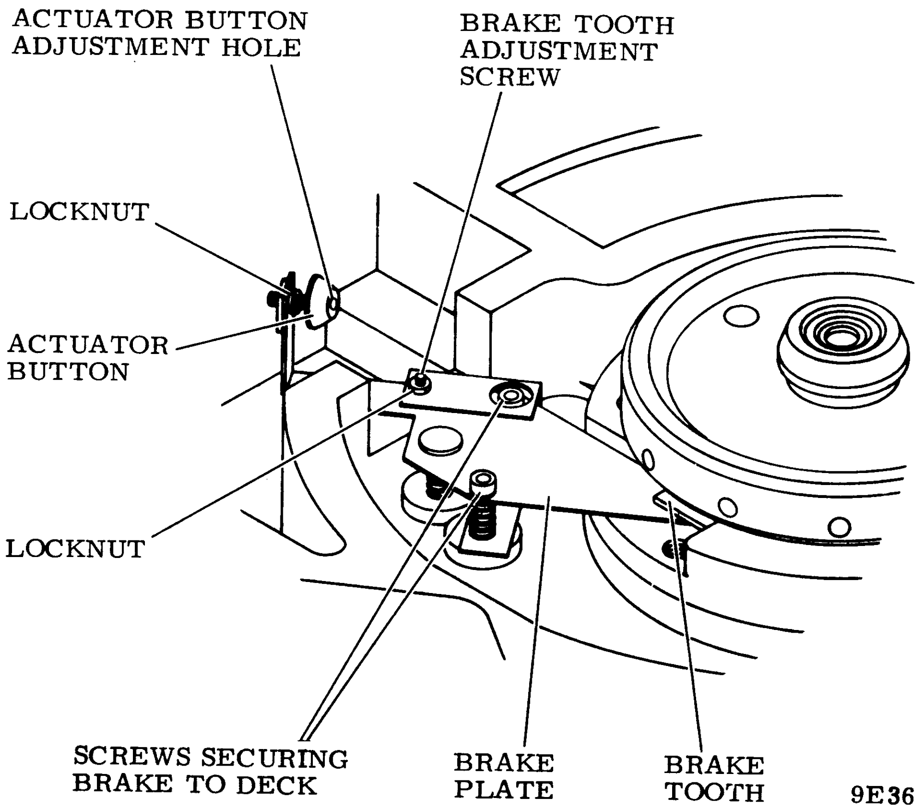


Figure 6-27. Parking Brake Replacement/Adjustment

PARKING BRAKE ADJUSTMENT

The parking brake has two adjustments (refer to figure 6-27); they are the actuator button to pack clearance and the brake tooth to bottom of spindle clearance.

The distance between the actuator button and the disk pack bottom disk surface is adjusted by turning the actuator button in or out. The brake tooth to bottom of spindle clearance is adjusted by the brake tooth adjustment screw.

Adjustment of brake tooth to bottom of spindle clearance requires only removing the brake cover plate; however, the entire shroud must also be removed to adjust brake button to disk pack clearance.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack. Leaving cover open, set MAIN AC circuit breaker to OFF.

3. Remove hardware securing brake cover plate and remove plate.

4. Check clearance between brake tooth and underside of spindle as follows:

   a. Rotate spindle until brake tooth is not engaged or under a notch in spindle.

   b. Check to see if clearance between tooth and underside of spindle is between 0.15 to 0.5 mm (0.005 to 0.020 in). If this requirement is not met, proceed to step 5. If it is met, proceed to step 6.

5. Adjust brake tooth to underside of spindle clearance as follows:

   a. Loosen locknut brake tooth adjustment screw.

   b. Adjust screw until clearance between tooth and underside of spindle is from 0.15 to 0.5 mm (0.005 to 0.020 in). Turning setscrew clockwise narrows gap and counterclockwise widens gap.

   c. When gap is correct tighten setscrew.

   d. Replace brake cover plate and hardware removed in step 3 and secure.

6. Install a scratch disk pack.

NOTE

In step 7 it is impossible to check the clearance with a conventional feeler gauge. However, a suitable tool can be constructed by taping the proper feeler gauge to the end of a long object such as a screw driver.

7. Check to ensure that clearance between actuator button and bottom disk surface on disk pack is between 0.25 and 0.5 mm (0.01 and 0.02 in). If this requirement is not met, proceed to step 8. If it is met, remove disk pack and proceed to step 19.

8. Remove scratch disk pack.

NOTE

If drive is installed inline with other drives, it may be necessary to move the drive out of line to remove the top cover.

9. Remove cabinet top cover.

10. Remove deck cover.

11. Remove pack access cover.

12. Remove shroud and shroud cover.

13. Adjust actuator button to disk pack clearance as follows:

    a. Install scratch disk pack.

    b. Loosen locknut on actuator button adjustment screw.

    c. Turn actuator button until clearance between button is between 0.25 and 0.5 mm (0.01 and 0.02 in). Turning button clockwise increases clearance and turning it counterclockwise decreases clearance.

    d. When gap is correct, tighten locknut.

CAUTION

Remove and install disk pack then rotate spindle to ensure there is no interference between brake tooth and spindle.

    e. Remove scratch disk pack.

14. Replace shroud and shroud cover.

15. Install pack access cover.

16. Replace deck cover.

NOTE

If drive was moved from inline position to remove top cover, reinstall drive inline after replacing top cover.

17. Install cabinet top cover.

18. Open pack access cover and clean shroud.

19. Close pack access cover.

POWER SUPPLY ASSEMBLY REPLACEMENT AND MAINTENANCE

The power supply is located on the floor, at the rear of the cabinet. Two types of power supplies are used. These are illustrated in figure 6-28. As illustrated, one power supply is mounted on slides that permits extending it out the rear of the cabinet. The other power supply, is mounted on the base of the cabinet and does not incorporate the slides. Both power supplies contain replaceable cards. The chart below illustrates card usage.

CARD TYPE Non-VDE	CARD TYPE VDE	DESCRIPTION
_ZCN	_ZCN	Power Amplifier
_YFN	_FNN	Relay Board
_YEN	----	Rectifier/Capacitor Board
----	_CBN	Rectifier/Filter Board
----	-CFN	Control Board

The following procedure describes replacement of the entire power supply as well as each of the cards. It also describes triac and power transistor replacement.

POWER SUPPLY ASSEMBLY REPLACEMENT (NON-VDE)

The following procedure describes removal and replacement of the entire power supply assembly.

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

   d. Disconnect power cable from site power receptacle.

   NOTE

   If drive is installed in line with other drives, pull it out of line to remove side panels.

2. Remove cabinet side panels.

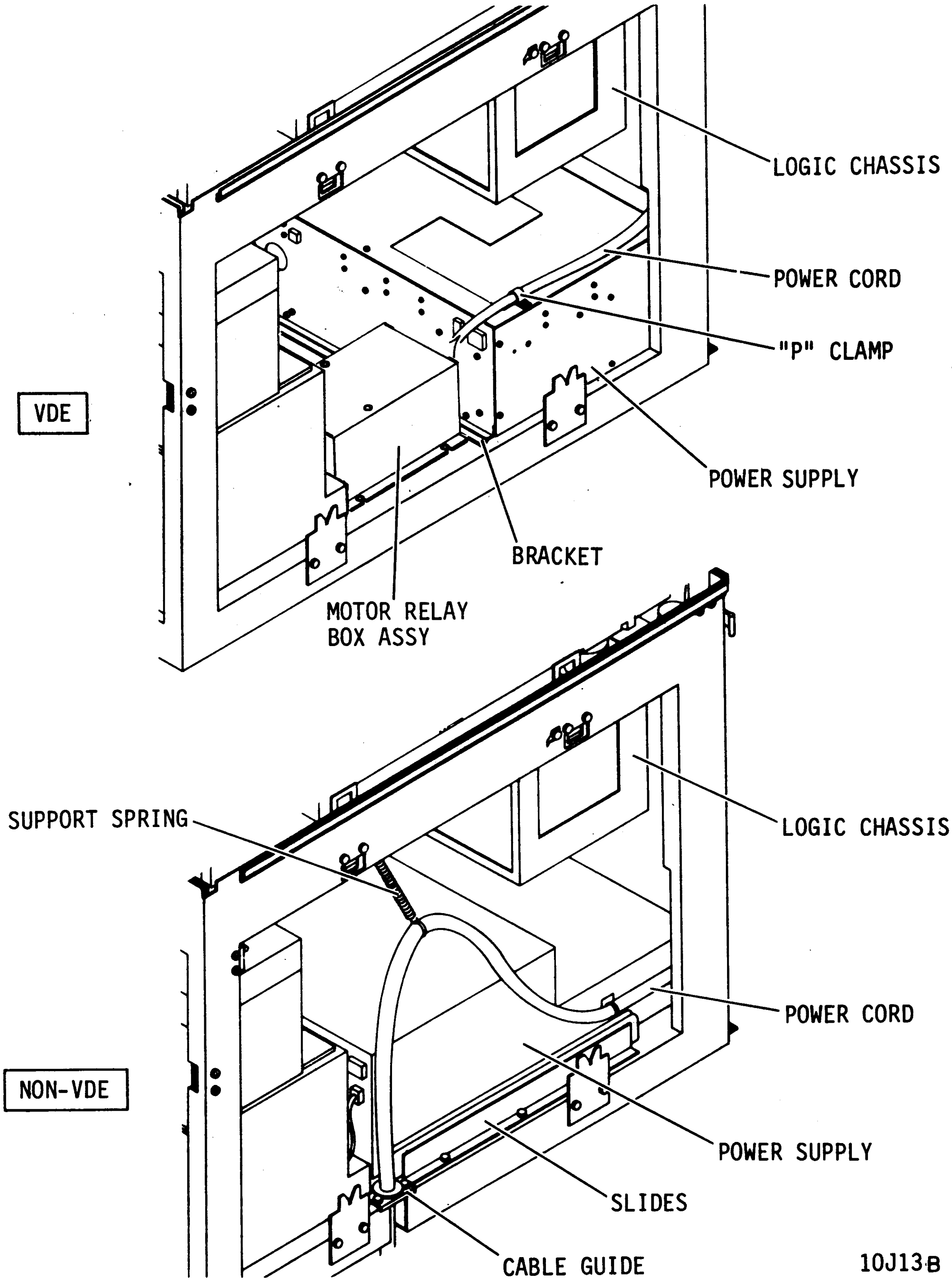


Figure 6-28. Power Supply Assembly Replacement

3. Remove hardware securing cable guide to frame and remove cable guide.

4. Disconnect support spring from power cable.

5. Disconnect all plug connectors to power supply. Also disconnect air hose by turning in counterclockwise direction until it comes free.

6. Remove cable clamp securing dc power cable (A1P4) to power supply.

7. Open cabinet rear door and swing logic chassis open.

8. Remove power supply top cover.

9. Disconnect ac and dc ground straps (refer to figure 6-29) and remove them from power supply. Replace top cover on power supply.

WARNING

Power supply is heavy. Use caution.

10. Remove hardware securing power supply slides to floor of drive cabinet and slide supply out rear of cabinet.

11. Slide replacement power supply into cabinet and secure slides to floor of cabinet.

12. Remove top cover from replacement power supply and connect ground straps (removed in step 9) as shown in figure 6-29.

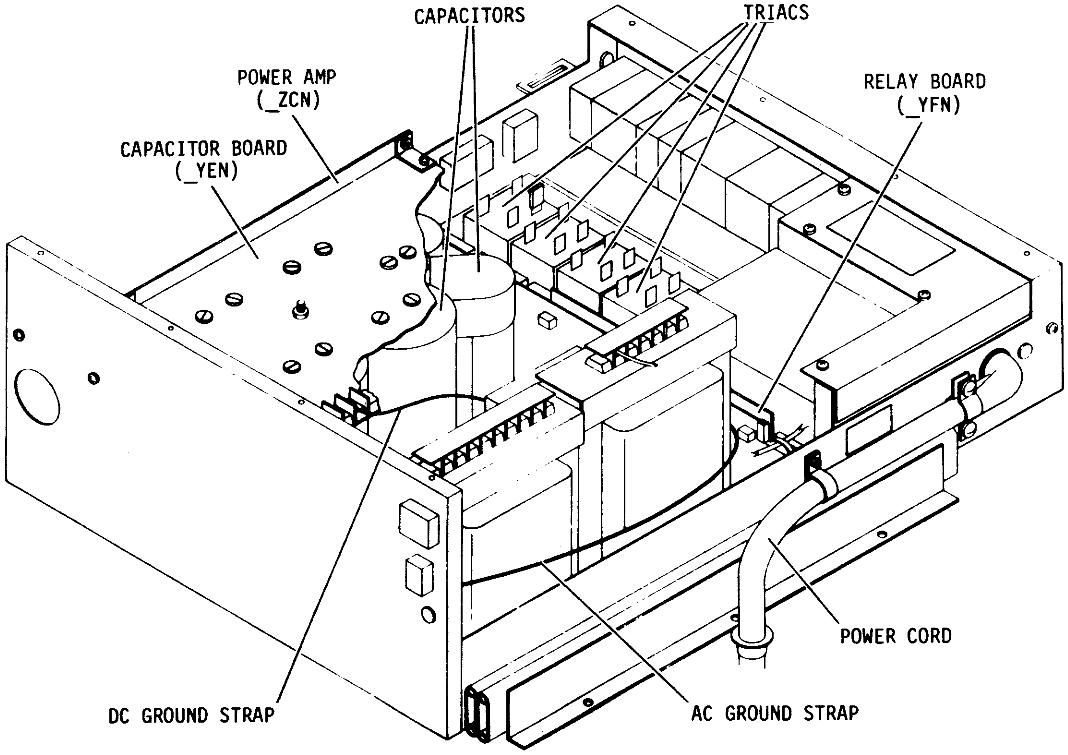
13. Connect power wiring as described in AC Power Wiring discussion in the Installation and Checkout section of the manual.

14. Replace top cover on power supply.

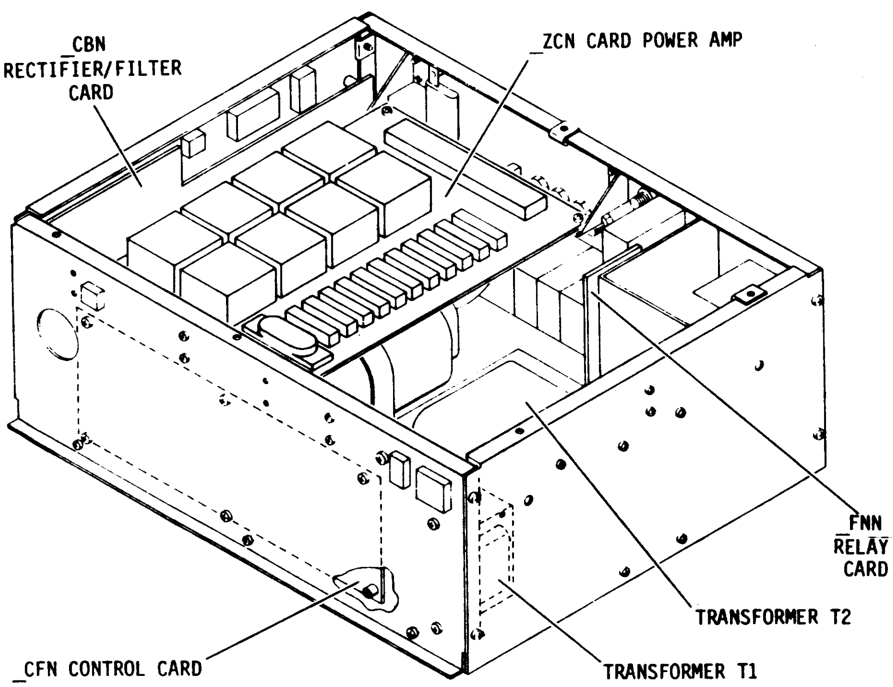
15. Reconnect all plugs to power supply. Also reconnect air hose by screwing it clockwise into hole.

16. Replace cable clamp securing dc power cable (A1P4) to power supply.

17. Position power cable in cable guide and secure cable guide to floor of cabinet.



NON-VDE POWER SUPPLY



VDE POWER SUPPLY

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Figure 6-29. Power Supply Card Replacement

18. Replace cabinet side panels.

19. Connect power cord to site power receptacle.

20. If drive was moved out of line to perform step 2, reinstall it inline.

21. Perform following procedures:

    a. +5 volt and -5 volt Test and Adjustment.

    b. DC Voltage Output Check.

—ZCN (POWER AMPLIFIER) CARD REPLACEMENT (NON-VDE)

The following procedure describes removal and replacement of the _ZCN card (refer to figure 6-29).

1. Remove power from drive as follows:

    a. Press START switch to stop drive motor and unload heads.

    b. Remove disk pack.

    c. Set MAIN AC circuit breaker to OFF.

    d. Disconnect power cable from site main power receptacle.

2. Slide power supply out and remove power supply top cover.

3. Note connections then disconnect all wires from _ZCN card.

4. Remove hardware securing card in power supply, remove insulated spring clip, then remove card.

5. Position replacement card in power supply, attach insulated spring clip removed from old card (step 4), and secure.

6. Connect wires to replacement _ZCN card.

7. Replace top cover on power supply and perform steps 1, 4 and 9 of Manual Controlled Servo Checks procedure.

—YEN (RECTIFIER/CAPACITOR) CARD REPLACEMENT (NON-VDE)

The following procedure describes removal and replacement of the _YEN card (refer to figure 6-29).

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

   d. Disconnect power cable from site main power receptacle.

2. Slide power supply out and remove power supply top cover.

3. Remove hardware securing _ZCN card, remove insulated spring clip, then move _ZCN card away from _YEN.

4. Note connections, then disconnect all wires from _YEN card.

5. Remove hardware securing card to capacitors.

6. Remove hardware from stud securing card to power supply, then remove card.

7. Ensure that all lockwashers are positioned on capacitors, then position _YEN card on capacitors and install screws.

8. Install hardware on stud and tighten.

9. Reposition _ZCN card and secure. Replace insulated spring clip.

10. Replace top cover on power supply and perform following procedures:

    a. +5 Volt and -5 Volt Test and Adjustment.

    b. Power Supply DC Output Voltage Check.

—YFN (RELAY) CARD REPLACEMENT (NON—VDE)

The following procedure describes removal and replacement of the _YFN card (refer to figure 6-29).

CAUTION

> Observe precautions described in discussion on Handling Electrostatic Devices in section 2, when working with _YFN card.

1. Remove power from drive as follows:

a. Press START switch to stop drive motor and unload heads.

b. Remove disk pack.

c. Set MAIN AC circuit breaker to OFF.

d. Disconnect power cable from site main power receptacle.

2. Slide power supply out and remove power supply top cover.

3. Remove connectors from _YFN card.

4. Carefully pry card off fasteners and remove from power supply.

5. Install replacement _YFN card in power supply by pushing it carefully onto fasteners.

6. Install connectors on replacement card.

7. Replace top cover on power supply and perform following procedures:

a. Set MAIN AC circuit breaker to ON and set LOCAL/REMOTE switch to LOCAL.

b. Install disk pack, press START switch and observe that drive motor starts and heads load.

c. Press START switch and observe that heads unload and pack stops rotating in approximately 30 seconds.

d. Set LOCAL/REMOTE switch to REMOTE (ensure sequence power is available).

e. Press START switch and observe that drive motor starts and heads load.

f. Press START switch and observe that heads unload and pack stops rotating in approximately 30 seconds.

g. Set MAIN AC circuit breaker to OFF.

POWER SUPPLY REPLACEMENT (VDE)

The following procedure describes removal and replacement of the entire power supply assembly used on VDE units.

1. Press the START switch to stop the drive motor and unload the heads.

2. Remove disk pack.

3. Set the MAIN AC circuit breaker to OFF.

4. Disconnect the power cord from the site power receptacle.

NOTE

If the drive is installed inline with other drives it must be pulled out of line to remove cabinet panels.

5. Remove the cabinet side panels and open the rear door.

6. Remove the screw securing the power cord clamp to the top of the power supply.

7. Disconnect the power cord from the power supply control panel.

8. Disconnect plugs P2, P3, P4, P6, P7, and P8 on the power supply.

9. Disconnect the air hose at the rear of the power supply by turning it counterclockwise.

10. Remove the hardware that secures the control panel end of the power supply to the cabinet base.

WARNING

Power supply is heavy. Use caution.

11. Pull the power supply out the rear of the cabinet.

12. To install the power supply, rest it on the cabinet base and push it toward the front of the drive until the lip at the rear of the power supply slips under the mounting bracket.

13. Secure the control panel end of the power supply to the chassis with the hardware removed in step 10.

14. Connect plugs P2, P3, P4, P6, P7, and P8 and attach the air hose by turning it clockwise into the power supply.

15. Connect the power cord to the receptacle on the power supply control panel.

16. Attach the power cord clamp to the top of the power supply.

17. Connect the power cord to the site power receptacle.

18. Place the MAIN AC circuit breaker in the ON position.

19. Perform DC voltage checks and ±5 V test and adjustment.

20. Replace the cabinet panels and position the drive inline with the other drives.

_ZCN (POWER AMPLIFIER) CARD REPLACEMENT (VDE)

The following procedure describes removal and replacement of the _ZCN card used in VDE units. (See figure 6-29).

1. Press the START switch to stop the drive motor and unload the heads.

2. Remove the power supply using the Power Supply Replacement procedure.

3. Remove the power supply cover.

4. Note all lead connections on the _ZCN card. Then disconnect all leads.

5. Remove the hardware that secures the __ZCN card to the mounting brackets, and remove the card.

6. Position the replacement card on the mounting brackets and secure it with the hardware removed in step 5.

7. Connect all leads to the _ZCN card.

8. Install the power supply top cover.

9. Install the power supply in the cabinet.

10. Perform steps 1 and 9 of the Manual Controlled Servo Checks procedure.

_FNN (RELAY) CARD REPLACEMENT (VDE)

The following procedure describes removal and replacement of the _FNN card used in VDE units. (See figure 6-29.)

1. Press the START switch to stop the drive motor and unload the heads.

2. Remove the power supply using the Power Supply Replacement procedure.

3. Remove the power supply cover.

4. Disconnect P1 at the _FNN card.

5. Remove the hardware that secures the card to the power supply chassis and then remove the card.

6. Reverse steps 1-5 to install the replacement _FNN card.

-CFN (CONTROL) CARD REPLACEMENT (VDE)

The following procedure describes removal and replacement of the _CFN card used in VDE units. (See figure 6-29).

1. Press the START switch to stop the drive motor and unload the heads.

2. Remove the power supply using the Power Supply Replacement procedure.

3. Remove the power supply cover.

4. Remove the _ZCN (Power Amplifier) card.

5. Disconnect connectors P1, P2, P3, and P4 on the _CFN card.

6. Remove the hardware that secures the __CFN card to the rear panel of the power supply. Remove the card.

7. Position the replacement _CFN card on the rear panel of the power supply and secure it with the hardware removed in step 6.

8. Reverse steps 1-5 to complete the installation.

-CBN (RECTIFIER/FILTER) CARD REPLACEMENT (VDE)

The following procedure describes removal and replacement of the _CBN card used in VDE units. (See figure 6-29).

1. Press the START switch to stop the drive motor and unload the heads.

2. Remove the power supply using the Power Supply Replacement procedure.

3. Remove the power supply cover.

4. Remove the _ZCN (Power Amplifier) card.

5. Disconnect connectors P1, P2, and P3 and the _CBN card.

6. Remove the hardware that secures the _CBN card to the power supply side panel. Remove the card.

7. Place the replacement _CBN card in position and secure it with the hardware removed in step 6.

8. Reverse steps 1-5 to complete the installation.

9. Perform DC voltage check procedures.

TRIAC AND POWER TRANSISTOR REPLACEMENT

When replacing triacs or power transistors, complete the following procedures:

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Set MAIN AC circuit breaker to OFF.

   c. Disconnect power cable from site power receptacle.

2. Swing logic chassis open, slide power supply out, and remove power supply top cover.

3. Remove defective triac or power transistor.

4. Apply a coating of silicon grease to mating surfaces of replacement triac or power transistor and power supply (or heat sink in case of power transistor).

5. Install replacement triac or power transistor.

6. Replace cover on power supply and slide power supply into normal position.

7. Close logic chassis and cabinet rear door.

READ/WRITE CHASSIS –XGN CARD REPLACEMENT

The _XGN card is located in read/write chassis location E05. It is mounted on the _XFN card in location E04 (the _XFN card is also referred to as the mother board). Replacing the _XGN card involves removing the read/write chassis from the deck and then removing the _XGN card from its position on the mother board (refer to figure 6-30).

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

2. Open cabinet top cover and remove deck cover.

3. Remove read/write chassis from deck as follows (refer to figure 6-30):

   a. Note connections and remove cable plugs PE1, PE2, PE3, and PE5 from read/write cards and cut tie wraps securing wires to left side of chassis.

   b. Remove cards E01, E02, and E03 from read/write chassis.

   c. Note connections and remove head cable plugs from _XGN card starting with top plug.

   d. Remove hardware securing read/write chassis to deck, slide assembly backward, and remove chassis from deck.

4. Remove _XGN card from mother board as follows (refer to figure 6-30):

   a. Remove hardware securing _XGN card to mother board.

CAUTION

Use care not to damage pins.

   b. Pry _XGN card from mother board.

5. Install replacement _XGN card on mother board as follows:

CAUTION

Ensure that all pins go through the proper holes and all pins are straight.

   a. Position _XGN card over pins on mother board then press cards together.

   b. Secure _XGN card to mother board.

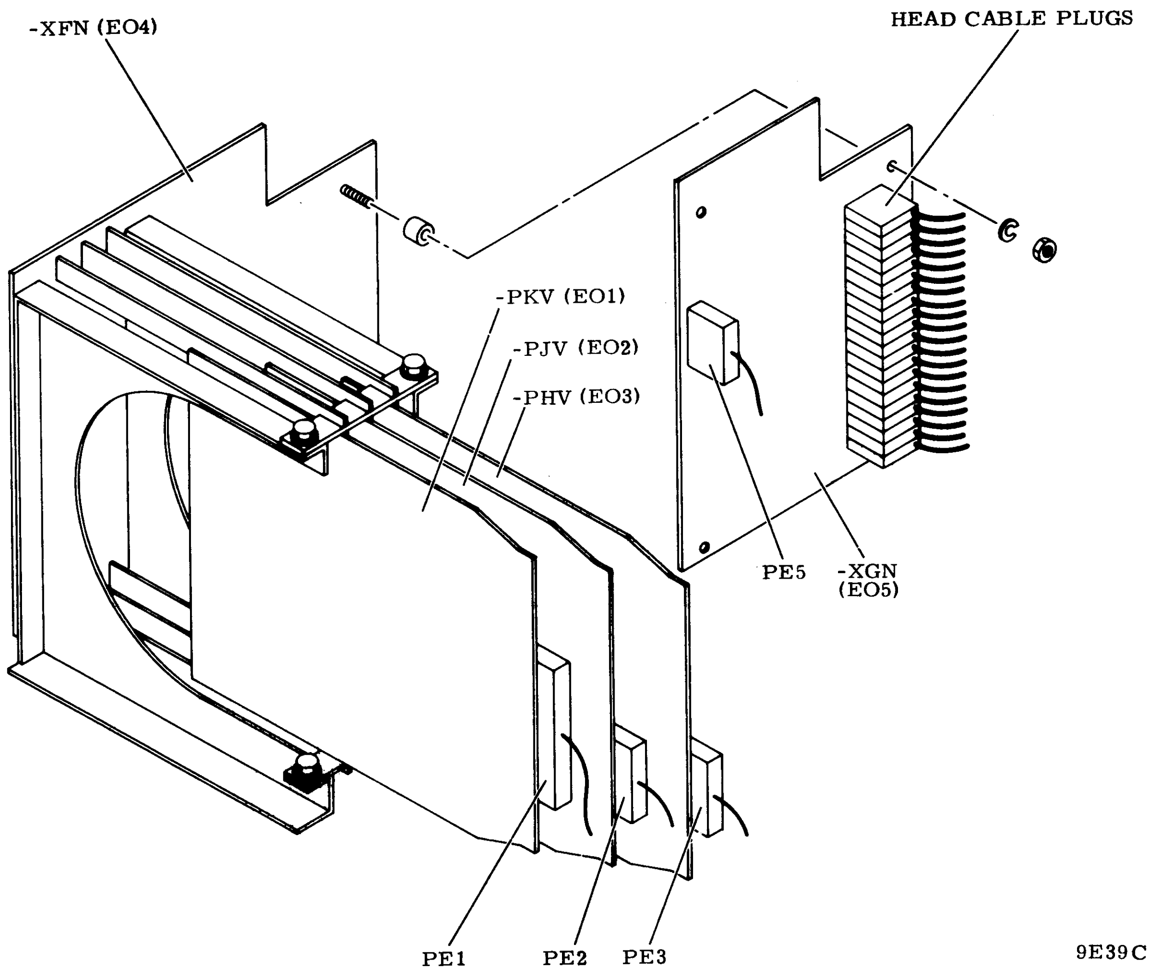


Figure 6-30. Read/Write Chassis Card Replacement

6. Install read/write chassis on deck as follows:

   a. Position read/write chassis on deck while ensuring that mother board engages the clip on actuator housing.

   b. Secure read/write chassis to deck.

   NOTE

   Head cable connectors are keyed and plug to mother board only one way. Ensure that cable between head-arm and plug is not twisted or kinked.

   c. Connect head cable plugs, starting with top plug (0).

   d. Replace cards E01, E02 and E03 in read/write chassis.

   e. Connect cable plugs PE1, PE2, PE3, and PE5 and attach tie wraps securing wires to left side of chassis.

7. Install deck cover and close cabinet top cover.

READ/WRITE CHASSIS –XFN (MOTHER BOARD) REPLACEMENT

The _XFN card is also referred to as the mother board. All the other cards in the read/write chassis plug onto pins on the mother board. Replacing the mother board involves removing the read/write chassis from the deck, disconnecting the other cards from the mother board, then removing the mother board from the read/write chassis.

1. Remove read/write chassis from deck and _XGN card from mother board by performing steps 1 through 6 of Read/Write Chassis _XGN Card Replacement procedure.

2. Separate mother board from read/write chassis by removing hardware (refer to figure 6-30) then set mother board aside.

3. Position replacement mother board on read/write chassis and secure.

4. Replace __XGN card on replacement mother board as instructed in step 5 of Read/Write Chassis _XGN Card Replacement procedure. Note that although step 5 refers to a replacement _XGN card, in this case the old card is reinstalled.

5. Perform steps 6 and 7 of Read/Write Chassis _XGN Card Replacement procedure.

SERVO PREAMP BOARD REPLACEMENT

This board is located in the servo preamp housing, which is mounted on the deck (refer to figure 6-31). Replacing the board involves removing the board from the preamp housing.

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

2. Open cabinet top cover and remove deck cover.

3. Remove Servo Preamp board as follows:

   a. Remove hardware securing servo preamp cover and remove cover.

   b. Disconnect servo head cable plug and output plug P8 from servo preamp board.

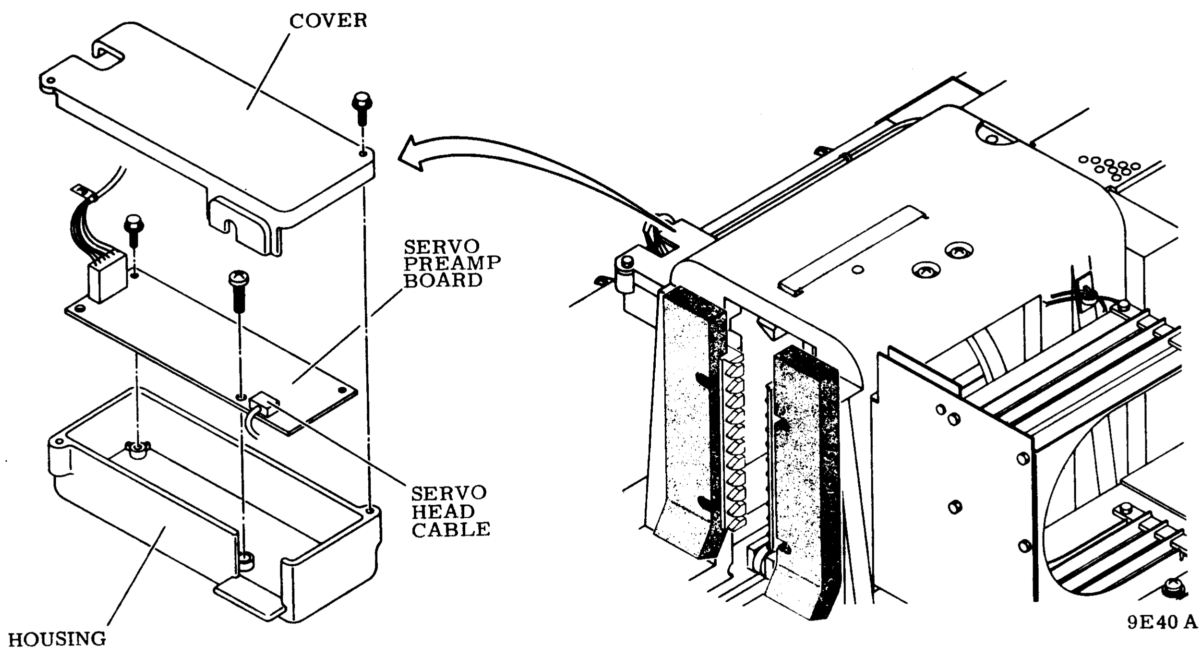


Figure 6-31. Servo Preamp Board Replacement

c. Remove hardware inside preamp housing that secure housing to deck.

d. Remove hardware securing preamp circuit board to housing then remove circuit board and set aside.

4. Install replacement servo preamp board as follows:

a. Secure preamp circuit board to housing.

b. Secure housing to deck.

c. Connect servo head cable plug and output plug P8 to preamp circuit board.

d. Secure housing cover to housing.

5. Install deck cover and close cabinet top cover.

SPEED SENSOR ASSEMBLY REPLACEMENT

The speed sensor assembly consists of the speed sensor and its mounting bracket, and is located on the pack sensor assembly. The following procedure describes speed sensor assembly replacement. Speed sensor adjustment is covered in the Speed Sensor Adjustment procedure.

REPLACEMENT (S/C 08 AND BELOW)

1. Remove power from the drive as follows:

a. Press START switch to stop drive motor and unload heads.

b. Remove disk pack.

c. Set MAIN AC circuit breaker to OFF.

2. Open cabinet front door.

3. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

4. Refer to figure 6-32 and remove speed sensor assembly as follows:

a. Disconnect speed sensor cable plug A3P3.

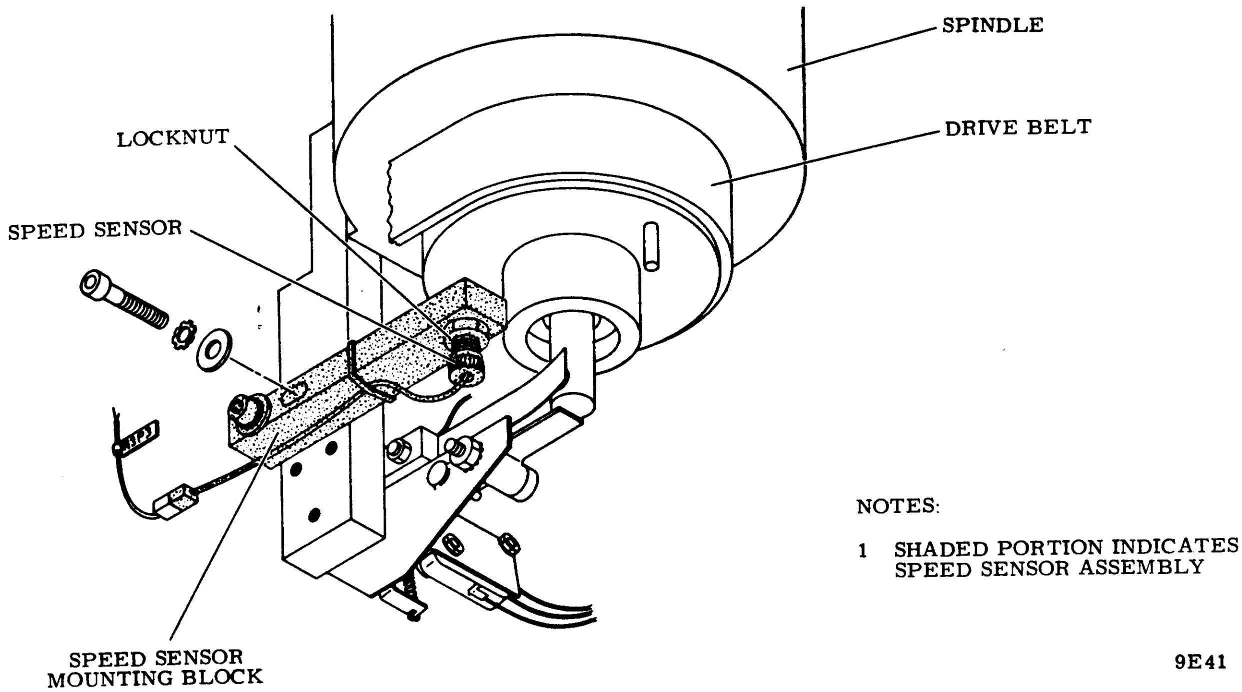


Figure 6-32. Speed Sensor Assembly Replacement (S/C 08 and Below)

b. Remove hardware securing speed sensor mounting bracket to pack sensor assembly and remove speed sensor assembly.

5. Install replacement speed sensor assembly as follows:

   a. Secure replacement speed sensor assembly to pack sensor assembly.

   b. Connect speed sensor cable plug A3P3.

   c. Secure speed sensor leadwire to speed sensor assembly mounting bracket with two cable ties.

6 Reinstall blower motor assembly (refer to Blower Motor Replacement procedure step 15).

7. Perform Speed Sensor Assembly Adjustment procedure.

REPLACEMENT (S/C 09 AND ABOVE)

1. Remove power from the drive as follows:

   a. Press START switch to stop drive motor and unload heads.

b. Remove disk pack.

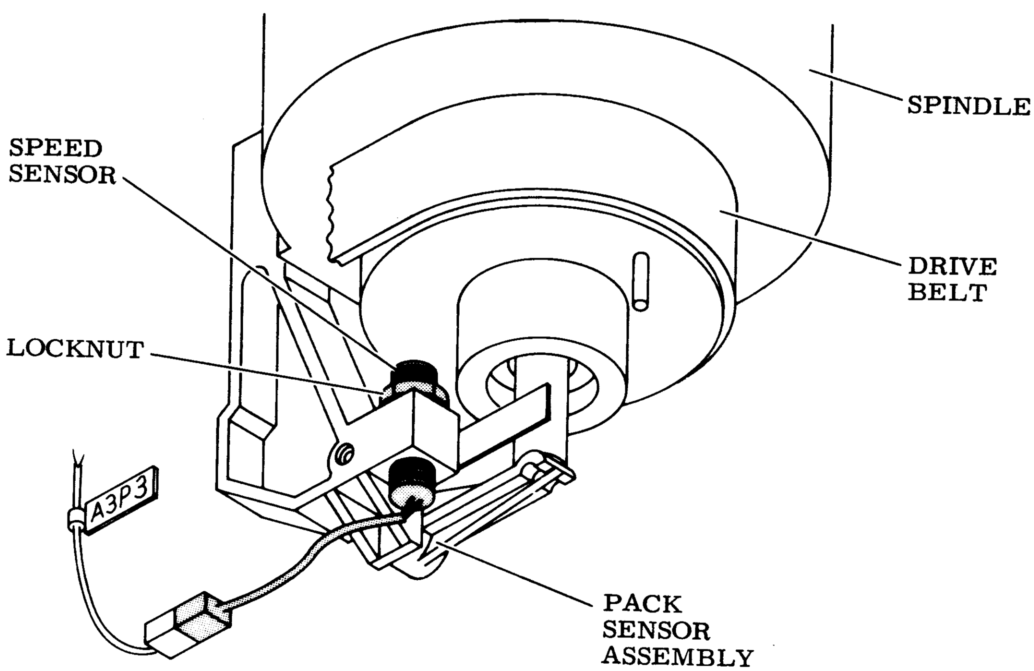
c. Set MAIN AC circuit breaker to OFF.

2. Open cabinet front door.

3. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

4. Refer to figure 6-33 and remove speed sensor assembly as follows:

   a. Disconnect speed sensor cable plug A3P3, and cut tie wrap from speed sensor leadwire.



NOTES: 1. SHADED AREAS INDICATE SPEED SENSOR ASSEMBLY.

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Figure 6-33. Speed Sensor Assembly Replacement (S/C 09 and Above)

b. Remove locknut from speed sensor.

c. Remove speed sensor from switch base.

5. Replace speed sensor assembly as follows:

   a. Install new speed sensor in switch base.

   b. Reinstall locknut on speed sensor. Torque to maximum 0.6 N·m (5 lbf·in).

   c. Connect speed sensor cable plug A3P3.

   d. Secure speed sensor leadwire to speed sensor switch base with a tie wrap.

   e. Perform speed sensor adjustment.

6. Reinstall blower assembly (refer to Blower Motor Replacement procedure step 15).

SPEED SENSOR ASSEMBLY ADJUSTMENT

The speed sensor assembly must be adjusted whenever the spindle assembly, pack sensor assembly, or speed sensor assembly are replaced. The speed sensor assembly has a lateral and a gap adjustment.

The lateral adjustment is accomplished by moving the speed sensor mounting bracket sideways until the sensor tip is in line with the steel pin on the spindle pulley.

The gap adjustment is accomplished by turning the speed sensor to achieve a specific distance between the sensor tip and the steel pin in the spindle pulley.

ADJUSTMENT (S/C 08 AND BELOW)

1. Remove power from the drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

2. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

CAUTION

Ensure that steel pin in pulley does not contact speed sensor. This could happen if speed sensor was significantly out of adjustment as, for example, following replacement.

3. Check lateral alignment of sensor tip and steel pin in spindle pulley as follows:

   a. Rotate spindle until speed pin in bottom of pulley is as close as possible to being centered over sensor tip.

   b. If steel pin will not center over sensor tip (refer to figure 6-32) proceed to step 4. If it is centered as in figure 6-34 proceed to step 5.

4. Adjust lateral alignment as follows (refer to figure 6-34):

   a. Loosen hardware securing sensor mounting bracket to pack sensor assembly.

   b. Move sensor mounting bracket either forward or backward until steel pin can be centered over sensor tip.

   c. Tighten screws in sensor mounting bracket.

   d. Recheck alignment and readjust if necessary.

5. Check gap between steel pin and sensor tip as follows (refer to figure 6-34):

   a. Rotate spindle pulley until steel pin is centered over sensor tip.

   b. Using a non metallic feeler gauge, check that gap between steel pin and sensor tip is between 0.40 and 0.50 mm (0.016 and 0.022 in).

   c. If gap is not within limits specified go to step 6. If it is within limits proceed to step 7.

6. Adjust gap between steel pin and sensor tip as follows:

   a. Loosen locknut on speed sensor by turning counterclockwise.

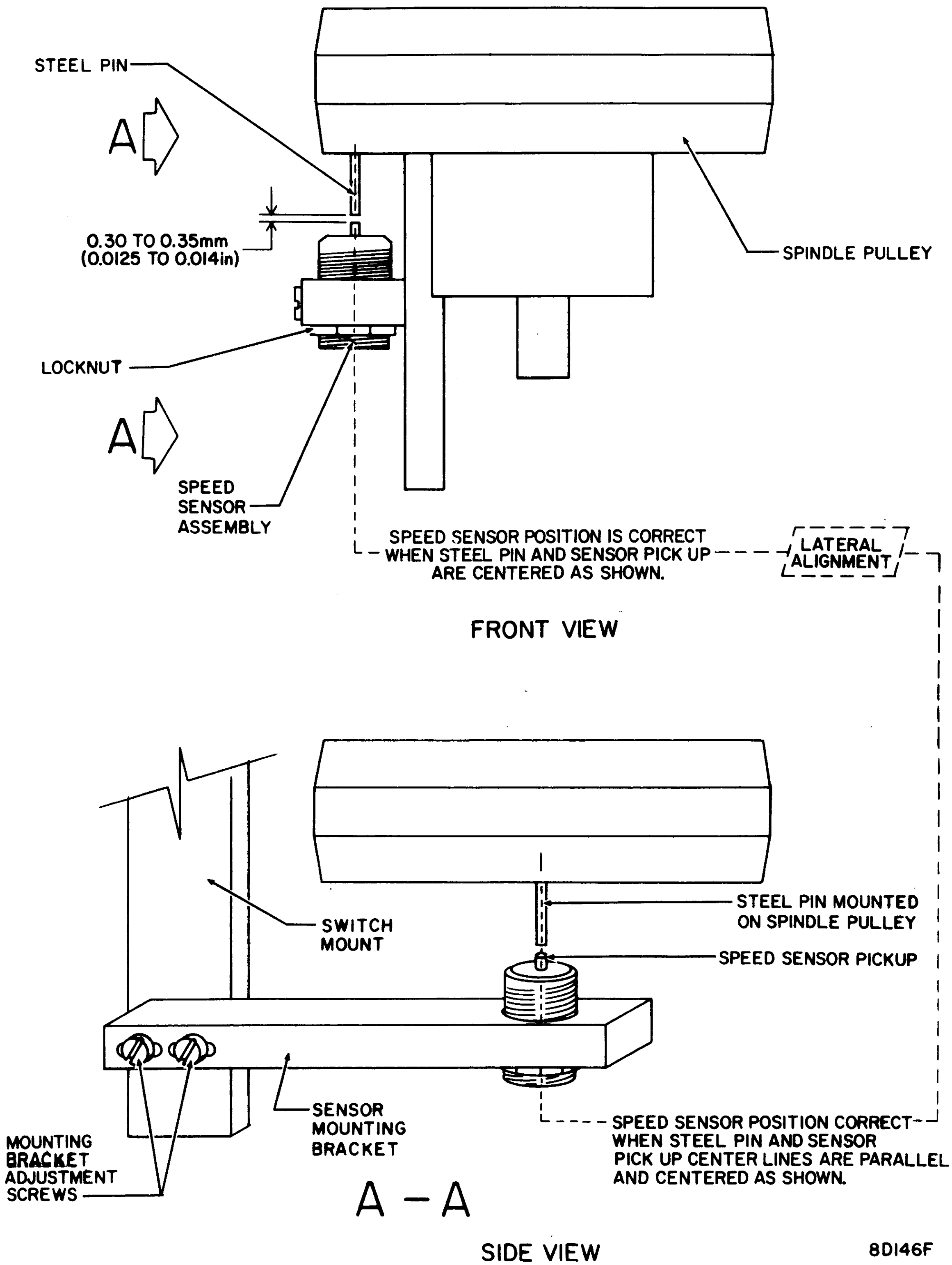

Figure 6-34. Speed Sensor Assembly Adjustment
(S/C 08 and Below)

CAUTION

Do not allow sensor tip to contact steel pin in pulley or damage to sensor tip or steel pin will result.

b. Turn sensor clockwise (looking from below) to narrow gap or counterclockwise to widen gap until gap specified in step 5 is obtained.

