

UD002555-01

**DRIVE EXERCISER/
DIAGNOSTIC UNIT FOR
ISS MODEL 7330 S/DA,
7330-10, -11, -12 &
UNIVAC TYPE 8430, 8433
AND 8434 DISK DRIVES**

**OPERATION AND
SERVICE MANUAL**

MARCH, 1977

ISS
SPERRY UNIVAC®

DRIVE EXERCISER/DIAGNOSTIC UNIT FOR ISS MODEL 7330 S/DA,
7330-10, -11, -12 & UNIVAC TYPE 8430, 8433 & 8434 DISK DRIVES

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Information Storage Systems
10435 North Tantau Avenue
Cupertino, California 95014
Tel: (408) 257-6220 TELEX 357440

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PREFACE

This manual is an aid to the Customer Engineer in operating the Drive Exerciser/Diagnostic Unit (DEDU) and contains eight chapters as follows:

Chapter 1, Introduction, includes a general description of the DEDU equipment specifications, and the location of major device components.

Chapter 2, Installation, includes instructions for packing, unpacking, inspecting and installing the DEDU.

Chapter 3, Operational Description, contains operational procedures, and a description of all DEDU Controls and Indicators.

Chapter 4, Functional Description, contains technical information on the DEDU, supported by block diagrams, sequence flow charts, and timing diagrams.

Chapter 5, Maintenance, describes basic maintenance philosophy and procedures for component replacement.

Chapter 6, Removal and Replacement Procedures, contains procedures for the removal and replacement of specific modules in the DEDU.

Chapter 7, contains logic diagrams for the DEDU.

Chapter 8, Illustrated Parts Breakdown, contains a complete list of all replaceable parts and associated part numbers for ordering.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

The Drive Exerciser/Diagnostic Unit (DEDU), shown in Figure 1-1, is a portable test unit for the alignment and servicing of the following Disk Storage Drive Models:

ISS 7330 S/DA
ISS 7330-10, -11, -12
UNIVAC 8430
UNIVAC 8433-00/01, 02/03, 04/05
UNIVAC 8434

The DEDU can be used effectively as a troubleshooting aid since most drive functions can be simulated and the results monitored on the DEDU Control Panel displays. The DEDU operates in two modes: On-line with the Control Unit Drive Interface (CUDI) cables connected or off-line from the DEDU. Both modes enable the operator to simulate drive functions and monitor drive performance. In the on-line mode the operator has the following capabilities:

1. Monitor drive responses to commands from the SCU.
2. Align the drive using diagnostic routines from the SCU.

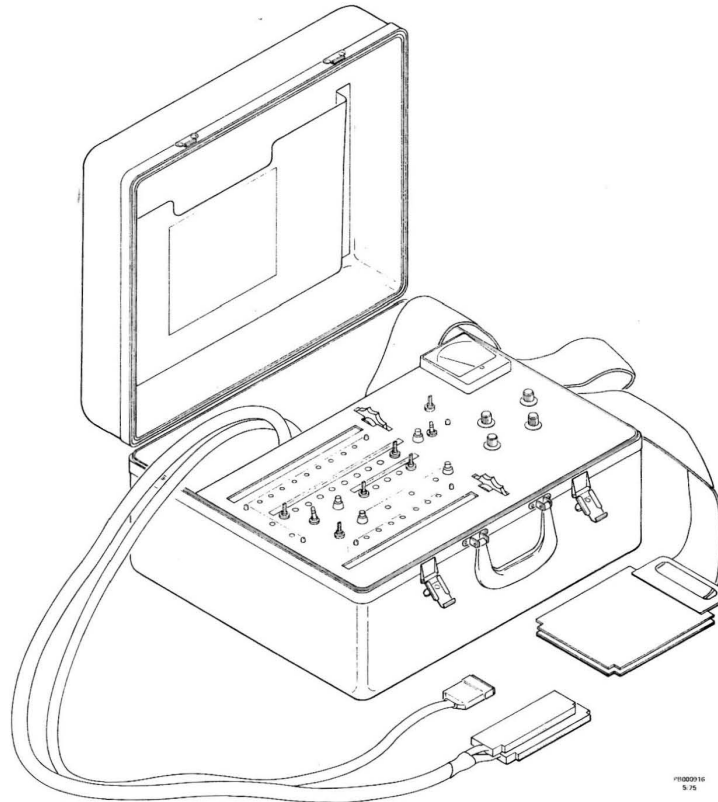


Figure 1-1. Drive Exerciser/Diagnostic Unit P/N 9021401

In the off-line mode the SCU is not connected to the drive. Most SCU commands can be simulated by the DEDU except those commands that require read/write data transfers or SCU diagnostic routines. The off-line mode minimizes the impact on a system when a drive is down for repair.

1.2 PHYSICAL CHARACTERISTICS

The DEDU weighs 16 pounds and is housed in a high-strength plastic case. Considerable impact protection is provided by the mounting methods used for internal components. The necessary cables and adapters required for attachment of the DEDU to the disk drives are provided with the DEDU and stored inside the case.

1.3 COMPONENT LOCATIONS

There are eleven circuit boards behind the DEDU Operator Panel. The panel must be lifted clear of the case to gain access to the circuit boards and test points. Component locations are shown in Figure 1-2 (3 bolted to display assembly, as individually indicated, 8 in card cage, as indicated by arrows A1-C3).

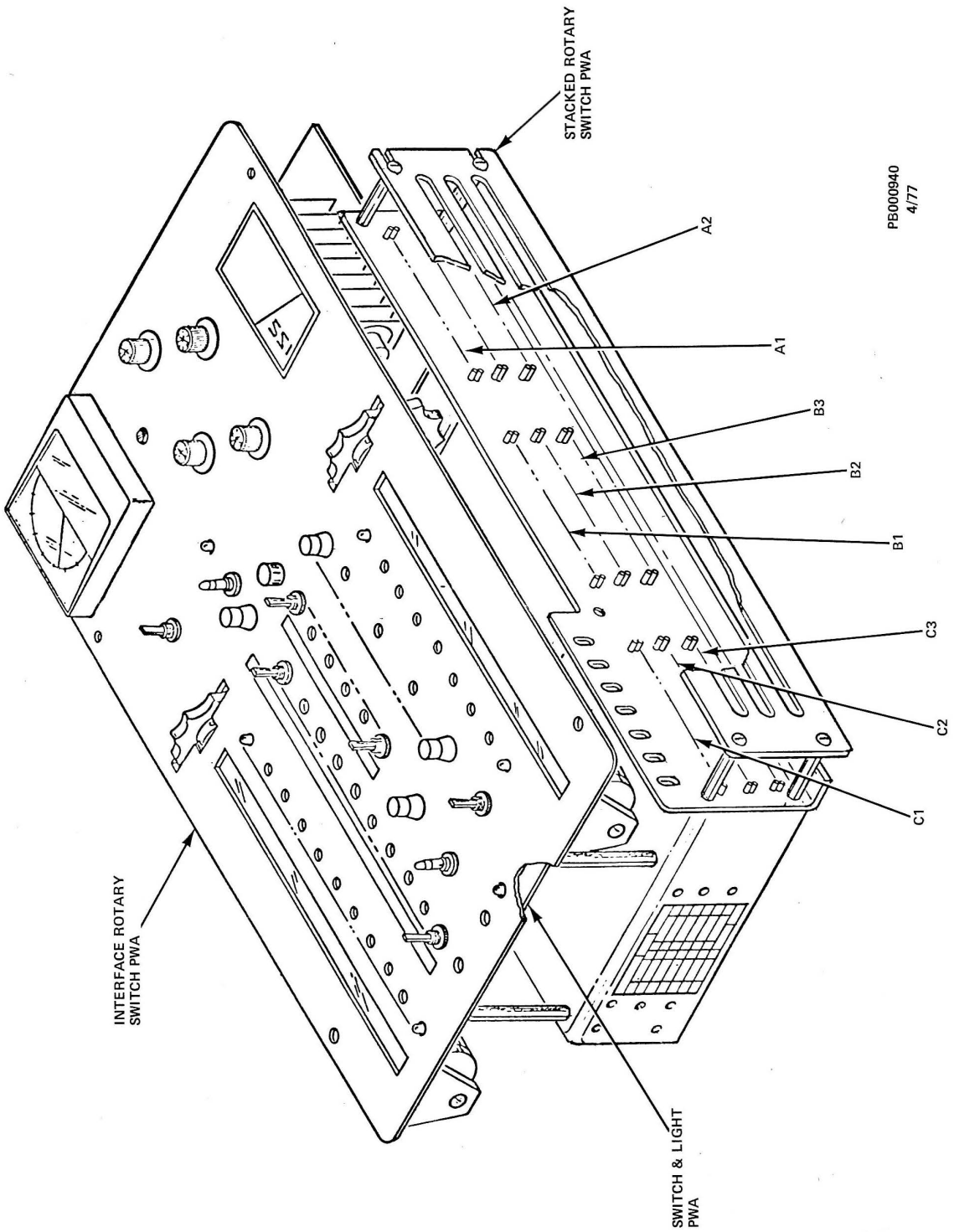


Figure 1-2. DEDU Component Locations

CHAPTER 2

INSTALLATION

2.1 INTRODUCTION

This chapter contains inspection and preparation procedures for the DEDU. The DEDU is contained in its own carrying case; therefore no special unpacking and packing instructions are required.

2.2 INSPECTION

Before using the DEDU, visually inspect cables and connectors for loose or broken connections, and paddle cards for cracks or breaks.

2.3 INSPECTION

CAUTION

Ensure that the drive is stopped and CB1 or service switch is set to OFF before connecting the DEDU to the drive.

Connect the DEDU to a disk drive using the following procedure:

1. Obtain permission to disrupt data processing operations. Then set SCU ENABLED/DISABLED switch to DISABLED.
2. Stop drive by pressing START switch to release it from the latched-down position.
3. Set SCU CE/NORMAL/IN-LINE switch to CE.
4. Remove rear cover panel on drive and set circuit breaker CB1 to the OFF position.
5. Open drive electronic gate and insert DEDU buffer paddle assembly (A09 and A10) into gate.
6. Connect DEDU 9-pin cable plug to drive power supply receptacle on power supply for 8430 and on drive gate for 8433.

NOTE: Steps 7 and 8 are for off-line drive test only.

7. Remove signal cable connectors from Line Receivers and Line Drivers PWAs at sockets A1B05 and A1B07, respectively. Replace with proper connector from DEDU.

8. Install the PWB Sequence Pick jumper (P/N P9702151-00) between the SCU signal cables removed in Step 7.
9. Verify that SCU POWER ON/OFF switch is set to ON.
10. Set SCU CE/NORMAL/IN-LINE switch to NORMAL.
11. Set SCU ENABLED/DISABLED switch to ENABLED.
12. Set DEDU switches as follows:
 - ROUTINE to RECAL (Off-line test only)
 - MODE to SING STEP (Off-line test only)
 - OFFSET (μ in.)/DATA/MODULE switches all down (Off-line test only)
 - HEAD switches all down (Off-line test only)
 - FUNCTION to OFF
 - RANGE to fully CW (unlabeled) position
 - EMA ENABLE/DISABLE to ENABLE
 - PROGRAM to INTERRUPT (On-line test only)
13. Set drive Service switch to the ON position.
14. Press drive START switch to latched-down position.

2.4 HEAD LOAD CHECK

After DEDU has been connected to the drive according to Paragraph 2.3, perform head load check as follows:

1. Verify that CUDI cables are connected to drive electronic gate slots A1B5P2 and A1B07P2.
2. On DEDU control panel, set EMA ENABLE/DISABLE switch to DISABLE.
3. Set FAILSAFE/INHIBIT switch to FAILSAFE.
4. Set DEDU rotary switches as follows:
 - FUNCTION to OFF
 - MODE to SING STEP
 - ROUTINE to RECALIBRATE
5. Set all DATA and HEAD toggle switches to the OFF position (all down).
6. Set drive Service Switch to the ON position.
7. Press LAMP TEST pushbutton to verify that all DEDU indicators illuminate; then release.
8. Verify that GATE LOGIC DISPLAY roll chart indicators are illuminated as shown in Table 2-1.

9. Return DEDU to the configuration of Paragraph 2.3.

Table 2-1. Gate Logic Display Roll Chart Indications, Head Load Check

| ROLL CHART POSITION | INDICATORS ILLUMINATED |
|---------------------------|--|
| 1 | ALLOW HD LOAD |
| 2 | 1, 2, 4, 8, 16, 32, and 256 |
| 3 | DIFF 512 |
| 4 | NONE |
| 5 | MOD SELECT |
| 6 | BUS OUT VALID |
| 7 | PARITY |
| 8 | NONE |
| 9 | ODD CYL, EVEN TRK STOP, 1ST CYL DETECTED, and SEEK IN PROCESS |
| 10 | RETRACTED MODE, HOLD REVERSE, and ALLOW HEAD LOAD |
| 11 | NONE |
| 12 | 0.5 ms, 1.0 ms, 4.2 ms, 8.3 ms and 16.7 ms |

CHAPTER 3 OPERATIONAL DESCRIPTION

3.1 INTRODUCTION

This chapter contains operational procedures for the DEDU and provides a description of all controls and indicators and their use.

3.2 CONTROLS AND INDICATORS

Figure 3-1 illustrates the arrangement of controls and indicators on the DEDU control panel. A description of each control and indicator is shown in Table 3-1.

