TO: Northeast Area ATS's & DTS's
FROM: Bill Dini
DATE: April 24, 1981
SUBJECT: Series 24 TB216A FTU

Attached is the procedure of the series 24 FTU. There are presently 3 models of the TB216A used in the field today. The series number of the FTU is located on the inside top left corner of the display panel. This is an extra which is done after the 5754 code is entered and allows writing on all cylinders except 256. This procedure applies only to the series 24 and is not needed on the 19 and 23 series.

If you have any questions, please call Bill Dini at 1-800-225-3304.

Regards,

Bill Dini
Area Technical Specialist

Attach.

BD: LCM: 0756A
NOTE

Perform step 16 to write on C.E. (innermost, highest number) cylinder only. Perform steps 16 and 17 to write all tracks except 256, (track 256 is locked out when drive is controlled by FTU).

16. Allow writing only on CE (innermost highest number) cylinder by proceeding as follows:
   a. Rotate DATA ENTRY switch to position B.
   b. Enter 5754 via keyboard.
   c. Press LOAD key.

17. Allow writing on all cylinders (except 256) by proceeding as follows:
   a. Rotate DATA ENTRY switch to position E.
   b. Press DISP key.
   c. Press BIT key.
   d. Press 1 key.
   e. Press LOAD key.

18. Press GO key. FTU is now commanding drive to perform desired write operation.

Write/Read or Write/Read Format Operation

The following procedure describes how to prepare the FTU to command the drive to first write information and then to read the same information back. During a write/read format operation, the FTU writes then reads the entire record including the address field (see figure 2-7). During a write/read, the entire record is read but only the data field portion of a record is written. In both cases, the operator can control only what is written in the data field portion of the record, the address field is automatically calculated and supplied by the FTU.

1. Perform Power Up Initialization procedure.

2. Perform Drive Selection procedure.
III.A.7

PERIPHERALS-DISK DRIVES-CDC PHOENIX 9448 CMD.

TOPIC: TB216 CDC DISK TESTERS

With new TB216 CDC Series Code 23_and_above there is a new set up that has to be done to be able to write and read on all tracks.

The FTU with the old set up will only allow you to write and read on the "CE Cylinder", number 822.

To know if you have a new tester, after you select the drive, rotate the "Data Entry" switch to "F", if it displays a Hex code 336 you have a new tester. No code is an old tester.

If you do have a new tester you will now have to set up in the following way:

1. Turn "Data Entry" switch to "Device Type" and enter the drive code. Then depress "Load".

2. Turn "Data Entry" switch to "B" and enter 5754 then depress "Load".

3. With "Write Protect" switch up depress "SEL DRV". Then switch "Write Protect" down.

4. Turn "Data Entry" Switch to "E" then depress the following buttons in the following order:
   a. DISP
   b. BIT
   c. 1
   d. LOAD

The above steps will allow you to write and read on all cylinders except 256. The FTU will prevent the use of cylinder 256.

We will be updating all TB216's shortly and this procedure will be followed on all testers.
PHOENIX ALIGNMENT

1. PURGE UNIT and ALIGNMENT PACK (up to speed, servo disconnected)

2. CABLING (Disk and FTU off)
   A. Install alignment extender brd in drive, slot 4, and alignment board into extender
   B. Install 2 wire cable from Servo Fine (white to front) to R/W Preampl (white on top)
   C. Install 8 wire cable from Servo Fine (Arrow points up and towards wire) to Alignment Extender Brd (Arrow points to rear of drive away from wire)
   D. Install 3 ribbon cables between FTU and Drive.
      Small cable from J1 of Brd 2 in FTU (red wire to right) to I/O Brd (red wire on top) bottom of A connector via adapter cable.
      Medium cable from J3 of Brd 2 in FTU (red wire to right) to CONTROL/MUX Brd, B connector (red wire on top)
      Large cable from J2 of Brd 2 in FTU (red wire to right) to I/O Brd (red wire on top) top of A connector via adapter cable.

3. SWITCH SETTINGS (Setting up for removable servo alignment)
   A. Alignment extender board: S1 to FXD (Load off fixed servo)
   B. Alignment Board: S1 to N (negative polarity of alignment voltage)
      S2 to RW (always RW with Phoenix)
      S3 to X1 (Attenuation factor of alignment voltage)
   C. Servo Fine: S1 to S (looking at servo head)
   D. FTU: Data Entry to Device Type; R/W Select to Alignment; Access Select To Direct Seek

HEAD and RECORD to manual, START and RUN off
STEP-down; SINGLE/CONT.-cont;-- to center; LATE/EARLY-center
WRITE FLAG-off; WRITE PROTECT-on; AM/SECTOR-sector; EOT STOP-off
ERROR OVERRIDES-off; SHIFT PATT/DATA PATT-data pat; SEQ PWR-off
4. INITIAL POWER ON

A. Power on FTU

B. Pull out card cage, loosen removable heads to 4 lb/(if fixed servo has been loosened, it should be centered and tightened to 12 lb/)

C. Power on drive to LOAD (Alignment pack previously installed and purged)

D. FTU-START and RUN switches to ON(3rd row down, 7 right most lites come on)

E. FTU-key in 8905 (90 Meg), 8903 (60 Meg), 8901 (30 Meg)
   Key LOAD then SEL DRIVE (Busy light will flash till drive ready) set DATA Entry switch to destination

F. Bring Drive to READY (Busy light stops blinking on FTU)

5. SCOPE and METER SET UP

A. Scope: Ch 1- 50 mV/div to READ SIGNAL on Alignment Board
   Ground to chassis
   Sync on Ch 1,1 microsec/div

B. Volt Meter: 500 milV scale
   Positive lead to + TP. of Align Brd., Neg lead to - TP of Align Brd.
"CAUTION: WHEN TIGHTENING OR LOOSENING HEADS IT'S A GOOD IDEA TO HAVE HEADS UNLOADED"

6. ALIGNMENT of REMOVABLE SERVO to FIXED SERVO

A. Key RTZ on FTU (heads should move slightly)

B. Move R Servo Head to the outer guard band and back to track 0 using scope (first balanced dibit pattern) heads previously loosened to 4 lb/ (See diagram on next page)

C. Key in CLR, 0404, LOAD, GO

D. Rough Adj—Adjust head till dibit pattern on scope is balanced.

E. Fine Adj—fine adjust head for meter reading as close to 0 Mil V as possible.

F. Calculate offset—record meter reading, switch Sl of Align Brd. to P. Record reading, subtract readings, should be less than 50 Mil V (if off, loosen, Fine Adj again)

EXAMPLE:
P reading (+25 milV)—N reading (+5 milV)=20 milV offset
P reading (+25 milV)—N reading (-10 milV)=35 milV offset
P reading (-5 milV)—N reading (-10 mil V)= 5 milV offset

G. Tighten down head to 12 lb/ making sure meter reading is less than +/- 50 milV while guiding carriage with other hand and then recheck offset.

H. Seek track 0 (key CLR, RTZ) and check for dibit pattern (not in outer guard band)

I. Seek track 822 (key 0822, LOAD,GO) and check for bal. dibit pattern (if either step H. or I does not show bal. dibit pattern you are off a track, restart at A)

J. Recheck track 404 (key RTZ, CLR, 0404, LOAD,GO, CALCULATE OFFSET, LESS THAN 50 MILV, if not loosen head, fine adj. again)

K. Check offset at track 8 for less than 350 milV (key CLR,008, LOAD,GO)

L. Check offset at track 800 for less than 350 milV (key CLR,0800, LOAD, GO)(if step L or M off, fine adj.)
7. ALIGNMENT of REMOVABLE DATA to REMOVABLE SERVO

A. Sl of servo fine to D (looking at data head), Sl of align ext brd to normal (seeking off removable servo), seek track 0 (key RTZ) (data head previously loosened to 4 lb/)

B. Seek track 404 (key CLR,0404,LOAD,GO)

C. Rough adjust-adjust head till dabit pattern on scope is balanced

D. Fine adjust-adjust head for meter reading as close to 0milV as possible

E. Calculate offset-(as in step 6.f.) should be less than 50 milV

F. Tighten down head to 12 lb/ guiding carriage making sure meter reading is less than +/- 50 milV and recheck offset (if off redo fine adjust)

G. Key RTZ then recheck offset at 404 (key CLR,0404,LOAD,GO)

H. Check offset at track 8 for less than 350 milV (key CLR,0008,LOAD,GO)

I. Check offset at track 800 for less than 350 milV(key CLR,0800,LOAD,GO)(if step H or I is off, fine adjust again.)

OUTER GUARD BAND

OSCILLOSCOPE SETTINGS
LOGIC GROUND TO SCOPE GROUND
VOLTS/DIV
CH 1 - 0.5 V
CH 2 - NOT USED
TIME/DIV
A - 0.5 μs
B - NOT USED
TRIGGERING
A - INTERNAL POSITIVE
B - NOT USED
PROBE CONNECTIONS (USE X10 PROBE)
CH 1 TO FTU DIBITS JACK
CH 2 NOT USED

BALANCED DIBIT PATTERN (ON TRACK)
EM1 I/O Bd.

1. Main interface between drive and controller.

2. Performs the following functions:
   a. Receipt and ttl conversion of signal from controller.
   b. Decoding of tag lines and bus bits.
   c. Driving of signals to controller.

3. Contains
   a. Local/remote switch: for selection of power sequence (local).
   b. Norm/Disable switch: inhibits I/O to the drive (norm).
   c. Connectors for "A" cable and terminator.

EM2 Control/Mux Bd.

1. Works closely with the I/O bd. in managing controller drive interface signals.

2. Performs the following functions:
   a. Fault detection/reset
   b. Unit selection.
   c. Head selection.
   d. Reception, shaping and transmission of servo and data signals to/from controller.

3. Contains
   a. Connection for "B" cable.
   b. Fault lights CR1 through CR7.
   c. Fault readout toggle switch.
EM3 Servo Course Bd.

1. General control over drive functions

2. Performs following functions:
   a. System drive status monitoring.
   b. Cylinder addressing.
   c. Servo positioning velocity/control.
   d. Spindle speed monitoring.
   e. EOT detection circuitry.
   f. Interrupt processing.
   g. Sector detection and pulse generation.
   h. Track center detection.

3. Contains:
   a. 8080 microprocessor.
   b. Velocity gain adjustment pot.

EM6 Servo Fine Bd.

1. Basiclly interrupts servo platter surface.

2. Responsible for:
   a. Servo positioning error signals (AGC, PLO)
   b. Volume switching.
   c. Generates various clocks (403kHz, 806kHz, 9.6mhz, 19.34mhz)
   d. Index detection and sector sync.

3. Contains servo/data switch used during alignment.
EM7 R/W Bd.

1. Handles the timing and processing of read data and write data signals.
2. NRZ-MFM (write) encoding.
3. MFM-NRZ (read) encoding.
4. Compensates the MFM data by peak shifting the data depending on the frequency of the flux reversals.

Relay Control Circuit Bd.

1. Contains:
   a. K1 (spindle motor relay)
   b. K2 (voice coil relay)

note. Solid state relay SSR1 energizes first then K1 SSR1 not on relay board.
R/W Preamplifier

1. Link between R/W heads and electronics module.
2. Amplifies read signals.
3. Develops write current for the selected head.
   a. 7 different magnitudes (zones) of write current depending
      on the cylinder address.

Servo Preamplifier

1. Link between the servo heads and the electronics module.
2. Amplifies dlb signals from the servo platter surface.

Power Amp Bd.

1. Drives the voice coil/head assy. and controls emergency retract
   a. Velocity command signal (P com).
   b. Retract signal (P retract).

Operator Control Bd.

1. Supports start/stop switch, fault reset and indicator, and protect switches
   a) address plug (0 for VS and WP, 1 for 2200 first drive)

Power Supply

1. +5 volts (digital logic - TTL)
2. -5 volts (digital logic - TTL)
3. +20 volts (used to develop +12, +15, +6)
4. +32 volts (voice coil/positioner, +32 for pack unlock sol.)
5. 35 volts AC (for drive motor braking)
FAULT DIAGNOSIS

DISPLAY MODE 1 - Non-Microprocessor Detected Faults

Display mode 1 faults are displayed immediately when faults are detected. Faults can be cleared by front panel if fault conditions are gone.

CR1 (NH) - NO HEAD SELECT FLT. Indicates that the I/O selected an existing head address.

CR2 (MP) - Lights only when M.P. is active. (Display modes 2 through 5)

CR3 (WF) - WRITE FAULT. Indicates that a loss of AC or DC write current has occurred.

CR4 (W-R) - WRITE OR READ OFF CYLINDER. Indicates that an attempt was made to write or read during a seek, RTZ, or volume change.

CR5 (W-R) - WRITE AND READ FAULT. Indicates an attempt to write and read simultaneously.

CR6 (VF) - VOLTAGE FAULT. Indicates a below normal voltage.

CR7 (HS) - HEAD SELECT FAULT. Indicates a multiple head select (2 or more heads) selected.

***** NOTE *****

Display mode 4 may follow display mode 1 if no cylinder address stored. A cylinder address is stored only after a seek command has been completed.

***************
DISPLAY MODE 2 - Present Cylinder Address

Displays present cylinder address. Resets display mode 1

(S1)*

1 (CR6-CR7) Highest order bits of cylinder address...CR3 only if zero.
2 (CR4-CR7) Next highest order bits of address.......CR3 only if zero.
3 (CR4-CR7) Lowest order bits of cylinder address....CR3 only if zero.

DISPLAY MODE 3 - Separator

(S1)*

4 (CR2 only) Display Mode 3 is a separator between Mode 2 and Mode 4
If display Mode 3 does not occur it should be recognized
that the first three actuations of S1 displayed M P faults.

DISPLAY MODE 4 - Microprocessor faults

(S1)*

5 or 1 (CR3-CR7) Display mode 4 displays faults detected by the M.P.
6 or 2 The phases in which the errors occurred are displayed
7 or 3 first, then the type of fault is displayed.
etc These faults can be decoded by the use of the table
found on the next page.
(CR3-CR7) all on indicate Fault registers are clear.

* (S1) indicates actuations of S1 on the Control/Mux PWA.
**Microprocessor Fault Codes and Meanings**

Codes 01 through 0C represent the 12 phases of operation that are checked by the microprocessor. Codes 0F through 1E represent the fault types that could have occurred in one of the phases. In display mode 4 the phase codes are read out in order first and then the fault codes in order. Code hex 1F is read after the last fault code is read out.