CAUTION

Do not over tighten speed sensor locknut or damage to speed sensor will result.

c. After adjusting speed sensor for correct gap, hold sensor stationary and tighten locknut.

d. Recheck gap as instructed in step 5.

7. Replace blower assembly (refer to Blower Motor Replacement procedure step 15).

8. Close cabinet front door.

9. Perform Speed Sensor Output Check procedure.

ADJUSTMENT (S/C 09 AND ABOVE)

1. Stop spindle motor.

2. Remove disk pack.

3. Set MAIN AC circuit breaker to OFF.

4. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

5. Use feeler gauge to ensure that gap between sensor tip and pin is as follows (refer to figure 6-35):

   Non-VDE: 0.152 to 0.254 mm (0.006 to 0.010 in),
   VDE: 0.100 to 0.203 mm (0.004 to 0.008 in)

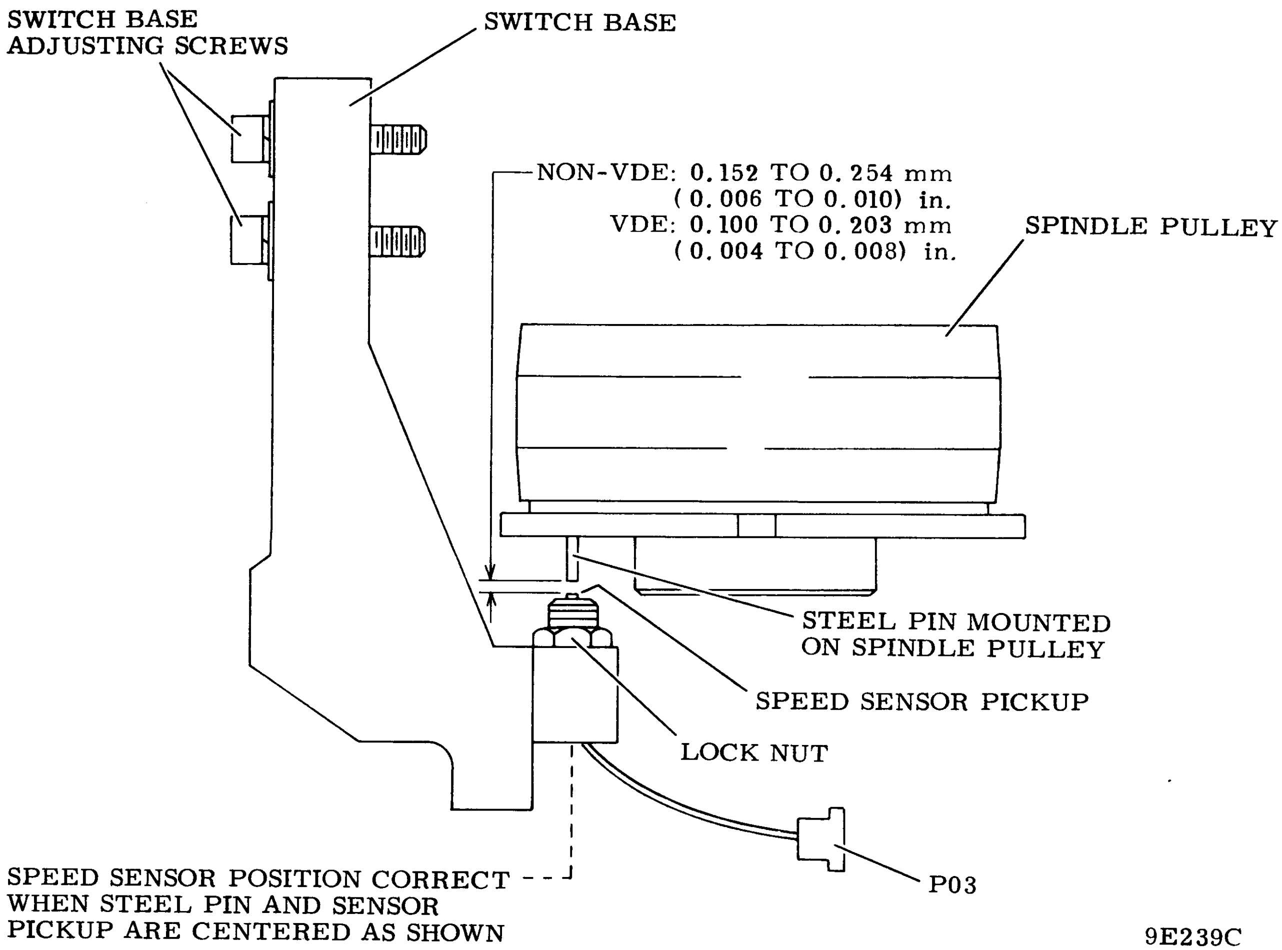

Figure 6-35. Speed Sensor Assembly Adjustment (S/C 09 and Above)

CAUTION

Ensure that steel pin in pulley does not contact speed sensor. This could happen if speed sensor was significantly out of adjustment as, for example, following replacement.

6. If requirement of step 5 is not met, adjust speed sensor as follows:

   a. Loosen locknut on speed sensor assembly.

   b. Adjust sensor assembly (clockwise rotation closes gap, counterclockwise rotation widens gap) to meet the requirements of step 5.

CAUTION

Do not over tighten locknut in next step, or you might damage plastic threads.

c. Torque locknut to 0.6 $\pm$0.1 N·m (5 $\pm$1 lbf·in).

d. Recheck dimension of gap.

7. Reinstall blower assembly (refer to Blower Motor Replacement procedure step 15).

8. Perform Speed Sensor Output Check procedure of Miscellaneous Logic Check.

SPINDLE LOCKSHAFT REPLACEMENT

The lockshaft is located within the spindle assembly (refer to figure 6-36); however, the lockshaft may be removed without removing the spindle. There is no adjustment required after lockshaft replacement.

REPLACEMENT (S/C 08 AND BELOW)

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Leaving cover open, set MAIN AC circuit breaker to OFF.

2. Open cabinet front door.

3. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

4. Remove leadwire to static groundspring.

5. Remove hardware securing groundspring mounting bracket to pack sensor assembly mounting block (refer to figure 6-34), then remove ground spring and mounting block.

6. Loosen pack on switch mounting plate adjustment screw (refer to figure 6-23) and swing mounting plate down so it will not interfere with lockshaft removal.

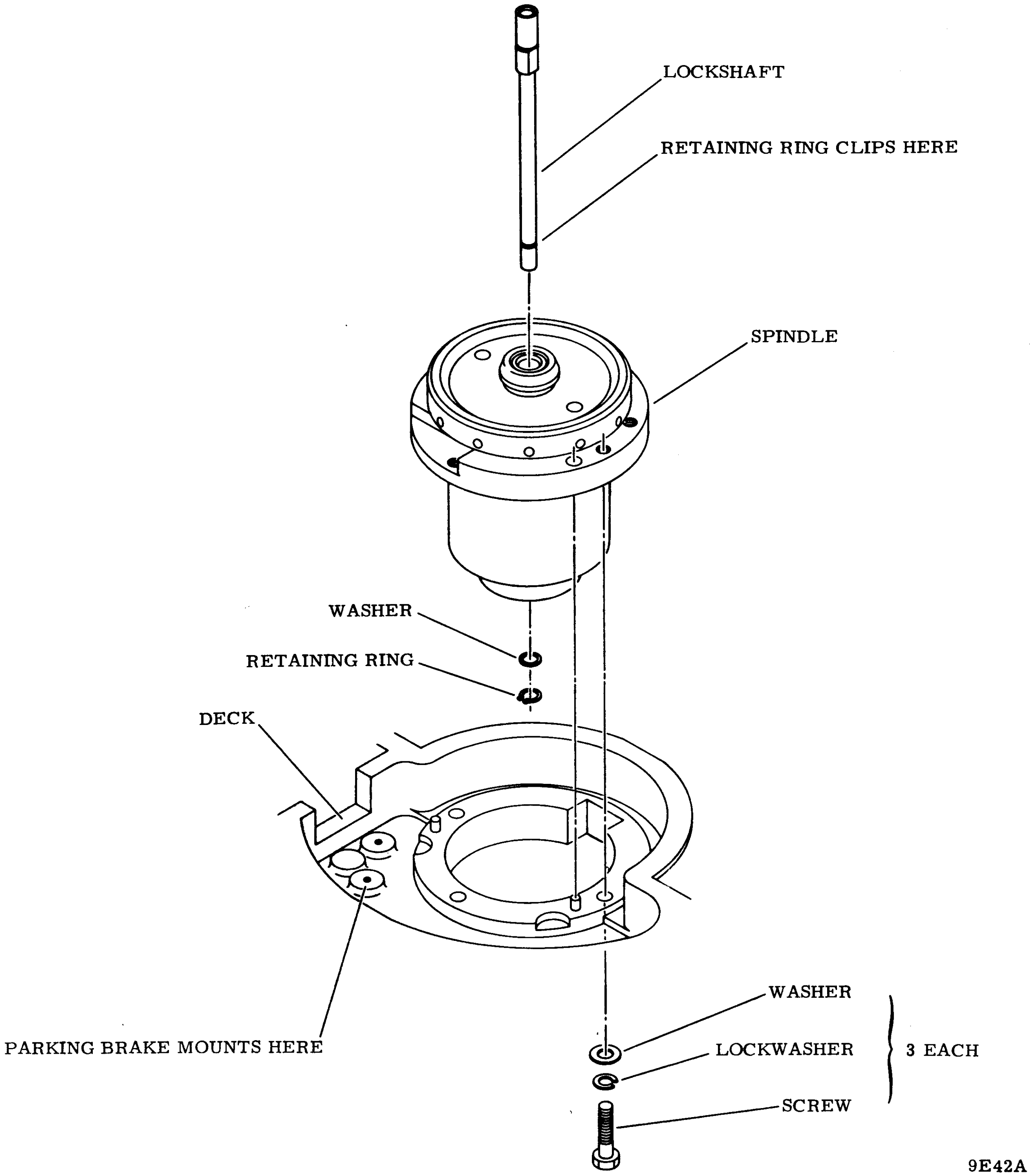

Figure 6-36. Spindle and Lockshaft Replacement

NOTE

In the following step, do not remove retaining ring securing springs in spindle assembly (this is retaining ring located behind flat washer removed in next step).

7. Remove hardware from lower end of lockshaft (refer to figure 6-36).

8. Carefully raise lockshaft out of top of spindle assembly.

9. Lower replacement lockshaft into spindle, then push lockshaft down until hardware can be snapped into place, thus securing lockshaft in spindle assembly.

CAUTION

Push downward on lockshaft making certain that it is free to move downward against internal spring force. Lockshaft must be free and not bind.

10. Position pack on switch mounting plate so that it is approximately in its normal position and tighten adjustment screw (refer to figure 6-23).

11. Position groundspring mounting bracket on pack sensor assembly mounting block, so that contact on end of spring is contacting lockshaft, then loosely secure block.

12. Install scratch pack and perform Pack On Switch Adjustment procedure .

13. Reconnect leadwire to static groundspring.

14. Perform Static Groundspring Adjustment procedure steps 4 and 5.

15. Reinstall blower assembly (refer to Blower Motor Replacement procedure step 15).

16. Close cabinet front door.

REPLACEMENT (S/C 09 AND ABOVE)

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

b. Remove disk pack.

c. Leaving cover open, set MAIN AC circuit breaker to OFF.

2. Open cabinet front door.

3. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

NOTE

Make sure that opening of lower air output section of blower assembly is covered to prevent any hardware from dropping into blower assembly.

4. Remove pack sensor assembly (refer to Pack Sensor Assembly replacement).

NOTE

In the following step, do not remove retaining ring securing springs in spindle assembly (this is retaining ring located behind flat washer removed in next step).

5. Remove hardware from lower end of lockshaft (refer to figure 6-36).

6. Carefully raise lockshaft out of top of spindle assembly.

7. Lower replacement lockshaft into spindle then push lockshaft down until hardware can be snapped into place, thus securing lockshaft in spindle assembly.

CAUTION

Push downward on lockshaft making certain that it is free to move downward against internal spring force. Lockshaft must be free and not binding.

8. Reinstall pack sensor assembly (refer to pack sensor assembly replacement).

9. Install scratch pack and perform pack on switch adjustment procedure.

10. Reconnect leadwire to static groundspring.

11. Perform Static Groundspring Adjustment procedure.

12. Reinstall blower assembly (refer to Blower Motor Replacement procedure step 15).

13. Close cabinet front door.

SPINDLE ASSEMBLY REPLACEMENT

The spindle assembly (refer to figure 6-36) includes the spindle and lockshaft. It is removed from the top of the deck with the pack sensor assembly still attached. The pack sensor assembly is then transferred to the replacement spindle and they are both replaced in the drive. The spindle must be realigned to the carriage following a spindle replacement. This is covered in the Spindle to Carriage Alignment procedure.

CAUTION

When spindle assembly is removed from drive or shipping container, do not allow it to rest on pulley end of assembly. When it must be set down, lay it on its side or on spindle face plate. Improper handling of spindle assembly may cause damage to spindle bearings which could result in premature failure of spindle or even damage to disks and heads.

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

2. Open drive cabinet front door.

3. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

4. Identify leadwires to pack on switch and static groundspring then disconnect leadwires and remove the tie wraps securing wires to pack sensor assembly.

5. Disconnect speed sensor plug A3P3.

6. Open cabinet rear door.

7. Remove drive belt as follows (refer to figures 6-7 and 6-8).

WARNING

To prevent possible eye injury, safety glasses must be worn when removing or replacing idler springs.

a. Attach spring puller (refer to list of maintenance tools in section 2) to spring. Check to ensure that spring is inserted into spring puller groove and end of spring is seated in round hole at the outer end of the tool (see figure 6-9).

b. Exert a force on the spring sufficient to remove it from the spring bracket standoff.

c. Slowly release the tension on the spring and remove it from the motor mounting plate standoff.

d. Twist the spring puller to remove it from the spring.

e. Remove the other spring using the same procedure.

f. Move motor mounting plate toward spindle to relieve tension on drive belt then slip belt off pulleys and set aside.

8. Remove parking brake assembly as follows (refer to figure 6-27):

   a. Open pack access cover.

   b. Remove hardware securing brake cover to shroud then remove cover and set aside.

   c. Remove hardware securing parking brake assembly to deck casting, then remove and set assembly aside.

9. Remove spindle assembly as follows (refer to figure 6-36):

   a. Remove hardware (located under deck) securing spindle assembly to deck.

CAUTION

When removing spindle, use care not to damage pack sensor assembly.

WARNING

Spindle is heavy. Use caution.

b. Lift spindle assembly straight up and off from dowel pins and remove from drive.

c. Remove pack sensor assembly from old spindle assembly and install on replacement spindle assembly.

NOTE

Ensure mating surfaces of spindle and deck are clean.

10. Lower replacement spindle into position on deck orienting pack sensor assembly toward drive motor and fitting spindle over pins in deck.

NOTE

Tighten spindle down evenly, keeping its bottom surface parallel to deck surface.

11. Secure spindle assembly to deck. Leave screws loose enough to allow lateral movement of spindle to carriage alignment.

12. Perform Spindle to Carriage Alignment procedure steps 5 through 23.

NOTE

Apply Loctite Primer, Grade N, and Loctite Grade C to screws used in step 14.

13. Secure parking brake to deck.

14. Perform Parking Brake Adjustment procedure steps 4 through 18.

15. Replace drive belt as follows (refer to figures 6-7 and 6-8):

a. Move drive motor and mounting plate back and forth several times to ensure the mounting plate is free to move.

WARNING

To prevent possible eye injury, safety glasses must be worn when removing or replacing idler springs.

b. Fit one end of spring over the motor mounting plate standoff.

c. Attach spring puller (refer to list of maintenance tools in section 2) to spring. Check to ensure that spring is inserted into the spring puller groove and the end of the spring is seated in the round hole at the outer end of the tool (see figure 6-9).

d. Install the belt (smooth side against pulleys) on both pulleys and exert a sufficient force on the motor mounting plate to maintain the belt in this position.

e. Exert a force on the spring sufficient to allow the end of the spring to be placed over the spring bracket standoff. Check to ensure that the curved ends of the spring are seated in the groove of each standoff.

f. Remove the spring puller from the spring by twisting and pushing at the same time.

g. Install the other spring using the same procedure.

h. Manually rotate spindle to seat drive belt.

i. Close rear door.

16. Perform Pack On Switch Adjustment procedure.

17. Replace groundlead on static groundspring and perform Static Groundspring Adjustment procedure.

18. Reconnect speed sensor cable plug A3P3.

19. Perform Speed Sensor Adjustment procedure.

20. Reinstall blower assembly (refer to Blower Assembly Replacement procedure step 15).

21. Close cabinet front door.

22. Perform Speed Sensor Output Check procedure.

SPINDLE TO CARRIAGE ALIGNMENT

This adjustment is required whenever the spindle is loosened from the deck casting. A similar adjustment must be made when the actuator is loosened from the deck; however, this is described in the Actuator Replacement procedure.

The spindle and carriage are properly aligned when carriage motion is along a radial line from the axis of rotation of the spindle assembly. The following describes spindle to carriage alignment.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack. Leaving cover open, set MAIN AC circuit breaker to OFF.

3. Raise top cover, then open pack access cover as far as possible (refer to figure 6-37).

4. Remove heads from surface position 17 and 18 as instructed in Head-Arm Replacement procedure steps 5, 6, and 8.

5. Install and position carriage alignment arm as follows (refer to figure 6-4):

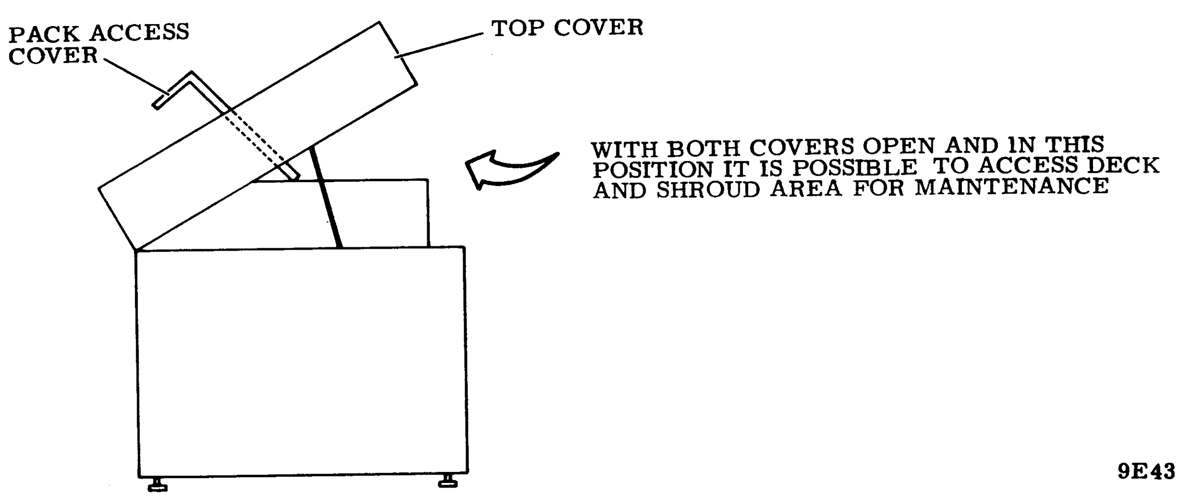

Figure 6-37. Cabinet with Pack Access and Top Cover Open

a. Install carriage alignment arm in head position 17 (second head position from bottom) and at an angle approximately parallel to the deck. Torque clamp screw to 0.5 ±0.1 N·m (4 ±0.5 lbf·in).

b. Slowly extend carriage until heads load, then forward until carriage alignment arm clears edge of spindle and is positioned approximately over spindle hub.

c. Loosen head-arm clamp screw, and tilt carriage alignment arm downward until it aligns with spindle hub as shown in figure 6-4, then torque clamp screw to 0.5 ±0.1 N·m (4 ±0.5 lbf·in).

d. Close top cover thus allowing pack access cover to fully open.

6. Check to see if clearance between carriage alignment arm and spindle hub is as specified in figure 6-4. If clearance is not as specified, proceed to step 7. If clearance is as specified, proceed to step 20.

7. Raise top cover so that covers are as shown in figure 6-37.

8. Unload heads and remove carriage alignment arm.

9. Close top cover allowing pack access cover to fully open.

10. Remove hardware securing parking brake cover to shroud and remove cover.

11. Raise top cover so that covers are as shown in figure 6-37.

12. Install and position carriage alignment are as instructed in step 5.

13. Close top cover allowing pack access cover to fully open.

14. Loosen hardware securing spindle to deck thus allowing lateral movement of spindle assembly.

NOTE

If specified clearance is obtained in step 15, proceed to step 17. However, if it is too far out of alignment to be adjusted in this manner, move the actuator housing to obtain the proper clearance. In this case proceed to step 16.

15. Using spindle adjustment tool, move spindle to obtain clearance specified in figure 6-4.

16. Align spindle to carriage by moving actuator housing as follows:

    a. Move spindle until dowel pins (refer to 6-4) are centered in spindle slots, then tighten hardware securing spindle to deck.

    b. Raise top cover so that covers are as shown in figure 6-37.

    c. Unload heads and remove carriage alignment arm.

    d. Close pack access and top covers.

    e. Loosen the hardware securing actuator housing to the deck.

NOTE

> To gain access to the pack area while the drive is powered down, pull down on the solenoid latch and up on the pack access cover latch release.

17. Open pack access cover and secure spindle by tightening spindle screws.

18. Recheck clearance and if it is incorrect, repeat steps 14 and 15 until proper clearance is obtained.

19. Raise top cover so that covers are as shown in figure 6-37.

20. Unload heads and remove carriage alignment arm.

21. Replace heads (removed in step 4) as instructed in Head-Arm Assembly Replacement procedure steps 9 - 11.

22. Close top cover allowing pack access cover to fully open.

23. Replace parking brake cover.

24. Perform Head Alignment procedure for heads in surface positions 17 and 18.

STATIC GROUNDSPRING REPLACEMENT

The static groundspring is mounted on the static groundspring mounting bracket which, in turn, is mounted on the pack sensor assembly.

This procedure describes removal and replacement of the groundspring from its mounting bracket. Adjustment is required following replacement. This is described in the Static Groundspring Adjustment procedure

REPLACEMENT (S/C 08 AND BELOW)

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Remove disk pack.

   c. Set MAIN AC circuit breaker to OFF.

2. Remove blower assembly. (Refer to Blower Motor Replacement procedure steps 3 and 4).

3. Refer to figure 6-38 and remove static groundspring leadwire from terminal on groundspring.

4. Remove static groundspring from its mounting block and set aside.

5. Install replacement groundspring on static groundspring mounting block.

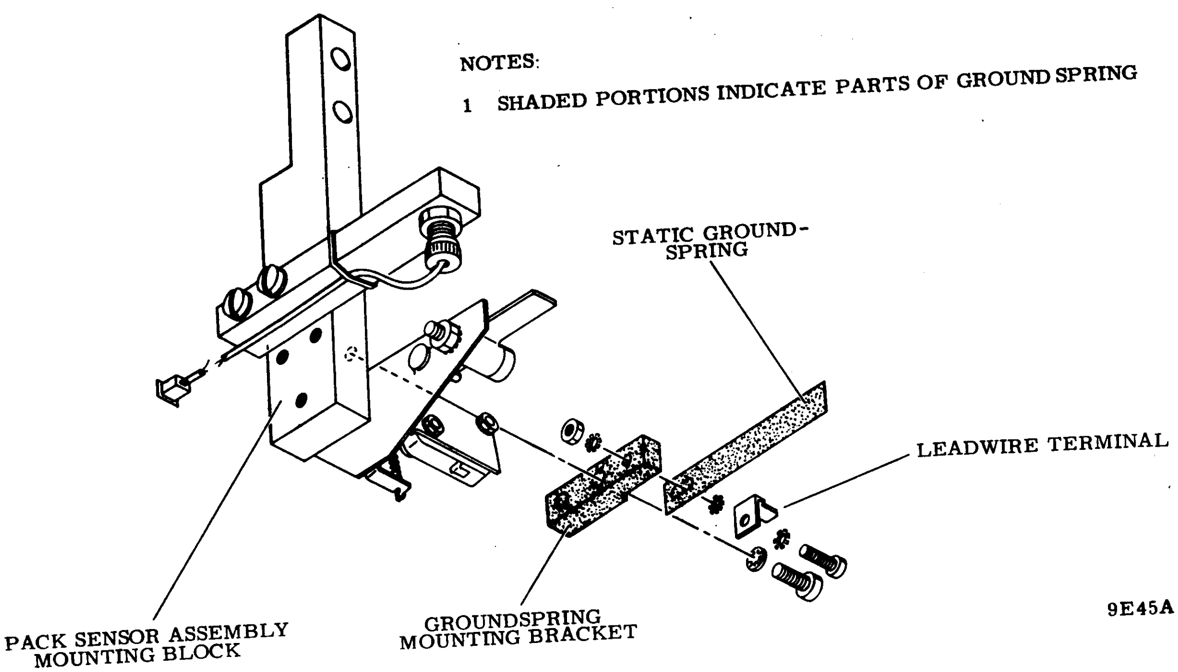

Figure 6-38. Static Groundspring Replacement (S/C 08 and Below)

6. Replace static groundspring leadwire to groundspring terminal.

7. Reinstall blower motor assembly (refer to Blower Motor Replacement procedure step 15).

8. Perform Static Groundspring adjustment procedure.

9. Replace blower assembly (refer to Blower Motor Replacement procedure).

REPLACEMENT (S/C 09 AND ABOVE)

1. Stop spindle motor.

2. Remove disk pack.

3. Set MAIN AC circuit breaker to OFF.

4. Refer to Side Panel Removal/Installation procedure and remove left (viewed from front) side panel.

5. Refer to figure 6-39 and remove static ground spring leadwire.

6. Remove self threading screw, lockwasher, terminal lug, and groundspring from switch base bracket.

7. Install replacement groundspring on switch base bracket using screw, lockwasher, and terminal lug.

8. Perform Static Groundspring Adjustment procedure.

9. Connect groundspring leadwire.

10. Reinstall side panel per Side Panel Removal/Installation procedure.

STATIC GROUNDSPRING ADJUSTMENT

This adjustment properly positions the static groundspring in relation to the lockshaft. A check is also made to ensure the groundspring has the correct tension.

ADJUSTMENT (S/C 08 AND BELOW)

1. Remove power from drive as follows:

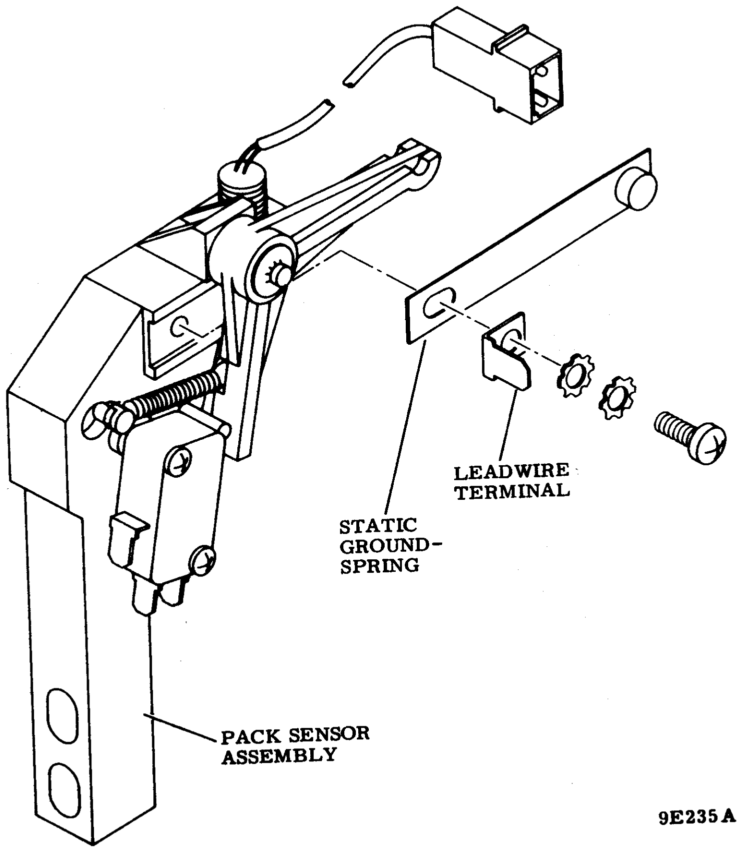

Figure 6-39. Static Groundspring Replacement
(S/C 09 and Above)

a. Press START switch to stop drive motor and unload heads.

b. Remove disk pack.

c. Set MAIN AC circuit breaker to OFF.

2. Remove blower assembly (refer to Blower Motor Replacement procedure steps 3 and 4).

3. Refer to figure 6-38 and check that static groundspring is approximately centered vertically and on lockshaft (refer to figure 6-40). If spring is not centered, loosen hardware securing spring to its mounting bracket, center spring as required then tighten screw.

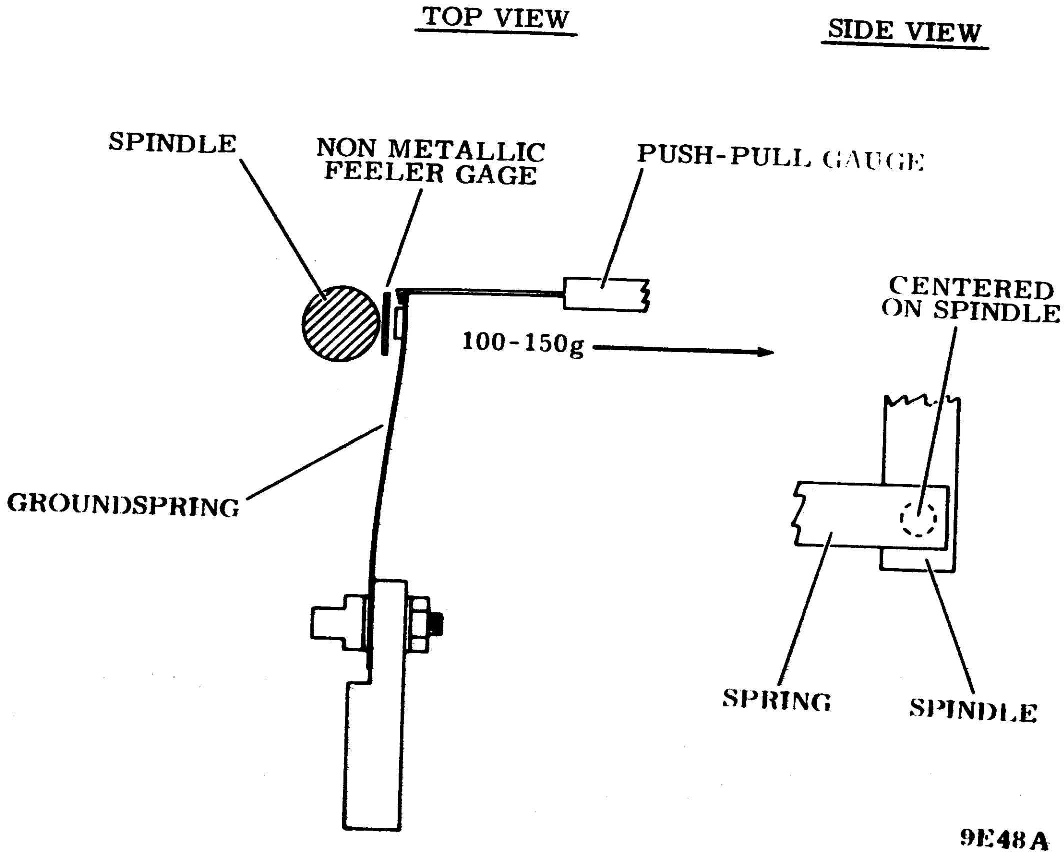

Figure 6-40. Static Groundspring Adjustment

4. Check static groundspring tension as follows:

   a. Place 0.05 to 0.10 mm (0.002 to 0.005 in) non-metallic feeler gauge between groundspring and lockshaft.

   b. Hook push pull gauge to outer end of groundspring and note force required to allow feeler gauge to fall free. Force should be from 100 to 150 grams.

   c. If requirements of step b are not met, carefully bend groundspring to adjust tension.

5. Replace blower assembly (refer to Blower Motor Replacement procedure step 15).

6. Close cabinet front door.

ADJUSTMENT (S/C 09 AND ABOVE)

1. Stop spindle motor.

2. Remove disk pack.

3. Set MAIN AC circuit breaker to OFF.

4. Refer to Side Panel Removal/Installation procedure and remove left (viewed from front) side panel.

5. Refer to figure 6-40 and visually check that groundspring is approximately centered on lockshaft.

6. If required, loosen hardware securing groundspring to mounting bracket and center spring as required. Tighten hardware.

7. Place a 0.5 ±0.05 mm (0.019 ±0.003 in) non-metallic feeler gauge between groundspring and lockshaft.

8. Hook a push-pull gauge to outer end of groundspring.

9. Force (applied perpendicular to spring) required to allow feeler gauge to fall free should be 125 (±25) grams.

10. If required, adjust set screw in switch base bracket for proper spring tension.

11. Reinstall side panel per Side Panel Removal/Installation procedure.

VELOCITY TRANSDUCER ASSEMBLY REPLACEMENT

The velocity transducer assembly consists of the coil housing, transducer core, and the extension rod (refer to figure 6-5).

The coil housing is secured to the magnet assembly while the transducer core (located inside the coil housing) is connected to the carriage by the extension rod. As the carriage is moved to position the head-arm assemblies, the transducer core and extension rod move with it. The following describes replacement of the transducer coil housing and core.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

3. Open cabinet top cover and remove deck cover.

4. Disconnect voice coil yellow leadwire.

5. Remove transducer coil and core assembly as follows:

   a. Manually move carriage forward until end of extension rod can be unthreaded from carriage (refer to figure 6-5). However, do not remove transducer core and rod until instructed to do so.

   b. Remove velocity transducer cable plug P4.

   c. Remove hardware securing velocity transducer end cap to magnet and remove end cap.

CAUTION

Transducer core can be rendered unusable if it comes in contact with a ferromagnetic object.

   d. Carefully remove coil housing and transducer core (connected to extension rod) from magnet and set aside.

6. Carefully remove replacement coil and core from shipping container and set on a nonferrous surface.

7. Determine which end of the replacement transducer core is to be connected to extension rod as follows:

NOTE

Replacement transducer core should have a red dot or stripe indicating the north pole end of the core. Therefore, the unmarked end is the core's south pole. The unmarked end (south pole) always connects to the extension rod. Whether or not core has a marked end, always check replacement core to determine polarity.

   a. Place end of replacement transducer core (end without red marking if it is marked) next to end of defective transducer core which is connected to extension rod. If cores repel each other, this is the end of replacement transducer core that connects to extension rod. If cores attract each other, opposite end connects to extension rod.

   b. After determining which end of replacement transducer core to connect to extension rod, place replacement transducer core on a nonferrous surface.

CAUTION

Grasp extension rod at end nearest transducer core when separating or connecting the two.

8. Carefully unthread extension rod from defective transducer core assembly and set defective transducer core aside.

NOTE

Apply one drop of Loctite, Grade C, to end of extension rod connecting to transducer core.

9. Thread extension rod into end of transducer core observing that polarity of replacement core is same as old transducer core. Wipe off excess Loctite.

10. Insert replacement transducer core and extension rod into replacement coil housing until core is completely contained in housing.

11. Install replacement transducer core and coil housing in magnet as follows:

    a. Insert replacement coil housing, containing transducer core and extension rod, into magnet.

    b. Position velocity transducer end cap and spring on magnet, then secure end cap to magnet.

    c. Apply one drop of Loctite, Grade C, to extension rod threads, then thread extension rod into carriage.

    d. Connect velocity transducer cable plug P4.

12. Manually move carriage back to retracted stop.

13. Set MAIN AC circuit breaker to ON.

14. Install scratch disk pack.

15. Ensure velocity transducer output has proper polarity by performing following the check:

    a. Open cabinet rear door.

    b. Open logic chassis and remove card cover.

    c. Connect oscilloscope channel 1 (using 10X probe) to A20-TPE.

d. Trigger oscilloscope positive internal.

e. Press START switch to start drive motor.

CAUTION

Refer to Manually Positioning Carriage procedure in General Maintenance section 2 (steps 4 and 5) when performing steps f and g.

f. Manually load heads.

g. Manually move carriage in a forward direction and observe that oscilloscope waveform goes in a negative direction. If signal goes positive, transducer core is in backwards. In this case, remove core, turn it end for end and repeat this check.

h. Manually retract heads as instructed in step 7 of Manually Positioning Carriage procedure.

i. Press START switch to stop drive motor and unload heads.

j. Remove disk pack.

16. Set MAIN AC circuit breaker to OFF.

17. Reconnect yellow leadwire to voice coil.

18. Replace deck cover and close top cover.

19. Perform the following procedures:

    a. Servo System Adjustments.

    b. Velocity Transducer Gain Uniformity Check.

VOICE COIL FLEX LEAD REPLACEMENT

The voice coil flex leads are attached between the carriage and actuator housing. They consist of flexible copper strips separated by flexible insulators. The following procedure describes replacement and adjustment of the flex leads. Adjustment is required so they do not bind, kink, or restrict carriage travel.

1. Press START switch to stop drive motor and unload heads.

2. Open pack access cover and remove pack, close cover, and set MAIN AC circuit breaker to OFF.

3. Open drive top cover and remove deck cover.

4. Remove connectors from cards E01, E02, and E03 in read/write chassis. Remove these cards and set them aside.

5. Disconnect voice coil leadwires coming from power amplifier from voice coil flex leads (refer to figure 6-41).

6. Remove voice coil flex lead as follows:

   a. Remove hardware securing voice coil leads and flex lead mounting bracket to actuator housing.

   b. Separate flex leads from mounting bracket and attaching hardware then set bracket and attaching hardware aside.

   c. Position free end of flex leads out of actuator housing.

   d. Manually extend carriage until end of flex leads attached to carriage is easily accessed.

   e. Remove hardware securing number two (brown) leadwire, flex leads and backing plate to carriage.

   f. Disconnect number one (yellow) leadwire from flex lead.

   g. Remove voice coil flex leads and backing plate from actuator housing and set aside.

CAUTION

Handle replacement flex leads carefully; do not bend or twist them. Also, ensure that flex lead copper strips are parallel when installation is complete.

7. Install replacement voice coil flex leads as follows:

   a. Position flex leads inside actuator housing as shown in figure 6-41 only with mounting bracket not in place.

NOTE

Apply one drop of Loctite, Grade C, to screws used in steps b, c and d.

   b. Secure number one (yellow) leadwire to flex conductor.

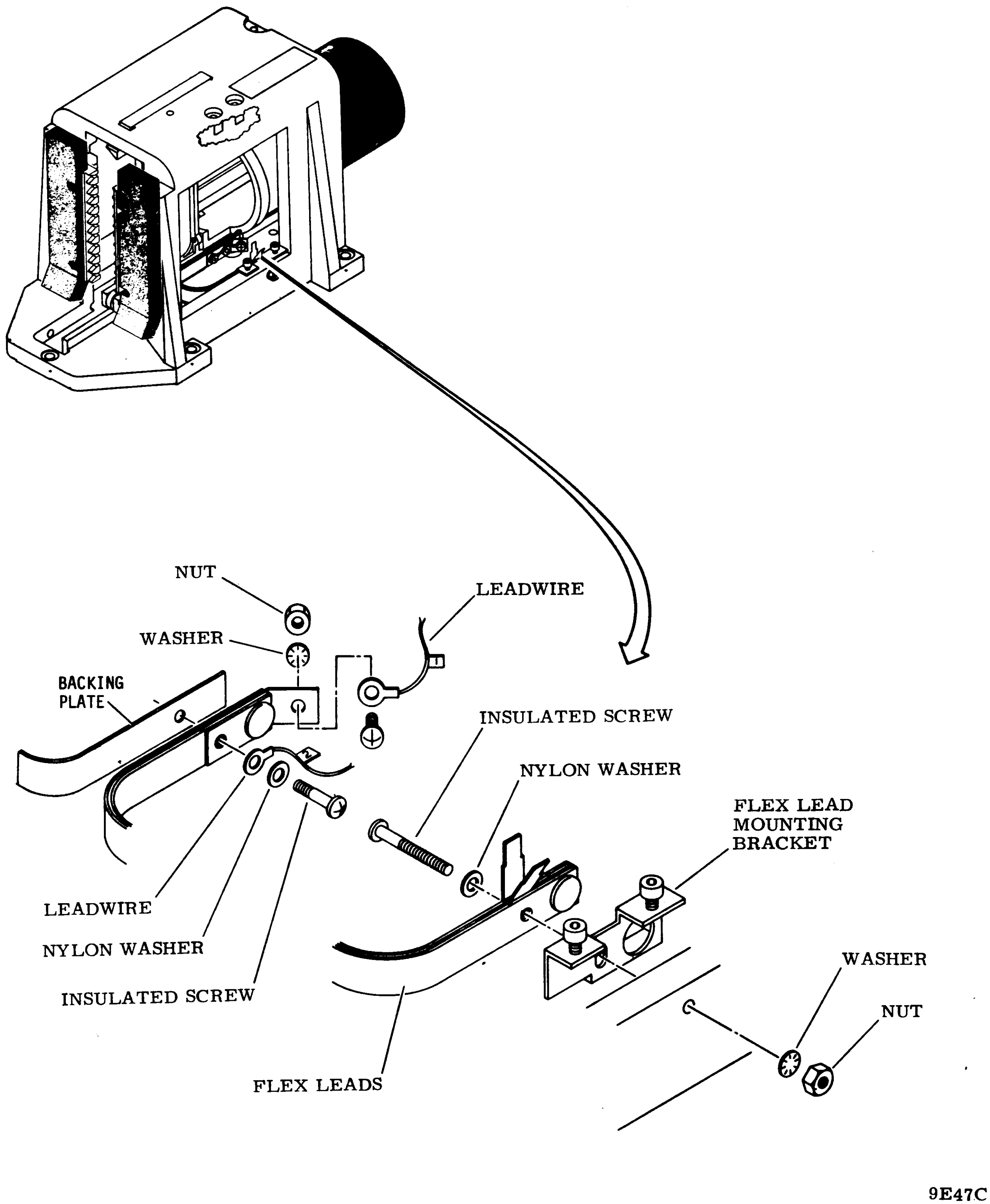

Figure 6-41. Voice Coil Flex Lead Replacement

c. Secure number two (brown) leadwire, flex lead and backing plate to carriage.

d. Secure flex lead mounting bracket and flex leads to actuator housing as shown on figure 6-41.

8. Inspect and adjust voice coil flex leads as follows:

   a. Ensure that leads do not touch carriage casting. If necessary, carefully bend leads until this requirement is met.

   b. Ensure that copper strips are parallel. If necessary, loosen all screws and adjust copper strips until they are parallel.

   c. Check that flex leads travel freely, without kinking or interfering with carriage movement, through entire range of travel. If necessary, adjust mounting bracket or flex lead connections.

9. Perform steps 5 and 6 of Clean Carriage Rails and Bearings procedure in Preventive Maintenance section.

10. Reconnect voice coil leadwires.

11. Replace cards E01, E02 and E03 in read/write chassis and reconnect connectors to them.

12. Manually move heads back to fully retracted position.

13. Replace plastic magnet shield on magnet.

14. Replace deck cover and close top cover.

VOICE COIL REPLACEMENT

The following procedure describes replacement of the voice coil without removing the carriage or heads (refer to figure 6-3).

1. Remove power from drive as follows:

   a. Press START switch to stop drive motor and unload heads.

   b. Set MAIN AC circuit breaker to OFF.