Table 3-1. DEDU Controls and Indicators

| CONTROL(s) OR INDICATOR(s) | DESCRIPTION |
|----------------------------|--|
| Meter | -100/0/+100 microampere movement |
| ROUTINE Rotary Switch | <p>Eight position rotary switch used to select eight predetermined routines as shown below:</p> <p>RECALIBRATE position - causes the carriage to be moved to the inner guard band and then returned to position the heads at cylinder 000.</p> <p>RECAL/SEEK position - causes a recalibration to cylinder 000 to be executed followed by a seek operation to position the carriage to the cylinder selected by the value entered on the DATA switches.</p> <p>SEEK/SEEK position - causes a forward seek to be executed from the initial cylinder position to a higher order cylinder followed by a reverse seek to the initial cylinder position.</p> <p>INCR SEEK position - selects an incremental seek operation. The carriage is moved forward by the increment entered on the DATA switches on successive cycles until the increment is greater than the number of cylinders on the outer guard band. The carriage is then moved by reverse increments until the move increment is greater than the number of cylinders to the inner guard band and the operation is then reversed.</p> |

Table 3-1. DEDU Controls and Indicators (Cont)

| CONTROL(s) OR INDICATOR(s) | DESCRIPTION |
|---|---|
| <p>ROUTINE Rotary Switch (Cont)</p> | <p>HEAD SEEK SEL position - causes one of the nineteen read/write heads to be selected according to the setting of the DEDU HEAD toggle switches.</p> <p>SECTOR SEARCH position - selects one of 128 sectors according to the setting of the OFFSET/DATA/MODULE toggle switches.</p> <p>OFFSET position - offsets the heads from cylinder center according to the setting of the OFFSET/DATA/MODULE toggle switches.</p> <p>MOD SELECT position - inhibits CE MOD select signal and initiates a command cycle to test the drive mode select network. The setting of the OFFSET/DATA/MODULE toggle switches must correspond to the MOD plug installed in the drive.</p> |
| <p>MODE Rotary Switch</p> | <p>Four-position rotary switch used to select one of four methods of executing commands in the routine selected by the ROUTINE switch as explained below.</p> <p>SING STEP position - causes DEDU sequence logic to advance one state each time the START switch is pressed if a command is not issued in that state. If a command is issued in that state the sequence logic will advance one state for every two depressions of the START switch.</p> <p>SING OP position - causes the drive to execute one command cycle in the selected routine when the START pushbutton is pressed and then stop when the DEDU shift register reaches state 6.</p> <p>RUN position - causes the drive to continuously execute the command functions in the selected routine in sequence when the DEDU detects the drive File Ready status. Setting the MODE switch back to SING OP stops execution of command functions when the DEDU shift register reaches state 6.</p> <p>AUTO RECAL position - drive operation is similar to RUN mode with the exception that after an aborted routine (seek incomplete) the recalibrate routine is automatically initiated before the routine is repeated.</p> |

Table 3-1. DEDU Controls and Indicators (Cont)

| CONTROL(s) OR INDICATOR(s) | DESCRIPTION |
|-------------------------------|---|
| <p>FUNCTION Rotary Switch</p> | <p>Five position rotary switch used to select one of five functions as shown below.</p> <p>SYST OFFSET ADJ position - the track-following (TF) position error signals are applied to the meter so that any offset can be adjusted to zero (nulled), when drive is in RET. Mode.</p> <p>MTR CAL/HD ALIGN position - amplified read/write head position signals from the selected read/write head are applied to the meter so that any head align error can be adjusted to near zero. Also used for zeroing the meter drive system in RET. Mode prior to head alignment.</p> <p>GL POS 2 ADJ position - applies one of the two drive position transducer signals (GLASS POS SEG 2) to the meter to verify and adjust drive tachometer gain.</p> <p>GL CYL VIC ADJ position - applies the other drive position transducer signal to the meter to verify and adjust drive tachometer gain.</p> <p>OFF position - switch is inactive and should be set to this position before applying power to the drive or DEDU and when powering up the drive.</p> |
| <p>RANGE Switch</p> | <p>Four position rotary switch that is used to select meter sensitivity as shown below.</p> <p>Unlabeled top position - not used.</p> <p>100μin position - the full-scale deflection of the meter is nearly equal to 100 microinches of offset. This position is used for final head alignment.</p> <p>1000μin position - the full-scale deflection of the meter is nearly equal to 1000 microinches of offset. This position is used for initial head alignment.</p> <p>POS SIG position - used when checking or adjusting amplitude of the glass position signals.</p> |

Table 3-1. DEDU Controls and Indicators (Cont)

| CONTROL(s) OR INDICATOR(s) | DESCRIPTION |
|--|--|
| OFFSET/DATA/MODULE | <p>Ten toggle switches used to set values for the following data:</p> <ul style="list-style-type: none"> Mod Address Cylinder Address Carriage Direction Cylinder Difference Sector Offset |
| HEAD Switches | <p>Five toggle switches used to provide head select data to the drive.</p> |
| EMA Switch | <p>Toggle switch used to apply power (ENABLE position) or remove power (DISABLE/HOLD UNSAFE RESET position) from the EMA. The DISABLE/HOLD UNSAFE RESET position also inhibits the drive failsafe provision and holds the unsafe latches reset.</p> |
| PROGRAM Toggle Switch | <p>RUN position permits microprogram IE to run normally. The INTERRUPT position stops the microprogram while running in-line head alignment diagnostic routine IE to allow head adjustment.</p> |
| FAILSAFE/INHIBIT Toggle Switch | <p>FAILSAFE position allows the drives' failsafe provision to operate normally. The INHIBIT position disables the drives failsafe provision when the FUNCTION switch is set to MTR CAL/HD ALIGN or SYS OFFSET.</p> |
| CE RST INTRPT/NORMAL/DROP CE MOD SEL Toggle Switch | <p>Used to allow storage control unit operation on a dual port drive while the DEDU is installed. Switch must be in the NORMAL position to allow the DEDU to issue seek or offset commands.</p> |
| RESET UNSAFE Pushbutton Switch | <p>Resets the unsafe latches in the drive.</p> |
| RESET HEADS Pushbutton Switch | <p>Resets head address register to 00 when momentarily pressed.</p> |
| HEAD ADVANCE Pushbutton Switch | <p>Advances the count stored in the head address register by one each time switch is pressed.</p> |
| RECAL Pushbutton Switch (Red) | <p>Initiates a restore operation that positions the heads to cylinder 000 when pressed.</p> |

Table 3-1. DEDU Controls and Indicators (Cont)

| CONTROL(s) OR INDICATOR(s) | DESCRIPTION |
|---------------------------------------|--|
| RESET Pushbutton Switch | Resets the shift register to SHIFT 6 when pressed. |
| START Pushbutton Switch | Initiates selected operation when pressed. Also steps the DEDU shift register if the MODE switch is in the SIGN STEP position. |
| LAMP TEST Pushbutton | All DEDU LED displays should illuminate when pressed. |
| HEAD ALIGNMENT SAFE Indicator | LED that illuminates to indicate that the FUNCTION and FAILSAFE INHIBIT switches are properly set for head alignment. NOTE: LED will not illuminate if drive circuits are working properly. |
| SEEK INCOMPLETE Indicator | LED that provides a constant monitor of seek status and illuminates during a seek operation. |
| DEVICE CHECK Indicator | LED that illuminates when the DEVICE CHECK signal is received from the drive. |
| TAG GATE Indicator | LED that illuminates when the TAG GATE signal is generated from the DEDU shift register PWA. |
| TAG VALID Indicator | LED that illuminates when the TAG VALID signal is received from the drive through the CUDI interface. |
| METER ZERO ADJ Potentiometer | Allows external calibration of the DEDU prior to performing head alignment. |
| INTERFACE DISPLAY (BUS IN) Indicators | 9 LED display that illuminates according to the configuration of the INTERFACE DISPLAY (BUS IN) roll chart display selected and is valid only if the DISPLAY VALID indicator is illuminated. |
| GATE LOGIC DISPLAY Indicators | 9 LED display that illuminates according to the configuration of the GATE LOGIC DISPLAY roll chart display selected. |
| DISPLAY VALID Indicator | Illuminates during SHIFT REG 6 to indicate that INTERFACE DISPLAY (BUS IN) display is valid. |

Table 3-1. DEDU Controls and Indicators (Cont)

| CONTROL(S) OR INDICATOR(S) | DESCRIPTION |
|---|--|
| 200/300 MB Switch* *See No. 1, Figure 3-1. | On paddle card assembly, set to 200 MB for 7330-11 and 300 MB for 7330-12. Disregard in 7330-1/10. NOTE: 7330-11/12 operation. Ensure that 200/300 megabyte switch on DEDU buffer paddle is properly set before seek operations are performed. Refer to Table 3-1. |

3.3 DEDU ROLL CHART ASSIGNMENTS

The INTERFACE DISPLAY (BUS IN) and GATE LOGIC DISPLAY roll chart assignments are shown in Figures 3-2 and 3-3 respectively.

3.4 OPERATIONAL PROCEDURES

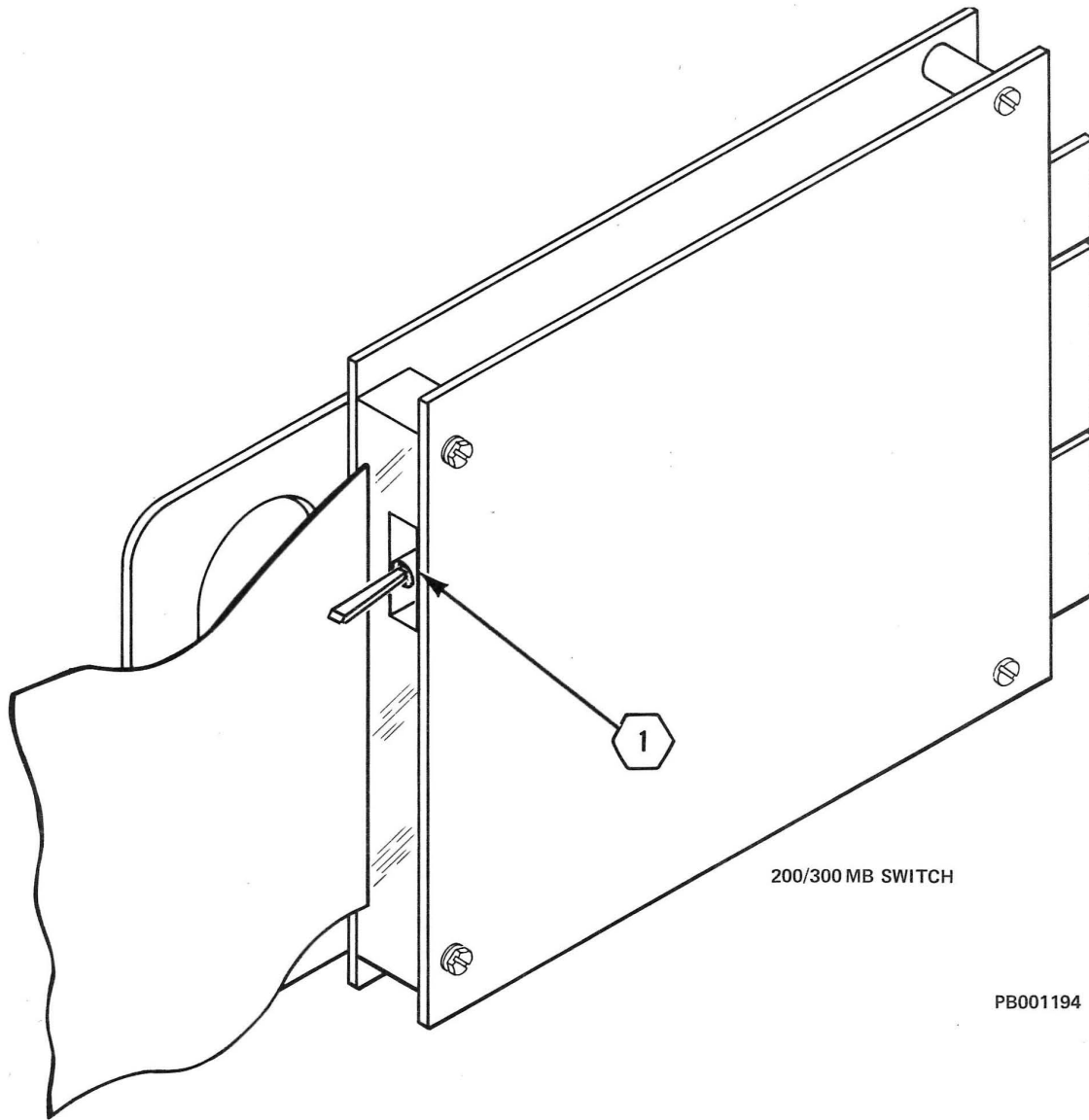
Operational procedures for checkout of a disk drive using the DEDU are given in the following paragraphs. Before performing any of the operational procedures ensure that DEDU has been connected to the drive according to the installation procedures of Chapter 2.

3.4.1 Head Load Diagnostic Procedure

Perform the Head Load Diagnostic Procedure as follows:

1. Place GATE LOGIC DISPLAY roll chart to position 1, HEAD LOAD DIAG (refer to Figure 3-1).
2. Verify that ALLOW HD LOAD indicator is illuminated.
3. Apply power to drive by pressing drive START switch.
4. Verify that DR FWD 5"/SEC indicator illuminates after disk pack has come up to speed (12 to 15 seconds).
5. Set EMA switch to the ENABLE positions.
6. Verify that all GATE LOGIC DISPLAY indicators illuminate in sequence to indicate a complete head load.

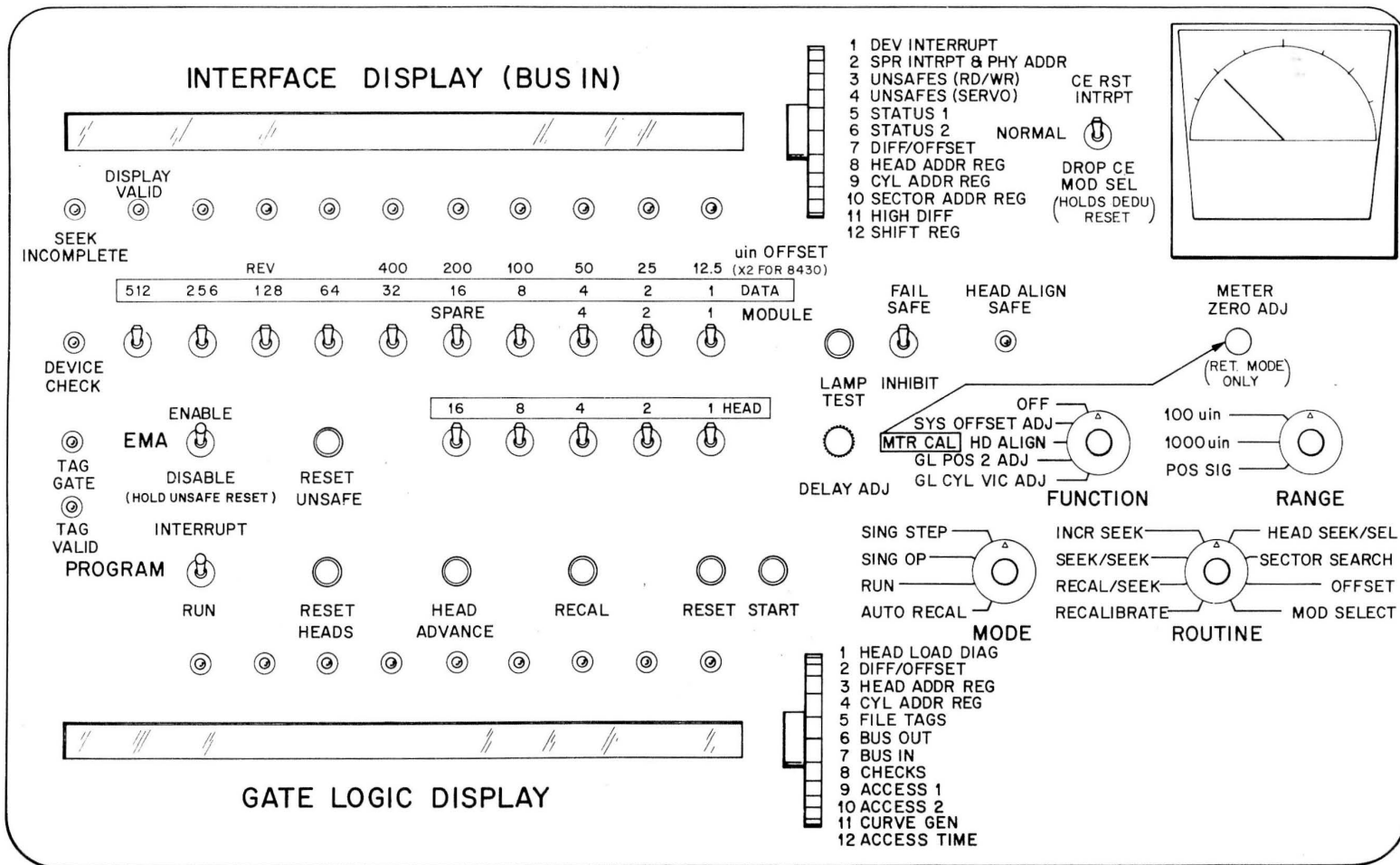
NOTE: If DEVICE CHECK indicator illuminates, press RESET UNSAFE switch and wait approximately 5 seconds for head load.