<table>
<thead>
<tr>
<th>HEX CODE</th>
<th>BINARY CODE</th>
<th>PHASE OF OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>00001</td>
<td>RETURN TO TRACK CENTER</td>
</tr>
<tr>
<td>02</td>
<td>00010</td>
<td>WAIT FOR COARSE SEEK COMPLETION</td>
</tr>
<tr>
<td>03</td>
<td>00011</td>
<td>AFTER SEEK SETTLING</td>
</tr>
<tr>
<td>04</td>
<td>00100</td>
<td>IDLE LOOP</td>
</tr>
<tr>
<td>05</td>
<td>00101</td>
<td>RETURN TO ZERO MOTION</td>
</tr>
<tr>
<td>06</td>
<td>00110</td>
<td>END OF VELOCITY TABLE</td>
</tr>
<tr>
<td>07</td>
<td>00111</td>
<td>HEAD LOAD</td>
</tr>
<tr>
<td>08</td>
<td>01000</td>
<td>AWAIT AGC DURING HEAD LOAD</td>
</tr>
<tr>
<td>09</td>
<td>01001</td>
<td>AWAIT TRACK CENTER-LOAD OR RTZ</td>
</tr>
<tr>
<td>0A</td>
<td>01010</td>
<td>SETTLING-LOAD OR RTZ</td>
</tr>
<tr>
<td>0B</td>
<td>01011</td>
<td>OFFSET ACTIVE</td>
</tr>
<tr>
<td>0C</td>
<td>01100</td>
<td>CLEAR OFFSET SETTLING</td>
</tr>
</tbody>
</table>

**FAULT TYPE**

<table>
<thead>
<tr>
<th>HEX CODE</th>
<th>BINARY CODE</th>
<th>FAULT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0F</td>
<td>01111</td>
<td>SPINDLE DID NOT START/STOP IN 2 MINUTES AFTER ERSLO/ERSTP WAS NOTED (10000/10100)</td>
</tr>
<tr>
<td>10</td>
<td>10000</td>
<td>SPINDLE START GT 60 SEC</td>
</tr>
<tr>
<td>11</td>
<td>10001</td>
<td>NO SPINDLE MOVEMENT OR NOT UP TO SPEED IN 2 MIN</td>
</tr>
<tr>
<td>12</td>
<td>10010</td>
<td>MOTOR OVERHEATED</td>
</tr>
<tr>
<td>13</td>
<td>10011</td>
<td>SOLID STATE RELAY FAILURE</td>
</tr>
<tr>
<td>14</td>
<td>10100</td>
<td>STOP TIMEOUT</td>
</tr>
<tr>
<td>15</td>
<td>10101</td>
<td>EMERGENCY RETRACT FAILURE</td>
</tr>
<tr>
<td>16</td>
<td>10110</td>
<td>NORMAL RETRACT FAILURE</td>
</tr>
<tr>
<td>17</td>
<td>10111</td>
<td>CYLINDER ADDRESS GT 822</td>
</tr>
<tr>
<td>18</td>
<td>11000</td>
<td>OFF TRACK GT 1200 USEC</td>
</tr>
<tr>
<td>19</td>
<td>11001</td>
<td>UNEXPECTED AGC IN HEAD LOAD</td>
</tr>
<tr>
<td>1A</td>
<td>11010</td>
<td>LOST AGC</td>
</tr>
<tr>
<td>1B</td>
<td>11011</td>
<td>SPEED TOO LOW</td>
</tr>
<tr>
<td>1C</td>
<td>11100</td>
<td>LOST SPEED PULSES</td>
</tr>
<tr>
<td>1D</td>
<td>11101</td>
<td>ALLOWED TIME EXPIRED</td>
</tr>
<tr>
<td>1E</td>
<td>11110</td>
<td>NO TRACK LOCK IN SETTLING</td>
</tr>
<tr>
<td>1F</td>
<td>11111</td>
<td>MICROPROCESSOR FAULT CODE SUMMARY READOUT IS COMPLETE</td>
</tr>
</tbody>
</table>

*CR3-CR7. "1" means light on. "0" means light OFF.*
VELOCITY GAIN

There is only one adjustment that is required by field service personnel; this is the Velocity Gain Adjustment. Misadjustment of this control may cause difficulties that appear to be malfunctions of the hardware. If any servo pcb is replaced velocity gain should be checked.

VELOCITY GAIN ADJUSTMENT

1. Position switch S1-8 on the Servo Coarse PWA to the OFF (open contact) position (right side down).

2. Actuate the momentary switch on the Control/Mux PWA(S1) and observe the fault indicators.

3. When (S1) on the Control/Mux PWA is actuated, the carriage seeks to and stops at track 822.

4. One of the fault indicators #3 through #7 will light to indicate the status of the Velocity gain.

5. Adjust R7 on the Servo Course PWA actuate S1 after each R7 adjustment until only fault indicator #5 is on, then continue to turn R7 an additional 1/2 turn in the same direction.

6. Return S1-8 on the Servo Course PWA to its normal (ON) position.

VELOCITY GAIN ADJUSTMENT TABLE

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>INTERPRETATION</th>
<th>SERVO COURSE R7 ADJUSTMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR 3</td>
<td>Velocity gain very low</td>
<td>Turn clock-wise coarse</td>
</tr>
<tr>
<td>CR 4</td>
<td>Velocity gain low</td>
<td>Fine tune clock-wise</td>
</tr>
<tr>
<td>CR 5</td>
<td>Velocity gain all right</td>
<td>No adjustment necessary</td>
</tr>
<tr>
<td>CR 6</td>
<td>Velocity gain high</td>
<td>Fine tune counter clock-wise</td>
</tr>
<tr>
<td>CR 7</td>
<td>Velocity very high</td>
<td>Turn counter clock-wise</td>
</tr>
</tbody>
</table>
ALIGNMENT PROCEDURE

FTU Connection

1. Install cables as shown on next pages.

2. Set rotary switches on the FTU as follows:
   DATA ENTRY  DEVICE TYPE
   RD/WRT SELECT  ALIGNMENT
   ACCESS SELECT  DIRECT SEEK

3. Set toggle switches on the FTU as follows:
   TOP ROW   UP  CTR  UP  UP  DOWN
   CTR ROW   DOWN  CTR  CTR  DOWN  UP  DOWN
   BTM ROW   ALL  DOWN

4. Toggle START and RUN back to the up position.

5. On the FTU keyboard enter CLR, 8905, LOAD.

6. Switch the DATA ENTRY rotary switch on the FTU to UNIT NUMBER.

7. Enter SEL. DRIVE on the FTU keyboard. The ready light on the FTU should be on.

8. Set the DATA ENTRY rotary switch on the FTU to DESTINATION.

9. Enter RTZ on the FTU keyboard, the drive should do a restore.

10. Allow C.E. alignment pack to temperature stabilize for 30 minutes.

   A) To command a seek key RTZ, CLEAR, CYLINDER ADDRESS, LOAD, GO.

   B). To use the FTU display to calculate offset voltage key BIT GO after entering cylinder address
AZPV PWA HAS NO INDICATORS.

Refer to parts listing in Appendix A for Data Cables.

HEAD ALIGNMENT BLOCK DIAGRAM
HEAD ALIGNMENT

Set up.

Assemble and plug the "A" and "B" cables into the FTU (RED LINE ON CABLES GO TO PIN 1).
CARTRIDGE HEAD ALIGNMENTS

Outer Guard Band Detection

1. Set switches as follows:
   a) (AZPV) Align. Card   S1  N position
      S2  RW position
      S3  Xl position
   b) Ext Card             FXD position,
   c) Servo Fine Card      S position

2. Issue a RTZ command to the fixed disk.

3. Move the cartridge servo head to the rear of the drive until
   the outer guard band is reached. (see top fig. 9-3)

4. Once the guard band has been located move the cartridge servo
   head forward until cylinder zero is reached.(see bottom fig. 9-3).

5. Preform a seek to track 822 to ensure that the cartridge servo
   head is on track (the guard band should not be present).
   This will assure that both servo heads are aligned over the same
   servo track.

** CAUTION**

WHENEVER THE HEADS ARE ADJUSTED OR THE CLAMPING
SCREWS TURNED WHILE THE HEADS ARE FLYING, EXTREME
CARE SHOULD BE TAKEN SO AS NOT TO MOVE THE CARRIAGE
ASSEMBLY IN A LATERAL DIRECTION. THIS CAN RESULT
IN A HEAD CRASH. COUNTER FORCE SHOULD BE APPLIED
ON THE OPPOSITE SIDE OF THE CARRIAGE.
FIGURE 9-3  GUARD-BAND WAVEFORM PATTERN
CARTRIDGE SERVO HEAD ALIGNMENT

1. Perform a seek to track 404

2. Align the cartridge servo for an offset less than 50 mV.

3. Torque head to between 8 and 10 in-lbs. Readjust offset if necessary. Torque heads to 12 in-lbs.

4. Perform a seek to cylinder 8 and 800. The calculated offset should be less than 350 mV. Minor adjustments can be made if either offset is greater than 350 mV. However, the final offset at cylinder 404 should not be greater than 75 mV.

CARTRIDGE R/W HEAD ALIGNMENT

1. Set switches as follows:
   a) (AZPV) Align. Card
      S1 N position
      S2 R/W position
      S3 X1 position
   b) Ext Card
      NORM position
   c) Servo Fine Card
      D position

2. Repeat steps for cartridge servo head except that offset tolerances are different.
   Cylinder 404 offset less than 40 mV.
   Cylinder 8 offset less than 75 mV.
   Cylinder 800 offset less than 75 mV.
Voltage Check Points

To check true voltage levels for ±20V and ±5V will require the Customer Engineer to perform the procedure in Section 2.5 of this manual. This will permit the Electronic Module to be hinged out 90° for access to the voltage terminals on the bottom of the motherboard shown in illustration. The voltage readings indicated, proceed forward from the bottom rear of the terminal screws on the Electronic Module. Checking voltages on connector pins is discouraged.

MOTHERBOARD TEST POINTS

FOR VOLTAGE CHECKS

Using the DC ground terminal at the rear of the base pan as a reference point, check the DC voltages at points shown
FIXED MODULE REPLACEMENT/RUNOUT CHECK

The new fixed module is secured to the shipping container in a different manner from the old style. To remove the bottom of the shipping container loosen the two center screws on the locating fixture. These screws are numbered "B" in the CDC manual page 6-16. The plastic screws are not used on the newer modules.

RUNOUT CHECK

The new procedure to check electrical runout is to connect scope to test point 10 on the servo course PCB. Volt/div. - 1 volt, time base is 10 milliseconds. Ground test point 9 on the servo course PCB. Select the removable or a fixed R/W head, which ever is to be tested. Observe the wave form at TP10. Peak to peak should be less than 2 volts. If the signal is larger than 2 volts the module is considered to be bad and replaced.
### PHOENIX DISK DRIVE
#### PRINTED CIRCUIT BOARDS

<table>
<thead>
<tr>
<th>WLI</th>
<th>CDC #</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>5778</td>
<td>77616790</td>
<td>PCB I/O EMI</td>
</tr>
<tr>
<td>5779</td>
<td>77616600</td>
<td>PCB CNTL/Mux EM2</td>
</tr>
<tr>
<td>5780</td>
<td>75885600</td>
<td>PCB Servo/Course EM3</td>
</tr>
<tr>
<td>5782</td>
<td>75886300</td>
<td>PCB Servo/Fine EM5</td>
</tr>
<tr>
<td>5783</td>
<td>75886350</td>
<td>PCB Servo/Write EM7</td>
</tr>
<tr>
<td>5784</td>
<td>75885750</td>
<td>PCB Servo/Fine Pre Amp</td>
</tr>
<tr>
<td>5785</td>
<td>75885950</td>
<td>PCB Pwr Amp</td>
</tr>
<tr>
<td>5786</td>
<td>75898850</td>
<td>PCB Relay CNTL</td>
</tr>
<tr>
<td>5787</td>
<td>75895150</td>
<td>PCB Oper CNTL Pnl.</td>
</tr>
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<td>PCB Servo Pre Amp</td>
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*ALL 726-XXXX*
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<td>75010105</td>
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<td>92314113</td>
<td>Head Arm Assy, Servo</td>
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<td>726-5559</td>
<td>50223603</td>
<td>Belt 60 Hz (80)</td>
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<td>726-5629</td>
<td>50223703</td>
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<tr>
<td>726-5630</td>
<td>95575000</td>
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<td>726-5747</td>
<td>93418334</td>
<td>Rectifier</td>
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<td>726-5748</td>
<td>75880045</td>
<td>Fuse 6A 250V</td>
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<tr>
<td>726-5757</td>
<td>75885996</td>
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<td>726-5758</td>
<td>75881911</td>
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</tr>
<tr>
<td>726-5759</td>
<td>77610050</td>
<td>Filter Course &amp; Gasket</td>
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<td>726-5760</td>
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<td>95583504</td>
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<td>PCB Servo/Fine EM6</td>
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<td>75885750</td>
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<td>PCB Read/Write Pre-Amp</td>
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<td>Fuse 10A 125V</td>
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<td>Blower Motor 50Hz</td>
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<td>Switch, Protect</td>
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<td>726-5833</td>
<td>Resistor Wire Wound</td>
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<td>726-9679</td>
<td>Jumper Ext.</td>
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<td>726-9680</td>
<td>Head Align. CBL 1</td>
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<td>726-9681</td>
<td>Head Align. CBL 2</td>
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<td>726-9682</td>
<td>Carr. Link Tool</td>
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<td>726-9683</td>
<td>CE Cartridge 1204-51</td>
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<td>726-9698</td>
<td>TB216 (FTU) Disk Exercisor</td>
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<td>Torque Tip Short</td>
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<td>726-5611</td>
<td>Min Alignment Kit</td>
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</table>
FIGURE 7-19. CMD HARNESS (SHEET 1 OF 2)
FIGURE 7-13. CMD HARNESSSES (SHEET 2 OF 2)
TECH TIP

Quick Test Method: For Soft/Hard Disk/Head Crash.

Advantage: No pack or head exposure for visual inspection required. Absolute detection of soft crash damage (momentary touchdown) to head.

Procedure and Equipment Required:

1. Equipment:
   - Screwdriver, Phillips #1
   - DVM - Fluke Model 8000 series.
   - Note: Readings are based on particular DVM model. Other types of DVM’s may supply different constant current levels when in low ohm ranges and will affect values of OCR obtained.

2. Procedure:
   - Obtain access to read/write plugs from heads at entrance to logic card/cage assembly.
   - Set up DVM to OHMS Mode, 200 ohm range.

3. Performance Continuity checks per illustration.
   - Note: It may be necessary to fashion test probes from paper clip wire in order to gain access to plug connections.

4. A variation of greater than 10 ohm or open/shorted condition indicates defective head coil assembly requiring replacement and a further inspection of disk pack.

PAT FINUCANE, SCE
TOWSON-3412

1/27/83
**PHOENIX SWITCH SETTINGS - 2200**

(normal operation)

X- denotes position

---

**M1 - I/O PWA**

**S1** Remote **S2** Disable **S3**

<table>
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<tr>
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<th>OFF</th>
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<tbody>
<tr>
<td>X</td>
<td>X</td>
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<td>-2</td>
<td>-3</td>
</tr>
<tr>
<td>-4</td>
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</tr>
</tbody>
</table>

---

**EM2 - CONTROL/MUX PWA**

CR1 CR2 CR3 CR4 CR5 CR6 CR7

NH MP WF WTR WR VF NS

NH- No Head Select
MP- Lites for microprocessor Faults
WF- Loss of AC or DC write current
WTR- Write or Read off cylinder

---

**U33** determines number of platters
X- denotes jumper cut

<table>
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<tr>
<th>2²</th>
<th>2'</th>
<th>2º</th>
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<td>IN</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>X</td>
<td>IN</td>
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**EM3 - SERVO COARSE PWA**

**S1**

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<td>-3</td>
<td>-2</td>
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---

**EM6 - SERVO FINE PWA**

**S1**

DATA SERVO

Doesn't matter. Used for head alignment only.

---

300 MeV - 2265V-2 Local - Normal
75 MeV - 2265V-1 Local - Normal

---

3200 - 2265V-2 Local - Normal
2200 - 2265V-1 Local - Normal
Figure 7-1. Block Diagram
### SEEK VELOCITY PROFILE

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<tr>
<th>SEEK DISTANCE</th>
<th>SEGMENT *</th>
<th>NUMBER OF CYL</th>
<th>VELOCITY (IPS)</th>
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<tr>
<td>822 - 626</td>
<td>16</td>
<td>197</td>
<td>74.0</td>
</tr>
<tr>
<td>625 - 429</td>
<td>15</td>
<td>197</td>
<td>74.0</td>
</tr>
<tr>
<td>428 - 232</td>
<td>14</td>
<td>197</td>
<td>74.0</td>
</tr>
<tr>
<td>231 - 165</td>
<td>13</td>
<td>67</td>
<td>63.3</td>
</tr>
<tr>
<td>164 - 116</td>
<td>12</td>
<td>49</td>
<td>51.9</td>
</tr>
<tr>
<td>115 - 74</td>
<td>11</td>
<td>42</td>
<td>41.2</td>
</tr>
<tr>
<td>73 - 48</td>
<td>10</td>
<td>26</td>
<td>31.6</td>
</tr>
<tr>
<td>47 - 33</td>
<td>9</td>
<td>15</td>
<td>23.9</td>
</tr>
<tr>
<td>32 - 18</td>
<td>8</td>
<td>15</td>
<td>17.3</td>
</tr>
<tr>
<td>17 - 12</td>
<td>7</td>
<td>6</td>
<td>11.9</td>
</tr>
<tr>
<td>11 - 8</td>
<td>6</td>
<td>4</td>
<td>8.95</td>
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<td>1</td>
<td>2.63</td>
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**TABLE 7-1, Velocity Profile**

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<th>PHASE</th>
<th>PHASE INDICATORS</th>
<th>CODE (HEX)</th>
<th>PHASE</th>
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<td></td>
<td>01</td>
<td>Return to Track Center</td>
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<td>07</td>
<td>Head Load</td>
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<tr>
<td></td>
<td>02</td>
<td>Wait for Coarse Seek Comp.</td>
<td></td>
<td>08</td>
<td>Await AGC during</td>
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<tr>
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<td>03</td>
<td>After Seek Settling</td>
<td></td>
<td>09</td>
<td>Head Load</td>
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<td></td>
<td>04</td>
<td>Idle Loop</td>
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<td></td>
<td>Await Track Center- Load or RTZ</td>
</tr>
<tr>
<td></td>
<td>05</td>
<td>Return to Zero Motion</td>
<td></td>
<td></td>
<td>Settling-Load or RTZ</td>
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<td>06</td>
<td>End/of Velocity Table</td>
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<td>0A</td>
<td>OFFSET Active</td>
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<td></td>
<td></td>
<td>0B</td>
<td>Clear OFFSET Settling</td>
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<table>
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<th>FAULT INDICATORS</th>
<th>CODE (HEX)</th>
<th>FAULT TYPE</th>
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<td></td>
<td>0F</td>
<td>Spindle did not Start/Stop in 2 minutes 10 or 14 was noted</td>
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<td>10</td>
<td>Spindle Start GT 70 SEC max</td>
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<tr>
<td></td>
<td>11</td>
<td>No spindle movement or not up to speed in 2 MIN</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Motor Overheated</td>
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<tr>
<td></td>
<td>13</td>
<td>Solid State Relay Failure</td>
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<tr>
<td></td>
<td>14</td>
<td>Stop Timeout</td>
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<td>15</td>
<td>Emergency Retract Failure</td>
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<td>16</td>
<td>Normal Retract Failure</td>
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<td>17</td>
<td>Cylinder Address GT 822</td>
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<td>18</td>
<td>OFF Track GT 1200 USEC</td>
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<td></td>
<td>19</td>
<td>Unexpected AGC in Head Load</td>
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<td>1A</td>
<td>Lost AGC</td>
</tr>
<tr>
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<td>1B</td>
<td>Speed Too Low</td>
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<td>1C</td>
<td>Lost Speed Pulses</td>
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<td></td>
<td>1D</td>
<td>Allowed Time Expired</td>
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<tr>
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<td>1E</td>
<td>No Track Lock in Settling</td>
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</table>

Table 7-3 Microprocessor Phase/Fault Codes

7-23
January 12, 1979

Mr. Charlie Torrielli
Wang Labs
836 North Street
Tewksbury, Massachusetts 01876

Charlie:

This is the new head alignment procedure we promised. The changes are as follows:

1. The offset limits at cylinder 8 and 800 for servo head to servo head alignment have been changed from 200 mV to 350 mV.