2. Remove disk pack.

3. Raise top cover and remove deck cover.

CAUTION

The magnetic field generated by the magnet is very strong. Permanent watch damage could occur if watch gets near magnet.

4. Remove Read/Write logic cards from locations E01, E02, and E03.

5. Manually position carriage so that carriage locking pin can be inserted into locking pin alignment hole to lock the carriage in the track alignment position.

NOTE

Remember positioning and routing of voice coil leadwires and where they attach to carriage for reassembly.

6. Remove the flex lead mounting hardware attached to the voice coil (refer to Voice Coil Flex Lead Replacement procedure steps 6e, 6f and 6g).

7. Remove flex lead backing plate.

CAUTION

Do not disassemble the velocity transducer.

8. Refer to Velocity Transducer Replacement procedure and remove the velocity transducer from the magnet assembly.

9. Remove magnet assembly as follows (refer to figure 6-3).

NOTE

To assure realignment of the magnet during reassembly, make sure to make alignment marks where magnet and actuator meet and where the magnet rests on the deck casting.

   a. Loosen hardware securing rear deck seal to frame and remove rear deck seal.

   b. Loosen hardware securing rear deck plate to deck and remove rear deck plate.

   c. Remove top cover latch attached to frame.

   d. Remove plastic magnet cover by prying cover from magnet assembly.

CAUTION

Be careful when removing screw in the next step. The magnet will cause a pulling pressure to the wrench being used and could damage the actuator components.

e. Remove screw securing actuator housing to magnet assembly. This screw is located at the top inside surface of the actuator housing next to the magnet.

f. Move carriage as far forward as possible.

g. Remove hardware securing stop plate to stop mount on magnet.

h. Remove hardware (under deck) securing magnet assembly to deck.

CAUTION

When removing magnet assembly, use care not to damage voice coil. Also, make sure magnet is away from metal filings and other metallic objects.

i. Remove magnet from deck by sliding straight back from voice coil (ensure that voice coil is pushed forward).

CAUTION

When removing only the voice coil, do not remove carriage from actuator housing. Removal could cause bearing-to-rail misalignment. Ensure that carriage locking pin is seated in shipping lock location.

10. Remove hardware securing the voice coil to the carriage. Gently rest the coil on the deck casting.

11. Remove hardware attaching the number one (yellow) voice coil leadwire to the flex lead. Ensure that carriage locking pin is seated in shipping lock position. Remove the voice coil.

NOTE

Apply one drop of Loctite, Grade C, to screws used in steps 12 and 14.

12. Gently rest replacement voice coil on deck casting and secure the number one (yellow) voice coil leadwire to the flex lead.

CAUTION

Be careful when attaching voice coil to carriage; otherwise, servo circuit could become unstable and cause "ringing".

13. Attach replacement voice coil to the carriage using four screws and lockwashers. Position coil on alignment pin and tighten screws in a cross pattern to 1.3 $\pm$ 0.1 N·m (12 $\pm$ 1 lbf·in). Avoid any mechanical distortion.

14. Secure number one (yellow) and two (brown) leadwires, flex lead, and backing plate to carriage.

CAUTION

To avoid damaging voice coil windings, use care when performing the following step.

15. Install magnet assembly by carefully sliding magnet into position and loosely secure it to deck.

CAUTION

To avoid voice coil damage, use care when performing the following step.

16. Align magnet and voice coil as follows:

    a. Loosely install hardware through top of actuator into magnet assembly.

    b. Remove carriage locking pin from alignment hole and place in storage hole.

    c. Slowly move voice coil in and out of magnet assembly while moving magnet assembly as necessary to ensure voice coil is not making contact with it.

    d. While moving coil in and out of magnet insert a 0.15 mm (0.005 in) non metallic feeler gauge between coil and magnet to ensure a 0.15 mm (0.005 in) gap exists all around coil.

    e. Torque screw through top of actuator, to 6.8 $\pm$ 0.2 N·m (60 $\pm$ 2 lbf·in).

    f. Recheck gap and if required, loosen screw, and repeat alignment procedure until proper gap is obtained.

    g. Torque hardware securing magnet to deck to 3.4 $\pm$ 0.1 N·m (30 $\pm$ 1 lbf·in).

h. Recheck gap (step c) and if required, loosen all magnet screws and repeat steps b through f until proper gap is obtained.

17. Secure stop plates to magnet assembly. Ensure that stop rods do not rub on stop plates during carriage movement.

18. Replace plastic magnet shield.

19. Install velocity transducer assembly as described in Velocity Transducer Assembly Replacement procedure.

20. Inspect and adjust voice coil leadwires and voice coil flex leads as described in the Voice Coil Flex Lead Replacement procedure.

21. Remove carriage locking pin, place it in storage hole, and return carriage to fully retracted position.

22. Install logic cards in read/write chassis.

23. Replace cable connectors on read/write cards.

24. Replace rear deck seal and rear deck plate.

25. Replace deck cover and lower top cover.

26. Replace disk pack.

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REVISIONS

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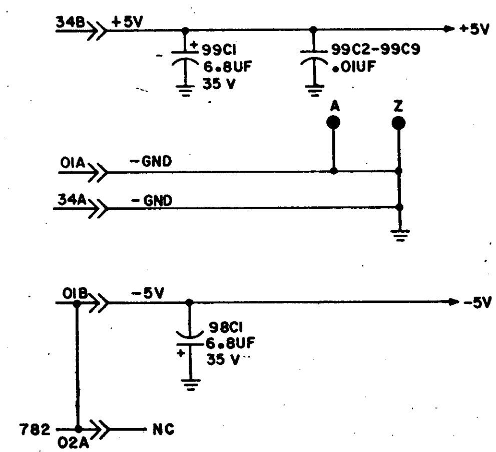

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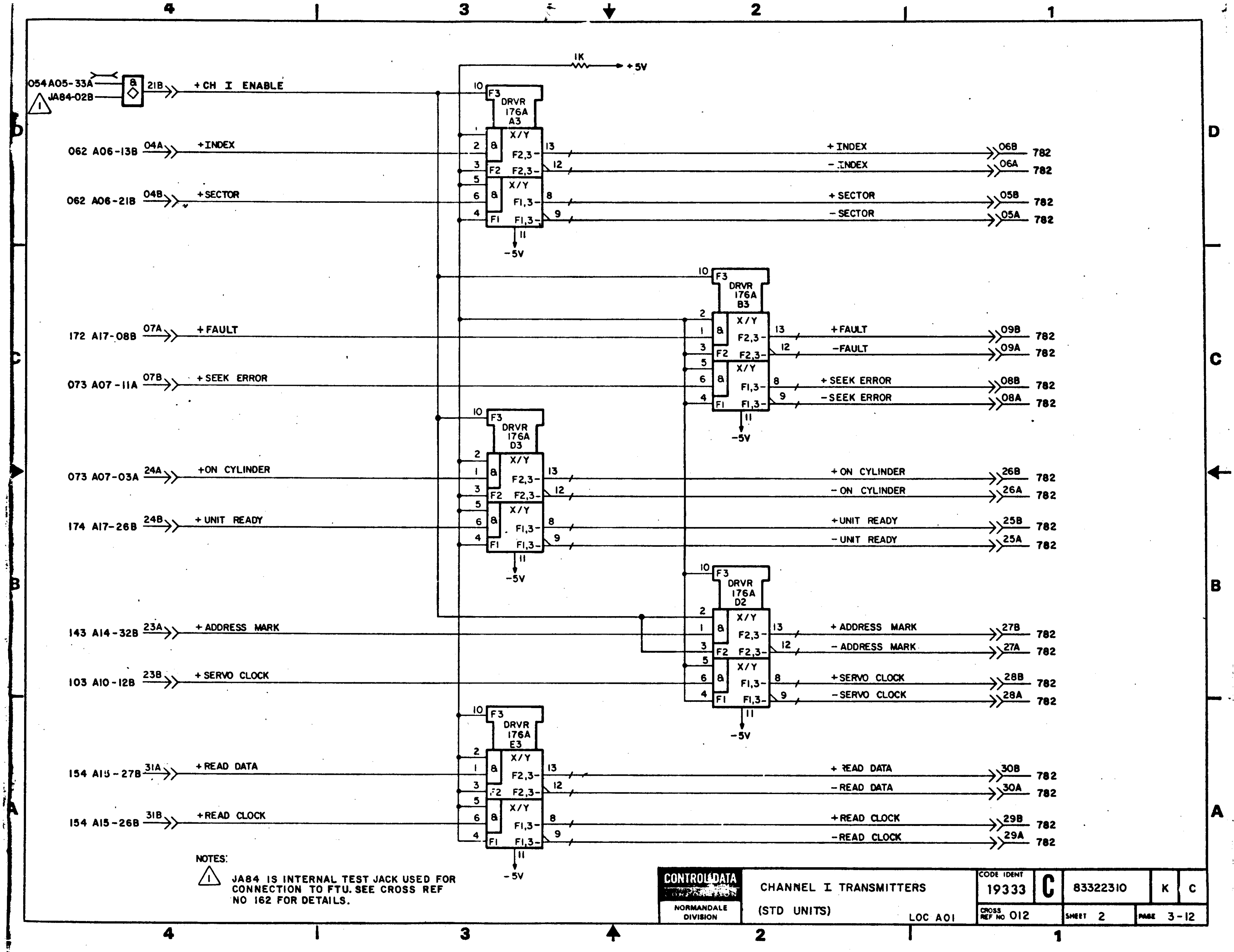
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1 JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REF NO 162 FOR DETAILS.
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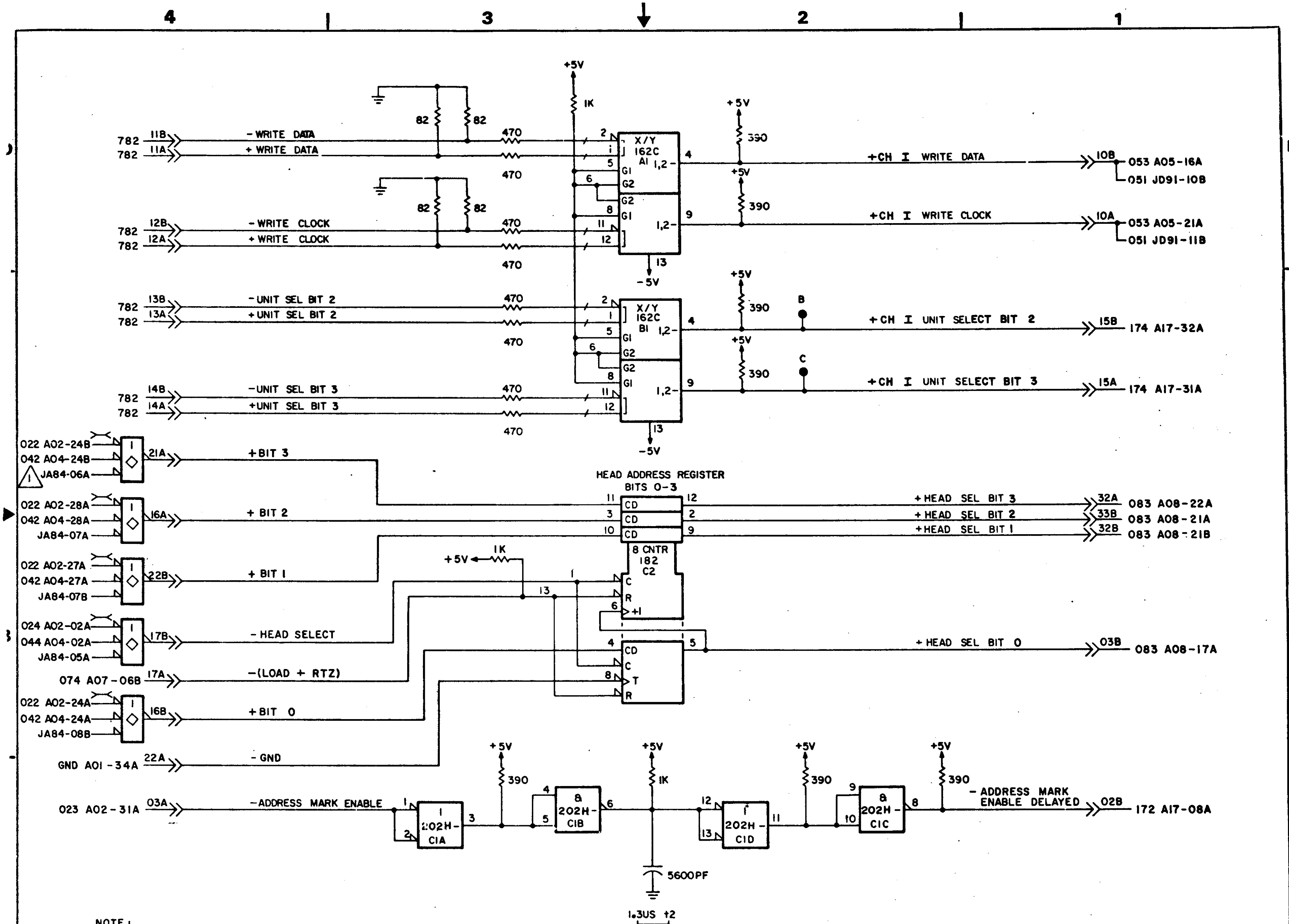
PAGE 3-12



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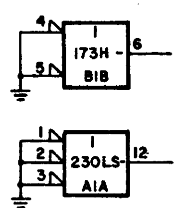

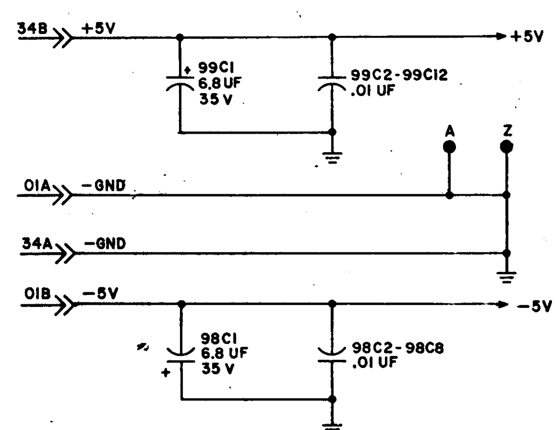

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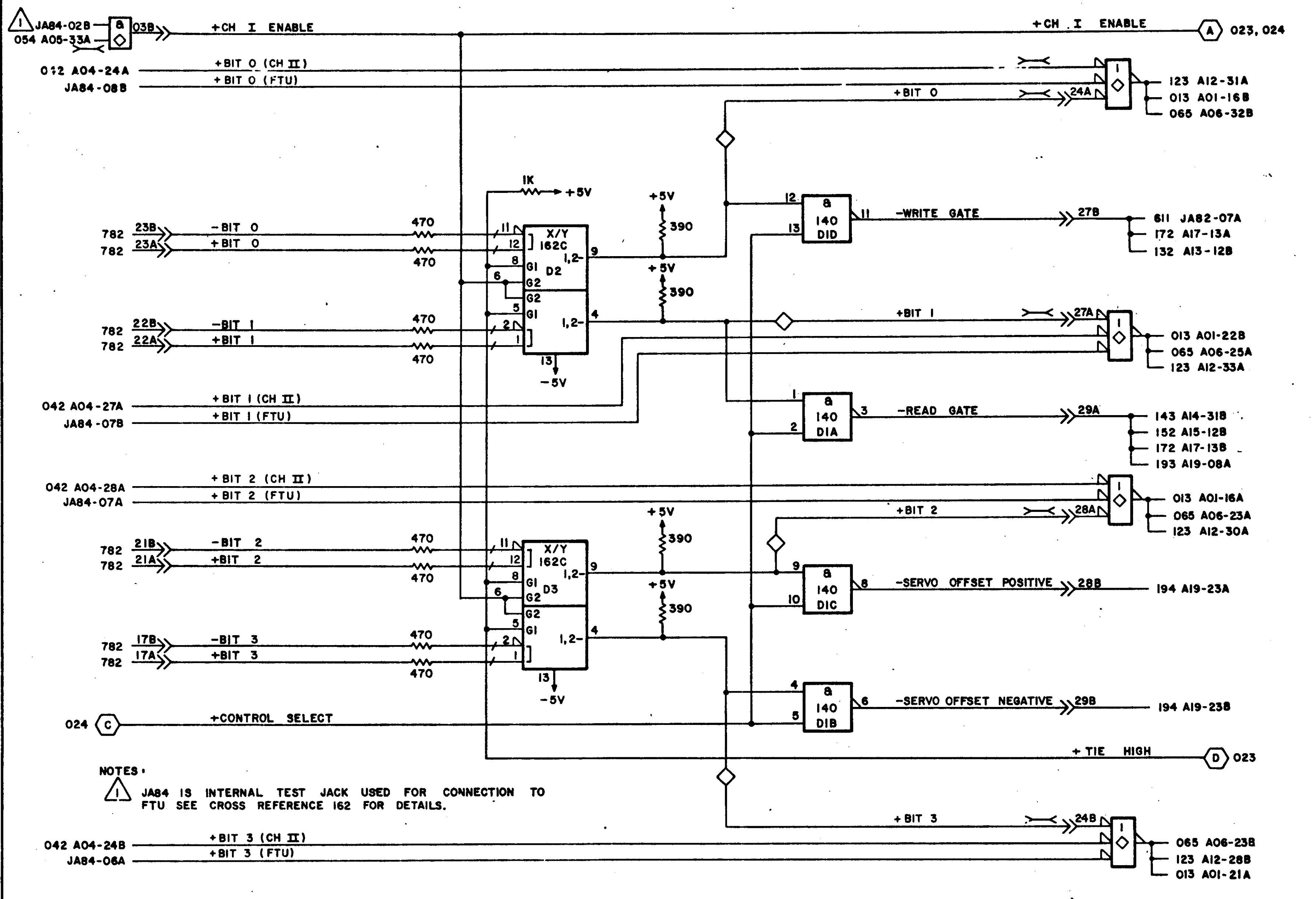

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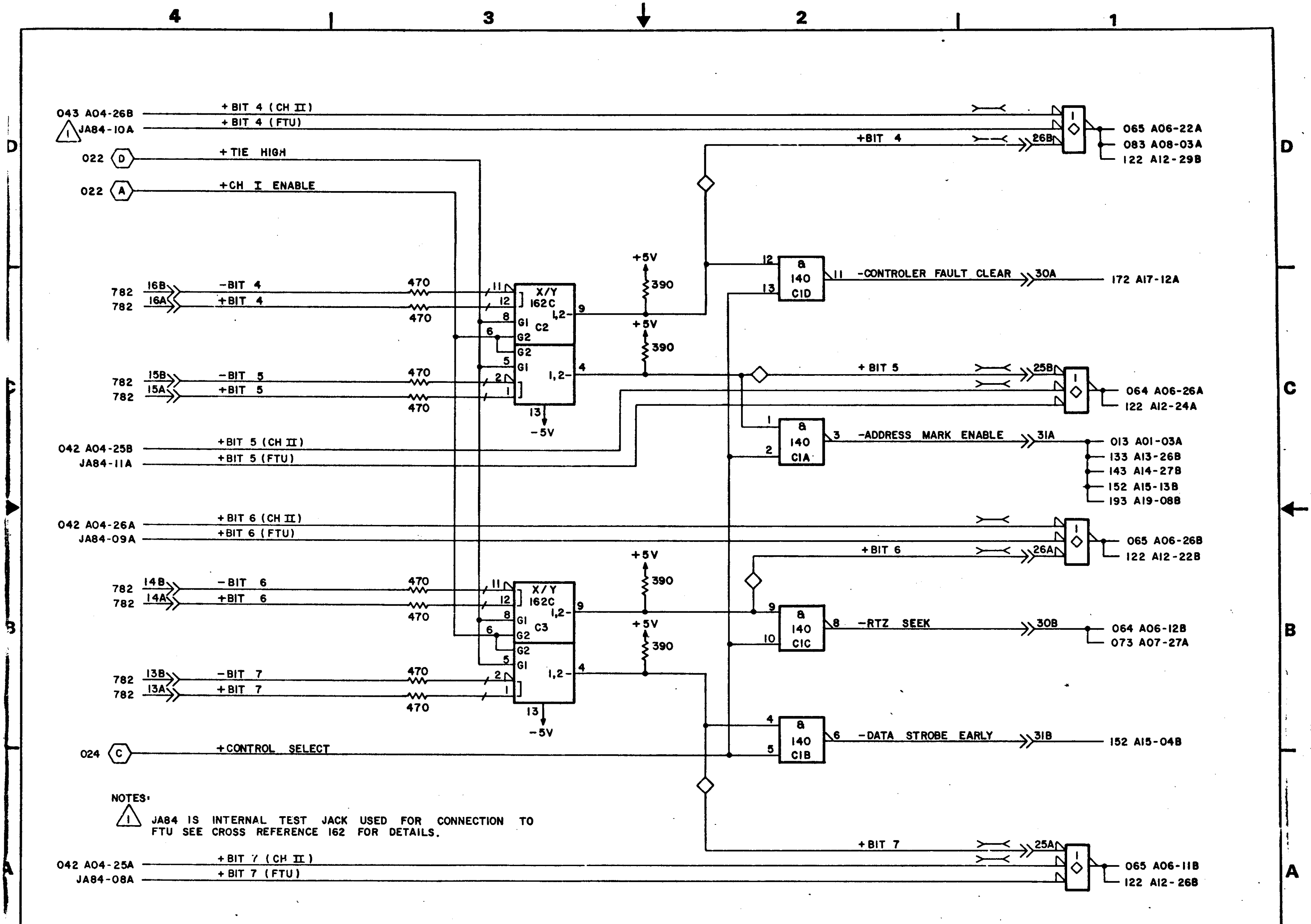

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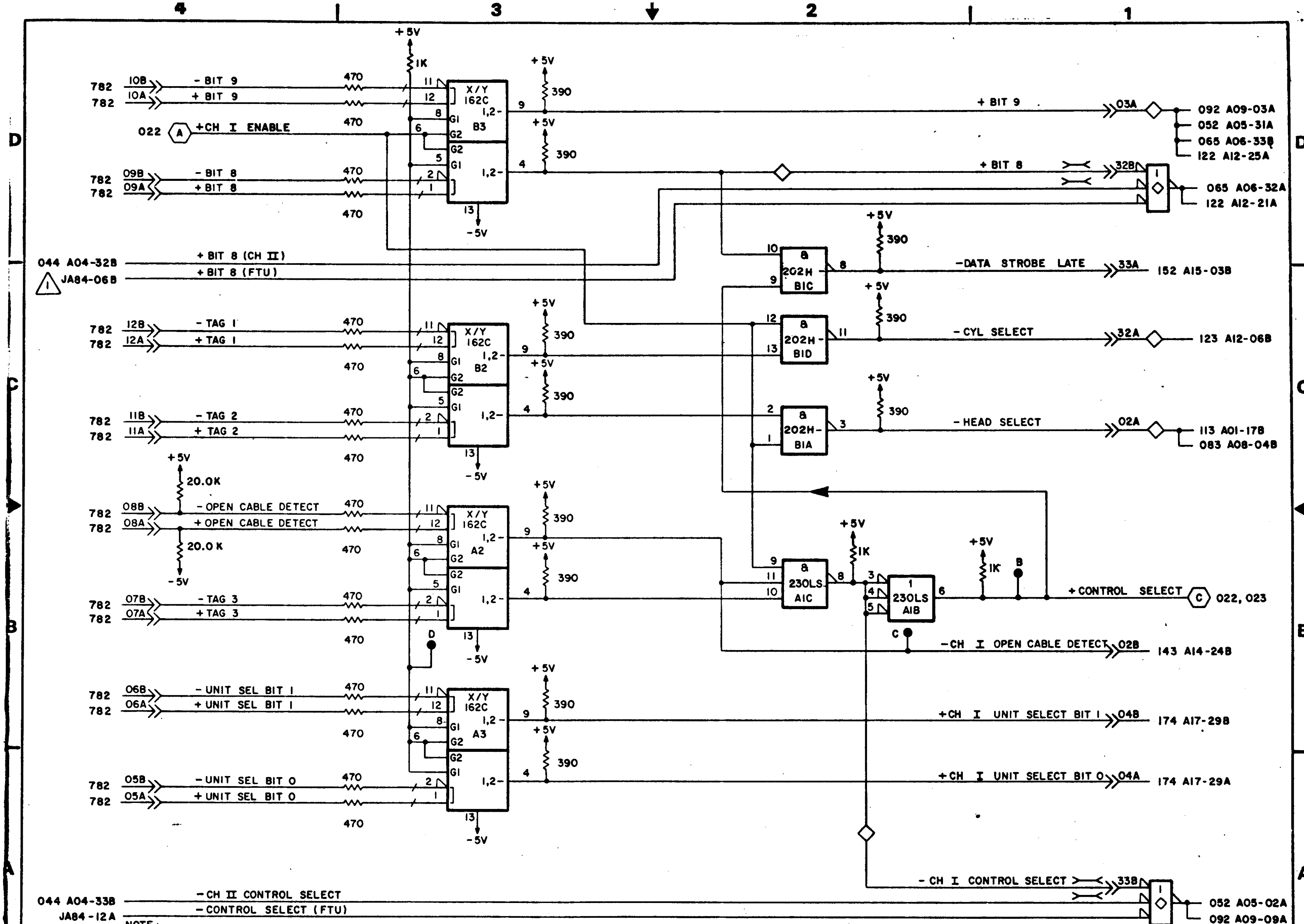

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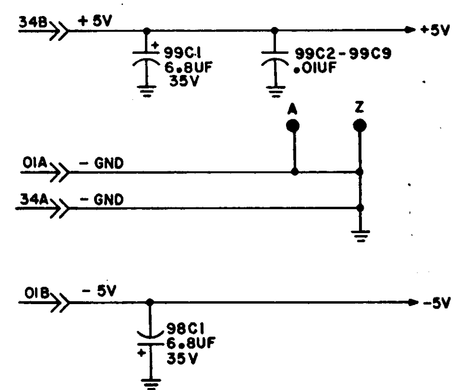
REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED			
B	PE48568	ERROR CORRECTION	DM	7-11-77	
C	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-8-78	
D	PE57173	CHG IC FAMILIES	[illegible]	4-22-82	

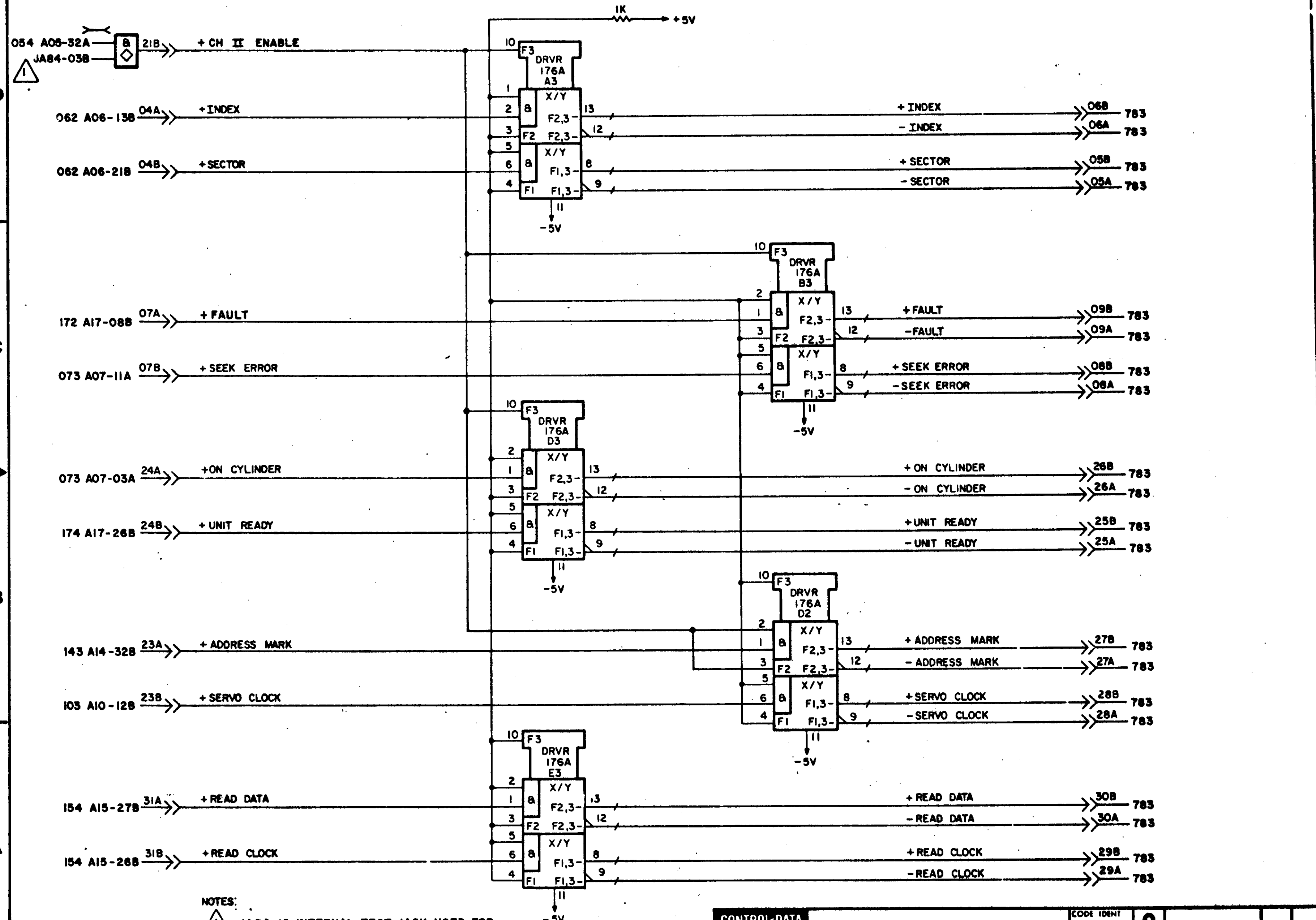


APPLICABLE TO STD UNITS

DRAWN	W.BERGSTROM	10-13-76	CONTROL DATA	CHANNEL II TRANSMITTERS AND RECEIVERS DIAGRAMS
CHECKED			NORMANDALE DIVISION	TYPE: FTVV LOC: A03
ENGINEER	[illegible]	[illegible]		
APPROVED				

CODE IDENT				
19333	C	83322310	AB	D
CROSS REF NO 031	SHEET 1 OF 3	PAGE 3-27		

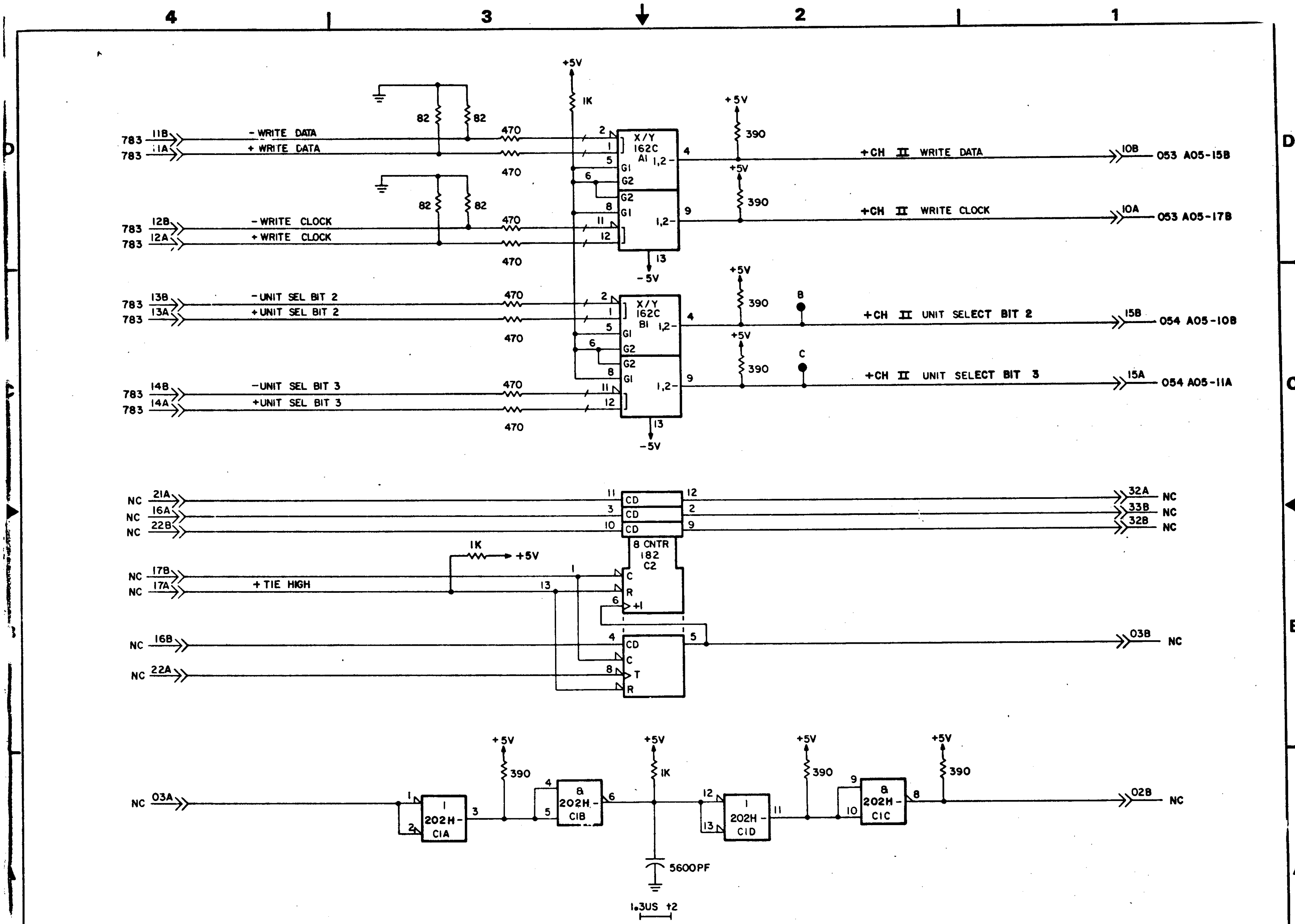
REF 83215203



NOTES:

1. JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REF NO. 162 FOR DETAILS.

CONTROL DATA CORPORATION, NORMANDALE DIVISION	CHANNEL II TRANSMITTERS (STD UNITS) LOC: A03	CODE IDENT 19333	C	83322310	K C
		CROSS REF NO 032	SHEET 2	PAGE 3-28	



CONTROL DATA CORPORATION
NORMANDALE DIVISION

CHANNEL II RECEIVERS (STD UNITS)

LOC: A03

CODE IDENT 19333	C	83322310	AB	D
CROSS REF NO 033		SHEET 3	PAGE 3-29/30	

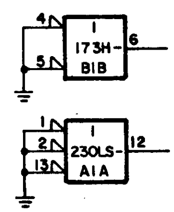
REVISION STATUS OF SHEETS

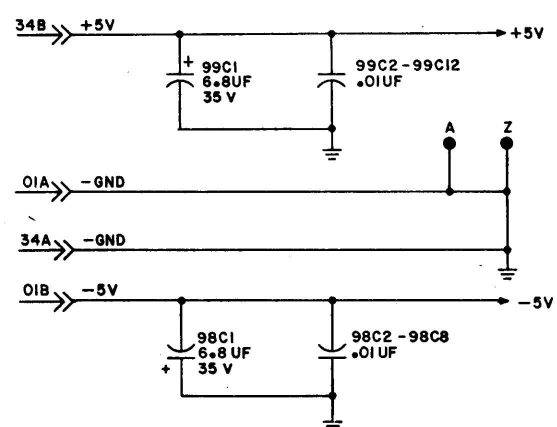
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	B	B	B																
C	B	B	C																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	BJE	—	
B	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-8-78	
C	PE57173	CHG IC FAMILIES	SCHLIEP	4-22-82	

UNUSED LOGIC ELEMENTS

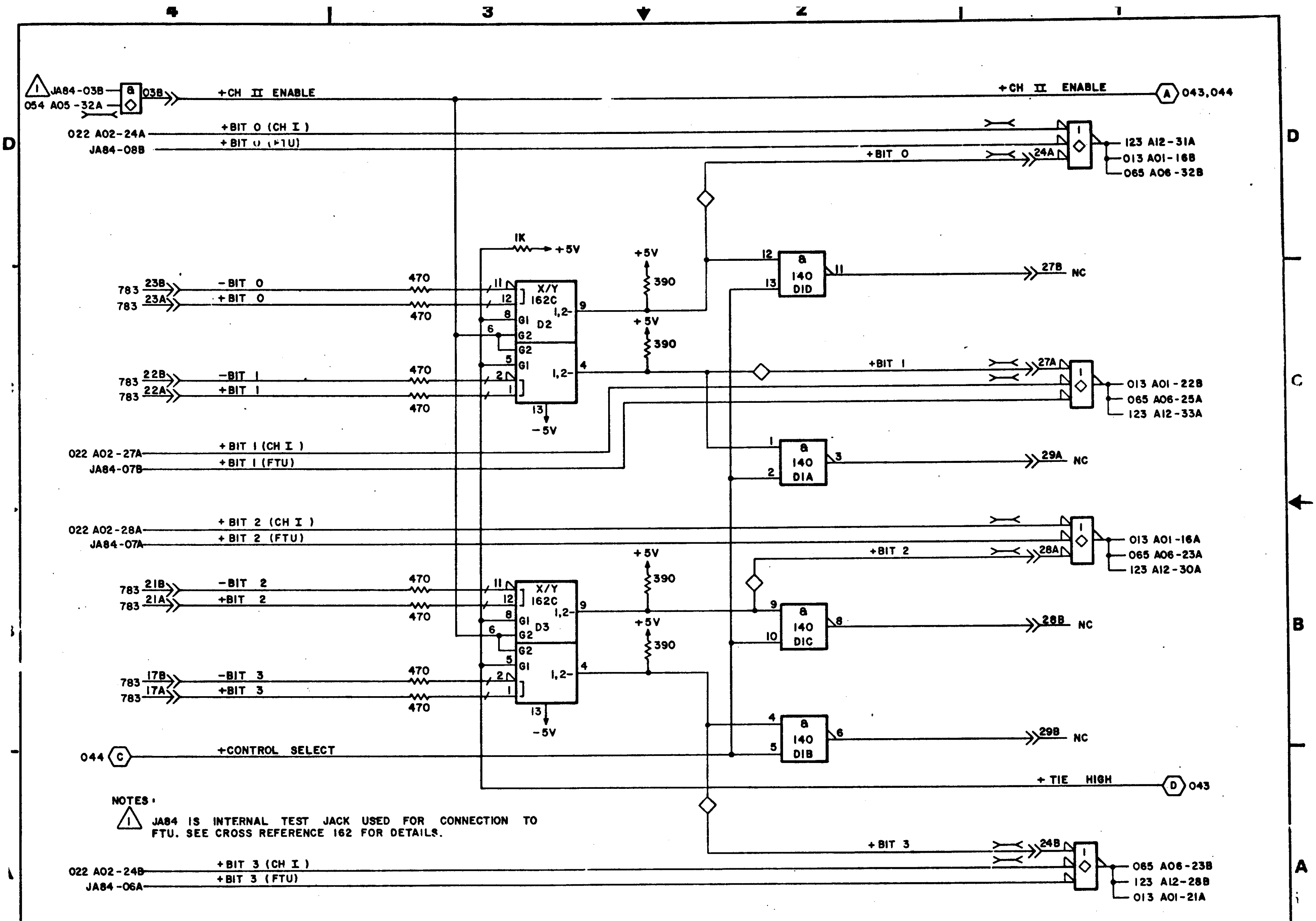




APPLICABLE TO BK7XX = 9766

DRAWN	W.BERGSTROM	10-13-76	CONTROL DATA CORPORATION	CHANNEL II RECEIVERS DIAGRAMS	CODE IDENT 19333	C	83322310	AB	C
CHECKED			NORMANDALE DIVISION	TYPE: JRVV LOC: A04	CROSS REF NO 041		SHEET 1 OF 4	PAGE 3-39	
ENGINEER	[illegible]	11/12/76							
APPROVED									

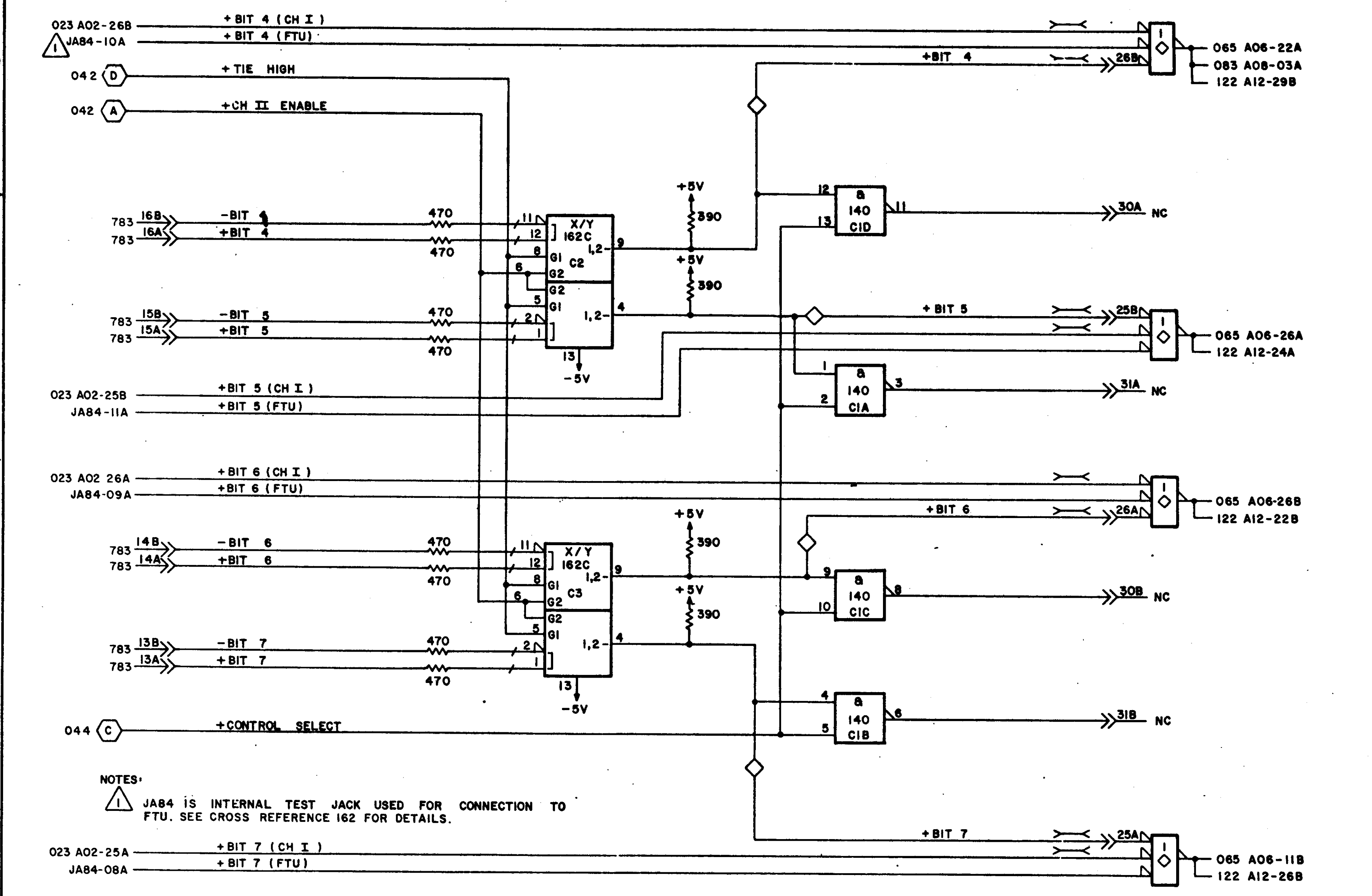
REF 83215204



NOTES:

1. JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REFERENCE 162 FOR DETAILS.

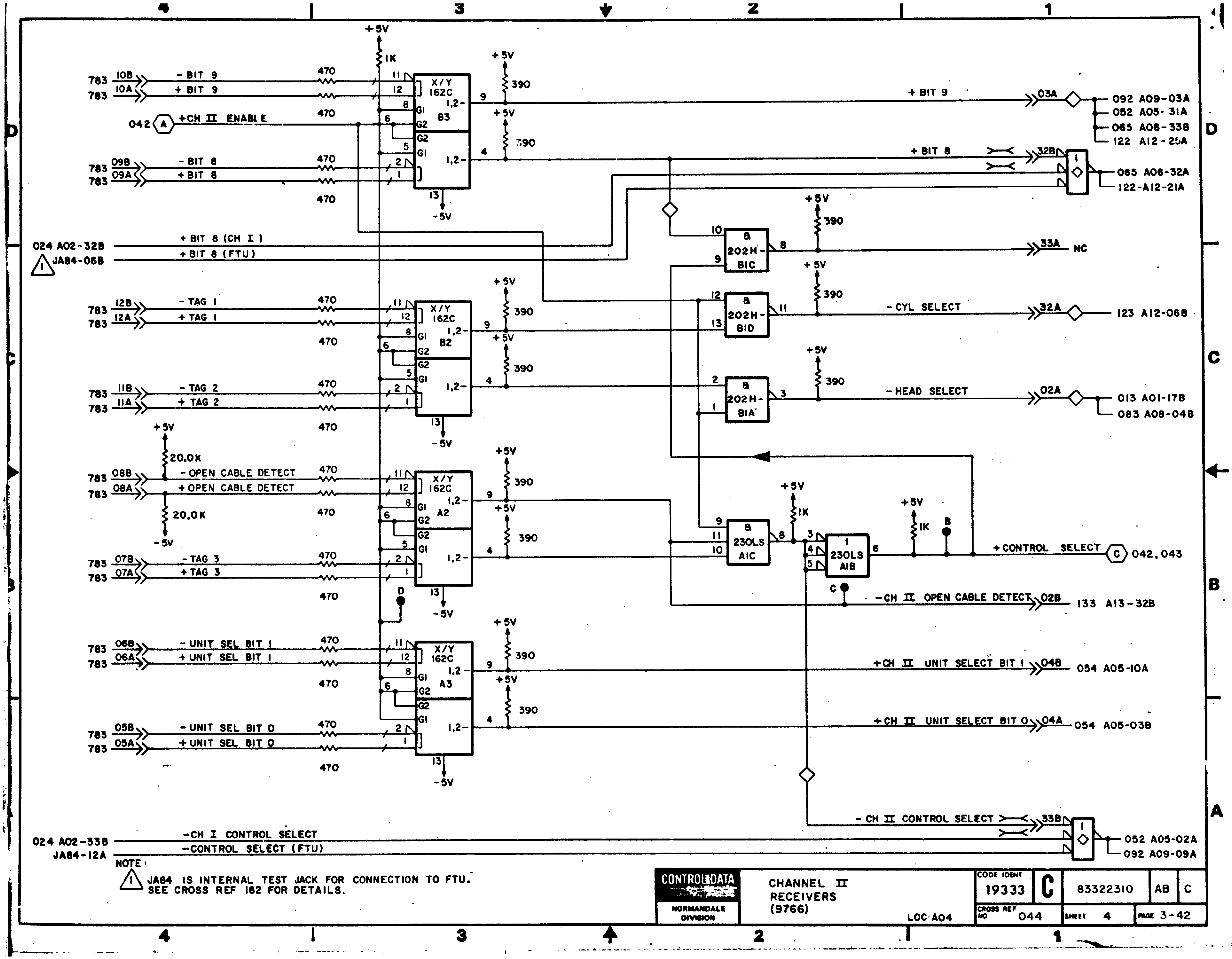
CONTROL DATA CORPORATION NORMANDALE DIVISION	CHANNEL II RECEIVERS (9766) LOC A04	CODE IDENT 19333	C	83322310	K B
		CROSS REF NO 042		SHEET 2	PAGE 3-40



NOTES:

1. JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REFERENCE 162 FOR DETAILS.

CONTROL DATA CORPORATION NORMANDALE DIVISION	CHANNEL II RECEIVERS (9766) LOC: A04	CODE IDENT 19333	C	83322310	K B
		CROSS REF NO 043		SHEET 3	PAGE 3-41



783 10B -BIT 9
783 10A +BIT 9
042 A +CH II ENABLE
783 09B -BIT 8
783 09A +BIT 8
X/Y 162C B3
+BIT 9 03A 092 A09-03A
052 A05-31A
065 A06-33B
122 A12-25A
+BIT 8 32B 065 A06-32A
122-A12-21A
024 A02-32B +BIT 8 (CH I)
JA84-06B +BIT 8 (FTU)
8 202H-B1C 33A NC
783 12B -TAG 1
783 12A +TAG 1
X/Y 162C B2
783 11B -TAG 2
783 11A +TAG 2
8 202H-B1D -CYL SELECT 32A 123 A12-06B
8 202H-B1A -HEAD SELECT 02A 013 A01-17B
083 A08-04B
783 08B -OPEN CABLE DETECT
783 08A +OPEN CABLE DETECT
20.0K
X/Y 162C A2
783 07B -TAG 3
783 07A +TAG 3
8 230LS A1C
1 230LS A1B
+CONTROL SELECT C 042, 043
-CH II OPEN CABLE DETECT 02B 133 A13-32B
783 06B -UNIT SEL BIT 1
783 06A +UNIT SEL BIT 1
X/Y 162C A3
783 05B -UNIT SEL BIT 0
783 05A +UNIT SEL BIT 0
+CH II UNIT SELECT BIT 1 04B 054 A05-10A
+CH II UNIT SELECT BIT 0 04A 054 A05-03B
-CH II CONTROL SELECT 33B 052 A05-02A
092 A09-09A
024 A02-33B -CH I CONTROL SELECT
JA84-12A -CONTROL SELECT (FTU)
NOTE:
1 JA84 IS INTERNAL TEST JACK FOR CONNECTION TO FTU. SEE CROSS REF 162 FOR DETAILS.
CONTROL DATA
NORMANDALE DIVISION
CHANNEL II RECEIVERS (9766)
LOC A04
CODE IDENT 19333
C
83322310
AB
C
CROSS REF NO 044
SHEET 4
PAGE 3-42

REVISIONS					
REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA		
B	PE35259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-8-78	
C	PE60129A	HFRV COST REDUCTION	SCHLIEP	4-22-82	

REVISION STATUS OF SHEETS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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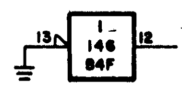
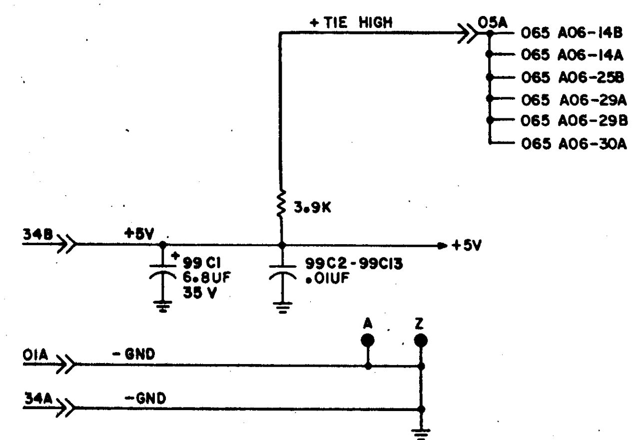
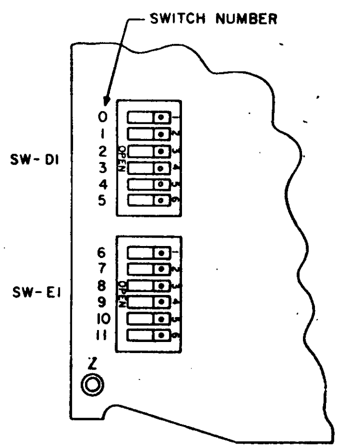
B	B	B	B	B															
C	C	C	B	B															

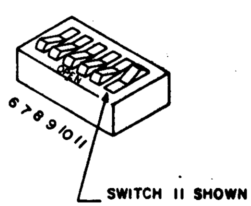
UNUSED LOGIC ELEMENT



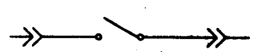


SECTOR SWITCHES





SWITCH POSITIONING

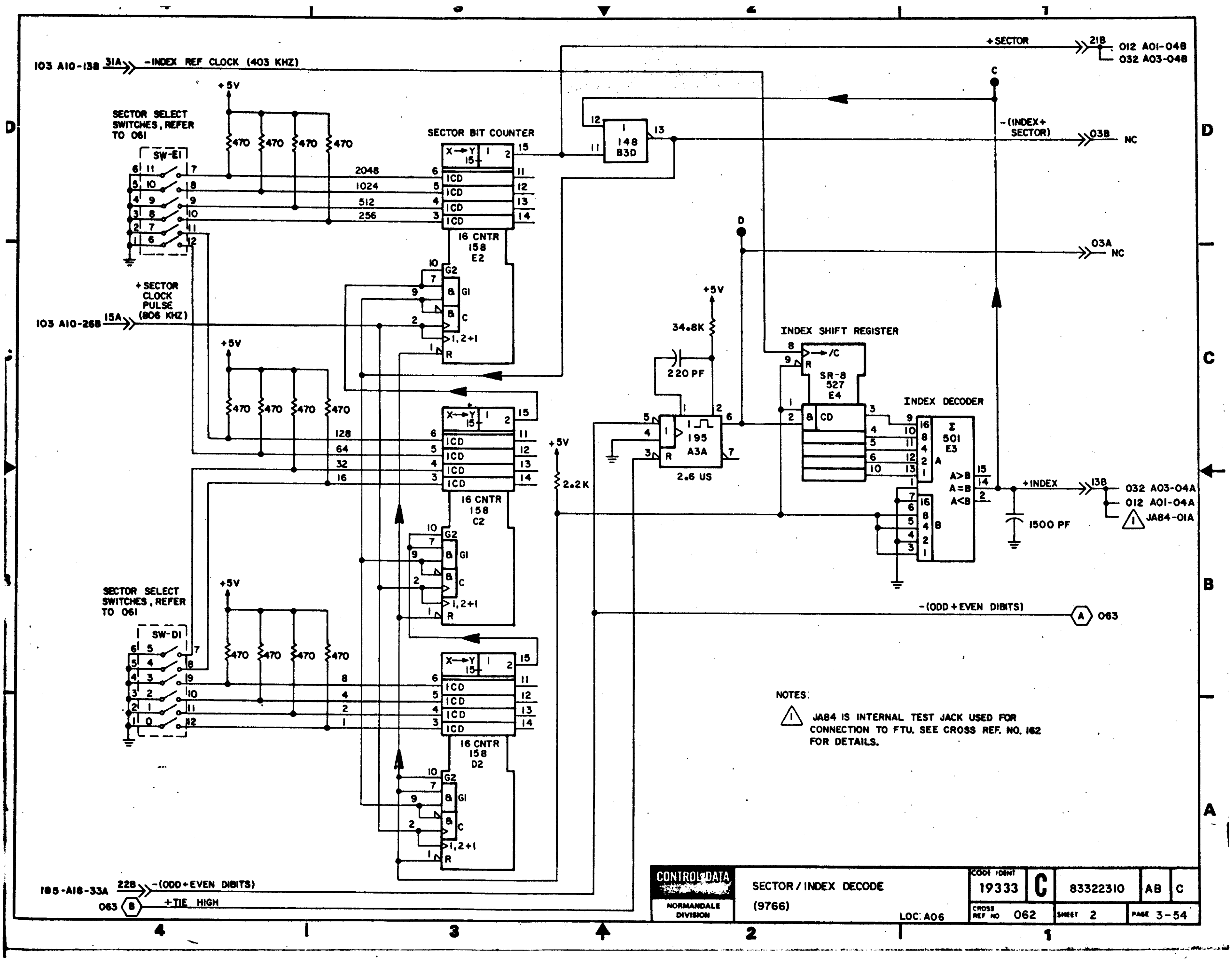


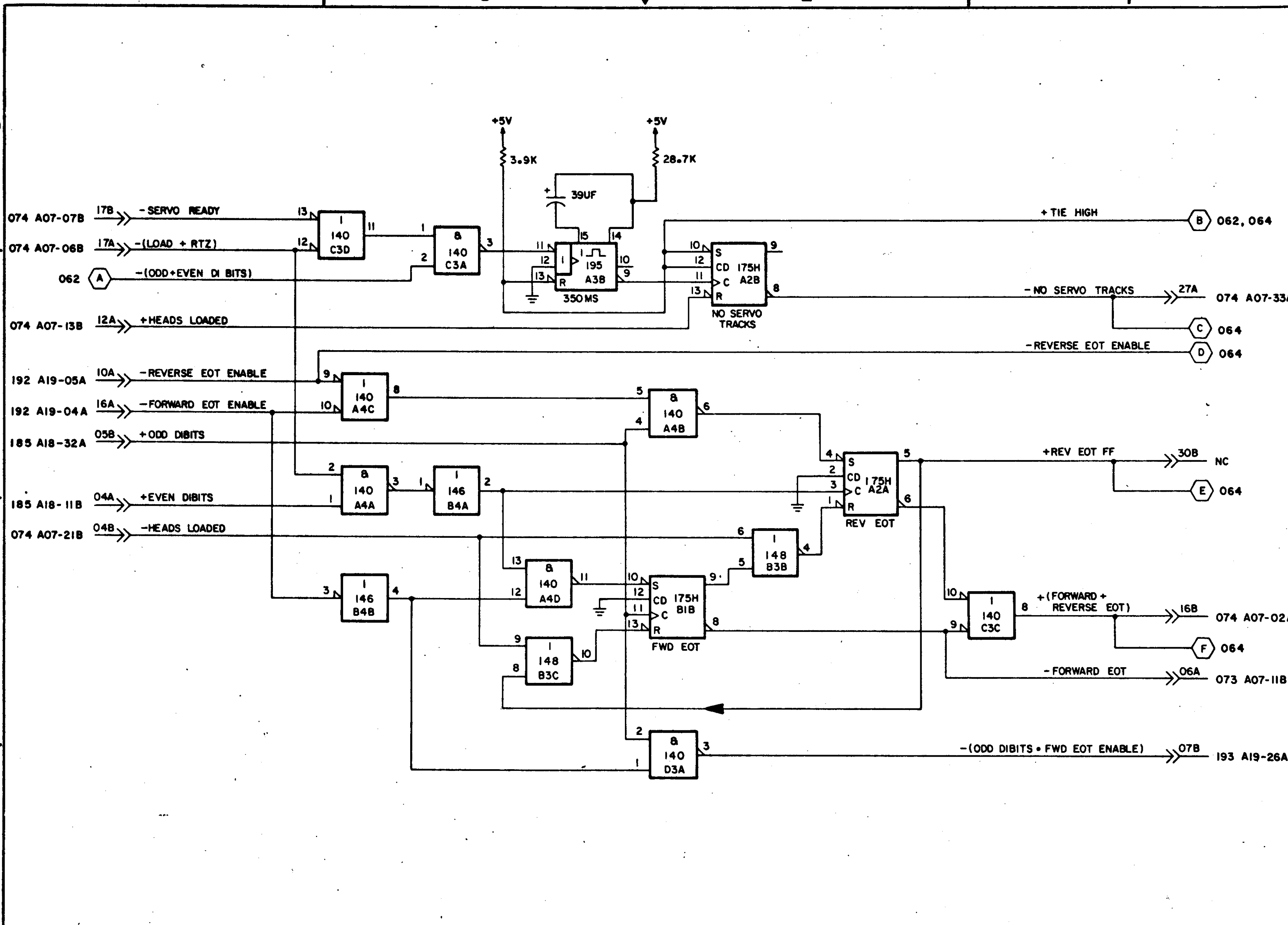
(OPEN POSITION)
SWITCH CONVENTION

NOTE:
1. REFER TO SECTION 1 OF MAINTENANCE MANUAL FOR INFORMATION ON HOW TO SELECT DIFFERENT SECTOR COUNTS.

APPLICABLE TO BK7XX W/O SECTOR & INDEX ON A & B CABLE

DRAWN	[illegible]	10/10/76	CONTROL DATA	ACCESS CONTROL AND INDEX / SECTOR DECODE DIAGRAMS	CODE IDENT 19333 C 83322310 AB C
CHECKED			NORMANDALE DIVISION	TYPE: FLTV LOC: A06	CROSS REF NO 061
ENGINEER	[illegible]	11/12/76			SHEET 1 OF 5
APPROVED					PAGE 3-53

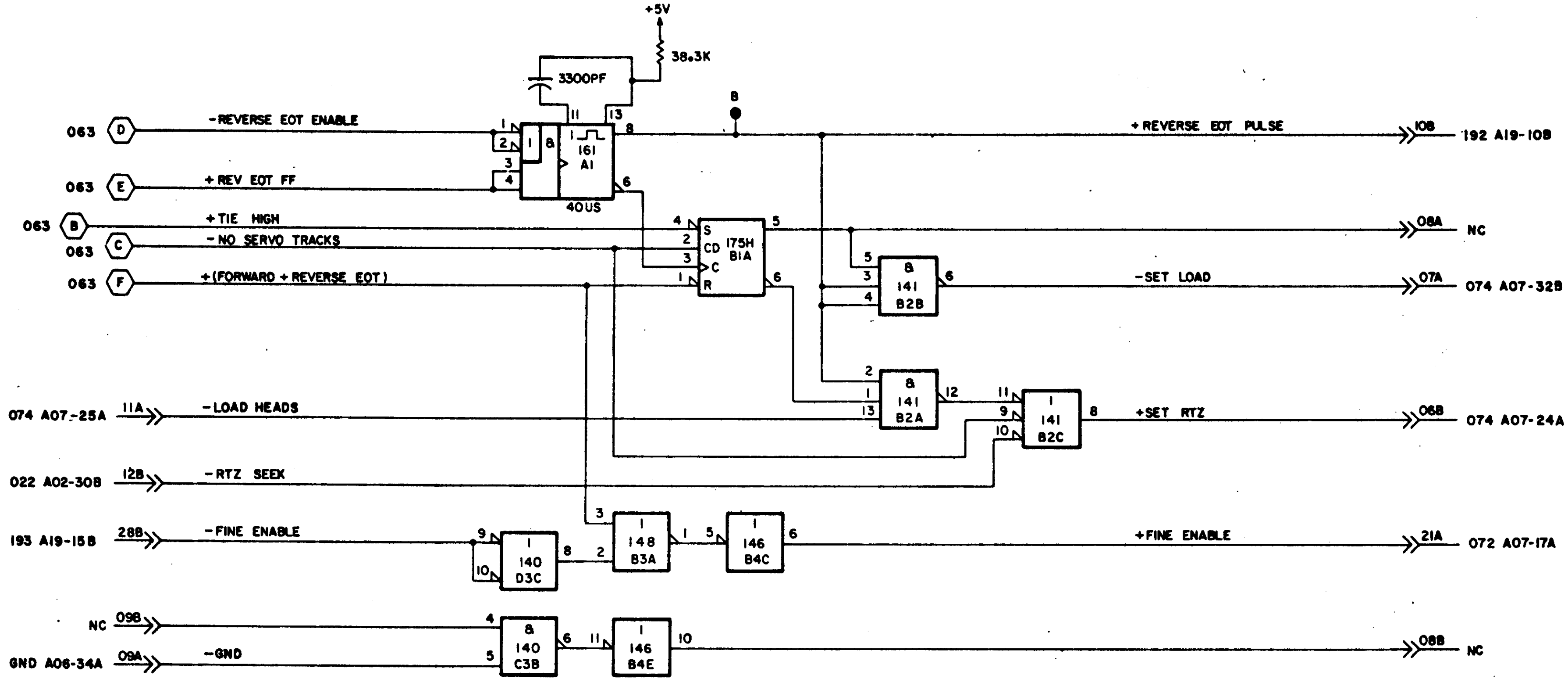

103 A10-13B
31A
-INDEX REF CLOCK (403 KHZ)
+SECTOR
21B
012 A01-04B
032 A03-04B
SECTOR SELECT SWITCHES, REFER TO 061
SW-E1
+5V
470
SECTOR BIT COUNTER
2048
1024
512
256
ICD
16 CNTR
158
E2
G2
GI
C
1,2+1
R
X→Y
15
148
B3D
-(INDEX+ SECTOR)
03B
NC
D
03A
NC
+SECTOR CLOCK PULSE (806 KHZ)
103 A10-26B
15A
128
64
32
16
16 CNTR
158
C2
+5V
2.2K
34.8K
220 PF
195
A3A
2.6 US
INDEX SHIFT REGISTER
SR-8
527
E4
/C
CD
INDEX DECODER
Σ
501
E3
A>B
A=B
A<B
+INDEX
13B
032 A03-04A
012 A01-04A
JA84-01A
1500 PF
-(ODD+EVEN DIBITS)
063
SECTOR SELECT SWITCHES, REFER TO 061
SW-D1
8
4
2
1
16 CNTR
158
D2
NOTES:
JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REF. NO. 162 FOR DETAILS.
185-A18-33A
22B
-(ODD+EVEN DIBITS)
063
+TIE HIGH
CONTROL DATA
NORMANDALE DIVISION
SECTOR / INDEX DECODE
(9766)
LOC: A06
CODE IDENT
19333
C
83322310
AB
C
CROSS REF NO 062
SHEET 2
PAGE 3-54



CONTROL DATA
NORMANDALE DIVISION

FORWARD AND REVERSE EOT
(9766)
LOC: A06

CODE IDENT 19333	C	83322310	AB	C	
CROSS REF NO 063	SHEET 3	PAGE 3-55			



CONTROL DATA CORPORATION NORMANDALE DIVISION	REVERSE EOT PULSE (9766) LOC A06	CODE IDENT 19333	C	83322310 K B
		CROSS REF NO 064	SHEET 4	PAGE 3-56

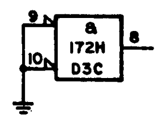
REVISION STATUS OF SHEETS

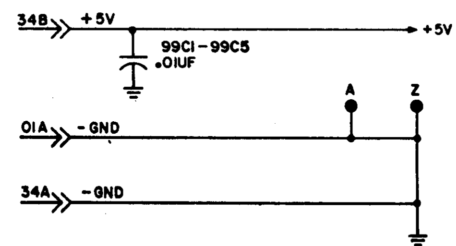
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	B	A	A																
C	C	C	C																
D	C	D	C																
E	E	D	C																
F	F	D	C																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA		
B	PE22908	CHANGE DELAY	MA	9-1-77	
C	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-8-78	
D	PE57278	ADD WIRE INFORMATION TO LOGIC	SCHLIEP	4-22-82	
E	PE60493	TIMING RES CHG	SCHLIEP	4-22-82	
F	DJ00089A	CHG ONE-SHOT RES	SCHLIEP	4-22-82	

UNUSED LOGIC ELEMENT

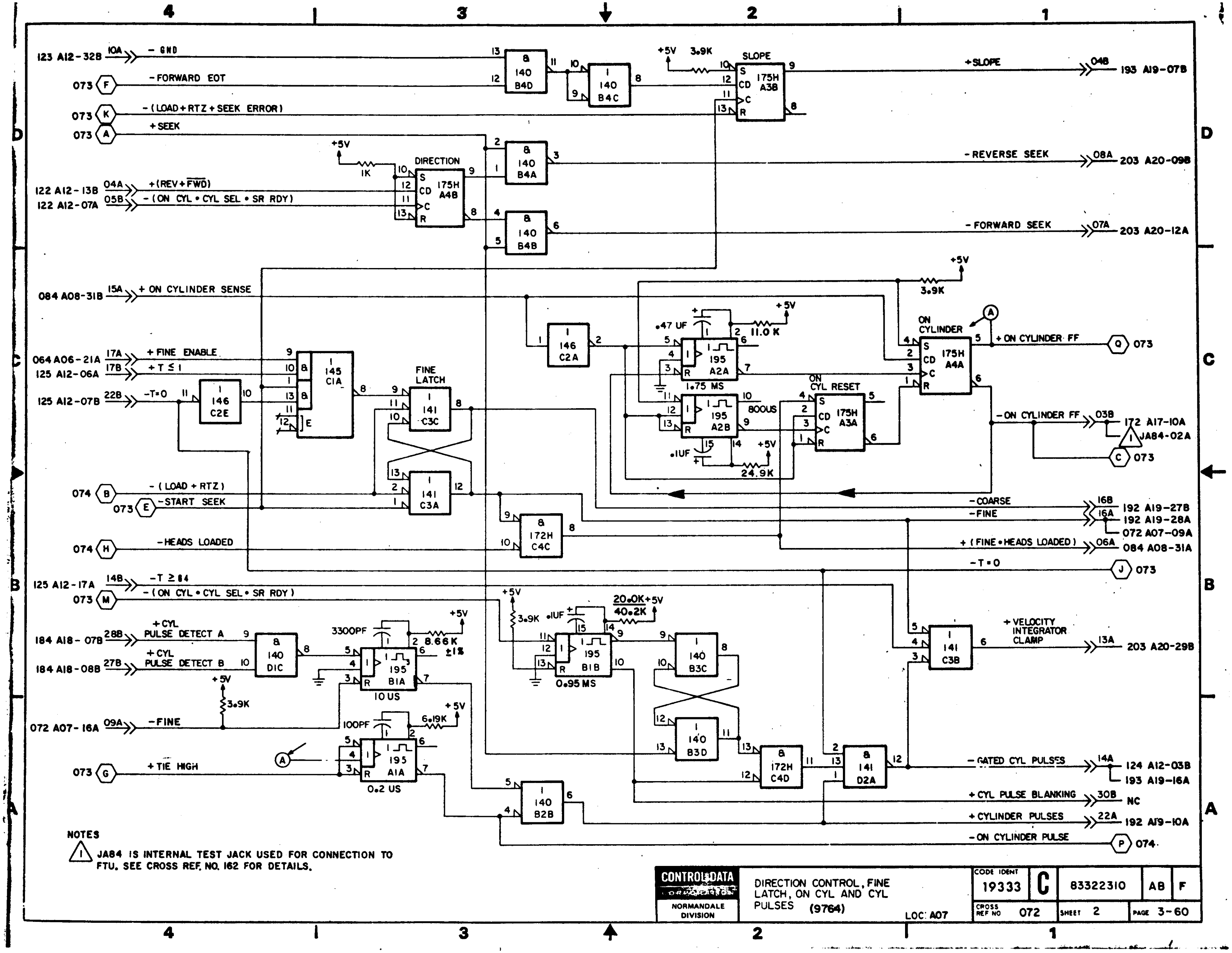




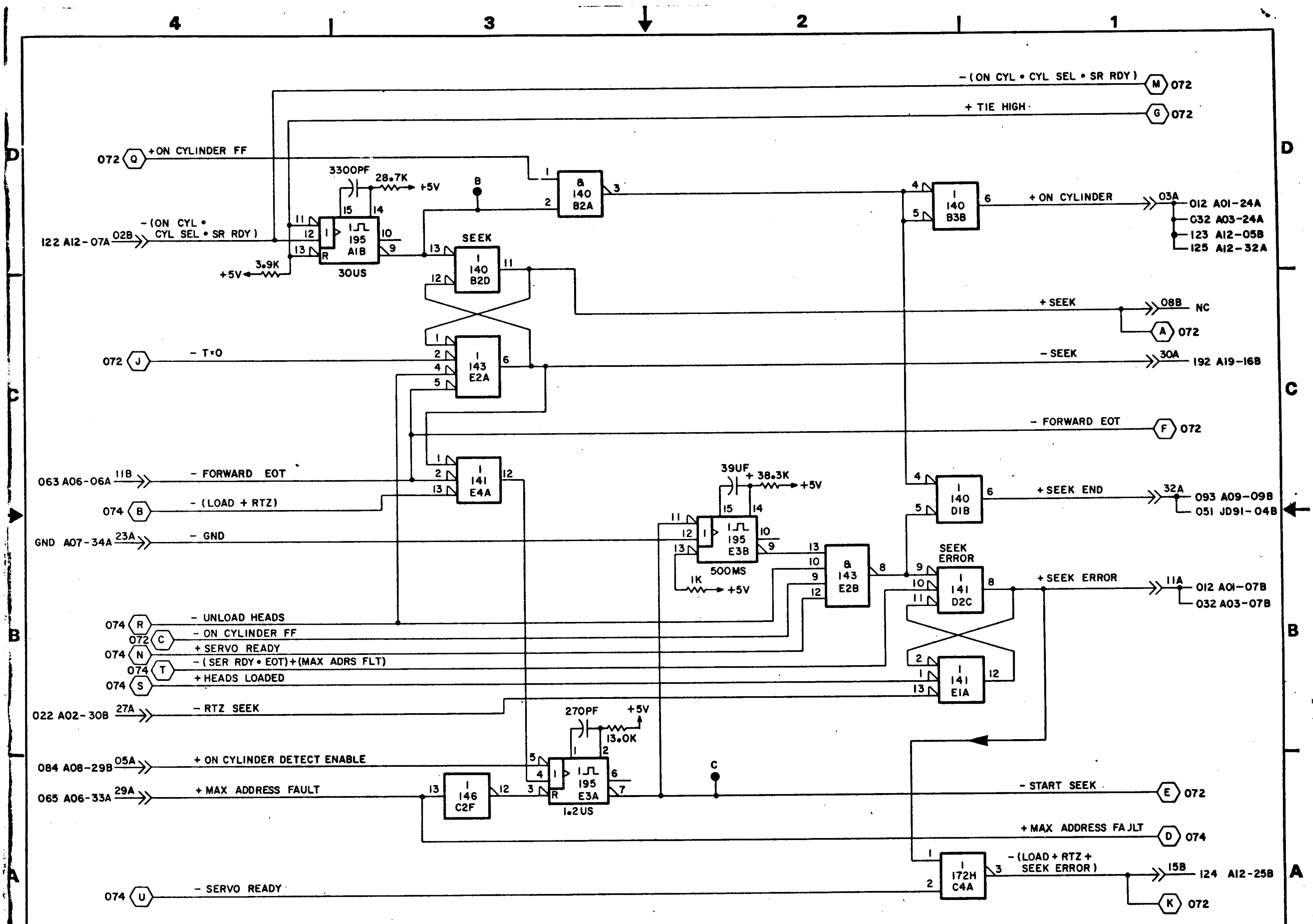
APPLICABLE TO BK6XX = 9764

DRAWN	S. BENTLER	11-4-76	CONTROL DATA	ACCESS CONTROL NO. 1 DIAGRAMS	CODE IDENT 19333	C	83322310	AB	F
CHECKED									
ENGINEER	[illegible]	11/13/76	NORMANDALE DIVISION	TYPE: MLVV LOC A07	CROSS REF NO 071		SHEET 1 OF 4	PAGE 3-59	
APPROVED									

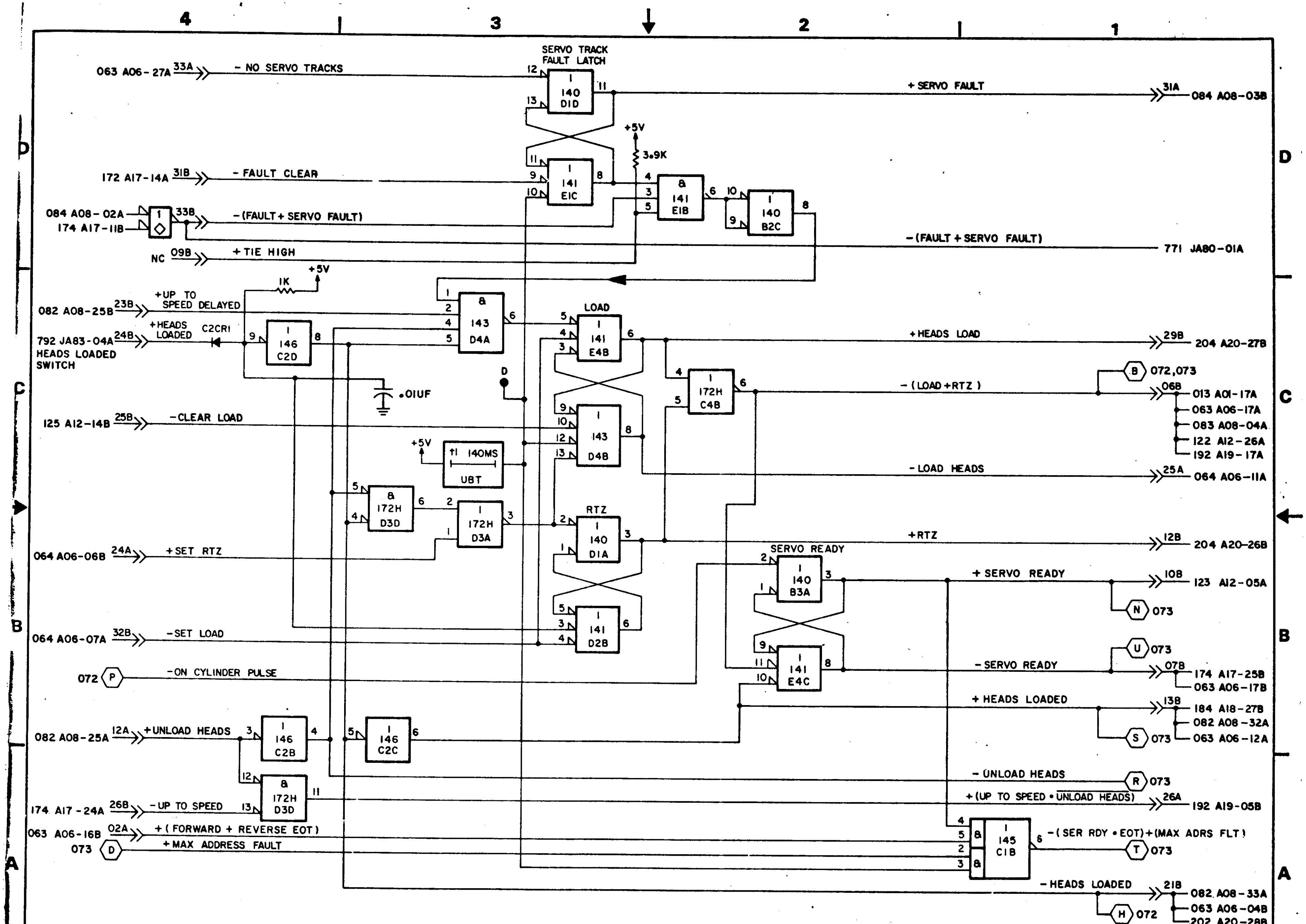
REF 83215304



123 A12-32B 10A -GND
073 F -FORWARD EOT
073 K -(LOAD+RTZ+SEEK ERROR)
073 A +SEEK
122 A12-13B 04A +(REV+FWD)
122 A12-07A 05B -(ON CYL • CYL SEL • SR RDY)
084 A08-31B 15A +ON CYLINDER SENSE
064 A06-21A 17A +FINE ENABLE
125 A12-06A 17B +T ≤ 1
125 A12-07B 22B -T=0
074 B -(LOAD + RTZ)
073 E -START SEEK
074 H -HEADS LOADED
125 A12-17A 14B -T ≥ 64
073 M -(ON CYL • CYL SEL • SR RDY)
184 A18-07B 28B +CYL PULSE DETECT A
184 A18-08B 27B +CYL PULSE DETECT B
072 A07-16A 09A -FINE
073 G +TIE HIGH
SLOPE
DIRECTION
FINE LATCH
ON CYLINDER
ON CYL RESET
+SLOPE 04B 193 A19-07B
-REVERSE SEEK 08A 203 A20-09B
-FORWARD SEEK 07A 203 A20-12A
+ON CYLINDER FF Q 073
-ON CYLINDER FF 03B 172 A17-10A
JA84-02A
C 073
-COARSE 16B 192 A19-27B
-FINE 16A 192 A19-28A
072 A07-09A
+(FINE • HEADS LOADED) 06A 084 A08-31A
-T=0 J 073
+VELOCITY INTEGRATOR CLAMP 13A 203 A20-29B
-GATED CYL PULSES 14A 124 A12-03B
193 A19-16A
+CYL PULSE BLANKING 30B NC
+CYLINDER PULSES 22A 192 A19-10A
-ON CYLINDER PULSE P 074
1.75 MS
800US
10 US
0.2 US
0.95 MS
NOTES
1 JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REF. NO. 162 FOR DETAILS.
CONTROL DATA CORPORATION
NORMANDALE DIVISION
DIRECTION CONTROL, FINE LATCH, ON CYL AND CYL PULSES (9764)
LOC: A07
CODE IDENT 19333
C
83322310
AB
F
CROSS REF NO 072
SHEET 2
PAGE 3-60



CONTROL DATA CORPORATION NORMANDALE DIVISION	SEEK FF AND SEEK ERROR DECTECTION (9764) LOC: A07	CODE IDENT 19333	C	83322310	AB	D
		CROSS REF NO 073		SHEET 3		3-61



CONTROL DATA CORPORATION

NORMANDALE DIVISION

SERVO FAULT, LOAD FF, AND RTZ FF

(9764)

LOC: A07

CODE IDENT				
19333	C	83322310	K	C
CROSS REF NO 074		SHEET 4	PAGE 3-62	

REVISION STATUS OF SHEETS																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
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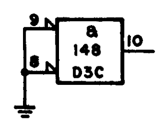
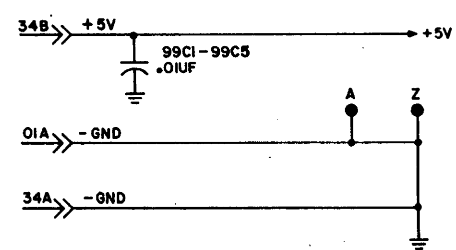
B	B	A	A																
C	C	C	C																
D	C	D	C																
E	C	D	E																
F	F	F	F																
G	G	F	F																
H	H	F	F																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA	10-15-76	
B	PE22908	CHANGE DELAY	MA	9-1-77	
C	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-8-78	
D	PE57278	ADD WIRE INFORMATION TO LOGIC	SCHLIEP	4-22-82	
E	PE60129A	HFRV COST REDUCTION	SCHLIEP	4-22-82	
F	PE60342	LOGIC DIAGRAM UPDATE	SCHLIEP	4-22-82	
G	PE60493	TIMING RES CHG	SCHLIEP	4-22-82	
H	DJ[illegible]A	CHG ONE-SHOT RES	SCHLIEP	4-22-82	

UNUSED LOGIC ELEMENT

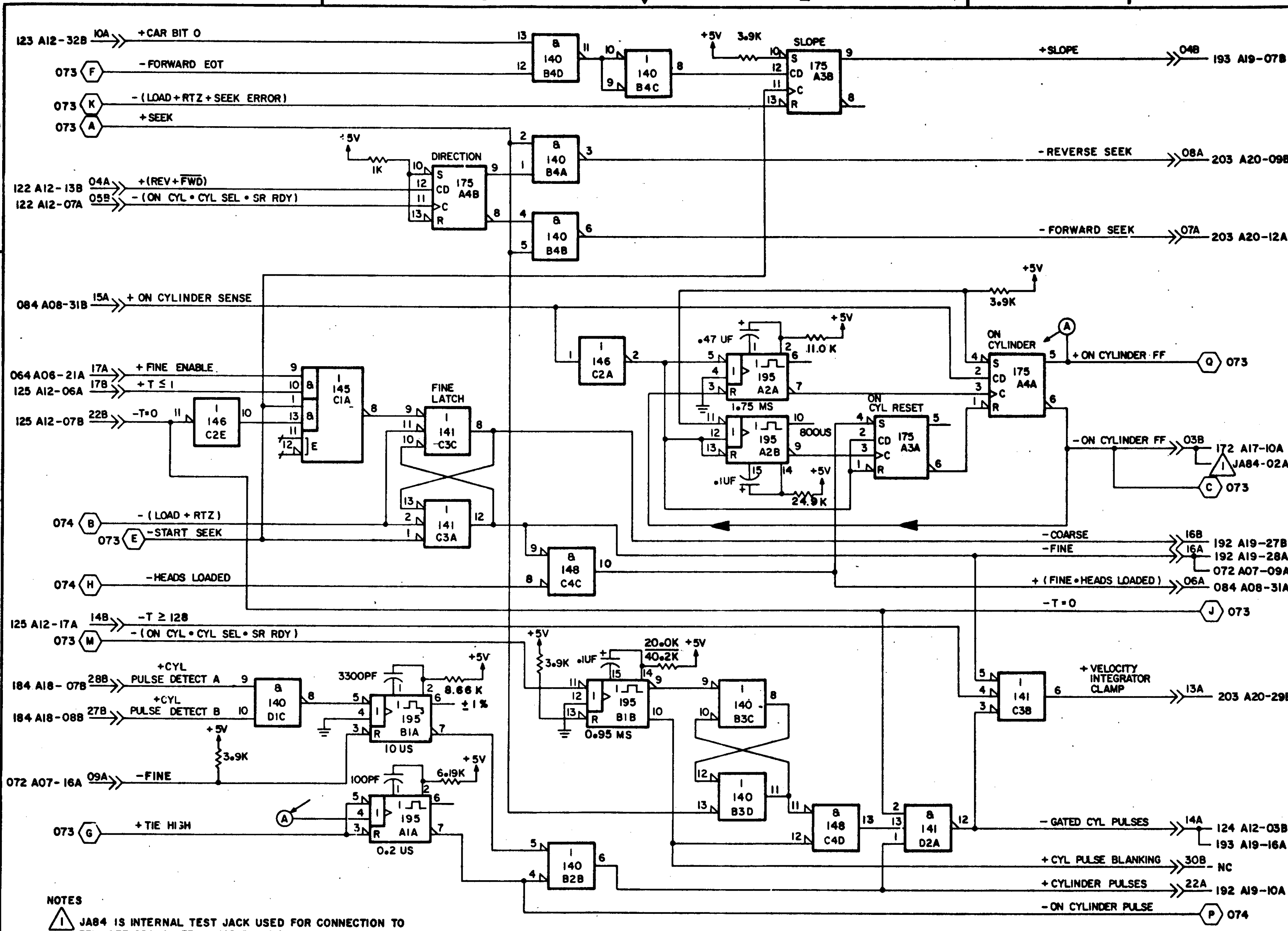




APPLICABLE TO BK7XX = 9766

DRAWN	G. Rabine	10-4-76	CONTROL DATA	ACCESS CONTROL NO. 1 DIAGRAMS	CODE IDENT 19333	C	83322310
CHECKED			NORMANDALE DIVISION				AB
ENGINEER	[illegible]	11/12/76		TYPE: MLVV	CROSS REF NO 071	SHEET 1 OF 4	H
APPROVED				LOC A07			PAGE 3-63

REF 83215207



NOTES

1. JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REF. NO. 162 FOR DETAILS.

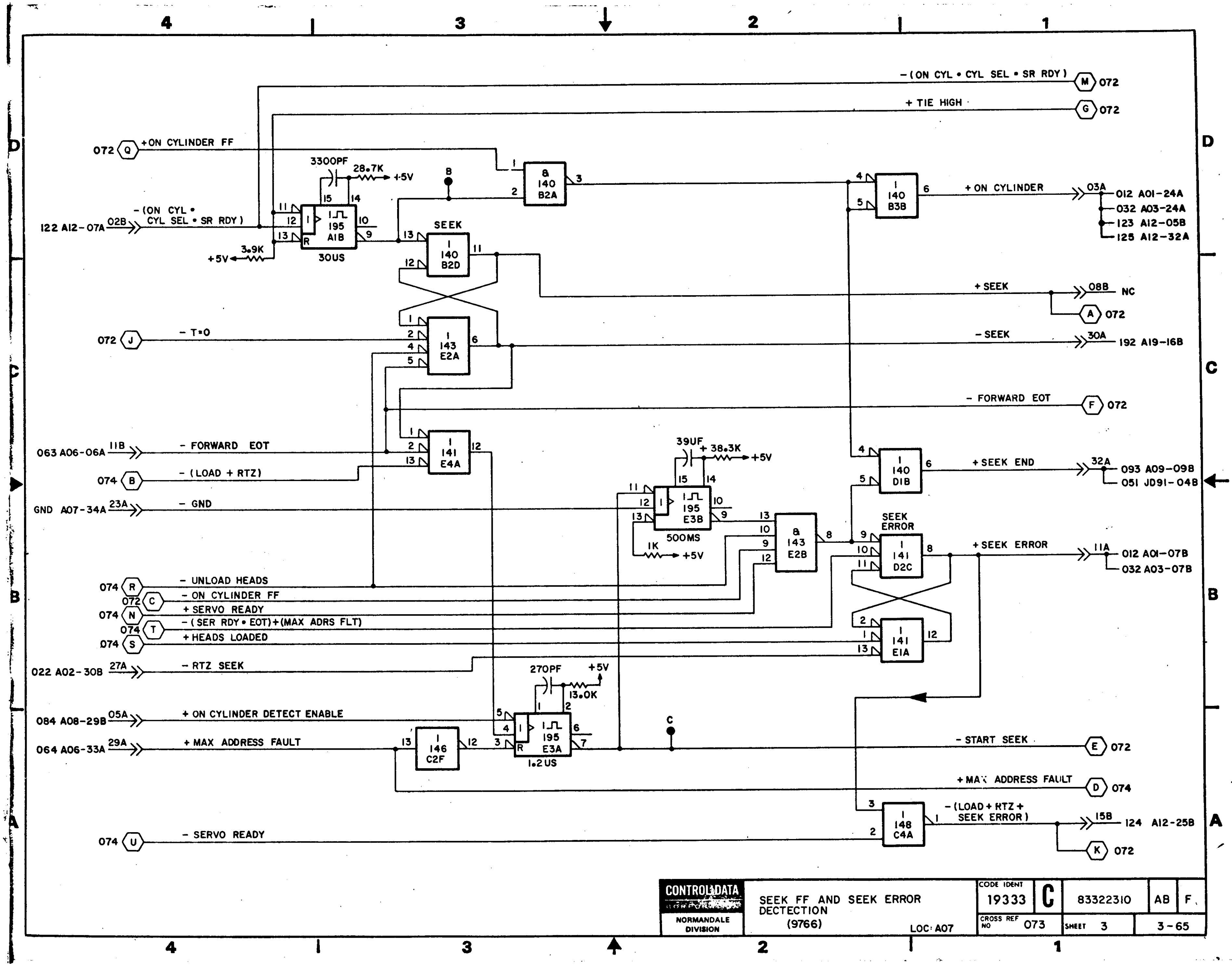
CONTROL DATA — NORMANDALE DIVISION

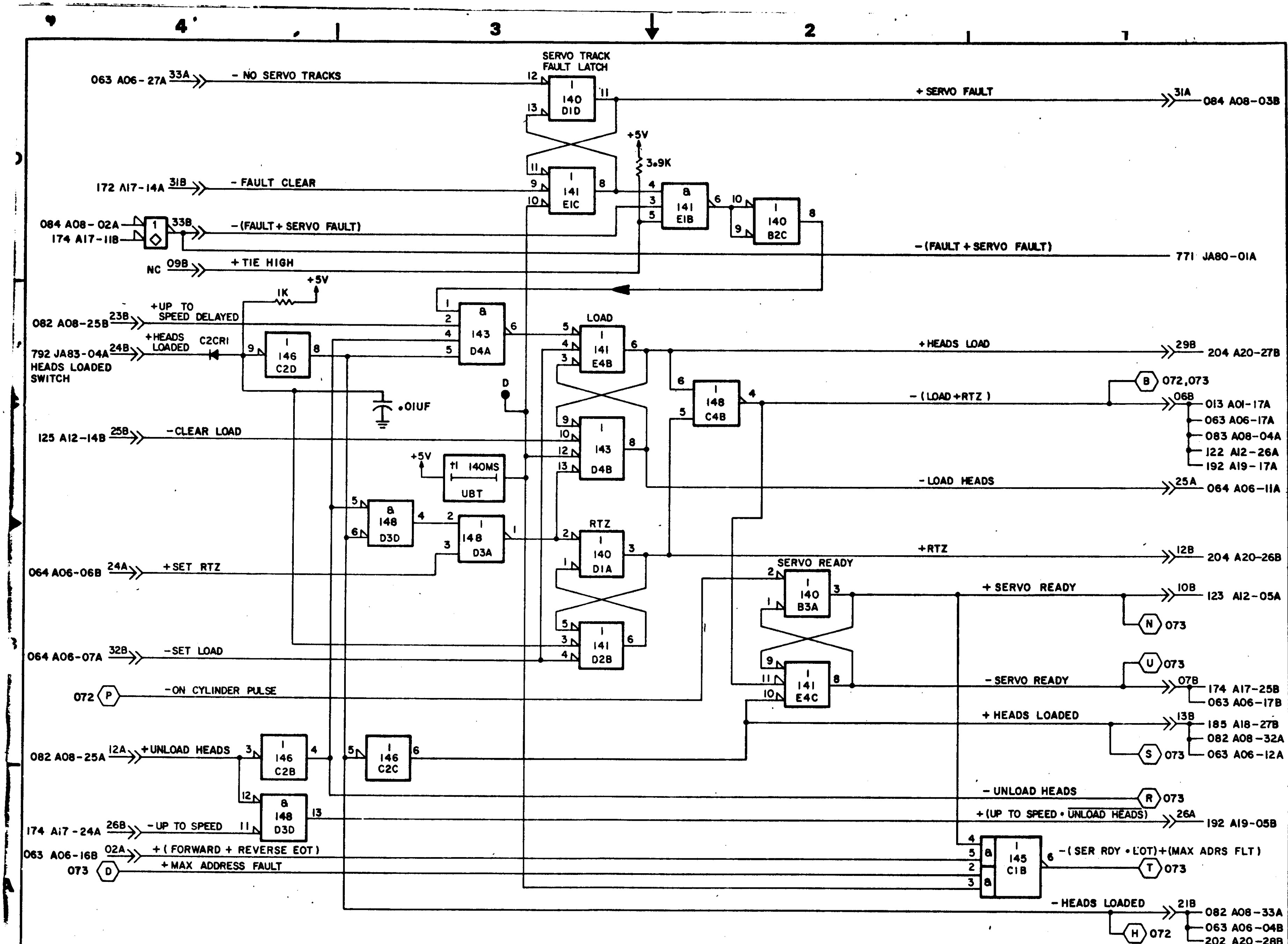
DIRECTION CONTROL, FINE LATCH, ON CYL AND CYL PULSES (9766)