200/300 MB SWITCH

PB001194

Figure 3-1. Location of 200/300 MG Switch



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Figure 3-2. DEDU Control Panel

| ROLL CHART SWITCH POSITION | ROLL CHART ASSIGNMENTS | | | | | | | | | |
|----------------------------|-------------------------------|------------------------|------------------|-----------------|-----------------------|------------------|----------------|----------------|------------------|-----------------|
| 12 | ACCESS TIMING | | | 33.3 ms | 16.7 ms* | 8.3 ms* | 4.2 ms | 2.1 ms* | 1.0 ms* | 0.5 ms |
| 11 | CURVE GEN | GO FORWARD | GO REVERSE | DR FWD 5"/SEC | DR FWD 20"/SEC | DR REV 5"/SEC | | | | |
| 10 | ACCESS II | RETRACTED MODE | HOLD REVERSE | ALLOW HEAD LOAD | DR TO INNER GUARD BND | INNER GUARD BND | DIFF < 64 | | | |
| 9 | ACCESS I | FILE READY | DIFF = 0 | DIFF = 1 | LINEAR MODE | EVEN CYL | ODD CYL | EVEN TRK STOP | 1ST CYL DETECTED | SEEK IN PROCESS |
| 8 | CHECKS | DEVICE CHECK | | TAG VALID | UNSAFE LATCH | INDEX ERROR | MTR SEQ ERROR | | SIGN CHANGE | INTERRUPT |
| 7 | BUS IN | PARITY | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 6 | BUS OUT | BUS OUT VALID | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 5 | FILE TAGS $\frac{8433}{7330}$ | MOD SEL GT POLL INT | TAG GATE MOD SEL | MOD SEL SET CYL | TAG VALID | TAG 8 SET HD DIR | TAG 4 SET SECT | TAG 2 SET DIFF | TAG 1 OPERATE | DEVICE CHECK |
| 4 | CYL ADDR REG HD ALIGN ERR | 256 | 128 REV | 64 400 uin | 32 200 uin | 16 100 uin | 8 50 uin | 4 25 uin | 2 12.5 uin | 1 6.3 uin |
| 3 | HEAD ADDR REG | SEL HD ALGN ERR IS FWD | FORWARD | CAR 512 | DIFF 512 | 16 | 8 | 4 | 2 | 1 |
| 2 | DIFFERENCE OFFSET | 256 | 128 REV | 64 | 32 400 uin | 16 200 uin | 8 100 uin | 4 50 uin | 2 25 uin | 1 12.5 uin |
| 1 | HEAD LOAD DIAGNOSTIC | ALLOW HD LOAD | DR FWD 5"/SEC | DR FWD 20"/SEC | DR TO INNER GD BND | GO REVERSE | DIFF < 64 | DIFF = 1 | LIN MODE | FILE READY |

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Figure 3-3. Interface Display (BUS IN) Roll Chart Assignments

| ROLL CHART SWITCH POSITION | ROLL CHART ASSIGNMENTS | | | | | | | | | |
|----------------------------|--------------------------|-----------------|-------------------|---------------------|-----------------|------------------|-------------------------|-----------------|-----------------|-----------------|
| 12 | DSDDU SHIFT REG | SEEK INCOMPLETE | TAG GATE | SHIFT REG 0 | SHIFT REG 1 | SHIFT REG 2 | SHIFT REG 3 | SHIFT REG 4 | SHIFT REG 5 | SHIFT REG 6 |
| 11 | HIGH DIFF | PARITY | | DIFF 512 | DIFF 256 | | | | | |
| 10 | SECTOR ADDR REG | PARITY | HI SIDE OF SECTOR | SAR 64 | SAR 32 | SAR 16 | SAR 8 | SAR 4 | SAR 2 | SAR 1 |
| 9 | CYL ADDR REG | PARITY | CAR 128 | CAR 64 | CAR 32 | CAR 16 | CAR 8 | CAR 4 | CAR 2 | CAR 1 |
| 8 | HEAD ADDR REG | PARITY | REVERSE | CAR 512 | CAR 256 | HAR 16 | HAR 8 | HAR 4 | HAR 2 | HAR 1 |
| 7 | DIFFERENCE OFFSET | PARITY | DIFF 128 REV | DIFF 64 | DIFF 32 400 uin | DIFF 16 200 uin | DIFF 8 100 uin | DIFF 4 50 uin | DIFF 2 25 uin | DIFF 1 12.5 uin |
| 6 | STATUS 2 | PARITY | INDEX ERROR | OFFSET ACTIVE | | READ ONLY | RD/WR READY | INDEX | END OF CYLINDER | WR CURR SENSE |
| 5 | STATUS 1 | PARITY | INDEX ERROR | OFFSET ACTIVE | SEEK INCOMPLETE | SK/OFF/ FMT/RLSD | ON LINE | PACK CHANGE | BUSY | RCD SRH IN PROG |
| 4 | UNSAFES (SERVO) | PARITY | PERMANENT ERROR | | | | ANY PS UNSF XCPT 30V DC | PACK SPD UNSAFE | VELOCITY UNSAFE | 30V DC UNSAFE |
| 3 | UNSAFES (RD/WR) | PARITY | WRITE OVERRUN | INDEX ERR WITH WRET | WR READY UNSAFE | BUS OUT INVALID | HEADS UNSAFE | PLO UNSAFE | DC WRITE UNSAFE | AC WRITE UNSAFE |
| 2 | SPR INTERRUPT & PHY ADDR | PARITY | SPARE MODULE | | | | | PHY ADDR 1 | PHY ADDR 2 | PHY ADDR 3 |
| 1 | DEVICE INTERRUPT | PARITY | MODULE 0 | MODULE 1 | MODULE 2 | MODULE 3 | MODULE 4 | MODULE 5 | MODULE 6 | MODULE 7 |

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Figure 3-4. Gate Logic Display Roll Chart Assignments

7. Press RESET switch.
8. Press RECAL switch and verify that drive does restore to CYL 000.

NOTE: At the end of any routine press RESET switch and then press RECAL switch.

3.4.2 Recalibrate Routine

Perform Recalibrate Routine as follows:

1. Set FUNCTION switch to fully clockwise position (off).
2. Set MODE switch to SING STEP.
3. Set ROUTINE switch to RECALIBRATE.
4. Place INTERFACE DISPLAY (BUS IN) roll chart to position 12, SHIFT REG.
5. Place GATE LOGIC DISPLAY roller to position 5, FILE TAGS.
6. Press DEDU START switch five times and verify that only the INTERFACE DISPLAY (BUS IN) SR4 indicator is illuminated.
7. Press DEDU START switch and verify the following:
 - a. INTERFACE DISPLAY (BUS IN) TAG GATE and SR5 indicators illuminate.
 - b. GATE LOGIC DISPLAY TAG GATE, MOD SEL, TAG VALID, TAG 8, and TAG 1 indicators illuminate.
 - c. TAG GATE and TAG VALID indicators illuminate.
 - d. Drive performs recalibration routine continuously.
8. Press DEDU START switch and verify that TAG GATE and TAG VALID indicators extinguish and that drive discontinues recalibration.
9. Press DEDU START switch and verify that INTERFACE DISPLAY (BUS IN) DISPLAY VALID and SHIFT REG 6 indicators illuminate.
10. Set MODE switch to the SIGN OP position.
11. Place GATE LOGIC DISPLAY roll chart in position 11, CURVE GEN.
12. Press DEDU START switch and verify that DR FWD 5"/sec and GO REVERSE indicators illuminate sequentially as drive performs recalibration routine.
13. Set MODE switch to RUN position and press DEDU START switch.

14. Verify that drive performs recalibration routine continuously.
15. Set MODE switch to AUTO RECAL.
16. Verify that drive continues to perform routine without interruption.
17. Press RESET and RECAL switches.

3.4.3 Recal/Seek Routine

Perform the Recal/Seek Routine as follows:

1. Set ROUTINE switch to the RECAL/SEEK position.
2. Place GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
3. Place INTERFACE DISPLAY (BUS IN) roll chart to position 5 (SHIFT REG).
4. Press START switch six times.
5. Verify that drive performs continuous recalibration.
6. Press START switch twice and verify that drive stops recalibration and INTERFACE DISPLAY (BUS IN) SHIFT REG 6 indicator (position 12) is illuminated.
7. Set DATA switches 256, 16 and 1 to the ON (UP) position.
8. Press START switch and verify that the following indicators are illuminated:
 - a. INTERFACE DISPLAY (BUS IN) roll chart position 12 TAG GATE indicator.
 - b. GATE LOGIC DISPLAY roll chart position 5 TAG GATE, TAG VALID, MOD SEL, and TAG 4 indicators.
 - c. TAG GATE and TAG VALID indicators.
9. Press START switch twice and verify that the following indicators are illuminated:
 - a. INTERFACE DISPLAY (BUS IN) roll chart position 12 TAG GATE and SHIFT REG 1 indicators.
 - b. GATE LOGIC DISPLAY roll chart position 5 TAG GATE, TAG VALID, MOD SEL, TAG 4 and TAG 2 indicators.
10. Move GATE LOGIC DISPLAY roll chart to position 4 (CYCL ADDR REG) and verify that the bit 1 and bit 16 indicators illuminate.

11. Return GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
12. Press START switch twice and verify that the following indicators illuminate:
 - a. INTERFACE DISPLAY (BUS IN) roll chart TAG GATE and SHIFT REG 3 indicators.
 - b. GATE LOGIC DISPLAY roll chart TAG GATE, TAG VALID, MOD SEL, TAG 4, TAG 2 and TAG 1 indicators.
13. Move GATE LOGIC DISPLAY roll chart to position 4 (CYL ADDR REG) and verify that cylinder 256 indicator is illuminated.
14. Move GATE LOGIC DISPLAY roll chart to position 3 (HEAD ADDR REG) and verify that FORWARD indicator is illuminated.
15. Move GATE LOGIC DISPLAY roll chart back to position 5 (FILE TAGS).
16. Press START switch twice and verify that the following indicators illuminate:
 - a. INTERFACE DISPLAY (BUS IN) roll chart position 12 - TAG GATE and SHIFT REG 3 indicators.
 - b. GATE LOGIC DISPLAY roll chart position 5 - TAG GATE, TAG VALID, MOD SEL and TAG 8 indicators illuminate.
17. Move GATE LOGIC DISPLAY roll chart to position 2, DIFF/OFFSET and verify that DIFFERENCE bit 1 and bit 16 indicators are illuminated.
18. Return GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
19. Press START twice and verify that the following indicators illuminate:

INTERFACE DISPLAY (BUS IN) roll chart position 12 - TAG GATE and SHIFT REG 4 indicators.

GATE LOGIC DISPLAY roll chart position 5 - TAG GATE, TAG VALID, MOD SEL, TAG 8, TAG 4, and TAG 2 indicators.
20. Move GATE LOGIC DISPLAY roll chart to position 2 (DIFF/OFFSET) and verify that DIFFERENCE bit 256 indicator is illuminated.
21. Return GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
22. Press START switch twice and verify that the following indicators are illuminated.
 - a. INTERFACE DISPLAY (BUS IN) roll chart position 12 - TAG GATE and SHIFT REG 5 indicators.

- b. GATE LOGIC DISPLAY roll chart position 5 - TAG GATE, TAG VALID, MOD SEL, TAG 8 and TAG 1 indicators.
23. Move GATE LOGIC DISPLAY roll chart to position 6 (BUS OUT) and verify that BUS OUT bit 16 indicator is illuminated.
24. Move GATE LOGIC DISPLAY roll chart to position 4 (CYL ADDR REG) and verify that CYL ADDR REG 256, 16 and 1 bit indicators are illuminated.
25. Move GATE LOGIC DISPLAY roll chart to position 3 (HEAD ADDR REG) and verify that HEAD ADDR REG bit 128 indicator is illuminated.
26. Move GATE LOGIC DISPLAY roll chart to position 2 (DIFF/OFFSET) and verify that DIFFERENCE equals zero (all indicators extinguished).
27. Move GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
28. Press START switch twice and verify that GATE LOGIC DISPLAY position 5 MOD SELECT indicator and INTERFACE DISPLAY (BUS IN) position 12. SHIFT REG 6 indicator illuminates. Also verify that DISPLAY VALID indicator illuminates.
29. Press RESET switch.
30. Press RECAL switch.
31. Set MODE switch to SING OP.
32. Press START switch.
33. Verify that drive performs recalibration.
34. Press START switch.
35. Move GATE LOGIC DISPLAY roll chart to position 4 (CYL ADDR REG).
36. Verify that CYL ADDR REG bit 256, 16 and 1 indicators illuminate.
37. Press RESET switch.
38. Press RECAL switch.
39. Set MODE switch to RUN.
40. Press START switch.
41. Verify that drive performs continuous Recalibration/Seek operation.
42. Adjust DELAY ADJ potentiometer in both directions and verify that drive speeds up and slows down according to which direction the potentiometer is adjusted.
43. ADJUST DELAY ADJ potentiometer for fastest drive operation.

44. Set MODE switch to AUTO RECAL and verify that drive continues recalibration/seek operation.
45. Press RESET switch.
46. Press RECAL switch.

3.4.4 Seek/Seek Routine

Perform the Seek/Seek routine as follows:

1. Set ROUTINE switch to SEEK/SEEK.
2. Set MODE switch to SING STEP.
3. Place GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
4. Place INTERFACE DISPLAY (BUS IN) roll chart to position 12 (SHIFT REG).
5. Set DATA switches 256 and 16 to the on (UP) position.
6. Set HEAD switch 4 to the on (DOWN) position.
7. Press START switch and verify that the following indicators illuminate:
 - a. INTERFACE DISPLAY (BUS IN) roll chart TAG GATE and SHIFT REG 0 indicators.
 - b. GATE LOGIC DISPLAY roll chart TAG GATE, TAG VALID, MOD SELECT and TAG 4 (Request Status) indicators.
8. Press START switch twice and verify that the following indicators illuminate.
 - a. INTERFACE DISPLAY (BUS IN) roll chart - TAG GATE and SHIFT REG 1 indicators.
 - b. GATE LOGIC DISPLAY roll chart - same as step 7 plus TAG 2 (set cyl) indicator.
9. Move GATE LOGIC DISPLAY roll chart to position 6 (BUS OUT) and verify that BUS OUT 16 indicator illuminates.
10. Move GATE LOGIC DISPLAY roll chart to position 7 (BUS IN) and verify that BUS IN 16 indicator illuminates.
11. Press START switch twice and verify that the following indicators are illuminated:
 - a. INTERFACE DISPLAY (BUS IN) roll chart TAG GATE and SHIFT REG 2 indicators.