2. The offset limits at cylinder 8 and 800 for servo head to data head alignment (cartridge) have been deleted.

The alignment limits at cylinder 404 remain the same.

The 8 and 800 checks were in the procedure to detect an out-of-tolerance mechanical assembly, particularly a "bowed" or non-parallel carriage guide rod. The 8 and 800 check during servo head to servo head alignment will do this, and it is not necessary to repeat this check for servo to data alignment.

Please call me at 405/946-5421, extension 4137 if you have any questions.

Regards,

R. V. Woodham
Product Engineering

RVW: sjp

encl.
### VELOCITY COMMAND

<table>
<thead>
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<td>428</td>
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**NOTE:** TABLE ENTRY LEVEL FOUND BY A BINARY SEARCH ROUTINE.
PHOENIX POWER SUPPLY AND AMPLIFIER PROBLEM ISOLATION PROCEDURE

1. The voltages produced by the CMD power supply are effectively interlocked to protect the drive electronics in nearly all cases where it appears that the power supply has failed, the 32 volt load (power amplifier circuitry) is actually the culprit. Figs. A & B are basic and less basic drawings of the power circuitry.

2. If the Power Amplifier of the CMD fails, it usually manifests itself as one or more of the darlington pairs being shorted. In many cases, the heads home switch is defective and the microprocessor doesn't know that a move was complete. As a result, the drive commands for the voice coil don't shut off at the proper time and the Power Amplifier burns up. When a darlington shorts out, this causes the power supply to effectively fold back into itself and generate little or no voltages at all. The proper procedure is to insure that the heads home switch is working properly, replace any shorted components and then look for the power supply to come up again. It is recommended that you disconnect the voice coil plug (A1P1) until you are sure that the heads home switch is operating correctly.

3. To isolate the entire 32 volt network from the power supply, it can be easily accomplished by disconnecting the plug leaving the power supply which goes into the 32 volt filter at the filter end of the harness. (J1/P1 of the filter, Fig. B) The filter is located in the center of the base pan where the blower and other large components are mounted. When the 32 volt load is taken off the power supply at that point, it is removed from the power amp, relay control board and the logic rack. (see figure A on the following page) If the power supply does come up with the plug removed, you should see a fault light on the operators panel and CR6 should be lit on the control mux pcb. This indicates the power supply is probably OK. If the power doesn't come up, the problem is in one of the other supply circuits or the power supply itself. It will be necessary to check the fuses on the power supply and/or replace the regulator on the supply or the supply itself.

CAUTION

4. At this point you will not know if the 32 volt output of the power supply is actually present because it is disconnected from the voltage sense circuits on EM2. If the power supply came up, check to make sure that there is actually plus and minus 32 volts at the end of the plug coming from the power supply. The reason for doing this is to insure you don't blow up another power amp later. The power amp has to have both plus and minus 32 volts at the right terminals for the correct bias on the darlington or they will short out as soon as power is applied and the power supply will be dead again.
5. Now, you can shut down the power, disconnect terminals 1, 3, 8 & 10 from the power amp, reconnect the input to the 32 volt filter, then bring up the power again. This will reconnect all 32 volt circuitry except the power amplifier. If the power amp was the only problem left to be repaired, the front door lock will open (click) and the ready lite will flash once, the fault light will be off and CR6 will not be lit. If this is the case, replace the power amp or replace the determined defective transistors which are bad using the power amp representitive schematic and resistance chart, (Figs. C&D), included with this blurb as a guide.

For information, the darlington amplifiers have WLI numbers. They are as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>726-5769</td>
</tr>
<tr>
<td>Q2</td>
<td>726-5629</td>
</tr>
<tr>
<td>Q3</td>
<td>726-5630</td>
</tr>
</tbody>
</table>

HHSW (heads home switch)  
726-5767
New Phoenix air filters have a duct (opening) to facilitate air flow measurements with an air flow meter (726-9710). Remove the red cap. Insert necessary tubing and check for at least .75 inches when doing a PM. If less, replace the filter.

**IMPORTANT**

This measurement must be done with heads loaded at cylinder 0 and the deck lowered to the normal position.

This means that you will have to route the hoses from the filter properly in order to insure proper and complete air flow when the deck is lowered from the maintenance position back to the normal position.

Make sure you replace the red cap after measuring airflow before returning machine to normal operation, or else HEAD CRASH WILL occur.

III.A.7.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Fault Code</th>
<th>Error Description</th>
<th>Immediate</th>
<th>Extended</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1D &amp; 15</td>
<td>Emergency retract failure after head retract timeout (44 Oms) (Fault 1D, Fault 15).</td>
<td>1. Replace power amplifier.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Replace servo coarse board.</td>
<td></td>
</tr>
<tr>
<td>01</td>
<td>1D</td>
<td>Timeout (8 Oms) during return to track center after a seek (seek error phase 01 Fault code 1D).</td>
<td>3. Replace power amplifier.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Replace servo coarse board.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Replace servo fine board.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Replace power amplifier.</td>
<td>Possible bad servo head.</td>
</tr>
<tr>
<td>02</td>
<td>1A</td>
<td>Lost automatic gain control (AGC) during wait coarse complete for a seek (seek error phase 02 Fault code 1A).</td>
<td>1. Replace servo coarse board.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Replace servo fine board.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Replace power amp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Replace cartridge.</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>1D</td>
<td>Timeout (8 Oms) during wait coarse complete for a seek (seek error phase 02 Fault code 1D).</td>
<td>Reference error code A16.</td>
<td></td>
</tr>
</tbody>
</table>

<p>|       |            |                                                                                   | 1. Replace servo coarse board.                                              | Check for mechanical problems: |
|       |            |                                                                                   | 2. Replace servo fine board.                                                | a. Bearing plate             |
|       |            |                                                                                   |                                                                           | c. Cudie rod.                |</p>
<table>
<thead>
<tr>
<th>Phase</th>
<th>Fault Code</th>
<th>Error Description</th>
<th>Immediate</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>1A</td>
<td>Lost AGC during after seek settling (seek error phase 03 Fault code 1A).</td>
<td>Reference error code A16.</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>1E</td>
<td>No track lock in settling during after seek settling (seek error phase 03 Fault code 1E).</td>
<td>Reference error code A21.</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>1D</td>
<td>Timeout (8 Oms) during after seek settling (seek error phase 03 Fault code 1D).</td>
<td>Reference Error Code A16.</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>1D &amp; 1E</td>
<td>Timeout (8 Oms) and no track lock in settling during after seek settling (seek error phase 03 Fault code 1D and 1E).</td>
<td>Reference Error Code A21.</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>1B</td>
<td>Off track GT 1200 US during idle loop (seek error phase 04 Fault code 1B).</td>
<td>Reference error code A21.</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>1B</td>
<td>Off track GT 1200 US during idle loop (seek error phase 04 Fault code 1B).</td>
<td>Reference error code A21.</td>
<td></td>
</tr>
<tr>
<td>Phase</td>
<td>Fault Code</td>
<td>Error Description</td>
<td>Immediate</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>04</td>
<td>1A</td>
<td>Lost AGC during idle loop (seek error phase 04 fault code 1A).</td>
<td>1. Replace servo fine board.</td>
<td>1. Check servo head and cables.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Replace servo coarse board.</td>
<td>2. Check cable between servo preamp and servo fine board.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Replace servo preamp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Replace power amp.</td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>1B &amp; 1E</td>
<td>Off track GT 1200 US and no track lock in settling during idle loop (seek error phase 04 fault codes 1B and 1E).</td>
<td>Reference error code A21.</td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>1D</td>
<td>Timeout (50 Oms) during RTZ motion (seek error phase 05 fault code 1D).</td>
<td>1. Replace servo coarse board.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Replace power amp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Check voice coil cables.</td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>1D</td>
<td>Timeout (8 Oms) during end of velocity table (seek error phase 06 fault code 1D).</td>
<td>Reference error code A44.</td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>1A</td>
<td>Lost AGC during end of velocity table (seek error phase 06 fault code 1A).</td>
<td>1. Replace servo coarse board.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Replace servo fine board.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Replace servo preamp.</td>
<td></td>
</tr>
<tr>
<td>Phase</td>
<td>Fault Code</td>
<td>Error Description</td>
<td>Immediate</td>
<td>Extended</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>------------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>08</td>
<td>1D</td>
<td>Timeout (30 Oms) during await AGC during head load (seek error phase 08 fault code 1D).</td>
<td>1. Replace servo fine board. 2. Replace servo preamp.</td>
<td>Check servo head and cable.</td>
</tr>
<tr>
<td>09</td>
<td>1D</td>
<td>Timeout (30 Oms) during await track center during head load/RTZ (seek error phase 09 fault code 1D).</td>
<td>Reference error code A56.</td>
<td></td>
</tr>
<tr>
<td>0A</td>
<td>1A</td>
<td>Lost AGC during settling head load/RTZ (seek error phase 0A fault code 1A).</td>
<td>1. Replace servo fine board. 2. Replace servo coarse board. 3. Replace servo preamp.</td>
<td>Check servo head and cable.</td>
</tr>
<tr>
<td>0B</td>
<td>1A</td>
<td>Lost AGC during offset active (seek error phase 0B fault code 1A).</td>
<td>1. Replace servo coarse board. 2. Replace servo fine board. 3. Replace power amp.</td>
<td>1. Check voice coil and associated cabling. 2. Check servo head and cables.</td>
</tr>
<tr>
<td>0C</td>
<td>1A</td>
<td>Lost AGC during clear offset settling (seek error phase 0C fault code 1A).</td>
<td>Reference error code A72.</td>
<td></td>
</tr>
<tr>
<td>Phase</td>
<td>Fault Code</td>
<td>Error Description</td>
<td>Immediate</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>-------------------</td>
<td>------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>Spindle start GT 60 Sec. (Fault Code-10)</td>
<td>Reference Error Code A97</td>
<td>Check relay control and cabling.</td>
</tr>
</tbody>
</table>
|       | 10 & OF    | Spindle start GT 60 Sec & spindle did not start/stop in 2 minutes after ERSLO/ERSTP was noted (Fault Codes 10 & OF). | 1. Check drive belt.  
2. Replace motor starter capacitor.  
3. Replace solid state relay. | |
| 11    |            | No spindle movement or no up to speed in 2 min. (Fault Code 11). | 1. Replace solid state relay.  
2. Check drive belt. | Check relay control and cabling.  
Verify speed sensor. |
| 12    |            | Solid state relay not activated (Fault code 12). | 1. Replace servo coarse board. | Check relay control and cabling. |
| 13    |            | Solid state relay failure (Fault 13). | 1. Replace solid state relay.  
2. Replace servo coarse board.  
3. Replace relay control. | |
| 14    |            | Stop Timeout (2 min.) (Fault code 14). | 1. Replace servo coarse board.  
2. Check drive belt. | Check relay control and cabling. |
| 14 & OF |          | Stop timeout (2 min.) & spindle did not start/stop in 2 minutes after ERSLO/ERSTP was noted (Fault codes 14 & OF). | 1. Replace servo coarse board.  
2. Check drive belt.  
3. Replace solid state relay. | Check relay and control cabling. |
<table>
<thead>
<tr>
<th>Phase Code</th>
<th>Error Description</th>
<th>Immediate Action</th>
<th>Corrective Action</th>
<th>Extended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Normal retract circuitry failure (Fault 16).</td>
<td>1. Replace power amplifier ex. 2. Replace servo coarse board.</td>
<td>Check host controller/software.</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Cylinder address GT 822 (Seek error Fault code 17).</td>
<td>1. Replace I/O board. 2. Replace servo coarse board.</td>
<td>1. Verify speed sensor operation. 2. Check: Motor a, Pulleys b, Belt c. 3. Replace solid state relay. 4. Replace servo coarse board.</td>
<td></td>
</tr>
<tr>
<td>1B</td>
<td>RPM fault (Fault code 1B).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1C</td>
<td>Lost speed pulses (1C).</td>
<td>1. Replace RPM sensor. 2. Replace servo coarse board. 3. Check cables from sensor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1D</td>
<td>Timeout (44 Oms) awaiting head retract (Fault 1D).</td>
<td>1. Replace servo coarse board. 2. Replace power amplifier.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
POTENTIAL FIXED MODULE PROBLEM

CDC has introduced a fixed module with a chrome plated hub. If this hub is over torqued it could cause some of the chrome to flake off possibly causing a head crash. Please use the specs called for when tightening down the hub, tightening them in the given sequence to 4 lb/inch, then 7 lb/inch, and finally to 10 lb/inch as shown in the removal/replacement of the fixed module in the Phoenix manual, part number 729-0198A. If this problem is found please mark repair tag "Flaking Hub".

The drive should be purged 30 minutes after replacing the fixed module, up to speed, heads unloaded.

NEW SERVO COARSE BOARD

There is a new Servo Coarse Board in the field completely compatible with all other boards and under the same part number, 726-5780.

This new board, however, does have a head load delay jumper located near the right board extractor lever.

Jumper to left 90 second delay before head load
Jumper to right 120 second delay before head load

The 120 second delay is recommended to increase purge time, therefore hopefully decreasing head crashes.
PHOENIX

Switch Settings

There are new style I/O boards and Control/Mux boards in the field which have switch banks on them. The settings for these switch banks are as follows:

<table>
<thead>
<tr>
<th>I/O Board</th>
<th>Control/Mux Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ON (Off inhibits sector count)</td>
<td>1. OFF Spare</td>
</tr>
<tr>
<td>2. OFF (Pseudo seek, not used by WANG)</td>
<td>2. ON (Off inhibits sector)</td>
</tr>
<tr>
<td>3. OFF Spare</td>
<td>3. ON (Allows selection of fixed and removable, OFF-only select fixed)</td>
</tr>
<tr>
<td>4. OFF Spare</td>
<td></td>
</tr>
</tbody>
</table>

Thanks to Joe McDermott for his assistance with this information.
PHOENIX

CHECKING FILTER

Phoenix filters are now being shipped with a hole on the side for checking air pressure to determine if the filter is allowing enough air to pass through. The hole on those seen so far has an orange plug in it.

To check the filter, power down drive, remove covers, remove plug which should be accessible from left side. Using the Dwyer 460 Air meter, (part number 726-9710), connect the supplied rubber tubing to the outer connector of the meter and the metal angle connector to the other end of the rubber tube. Place the other end of the angle connector in the hole in the filter, and block the other connector hole of the meter with your finger. Power the drive to the load state and check for a reading on the 1 in Water Draft or Pressure-High Range Scale. A reading of below .75 in, calls for replacement of the filter. A new filter in a drive in the shop gave a reading of .95 in.