LOC: A07

CODE IDENT 19333 | C | 83322310 | AB | H

CROSS REF NO 072 | SHEET 2 | PAGE 3-64


-(ON CYL • CYL SEL • SR RDY)
M 072
+TIE HIGH
G 072
072 Q +ON CYLINDER FF
3300PF
28.7K
+5V
B
& 140 B2A
1 140 B3B
+ON CYLINDER
03A
012 A01-24A
032 A03-24A
123 A12-05B
125 A12-32A
-(ON CYL • CYL SEL • SR RDY)
122 A12-07A 02B
1 195 A1B
30US
3.9K
SEEK
1 140 B2D
+SEEK
08B NC
A 072
072 J -T=0
1 143 E2A
-SEEK
30A 192 A19-16B
-FORWARD EOT
F 072
063 A06-06A 11B -FORWARD EOT
074 B -(LOAD + RTZ)
1 141 E4A
39UF
38.3K
1 195 E3B
500MS
1K
1 140 D1B
+SEEK END
32A 093 A09-09B
051 JD91-04B
GND A07-34A 23A -GND
& 143 E2B
SEEK ERROR
1 141 D2C
+SEEK ERROR
11A 012 A01-07B
032 A03-07B
074 R -UNLOAD HEADS
072 C -ON CYLINDER FF
074 N +SERVO READY
074 T -(SER RDY • EOT)+(MAX ADRS FLT)
074 S +HEADS LOADED
1 141 E1A
022 A02-30B 27A -RTZ SEEK
270PF
13.0K
084 A08-29B 05A +ON CYLINDER DETECT ENABLE
C
064 A06-33A 29A +MAX ADDRESS FAULT
1 146 C2F
1 195 E3A
1.2US
-START SEEK
E 072
+MAX ADDRESS FAULT
D 074
-(LOAD + RTZ + SEEK ERROR)
1 148 C4A
15B 124 A12-25B
K 072
074 U -SERVO READY
CONTROL DATA CORPORATION
NORMANDALE DIVISION
SEEK FF AND SEEK ERROR DECTECTION (9766)
LOC: A07
CODE IDENT 19333
C
83322310
AB
F
CROSS REF NO 073
SHEET 3
3-65



CONTROL DATA CORPORATION
NORMANDALE DIVISION

SERVO FAULT, LOAD FF, AND RTZ FF
(9766)
LOC: A07

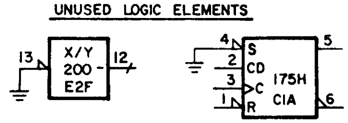
CODE IDENT 19333	C	83322310	AB	F
CROSS REF NO 074		SHEET 4	PAGE 3-66	

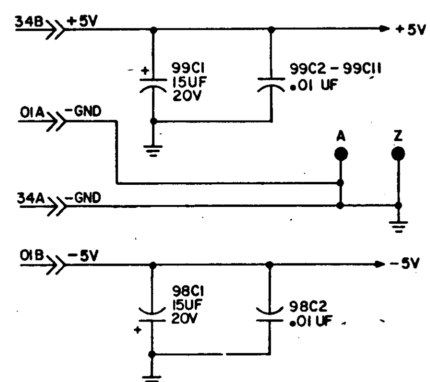
REVISION STATUS OF SHEETS																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	B	B	B																
C	C	B	B																
D	D	B	B																
E	E	B	B																
F	E	B	B																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA		
B	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-8-78	
C	PE57097	ADD INTERLOCK	GR	3-29-79	
D	PE57426A	CHANGE WIRE WRAP	CB	1-29-81	
E	PE57622A	ADD FILTER DIODES	SCHLIEP	4-22-82	
F	PE57278	ADD WIRE INFORMATION TO LOGIC	SCHLIEP	4-22-82	

UNUSED LOGIC ELEMENTS

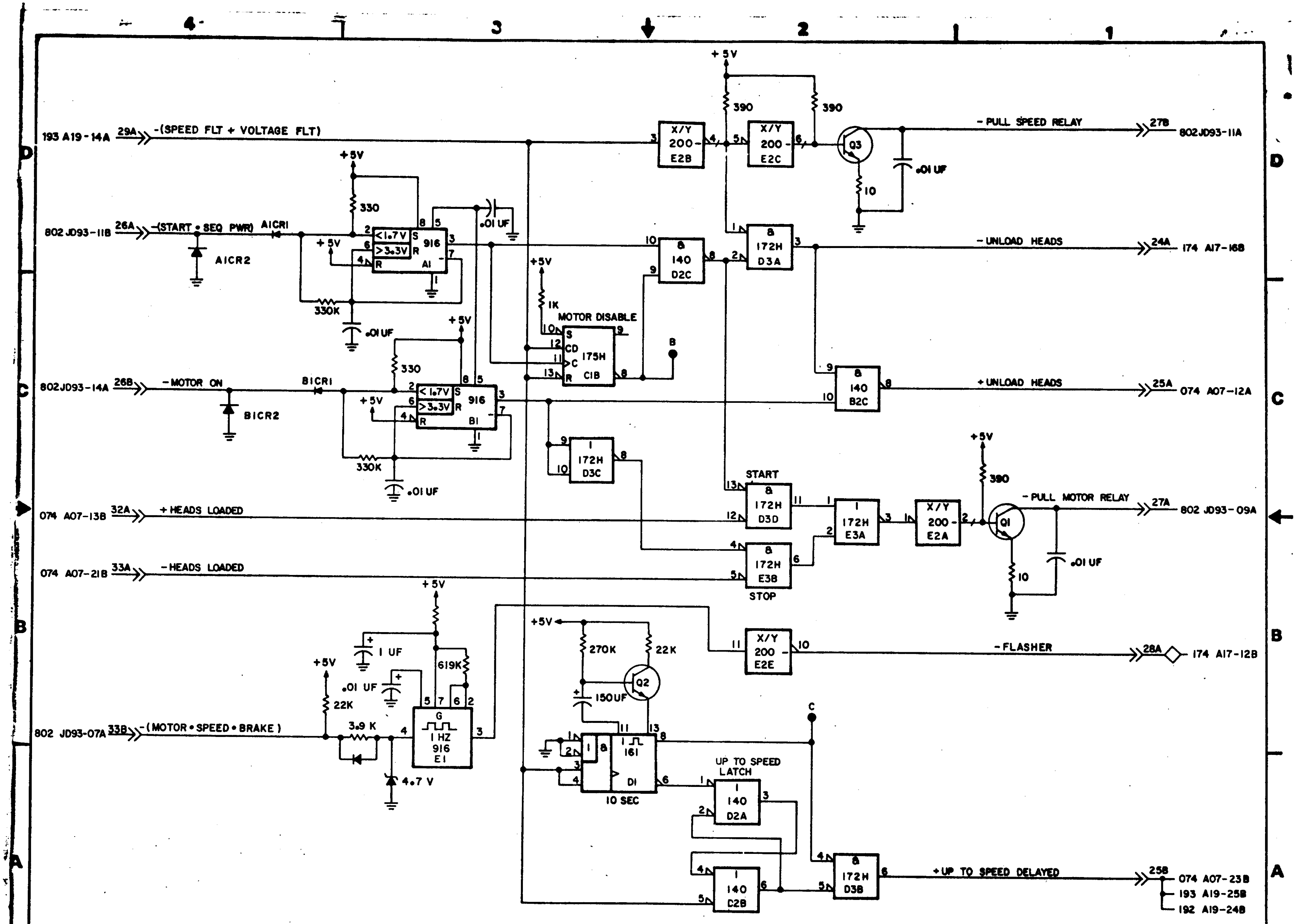




APPLICABLE TO BK6XX=9764

DRAWN	MANDERSON	CONTROL DATA	DIFF BITS, HEAD REG SPEED ENABLE, UNIT SELECT DIAGRAMS	CODE IDENT 19333	C	83322310	AB	F
CHECKED								
ENGINEER		NORMANDALE DIVISION	TYPE: CQPV LOC: A08	CROSS REF NO 081	SHEET 1 OF 4	PAGE 3-67		
APPROVED								

REF 83215305



CONTROL DATA
NORMANDALE DIVISION

SPEED RELAY AND MOTOR RELAY CONTROL. UP TO SPEED
(9764)
LOC: A08

CODE IDENT 19333	C	83322310	AB	E
CROSS REF NO 082	SHEET 2	PAGE 3-68		

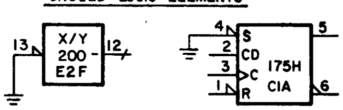
REVISION STATUS OF SHEETS

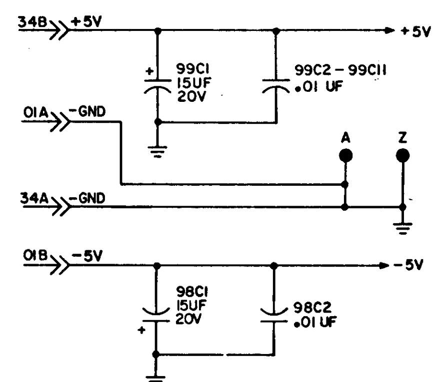
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	B	A	A																
C	C	C	C																
D	D	C	C																
E	E	C	C																
F	F	C	C																
G	F	C	C																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA	1-30-76	
B	PE22820	CORRECT DIAGRAMS	SB	5-5-77	
C	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-8-78	
D	PE57097	ADD INTERLOCK	GR	3-28-79	
E	PE57426	CHANGE WIRE WRAP	CB	1-29-81	JK
F	PE57622A	ADD FILTER DIODES	SCHLIEP	4-22-82	
G	PE57278	ADD WIRE INFORMATION TO LOGIC	SCHLIEP	4-22-82	

UNUSED LOGIC ELEMENTS

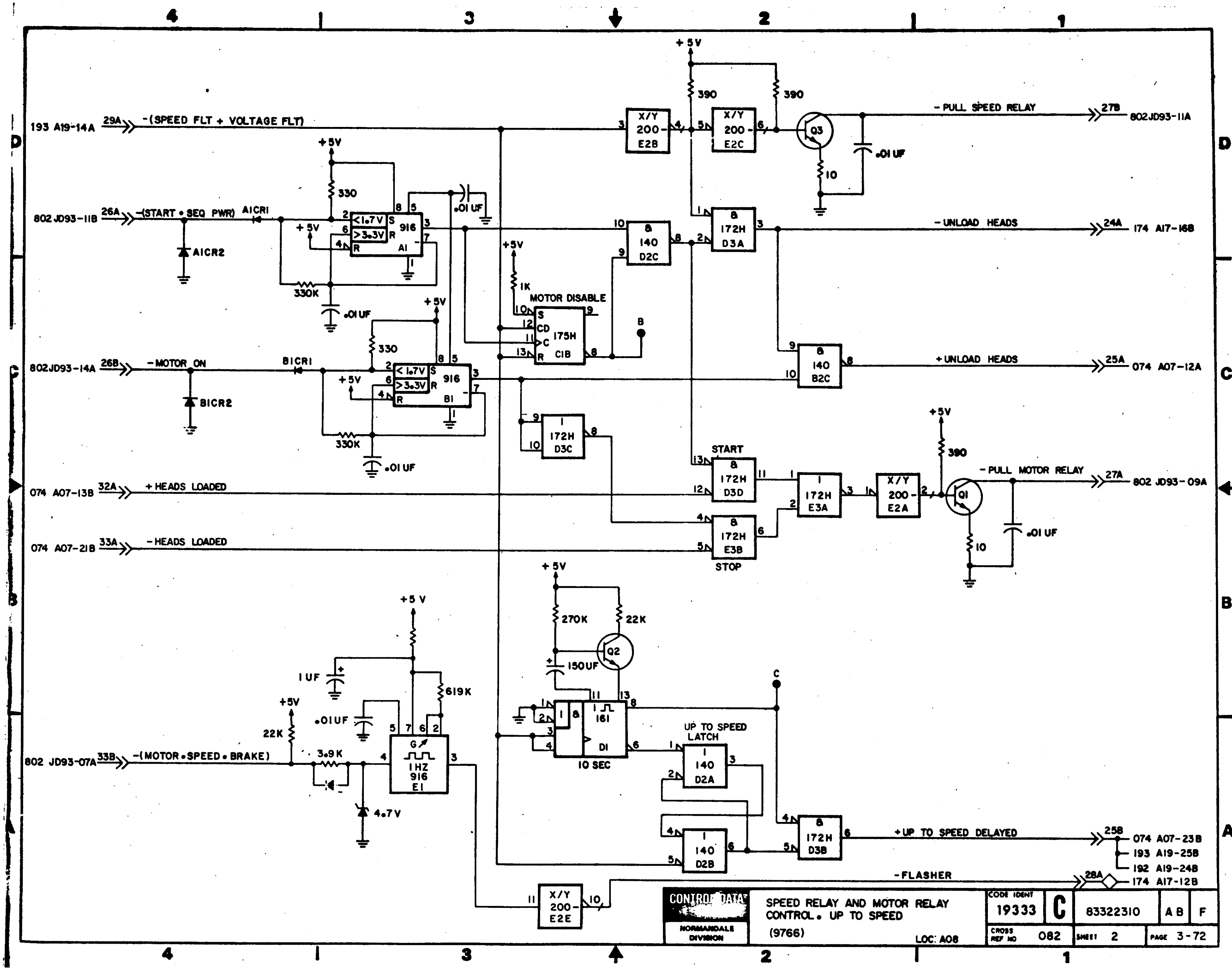




APPLICABLE TO BK7XX=9766

DRAWN	MANDERSON	10-15-75	CONTROL DATA	DIFF BITS, HEAD REG SPEED ENABLE, UNIT SELECT DIAGRAMS	CODE IDENT 19333	C	83322310	AB	G
CHECKED									
ENGINEER	B. T.	11/11/75	NORMANDALE DIVISION	TYPE: CQPV LOC: A08	CROSS REF NO 081	SHEET 1 OF 4	PAGE 3-71		
APPROVED									

REF 83215208



193 A19-14A 29A -(SPEED FLT + VOLTAGE FLT)
802 JD93-11B 26A -(START • SEQ PWR) A1CR1
A1CR2
802JD93-14A 26B -MOTOR ON B1CR1
B1CR2
074 A07-13B 32A +HEADS LOADED
074 A07-21B 33A -HEADS LOADED
802 JD93-07A 33B -(MOTOR • SPEED • BRAKE)
+5V
390
X/Y 200 E2B
X/Y 200 E2C
Q3
10
.01 UF
-PULL SPEED RELAY 27B 802JD93-11A
330
<1.7V
>3.3V
916 A1
.01 UF
330K
172H D3A
-UNLOAD HEADS 24A 174 A17-16B
140 D2C
1K
MOTOR DISABLE
175H C1B
B
140 B2C
+UNLOAD HEADS 25A 074 A07-12A
916 B1
172H D3C
START
172H D3D
172H E3A
X/Y 200 E2A
Q1
-PULL MOTOR RELAY 27A 802 JD93-09A
172H E3B
STOP
270K
22K
Q2
150UF
1 UF
619K
.01UF
22K
3.9K
4.7V
1HZ 916 E1
161 D1
10 SEC
C
UP TO SPEED LATCH
140 D2A
140 D2B
172H D3B
+UP TO SPEED DELAYED 25B 074 A07-23B
193 A19-25B
192 A19-24B
-FLASHER 28A 174 A17-12B
X/Y 200 E2E
CONTROL DATA
NORMANDALE DIVISION
SPEED RELAY AND MOTOR RELAY CONTROL. UP TO SPEED
(9766)
LOC: A08
CODE IDENT 19333
C
83322310
A B
F
CROSS REF NO 082
SHEET 2
PAGE 3-72

REVISION STATUS OF SHEETS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	A	B	A																
C	A	B	C																
D	D	D	D																
E	D	E	D																
F	D	E	F																
G	G	E	F																
H	G	H	F																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA	-16-76	
B	PE48555	REPLACE CLSV REV B WITH REV C	SB	5-5-77	
C	PE22926	ERROR CORRECTION	DM	7-11-77	
D	PE48650	CLSV CARD CHANGE	DM	12-6-77	
E	PE55185	CHANGE DELAY CLSV	A.A.O	8-4-78	
F	PE55259	LOGIC DIAG. IMPROVEMENT	MA	9-25-78	
G	PE57278	ADD WIRE INFO TO LOGIC	N P	4-22-8[illegible]	
H	PE80129A	HFRV COST REDUCTION	N P	4-22-82	

DRAWN	G. RABINE	10-9-76
CHECKED		
ENGINEER		
APPROVED		

CONTROL DATA
NORMANDALE DIVISION

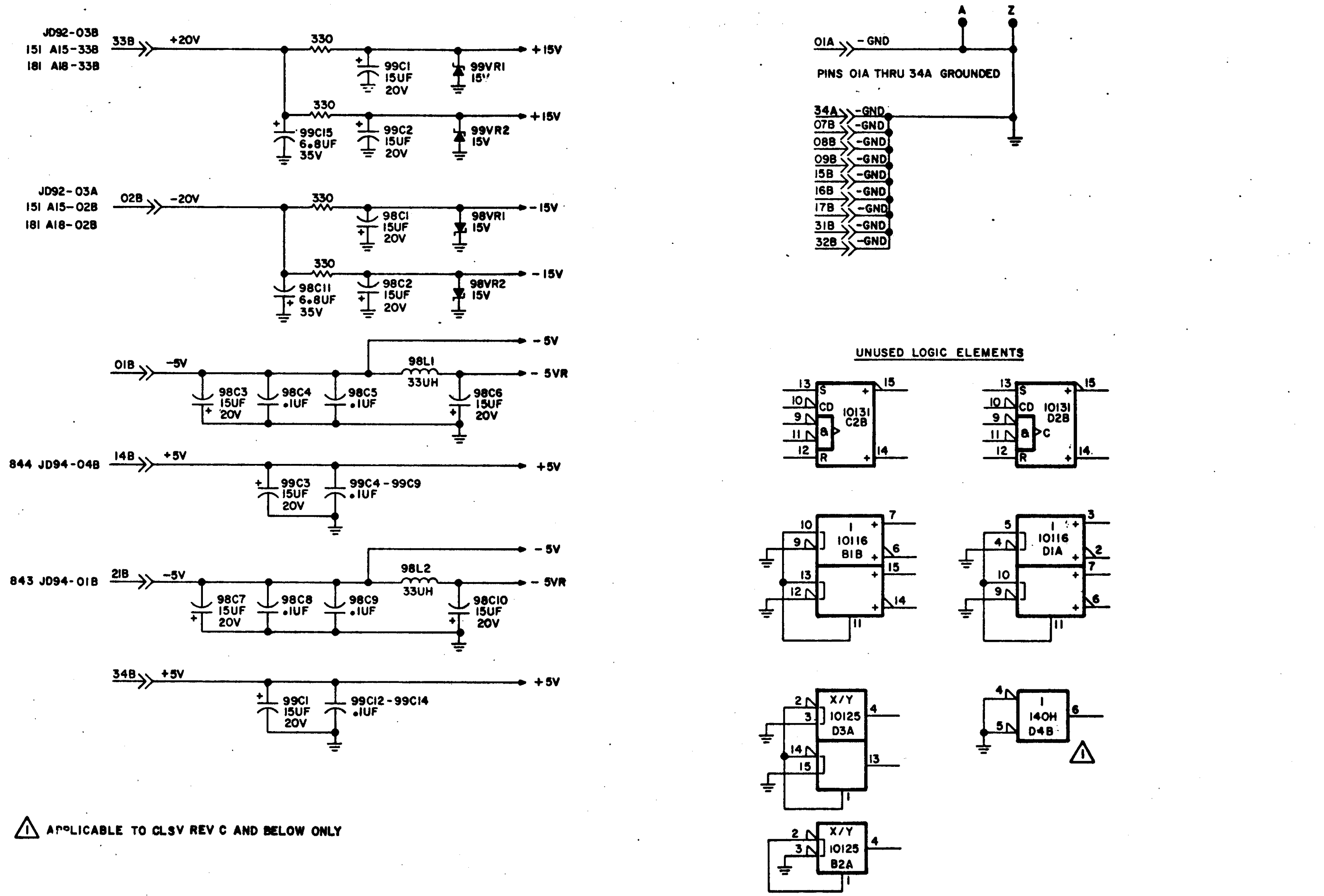
WRITE CLOCK 806 KHZ
TO 9.67 MHZ

TYPE: CLSV   LOC: A10

CODE IDENT 19333 | C | 83322310 | A B | H

CROSS REF NO 101 | SHEET 1 OF 4 | PAGE 3-79

REF 83215210

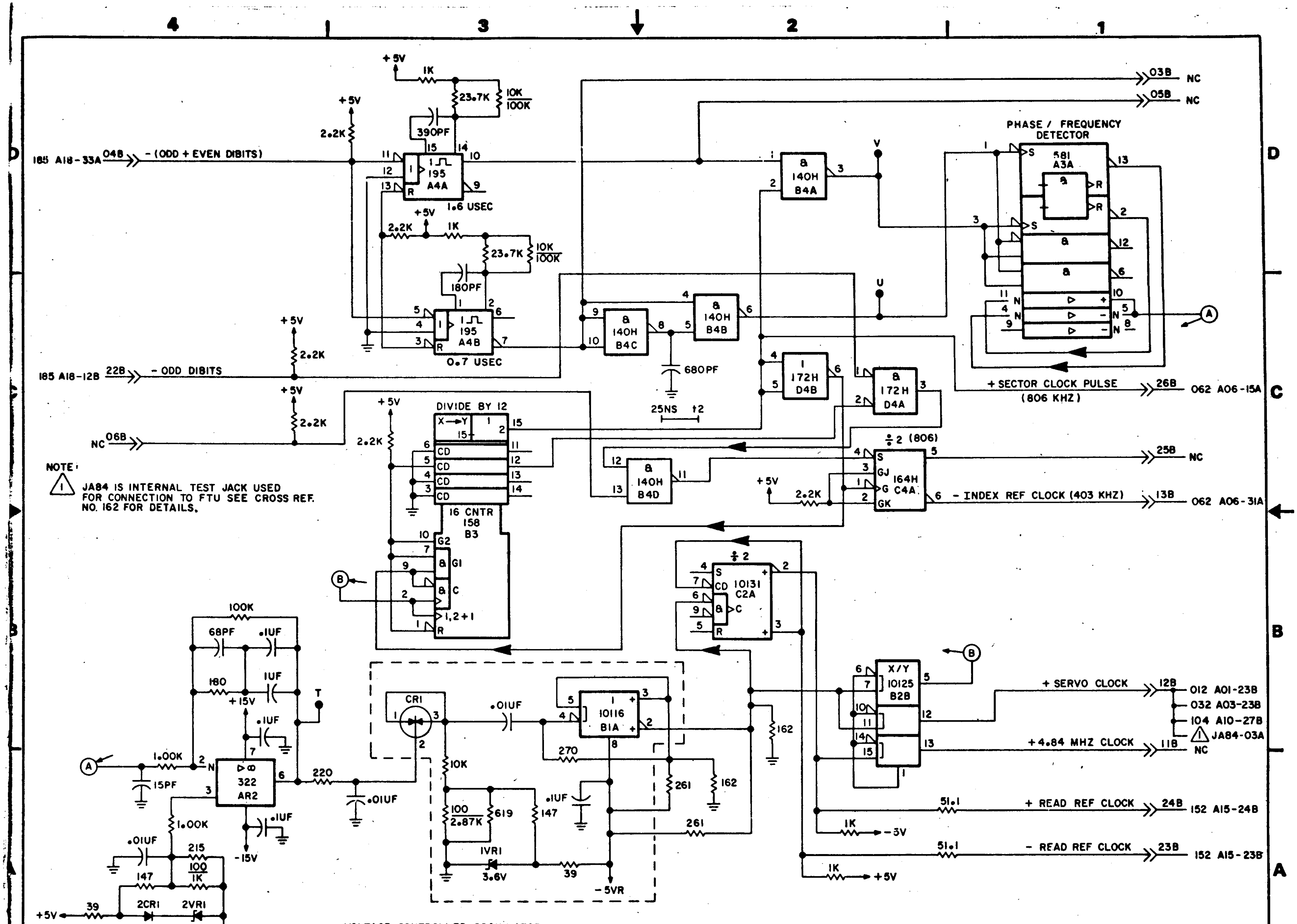


CONTROL DATA
NORMANDALE DIVISION

POWER INPUT PINS AND
UNUSED LOGIC ELEMENTS

LOC: A10

CODE IDENT					
19333	C	83322310	A	B	G
CROSS REF NO 102	SHEET 2	PAGE 3-80			

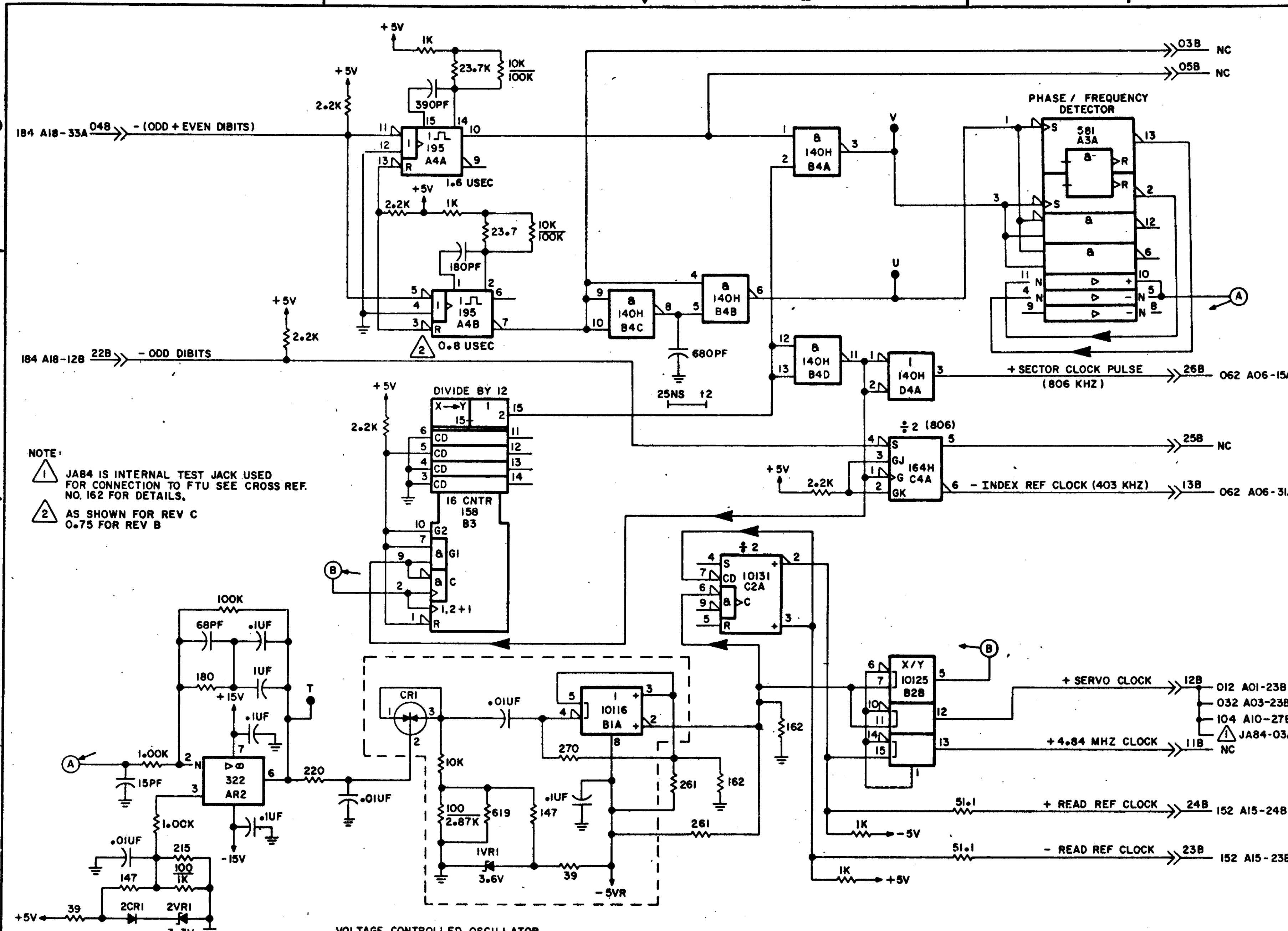


CONTROL DATA
NORMANDALE DIVISION

SECTOR, INDEX, REF AND WRITE PLO CLOCKS

LOC A10

CODE IDENT 19333	C	83322310	AB	H
CROSS REF NO 103	SHEET 3	PAGE 3-81		



CONTROL DATA NORMANDALE DIVISION	SECTOR, INDEX, REF AND WRITE PLO CLOCKS	CODE IDENT 19333	C 83322310 W D
	CLSV REV C & BELOW LOC A10	CROSS REF NO 103	SHEET 3A PAGE 3-82

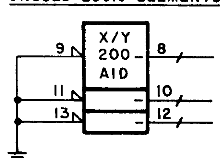
REVISION STATUS OF SHEETS

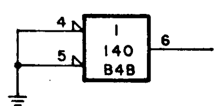
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A	A															
B	B	B	B	B															
C	B	B	B	C															

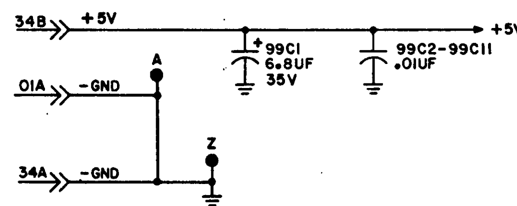
REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED			
B	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-9-78	
C	PE57276	ADD WIRE INFO TO LOGIC	K P	4-23-78	

UNUSED LOGIC ELEMENTS



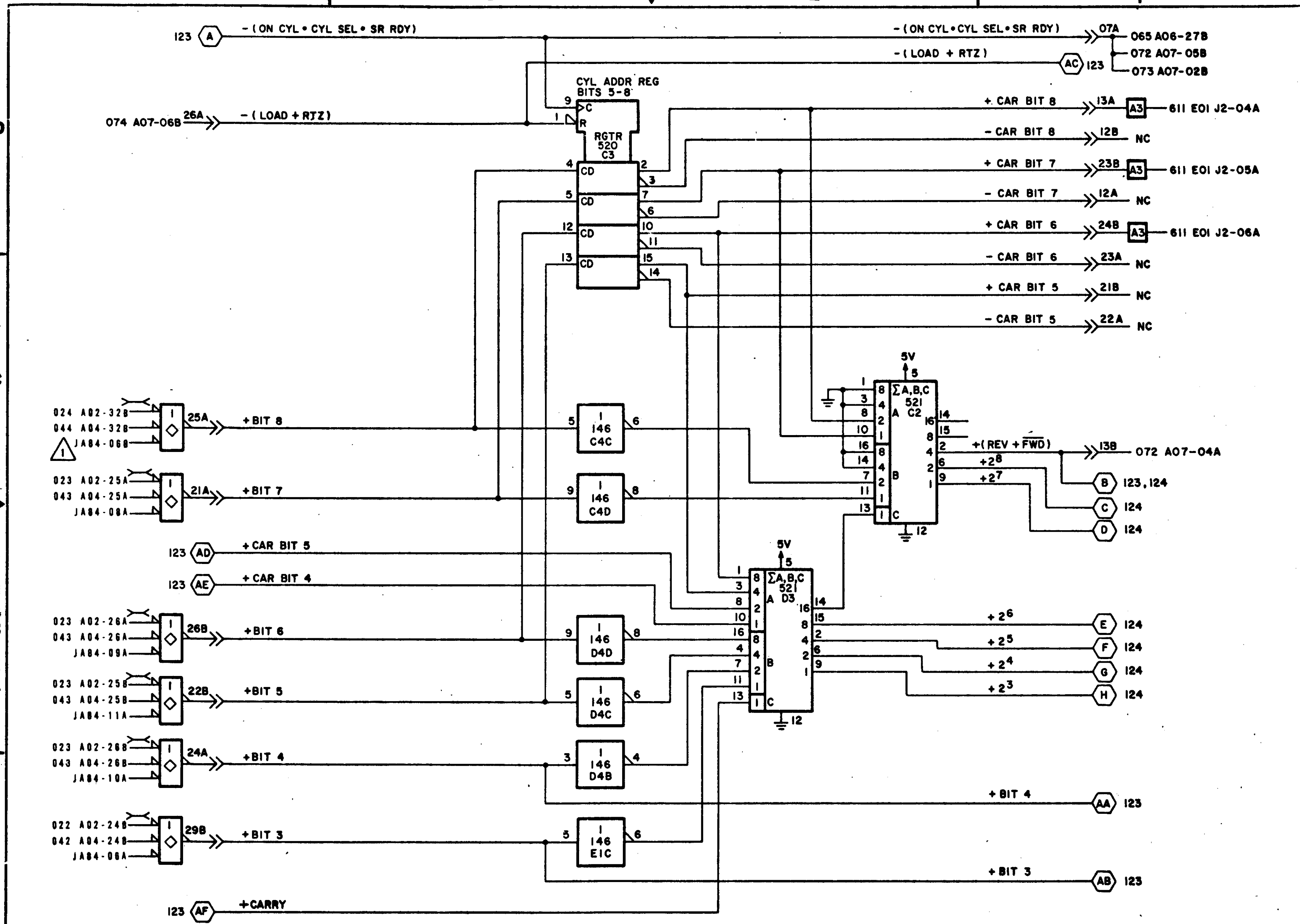




APPLICABLE TO BK6XX = 9764

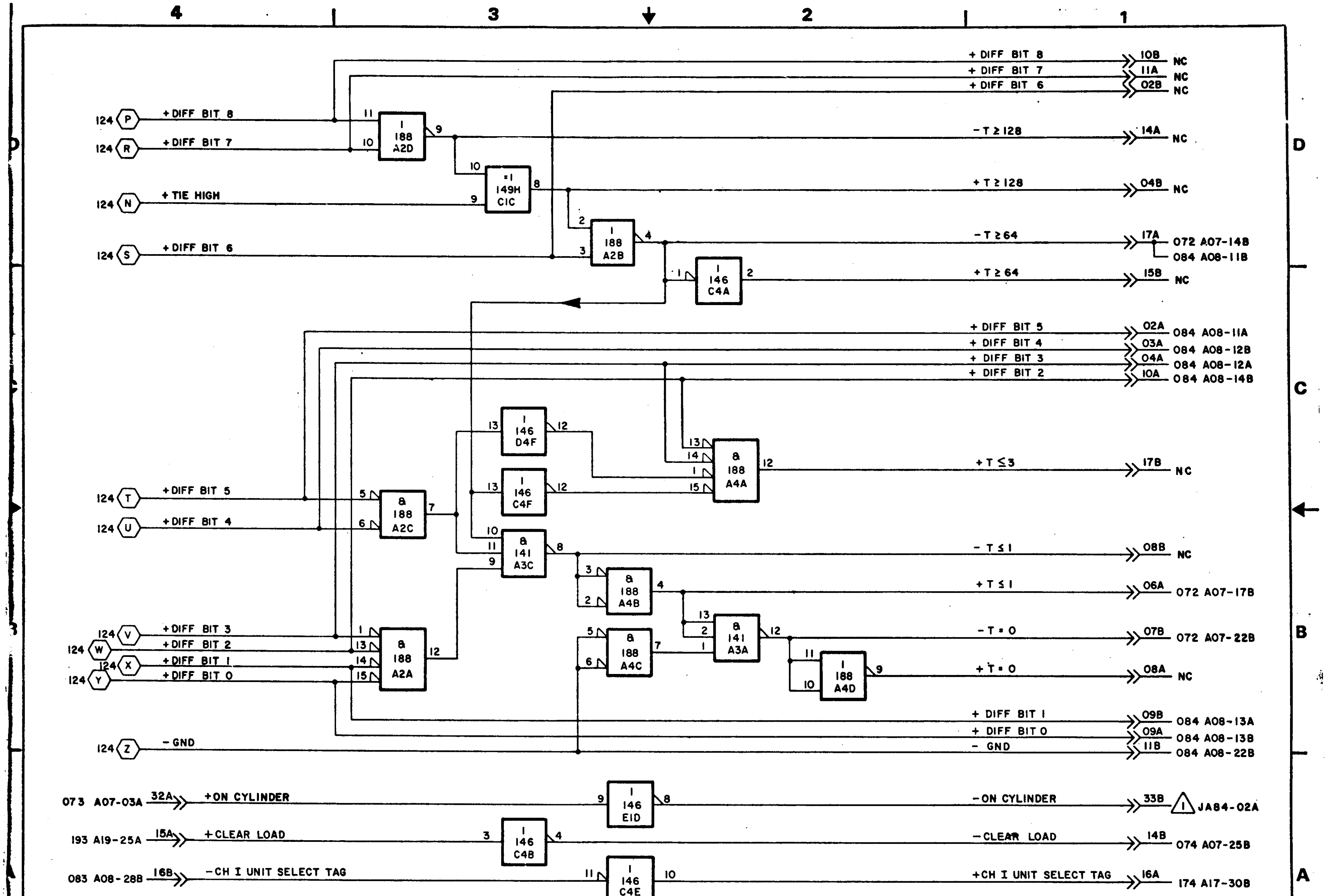
DRAWN	G. RABINE	11/7/76	CONTROL DATA	DIFFERENCE GENERATOR AND CONTROL DIAGRAMS	CODE IDENT 19333	C	83322310
CHECKED							A B / C
ENGINEER		11/11/76	NORMANDALE DIVISION	TYPE: FLWV LOC: A12	CROSS REF NO 121	SHEET 1 OF 5	PAGE 3-83
APPROVED							

REF 83215306



NOTE:
1. JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REF. NO. 162 FOR DETAILS.

CONTROL DATA NORMANDALE DIVISION	CYLINDER ADDRESS REGISTER (9764) LOC: A12	CODE IDENT 19333	C	83322310	K	B
		CROSS REF NO 122	SHEET 2	PAGE 3-84		



JA8A IS INTERNAL TEST JACK FOR CONNECTION TO FTU. SEE CROSS REF. NO. 162 FOR DETAILS.