- b. GATE LOGIC DISPLAY roll chart BUS IN 32 and BUS IN 4 indicators.
12. Move GATE LOGIC DISPLAY roll chart to position 6 (BUS OUT) and verify that BUS OUT 32 and BUS OUT 4 indicators are illuminated.
 13. Move GATE LOGIC DISPLAY roll chart to position 5 and verify that the TAG GATE MOD SEL, TAG VALID, TAG 4, TAG 2 and TAG 1 (SET HEAD) indicators illuminate.
 14. Move GATE LOGIC DISPLAY roll chart to position 3 and verify that FORWARD (bit 128) indicator illuminates.
 15. Press START switch twice and verify that the following indicators are illuminated:
 - a. INTERFACE DISPLAY (BUS IN) roll chart TAG GATE and SHIFT REG 3 indicators.
 - b. GATE LOGIC DISPLAY roll chart TAG GATE, TAG VALID, MOD SEL and TAG 8 (SET DIFF) indicators.
 16. Move GATE LOGIC DISPLAY roll chart to position 6 (BUS OUT) and verify that BUS OUT 16 indicator illuminates.
 17. Move GATE LOGIC DISPLAY roll chart to position 7 (BUS IN) and verify that BUS IN 16 indicator illuminates.
 18. Move GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
 19. Press START switch twice and verify that the following indicators are illuminated:

INTERFACE DISPLAY (BUS IN) roll chart - TAG GATE and SHIFT REG 4 indicators.

GATE LOGIC DISPLAY roll chart - TAG GATE, TAG VALID, MOD SEL, TAG 8, TAG 4 and TAG 2 indicators.
 20. Move GATE LOGIC DISPLAY roll chart to position 6 (BUS OUT) and verify that BUS OUT 32 indicator illuminates.
 21. Move GATE LOGIC DISPLAY roll chart to position 7 (BUS IN) and verify that BUS IN 32 indicator illuminates.
 22. Move GATE LOGIC DISPLAY roll chart to position 4 (CYL ADDR REG).
 23. Press START switch twice and verify that the following indicators illuminate:
 - a. INTERFACE DISPLAY (BUS IN) roll chart - TAG GATE and SHIFT REG 5 indicators.

- b. GATE LOGIC DISPLAY roll chart - CYL ADDR REG bit 256 and bit 16 indicators.
24. Move GATE LOGIC DISPLAY roll chart to position 3 (HEAD ADDR REG) and verify that HEAD ADDR REG bit 128 and bit 4 indicators illuminate.
 25. Move GATE LOGIC DISPLAY roll chart to position 2 (DIFF/OFFSET) and verify that DIFFERENCE is equal to zero (all indicators extinguished).
 26. Move GATE LOGIC DISPLAY roll chart to position 5 (FILE TAG) and verify that TAG GATE, TAG VALID, MOD SEL, TAG 8 and TAG 1 indicators illuminate.
 27. Move GATE LOGIC DISPLAY roll chart to position 6 (BUS OUT) and verify that BUS OUT 16 (seek start) indicator illuminates.
 28. Press START switch twice and verify that INTERFACE DISPLAY roll chart DISPLAY VALID and SHIFT REG 6 indicators illuminate.
 29. Move GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS) and verify that MOD SEL indicator illuminates.
 30. Repeat steps 3 through 29 for reverse seek.

NOTE: Ensure that FORWARD indicator (GATE LOGIC DISPLAY roll chart, position 3 - HEAD ADDR REG) extinguishes when INTERFACE DISPLAY (BUS IN) roll chart SHIFT REG 2, TAG 1, TAG 2 and TAG 4 indicators are illuminated.

31. Set MODE switch to SING OP.
32. Press RESET switch.
33. Press RECAL switch.
34. Move GATE LOGIC DISPLAY roll chart to position 12 (access time).
35. Press START switch.
36. Verify that ACCESS TIMING indicators add up to 27.1 ± 0.5 ms (16.7 ms + 8.3 ms + 2.1 ms and 0.5 ms indicators illuminated).
37. Set MODE switch to RUN.
38. Set DATA switch 256 to the off (down) position.
39. Press RESET switch.
40. Press RECAL switch.
41. Set MODE switch to AUTO RECAL.

42. Set DATA switches 512, 256, 32, 8 and 2 to the on (up) position to select cylinder 810.

NOTE: For 200 megabyte machine only.
For 100 megabyte machine select
cylinder 405 with DATA switches.

43. Verify that drive performs a continuous seek to cylinder 810 (405 for 100 megabyte drive).
44. Press RESET switch.
45. Press RECAL switch.

3.4.5 Incremental Seek Routine

Perform the incremental seek routine as follows:

1. Set ROUTINE switch to INCR SEEK.
2. Set MODE switch to SING STEP.
3. Set FUNCTION and RANGE switches fully clockwise.
4. Place INTERFACE DISPLAY (BUS IN) roll chart to position 12 (SHIFT REG).
5. Place GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
6. Press START switch repeatedly and observe that FILE TAGS indicators sequence with SHIFT REG indicators. Refer to Figure 3-1.
7. Press RESET and RECAL switches.
8. Set MODE switch to SING OP.
9. Move GATE LOGIC DISPLAY roll chart to position 4 (CYL ADDR REG).
10. Press START switch repeatedly and observe that carriage increments forward one cylinder each time START switch is pressed.
11. Press RESET and RECAL switches.
12. Set MODE switch to RUN.
13. Press START switch and verify that drive performs a 1 cylinder incremental seek.
14. Move GATE LOGIC DISPLAY roll cart to position 3 (HEAD ADDR REG) and verify that FORWARD Indicator illuminates.
15. Verify that when seeks pass cylinder 511 that CAR 512 indicator illuminates.

16. Move GATE LOGIC DISPLAY roll chart to position 4 (CYL ADDR REG).
17. Press RESET and RECAL switches and repeat steps 9 through 16 for cylinders 2, 4, 8, 16, 32, 64, 128, 256 and 512.
18. Set MODE switch to AUTO RECAL.
19. Set DATA switch 1 to the on (up) position.
20. Verify that drive performs a 1 cylinder incremental seek.

3.4.6 Head Seek/Select Routine

Perform the Head Seek/Select routine as follows:

1. Set MODE switch to SING STEP.
2. Set ROUTINE switch to HEAD SEEK SEL.
3. Set INTERFACE DISPLAY (BUS IN) roll chart to position 12 (SHIFT REG).
4. Set GATE LOGIC DISPLAY roll chart to position 3 (HEAD ADDR REG).
5. Press RESET switch.
6. Press RECAL switch.
7. Press RESET HEADS switch.
8. Set HEAD switch 16 to the on (up) position.
9. Set all DATA switches to the off (down) position.
10. Press START switch three times.
11. Verify that INTERFACE DISPLAY (BUS IN) roll chart TAG GATE and SHIFT REG 2 indicators illuminate.
12. Verify that GATE LOGIC DISPLAY roll chart HEAD ADDR REG bit 16 indicator illuminates.
13. Press START switch five times.
14. Verify that INTERFACE DISPLAY (BUS IN) TAG GATE and SHIFT REG 5 indicators illuminate.
15. Verify that GATE LOGIC DISPLAY roll chart HEAD ADDR REG bit 16 and bit 1 indicators illuminate to indicate selection of Head 17.
16. Press START switch twice.
17. Verify that INTERFACE DISPLAY (BUS IN) roll chart SHIFT REG 6 and DISPLAY VALID indicators illuminate.

18. Set MODE switch to SING OP.
19. Press RESET switch.
20. Press START switch twice and verify selection of Head 17 (GATE LOGIC DISPLAY roll chart HEAD ADDR REG bit 16 and bit 1 indicators illuminate).
21. Press START switch twice and verify selection of Head 18 (GATE LOGIC DISPLAY roll chart HEAD ADDR REG bit 16 and bit 2 indicators illuminate).
22. Press START switch twice and verify selection of Head 19 (GATE LOGIC DISPLAY roll chart HEAD ADDR REG bit 16, bit 2 and bit 1 indicators illuminate).
23. Move INTERFACE DISPLAY (BUS IN) roll chart to position 6 (STATUS 2) and verify that END OF CYLINDER indicator illuminates.
24. Move INTERFACE DISPLAY (BUS (N)) roll chart to position 12 (SHIFT REG).
25. Press START switch eight times and verify selection of Head 20 (GATE LOGIC DISPLAY, roll chart HEAD ADDR REG bit 16 and bit 4 indicators illuminate).
26. Verify that DEVICE CHECK indicator is illuminated.
27. Press START switch twice.
28. Verify that TAG GATE and SHIFT REG 6 indicators illuminate.
29. Move INTERFACE DISPLAY (BUS IN) roll chart to position 3 (UNSAFES (RD/WR)) and verify that HEADS UNSAFE indicator illuminates.
30. Press and Release RESET UNSAFE switch and verify that UNSAFE is reset only as long as switch is pressed.
31. Press RESET HEADS switch and verify that HEADS UNSAFE is still active.
32. Verify that HEAD ADDRESS REGISTER display on GATE LOGIC DISPLAY roll chart is extinguished.
33. Press RESET UNSAFE switch and verify that DEVICE CHECK and HEADS UNSAFE are both permanently cleared.

3.4.7 Sector Search Routine

Perform the Sector Search Routine as follows:

NOTE: Spare Mod plugs must be inserted in drive for the sector search routine.

1. Set MODE switch to SING OP.
2. Set ROUTINE switch to SECTOR SEARCH.
3. Set INTERFACE DISPLAY (BUS IN) roll chart to position 10 (SECTOR ADDR REG).
4. Ensure that DATA switches are set to the off (down) position.
5. Set DATA switch 1 to the on (up) position.
6. Set all HEAD switches to the off (down) position.
7. Set DATA switches and verify that indicators illuminate as shown in Table 3-2 each time START switch is pressed once for each line of the table.

Table 3-2. Sector Search Routine Indications

| DATA SWITCHES SET TO ON (UP) POSITION | INDICATORS ILLUMINATED (SECTOR ADDR REG) | | | | | | |
|--|---|-------------|-------------|-----------|---------|-------|-----|
| | 128 | 64 | 32 | 16 | 8 | 4 | 2 1 |
| 1 | | | | | | | X |
| 2,1 | | | | | | | X X |
| 4,2,1 | | | | | | X X X | |
| 8,4,2,1 | | | | | X X X X | | |
| 16,8,4,2,1 | | | | X X X X X | | | |
| 32,16,8,4,2,1 | | | X X X X X X | | | | |
| 64,32,16,8,4,2,1 | X X | X X X X X X | | | | | |

8. Press RESET and RECAL switches.

3.4.8 Offset Routine

Perform the offset Routine as follows:

1. Set MODE switch to SING OP.
2. Set ROUTINE switch to OFFSET.
3. Set DATA switch 1 to the on (up) position.
4. Set INTERFACE DISPLAY (BUS IN) roll chart to position 7 (DIFF/OFFSET).
5. Connect channel 1 scope probe to drive connector A1A01-29 (Filtered Servo signals).

NOTE: Connect scope probe to A1A03-29 for 100 megabyte device.

6. Set scope for 2v/cm and .5 μ sec/cm.
7. Verify that dibits are displayed on the scope as shown in Figure 3-4.
8. Refer to Table 3-3 and press START switch for each line in the table. Verify that scope and INTERFACE DISPLAY (BUS IN) roll chart OFFSET indications correspond to the table.
9. Set all DATA switches to the off (down) position.
10. Press RESET and RECAL switches.

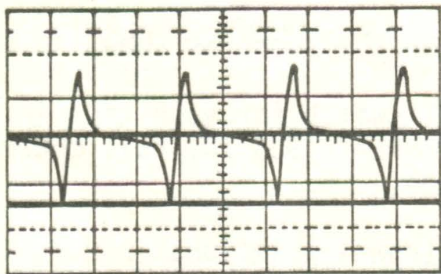
3.4.9 Mod Select Routine

Perform the mod select routine as follows:

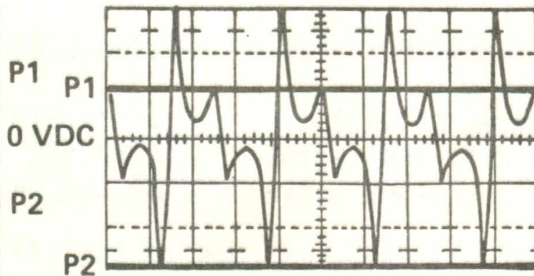
1. Set MODE switch to SING STEP.
2. Set ROUTINE switch to MOD SELECT.
3. Insert any Mod plug into drive.
4. Set GATE LOGIC DISPLAY roll chart to position 5 (FILE TAGS).
5. Verify that GATE LOGIC DISPLAY roll chart bit 64 (MOD SELECT) indicator is extinguished.
6. Press START switch six times and verify that INTERFACE DISPLAY (BUS IN) roll chart TAG GATE and SHIFT REG 5 indicators are both illuminated.
7. Verify that GATE LOGIC DISPLAY roll chart TAG GATE, TAG VALID, and bit 64 (MOD SEL) indicators are illuminated.

NOTE: Bit 64 (MOD SEL) will not illuminate if DEDU is being used with a 100 megabyte device.

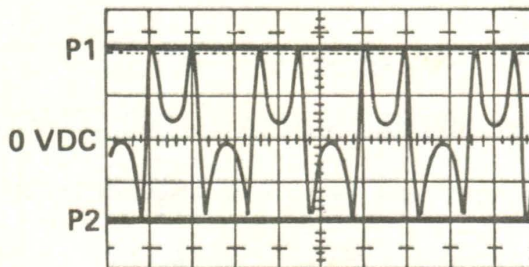
8. Press RESET switch.
9. Set CE RST INTRPT/NORMAL/DROP CE MOD SEL switch to DROP CE MOD SEL position.
10. Repeat steps 6 through 8 and verify that GATE LOGIC DISPLAY roll chart bit 64 (MOD SELECT) indicator does not illuminate.