Make sure pre-filter is clean.

Please date your filters so that it can be plainly seen how often they need to be changed at particular sites. Sites requiring a filter change more frequently than what is called for may be billable.
When using the new Catseye Alignment Disk to check for radial head alignment, the following scope settings can be used:

CH. 1 -.2V/Div AC TP1
1 or 2 milsec/div.
Sync.-CH 1 AC or EXT UPPER INDEX

A sample of the radial head signal was sent out in District Newsletter 9. The other adjustments should be the same as the GDC tribit pack.

**Some catseye alignment disks have been found to have no index signal on track 402. If you find this to be the case with the alignment disk you are using, please tag the disk as such and send it back to Lawrence. The azimuth cannot be checked without an index signal on track 402 and compatibility problems could arise. If you have any questions please contact us at the District.**
PHOENIX
Upgrading Phoenix Drive

When upgrading a Phoenix drive from a 30 or 60 MEG drive to a 90 MEG drive under REL 5.XX it is sometimes necessary to write over the fixed platter using the FTU to destroy the VTOC prior to initializing the fixed platter.
PHOENIX

NEW RELAY BOARDS FOR BLOCK POINT 4 DRIVES

Phoenix Block Point 4 drives are now being delivered with a new relay control board.

The CDC P/N is 777i3900. This board is not compatible with 726-6724 (CDC # 77680650), the first Relay Board with pluggable connectors.

The part number for the new Relay Board is 726-6724A.

726-5786  Original Relay Board (screw type connector)
726-6724  CDC P/N 77680850 First BP 4 Drives (pluggable connector)
726-6724A  CDC P/N 777i3900 Latest BP 4 Drives (pluggable connectors)
P.S.N. III-A-7-4, Phoenix Terminator Modification

The following is a concern from Bob Peebles of the New England District. If anyone has had this situation please call the Area so that we may check into it.

This PSN is to correct the termination of OPEN CABLE DETECT signal line. It calls for the cutting of the etch from pins 14 and 44 on the terminator and adding a resistor to U3-5, and U3-6. The result of this will be to float the OPEN CABLE DETECT signals and add a 470 Ohm resistor between ground and a 5.6 Ohm terminator according to the CDC C.M.D. manual. The correct point for connecting the added resistors should be to pins 14 and 44 thus terminating them with 470 Ohm resistors instead of 5.6 Ohm resistors.
The maximum length of "A" cable which can be used off of one I.O.P. connecting up to 4 drives is 100 feet. The maximum "B" cable length to any one drive is 50 feet.
TECHNICAL SERVICE BULLETIN

SECTION: Hardware Technical

NUMBER: HWT 7149   REPLACES: _______   DATE: 08/04/87   PAGE 1 OF 1

MATRIX ID. 3105   PRODUCT/RELEASE# CDC PHOENIX DISK DRIVE

TITLE: PHOENIX CARRIAGE BUMPER PROBLEM

PURPOSE:
To inform the field of a possible problem with the rubber Carriage Stop Bumper on the Phoenix 2280, 2280V, and 6580V disk drives.

EXPLANATION:
The Carriage Stop Bumper is mounted on a metal bracket attached to the cam towers of the Phoenix drive. Its only purpose is to prevent the carriage from crashing into the actuator housing during an uncontrolled seek to spindle. Heat can cause the glue to melt and the bumper to slip down into the path of the carriage. This can prevent the carriage from positioning the heads to the inner cylinders of the drive. The problem can show up as intermittent seek errors.

The bumper is identified as reference numbers 389 and 403 of figure 7-9 (DECK ASSEMBLY) in the Phoenix Product Maintenance Manual, WLI# 741-1063A.

CORRECTIVE ACTION:
The bumper can easily be removed and glued back in place.
TECHNICAL SERVICE BULLETIN

SECTION: Hardware Technical

NUMBER: HWT 5049  
REPLACES: N/A  
DATE: 03/05/85  
MATRIX ID. 3105  
PRODUCT/RELEASE#: Phoenix Disk  
TITLE: Absolute Filter Causing Airlflow Problems

Wang has been delivering an improved Phoenix absolute filter for approximately nine months. This filter is distinguished by new packaging and an orange gasket around the exhaust outlet. Another distinguishing feature is the stabilizing "toes" at the underside of the exhaust outlet. It has been reported that the air hose from the no-air plenum will sometimes get caught under one of the stabilizers. The air pressure will then be cut off and the drive disabled. Care should be exercised when installing a new filter to prevent the air hose from being cut off.
III.A.7
PERIPHERALS-DISK DRIVES-CDC PHOENIX 9448 CMD.

TOPIC: IMPROPERLY INSTALLED CAPACITORS

On the PCB CNTL/MUX, WLI 726-5779, capacitor C44, a 4.7µF 20V cap, may be installed backwards. After approximately 4 hours of operation the cap will short +5V causing emergency retract and constant reverse drive. If power is left on the servo power amp will short out. Please check on all new installations for this problem. Should this problem arise, please contact the Technical Assistance Center. Please have the CDC SN of drive when you call in.
III.A.7
PERIPHERALS-DISK DRIVES-CDC PHOENIX 9448 CMD.

TOPIC: POTENTIAL PROBLEM ON PHOENIX

With Phoenix drives CDC S/N's 1500 and below, a problem has been found in two carriage assemblies with Barden bearings. If the carriage is making a lot of noise, such as in a dry bearing, replacement may be necessary. Most of the drives with this problem have been found, however, there may be a small number in the field.
III.A.7
PERIPHERALS-DISK DRIVES-CDC PHOENIX 9448 CMD.

TOPIC: PHOENIX FIXED MODULE REPLACEMENT

The new fixed module is secured to the shipping container in a different manner from the old style. To remove the bottom of the shipping container, loosen the two center screws on the locating fixture. These screws are numbered "B" in the CDC manual # 75888415 in the maintenance section, page 6-16. The plastic screws are not used on newer modules.

There is also a new procedure to check electrical runout on the fixed module. After purging for a reasonable time period, load the heads. Connect a scope to test point 10 on the servo-coarse PCB. Volt/Div. - 1 volt, time base 10 milliseconds. Ground test point 9 of the servo-coarse PCB and select a head greater than 1 and observe the wave form of TP 10. Peak to peak should be less than 2 volts. If the signal is larger than 2 volts, the module is to be considered bad and replaced.

A PSN on this procedure will be issued shortly. The new Phoenix OEM manuals are in print and will also be available shortly. We will issue the part number for the manual as soon as we can do so.
III.A.7
PERIPHERALS-DISK DRIVES-CDC PHOENIX 944B CM.

TOPIC: --CARRIAGE_CENTER_RAIL_TORQUE

Torquing the center rail:

1) Inspect the rail screw hole for contamination.
2) Using lock tight, torque the screw to 1.25 inch lbs. plus/minus 0.25.

Note: This torque specification is critical and should be rigidly adhered to.
VI.B.1
VS SYSTEMS-INTERFACE-DISK I/O PROCESSORS.

**TOPIC: VS-100_DISK_CABLES -- INPUT_ECE_NWSLETTER**

Below is the list of part numbers for "A" and "B" cables for the VS-100:

<table>
<thead>
<tr>
<th>&quot;A&quot; Cable -- CPU to Disk</th>
<th>&quot;A&quot; Cable -- Daisy Chain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1) CPU to Phoenix</strong></td>
<td>Phoenix to Phoenix</td>
</tr>
<tr>
<td>15' 220-3041-7</td>
<td>220-3031-1</td>
</tr>
<tr>
<td>25' 220-3041-20</td>
<td></td>
</tr>
<tr>
<td>50' 220-3041-21</td>
<td>300 Meg to 300 MEG</td>
</tr>
<tr>
<td><strong>2) CPU to 80 MEG SMD</strong></td>
<td></td>
</tr>
<tr>
<td>15' 220-3041-9</td>
<td>220-3031-2</td>
</tr>
<tr>
<td>25' 220-3041-16</td>
<td>80 MEG to 80 MEG</td>
</tr>
<tr>
<td>50' 220-3041-19</td>
<td>220-3031-3</td>
</tr>
<tr>
<td><strong>3) CPU to 300 MEG SMD</strong></td>
<td></td>
</tr>
<tr>
<td>15' 220-3041-8</td>
<td>80 to 300 MEG</td>
</tr>
<tr>
<td>25' 220-3041-18</td>
<td>220-3031-4</td>
</tr>
<tr>
<td>50' 220-3041-19</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>&quot;B&quot; Cable -- CPU to Disk</th>
<th></th>
</tr>
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<tr>
<td><strong>1) CPU to Phoenix</strong></td>
<td>Phoenix to 300 MEG</td>
</tr>
<tr>
<td>15' 220-3033-21</td>
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<tr>
<td>25' 220-3033-22</td>
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<tr>
<td>50' 220-3033-33</td>
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<tr>
<td><strong>2) CPU to 80 MEG SMD</strong></td>
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</tr>
<tr>
<td>15' 220-3033-25</td>
<td>80 MEG to Phoenix</td>
</tr>
<tr>
<td>25' 220-3033-22</td>
<td>220-3031-6</td>
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<td>50' 220-3033-35</td>
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<tr>
<td><strong>3) CPU to 300 MEG SMD</strong></td>
<td></td>
</tr>
<tr>
<td>15' 220-3033-23</td>
<td></td>
</tr>
<tr>
<td>25' 220-3033-24</td>
<td></td>
</tr>
<tr>
<td>50' 220-3033-34</td>
<td></td>
</tr>
</tbody>
</table>
VI.B.1
VS SYSTEMS-INTERFACE-DISK I/O PROCESSORS.

**TOPIC: INITIAL INTERFACE CABLE ORDERING**

As of August 1, 1982 standard length disk cables will not be shipped automatically when a drive is ordered. The salesperson ordering the drive is required to order the proper length cabling. This is to assure the cable length is adequate for the customer's system layout and configurations. At the time of order, the salesperson may require the assistance of a Customer Engineer to assure proper cable lengths for disk drives.

If a disk drive is delivered for install without cabling or with improper length cabling, refer to section 3.4 of the Customer Engineering Policies and Procedures Manual for the escalation and process for resolution of the problem.
VI.C.1
VS SYSTEMS-SOFTWARE-OPERATING SYSTEMS.

**TOPIC: VS_OPERATING_SYSTEM_5.02.XX_WITH_SINGLE_PHOENIX_DRIVE.**

When an IPL is performed from the removable volume of a Phoenix drive, the System Paging Files are placed on the wrong volume by the Operating System (version 5.02.XX). Instead of going to the removable volume where they belong, they are placed on the fixed volume. Subsequent IPL attempts fail because the Operating System tries to place new paging files on the fixed volume without having scratched the old ones.

One way to circumvent this problem is to maintain a copy of Operating System version 5.01.XX on a removable volume. IPL from this volume and scratch the @SYSPACE library from the fixed volume. This procedure is to be performed right after having IPL'd from Operating System version 5.02.XX on a removable volume.
III.A.8 (3106)
PERIPHERALS-DISK DRIVES-CDC 75MB SMD BK/4XX-5XX.

**TOPIC: NEW STYLE TERMINATORS FOR DUAL CHANNEL DISKS**

The problems of making dual channel drives the last drive in a string is that two terminators cannot be mounted on the unit. A new terminator WLI# 210-8177 has been made for this application. This new terminator will have low profile resistor sips WLI# 333-0849 in place of the old style.

We expect the new style to be available by the end of February. The low profile sips can be used to upgrade an existing terminator if the situation warrants.
PERIPHERALS-DISK DRIVES-2200 DISK FUNCTION PROCESSORS.

2200 SYSTEMS-INTERFACE-DISK MULTIPLEXER.

TOPIC: 2280 ALTERNATE SECTOR PROBLEM

Problem Symptoms:

1. D82 errors.
2. D88 errors.
3. Disk hangs.

The above problems could be due to an alternate sector on the first sector of a track. We are addressing the alternate sector problem with this procedure.

Double Shooting Procedure:

1. On platters where an error occurs: run 'VERIFY T(0,52608)'. If there is an error on sector 52608, you do not have an alternate sector on the first sector of a track. An error on sector 52608 is expected. There is another problem with your system and you should troubleshoot it accordingly.

2. If there is no error on sector 52608 but errors exist on other parts of the disk, you have an alternate sector problem.

Solution:

1. Backup platter where problem occurs.
2. Reformat bad platter using 'FORMAT DISK T/aa' command. (aa = disk platter number.)
3. Run 'VERIFY T(0,52608)'. If there is no error on sector 52608 but errors exist on other parts of disk, you still have an alternate sector problem. Go to step 6.
4. If there is an error on sector 52608, you have recovered from the alternate sector problem.
5. Restore your data from the backup to the reformatted platter. Go to step 11.
6. At this point you have two choices. First is replacing the fixed module. To do this go to step 10. The second is that you must find the bad sector.
Verify the disk. Write down the sectors which verify bad. Add one to each sector and divide by sixteen. The sector address that divides evenly by sixteen is your bad sector.

If the sector is not within a file, go to step 7.

If the sector lies within a program file, go to step 8.

If the sector lies within a data file which is accessed by 'DATALOAD DC' or 'DATASAVE DC', go to step 9.

7. Make sure that the sector is not within a data file which is accessed by the 'DATALOAD DA or BA' or accessed by the 'DATASAVE DA or BA' commands. If it is, go to step 10. If it isn't, recommend that the customer avoid that sector. Go to step 11.

8. Follow the steps below to avoid the bad sector in a program file.

A. Key in 'SELECT DISK aaa' and 'CR'. (aaa = address of platter where bad sector is.)
B. Key in 'CLEAR' and 'CR'.
C. Key in 'MOVE T "ffffffT" TO T/ddd', and 'CR'.
   (ffffffT = file where bad sector exists.)
   (ddd = address of unused scratch platter.)
D. Key in 'SCRATCH T "ffffffT"' and 'CR'.
E. Key in 'CLEAR' and 'CR'.
F. Key in 'SAVE DC T("ffffff")"BADSEC", and 'CR'.
G. Key in 'MOVE T/ddd, "ffffffT" TO T' and 'CR'.
H. Go to step 11.

9. Follow the steps below to avoid the bad sector in a program file which can be accessed by 'DATASAVE DC' and 'DATALOAD DC' commands.

A. Key in 'SELECT DISK aaa' and 'CR'. (aaa = address of platter where bad sector is.)
B. Key in 'CLEAR' and 'CR'.
C. Key in 'MOVE T "ffffffT" TO T/ddd,' and 'CR'.
   (ffffffT = file where bad sector exists.)
   (ddd = address of unused scratch platter.)
D. Key in 'SCRATCH T "ffffffT"' and 'CR'.
E. Key in 'CLEAR' and 'CR'.
F. Key in 'DATASAVE DC OPEN T("ffffff")"BADSEC", and 'CR'.
G. Key in 'MOVE T/ddd, "ffffffT" TO T' and 'CR'.
H. Go to step 11.

10. This is the second choice. If the above steps fail to alleviate the problem, follow the steps below.

A. Backup all the fixed platters.
B. Remove and replace the fixed module.
C. Format all the fixed platters.
D. Restore all the backups to their appropriate platter.

11. Bring system back up and return to customer operation.

This fix is only temporary. The final fix will be a microcode update. No time frame has been given by R&D.
PERIPHERALS-DISK DRIVES-CDC PHOENIX 9448 CMD.

**TOPIC:** COMPATIBILITY BETWEEN DISKS (PHOENIX)

When suspected compatibility problems occur between disk drives, checking head alignment may not locate the problem. You should also check the index to burst as you check head alignment.

Procedure is on page 6-57 of Phoenix manual 723-0198A, Item 394.

1. Set up the drive as you would to do head alignment except you don't need the DVM attached to the alignment PCB.

2. Set the scope for negative trigger and sync on "index" test point 52 on the I/O PCB. This test point is below the left hand card extractor next to the "A" cable plug Ji.

3. Seek to cylinder 15 and probe test point "Y" of the alignment PCB. The index to burst (I-TO-B) should be 4 micro-seconds plus or minus 2.9 micro-seconds.