CONTROL DATA NORMANDALE DIVISION	DIFFERENCE COUNTER OUTPUT (9764) LOC: A12	CODE IDENT 19333	C	83322310	AB	C
		CROSS REF NO 125		SHEET 5	PAGE 3-87/88	

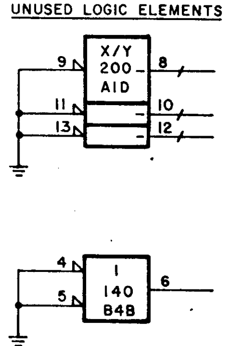
REVISION STATUS OF SHEETS

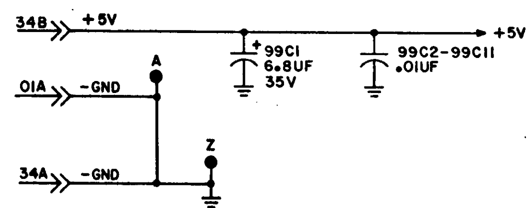
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A	A															
B	B	B	B	B															
C	B	B	B	C															
D	B	B	D	D															

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED			
B	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-9-78	
C	PE57270	ADD WIRE INFO TO LOGIC	N P	4-23-82	
D	PE57173	CHG I.C. FAMILIES	N P	4-23-82	

UNUSED LOGIC ELEMENTS

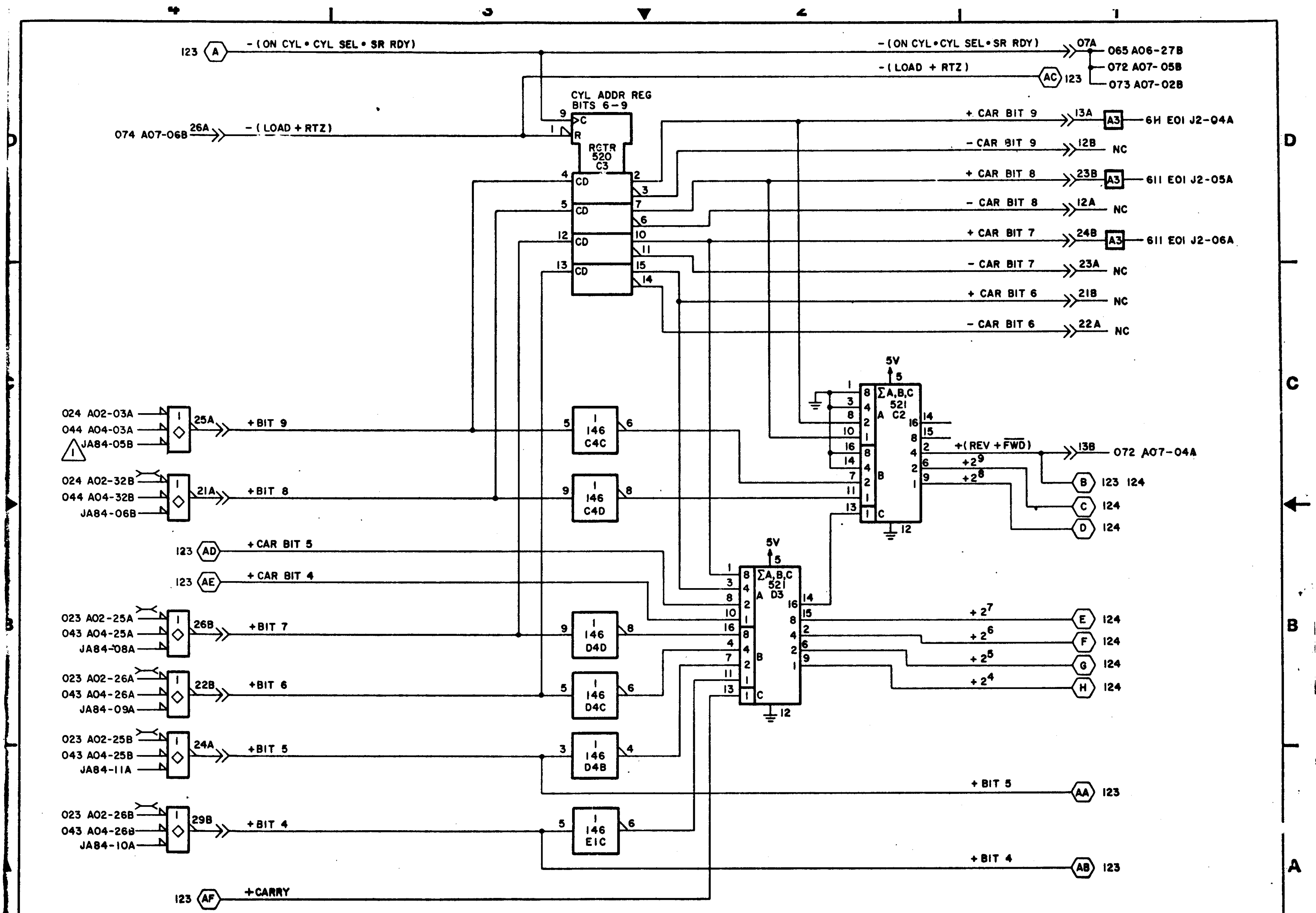




APPLICABLE TO BK7XX =9766

DRAWN	G. Rabine	8/21/76	CONTROL DATA	DIFFERENCE GENERATOR AND CONTROL DIAGRAMS	CODE IDENT 19333	C	83322310	AB	D
CHECKED							
ENGINEER		11/12/76	NORMANDALE DIVISION	TYPE: FLWV LOC: A12	CROSS REF NO 121	SHEET 1 OF 5	PAGE 3-89
APPROVED							

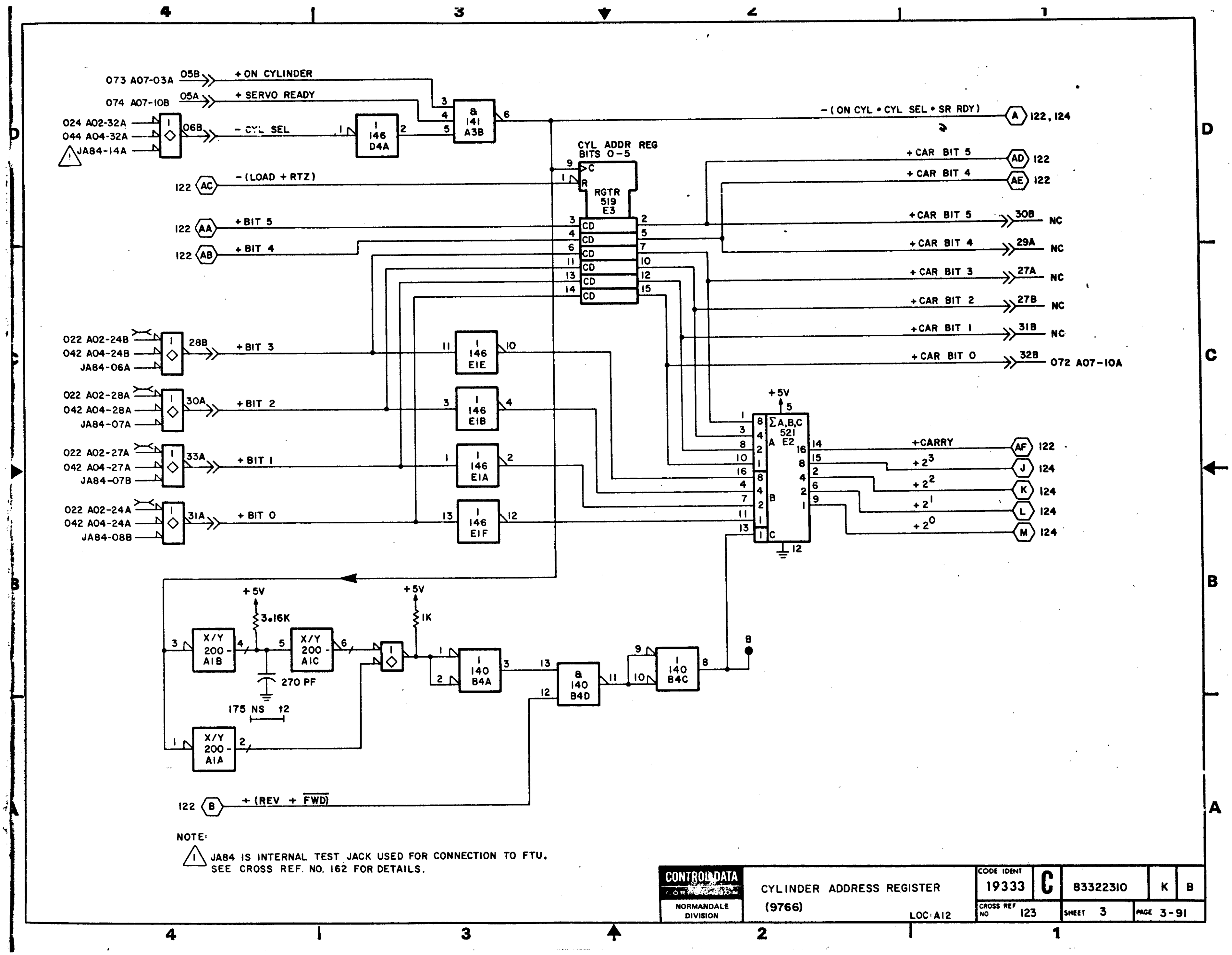
REF 83215212



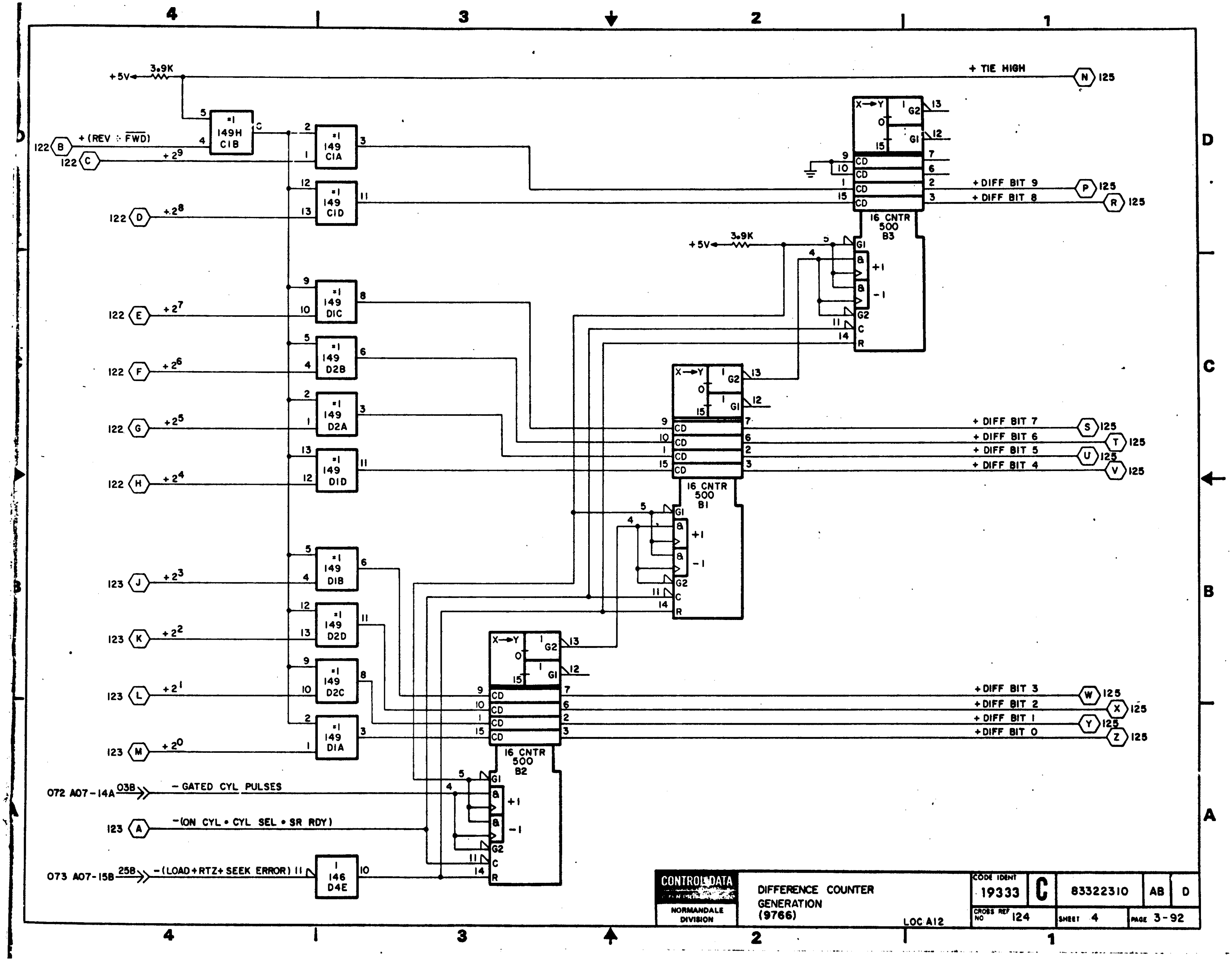
NOTE:

1. JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REF. NO. 162 FOR DETAILS.

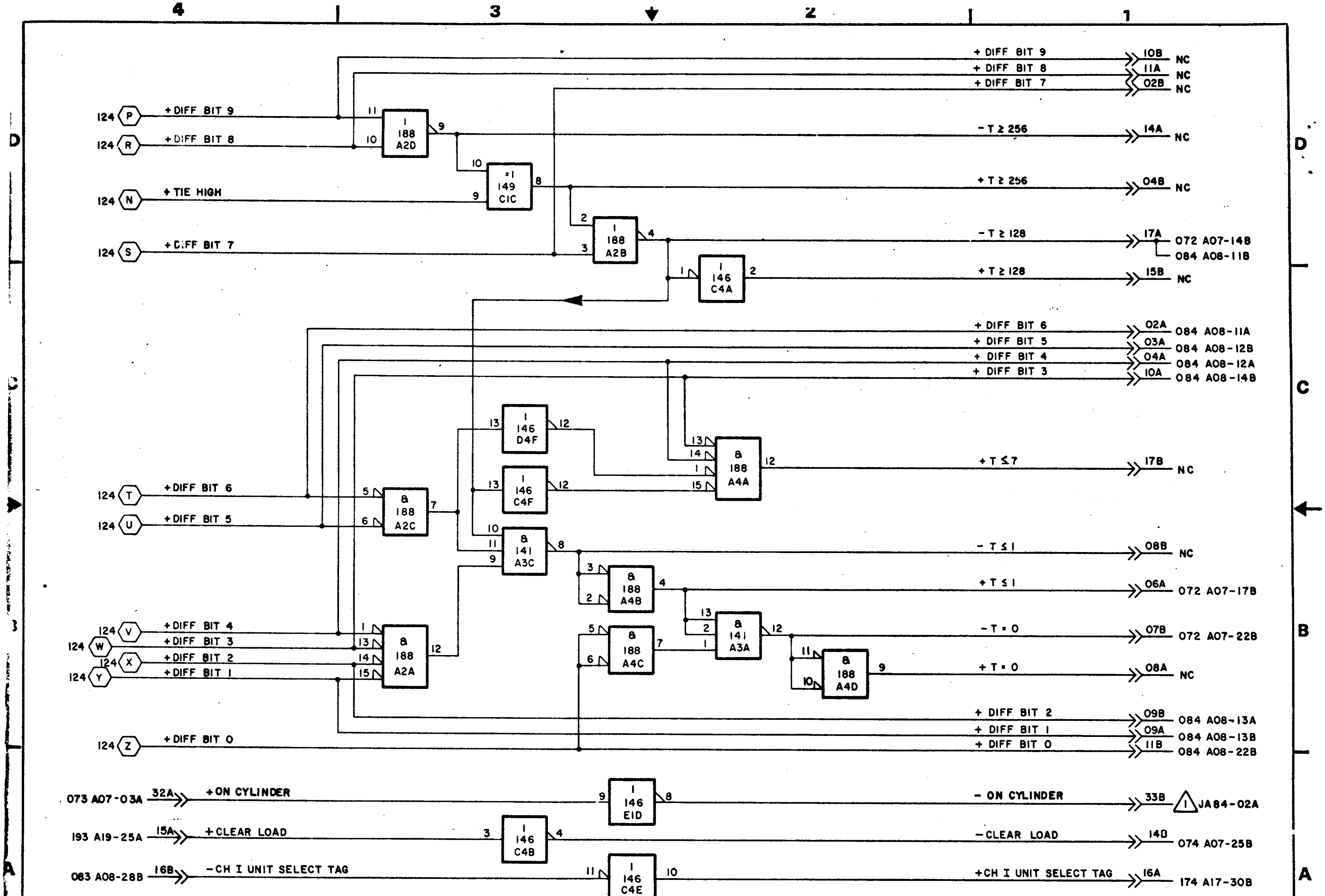
CONTROL DATA CORPORATION NORMANDALE DIVISION	CYLINDER ADDRESS REGISTER (9766) LOC: A12	CODE IDENT 19333	C	83322310	K	B
		CROSS REF NO 122	SHEET 2	PAGE 3-90		



073 A07-03A
05B
+ON CYLINDER
074 A07-10B
05A
+SERVO READY
024 A02-32A
044 A04-32A
JA84-14A
06B
-CYL SEL
146 D4A
141 A3B
-(ON CYL • CYL SEL • SR RDY)
122, 124
CYL ADDR REG BITS 0-5
RGTR 519 E3
122
-(LOAD + RTZ)
+BIT 5
+BIT 4
+CAR BIT 5
+CAR BIT 4
+CAR BIT 3
+CAR BIT 2
+CAR BIT 1
+CAR BIT 0
30B
29A
27A
27B
31B
32B
NC
072 A07-10A
022 A02-24B
042 A04-24B
JA84-06A
28B
+BIT 3
146 E1E
022 A02-28A
042 A04-28A
JA84-07A
30A
+BIT 2
146 E1B
022 A02-27A
042 A04-27A
JA84-07B
33A
+BIT 1
146 E1A
022 A02-24A
042 A04-24A
JA84-08B
31A
+BIT 0
146 E1F
+5V
ΣA,B,C 521 E2
+CARRY
$+2^3$
$+2^2$
$+2^1$
$+2^0$
124
X/Y 200-A1B
3.16K
X/Y 200-A1C
270 PF
1K
175 NS ±2
140 B4A
140 B4D
140 B4C
X/Y 200-A1A
122
+(REV + $\overline{FWD}$)
NOTE:
JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU. SEE CROSS REF. NO. 162 FOR DETAILS.
CONTROL DATA CORPORATION
NORMANDALE DIVISION
CYLINDER ADDRESS REGISTER (9766)
LOC: A12
CODE IDENT 19333
C
83322310
K
B
CROSS REF NO 123
SHEET 3
PAGE 3-91



+5V
3.9K
+ TIE HIGH
N 125
122 B + (REV : FWD)
122 C +2^9
149H C1B
149 C1A
149 C1D
122 D +2^8
122 E +2^7
149 D1C
122 F +2^6
149 D2B
122 G +2^5
149 D2A
122 H +2^4
149 D1D
123 J +2^3
149 D1B
123 K +2^2
149 D2D
123 L +2^1
149 D2C
123 M +2^0
149 D1A
072 A07-14A 03B − GATED CYL PULSES
123 A −(ON CYL • CYL SEL • SR RDY)
073 A07-15B 25B −(LOAD + RTZ + SEEK ERROR)
146 D4E
X→Y
CD
16 CNTR 500 B3
16 CNTR 500 B1
16 CNTR 500 B2
+1
−1
+ DIFF BIT 9 P 125
+ DIFF BIT 8 R 125
+ DIFF BIT 7 S 125
+ DIFF BIT 6 T 125
+ DIFF BIT 5 U 125
+ DIFF BIT 4 V 125
+ DIFF BIT 3 W 125
+ DIFF BIT 2 X 125
+ DIFF BIT 1 Y 125
+ DIFF BIT 0 Z 125
CONTROL DATA
NORMANDALE DIVISION
DIFFERENCE COUNTER GENERATION (9766)
LOC A12
CODE IDENT 19333
C
83322310
AB
D
CROSS REF NO 124
SHEET 4
PAGE 3-92



⚠1 JA84 IS INTERNAL TEST JACK FOR CONNECTION TO FTU.
SEE CROSS REF. NO. 162 FOR DETAILS.

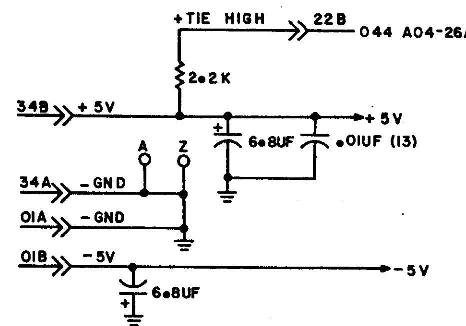
CONTROL DATA NORMANDALE DIVISION	DIFFERENCE COUNTER OUTPUT (9766) LOC: A12	CODE IDENT 19333	C	83322310	AB D
		CROSS REF NO 125	SHEET 5	PAGE 3-93/94	

REVISION STATUS OF SHEETS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	B	B	B																
C	B	B	B																

REVISIONS

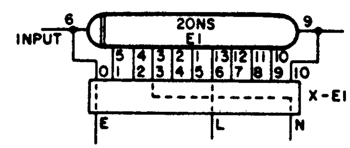
REV	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED CREATED FROM 83215917, REV C	CB	1-25-80	
B	PE57432	CHG. LOGIC DIAGRAM ON TLA	MF	9-3-80	
C	DH13152	ADD NOTES TO LD	N. P.	4-28-82	

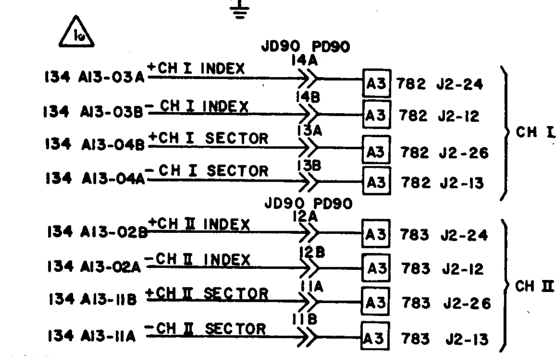


NOTE:

1. DELAY LINES ARE CONNECTED TO JUMPER BLOCK AS SHOWN IN DIAGRAM AT THE RIGHT. ACTUAL DELAYS ARE SELECTED DURING MANUFACTURING. THIS DIAGRAM SHOWS TYPICAL CONNECTIONS. DELAY TIME FOR EACH DELAY LINE PIN RELATIVE TO PIN 6 INPUT IS SHOWN IN CHART TO THE RIGHT.

PIN	20NS DELAY
5	2 NS
4	4 NS
3	6 NS
2	8 NS
1	10 NS
13	12 NS
12	14 NS
11	16 NS
10	18 NS
9	20NS





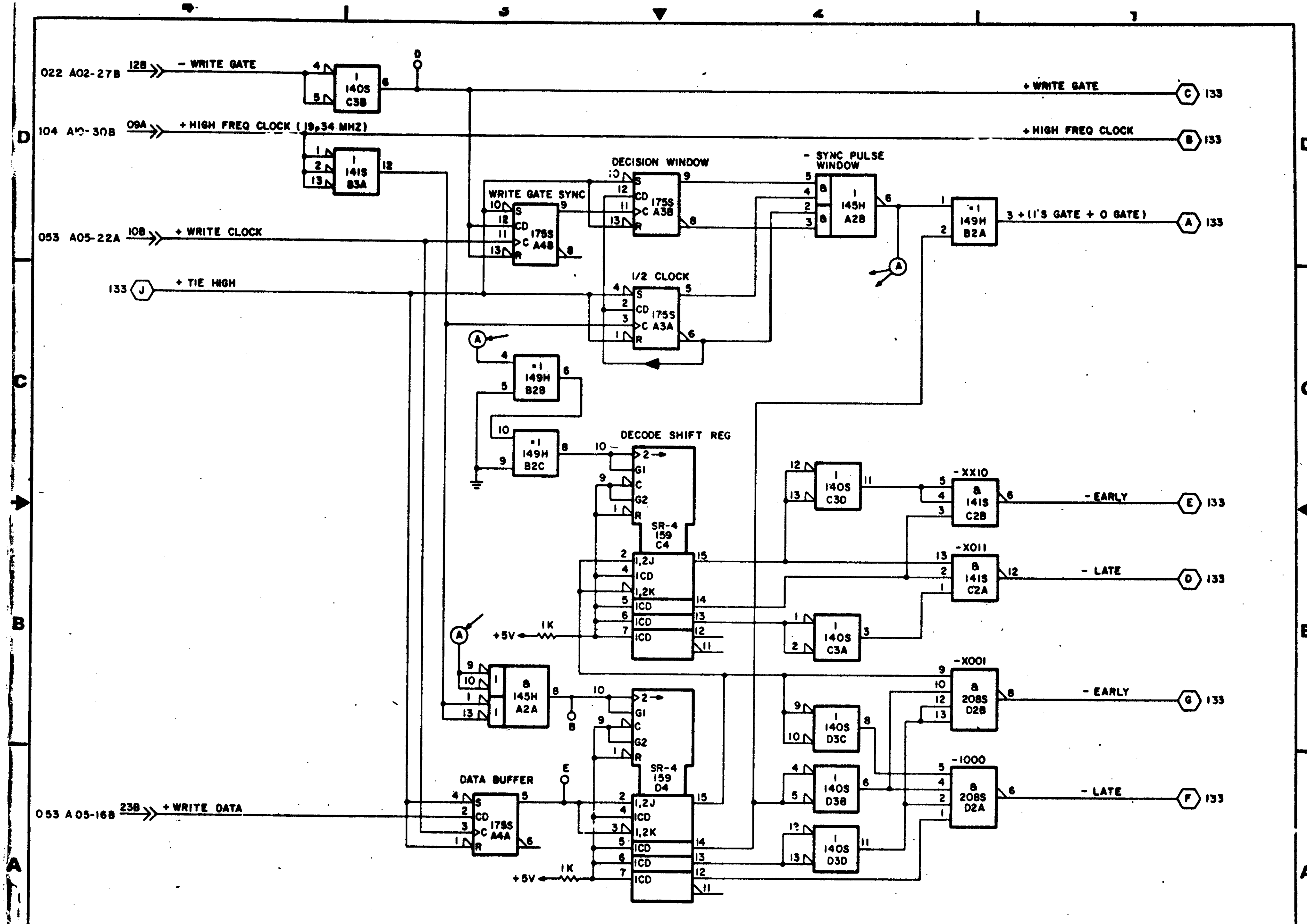
NOTE:

1. PD90 IS AN I/O CABLE CONNECTOR THAT IS PLUGGED ON TO THE PINS OF JD90 TO PLACE INDEX AND SECTOR SIGNALS ON THE "B" CABLE.

APPLICABLE TO BK7XX W/SECTOR & INDEX ON A & B CABLE

DRAWN	T. Hoang	11-26-80	CONTROL DATA	NRZ TO COMPENSATED MFM DIAGRAMS	CODE IDENT 19333	C
CHECKED			NORMANDALE DIVISION	TYPE: FLXV LOC: A13	CROSS REF NO 131	
ENGINEER					83322310	A B C
APPROVED					SHEET 1 of 4	PAGE 3-98.1

REF: 83215246



CONTROL DATA
NORMANDALE DIVISION

NRZ TO MFM DATA
PART I

LOC A13

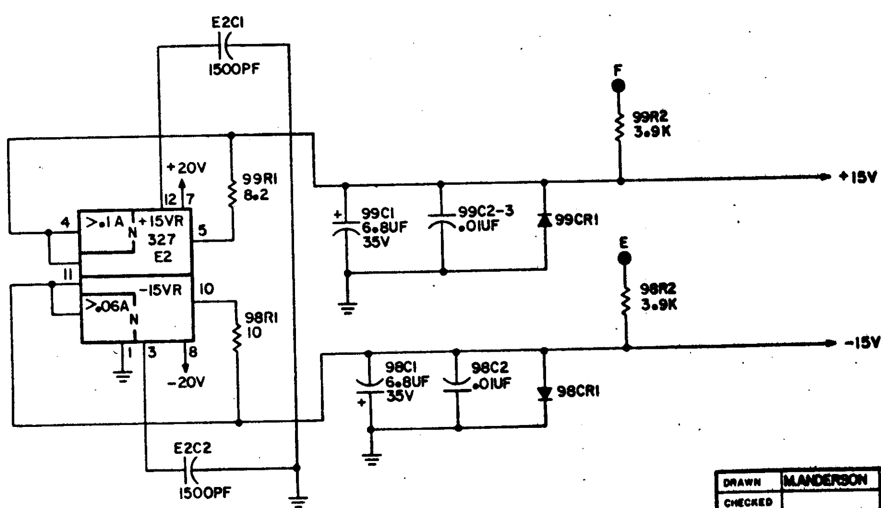
CODE IDENT 19333	C	-83322310	W	B
CROSS REF NC 132		SHEET 2		PAGE 3-98.2

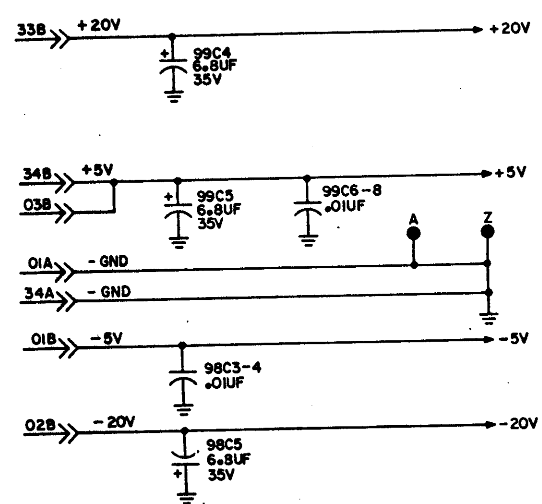
REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA	-19-76	
B	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-9-78	
C	PE57426	CHG WIRE WRAP	CB	1-30-81	
D	PE57544-A	CHANGE IC FAMILIES	S. A. W.	9/9/81	
E	DH13128	CORRECT AKGV SCH	DBH	4-23-82	

REVISION STATUS OF SHEETS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	B	B	A																
C	B	C	A																
D	D	D	D																
E	D	E	E																



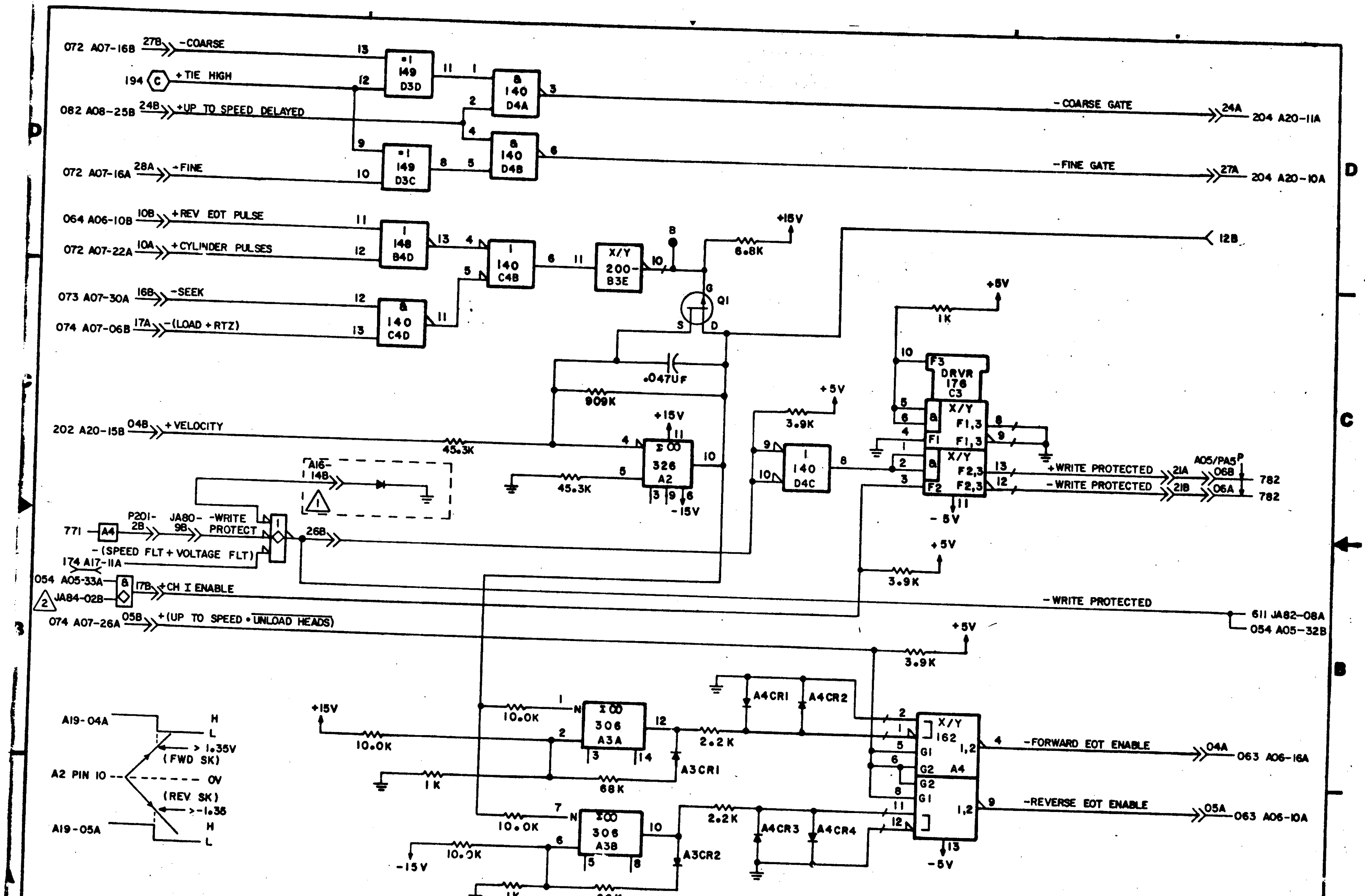


DRAWN	M.ANDERSON	04-76	CONTROL DATA
CHECKED			
ENGINEER		11/3/76	NORMANDALE DIVISION
APPROVED			

ACCESS CONTROL NO. 2
DIAGRAMS
TYPE: AKGV
LOC: A19

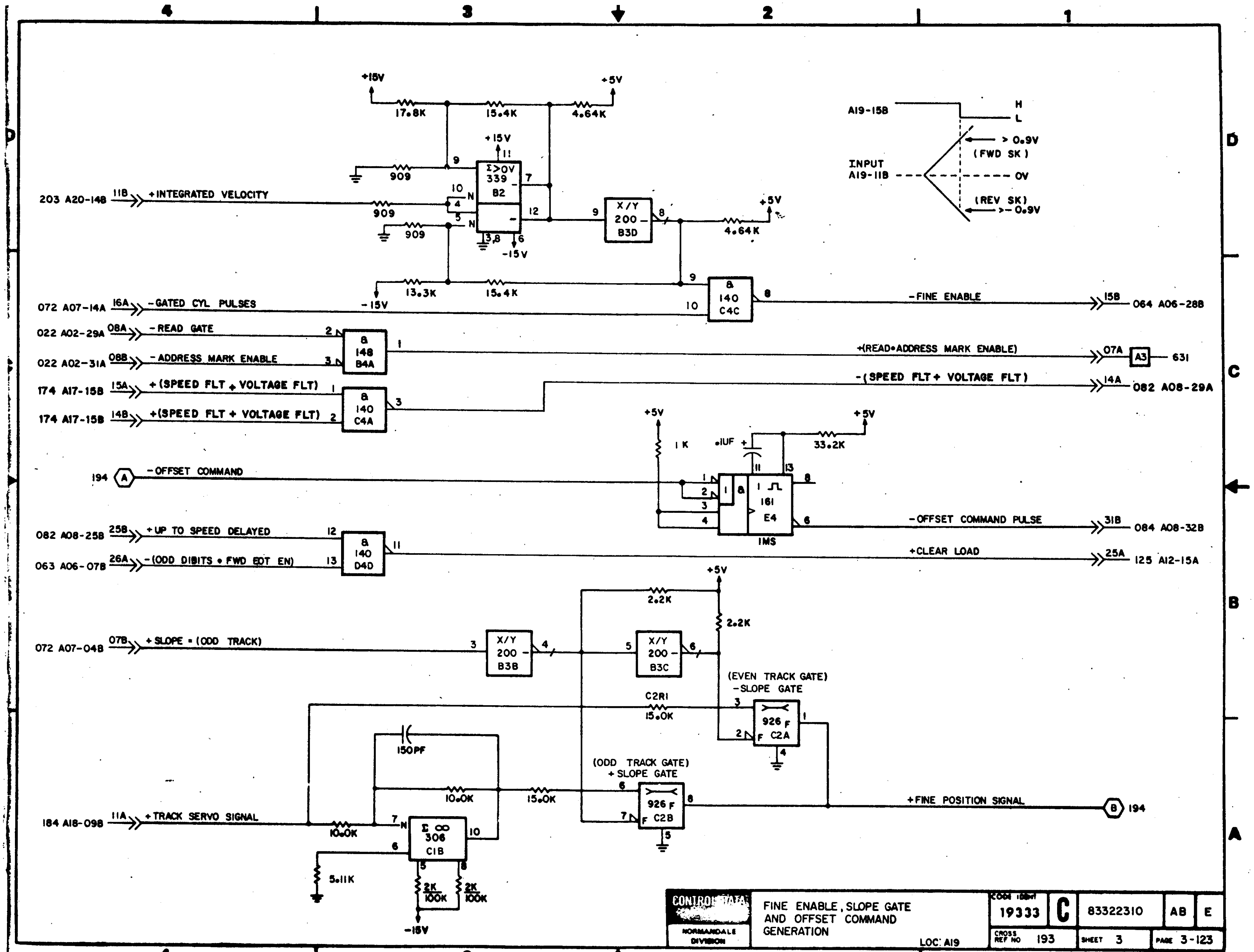
CODE IDENT	SIZE			
19333	C	83322310	AB	E
CROSS REF NO 191		SHEET 1 OF 4	PAGE 3-121	

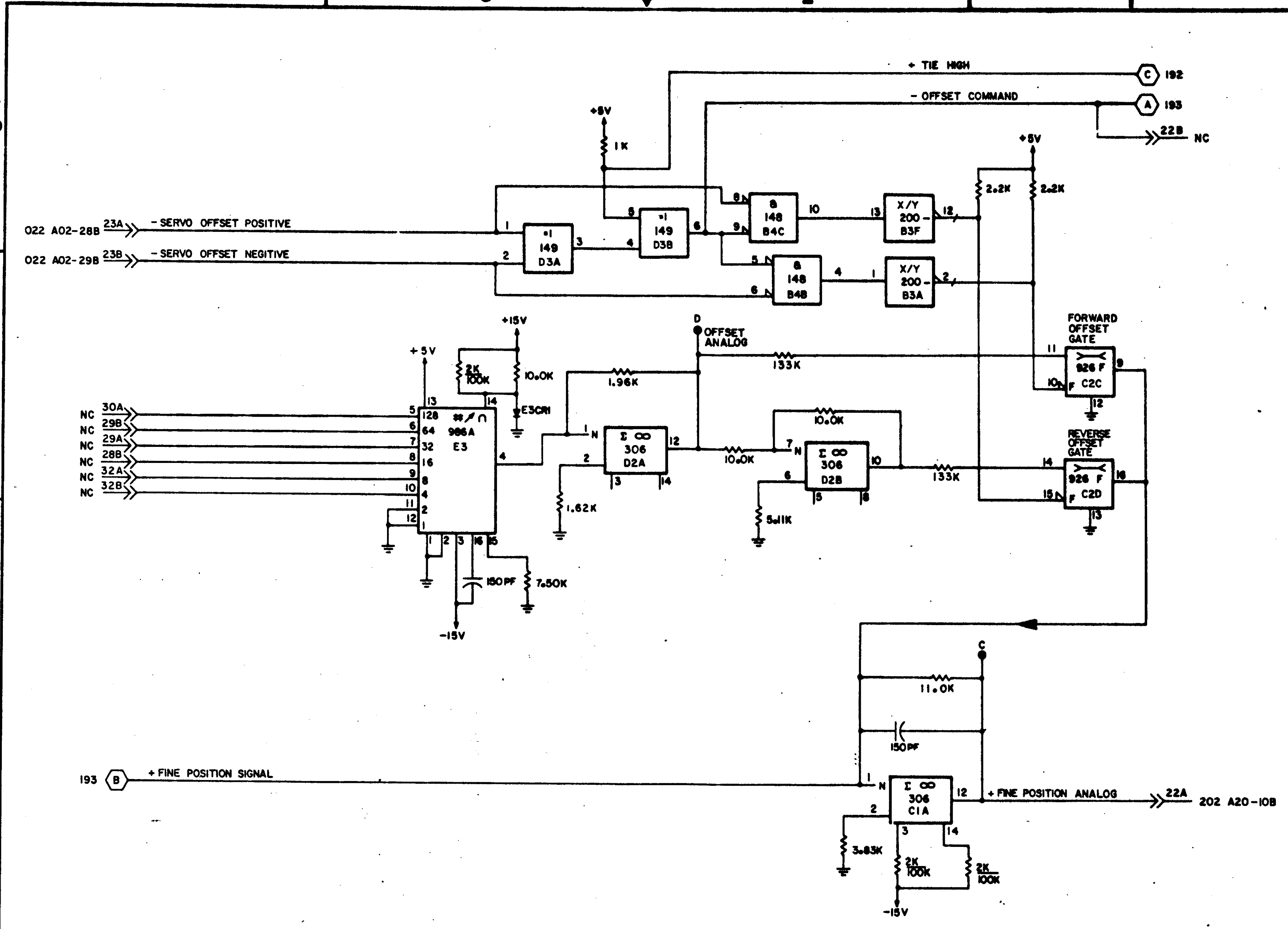
REF 83215219



1. PART OF HEAD ALIGNMENT CARD SEE CROSS REF 162 FOR DETAILS.
2. JA84 IS INTERNAL TEST JACK USED FOR CONNECTION TO FTU SEE CROSS REF NO 162 FOR DETAILS

CONTROL DATA NORMANDALE DIVISION	WRITE INHIBIT, FWD/REV EOT ENABLES, COARSE / FINE POSITION SIGNALS LOC A19	CODE IDENT 19333	C	83322310	Z	D
		CROSS REF NO 192		SHEET 2	PAGE 3-122	


203 A20-14B 11B +INTEGRATED VELOCITY
072 A07-14A 16A -GATED CYL PULSES
022 A02-29A 08A -READ GATE
022 A02-31A 08B -ADDRESS MARK ENABLE
174 A17-15B 15A +(SPEED FLT + VOLTAGE FLT)
174 A17-15B 14B +(SPEED FLT + VOLTAGE FLT)
194 A -OFFSET COMMAND
082 A08-25B 25B +UP TO SPEED DELAYED
063 A06-07B 26A -(ODD DIBITS • FWD EDT EN)
072 A07-04B 07B +SLOPE • (ODD TRACK)
184 A18-09B 11A +TRACK SERVO SIGNAL
-FINE ENABLE 15B 064 A06-28B
+(READ•ADDRESS MARK ENABLE) 07A A3 631
-(SPEED FLT + VOLTAGE FLT) 14A 082 A08-29A
-OFFSET COMMAND PULSE 31B 084 A08-32B
+CLEAR LOAD 25A 125 A12-15A
+FINE POSITION SIGNAL B 194
(EVEN TRACK GATE) -SLOPE GATE
(ODD TRACK GATE) +SLOPE GATE
A19-15B H L
INPUT A19-11B
> 0.9V (FWD SK)
0V
(REV SK) > -0.9V
CONTROL DATA
NORMANDALE DIVISION
FINE ENABLE, SLOPE GATE AND OFFSET COMMAND GENERATION
LOC: A19
19333 C 83322310 AB E
CROSS REF NO 193
SHEET 3
PAGE 3-123



CONTROL DATA

NORMANDALE DIVISION

FORWARD / REVERSE OFFSET AND FINE POSITION SIGNAL

LOC: A19

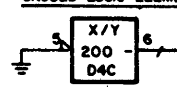
CODE IDENT 19333	C	83322310	AB	E
CROSS REF NO 194		SHEET 4	PAGE 3-124	

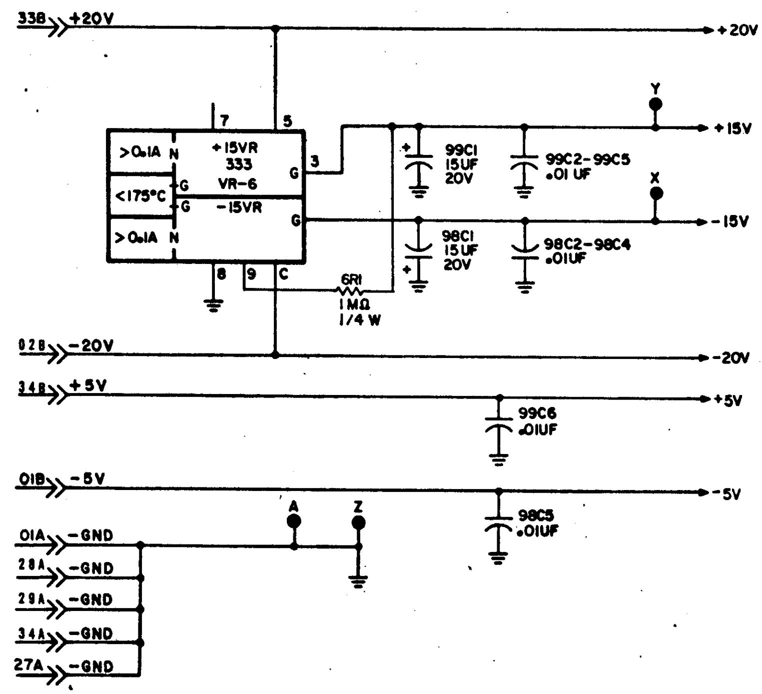
REVISION STATUS OF SHEETS

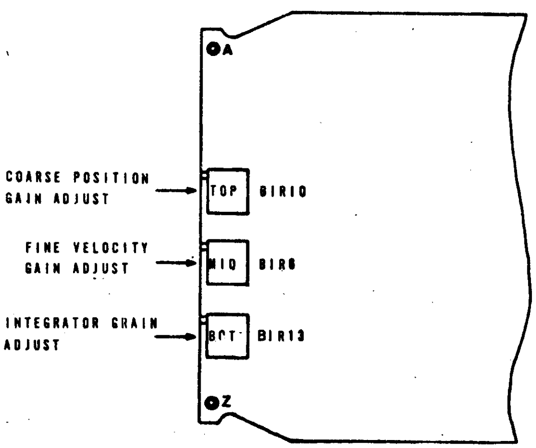
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	A	B	A																
C	C	C	C																
D	C	C	C																
E	E	C	E																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA	/ ‹-76	
B	PE22926	ERROR CORRECTION	DM	7-11-77	
C	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-9-78	
D	PE57589A	DESIGN IMPROVEMENT	NGL	8-10-81	
E	DH13126	DMSV GMSV CHG	N P	4-23-82	