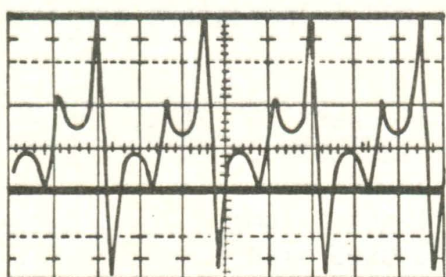
VIEW A. HEAD POSITIONED OVER EVEN SERVO TRACK (INNER GUARD BAND)



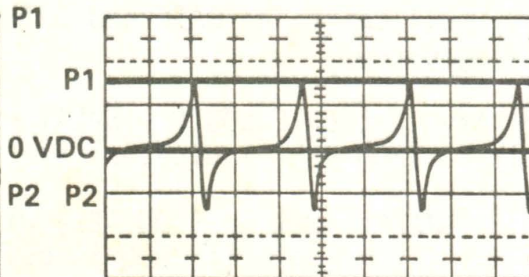
VIEW B. HEAD POSITIONED WITH 600 MICRINCHES FORWARD OFFSET FROM THE CYLINDER POSITION



VIEW C. HEAD CORRECTLY POSITIONED OVER CYLINDER



VIEW D. HEAD POSITIONED WITH 600 MICRINCHES REVERSE OFFSET FROM THE CYLINDER POSITION



VIEW E. HEAD POSITIONED OVER AN ODD SERVO TRACK (OUTER GUARD BAND)

PB000833
1/75

Figure 3-5. Head Align Signals (w/CE Pack)

Table 3-3. Offset Routine Indications

| DATA SWITCHES SET TO ON (UP POSITION) | SCOPE OFFSET INDICATION | OFFSET DISPLAY INDICATION |
|---------------------------------------|--|--|
| 1 | 12.5 μ in | 12.5 μ in |
| 1,2 | Verify change in waveform | 37.5 μ in |
| 1,2,4 | Verify change in waveform | 87.5 μ in |
| 1,2,4,8 | Verify change in waveform | 187.5 μ in |
| 1,2,4,8,16 | Verify change in waveform | 387.5 μ in |
| 1,2,4,8,16,32 | Verify change in waveform | 787.5 μ in NOTE: This indication good only for 100 megabyte device. |
| 16,32 | Verify change in in waveform | NOTE: This indication good only for 200 megabyte device. |
| 16,32,128(Rev) | Verify that direction of offset reverses | NOTE: This indication good only for 200 megabyte device. |

3.4.10 GLASS POSITION ADJUST PROCEDURE

Perform Glass Position adjust procedure as follows:

1. Set ROUTINE switch to SEEK/SEEK.
2. Set MODE switch to RUN.
3. Press START switch and verify that drive performs a continuous 16 cylinder seek.
4. Set FUNCTION switch to GL POS 2 ADJ.
5. Set RANGE switch to POS SIG.

6. Set scope on 2v/cm scale with ground reference on bottom line.
7. Place scope probe on A1A10-4 and A1A10-20 and observe that waveform is similar to that shown in Figure 3-5.
8. Observe waveform of Figure 3-5 and adjust potentiometers on PWA A1A15 for a value of 8.5v ground-to-peak.
9. Verify that DEDU meter reads $-20 \pm 20\mu\text{a}$.
10. Set FUNCTION switch to GL CYL VIC ADJ and verify that meter reads $-20 \pm 20\mu\text{a}$.
11. Press RESET switch.
12. Press RECAL switch.

3.4.11 HEAD ALIGNMENT PROCEDURES

Refer to the appropriate disk drive operation and service manual for head alignment procedures.

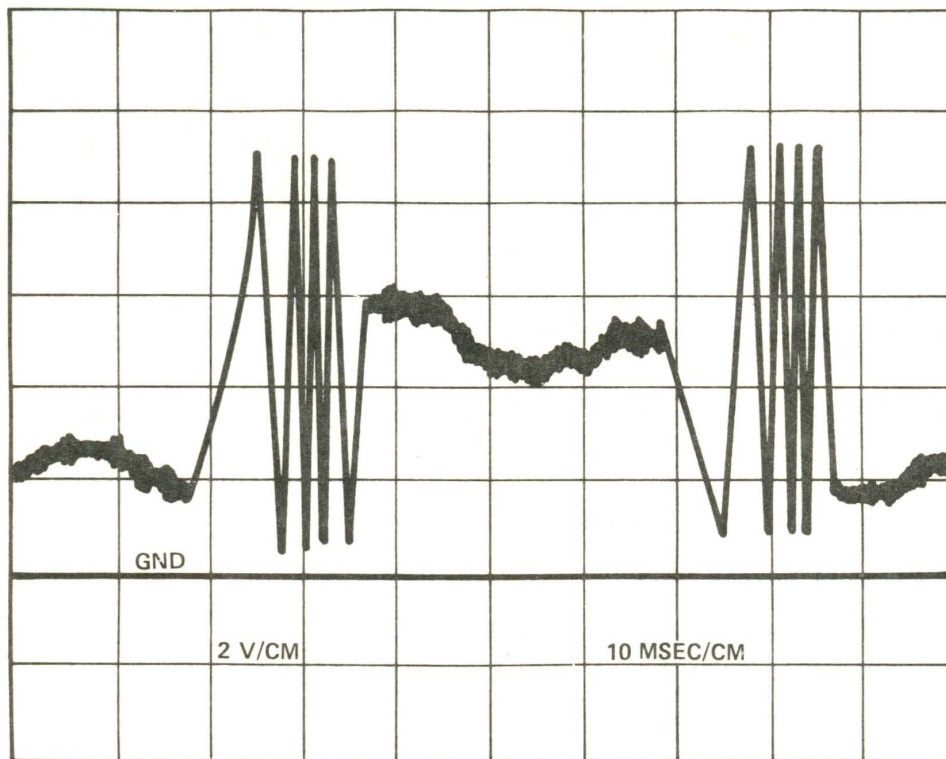


Figure 3-6. Glass Position Waveform

CHAPTER 4
FUNCTIONAL DESCRIPTION

**{Scanner's note: This page is just as found
in the 1977 printing of the Operation Manual.
There are no "Chapter 4" pages. Next scanned
page starts with "Chapter 5".**

To be supplied

CHAPTER 5

MAINTENANCE

5.1 INTRODUCTION

The DEDU is a test and alignment aid for the disk drive. To serve as a drive test aid, the DEDU must be in known working order. Conversely, a disk drive known to be in working order is required when DEDU troubleshooting is required. Field repair of the DEDU at the customer site should be limited to board (PWA) replacement. When the DEDU can not be repaired by board (PWA) replacement, it should be returned to a repair facility.

5.2 FAULT ISOLATION

When an apparent malfunction is detected with the DEDU connected to a disk drive, the failure should be isolated to either the DEDU or the disk drive. To isolate the failure, leave the DEDU connected to the drive and perform the following procedure:

1. Verify that the drive power supply voltages are correct by performing the procedure provided in Chapter 6 of the drive operation and service manual.
2. Check voltages on the DEDU according to the procedure of paragraph 5.3.
3. If power supply voltages are within specified limits, disconnect the DEDU and install it on a known good drive. If the problem persists, troubleshoot the DEDU. If the problem is corrected, reinstall the DEDU on the bad drive and troubleshoot the drive.
4. If the power supply voltages are not within the specified limits, remove power from the drive, disconnect the DEDU, and reapply power to the drive. Verify drive power supply voltages. If voltages are within specified limits troubleshoot the DEDU, otherwise troubleshoot the drive power network.

5.3 DEDU VOLTAGE CHECKS

Perform DEDU voltage checks using the following procedure:

1. Set the drive CB1 to off and connect DEDU power cable to A2J2 of drive assembly.
2. Set the drive CB2 off.
3. Set the drive CB1 on.

4. Check the following pins and voltages at the DEDU back panel.

| | |
|--------|-----------|
| B03-2 | Ground |
| B03-10 | +5 volts |
| B03-20 | +12 volts |
| B03-30 | +20 volts |
| B03-40 | -12 volts |
| B03-50 | -20 volts |
| B03-56 | -40 volts |
| B03-36 | -5 volts |

5.4 TROUBLESHOOTING

If a malfunction is isolated to the DEDU, refer to the troubleshooting chart of Table 5-1 for assistance in isolation of the problem to the PWA.

Table 5-1 contains a list of possible DEDU PWA malfunctions and should be used as a guide for PWA replacement at the customer site.

Table 5/1. Troubleshooting Chart

| PWA | POSSIBLE MALFUNCTIONS ASSOCIATED WITH PWA |
|--|---|
| PWA A1 (75008846) Comparator | Cannot calibrate system Cannot detect offset Velocity unsafes No meter response Cannot adjust access time Cannot do head alignment Cannot do offset correctly No ready delay adj |
| PWA B3 (75004249) TF Servo Clock | Cannot do head alignment Cannot calibrate system |
| PWA A3 (75008844) TF Servo Amp | Cannot calibrate system Velocity Unsafes No head alignment No 1.6 MHz (only if /calibrate is present) |
| PWA B1 (B9701692) Adder | Cannot reverse seek Seek Incompletes No data bits No CAR bits Wrong cylinder seeks No switch information to panel Cannot calculate difference Invalid seeks No seek/seek mode No recal/seek mode Will not run head alignment inline routine |
| PWA B2 (75008833) Harness Interface | Cannot decode position of routine switch Cannot decode position of mode switch Never senses display valid Invalid BUS IN to lights No mod select gate Incorrect display tags |
| PWA C1 (75008831) Receiver/Diagnostics | No Bus In No Tag Valid Wrong cylinder seeks No Head Load Diagnostic Display |
| PWA C2 (75008834) Encoder/Driver | No Bus Out No Tag Out, no Tag Gate No Mod Select Gate Incorrect parity No Sequence Pick or Controlled Ground No CE mode select |

Table 5-1. Troubleshooting Chart (Cont)

| PWA | POSSIBLE MALFUNCTIONS ASSOCIATED WITH PWA |
|---|--|
| PWA C3 (75008814) Shift Register | Cannot operate in run, OK single step No command response No Tag Gate No Set Offset No Module Address No Head Select/Read Gate |
| *PWA A9 (B9701682) Buffer Paddle | No head select for head alignment No input to indicators No Disable EMA No Inhibit failsafe No Calibrate No Head alignment Invalid drive error conditions |
| *PWA A10 (75008843) Buffer Paddle | No CAR information No HAR information No difference information No allow head load No Go Reverse indication No status (check) information No CE reset No head advance No restore |
| *A problem could exist in the ribbon cable attached to the buffer paddle. If this problem exists, the DEDU must be shipped to a depot repair facility for repair. | |

CHAPTER 6

REMOVAL AND REPLACEMENT

6.1 INTRODUCTION

The following removal and replacement procedures are an aid in gaining access to the DEDU PWA library for troubleshooting and component replacement. DEDU power, supplied by the drive, must be turned off or removed from the DEDU before any cable connection is broken or null, or any components are removed or replaced. Section 8 of this document includes an illustrated parts breakdown of the DEDU.

6.2 REMOVAL AND REPLACEMENT PROCEDURES

6.2.1 DEDU Removal Procedure - PWA Access

To gain access to the DEDU PWAs perform the following procedure:

1. Open cover of DEDU.
2. Remove two (2) hex screws (8.32 X .375) from lower panel face area.
3. Turn DEDU on its side and remove the two (2) screws (8.32 X .500) in bottom of cover. These screws are held by washers and nuts from inside of the DEDU case.
4. Return DEDU to upright position.

CAUTION

BE EXTREMELY CAREFUL TO AVOID WIRE
AND PIN DAMAGE.

5. Remove DEDU from case by holding the lower panel face and gently lifting from the back of the assembly.
6. Once DEDU assembly is removed from case, remove the two (2) remaining hex screws (8.32 X .375) from the upper panel face area.
7. Slide the cable outlet shroud down the cable assemblies, away from the DEDU card module.
8. Remove the PWA 6 card retainer by loosening the holding screw between the A and B rows.
9. Remove the cable and bracket assembly holding the receiver/driver cable onto C1 and C2 PWAs.

PWAs are now exposed for removal.

6.2.2 Installation Procedure - PWA Access

1. Reverse steps in PWA Access Removal procedures, Paragraph 2.2.1.

NOTE: Testing (Section 5) of new PWA assembly should be performed before reinstallation of DEDU module into case.

6.2.3 Meter Removal Procedure

Perform meter removal procedure as follows:

1. Perform Steps 1 through 7 of the PWA access removal procedure in Paragraph 6.2.1.
2. Remove the black wire bolted to the meter.
3. Measure meter resistance with a VOM set to RX1 or RX10 scale. If meter pegs to one side and VOM measures 100 to 350 ohms, the meter is functioning properly and a malfunction probably exists in the meter drive circuit on the switch and light PWA.
4. Remove the four nuts holding the meter. Meter is now free for removal from front of panel.

6.2.4 Meter Replacement Procedure

Reverse steps in meter removal procedure of Paragraph 6.2.3 and perform meter zero check and adjustment procedures provided in Chapter 3.

6.2.5 Switch and Light PWA Removal Procedure

Remove the Switch and Light PWA from the DEDU using the following procedure:

1. Perform PWA Access Removal as described in Paragraph 6.2.1.
2. Remove all cards from DEDU card cage.
3. Lay panel face down.

NOTE: Watch ribbon cables for binding.

4. Remove ribbon cables from cards as you remove cards.

NOTE: Check each ribbon cable for bent or broken pins and ensure that they are marked per location.

5. Remove two screws or paddle ribbon strain relief (A side socket area).
6. Remove plexiglass shield on backplane.

7. Remove coaxial cable connected to back plane (A3-5 (black), A3-1 (white), A3-09 (red), A2-02 (yellow)).
8. Remove switch and light power cable by disconnecting black and yellow socket above "B" row.
9. Remove coaxial fastener screw from logic gate.
10. Remove display panel ground wire (green and black wire) from display panel lug.
11. Remove four perimeter screws attached to standoffs.
12. Remove card file assembly and set aside.
13. Remove all ribbon cables except J6 and J8.

NOTE: Ribbon cables are fastened by panduit which must be cut.

14. Remove both screws from standoffs on PWA stack rotary switch.
15. Remove both nuts from PWA stacked rotary switch bracket on display panel.
16. Lift lower roller assembly with card and slowly work loose from roller support.
17. Remove assembly and set aside.
18. Remove remaining ribbon cables.
19. Disconnect leads from the meter.
20. Turn panel over on standoffs.
21. Remove all push button caps.
22. Remove dress nuts from toggle switches.
23. Remove the allen screw that holds caps for rotary switches and delayed pot.
24. Place all switches except ROUTINE switch in uppermost position.
25. Place ROUTINE switch to RECAL position.
26. Remove locking retainers from rotary switches.
27. Press down on all switches and knobs simultaneously to push card evenly through display panel.
28. Remove panel.

CAUTION

Do not turn switch and light card upside down . . . switch stops will fall out.

29. Place retainer nuts back on all rotary switches to prevent stops from falling out of switches.
30. Switch and light card is now ready for repair or test.