4. Seek to cylinder 79% and repeat.

5. If the I-TO-B is out, try replacing the head.

6. There is no adjustment other than the replacement of the head or the carriage assembly. You should check the center rail torque for 1.5 inch lbs.
FCO 1072, released on January 11, 1984, documents ECO # 29993. The I/O cable clamp on the drive is replaced with a new clamp. This change reduces static problems in the unit by properly grounding the I/O cables at the base of the cabinet and insures compliance with FCC regulations. The change is required on units shipped from Wang between June 1 and October 1, 1983. To obtain the FCO Kit, order WLI # 728-0088.
PERIPHERALS-DISK DRIVES-CDC PHOENIX

TOPIC: PHOENIX SERVO COURSE PCB'S

There is a new Servo Course PCB that is being shipped with new units. It is completely compatible with other Servo Course PCB's (726-5780).

This new Servo Course board has a jumper located near the right hand PCB extractor lever. This jumper is for the head load delay. With the jumper to the left side, there is a 90 second delay; with the jumper on the right side, there is a 120 second delay before head load. This delay was incorporated to allow extra purge and stabilization time for the cartridge. The lower particle count can reduce head crashes. Normal setting is 120 seconds.

XX YY
I I I

XX= 90 seconds, YY= 120 seconds
PERIPHERALS–DISK DRIVES–CDC PHOENIX

TOPIC: PHOENIX SERVO COARSE PCB'S CORRECTED JUMPER SETTINGS
FROM TAC N/L 40306, CATEGORY 3105, TOPIC: SAME

Due to incorrect information, the above mentioned N/L was in error. The disable jumper was mis-stated as being the load timing jumper. The correct jumper settings are stated below. We are sorry for any inconvenience this may have caused.

There is a new servo Coarse PCB CDC #77682950 that is being shipped with the new units. It is completely compatible with the other Servo Coarse PCB's (726-5780).

This new Servo Coarse board has a jumper (J1) located near the right hand PCB extractor lever. This jumper is for the Servo Disable. With the jumper to the left side, the Servo is disabled; with the jumper to the right side, the Servo is enabled.

The Head load timing jumper (J2 4 pin) is located in the middle of the PCB between U22 and U27.

This delay was incorporated to allow extra purge and stabilization time for the cartridge; the lower particle count can reduce head crashes.

| PCB = XX YY |
| XX YY |
| I I I |
| J1 |
| AA BB |
| U22 II II U27 |
| J2 |

XX= Disabled, YY= Enabled
AA= 120 Seconds, BB= 90 Seconds
This PSN applies to the CDC Model 9448 CMD "Phoenix" Disk Drive used in Wang Model 2280, 2280V, 6580 and the OIS-140.

The following procedure is used for the purpose of reducing the noise output from the Phoenix Disk Drive. It is to be performed only on customer request.

The procedure involves the installation of 12 pre-cut pieces of foam within the equipment cabinet. These items may be ordered from stock and include the following:

<table>
<thead>
<tr>
<th>QUANTITY</th>
<th>PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
<td>1</td>
<td>660-0693*</td>
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<tr>
<td>2</td>
<td>660-0690</td>
</tr>
<tr>
<td>2</td>
<td>660-0688</td>
</tr>
<tr>
<td>1</td>
<td>660-0686</td>
</tr>
<tr>
<td>1</td>
<td>660-0689</td>
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<tr>
<td>1</td>
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<tr>
<td>1</td>
<td>660-0683</td>
</tr>
<tr>
<td>2</td>
<td>660-0684</td>
</tr>
</tbody>
</table>

* This piece does not have any adhesive backing. It just wedges in place.
The procedure consists of positioning the 12 pieces as shown in Figures 1 and 2. Each piece except one has an adhesive coating on one side which is covered with a protective backing. The adhesive used is rather fast acting. Therefore, after removing the protective backing care should be taken to position the pieces correctly before allowing the adhesive to contact the cabinet.

The side pieces (Nos. 660-0688 and 660-0690) should be inserted first since the large top pieces (No. 660-0686) are cut to butt against them. The remaining pieces may be inserted in any order.
CUSTOMER ENGINEERING

PRODUCT SERVICE NOTICE

DATE: 5/81

CLASSIFICATION PERIPHERALS

CATEGORY DISK DRIVES

PRODUCT/APPL. CONTROL DATA CMD 9448

SEQUENCE # 2

TITLE:

CARTRIDGE MODULE DRIVE 9448, REPLACING FAILED POWER SUPPLY WITH NEW TYPE SUPPLY

---

EQUIPMENT AFFECTED

This Product Service Notice (PSN) applies to Control Data Corporation (CDC) Phoenix Cartridge Module Drive (CMD) 9448 Units, Series Code (Block Point) - 1 Serial Numbers 101 through 300, where the 60-Hz power supply has failed and requires replacement. CMD 9448 Units are given the following Wang Laboratories, Incorporated designations: 2280, 2280V, and 6580.

AFFECTED MANUAL

The change affects the Control Data Corporation Cartridge Module Drive Hardware Maintenance Manual, P/N 75888415. The Wang Laboratories, Inc. (WLI) P/N for the manual is 729-0198. This publication is an Outside Equipment Manufacturer (OEM) document.

---

WANG LABORATORIES, INC.
ONE INDUSTRIAL AVENUE, LOWELL, MASSACHUSETTS 01851, TEL. (617) 459-5000, TWX 710 343-6769, TELEX 94-7421

PRINTED IN U.S.A.
REORDER NO. 729-0946
DESCRIPTION OF CHANGE

The original 60-Hz power supply (CDC P/N 75830535) installed in these CMD units is block point one equipment. When this power supply fails and an identical replacement is ordered, a power supply (CDC P/N 77610705, WLI P/N 726-5777) associated with block point two CMD units is furnished. Block point two CMD units have serial numbers of 301 or higher. Block point one CMD units must be modified to accommodate block point two power supplies.

PURPOSE OF PSN

This PSN contains procedures required to update the affected manual to provide for:

1. Modifying the CMD unit to accommodate the new type power supply.
2. Installing the new type power supply in the modified CMD unit.

MODIFYING CMD UNIT

1. Remove failed power supply according to procedure in paragraph 6.7.15.3 of affected manual (WLI P/N 729-0198).
2. Refer to figure 1 and proceed as follows:
   a. Identify orange wire connected between relay control (RC) printed wiring assembly (PWA) TB2-1 and pin 2 of power supply connector PS1P1.
   b. Cut red plastic cable ties holding orange wire to base pan signal harness.
   c. Disconnect orange wire from terminal RCTB2-1 and from pin 2 of power supply connector PS1P1.
   d. Remove orange wire from base pan signal harness.
   e. Using Amp Pin Extractor Tool No. 458994-1 or small screwdrivers, remove pin 2 from power supply connector PS1P1.
   f. Identify wire in base pan signal harness with three-pin connector marked PS1-P4 on one end. Other end is bent back and covered with heat shrinkable tubing.
   g. Remove heat shrinkable tubing from wire identified in last step, and solder end marked RCTB2-1 to terminal RCTB2-1 in place of orange wire disconnected in step 2c.
3. Refer to figure 2 and proceed as follows:
   a. Remove jumper from W3 position on component side of PWA.
Figure 1. Base Pan Cutaway Showing Base Pan Signal Harness and Power Supply Connector PS1P1
Figure 2. Relay Control PWA Layout Showing Location of Jumpers to Be Changed

b. Locate jumper removed in step 3a and install it in W2 position on component side of PWA.

c. Solder both ends of W2 jumper.

d. Change marking of relay control printed wiring assembly (PWA) to part number 75898850 (WLI P/N 726-5786).

INSTALLING NEW POWER SUPPLY

1. Position new power supply in CMD unit in approximate position shown in figure 1.

2. Refer to figure 6-17 in affected manual (WLI P/N 729-0198) and plug power supply connectors PSIP1 1, PSIP2 2, and PSIP3 3, into their mating connectors.
3. Refer to figure 3 and insert connector PS1-P4 into power supply connector PS1P4.

4. Use procedure in paragraph 6.7.2 of affected manual (WLI P/N 729-0198) to:

a. Lower deck assembly from maintenance position into normal position.

b. Restore electronics module to its normal position.

Figure 3. Power Supply Showing Connection for New Connector PS1P4
5. Refer to figure 6-17 in affected manual (WLI P/N 729-0198), then:
   a. Connect frame ground wire (14) at power supply end.
   b. Align holes in base plate of power supply with four mounting holes in CMD base pan.
   c. Working from under side of CMD base pan, attach power supply to CMD base pan using four screws (4).

6. Use procedure in paragraph 2.3.1 of affected manual (WLI P/N 729-0198) to power up CMD unit.
CUSTOMER ENGINEERING

PRODUCT SERVICE NOTICE

DATE: 04/08/82

CLASSIFICATION PERIPHERALS

CATEGORY DISK DRIVES

PRODUCT/APPL. CDC PHOENIX 9448 CMD

SEQUENCE # 4A

TITLE: VS SYSTEM SMD AND CMD DISK DRIVE "A" CABLE TERMINATOR INCOMPATIBILITY MODIFICATION

NOTE

This PSN supercedes PSN III.A.7-4 (729-0993) to correct its instructions as noted by vertical black bars to the right of the corrected text and the error in figure 2.

1. SCOPE

This PSN provides instructions for determining compatibility of the VS System 2260V Cartridge and Service Module Disk Drive (CMD and SMD) combinations with the 'A' Cable Terminator. The terminator incompatibility problem arises when using the standard 726-5790 (WANG) or 75866100 (CDC) terminators with daisy chained SMD and CMD units when the CMD unit is connected last in the daisy chain. In this configuration, the terminator must be modified as described in paragraph 3 to provide correct termination for the Open Cable Detect signal line.

2. COMPATIBILITY CHECK

All daisy chained VS systems (60/80/100) in the field that have a combination of SMD/CMD or all CMD drives must be checked for terminator compatibility as follows.

a. If the SMD unit is the last unit of the daisy chain in a mixed SMD/CMD VS System (see figure 1A) there is no terminator compatibility problem.
FIGURE 1. THREE POSSIBLE CONFIGURATIONS OF DAISY CHAINED MIXED SMD/CMD AND ALL CMD DISK DRIVE SYSTEMS
b. If the CMD unit is the last unit of the daisy chain in a mixed SMD/CMD VS System (see figure 1B) the following three corrective options are available:

1. Rearrange the SMD/CMD units so that an SMD unit is the last unit in the daisy chain

2. Replace incompatible terminator (726-5790 or 75886100) with compatible terminator (WANG P/N 210-7177 or 210-7477)

3. Modify terminator 726-5790 or 75886100 as described in paragraph 3 and shown in figure 2

c. If the VS System has only CMD units in the daisy chain (see figure 1C), the terminator must be either replaced with a compatible terminator or the existing terminator modified to be made compatible as described in paragraph 3 and shown in figure 2.

3. MODIFICATION OF INCOMPATIBLE TERMINATORS

The following parts and tools are required to complete this modification:

- pin vise, WPN 726-9488
- #60 DRILL, WPN 726-9490
- two 470 Ohm, 1/4 Watt resistors, WPN 330-2048
- insulator, WPN 605-0124
- solder

a. Using the pin vise and #60 drill, drill two holes from the etch side (one on each side of the ground cable) through the ground plane on the opposite side of the PWA as shown in figure 2.

b. Cut the etches leading from pins 14 and 44 of connector J1 at pins 5 and 6 respectively of resistor pack U3 as shown in figure 2.

c. Slide insulators on the both leads of the two 470 ohm resistors and solder one end of one resistor to the etch leading from pin 14 and one end of the other resistor to to the etch leading from pin 44 of connector J1 as shown in figure 2.

d. Insert the remaining end lead of each of the two resistors through the two holes drilled through the PWA and ground plane and then solder as shown in figure 2.

NOTE
Using a VOM on RX1 scale, check for zero (0) ohms resistance between resistor leads at ground plane connection and ground cable to ensure continuity. A cold solder connection will cause input/output problems.
FIGURE 2  MODIFICATION OF INCOMPATIBLE TERMINATORS
726-5790 AND 75886100.
**FIELD CHANGE ORDER**

Equipment Affected: 2280, 2280V, 6580 (CDC Phoenix 9448 CMD)

Class: Problem Only

Org. Code: 3105 (III.A.7M)

Est. Install. Time: 2.5 hours

Ref. ECO: CDC FCO 33945

* THIS SUPERCEDES FCO 1064

**220V ONLY**

1. **REASON FOR CHANGE**
   
   A. To enable use of low air option.
   
   B. To increase shroud pressure.
   
   C. To increase device cooling.

2. **DESCRIPTION OF CHANGE**

   The CDC ID# 75889887 50/60 Hz. high voltage blower is replaced by the CDC ID# 75889889 50 Hz. high voltage blower.

3. **DOCUMENTATION AFFECTED**

   "Customer Engineering Reprint CDC Cartridge Module Drive," 729-0198A. (Henceforth, referred to as the "manual").

4. **PREREQUISITE (S)**

   This FCO should be installed only in 220, 230 and 240 volt 50 Hz. units having a CDC serial number below 89,209. New blowers were cut in starting with S/N 89,210.

5. **INSTALLATION PROCEDURE**

   Before proceeding with any rework, note the following caution.

   **ESD CAUTION**

   The circuit assemblies contained in this equipment can be degraded or destroyed by ELECTROSTATIC DISCHARGE (ESD).

   Static electrical charges can accumulate quickly on personnel, clothing, and synthetic materials. When brought in close proximity to, or in contact with delicate components, ELECTROSTATIC DISCHARGE OR FIELDS can cause damage to these parts. This damage may result in degraded reliability or immediate failure of the affected component or assembly.
To insure optimum/reliable equipment operation, it is required that technical support personnel discharge themselves by periodically touching the chassis ground prior to and during the handling of ESD susceptible assemblies. This procedure is very important when handling printed circuit boards.

A. Operate the START/STOP switch to the STOP position (out position), and wait for the spindle to stop rotating (READY lamp extinguished).

B. Set circuit breaker (by input power connector on back of base pan) to OFF position.

C. Remove A.C. power cord from power source.

D. Remove top cover per section 6.7.1. of manual.

E. Raise base deck per section 6.7.2. of manual.

F. Remove blower per steps 6-8 of Section 6.7.13 of manual.

G. Remove the power supply and card cage air hoses. Wash the interior of the air hoses with water. Dry the air hoses with vacuum. Reinstall air hoses in the unit.

H. Vacuum the plenum.

I. Install the replacement blower per steps 9-11 of Section 6.7.13 of the manual.

J. Perform Check-Out Procedure described in Section 6 below.

K. Document installation of FCO by completing a Call Report or Activity Report

6. CHECK-OUT PROCEDURE

A. Reconnect A.C. power cord to power source.

B. Turn on A.C. circuit breaker. Check to see that the blower is operating. Allow unit to purge 5 minutes.

C. Turn off circuit breaker. Lower the base deck per section 6.7.2 of manual.
D. Disconnect AlPl (the voice coil lead).

E. Turn on circuit breaker. Operate START/STOP switch to the START position and allow unit to spindle up and purge for 30 minutes.

F. Operate START/STOP switch to STOP position and wait for spindle to stop rotating.

G. Turn off circuit breaker.

H. Log the FCO number on unit FCO log on the side of the electronics module.

I. Reconnect AlPl.

J. Replace top cover per section 6.7.1. of manual.

K. Return disk to normal operations.

L. Run the appropriate diagnostic listed below:

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<th>Disk Drive</th>
<th>System</th>
<th>Part #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2280</td>
<td>VP/MVP</td>
<td>702-0146</td>
<td>2200 Multi Disk Exerciser</td>
</tr>
<tr>
<td></td>
<td></td>
<td>702-0128A</td>
<td>2200 General Disk Exerciser</td>
</tr>
<tr>
<td></td>
<td>LVP/SVP</td>
<td>732-0002B</td>
<td>System Exerciser</td>
</tr>
<tr>
<td>2280V</td>
<td>VS 25/45</td>
<td>732-0019</td>
<td>FTU 25 VS 25 Stand Alone FTU (Rev 2 BP only) Rev 6111</td>
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<tr>
<td></td>
<td></td>
<td>732-0036</td>
<td>FTU 25/45 Stand Alone FTU (Rev 3 BP only) Rev 6111</td>
</tr>
<tr>
<td></td>
<td>VS 80/90/100</td>
<td>702-0099A</td>
<td>FTU On-line OIS 5.0 or later, Rev 61C4</td>
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<tr>
<td>6580</td>
<td>OIS 140</td>
<td>702-0057E</td>
<td>Master Resident Diagnostic Package Rev 2284</td>
</tr>
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M. Run 727-0116 Stand Alone TB 216.
7. **FCO KIT PARTS LISTING**

* **KIT #728-0081A**

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Item Description</th>
</tr>
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<tbody>
<tr>
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<td>1</td>
<td>FCO document 1064A</td>
</tr>
<tr>
<td>726-6883</td>
<td>1</td>
<td>CDC Kit# 77715534 which contains one CDC ID# 75889889 Blower Assembly</td>
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</table>

8. **FCO KIT AVAILABILITY DATE**

FCO Kit# 728-0081-A will be available January 9, 1984. To obtain it, place a routine order through the Logistics Order Processing System.