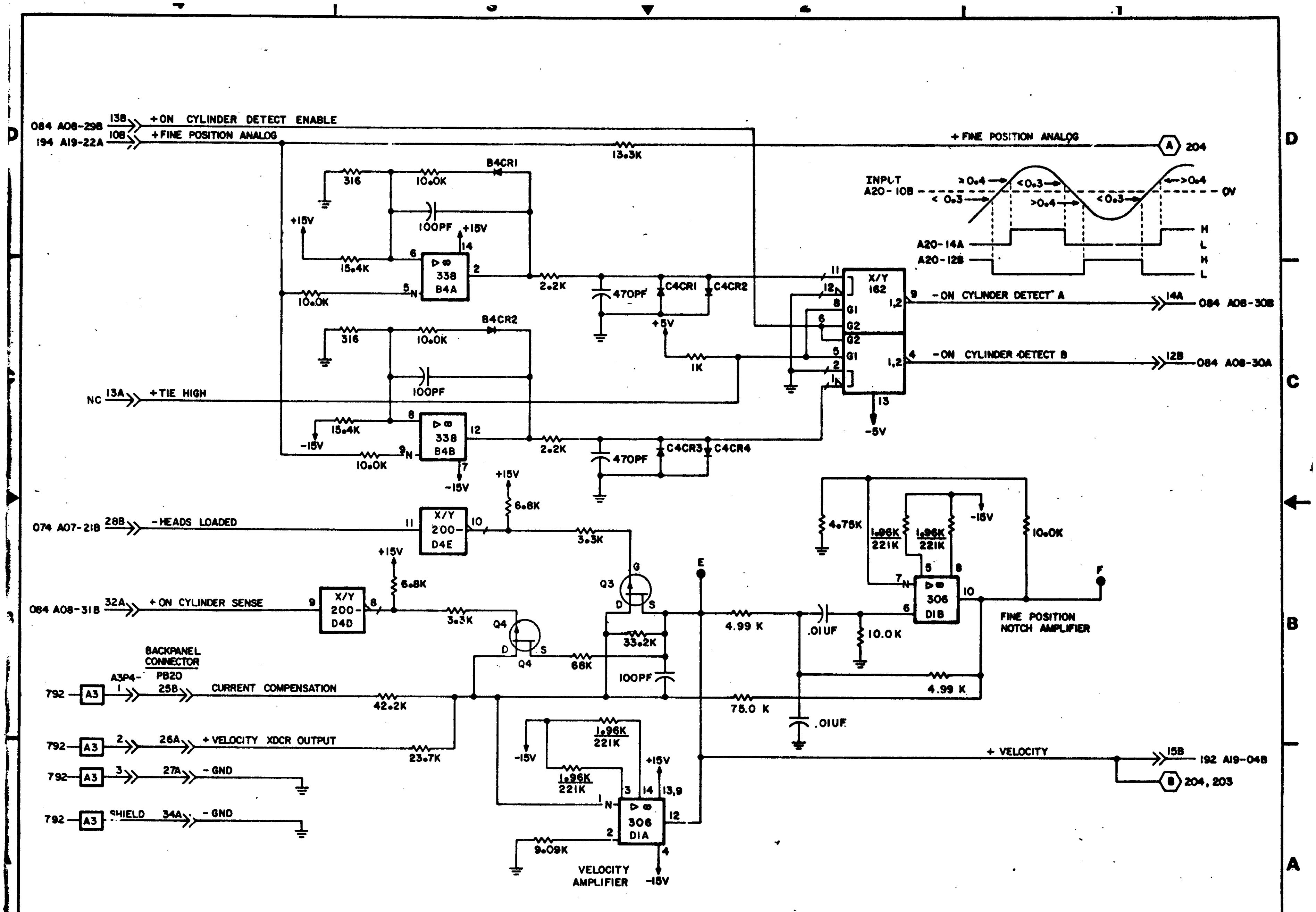




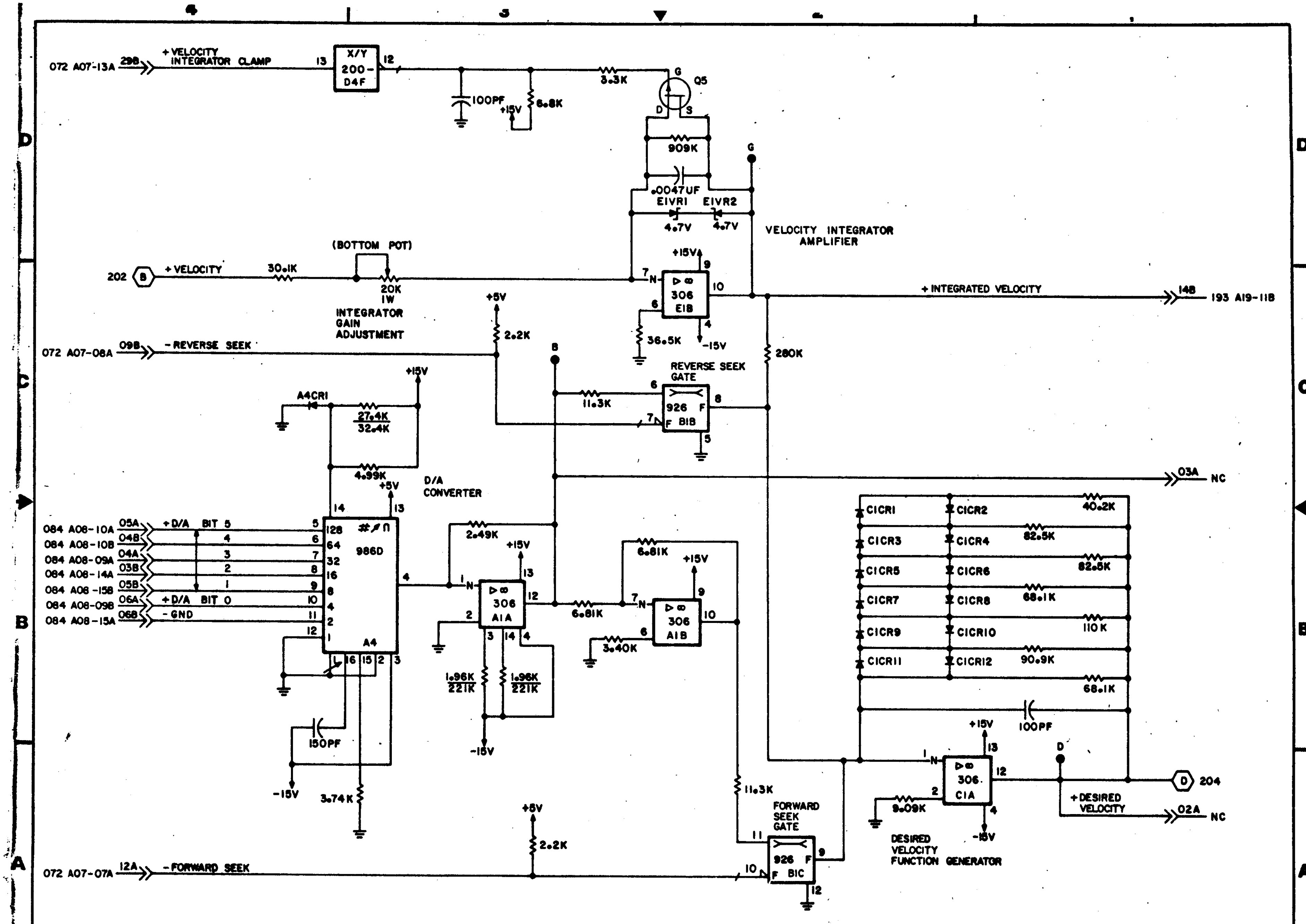
APPLICABLE TO BK6XX=9764

DRAWN	S. BENTLER	11-8-76	CONTROL DATA	ANALOG SERVO DIAGRAMS	CODE IDENT 19333	C	83322310	AB E
CHECKED								
ENGINEER	[signature]	11/12/76	NORMANDALE DIVISION	TYPE: DMSV LOC: A20	CROSS REF NO 201		SHEET 1 OF 4	PAGE 3-125
APPROVED								

REF 83215308



CONTROL DATA NORMANDALE DIVISION	CYLINDER DETECT, VELOCITY, AND VELOCITY GAIN ADJUST (9764) LOC: A20	CODE IDENT 19333	C	83322310	AB	E
		CROSS REF NO 202	SHEET 2		PAGE 3-126	

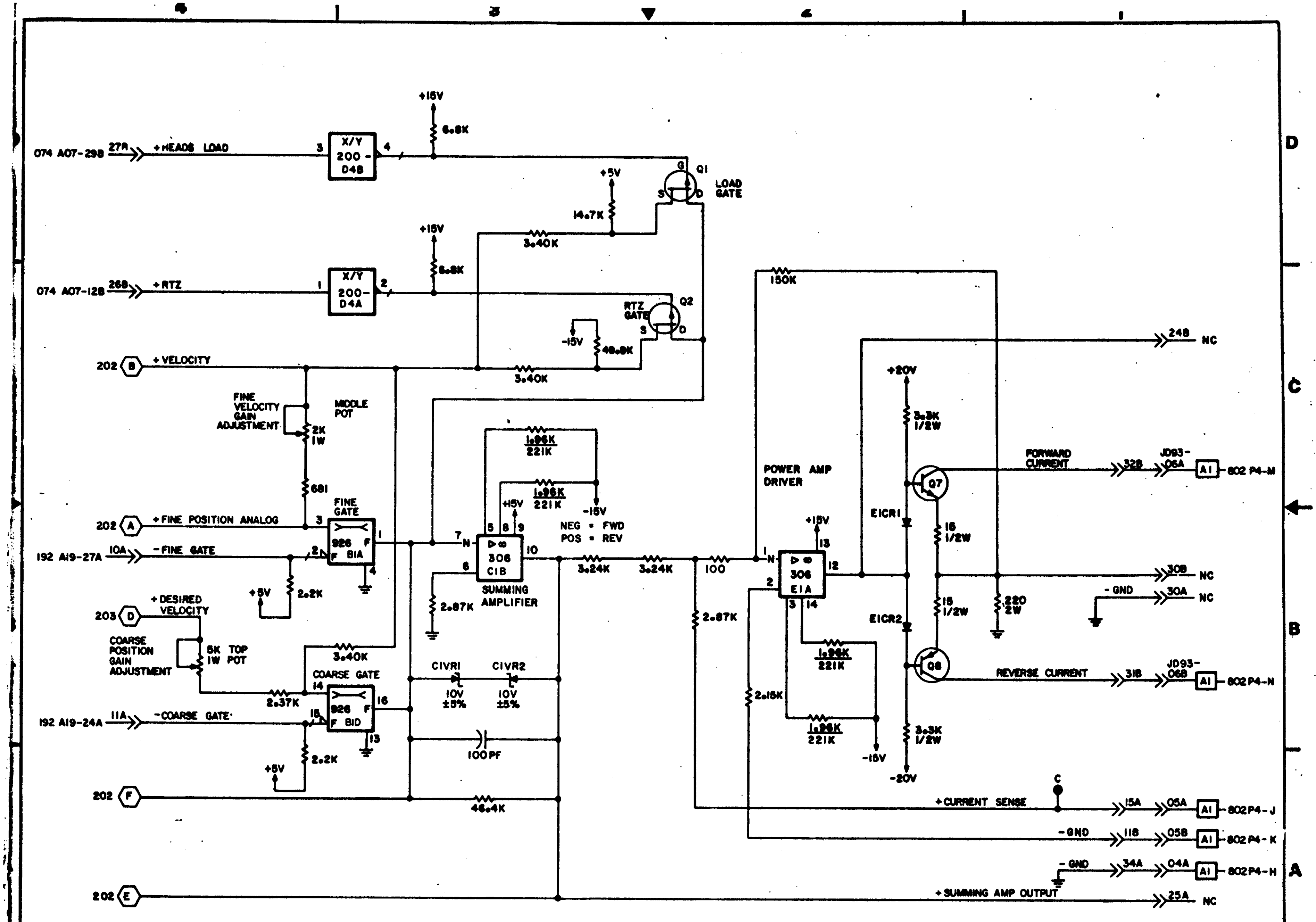


CONTROL DATA
NORMANDALE DIVISION

D/A CONVERTER AND DESIRED VELOCITY GENERATOR (9764)

LOC A20

CODE IDENT				
19333	C	83322310	K	C
CROSS REF NO 203	SHEET 3	PAGE 3-127		



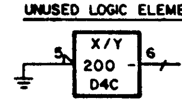
CONTROL DATA NORMANDALE DIVISION	SUMMING AMPLIFIER OUTPUT AND DRIVE CURRENT V/C PWR AMP (9764) LOC: A20	CODE IDENT 19333	C	83322310 AB E
		CROSS REF NO 204	SHEET 4	PAGE 3-128

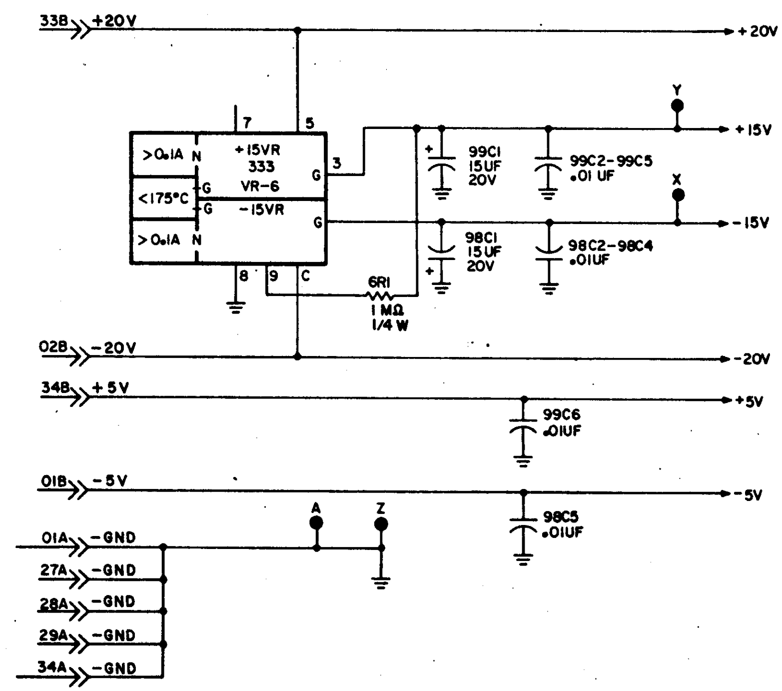
REVISION STATUS OF SHEETS

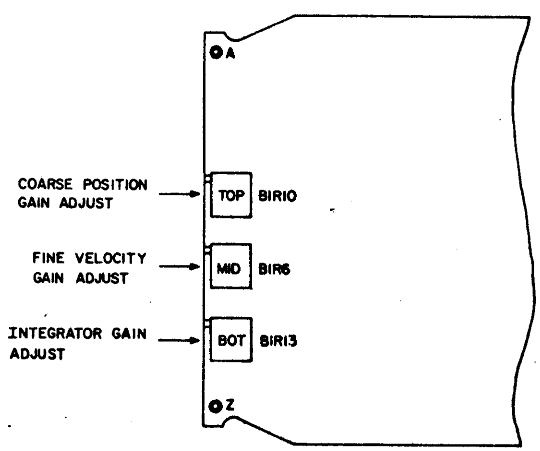
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	A	B	A																
C	C	C	C																
D	C	C	C																
E	E	C	E																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA	[illegible]-76	
B	PE22926	ERROR CORRECTION	DM	7-11-77	
C	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-9-78	
D	PE57589A	DESIGN IMPROVEMENT	TLF	6-11-81	MKP
E	DH13126	DMSV GMSV CHG	N P	4-23-82	





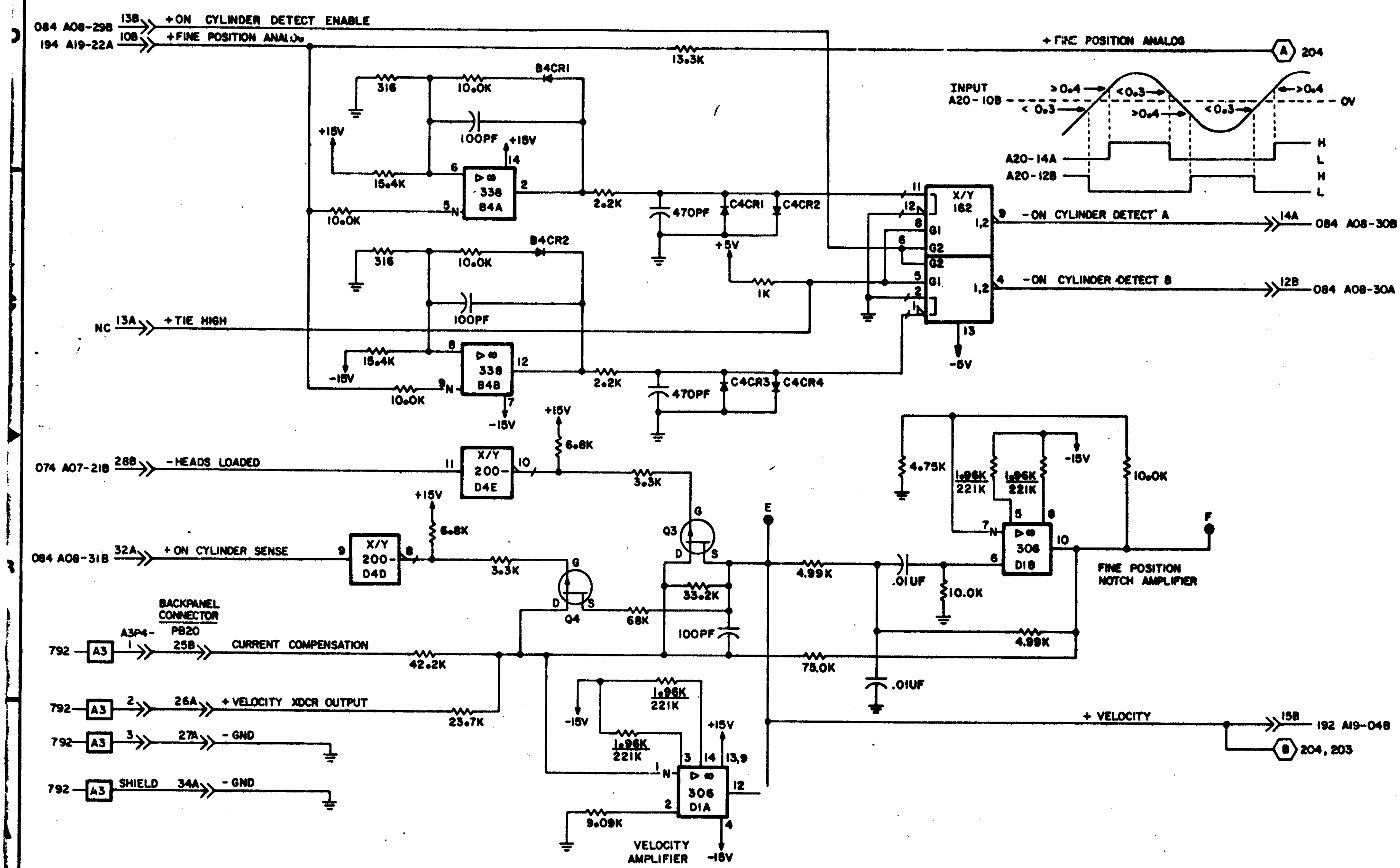


APPLICABLE TO BK7XX=9766

DRAWN	W.BERGSTROM	10-18-76	CONTROL DATA	ANALOG SERVO DIAGRAMS
CHECKED				
ENGINEER	[illegible]	11/12/[illegible]	NORMANDALE DIVISION	
APPROVED				TYPE: DMSV LOC: A20

CODE IDENT 19333	C	83322310	A B	E
CROSS REF NO 201	SHEET 1 OF 4	PAGE 3-129		

REF 83215220

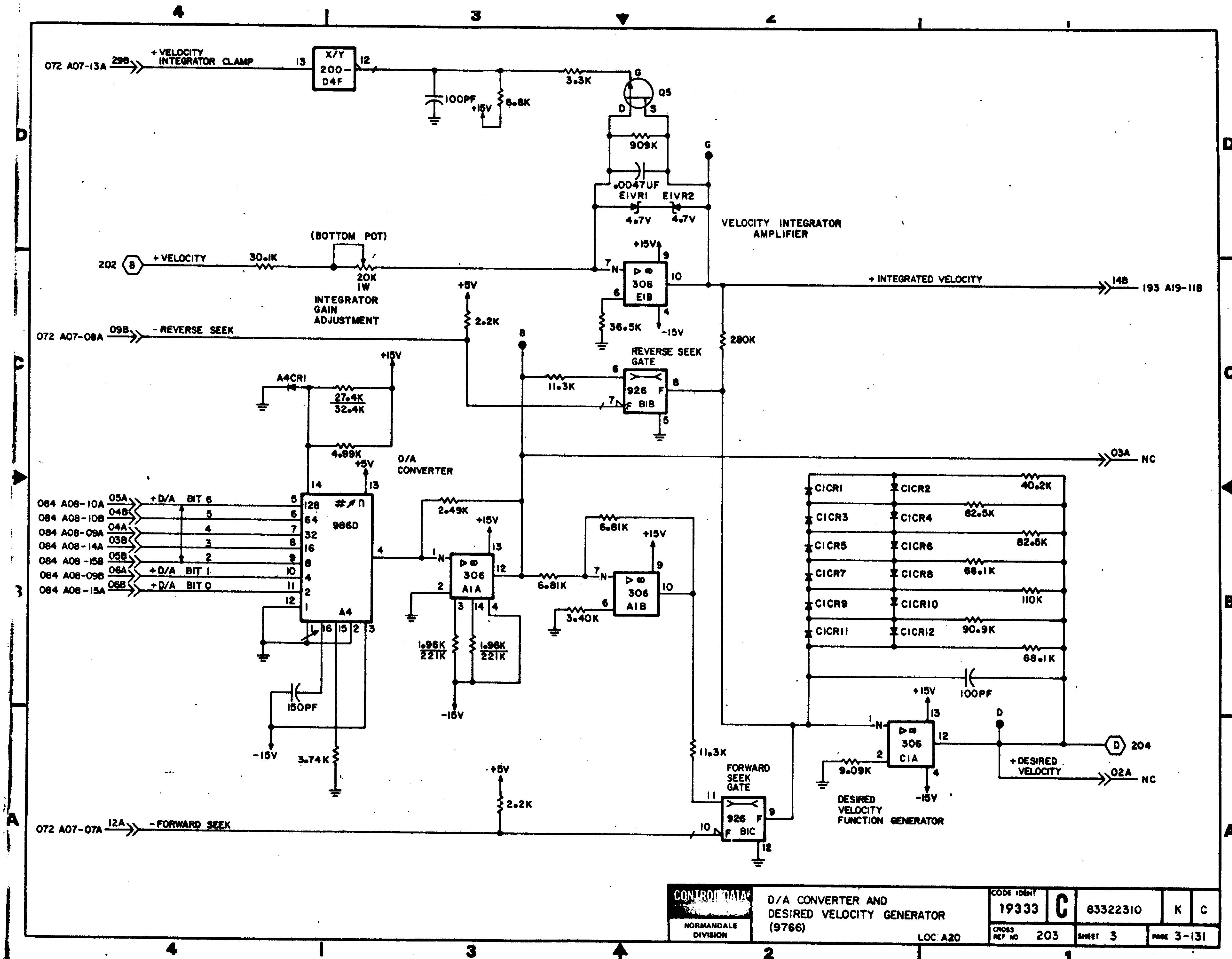


CONTROL DATA
NORMANDALE DIVISION

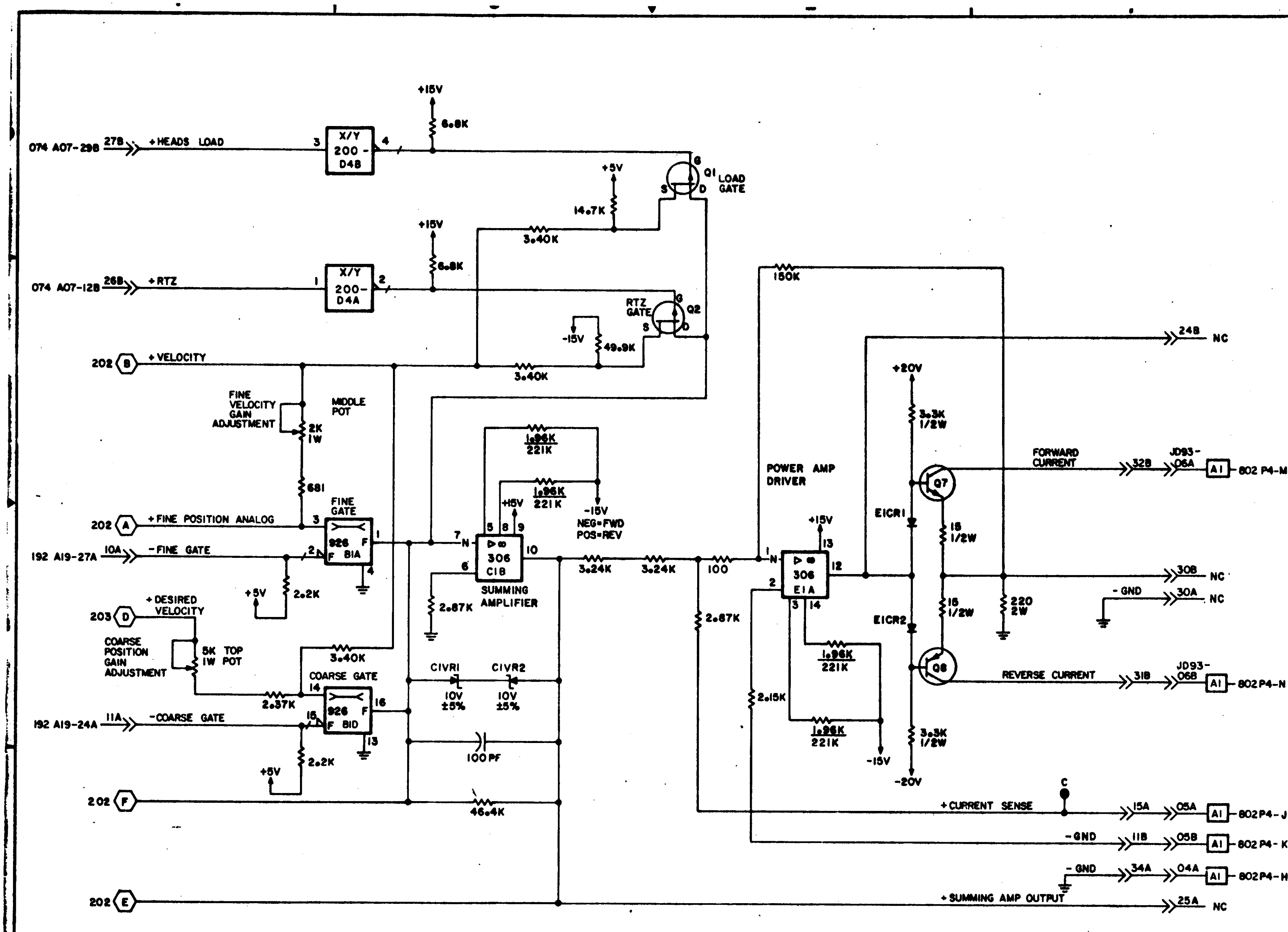
CYLINDER DETECT, VELOCITY, AND VELOCITY GAIN ADJUST (9766)

LOC: A20

CODE IDENT 19333	C	83322310	AB	E
CROSS REF NO 202		SHEET 2		PAGE 3-130



+VELOCITY INTEGRATOR CLAMP
072 A07-13A 29B
X/Y 200-D4F
100PF
+15V
6.8K
3.3K
Q5
909K
.0047UF
E1VR1 E1VR2
4.7V 4.7V
VELOCITY INTEGRATOR AMPLIFIER
202 B +VELOCITY
30.1K
(BOTTOM POT)
20K 1W
INTEGRATOR GAIN ADJUSTMENT
306 E1B
36.5K
-15V
+INTEGRATED VELOCITY
14B 193 A19-11B
072 A07-08A 09B -REVERSE SEEK
+5V
2.2K
280K
REVERSE SEEK GATE
926 B1B
11.3K
A4CR1
27.4K
32.4K
4.99K
D/A CONVERTER
03A NC
084 A08-10A 05A +D/A BIT 6
084 A08-10B 04B 5
084 A08-09A 04A 4
084 A08-14A 03B 3
084 A08-15B 05B 2
084 A08-09B 06A +D/A BIT 1
084 A08-15A 06B +D/A BIT 0
986D
A4
2.49K
306 A1A
6.81K
306 A1B
3.40K
1.96K 221K
1.96K 221K
150PF
3.74K
C1CR1 C1CR2 40.2K
C1CR3 C1CR4 82.5K
C1CR5 C1CR6 82.5K
C1CR7 C1CR8 68.1K
C1CR9 C1CR10 110K
C1CR11 C1CR12 90.9K
68.1K
100PF
306 C1A
9.09K
D 204
+DESIRED VELOCITY
02A NC
DESIRED VELOCITY FUNCTION GENERATOR
FORWARD SEEK GATE
926 B1C
072 A07-07A 12A -FORWARD SEEK
CONTROL DATA
NORMANDALE DIVISION
D/A CONVERTER AND
DESIRED VELOCITY GENERATOR
(9766)
LOC A20
CODE IDENT 19333
C
83322310
K C
CROSS REF NO 203
SHEET 3
PAGE 3-131



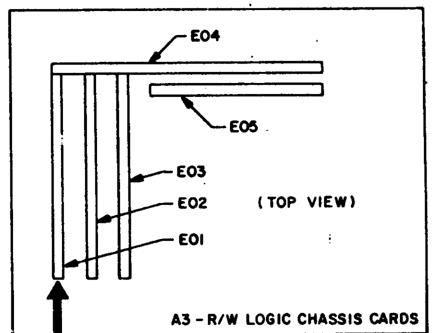
CONTROL DATA NORMANDALE DIVISION	SUMMING AMPLIFIER OUTPUT AND DRIVE CURRENT V/C PWR AMP (9766) LOC: A20	CODE IDENT 19333	C	83322310	AB E
		CROSS REF NO 204	SHEET 4		PAGE 3-132

REVISION STATUS OF SHEETS

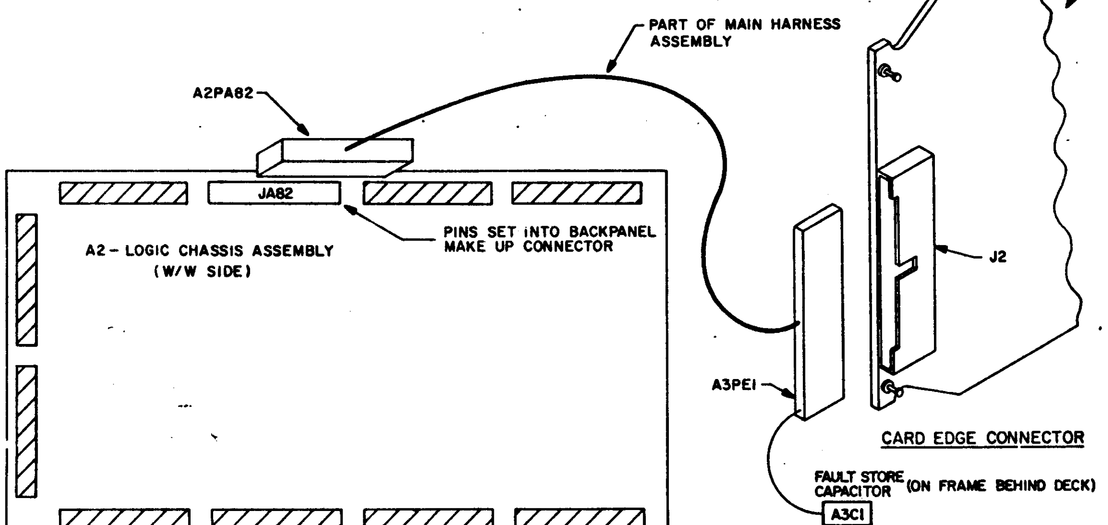
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A																	
B	B	B																	
C	B	C																	

REVISIONS

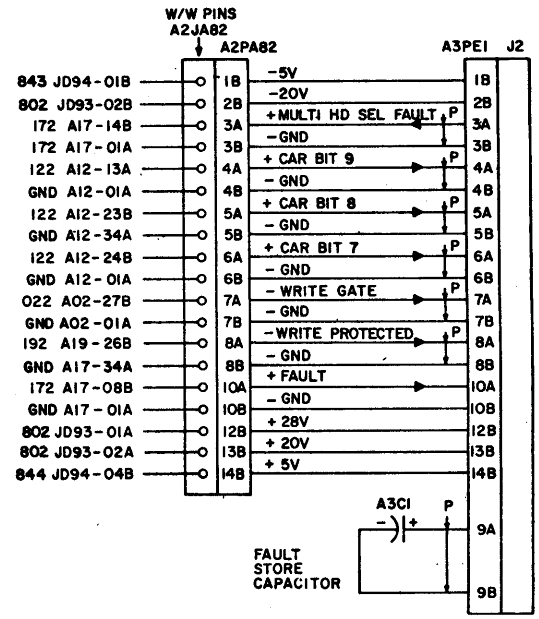
REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	[illegible]	RELEASED	MLA	[illegible]	
B	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-9-78	
C	PE57173	CHG I.C. FAMILIES	N. P.	4-23-82	



A3 - R/W LOGIC CHASSIS CARDS



CARD EDGE CONNECTOR

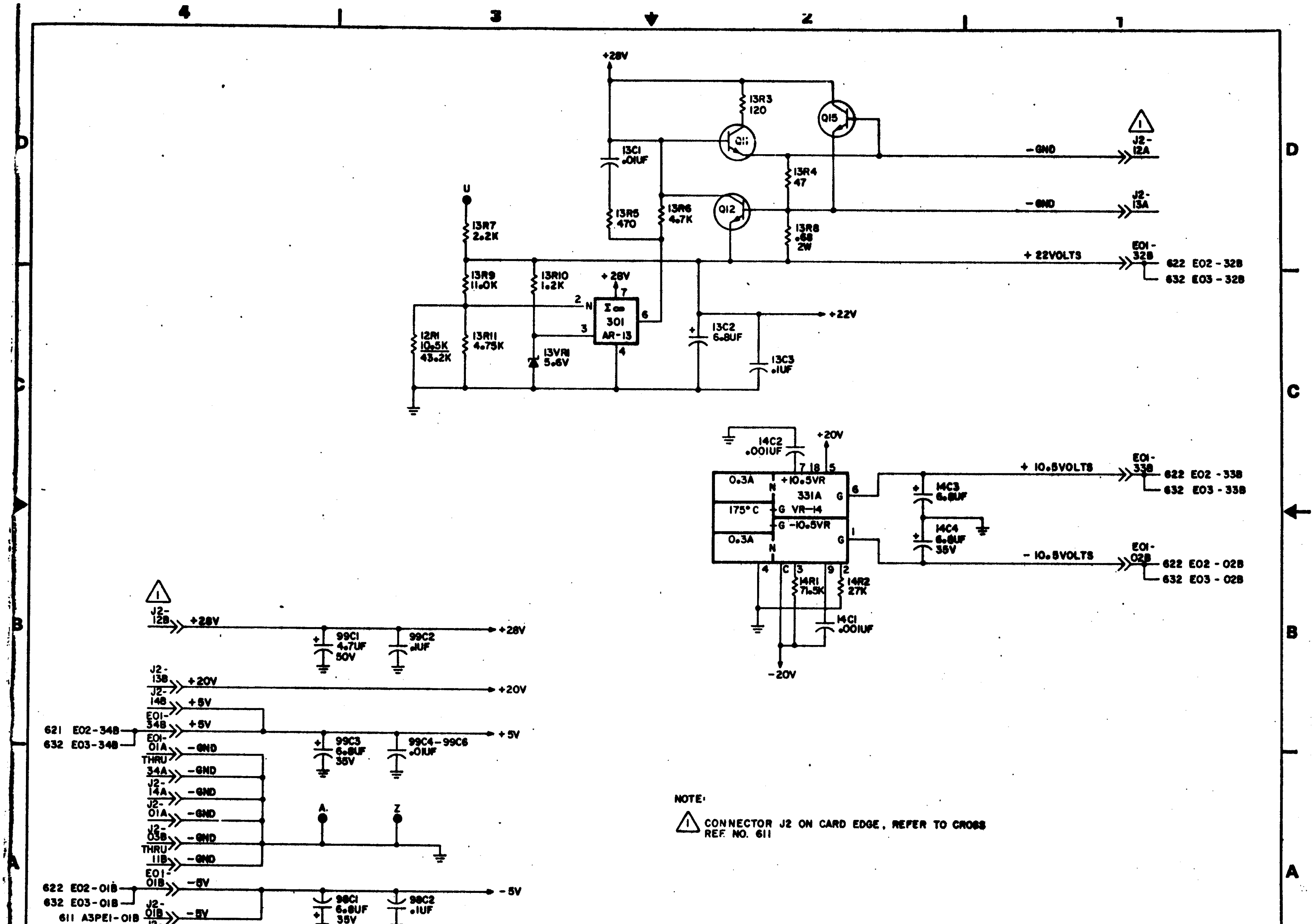


PA82 TO PE1 CABLING

APPLICABLE TO BK7XX=9766

DRAWN	[signature]	10/18/76	CONTROL DATA	R/W CONTROL AND CABLING DIAGRAMS	CODE IDENT 19333	C	83322310	AB	C
CHECKED									
ENGINEER	[signature]	11/12/76	NORMANDALE DIVISION	TYPE: 4PKV LOC: E01	CROSS REF NO 611	SHEET 1 OF 3	PAGE 3-137		
APPROVED									

REF 83215221



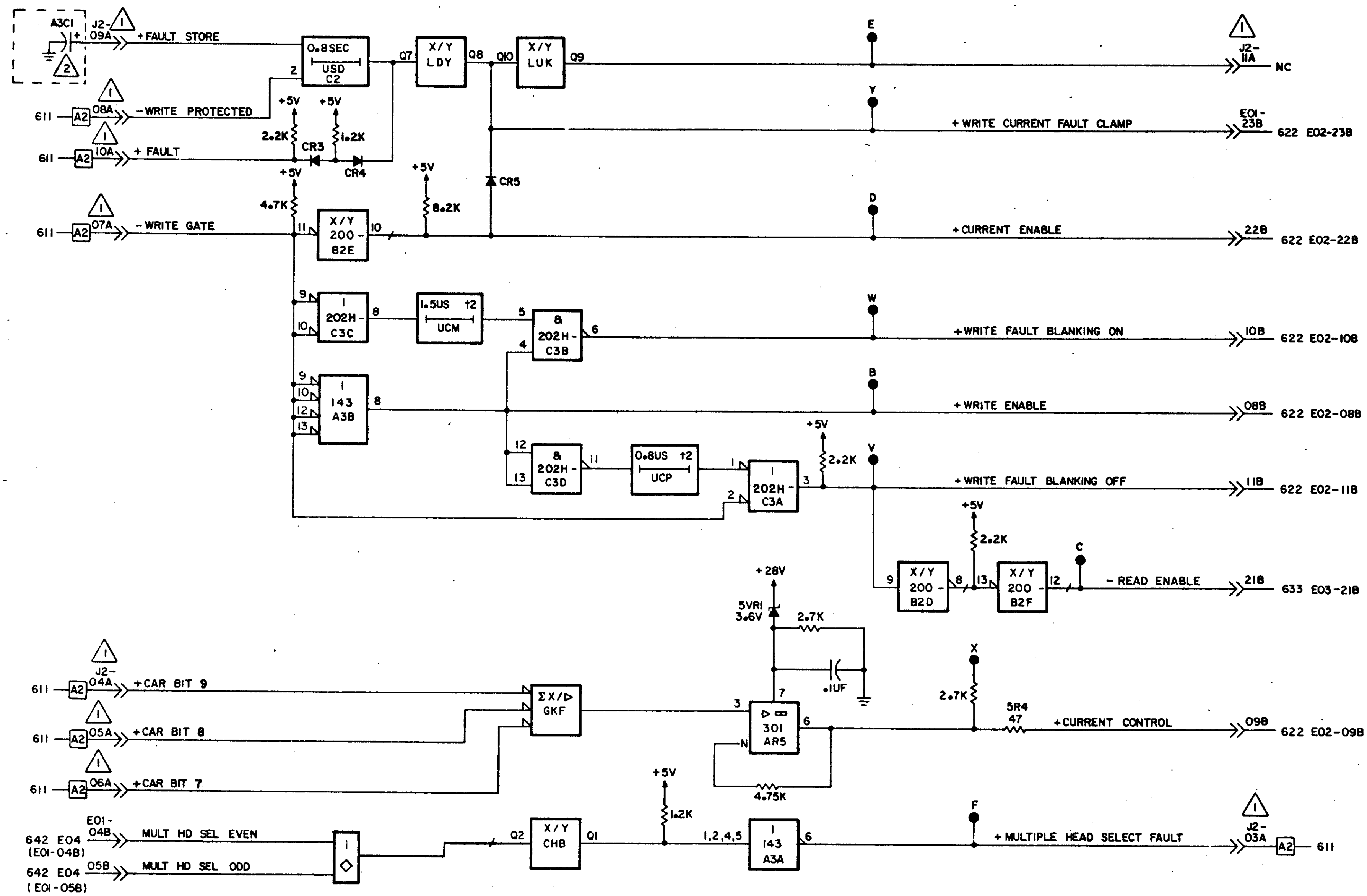
CONTROL DATA

NORMANDALE DIVISION

INPUT POWER WIRING AND CARD VOLTAGE CONTROL (9766)

LOC: E01

CODE IDENT				
19333	C	83322310	K	B
CROSS REF NO 612		SHEET 2	PAGE 3-138	



NOTES:

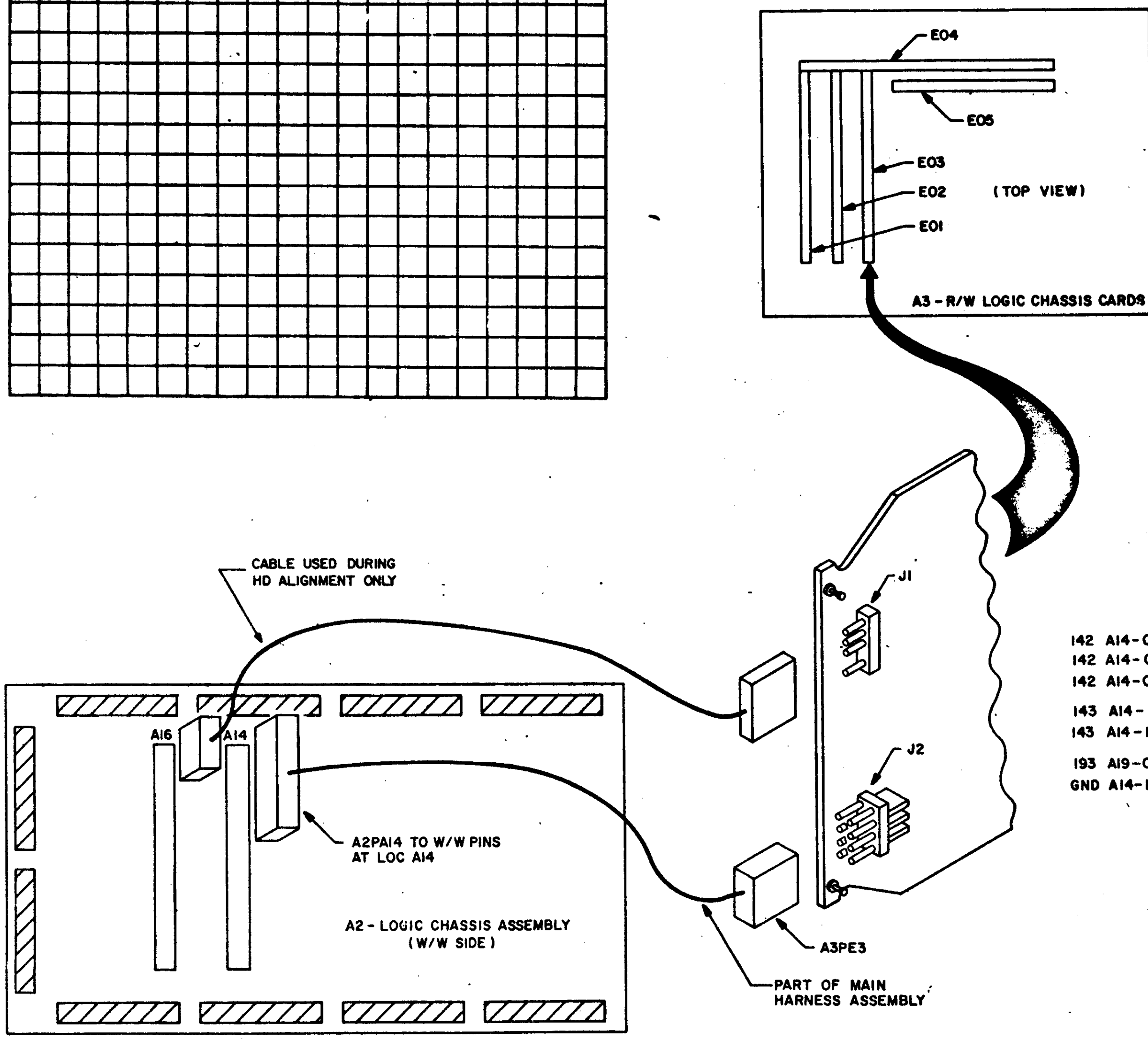
1. CONNECTOR J2 ON CARD EDGE, REFER TO CROSS REF NO 611
2. CAPACITOR MOUNTED ON FRAME

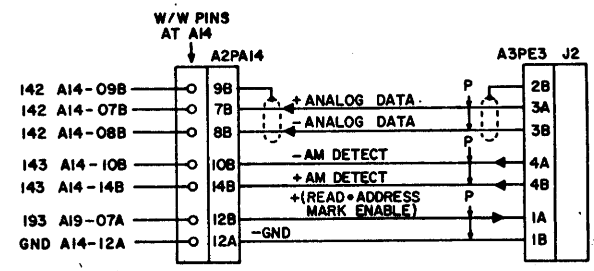
CONTROL DATA CORPORATION, NORMANDALE DIVISION	READ / WRITE CONTROL (9766) LOC:E01	CODE IDENT 19333	C	83322310	AB C
		CROSS REF NO 613		SHEET 3	PAGE 3-139/140

4 3 2 1

REVISION STATUS OF SHEETS																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A																	
B	A	B																	

REVISIONS					
REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASE	SB	10/17/76	
B	PE37441	CORRECT DIAGRAMS	N P	4-23-82	✓