6.2.6 Switch and Light PWA - Installation Procedure

Install the switch and light PWA by reversing the procedure of Paragraph 6.2.6.

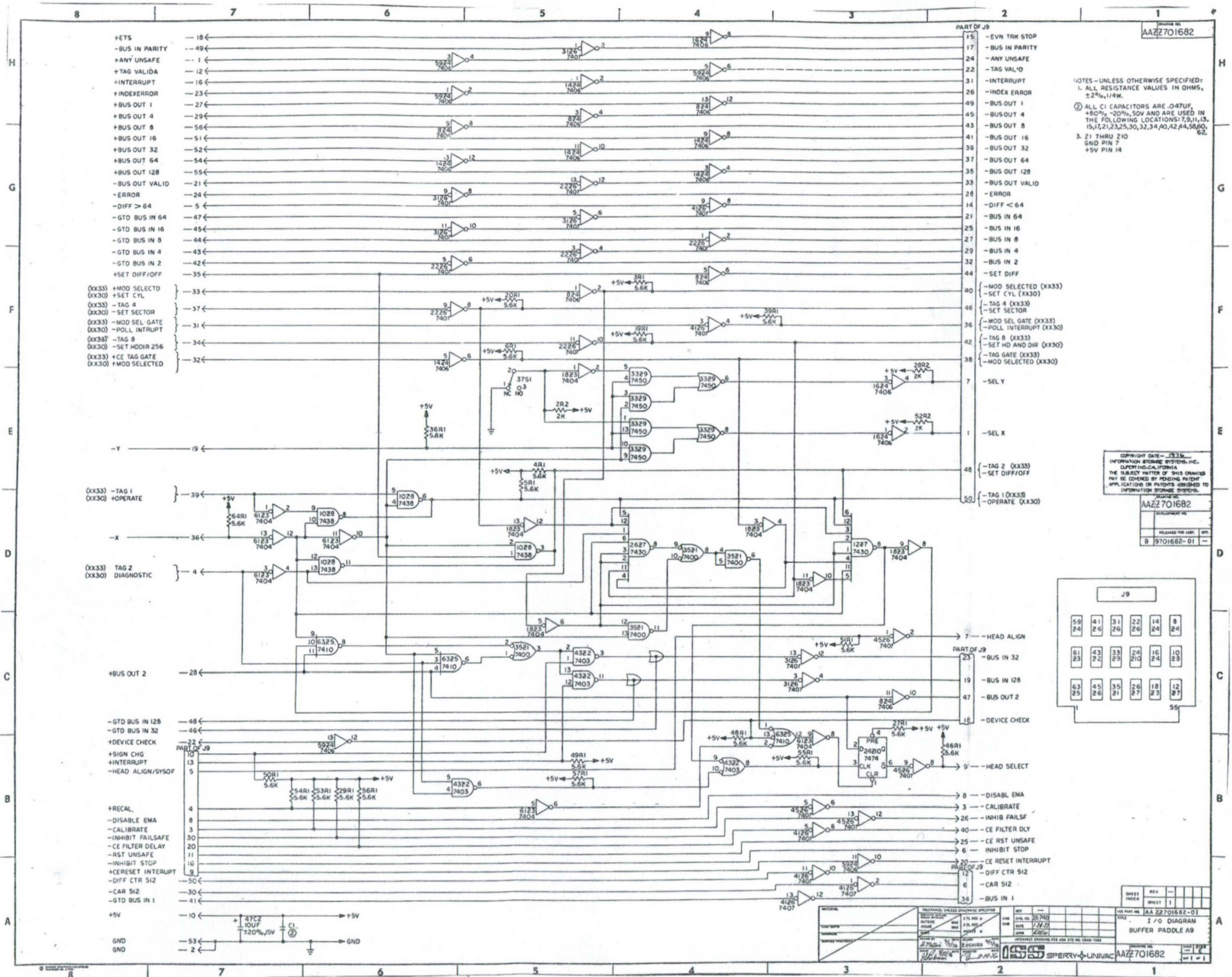
CHAPTER 7

LOGIC DIAGRAMS

7.1 INTRODUCTION

This chapter contains the logic diagrams and schematics for the DEDU PWAs as follows:

| DRAWING NO. | PWA |
|-------------|-------------------------|
| 07008846-3A | A1 Comparator |
| 09004249-4 | A2 TF Servo Clock |
| 09008844-2 | A3 TF Servo Amp |
| E9701680-01 | A9 Buffer Paddle |
| 09008843-1 | A10 Buffer Paddle |
| E9701690-01 | B01 Adder |
| 09008833-2 | B02 Harness Interface |
| 09008831-2 | C01 Receiver/Diagnostic |
| 09008834-2 | C02 Encoder/Driver |
| 09008814-2 | C03 Shift Register |
| 09008847-3 | Switch and Light Card |
| 09008848-3 | Stacked Rotary Switch |



NOTES - UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE VALUES IN OHMS, 2.5% TOL.
2. ALL C2 CAPACITORS ARE .01UF, 100V AND ARE USED IN THE FOLLOWING LOCATIONS: 7, 9, 10, 12, 17, 20, 22, 33, 43, 45, 50, 54, 64, 66, 74, 76, 84, 85, 90, 94.

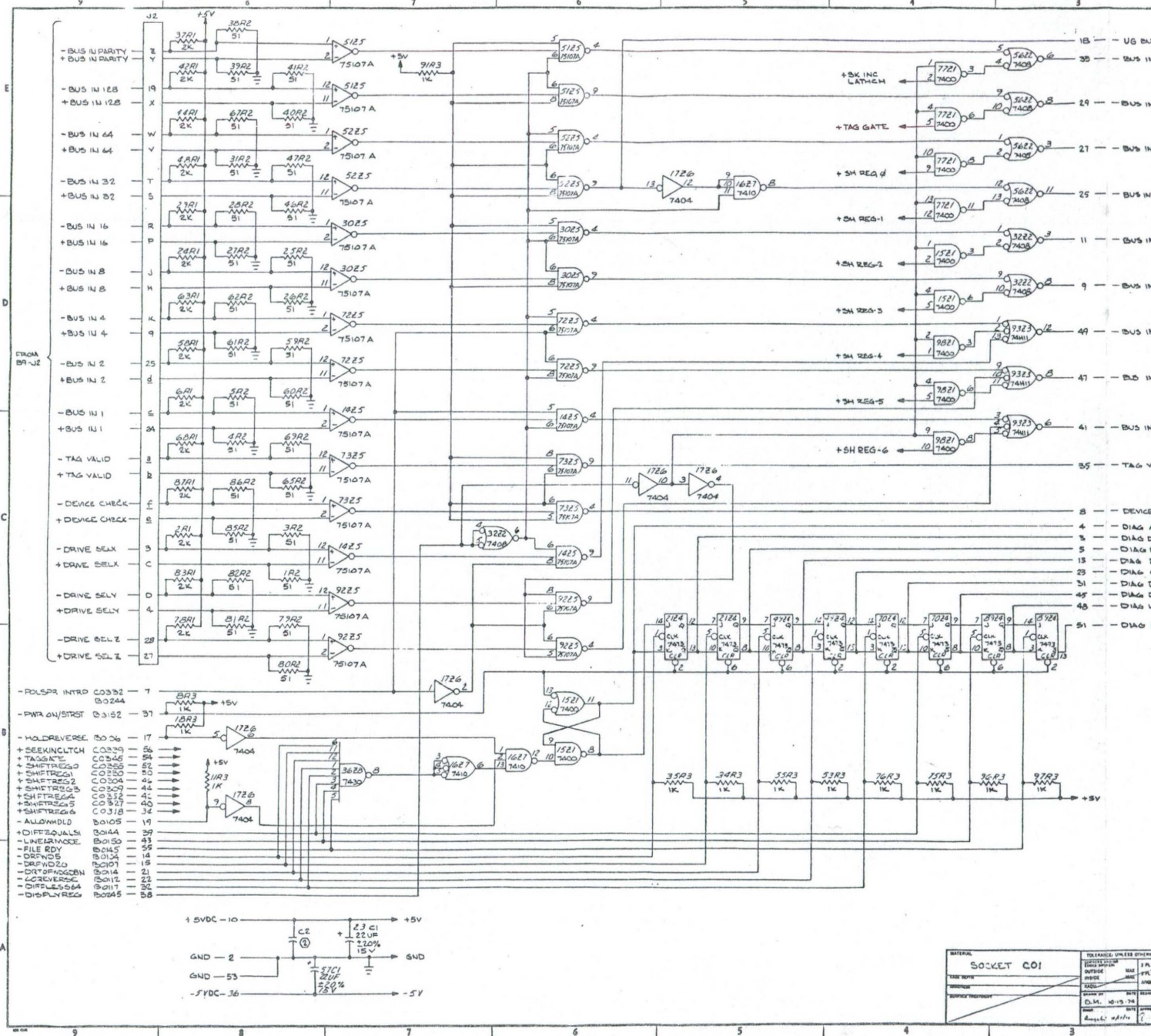
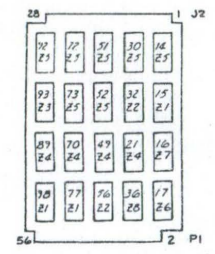
3. Z1, Z2, Z3, Z6, Z7, Z8
GND PIN 7
+5V PIN 14
Z4
GND PIN 11
+5V PIN 4
Z5
GND PIN 7
+5V PIN 13

- 8 - DEVICE CHECK COS40, B02E4
- 4 - DIAG ALL HDL B019
- 4 - DIAG DR FWD S B0141
- 5 - DIAG DR FWD E0 B036
- 15 - DIA GDRF2S B046
- 23 - DIAG GDRFV6 B038
- 31 - DIAG DFLO64 B0143
- 45 - DIAG DRF01 B0140
- 48 - DIAG LNW4DS B048
- 51 - DIAG FILE R0Y B0142

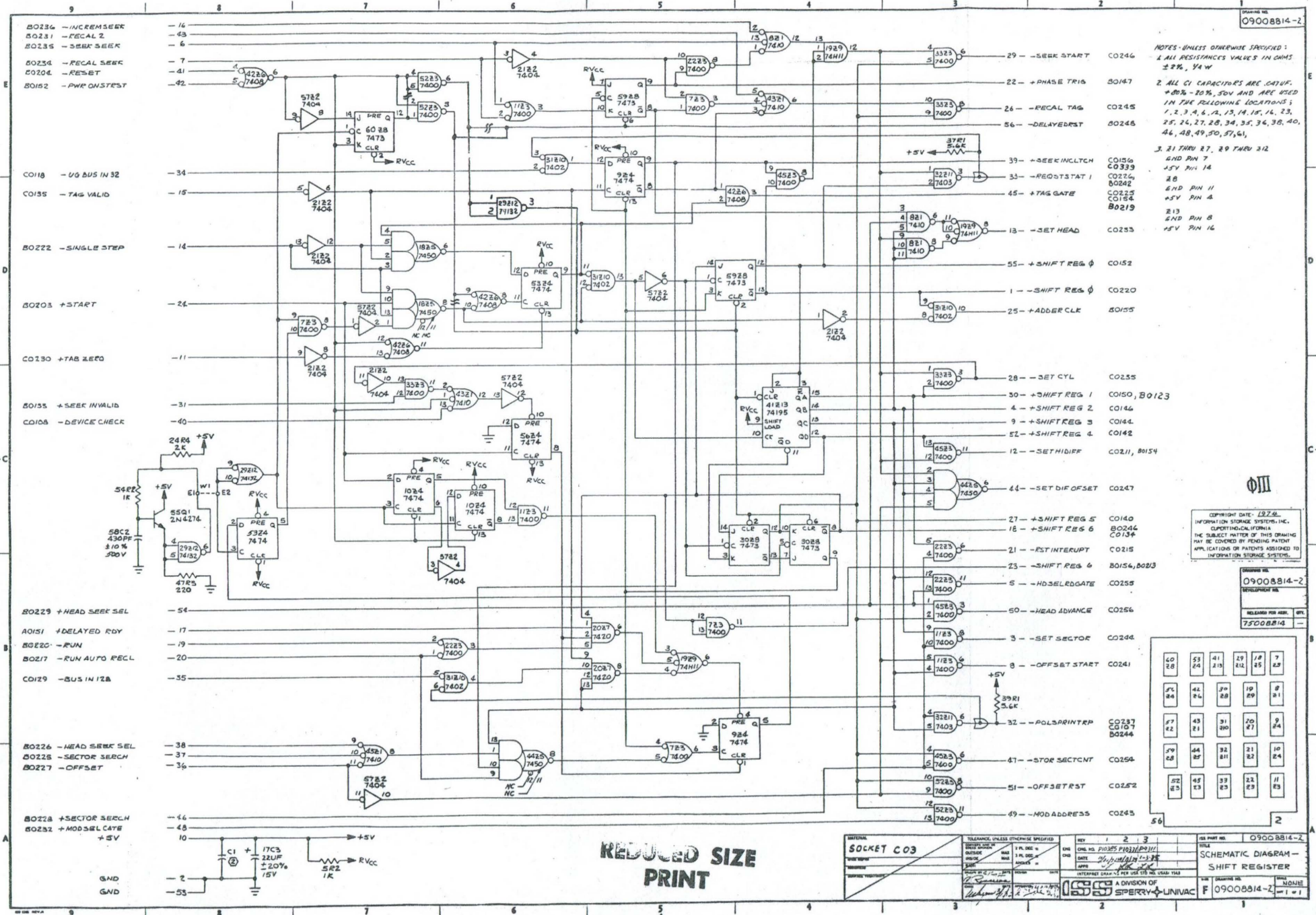
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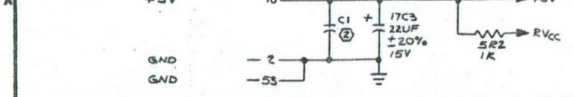


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NOTES UNLESS OTHERWISE SPECIFIED:
 1. ALL RESISTANCE VALUES IN OHMS
 2%, 5% W
 2. ALL CI CAPACITORS ARE CAPUF.
 +80% -20%, 50V AND ARE USED
 IN THE FOLLOWING LOCATIONS:
 1, 2, 3, 4, 6, 12, 13, 14, 15, 16, 23,
 25, 26, 27, 28, 34, 35, 36, 38, 40,
 46, 48, 49, 50, 57, 61,
 3, 21 THRU 27, 29 THRU 32
 END PIN 7
 CO156
 CO339
 JSY PIN 14
 CO226
 CO242
 END PIN 11
 CO225
 CO154
 BO219
 213
 END PIN 8
 JSY PIN 16

- BO236 - INCR SEEK
- BO231 - RECAL 2
- BO235 - SEBK SEEK
- BO234 - RECAL SEEK
- CO204 - RESET
- BO152 - PWR ONTEST
- CO118 - UG BUS IN 32
- CO155 - TAG VALID
- BO222 - SINGLE STEP
- BO203 +START
- CO130 +TAG ZERO
- BO155 +SEEK INVALID
- CO108 -DEVICE CHECK
- BO229 +HEAD SEBK SEL
- BO151 +DELAYED RBY
- BO220 -RUN
- BO217 -RUN AUTO RECL
- CO129 -BUS IN 12A
- BO224 -HEAD SEBK SEL
- BO225 -SECTOR SEBK
- BO227 -OFFSET
- BO228 +SECTOR SEBK
- BO252 +MODSEL CATE