9. **REMOVED PARTS DISPOSITION**

The removed 50/60 Hz high voltage blower should be returned to Wang.

From Latin America, send blowers to:

Wang Latin America Headquarters  
95 Merrick Way  
Suite 620  
Coral Gables, Florida 33134

Attention: Eric Garthe

From Western Europe, send blowers to:

Wang Europe S.A./N.V.  
Keerstraat 10  
9412 Erpe-Mere, Belgium

Attention: Chuck Chorman

10. **MISCELLANEOUS**

N/A

FCO 1064A

-4-
FIELD CHANGE ORDER

Equipment Affected 2280, 2280V, 6580 (CDC Phoenix 9448 CMD)
Class Problem Only FCO Kit # 728-0047
Org. Code III.A.7 (3105) FCO Doc. # *729-1298A
Est. Install. Time 10 Minutes Ref. ECO # 27287

Page 1 of 3

1. REASON FOR CHANGE
A. To assure compatibility of the CDC Phoenix 9448 CMD (Wang model used in 2280V, 2280, and 6580) with the A-Cable Terminator.
B. To correct intermittent device selection errors.

2. DESCRIPTION OF CHANGE
* Remove CDC CMD PCB #75886100 (WLI 726-5790) and replace with 210-8017 PCB.

3. DOCUMENTATION AFFECTED
A. Wang "Customer Engineering Reprint, CDC Cartridge Module Drive", 729-0198A.
B. Wang "Cartridge Module Disk Drive, CDC Model 9448 CMD (Phoenix Drive)", 729-0199.

4. PREREQUISITE (S)
N/A

5. INSTALLATION PROCEDURE
A. Operate the START switch to the stop position.
B. Turn AC power off using AC circuit breaker shown in Figure 1.
C. Lift furniture cover with built in handle at rear of drive. See section 2.7 of Wang "Cartridge Module Disk Drive, CDC Model 9448 CMD (Phoenix Drive)", 729-0199.
D. Remove and retain the two slotted screws on the left and right side of the dust cover at the rear of the drive. Remove the dust cover. See Section 2.7 referenced above in C.
* E. Refer to Figure 1. Remove the A-Cable Terminator, CDC CMD PCB #75886100 (WLI 726-5790), from the I/O J2 slot of the I/O PWA in the electronics module.

F. Install the new A-Cable Terminator 210-8017 PCB in the I/O J2 slot of the I/O PWA in the electronics module. Insure that cable is properly attached.

G. Run Check-Out Procedure described in Section 6 below.

H. Replace dust cover and install screws.

I. Replace furniture cover.

J. Document installation of FCO by completing a Call Report or Activity Report.

**FIGURE 1 ELECTRONICS MODULE/A-CABLE TERMINATOR LOCATIONS**

FCO 1024A

-2-
6. **CHECK-OUT PROCEDURE**

Run the appropriate diagnostic listed below:

<table>
<thead>
<tr>
<th>Disk Drive</th>
<th>System</th>
<th>Part #</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2280</td>
<td>VP/MVP</td>
<td>702-0146</td>
<td>2200 Multi Disk Exerciser</td>
</tr>
<tr>
<td></td>
<td></td>
<td>702-0128A</td>
<td>2200 General Disk Exerciser</td>
</tr>
<tr>
<td>LVP/SVP</td>
<td></td>
<td>732-0002B</td>
<td>System Exerciser</td>
</tr>
<tr>
<td>2280V</td>
<td>VS 25/45</td>
<td>732-0019</td>
<td>FTU 25 VS 25 Stand Alone FTU (Rev 2 BP only) Rev 6111</td>
</tr>
<tr>
<td></td>
<td></td>
<td>732-0036</td>
<td>FTU 25/45 Stand Alone FTU (Rev 3 BP only) Rev 6111</td>
</tr>
<tr>
<td></td>
<td>VS 80/90/100</td>
<td>702-0099A</td>
<td>FTU Online OIS 5.0 or later, Rev 61C4</td>
</tr>
<tr>
<td>6580</td>
<td>OIS 140</td>
<td>702-0057E</td>
<td>Master Resident Diagnostic Package Rev 2284</td>
</tr>
</tbody>
</table>

7. **FCO KIT PARTS LISTING**

**KIT #728-0047**

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>*729-1298A</td>
<td>1</td>
<td>*FCO #1024A Document</td>
</tr>
<tr>
<td>210-8017</td>
<td>1</td>
<td>CMD-A-Cable Terminator</td>
</tr>
</tbody>
</table>

8. **FCO KIT AVAILABILITY DATE**

FCO Kit #728-0047 will be available June 13, 1983. It can be obtained by placing a routine order through Logistics Order Processing System.

9. **REMOVED PARTS DISPOSITION**

Return CDC CMD PCB #75886100 (WLI 726-5790) to Home Office FSC, RDB 3933.

10. **MISCELLANEOUS**

This FCO formally resolves the A-Cable Terminator incompatibility problem described in PSN III.A.7.4A.

FCO 1024A
1. REASON FOR CHANGE

A. To assure compatibility of the CDC Phoenix 9448 CMD (Wang model used in 2280V, 2280, and 6580) with the A-Cable Terminator.

B. To correct intermittent device selection errors.

2. DESCRIPTION OF CHANGE

Remove CDC CMD PCB #75886100 and replace with 210-8017 PCB.

3. DOCUMENTATION AFFECTED

A. Wang "Customer Engineering Reprint, CDC Cartridge Module Drive", 729-0198A.

B. Wang "Cartridge Module Disk Drive, CDC Model 9448 CMD (Phoenix Drive)", 729-0199.

4. PREREQUISITE (S)

N/A

5. INSTALLATION PROCEDURE

A. Operate the START switch to the stop position.

B. Turn AC power off using AC circuit breaker shown in Figure 1.

C. Lift furniture cover with built in handle at rear of drive. See section 2.7 of Wang "Cartridge Module Disk Drive, CDC Model 9448 CMD (Phoenix Drive)", 729-0199.

D. Remove and retain the two slotted screws on the left and right side of the dust cover at the rear of the drive. Remove the dust cover. See Section 2.7 referenced above in C.
E. Refer to Figure 1. Remove the A-Cable Terminator, CDC CMD PCB #7586100, from the I/O J2 slot of the I/O PWA in the electronics module.

F. Install the new A-Cable Terminator 210-8017 PCB in the I/O J2 slot of the I/O PWA in the electronics module. Insure that cable is properly attached.

G. Run Check-Out Procedure described in Section 6 below.

H. Replace dust cover and install screws.

I. Replace furniture cover.

J. Document installation of FCO by completing a Call Report or Activity Report.

---

**Figure 1** ELECTRONICS MODULE/A-CABLE TERMINATOR LOCATIONS
6. CHECK-OUT PROCEDURE

Run the appropriate diagnostic listed below:

<table>
<thead>
<tr>
<th>Disk Drive</th>
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<tr>
<td>2280</td>
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<td></td>
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<td>702-0128A</td>
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</tr>
<tr>
<td></td>
<td>LVP/SVP</td>
<td>732-0002B</td>
<td>System Exerciser</td>
</tr>
<tr>
<td>2280V</td>
<td>VS 25/45</td>
<td>732-0019</td>
<td>FTU 25 VS 25 Stand Alone FTU (Rev 2 BP only) Rev 6111</td>
</tr>
<tr>
<td></td>
<td></td>
<td>732-0036</td>
<td>FTU 25/45 Stand Alone FTU (Rev 3 BP only) Rev 6111</td>
</tr>
<tr>
<td></td>
<td>VS 80/90/100</td>
<td>702-0099A</td>
<td>FTU Online OIS 5.0 or later, Rev 61C4</td>
</tr>
<tr>
<td>6580</td>
<td>OIS 140</td>
<td>702-0057E</td>
<td>Master Resident Diagnostic Package Rev 2284</td>
</tr>
</tbody>
</table>

7. FCO KIT PARTS LISTING

KIT #728-0047

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>729-1298</td>
<td>1</td>
<td>FCO #1024 Document</td>
</tr>
<tr>
<td>210-8017</td>
<td>1</td>
<td>CMD-A-Cable Terminator</td>
</tr>
</tbody>
</table>

8. FCO KIT AVAILABILITY DATE

FCO Kit #728-0047 will be available June 13, 1983. It can be obtained by placing a routine order through Logistics Order Processing System.

9. REMOVED PARTS DISPOSITION

N/A

10. MISCELLANEOUS

This FCO formally resolves the A-Cable Terminator incompatibility problem described in PSN III.A.7.4A.
1. **REASON FOR CHANGE**
   
   A. To prevent read cache from being lost when a reset is issued from one of the terminals on the system.
   
   B. To allow the DPU to reselect the destination drive when dumping the multi-sector write cache to one of the drives.

4. **DESCRIPTION OF CHANGE**
   
   Four PROM's on the 210-7423-A PCA are changed.

3. **DOCUMENTATION AFFECTED**
   
   N/A

4. **PREREQUISITE (S)**
   
   Refer to Step 10 for a list of serial numbers of units requiring this change.

5. **INSTALLATION PROCEDURE**
   
   A. Power off. Remove AC plug at wall.
   
   B. Refer to "Customer Engineering Maintenance Manual" (729-0971) p.4.3, sections 4.5 through 4.5.1 for top cover removal/replacement procedures.
   
   C. Refer to Figure 1. Remove the 210-7423-A PCA from the Disk Processing Unit (DPU).
   
   D. Refer to Figure 2. Change PROM's on the 210-7423-A PCA as follows:
      
      1. Component Side:
         
         


E. Reassemble the unit by reversing the procedures in Steps A through C.

F. Perform check-out procedure described in Section 6 below.

G. Document installation of this FCO by completing a Call Report or Activity Report.

**FIGURE 1**

CIRCUIT BOARD LOADING
6. **CHECK-OUT PROCEDURE**

Run 2280 Disk Diagnostics from 2200 Diagnostics Package #195-2956-0.

7. **FCO KIT PARTS LISTING**

**KIT #728-0104**

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty</th>
<th>Item Description</th>
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</thead>
<tbody>
<tr>
<td>729-1482</td>
<td>1</td>
<td>FCO Document 1086</td>
</tr>
<tr>
<td>378-4083-R8</td>
<td>1</td>
<td>PROM</td>
</tr>
<tr>
<td>378-4084-R8</td>
<td>1</td>
<td>PROM</td>
</tr>
<tr>
<td>378-4085-R8</td>
<td>1</td>
<td>PROM</td>
</tr>
<tr>
<td>378-4086-R8</td>
<td>1</td>
<td>PROM</td>
</tr>
</tbody>
</table>

8. **FCO KIT AVAILABILITY DATE**

FCO Kit # 728-0104 will be available May 7, 1984. It can be obtained by placing a routine order through the Logistics Order Processing System.

9. **REMOVED PARTS DISPOSITION**

Recycle removed PROM's through your FSC.

10. **MISCELLANEOUS**

This FCO applies to units that fall within the following serial number ranges.

<table>
<thead>
<tr>
<th>Serial Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>026513</td>
</tr>
<tr>
<td>135033 through 135984</td>
</tr>
<tr>
<td>687297</td>
</tr>
<tr>
<td>941797</td>
</tr>
<tr>
<td>DL5772</td>
</tr>
<tr>
<td>EB1277</td>
</tr>
<tr>
<td>EB1339 through EB1341</td>
</tr>
<tr>
<td>EB2626 through EB2632</td>
</tr>
<tr>
<td>FY1038</td>
</tr>
<tr>
<td>GN1706</td>
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<tr>
<td>GU1341</td>
</tr>
<tr>
<td>HN2809</td>
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<tr>
<td>HU1505</td>
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<tr>
<td>HU2465</td>
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<td>HU3775</td>
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<tr>
<td>HU5714</td>
</tr>
<tr>
<td>HU8365</td>
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<tr>
<td>HV1955</td>
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<tr>
<td>KV4680 through KV4813</td>
</tr>
<tr>
<td>KV5354 through KV5608</td>
</tr>
<tr>
<td>KV8056 through KY8454</td>
</tr>
<tr>
<td>LS1747</td>
</tr>
<tr>
<td>LY2317</td>
</tr>
<tr>
<td>NS17464 through NS17468</td>
</tr>
</tbody>
</table>
CUSTOMER ENGINEERING DIVISION

NEW PRODUCT NOTICE

PRODUCT: PHOENIX DISK DRIVE
MODEL NO: 2280, 2280V, 6580

NO: 7
DATE: 4/25/79

I. DESCRIPTION

The Phoenix Disk Drive is designed to be a high performance, random access, mass storage device. It is an available option for the Wang 2200 VP, 2200 MVP, 2200 VS, and Office Information System 140. The Phoenix is available to the 2200 VP and MVP as a Model 2280-1, -2, or -3; to the 2200 VS as a Model 2280V-1, -2, or -3; and to the OIS 140 as a Model 6580-1, -2, or -3.

The 2200 VS is interfaced to the Phoenix Drive by an IOP device at the CPU (see VS Interface RSL). The 2200VP and MVP are interfaced to the Phoenix by an I/O Controller at the CPU and a micro-processor attached to the Phoenix Drive (see Microprocessor RSL). The OIS interface will be outlined in a later NPN.

Storage capacity for the 2280 and 6580 models is as follows:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CAPACITY (In Bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>26,836,992 (27 Mbytes)</td>
</tr>
<tr>
<td>-2</td>
<td>53,673,894 (54 Mbytes)</td>
</tr>
<tr>
<td>-3</td>
<td>80,510,976 (80.5 Mbytes)</td>
</tr>
</tbody>
</table>

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WANG
LABORATORIES, INC.
ONE INDUSTRIAL AVENUE, LOWELL, MASSACHUSETTS 01851, TEL. (617) 891-4111, TWX 710 343-6769, TELEX 94-7421

Printed in U.S.A. 13-3289
The 2280V has a greater storage capacity then either the 2280 or 6580 Models because of a difference in formatting. The storage capacity of the 2280V is as follows:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CAPACITY (In Bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>30,265,344 (30 Mbytes)</td>
</tr>
<tr>
<td>-2</td>
<td>60,530,688 (60 Mbytes)</td>
</tr>
<tr>
<td>-3</td>
<td>90,796,032 (90 Mbytes)</td>
</tr>
</tbody>
</table>

In all models (2280, 2280V, 6580) 13.5 Mbytes are removable, the remainder is stored on from 1 to 5 fixed surfaces depending on the model number.

Specifications:
- Height 10.5 Inches (264 mm)
- Width 19.0 Inches (483mm)
- Length 31.75 Inches (806mm)
- Weight 170 lbs. (77.1kg)

*Power Requirements:
- 120VAC ±10% / 230VAC ±10%
- 60Hz ±1Hz / 50Hz ±1Hz
- 8.2A (15A at start up) / 4A (7.5A at start up)
- .950KWH

*The Disk Drive should have a separate dedicated power line.

II. MAINTENANCE

Maintenance requirements are similar to those of the 80/300 Meg Drive. An FTU (Field Test Unit) is necessary to simulate the control unit allowing the drive unit to be repaired off-line. See RSL for necessary alignment cables, alignment extender, head adjustment tool, spare boards, etc. A maintenance manual is currently being written and will be available in early May.
Following is the distribution strategy for the various test equipment used with the Phoenix Disk Drive:

**TB-216 (Field Test Unit)**
Distribution: One per Subsidiary
  Two per Area
  One per District
  Six to Home Office Repair
  Six to Home Office Training

**Alignment Tool**
Distribution: One per each domestic city
  Two per each Subsidiary
  Two per Area
  Four to Home Office Repair
  Six to Home Office Training
  Sixty for Rep coverage

**Alignment Pack**
Distribution: One per each domestic city
  Two per each Subsidiary
  Two per Area
  Four to Home Office Repair
  Six to Home Office Training
  Sixty for Rep coverage

III. LOGISTICS

A. Equipment Allocations:

There will be no automatic allocations of spares or serialized equipment. See section D for ordering procedures.

B. Recommended Spares List:

See attached RSL
C. Disposition Of Bad Parts:

Defective subassemblies will be returned to either Area or Home Office for exchange, as per RSL. Individual defective parts will be scrapped locally and replacements ordered.