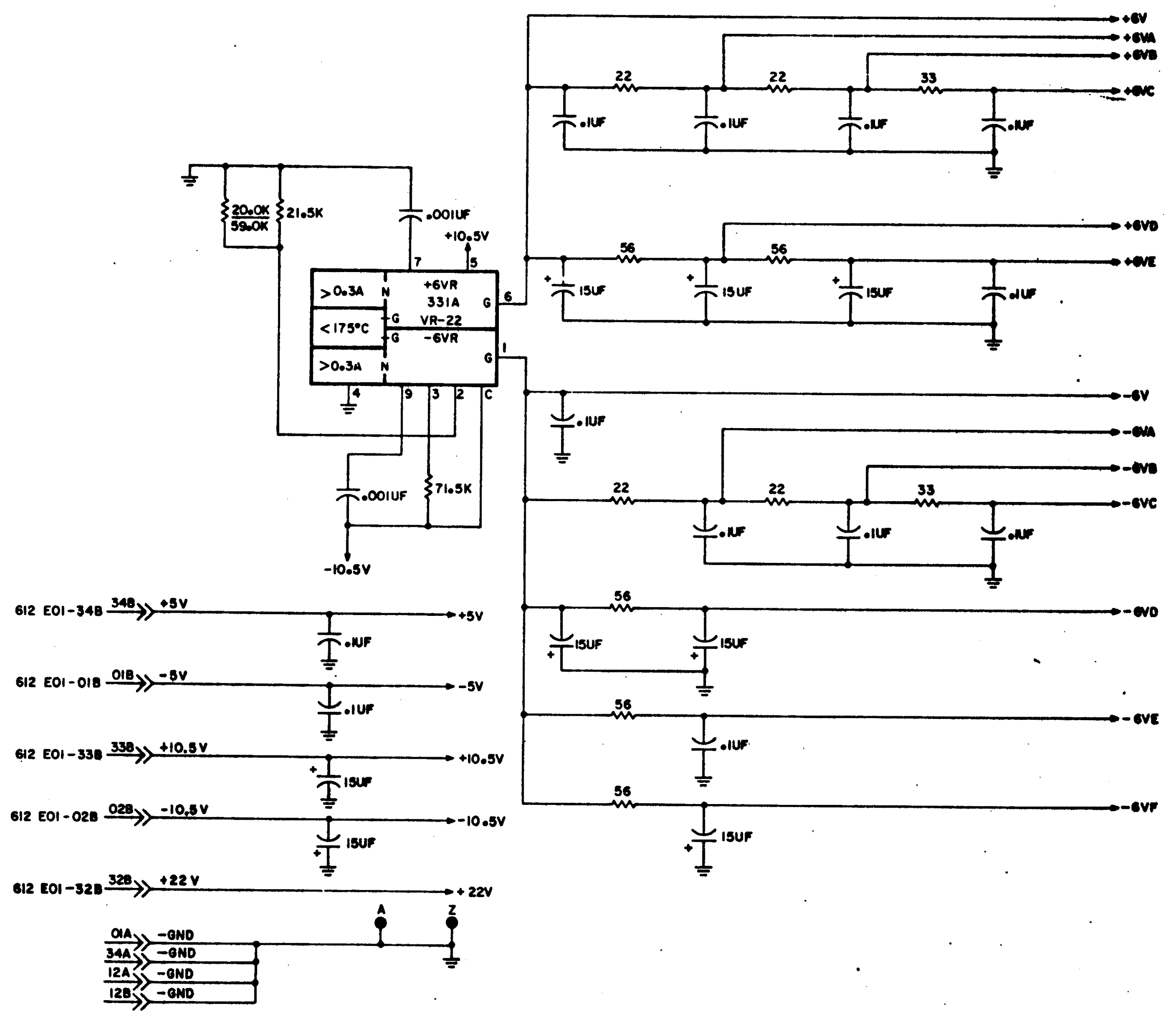




PA14 TO PE3 CABLING

DRAWN	Stephen Bentler	10/17/76		READ AMPLIFIER AND ADDRESS MARK DETECTION DIAGRAMS	CODE IDENT 19333	C	83322310	A B	B
CHECKED									
ENGINEER			NORMANDALE DIVISION	TYPE: 4PHV LOC: E03	CROSS REF NO 631	SHEET 1 OF 3		PAGE 3-145	
APPROVED									

REF 83215223



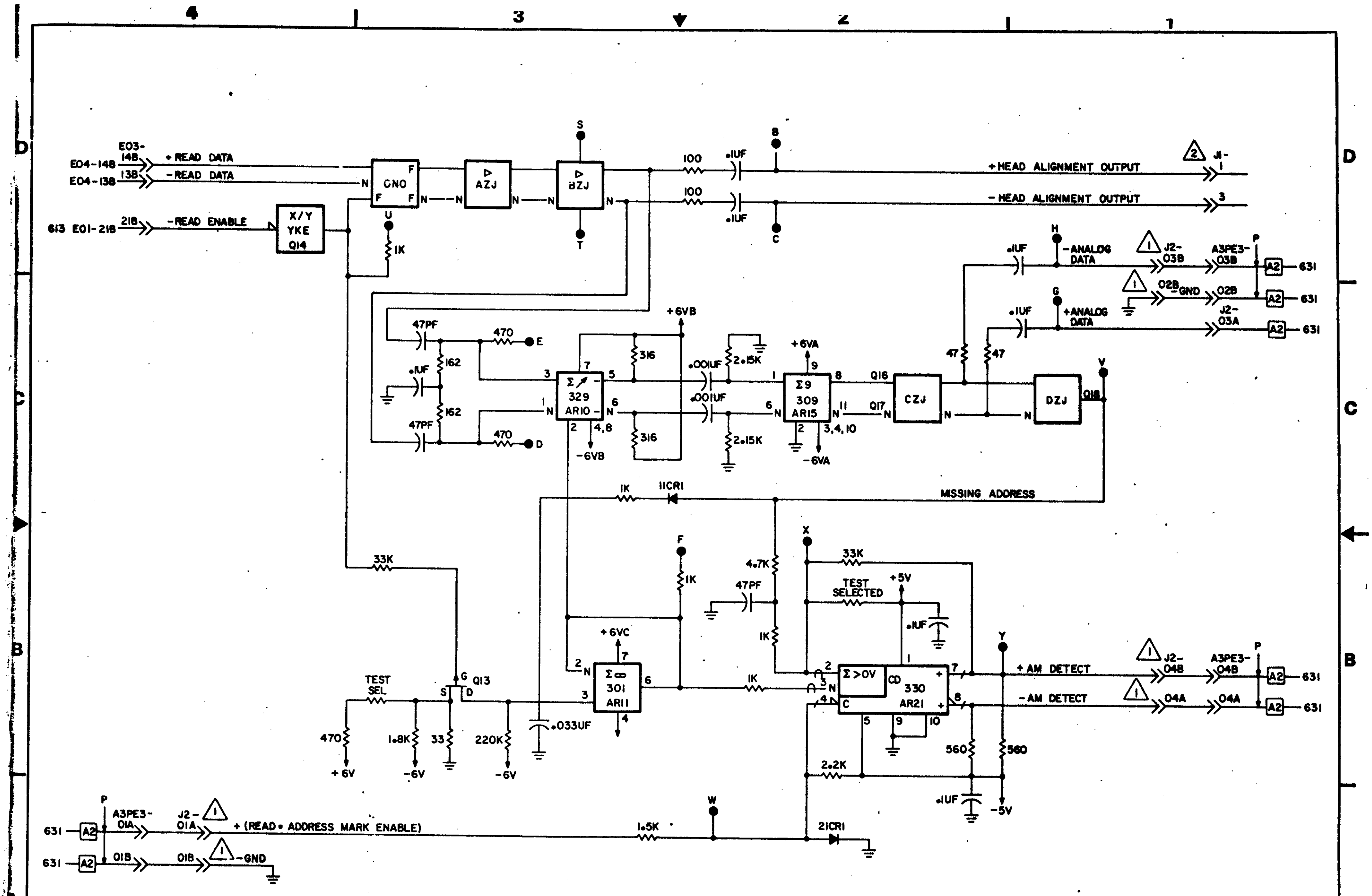
CONTROL DATA

NORMANDALE DIVISION

INPUT VOLTAGE PINS AND VOLTAGE REGULATOR

LOC: E03

19333	C	83322310	A	A
CROSS REF NO 632		SHEET 2	PAGE 3-146	



NOTE:

1. CONNECTOR J2 ON CARD EDGE, REFER TO CROSS REF NO 631
2. CONNECTOR J1 ON CARD EDGE, REFER TO CROSS REF NO 631

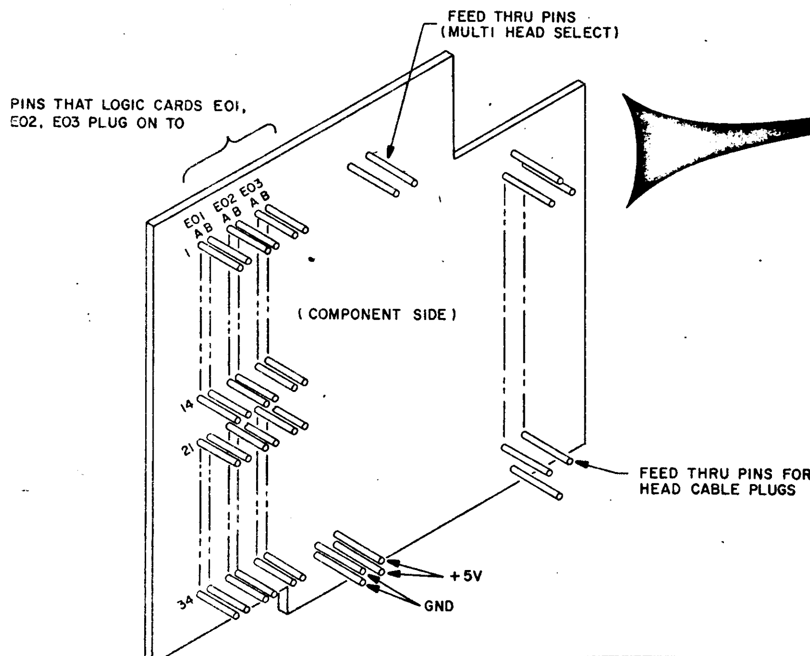
CONTROL DATA / NORMANDALE DIVISION	READ AMPLIFIER AND ADDRESS MARK DETECTION / LOC: E03	CODE IDENT 19333	C	83322310	AB	B
		CROSS REF NO 633		SHEET 3	PAGE 3-147/148	

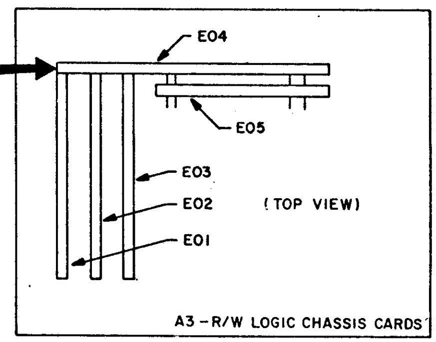
REVISION STATUS OF SHEETS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A																		
B	B																		
C	C																		
D	D																		

REVISIONS

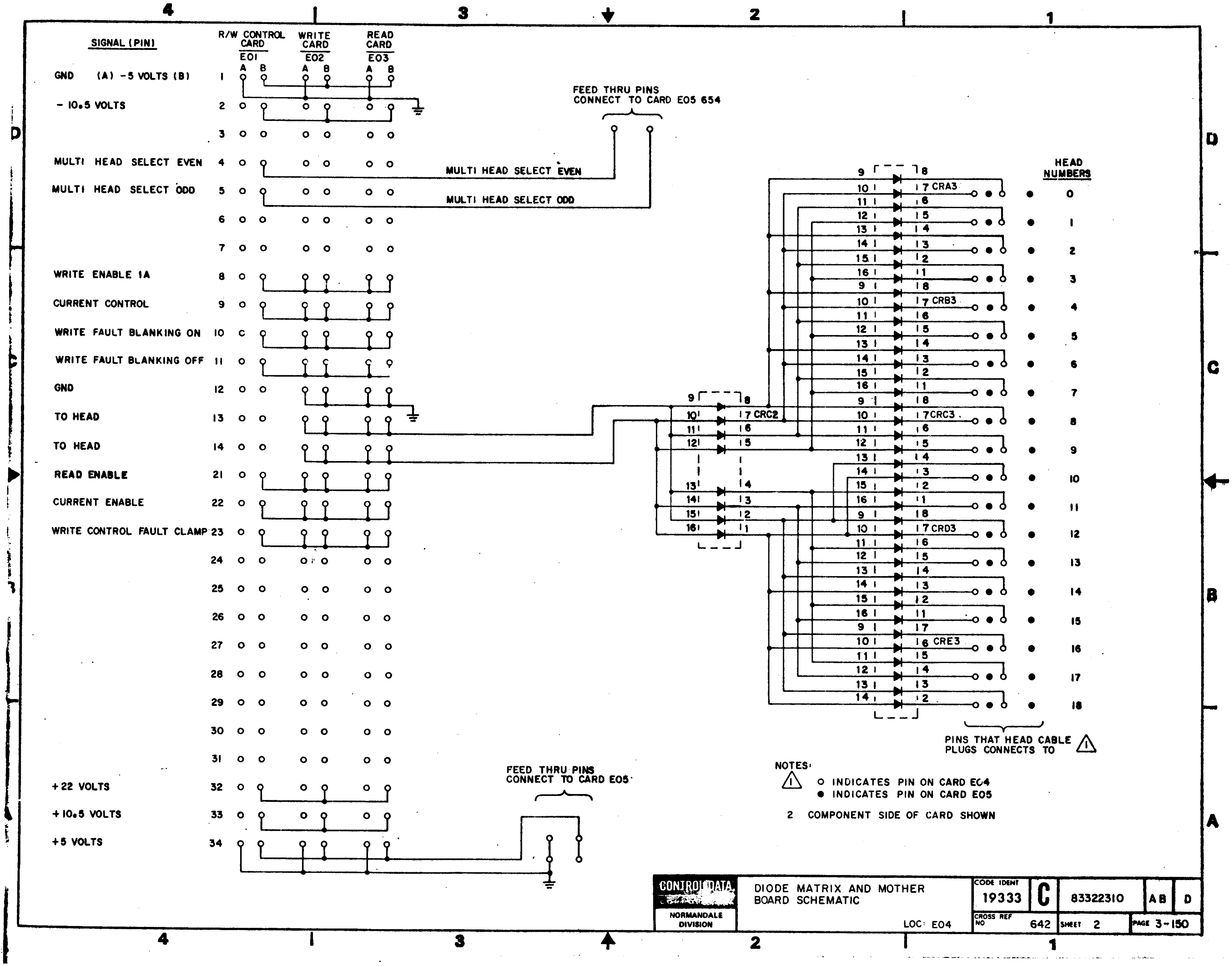
REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA	10-15-76	
B	PE55259	LOGIC DIAG. IMPROVEMENT	A.A.O	8-9-78	
C	PE57496	DIODE ARRAY	N. G. L.	6-10-81	MKP
D	PE57441	CORRECT DIAGRAMS	N. P.	4-26-82	





DRAWN	G. Rabine	10/12/76	CONTROL DATA	DIODE MATRIX AND MOTHER BOARD BOARD LAYOUT DIAGRAMS	CODE IDENT 19333	C	83322310	AB	D
CHECKED			NORMANDALE DIVISION	TYPE: 4XFN LOC: E04	CROSS REF NO 641	SHEET 1 OF 2	PAGE 3-149		
ENGINEER	[illegible]	11/12/76							
APPROVED									

REF 83215224


SIGNAL (PIN)
R/W CONTROL CARD E01
WRITE CARD E02
READ CARD E03
A B
GND (A) -5 VOLTS (B) 1
- 10.5 VOLTS 2
3
MULTI HEAD SELECT EVEN 4
MULTI HEAD SELECT ODD 5
6
7
WRITE ENABLE 1A 8
CURRENT CONTROL 9
WRITE FAULT BLANKING ON 10
WRITE FAULT BLANKING OFF 11
GND 12
TO HEAD 13
TO HEAD 14
READ ENABLE 21
CURRENT ENABLE 22
WRITE CONTROL FAULT CLAMP 23
24
25
26
27
28
29
30
31
+22 VOLTS 32
+10.5 VOLTS 33
+5 VOLTS 34
FEED THRU PINS CONNECT TO CARD E05 654
MULTI HEAD SELECT EVEN
MULTI HEAD SELECT ODD
FEED THRU PINS CONNECT TO CARD E05
CRA3
CRB3
CRC2
CRC3
CRD3
CRE3
HEAD NUMBERS
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
PINS THAT HEAD CABLE PLUGS CONNECTS TO 1
NOTES:
1 o INDICATES PIN ON CARD E04
• INDICATES PIN ON CARD E05
2 COMPONENT SIDE OF CARD SHOWN
CONTROL DATA
NORMANDALE DIVISION
DIODE MATRIX AND MOTHER BOARD SCHEMATIC
LOC: E04
CODE IDENT 19333
C
83322310
AB
D
CROSS REF NO 642
SHEET 2
PAGE 3-150

REVISION STATUS OF SHEETS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A	A																
B	B	A	A																
C	B	C	A																
D	B	D	A																
E	B	E	E																
F	B	F	E																
G	G	G	E																

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA		
B	PE57097	ADD INTERLOCK	CB	1-30-81	
C	PE57130	BLOWER WIRING	"	"	
D	PE57336	CORRECT SCHEMATIC	"	"	
E	PE57381D	CHG NOISE CAPS	"	"	[illegible]
F	PE13013	ADD NOTE TO LOGIC DIAGRAMS	S. A. W.	9/9/81	
G	DH13070-A	NEW NON-VDE P. S.	N. P.	4-26-82	

DRAWN	Stephen Bentler	10/15/76
CHECKED		
ENGINEER	[illegible]	[illegible]
APPROVED		

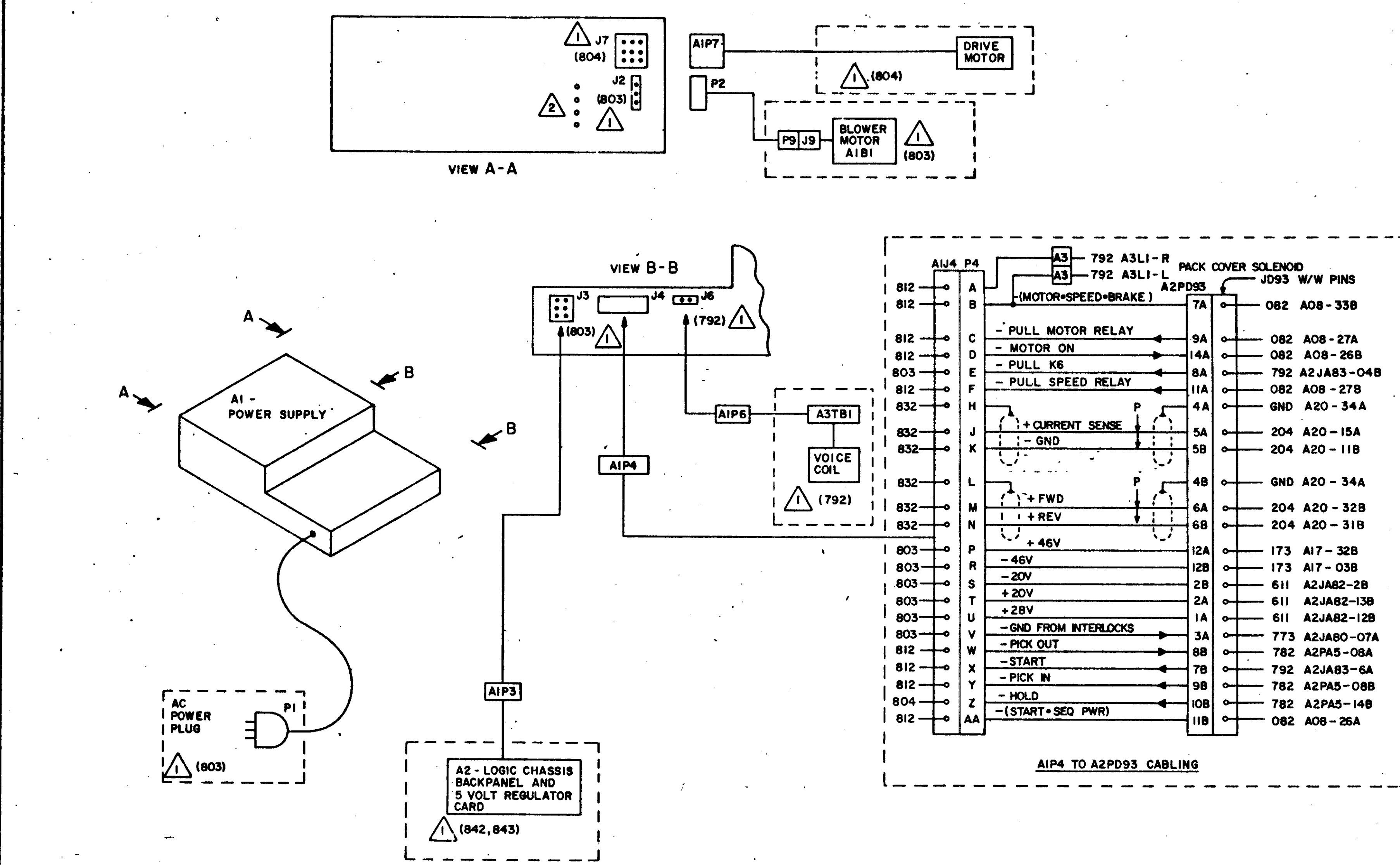
CONTROL DATA
NORMANDALE DIVISION

A1 - POWER SUPPLY DIAGRAMS

CODE IDENT 19333 | C | 83322310 | A B | G

CROSS REF NO 801 | SHEET 1 OF 4 | PAGE 3-177

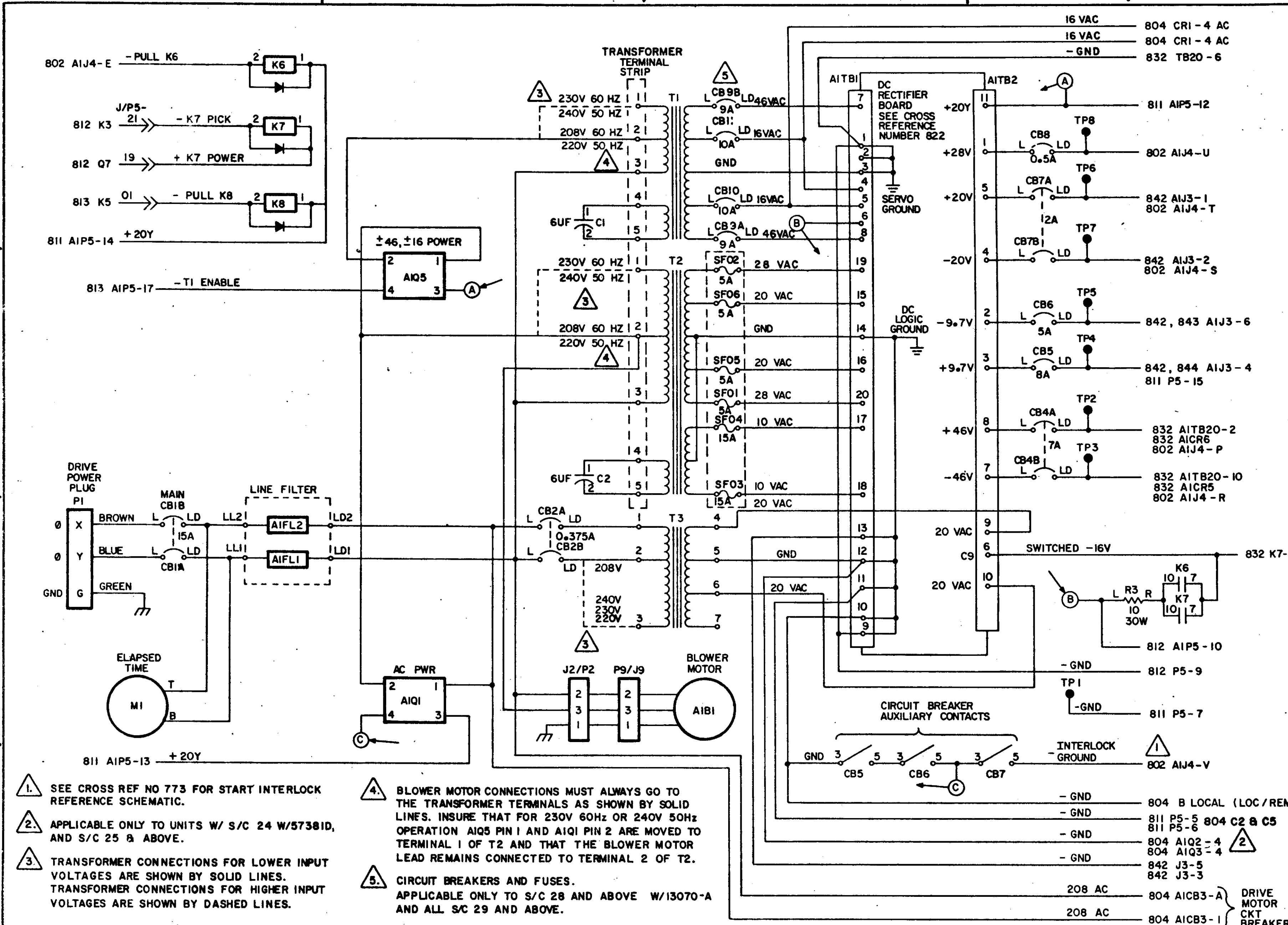
REF 83215230



NOTES:

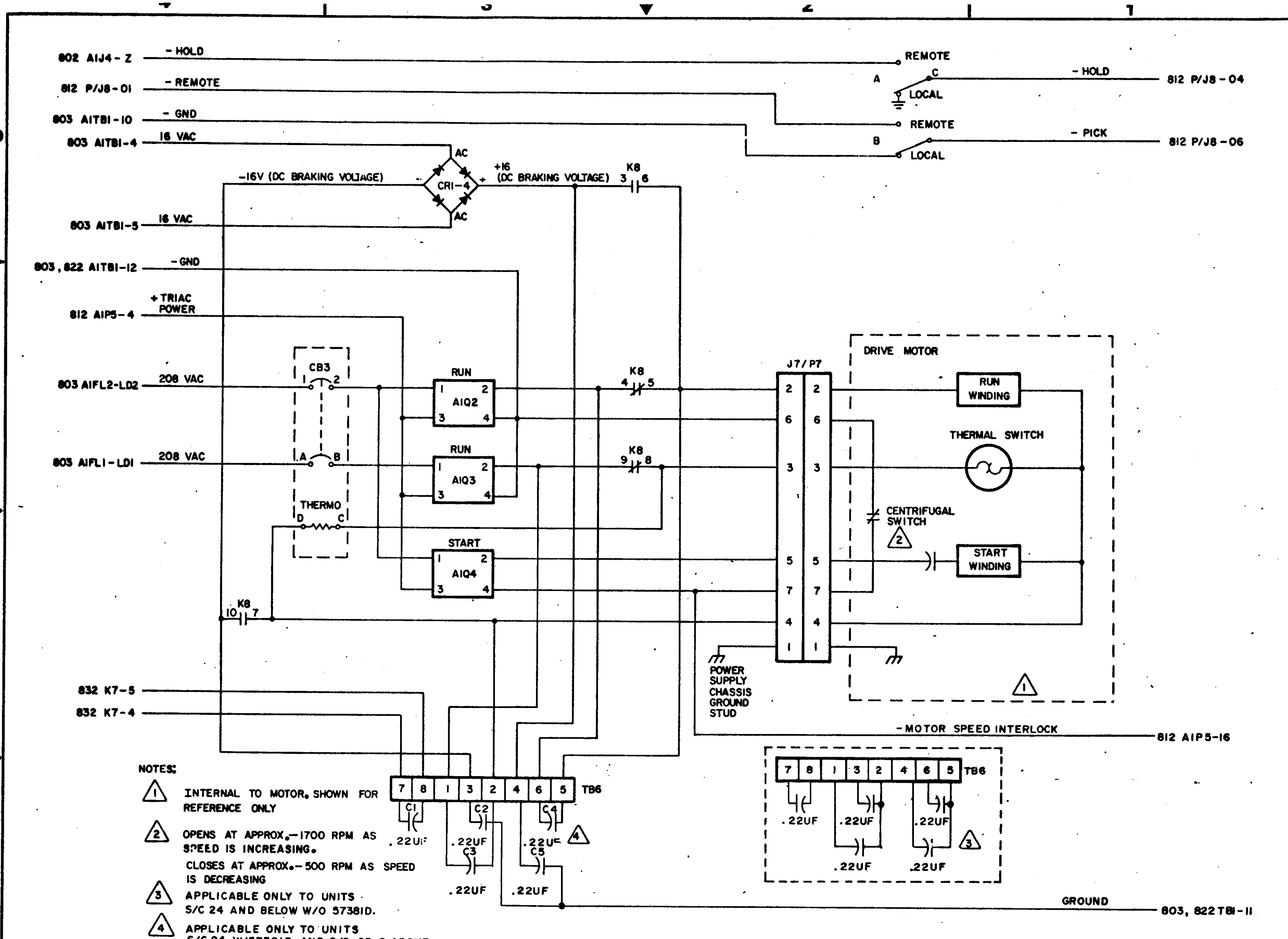
1. NUMBERS INSIDE PARENTHESIS ARE CROSS REFERENCE NUMBERS WHERE DETAILED CABLING INFORMATION MAY BE FOUND.
2. APPLICABLE ONLY TO UNITS S/C28 AND ABOVE W/13070-A, AND S/C 29 AND ABOVE.

CONTROL DATA NORMANDALE DIVISION	A1 - POWER SUPPLY EXTERNAL CABLING	CODE IDENT 19333	C	83322310	AB G
		CROSS REF NO 802	SHEET 2		PAGE 3-178



1. SEE CROSS REF NO 773 FOR START INTERLOCK REFERENCE SCHEMATIC.
2. APPLICABLE ONLY TO UNITS W/ S/C 24 W/57381D, AND S/C 25 & ABOVE.
3. TRANSFORMER CONNECTIONS FOR LOWER INPUT VOLTAGES ARE SHOWN BY SOLID LINES. TRANSFORMER CONNECTIONS FOR HIGHER INPUT VOLTAGES ARE SHOWN BY DASHED LINES.
4. BLOWER MOTOR CONNECTIONS MUST ALWAYS GO TO THE TRANSFORMER TERMINALS AS SHOWN BY SOLID LINES. INSURE THAT FOR 230V 60Hz OR 240V 50Hz OPERATION A1Q5 PIN 1 AND A1Q1 PIN 2 ARE MOVED TO TERMINAL 1 OF T2 AND THAT THE BLOWER MOTOR LEAD REMAINS CONNECTED TO TERMINAL 2 OF T2.
5. CIRCUIT BREAKERS AND FUSES. APPLICABLE ONLY TO S/C 28 AND ABOVE W/13070-A AND ALL S/C 29 AND ABOVE.

CONTROL DATA NORMANDALE DIVISION	A1-POWER SUPPLY AC POWER, DC CIRCUIT BREAKERS AND RELAYS K6, K7, K8	CODE IDENT 19333	C	83322310	AB G
		CROSS REF NO 803		SHEET 3	PAGE 3-179



NOTES:

1. INTERNAL TO MOTOR, SHOWN FOR REFERENCE ONLY
2. OPENS AT APPROX.-1700 RPM AS SPEED IS INCREASING. CLOSES AT APPROX.-500 RPM AS SPEED IS DECREASING
3. APPLICABLE ONLY TO UNITS S/C 24 AND BELOW W/O 57381D.
4. APPLICABLE ONLY TO UNITS S/C 24 W/57381D, AND S/C 25 & ABOVE.

CONTROL DATA CORPORATION — NORMANDALE DIVISION

AI-POWER SUPPLY DRIVE MOTOR, START TRIACS AND LOCAL / REMOTE SWITCH

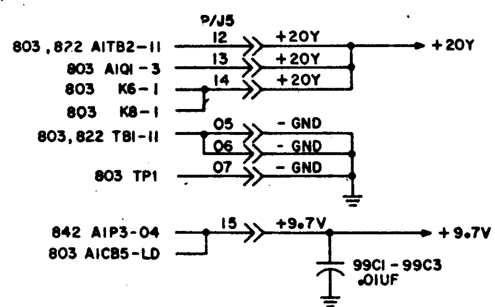
CODE IDENT	SIZE			
19333	C	83322310	AB	E
CROSS REF NO 804		SHEET 4		PAGE 3-180

REVISION STATUS OF SHEETS

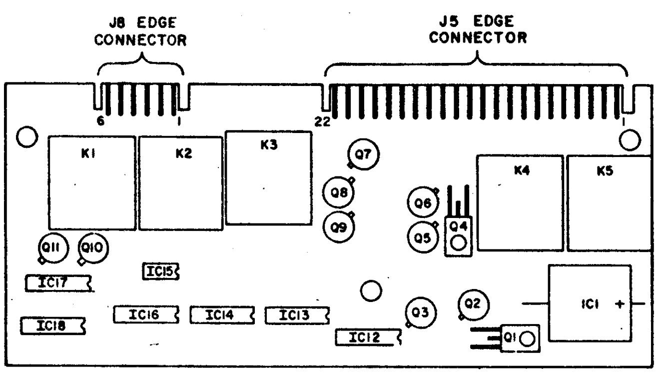
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A	A																	
B	B	B																	
C	C	C																	
D	C	D																	
E	E	D																	
F	F	D																	

REVISIONS

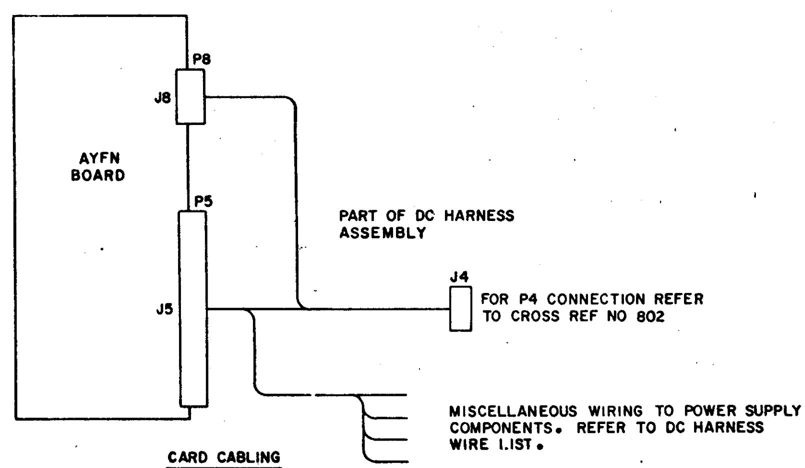
REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	MLA	2-19-76	
B	PE22820	CORRECT DIAGRAMS	SB	5-5-77	
C	PE55259	LOGIC DIA IMPROVEMENT			
D	PE57450	IMP TIMING NETWORK	CB	2-2-81	
E	PE57379A	AYEN CAP DELETE	N P	4-28-82	
F	PE57512	REWORK AYFN	N P	42862	



POWER WIRING



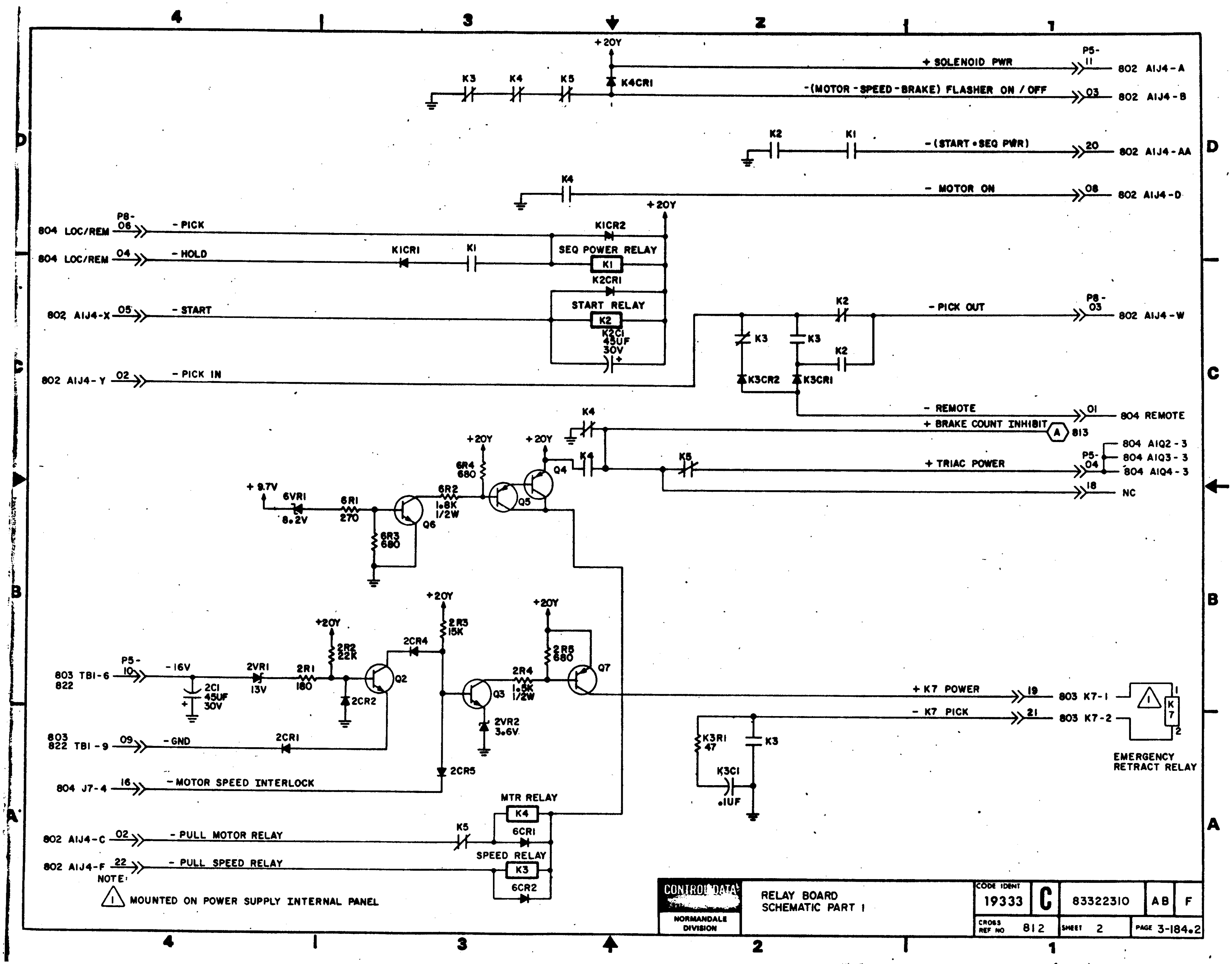
CARD COMPONENT LAYOUT



CARD CABLING

DRAWN	G. RABINE	10/11/76	CONTROL DATA	RELAY BOARD POWER WIRING, COMPONENT LAYOUT, AND DIAGRAMS	CODE IDENT 19333	C	83322310 A B F
CHECKED							
ENGINEER		11/12/76	NORMANDALE DIVISION	TYPE: AYFN	CROSS REF NO 811	SHEET 1 OF 3	PAGE 3-184.1
APPROVED							

REF 83215231



CONTROL DATA
NORMANDALE DIVISION

RELAY BOARD
SCHEMATIC PART I

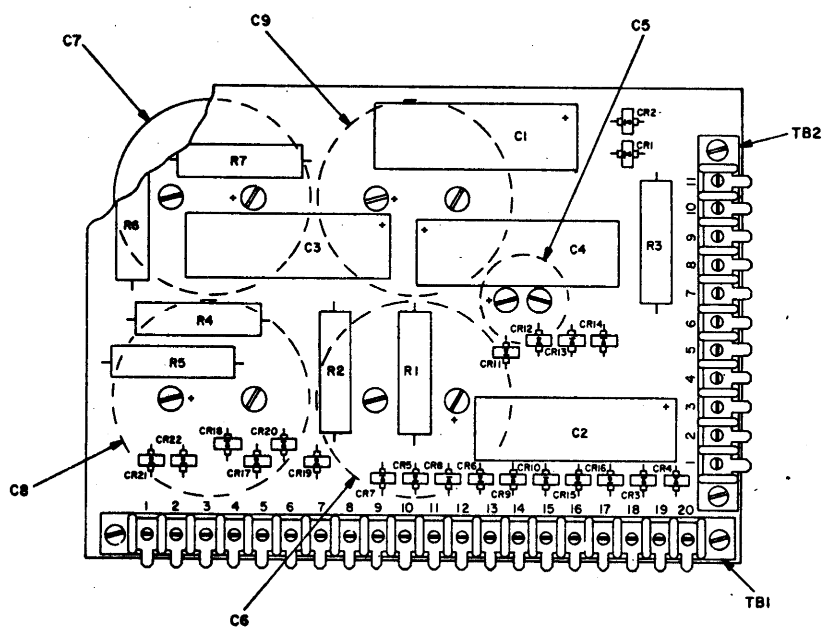
CODE IDENT				
19333	C	83322310	AB	F
CROSS REF NO 812	SHEET 2	PAGE 3-184.2		

REVISION STATUS OF SHEETS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	A																		
B	B																		
C	B																		

REVISIONS

REV.	ECO.	DESCRIPTION	DRFT.	DATE	CHK'D
A	PE23000	RELEASED	JK		
B	PE57381D	CHG NOISE CAPS	CB	2-2-81	JK
C	DH13101	INC NEW BOARD BLANK	N P	4-28-82	



BOARD IS MOUNTED ON TO CAPACITORS C5, C6, C7, C8, C9

DRAWN	M Anderson	10-15-76	CONTROL DATA
CHECKED			
ENGINEER	J. Novic	11/12/76	NORMANDALE DIVISION
APPROVED			

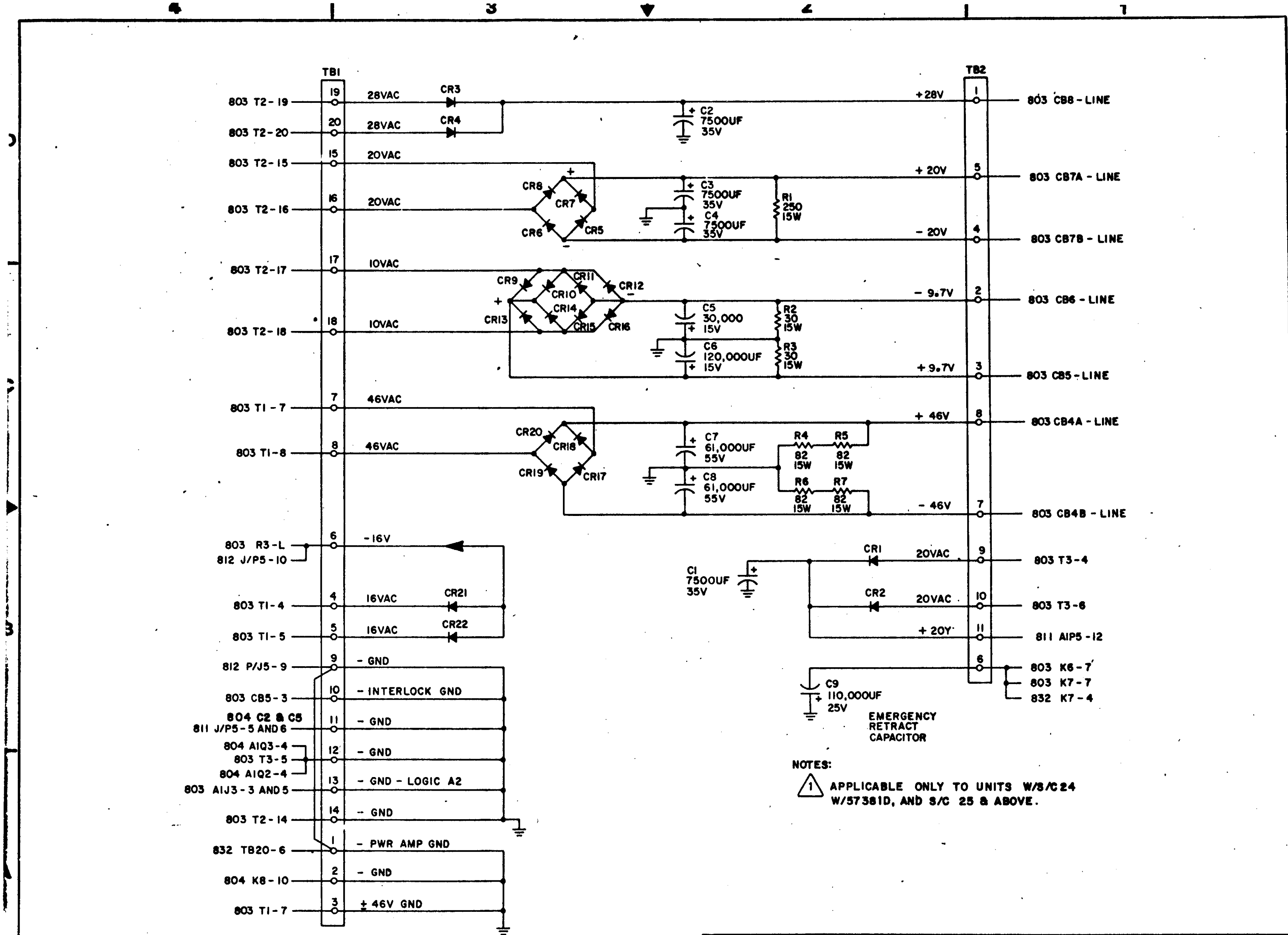
RECTIFIER AND CAPACITOR BOARD
COMPONENT LAYOUT AND DIAGRAMS

TYPE: 5YEN

CODE IDENT 19333 | C | 83322310 | A B | C

CROSS REF NO 821 | SHEET 1 OF 2 | PAGE 3-185

REF 83215232



NOTES:

1. APPLICABLE ONLY TO UNITS W/S/C 24 W/57381D, AND S/C 25 & ABOVE.

CONTROL DATA NORMANDALE DIVISION	RECTIFIER AND CAPACITOR BOARD	CODE IDENT 19333	C	83322310	W	B
		CROSS REF NO 822		SHEET 2	PAGE 3-186	