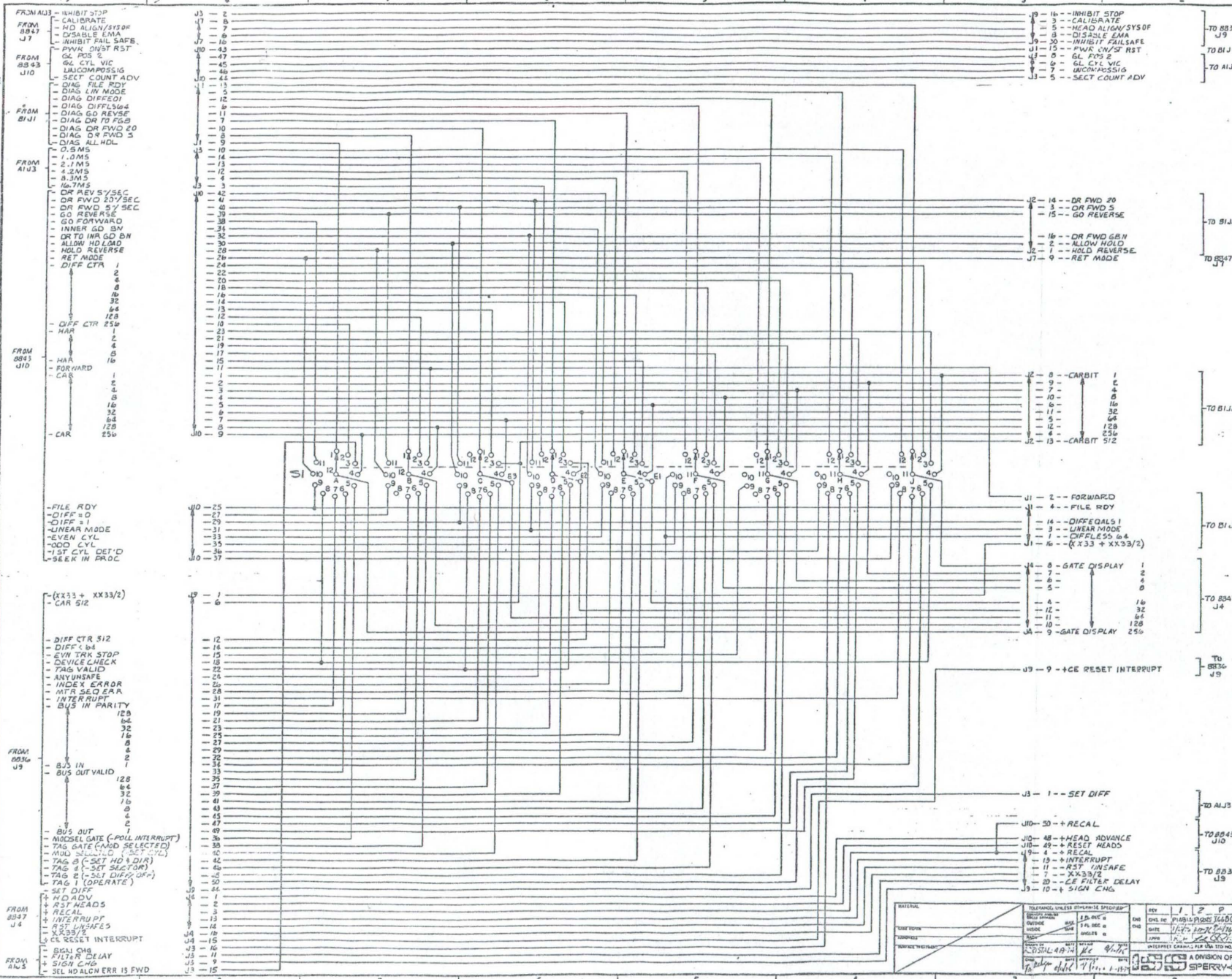


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| DATE | TIME | DATE | TIME | 50 | | | | 50 | 12/15/74 | KE | KE | 12/15/74 | KE | KE | 12/15/74 | KE | KE |
| DATE | TIME | DATE | TIME | 51 | | | | 51 | 12/15/74 | KE | KE | 12/15/74 | KE | KE | 12/15/74 | KE | KE |
| DATE | TIME | DATE | TIME | 52 | | | | 52 | 12/15/74 | KE | KE | 12/15/74 | KE | KE | 12/15/74 | KE | KE |
| DATE | TIME | DATE | TIME | 53 | | | | 53 | 12/15/74 | KE | KE | 12/15/74 | KE | KE | 12/15/74 | KE | KE |
| DATE | TIME | DATE | TIME | 54 | | | | 54 | 12/15/74 | KE | KE | 12/15/74 | KE | KE | 12/15/74 | KE | KE |
| DATE | TIME | DATE | TIME | 55 | | | | 55 | 12/15/74 | KE | KE | 12/15/74 | KE | KE | 12/15/74 | KE | KE |
| DATE | TIME | | | | | | | | | | | | | | | | |

CHAPTER 8

ILLUSTRATED PARTS BREAKDOWN

8.1 INTRODUCTION

This chapter contains lists of parts and accompanying illustrations, identifying and illustrating components, assemblies and detail parts of the Drive Exerciser Diagnostic Unit.

8.2 COLUMN EXPLANATION

8.2.1 "Fig. & Index" Column

This column shows the figure number of the unit breakdown and the index number which is cross referenced to a callout on the accompanying illustration.

- a. Index numbers are not assigned to assemblies where all details of the assembly have index numbers.
- b. Where two or more assemblies are combined in a single breakdown, the same or similar items with different part numbers or quantities have the same index number.
- c. All items having an index number are illustrated.

8.2.2 "Part Number" Column

This column lists the Information Storage Systems part number.

8.2.3 "Description" Column

This column lists the name of the part, followed by a description when required.

Assembly and part relationship are shown by indenture. Each separately illustrated assembly listing begins in indenture one.

Attaching parts follow and are in the same indenture as the items they attach. The letters "AP" in parenthesis follows the description of attaching parts.

| | |
|------------------------------|---|
| EXAMPLE: DUCT ASSY,BLOWER | 1 |
| SCREW,BIND.HD 8-32X.375 (AP) | 3 |
| .CLAMP,DUCT | 1 |

Gate designation and socket numbers for printed wiring assemblies (PWAs) are shown in parenthesis in the description.

EXAMPLE: PWA,SELECT (A19)

Electrical and electronic item descriptions have reference designations in parenthesis.

EXAMPLE: RESISTOR,10K 1/4W +2 PCT (R4)

8.2.4 "Qty Per Assy" Column

This column designates the quantity used at that particular application of the part. Where "REF" is shown, the quantity used is shown on the figure indicated in the "REF FIG." column. Where "AR" (as required) is shown, requirement is determined by user.

8.2.5 "Used On Code" Column

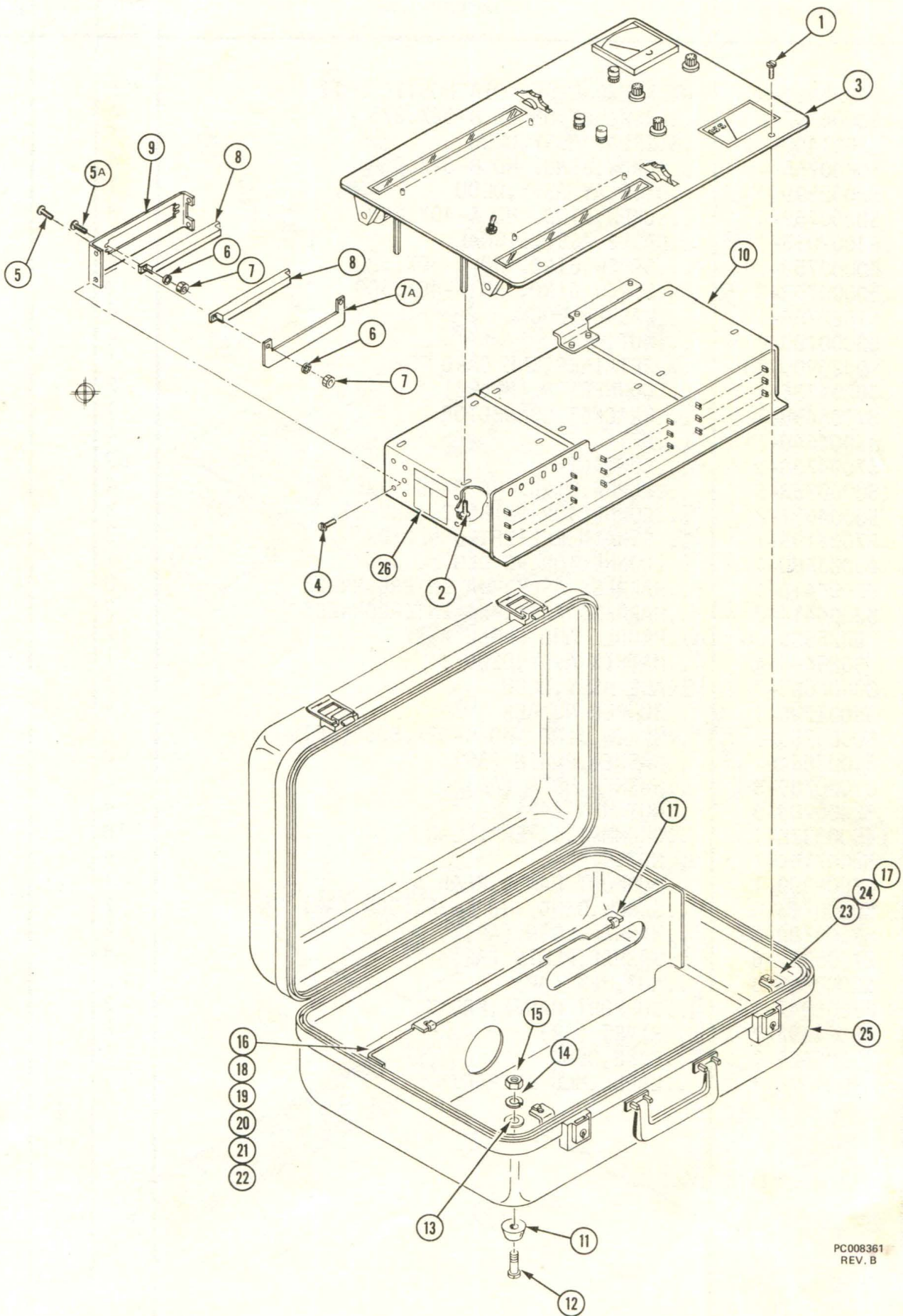
The explanations of codes used in this column are given at the end of each listing. Parts with no code in this column are used on all machines covered in this manual.

8.2.6 "Ref. Fig." Column

This column is used as a cross-reference between figures. A number in this column indicates the item is also shown on the figure referenced.

8.2.7 "NFR" Column

An "X" in this column indicates the part is Not Field Replaceable.

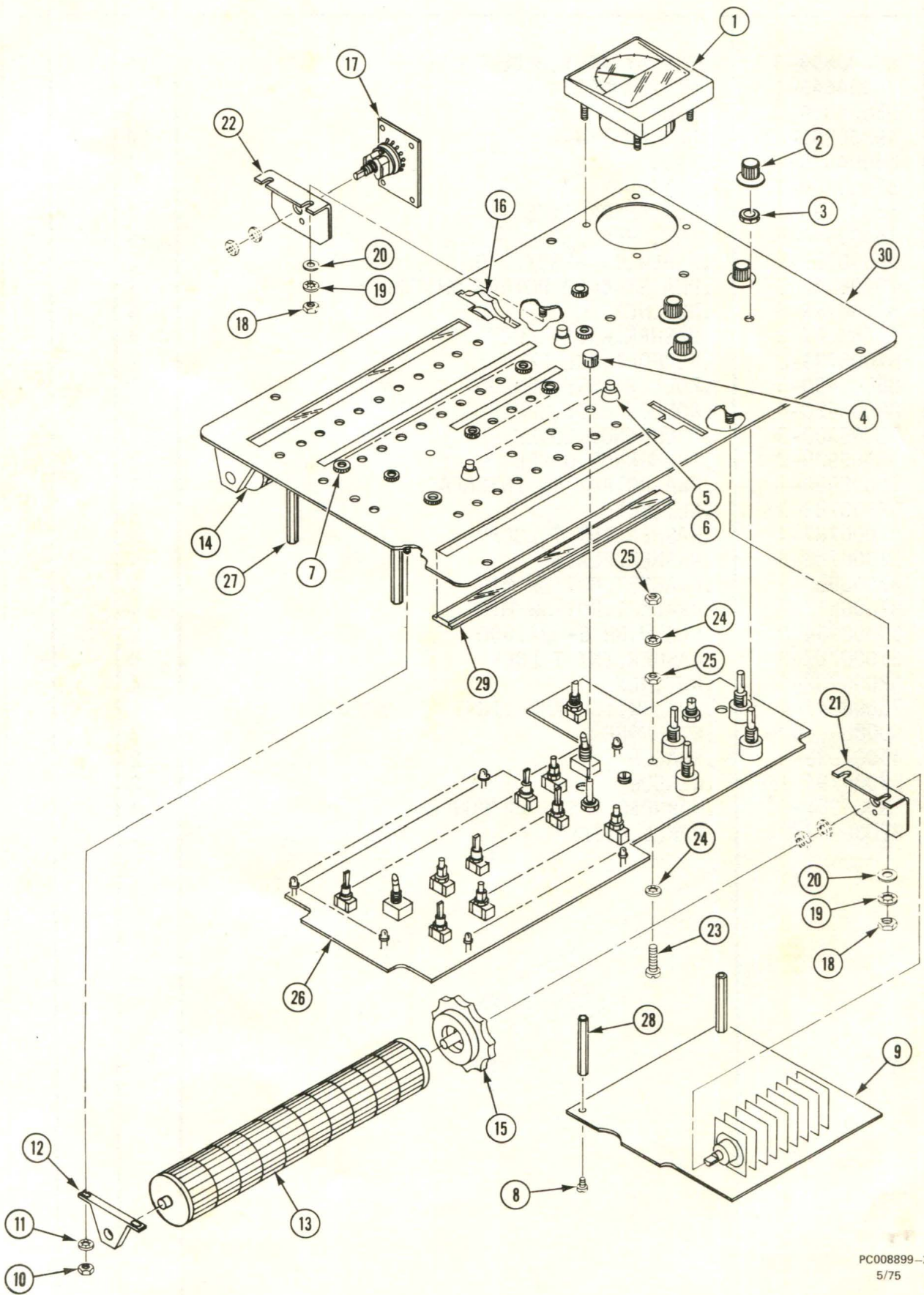


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Figure 8-1. Disk Exerciser Diagnostic Kit