D. Ordering Procedure:

Spare or serialized equipment must be ordered as follows:

Telex to: (TELEX #947-151)

LOGIC

ATTN: SUSAN HOMOLISKI

WANG MODEL NO.: 

WANG PART NO.: (If Serialized Equipment)

REQUESTING PERSON: 

RDB #: 

SHIP TO ADDRESS: 

SHIP TO PERSON: 

SALES ORDER NUMBER: 

ADDITIONAL REQUIREMENTS: 

________________________________________

________________________________________

COMMENTS: 

This request may be submitted when sales order is placed or at scheduling of installation.

Logistics will screen shipments from Distribution to help ensure that required spares and serialized equipment have been ordered by the installing RDB. If no order has been placed, Logistics will enter one and notify the installing RDB.

IV. DELIVERY

Limited delivery of both the 2280 and 2280V Drives has already begun with full scale delivery scheduled for late May, 1979. Delivery of the 6580 is not scheduled until June, 1979.
V. TRAINING

The first training class for the Phoenix Disk Drive is scheduled to be given May 14-18. A second class is scheduled for June 25-29. An audio-visual course on the Phoenix is also available. It is recommended that Area Offices have WPS personnel trained on the Phoenix to ensure support for it when it appears on the OIS 140.
# RECOMMENDED SPARES LIST

**Model Name:** PHOENIX DISK DRIVE  
**Part No.:** 725-0076, 726-0076-1 (50Hz)  
**Model No.:** 2280, 2280V, 6580  
**OEM Vendor(s):** CDC

<table>
<thead>
<tr>
<th>WANG PART NUMBER</th>
<th>OEM PART NUMBER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>NAME and DESCRIPTION</th>
<th>REPLACEABLE BRANCH, REPAIR DEPOT</th>
<th>REPAIR SOURCE AREA</th>
<th>H.O. AREA</th>
<th>RECOMMENDED QTY. - INITIAL SPARES</th>
<th>DIST. BRANCH</th>
<th>REPAIR DEPOT</th>
<th>COMMENTS</th>
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**Date:** 3/30/79  
**NO:** 2211 - REV 1  
**PLANNER:** 22

**Sheet 1 of 3**
# RECOMMENDED SPARES LIST

## Model Name: PHOENIX DISK DRIVE

### Part No.: 725-0076, 726-0076-1 (50Hz)

### Model No.: 2280, 2280V, 6580

### OEM Vendor(s): CDC

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**DATE:** 3/30/79  
**NO:** 2211 - REV 1  
**PLANNER:** 22  

**Sheet 2 of 3**
# RECOMMENDED SPARES LIST

**Model Name:** PHOENIX DISK DRIVE  
**Part No.:** 725-0076, 726-0076-1 (50HZ)  
**Model No.:** 2280, 2280V, 6580  
**OEM Vendor(s):** CDC  
**DATE:** 3/30/79  
**NO.:** 2211 - REV 1  
**PLANNER:** 22

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**SHEET 3 OF 3**
# RECOMMENDED SPARES LIST

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**Part No.:** 177-22VS-93  
**Model No.:** 2280V  
**OEM Vendor(s):**

**DATE:** 3/30/79  
**NO:** 2203 - REV 1  
**PLANNER:** 22

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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1220-0105-3</td>
<td></td>
<td>X</td>
<td></td>
<td>INTERFACE CABLE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PRECAUTIONARY GUIDELINES FOR MODEL 2280-SERIES DISK DRIVES

NOTE:

The 2280-series (Phoenix CMD) disk drives, the newest members of the 2200 systems disk family, are extremely delicate. Although the operating theory for the 2280-series disks drives combines elements of theory common to the earlier Hawk and SMD drives, the 2280-series equipment has been refined to such a critical point that existing "rules of thumb" used with the earlier drives are not adequate for the 2280-series units. The 2280-series drives have their own set of guidelines, particularly with respect to preventing head crashes, and these guidelines must be followed to ensure problem-free operation. This SNL provides both specific information that is applicable only to CE/service representatives and more- general usage guidelines that are also applicable to customer personnel using the equipment. Each Customer Engineer should see to it that all applicable customer personnel know of and adhere to the applicable usage guidelines, discussed in paragraph C.

A. INSTALLATION GUIDELINES

The following guidelines pertain to handling of the 2280-series equipment during system installation:

1. Inspect the carriage assembly and read/write heads very carefully for any signs of shipping damage.

2. Check that all pieces of packing material are removed, and ensure that the disk drive unit is clean inside.

3. If the interior of the disk drive unit must be cleaned, use only lint-free cloth.

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4. Never move the unit any significant distance without first putting the carriage locking pin in place to prevent the heads from moving onto the disks surfaces, which could damage the heads and/or disks.

5. Do not position the carriage manually. Such action could move the read/write heads onto the disks, causing the heads and/or disks to become damaged.

6. Do not leave the deck assembly in its raised position except while absolutely necessary for maintenance activities. (Contamination falling into the absolute filter exit while the deck is raised could be blown into the disk area when normal operation is resumed.)

7. Do not attempt to override any interlocks in the system. They are included for good reasons and should not be defeated at any time.

8. Purge all newly installed disk drives for at least 10 minutes. To purge, disconnect voice-coil power at A1P1 and then start the unit. Under these conditions, the spindle turns but the heads will not load.

9. Do not load the heads manually during the purge operation.

B. MAINTENANCE GUIDELINES

The following guidelines pertain to handling of the 2280-series disk drives during maintenance activities:

1. Change (clean) the disk drive's air filters at least every six months. In a very dusty environment, change them more often.

2. Since the 2280-series drives do not have an upper guard rail, take extreme care to not move the carriage assembly in a lateral direction (right angles to the normal direction of head movement) when turning the clamping screws to adjust the heads while the heads are flying. The resultant force from such motion could rotate the carriage assembly and cause severe damage to the heads and disks. To prevent this motion, carefully apply sufficient counter force on the opposite side of the carriage assembly while turning the screws.
C. SERVICE-RELATED AND CUSTOMER-RELATED GUIDELINES

The following guidelines pertain to handling of the 2280-series disk drives during normal operation. These guidelines must be followed both by service representatives and by customer-user personnel in order to ensure troublefree operation.

1. Disk cartridges can be stored either flat or on edge. If stored flat, the cartridges must be stored right-side-up. Although several cartridges can be stacked on top of one another, avoid stacking them more than five high, which could cause excessive pressure.

2. Keep a disk cartridge in the disk drive at all times, whether operating or not, so as to guarantee proper sealing of the shroud area from environmental contaminants.

3. Keep the disk-cartridge dust cover on the disk cartridge while that cartridge is outside of the disk receiver. The cover ensures a positive dust seal and immobilizes the contained disk.

4. While a cartridge is in the drive, with its bottom dust cover removed, store that dust cover upside down to prevent dust from collecting inside the cover.

5. Unless the pack access door must be opened for maintenance, keep that door closed to prevent dust from entering the pack area.

6. Whenever possible, leave disk drive ac power on at all times to ensure positive pressure in the pack area and to keep dust out.

7. If disk drive power must be turned off, do not open the circuit breaker switch until the disk has stopped rotating. (Blower power must be on whenever the disk is rotating, in order to prevent the disk drive unit from sucking in unfiltered air.)
A new disk drive, the Model 2280, has been added to the line of Mass Storage Devices that is available for use with the 2200 VP/MVP computer systems. Unlike other large capacity disk systems where the storage media is only available as either an entirely fixed volume or an entirely removable cartridge, the 2280 provides a single 13.4 megabyte removable cartridge and from 13.4 to 67 megabytes of fixed volume storage all within the same drive unit. The 2280 is available in three models; 2280-1, 2280-2 and 2280-3, with the smallest model (-1) providing approximately 27 megabytes of storage and the largest model (-3) providing approximately 80.5 megabytes. The 2280 disk controller and microprocessor allow two disk drives to be daisy-chained, providing up to 161 megabytes of on-line storage.

**PHYSICAL CHARACTERISTICS**

The Model 2280 is composed of a CDC Phoenix disk drive and a Wang manufactured microprocessor. Both the drive and microprocessor are contained in a single free-standing unit. The unit features a hinged front door for easy loading and removal of the one removable cartridge that the drive accommodates. The disk drive also contains a three platter fixed volume with the capacity of the volume being specified by way of a selected jumper configuration that is located in the disk drive. The jumper configuration is dependent on the model designation.

**STORAGE CAPACITY**

As stated previously, the 2280 physically contains four disk platters; one removable and three fixed. The number of fixed platters that are actually used depends on the model. The 2280-1 uses one fixed platter, the 2280-2 uses two and the 2280-3 uses three. One surface of the removable platter contains servo information which is
used by the disk drive and is not available to the user. The remaining surface of the removable platter is accessible by the user. The three fixed platters are normally referred to as the fixed volume. Regardless of the model, only one surface in the fixed volume is a servo surface and is not accessible by the user. The remaining fixed surfaces (1 for a 2280-1, 3 for a 2280-2 and 5 for a 2280-3) are available to the user. Each usable surface, fixed and removable, has a unique device address in the 2200 system. The addresses are D10 (D20,D30), D11 (D21,D31), D12 (D22,D32), D13 (D23,D33), D14 (D24,D34) and D15 (D25,D35). The relationship between the usable surfaces along with their addresses, and the physical disk platters is shown in Table 1.

TABLE 1

<table>
<thead>
<tr>
<th>Cartridge</th>
<th>Servo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D10</td>
</tr>
<tr>
<td>Fixed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>D11</td>
</tr>
<tr>
<td></td>
<td>D14</td>
</tr>
<tr>
<td></td>
<td>D15</td>
</tr>
</tbody>
</table>
Each usable surface is divided into a number of concentric recording tracks. Each surface has 824 tracks and every track is, in turn, sub-divided into 64 sectors. A sector is the smallest addressable unit on the disk platter and can store 256 bytes of information. The sectors on each surface are sequentially numbered and individual sectors can be directly addressed.

In addition there are 64 sectors (1 track) reserved on each usable surface for alternate sector addressing.

The exact storage capacities of the three models are shown below.

<table>
<thead>
<tr>
<th>Disk Unit</th>
<th>2280-1</th>
<th>2280-2</th>
<th>2280-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sectors/Surface</td>
<td>52,608</td>
<td>52,608</td>
<td>52,608</td>
</tr>
<tr>
<td>Total Sectors</td>
<td>105,216</td>
<td>210,432</td>
<td>315,648</td>
</tr>
<tr>
<td>Bytes Removable</td>
<td>13,467,648</td>
<td>13,467,648</td>
<td>13,467,648</td>
</tr>
<tr>
<td>Bytes Fixed</td>
<td>13,467,648</td>
<td>40,402,944</td>
<td>67,338,240</td>
</tr>
<tr>
<td>Total Bytes</td>
<td>26,935,296</td>
<td>53,870,592</td>
<td>80,805,888</td>
</tr>
</tbody>
</table>
PERFORMANCE

Rotation Speed ........................................ 3600 rpm
Average Access Time (position head to track) ....... 30 ms
Latency Time - Average (one-half revolution) ...... 8.33 ms (@ 3600 rpm)
Read/Write Time - One 256 byte sector including
  CPU/Controller overhead ............................. 9.33 ms
Move/Copy Time ....................................... Approx. 5 min per surface (13.4 Mbytes)

GENERAL SPECIFICATIONS

Physical Dimensions (w/cabinet stand enclosure)

  Height ...... 36 in. (91.4 cm)
  Width ...... 20.4 in. (51.8 cm)
  Depth ...... 32.6 in. (82.8 cm)

Weight ........ 170 lb (77.1 kg)

Power Requirements

Voltage ......... 115 or 230 VAC ± 10%, 50 or 60 HZ ± 1 cycle
Current

  Start-up ...... 15 amps (@ 120 VAC)
  Running ...... 8.2 amps (@ 120 VAC)

Cabling ........ 10 ft (3m.) cable to the disk controller board in CPU
  8 ft (2.5m.) to power source

Operating Environment .... 50°F to 95°F (10°C to 35°C)
  20% to 80% relative humidity
OPERATING SYSTEM REQUIREMENTS

The following are the minimum VP/MVP System requirements for the installation and operation of a 2280.

1a. 2200 VP  O.S. 2.0  WL #701-2118 J
1b. 2200 MVP  O.S. 1.7  WL #701-2294 H

2. The VP/MVP Bootstrap proms must be R1 version. 

3. A single disk controller modified for MVP use must be used (210-6541-2), on both VP and MVP systems.

4. A dual printer/disk controller may be used (210-7042-2).

* NOTE: The 2280 is not supported on 2200 B, C, S, or T CPU's or workstations.
FORMAT UTILITY

Before either the fixed or removable volumes can be used to store programs or data, they each must be formatted. Wang provides a utility program, $\text{FORMAT}$, that will reside on the VP/MVP operating system disk of each 2280 disk drive which can be used to format the disk surfaces. This utility requests that the operator identify the surface which is to be formatted with its logical address, and then automatically issues the appropriate instruction sequence to certify, format and verify the designated surface. Formatting should be necessary only once for each surface unless the surface begins to produce frequent read/write errors; in this case, reformatting may correct the problem. Reformattting, however, destroys all information previously recorded on the surface.

During the process of formatting, the disk controller writes control information (including sector address and error checking information) onto each disk sector and then fills the 256 byte user data area of the sector with zeros on the last pass. The disk controller also automatically performs a verification check to insure that the media is suitable for system use. The formatting processes are performed automatically under software control and if any sectors are found bad, the disk controller reassigns the bad sector to another sector in the spare track (823). Sector zero of track 823 contains a map of sectors that have been alternately assigned. When all sectors on the surface are formatted, the surface is ready to store programs and data. An I93 error that occurs during formatting indicates the surface is unacceptable for use because either sector zero of track 823 is bad or more than 2 sectors are bad in track 823.
INSTALLATION PROCEDURE

CONTROLLER - VOLTAGE ADJUSTMENT PROCEDURE

1. Remove top cover of controller.
2. Place L567 circuit board on an extender.
3. Turn Supply power ON.
4. Using a Digital Voltmeter check voltages for specified value(s) between the point indicated and +0V, as listed in Table 2. Adjust L567 pc trimpots to obtain correct voltage levels only where necessary. Never allow the -15VR power supply to exceed -17 vdc, otherwise permanent damage to the controller will result.
5. With an oscilloscope and X1 probe, measure the ripple at the points indicated in Table 2. AC ripple should not exceed the limits specified. If any voltage or ripple measurement is out of specification, troubleshoot the power supply.

---

**TABLE 2**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>VOLTAGE</th>
<th>LIMITS</th>
<th>ADJ</th>
<th>RIPPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>L567 Pin 1&lt;sub&gt;1&lt;/sub&gt;</td>
<td>+5VRM</td>
<td>+4.90 vdc to +5.10 vdc</td>
<td>R17&lt;sup&gt;2&lt;/sup&gt;</td>
<td>15 mvp-p</td>
</tr>
<tr>
<td>L567 Pin 2&lt;sub&gt;1&lt;/sub&gt;</td>
<td>+5VRL</td>
<td>+4.90 vdc to +5.10 vdc</td>
<td>R2&lt;sup&gt;1&lt;/sup&gt;</td>
<td>15 mvp-p</td>
</tr>
<tr>
<td>L567 Pin 12&lt;sub&gt;1&lt;/sub&gt;</td>
<td>+8VR</td>
<td>+8.50 vdc to +8.80 vdc</td>
<td>R13&lt;sup&gt;3&lt;/sup&gt;</td>
<td>20 mvp-p</td>
</tr>
<tr>
<td>L567 Pin 15&lt;sub&gt;1&lt;/sub&gt;</td>
<td>+12VR</td>
<td>+11.80 vdc to +12.20 vdc</td>
<td>R30&lt;sup&gt;4&lt;/sup&gt;</td>
<td>15 mvp-p</td>
</tr>
<tr>
<td>L567 Pin 5&lt;sub&gt;1&lt;/sub&gt;</td>
<td>-12VR</td>
<td>-11.80 vdc to -12.20 vdc</td>
<td>R34&lt;sup&gt;6&lt;/sup&gt;</td>
<td>15 mvp-p</td>
</tr>
<tr>
<td>L567 Pin 6&lt;sub&gt;1&lt;/sub&gt;</td>
<td>-15VR</td>
<td>-14.80 vdc to -15.20 vdc</td>
<td>R40&lt;sup&gt;5&lt;/sup&gt;</td>
<td>25 mvp-p</td>
</tr>
</tbody>
</table>
CABLE CONNECTIONS

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Cable #</th>
</tr>
</thead>
<tbody>
<tr>
<td>6541-2(7042-2)</td>
<td>210-7421</td>
<td>220-0138</td>
</tr>
<tr>
<td>7422 Bottom</td>
<td>Drive 1 V0 BRD</td>
<td>220-3041 &quot;A&quot; Cable</td>
</tr>
<tr>
<td>7422 Mid</td>
<td>Drive 1 CONTROL/MUX</td>
<td>220-3033-1 &quot;B&quot; Cable</td>
</tr>
</tbody>
</table>

Daisy Chain (Same as above plus the following)

<table>
<thead>
<tr>
<th>Drive 1</th>
<th>Drive 2</th>
<th>Cable #</th>
</tr>
</thead>
<tbody>
<tr>
<td>7422</td>
<td>Drive 2</td>
<td>220-3031 &quot;A&quot; Cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>220-3033-4 &quot;B&quot; Cable</td>
</tr>
</tbody>
</table>

BOARD LAYOUT

<table>
<thead>
<tr>
<th>Board</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>210-7421</td>
<td>ALU/MUX</td>
</tr>
<tr>
<td>210-7422</td>
<td>Eco/Disk Interface</td>
</tr>
<tr>
<td>210-7423</td>
<td>PROM/RAM</td>
</tr>
<tr>
<td>210-7424</td>
<td>Disk I/O Control</td>
</tr>
</tbody>
</table>

DRIVE SETUP

1. Before applying power, check the Control Mux board in the Phoenix drive to make sure the drive capacity selected matches the drive capacity listed on the work order by using Table 3.