| FIG & INDEX | PART NO. | DESCRIPTION | QTY PER ASSY | USED ON CODE | REF FIG | NFR |
|-------------|-------------|---------------------------------|--------------|--------------|---------|-----|
| 1- | 9025389-00 | DISK EXERCISER DIAGNOSTIC UNIT | REF | | | |
| -1 | 50004792-6 | .SCREW,BUTTON HD 8-32X.375 | 4 | | | |
| | 9021400-01 | .DISPLAY ASSY,DEDU | 1 | | | |
| -2 | 50000755-4 | ..SCREW,BIND. HD 8-32X.250 | 4 | | | |
| -3 | 88008899-3 | ..DISPLAY ASSY,DEDU | 1 | | 2 | |
| -4 | 50000753-4 | ..SCREW,BIND. HD 4-40X.250 | 3 | | | |
| | 84007815-1 | ..CABLE ASSY,SIGNAL | 1 | | | |
| -5 | 50000753-10 | ...SCREW,BIND. HD 4-40X.620 | 2 | | | |
| -5A | 50000753-8 | ...SCREW,BIND. HD 4-40X.500 | 2 | | | |
| -6 | 51000788-1 | ...WASHER,LOCK | 4 | | | |
| -7 | 52000783-4 | ...NUT,HEX | 4 | | | |
| -7A | 9020909-00 | ...RETAINER,ONE CARD | 1 | | | |
| -8 | 58004736-1 | ...CONNECTOR (P1,P2) | 2 | | | |
| -9 | 87008498-1 | ...BRACKET,CONNECTOR | 1 | | | |
| | 45004640-1 | ...KEY | 4 | | | |
| | 57004738-3 | ...CONTACT | 69 | | | |
| | 50000753-6 | ...SCREW,BIND. HD 4-40X.375 | 4 | | | |
| | 58004637-2 | ...CONNECTOR (A1B5P2,A1B9P2) | 2 | | | |
| | 87007195-1 | ...STRAIN RELIEF,CONNECTOR | 2 | | | |
| | 45003580-1 | ...CONNECTOR,90 DEG | 1 | | | |
| | 83006418-1 | ..HARNESS ASSY,PWA INTERCONNECT | 8 | | | |
| | 83006418-2 | ..HARNESS ASSY,PWA INTERCONNECT | 3 | | | |
| | 9025536-00 | ..PADDLE AND CABLE ASSY | 1 | | | |
| -10 | 9025485-4 | ..MATRIX ASSY,DEDU | 1 | | 3 | |
| | 88006653-7 | .CASE ASSY,DEDU | 1 | | | |
| -11 | 45001790-1 | ..BUMPER,RUBBER | 4 | | | |
| -12 | 50000755-8 | ..SCREW,BIND. HD 8-32X.500 (AP) | 4 | | | |
| -13 | 5100786-6 | ..WASHER,PLAIN (AP) | 4 | | | |
| -14 | 51000789-8 | ..WASHER,LOCK (AP) | 4 | | | |
| -15 | 52000783-8 | ..NUT,HEX (AP) | 4 | | | |
| -16 | 45003378-1 | ..GROMMET,CATERPILLAR | 18 | | | |
| -17 | 52007169-1 | ..NUT,U | 4 | | | |
| -18 | 87008399-1 | ..SUPPORT PANEL,REAR | 1 | | | |
| -19 | 50000755-8 | ..SCREW,BIND. HD 8-32X.500 (AP) | 2 | | | |
| -20 | 51000789-8 | ..WASHER,LOCK (AP) | 2 | | | |
| -21 | 51000786-6 | ..WASHER,PLAIN (AP) | 4 | | | |
| -22 | 52000783-8 | ..NUT,HEX (AP) | 2 | | | |
| -23 | 87006947-1 | ..SUPPORT PANEL,FRONT | 2 | | | |
| -24 | 48004692-7 | ..RIVET (AP) | 8 | | | |
| -25 | 45006801-1 | ..CASE,DEDU | 1 | | | |
| | 9021370-1 | ..LABLE,MCC EXTRACT | 1 | | | |

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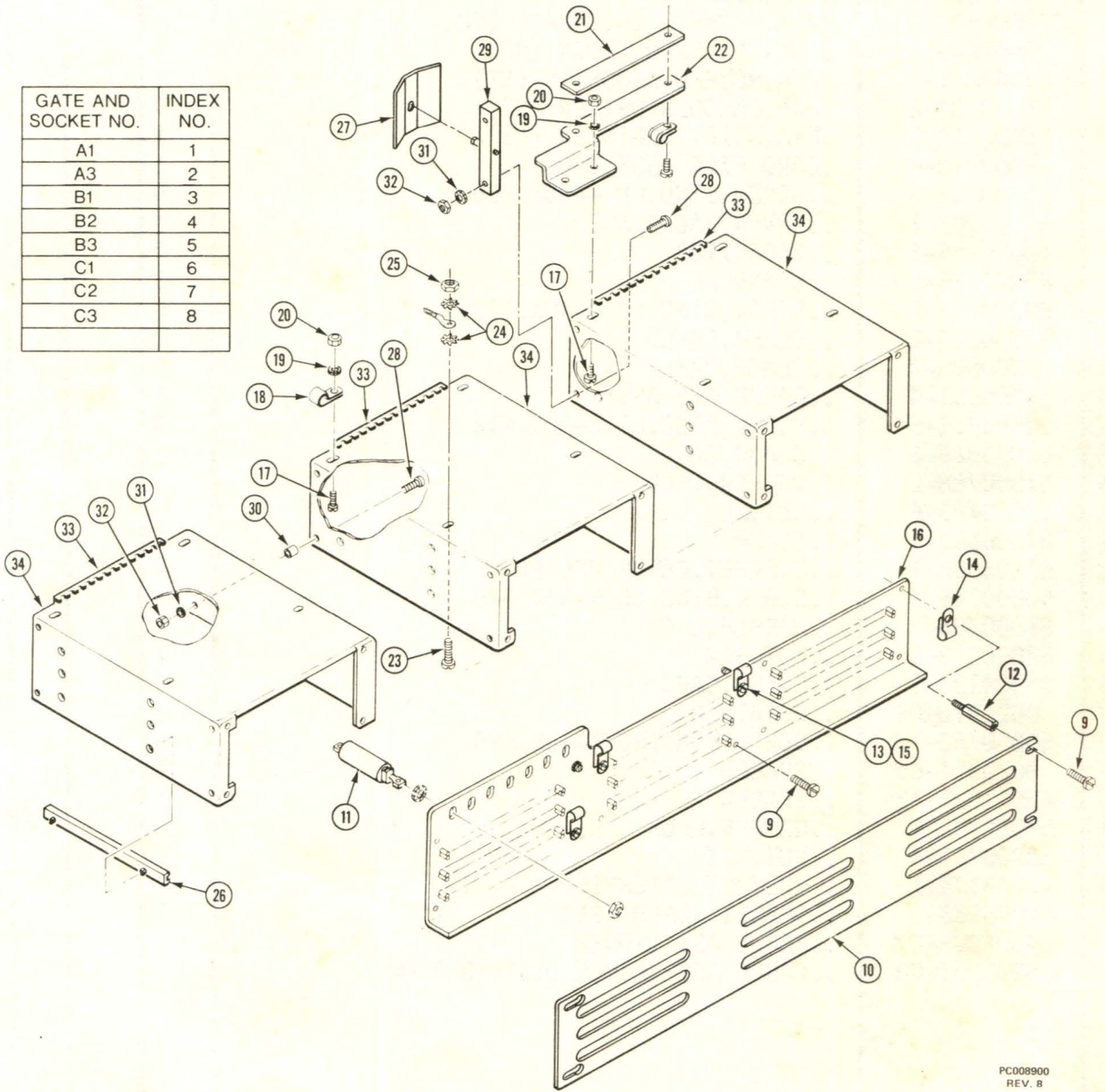
PC008899-2
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Figure 8-2. DEDU Display Panel Assembly

| FIG & INDEX | PART NO. | DESCRIPTION | QTY PER ASSY | USED ON CODE | REF FIG | NFR |
|-------------|-------------|----------------------------|--------------|--------------|---------|-----|
| 2- | 88008899-3 | DISPLAY ASSY,DEDU PANEL | REF | | 1 | |
| -1 | 76004643-1 | .MICROAMMETER ASSY | 1 | | | |
| -2 | 55004869-2 | .KNOB | 4 | | | |
| -3 | 49800265-01 | .NUT,SW 1/4-28 | 4 | | | |
| -4 | 55004870-1 | .KNOB | 1 | | | |
| -5 | 56800189-1 | .BUTTON | 7 | | | |
| -6 | 52800190-1 | .NUT,DECORATIVE | 7 | | | |
| -7 | 45003848-5 | .NUT,DRESS | 19 | | | |
| -8 | 50000755-4 | .SCREW,BH 8-32X.250 | 2 | | | |
| -9 | 75008848-3 | .PWA,STACKED ROTARY SWITCH | 1 | | | |
| -10 | 52000783-6 | .NUT,HEX | 4 | | | |
| -11 | 51000787-3 | .WASHER,EXT T LOCK | 4 | | | |
| -12 | 87006793-2 | .SUPPORT,ROLLER | 2 | | | |
| -13 | 88006420-5 | .ROLLER ASSY,LOWER | 1 | | | |
| -14 | 88006420-4 | .ROLLER ASSY,UPPER | 1 | | | |
| -15 | 88006909-3 | .THUMBKNOB,LOWER | 1 | | | |
| -16 | 88006909-2 | .THUMBKNOB,UPPER | 1 | | | |
| -17 | 75008990-1 | .PWA,ROTARY SW INTERFACE | 1 | | | |
| -18 | 52000783-8 | .NUT,HEX | 4 | | | |
| -19 | 51000787-4 | .WASHER,INT T LOCK | 4 | | | |
| -20 | 51000786-6 | .WASHER,PLAIN | 4 | | | |
| -21 | 87008902-1 | .BRACKET,ROT SW MTG | 1 | | | |
| -22 | 87006517-2 | .BRACKET,ROT SW MTG | 1 | | | |
| -23 | 50000754-8 | .SCREW,BH 6-32X.500 | 2 | | | |
| -24 | 51000787-3 | .WASHER,INT T LOCK | 4 | | | |
| -25 | 52000783-6 | .NUT,HEX | 4 | | | |
| -26 | 75008847-4 | .PWA,SWITCH AND LIGHT | 1 | | | |
| -27 | 9008855-00 | .STANDOFF | 4 | | | |
| -28 | 45007333-25 | .SPACER | 2 | | | |
| -29 | 87006794-1 | .WINDOW | 2 | | | |
| | 9008851-00 | .HARNES ASSY,PWA POWER | 1 | | | |
| -30 | 87008907-2 | .PANEL,DISPLAY | 1 | | | |

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| GATE AND SOCKET NO. | INDEX NO. |
|---------------------|-----------|
| A1 | 1 |
| A3 | 2 |
| B1 | 3 |
| B2 | 4 |
| B3 | 5 |
| C1 | 6 |
| C2 | 7 |
| C3 | 8 |



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Figure 8-3. DEDU Matrix Assembly

| FIG & INDEX | PART NO. | DESCRIPTION | QTY PER ASSY | USED ON CODE | REF FIG | NFR |
|-------------|-------------|----------------------------------|--------------|--------------|---------|-----|
| 3- | 9025485-4 | MATRIX ASSY, DEDU | REF | | 2 | |
| -1 | 75008846-6 | .PWA, COMPARATOR (A1) | 1 | | | |
| -2 | 75008844-4 | .PWA, TF SERVO AMP (A3) | 1 | | | |
| -3 | 9701692-01 | .PWA, ADDER (B1) | 1 | | | |
| -4 | 75008833-2 | .PWA, HARNESS INTERFACE (B2) | 1 | | | |
| -5 | 75004249-5 | .PWA, TF SERVO CLOCK (B3) | 1 | | | |
| -6 | 75008831-2 | .PWA, RCVR/DIAGNOSTIC (C1) | 1 | | | |
| -7 | 75008834-2 | .PWA, ENCODER/DRIVER (C2) | 1 | | | |
| -8 | 75008814-2 | .PWA, SHIFT REGISTER (C3) | 1 | | | |
| | 76008896-4 | .CARD FILE ASSY, DEDU | 1 | | | |
| -9 | 50000753-4 | ..SCREW, BIND. HD 4-40X.250 | 9 | | | |
| -10 | 87008897-1 | ..COVER, BACKPLANE | 1 | | | |
| -11 | 40010245-5 | ..CAPACITOR | 7 | | | |
| -12 | 87001026-50 | ..STANDOFF | 4 | | | |
| -13 | 50000753-5 | ..SCREW, BIND. HD 4-40X.312 | 5 | | | |
| -14 | 57000825-2 | ..CLAMP, CABLE | 2 | | | |
| -15 | 57000825-3 | ..CLAMP, CABLE | 3 | | | |
| -16 | 76008901-4 | ..BACKPLANE ASSY | 1 | | | |
| -17 | 50000754-5 | ..SCREW, BIND. HD 6-32X.312 | 3 | | | |
| -18 | 57000825-6 | ..CLAMP, CABLE | 1 | | | |
| -19 | 51000788-2 | ..WASHER, LOCK | 3 | | | |
| -20 | 52000783-6 | ..NUT, HEX | 3 | | | |
| -21 | 87006953-1 | ..CLAMP | 1 | | | |
| -22 | 87006952-1 | ..BRACKET, CABLE RELIEF | 1 | | | |
| -23 | 50000755-6 | ..SCREW, BIND. HD 8-32X.375 | 1 | | | |
| -24 | 51000788-3 | ..WASHER, LOCK | 2 | | | |
| -25 | 52000783-8 | ..NUT, HEX | 1 | | | |
| -26 | 45004132-1 | ..GUIDE, CARD | 18 | | | |
| -27 | 9020910-01 | ..RETAINER | 1 | | | |
| -28 | 50000753-10 | ..SCREW, BIND. HD 4-40X.625 | 3 | | | |
| -29 | 9020911-00 | ..SPACER | 1 | | | |
| -30 | 45001037-12 | ..SPACER | 1 | | | |
| -31 | 51000788-1 | ..WASHER, LOCK | 3 | | | |
| -32 | 52000783-4 | ..NUT, HEX | 3 | | | |
| -33 | 45003378-1 | ..GROMMET, CATERPILLAR (5 IN) | 3 | | | |
| -34 | 87006523-3 | ..CHASSIS, CARD FILE | 3 | | | |
| | 84008903-2 | ..CABLE ASSY, POWER | 1 | | | |
| | 9008852-00 | ..CABLE ASSY, POWER DISTRIBUTION | 1 | | | |

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{ BACK COVER }