   TABLE 3

<table>
<thead>
<tr>
<th>Drive Type</th>
<th>Setting of U3 on Control MUX Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>2280-1</td>
<td>! Cut between pins 6-11</td>
</tr>
<tr>
<td>2280-2</td>
<td>! Cut between pin 6-11 and 7-10</td>
</tr>
<tr>
<td>2280-3</td>
<td>! Cut between pins 6-11 and 8-9</td>
</tr>
</tbody>
</table>

2. It is also necessary to ensure the system is set up for 64 sector operation. Do this by setting switch 7 of the switch bank on the Servo Coarse board to the ON position and all others to the OFF position.
3. Install the drive select plug in the front panel of the drive. The only valid drive numbers are one and two. The number one plug should be installed in the Master drive; the number two plug should be installed in the Slave Drive.

4. Install a ground strap (WLI #220-1198) at least 18 Awg. from the terminal at the rear of the drive marked DC grd to the 2280 controller ground.
OPERATING INSTRUCTIONS

After performing the installation procedure, apply power to the CPU, microprocessor, and disk drive. When the door lock solenoid picks, open the cartridge door and insert a CDC 1204 cartridge; close the door and press start. The ready light should blink while the drive comes up to speed. The ready light will stay lit when the drive is ready for operation.
DIAGNOSTICS

A new diagnostic will be available for testing the 2280 disk under diskette WL #XXX-XXXX. An additional feature on this diskette is a 2280 head alignment utility which when used with a mini-alignment kit (WLI # 726-5611) eliminates the need for a CDC field test unit to perform head alignment. The following is a description of the diagnostic and its operation.

To operate the diagnostics enter the following:

SELECT DISK (ADDRESS OF DISK WHICH CONTAINS DIAGNOSTICS) (EXEC)

LOAD DCT "START" (EXEC)

RUN (EXEC)

The following should appear on the screen:

SF '0 --- DISK ACCESS TEST
SF '1 --- RANDOM VERIFY TEST
SF '2 --- MULTI-SECTOR TEST
SF '3 --- COPY TEST
SF '4 --- READ AND WRITE ON ONE SECTOR
SF '5 --- READ ONE SECTOR
SF '6 --- RANDOM READ AFTER WRITE (ALL SURFACES)
SF '7 --- RANDOM READ/WRITE TEST (ONE SURFACE)
SF '8 --- PHOENIX HEAD ALIGNMENT

: ___ STOP
The following prompts pertain to all the tests except 4, 5, 8. These tests will be explained later. Depress the appropriate special function key to select the desired test. The following will then appear:

***** DISK UNIT DIAGNOSTIC SET UP *****

WHICH DISK IS TO BE TESTED?  1 4

1. 2270-1
2. 2270A-1
3. 2270-2
4. 2270A-2
5. 2270-3
6. 2270A-3
7. 2230-1
8. 2230-2 or 2260B/C-1/4
9. 2230-3 or 2260B/C-1/2
10. 2260 B/C
11. 2260 B/C-2
12. 2280-1
13. 2280-2
14. 2280-2
15. Twin 2280-3
16. 2nd 2280-3

Select the type of drive to be tested by entering one of the numbers (1 thru 16) and keying (EXEC).

The following will appear:

DISK MODEL: (TYPE OF DISK SELECTED)

HAVE ALL SURFACES BEEN FORMATTED (Y or N)?  Y

<table>
<thead>
<tr>
<th>SURFACE NO.</th>
<th>PLATTER ADDRESS</th>
<th>START SECTOR</th>
<th>END SECTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>(ADDRESS)</td>
<td>0</td>
<td>52607</td>
</tr>
<tr>
<td>2.</td>
<td>(SELECTED)</td>
<td>0</td>
<td>52607</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>0</td>
<td>52607</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>0</td>
<td>52607</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>0</td>
<td>52607</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>0</td>
<td>52607</td>
</tr>
</tbody>
</table>
Enter Y or N then (EXEC). The following will appear:

**DISK MODEL: (TYPE OF DISK SELECTED)**

**WHICH SURFACE IS TO BE CHANGED (CR IF NONE)? _____**

At this time if any surface is not to be tested, the surface number (1 thru 6) should be entered, then (EXEC). If all surfaces are to be tested then only (EXEC) should be entered. To eliminate one or more than one surface from being tested, perform the following.

Enter the first surface number not to be tested, then key (EXEC). The following will appear:

**DISK MODEL: (TYPE OF DRIVE SELECTED)**

**IS THIS SURFACE TO BE TESTED (Y or N)? Y**

Enter N then (EXEC). The start and end sector numbers should not appear on the screen for the surface(s) not to be tested. Continue this procedure until all surfaces not to be tested have been entered.

Tests 4, 5, 8 differ slightly from the format of the other tests. Following is a brief explanation of each:

**SF 4:** Test 4 performs continuous reads and write of a selected sector. If test 4 is selected the following appears on the screen.

**STOP DATA ON DISK WILL BE Clobbered! Continue?**

Key CONTINUE, (EXEC) and the following will appear:

**DISK ADDRESS / 3 2 0**
Enter the address of the desired surface and the following appears.

SECTOR ADDRESS

Key in the desired sector address then (EXEC). The test should begin. The data pattern used is displayed on the left side of the screen and the number of accesses on the right. Key HALT to stop test.

SF 5: This test allows you to read one sector and display the data on the screen. This test can also be used to read the alternate sector map which is not normally available to the user. To run this test, select the disk and sector addresses as described in SF 4. After the data read from the sector is displayed, there are five options available.

SF 0: This SF key allows you to select another surface.

SF 1: This SF key allows you to select another sector on the same surface.

SF 2: This SF key will read the next sequential sector of the selected surface.

SF 3: This SF key converts the data read from sector 52608 (alternate sector map) to indicate which sectors have been alternately assigned during formatting.

SF 19 After the data is read from a sector, the data can be changed and written back onto a sector thru use of this key.
TEST DESCRIPTION

SF 0: This test performs 20 passes of random seeks then performs sequential writes and reads. After this, random read/writes are performed. This test runs continuously and will destroy data on the surfaces selected for testing.

SF 1: This test performs random verifies and runs continuously. This test does not destroy data.

SF 2: This test performs multi-sector writes with a pattern determined by the diagnostic. This test will destroy data and runs continuously.

SF 3: This test copies the data found in randomly selected sectors to other randomly selected sectors. This test will destroy data and runs continuously.

SF 4: This test writes and reads on one sector continuously and will destroy data.

SF 5: This test will read one sector and display the data read. This test can be used to determine alternate sector assignments. This can be done by reading sector 52608 and then depressing SF '3. This test does not destroy data.

SF 6: This test performs random writes/reads on selected surfaces. This test destroys data and runs continuously.

SF 7: This test uses only one surface. It starts out with a verify of the selected surface, then performs 100 maximum seeks. After this, the test performs random writes/reads of single sectors.

SF 8: This kit is used in conjunction with the mini alignment kit to replace the CDC field test unit by positioning the R/W heads over the alignment tracks.
Due to the unavailability of the present time of alignment packs from CDC, we have been forced to vary slightly from our recommended installation policies for Phoenix drives.

The pack contained in this box is a master data pack which is not to be used to perform alignments, but only to check that head alignment has not changed during shipment. Because a high percentage of drives arrive with the heads still in alignment, this master data pack determines whether or not a head alignment is required. This allows us to provide an alignment pack only where it is really necessary. There are two versions of these data packs available. One is for VS and one for VP/MVP. The label on the pack indicates which version the pack is. The following is the procedure to determine if the drive is in alignment.

A. VP/MVP SYSTEMS

1. After the drive has been installed at the customer's location, install the master data pack and allow the drive to purge for 5 minutes (start button depressed, voice coil plug disconnected) then continue with step 2.

2. Enter the following on the VP/MVP console;

   VERIFY T/DXX, (9, 58607) (EXEC)

   XX = DRIVE ADDRESS (10, 20, 30)

3. Visually check the head carriage to verify that no errors (hard or soft) occur. Hard errors are displayed on the screen, while soft errors are indicated by the head carriage performing a restore and a re-seek.

4. If no errors (hard or soft) occur, then the drive does not require a head alignment.
5. If any verify errors occur, remove the master data pack and install a scratch pack.

6. Format the scratch pack (Head 0) using the format utility on the system platier.

7. Perform steps 2 and 3 again.

8. If no errors occur, request an alignment pack. If errors occur, a hardware problem exists. Correct the hardware problems and return to step 1.

II. VS SYSTEM

1. Perform step 1 of VP/IVP System.

2. Load FTU program.

3. Enter appropriate device and volume (volume name is MASTER).

4. Select VERIFY DISK option.

5. At the end of the verify, if no errors (hard or soft) occur, no alignment is required.

6. If any errors occur, remove the master data pack and install a scratch pack.

7. Load DISKINIT, select INITIALIZE.

8. Perform VERIFY again. If no errors occur, request an alignment pack.

9. If errors occur, hardware problem exists. Correct the hardware problem and proceed to step 1.
WANG MODEL 2250

CARTRIDGE MODULE DRIVE

(CMD)

STUDENT INFORMATION SHEETS
PATH OF SERVO HEAD ACROSS DIBIT TRACKS

+ ODD TRACK
  (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+)

- EVEN TRACK
  (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-) (-)

+ ODD TRACK
  (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+) (+)

NOTES:

1. MOTION OF HEAD EXAGGERATED.
2. ALL WAVEFORMS IDEALIZED FOR PURPOSES OF ILLUSTRATION.
13,440 Dibits (round remainder of track)

INDEX

SECTOR SYNC

SECTOR Ø

⚠️ Propagation delay between U40/pin 8 and U40/pin 6 (Servo-Fine Board)

CMD-8
MODE 1

CR 2 ON?

YES

NO

CR 2 ON?

DECODE CR1 AND CR3-7 FOR LOGIC-DETECTED FAULTS

NO

ACTUATE S1

CR6 AND 7-HIGH ORDER CYLINDER ADDRESS BITS

ACTUATE S1

DISP. MODE 2

(Cylinder address)

Cylinder Address

YES

CR 3 ON?

NO

CYLINDER ADDRESS = 0

ACTUATE S1

ACTUATE S1

DISP. MODE 4

(MP FAULTS)

CR2-7 ALL ON?

NO

YES

END FAULT ROUTINE

CR2-7 ALL OFF?

(Separator)

NO

YES

DISP. MODE 3

CR4-7 = NEXT HIGHEST ORDER CYLINDER ADDRESS BITS

ACTUATE S1

ACTUATE S1

CR4-7 = LOW ORDER CYLINDER ADDRESS BITS

DECODE CR3-7 FOR MP-DETECTED FAULTS

ACTUATE S1

CMD-9
<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>NRZ</th>
<th>MFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock</td>
<td>Pulse at beginning of each cell.</td>
<td>Pulse at beginning of each cell.</td>
</tr>
<tr>
<td></td>
<td>Pulse at half-cell time.</td>
<td>Pulse at half-cell time.</td>
</tr>
<tr>
<td>&quot;1&quot; Bit</td>
<td>Clock pulse + data pulse at half-cell time.</td>
<td>Clock pulse and absence of pulse at half-cell time.</td>
</tr>
<tr>
<td>&quot;0&quot; Bit</td>
<td>Clock pulse is a &quot;0&quot;.</td>
<td>Absence of pulse was a &quot;0&quot;.</td>
</tr>
<tr>
<td>Transitions</td>
<td>A. At half-cell for every &quot;1&quot; bit (data).</td>
<td>A. Between each pair of &quot;0&quot; bits.</td>
</tr>
<tr>
<td></td>
<td>B. Between PAIRS of &quot;0&quot; bits only.</td>
<td>B. Between &quot;0&quot; and &quot;1&quot; combination.</td>
</tr>
</tbody>
</table>

**GENERAL Rules of NRZ vs. MFM Recording:**

- NRZ: Pulse at beginning of each cell.
- MFM: Pulse at beginning of each cell.

- "1" Bit: Clock pulse + data pulse at half-cell time.
- "0" Bit: Clock pulse is a "0".

- Transitions:
  - A. Between each pair of "0" bits only.
  - B. Between "0" and "1" combination.
CNTL/MUX CKT BRD
EM SLOT #2

1  o
2  o
3  o
4  o
5  o
6  o
7  o
8  o
9  o
10 o
11 o
12 o
13 o
14 o
15 o
16 o
17 o
18 o
19 o Voltage Fault, -5v (-)
20 o Voltage Fault, +5v (-)
21 o Fixed Head Selected (+)
22 o Write Gate (+)
23 o Write Inhibit (+)
24 o NHSE - Non-existent head select fault (+)
25 o Voltage Fault, +20 or +32v (-)
26 o Read Gate (+)
27 o Voltage Fault, +20 or +32v (-)
28 o Write Protect (+)
29 o Unit Selected (+)
30 o
31 o Unit Select/Logic Plug Address Compare (+)
32 o
33 o
34 o
35 o
36 o
37 o
38 o
39 o
40 o
41 o
42 o
43 o
44 o
45 o
46 o
47 o
48 o
49 o
50 o
51 o

1413A-002  CMD-13
SERVO COARSE CKT BRD
EM SLOT #3

1
2
3   Velocity
   Summing Amp (U30) output
5   Emergency Retract Velocity Control
   Notch Amp (U10) output
7   Velocity Current (DAC output)
9   Enable Track Centering (+)
   60 Hz Runout Compensator (Approx. 2v p-p)
11  Offset Change Pulse (-)
13  Track Center
   Unload Capacitor Voltage
15  Cylinder Pulse (Raw) (-)
   Spindle Speed Sensor Pulse (600 us) (+)
17  Cylinder Pulse (Shrunk – approx. 1.5 us) (+)

19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51
1 o
3 o
5 o
7 o
9 o
11 o
13 o Positive Dibits, AGC'D
15 o Negative Dibits, AGC'D
17 o
19 o
21 o
23 o
25 o SPE (Servo Position Error)
27 o I-SPE (Servo Position Error-Inverse)
29 o
31 o
33 o
35 o
37 o
39 o
41 o
43 o
45 o
47 o 806 KHz Feedback
49 o
51 o PLO Test Input

1413-004
CMD-15
READ/WRITE CKT BRD
EM SLOT #7

1
3
5
7
Read Data (MFM)
9
Read Data (MFM)
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
49
51

1413-005

CMD-16
$+5V_L = 2.5V$
$+5V_M = 8.9V$
$+8.5 = 9.65V$
MEMO TO:  ALL FIELD ANALYSTS

FROM:  TOM CAMP

SUBJECT:  RELEASE 2.0 - VP O.S.
          RELEASE 1.7 - MVP O.S.

DATE:  APRIL 18, 1979

Enclosed you will find copies of latest operating system software for the 2200VP and 2200MVP. These operating systems are required for any system using a 2280 disk.

These operating systems will be shipped with all 2280 disk drives, however, a mass distribution to our existing customer base is not planned. A return reply card will be sent to all existing users, and those who desire the new release may obtain it through software distribution. It is strongly recommended that all users be upgraded to the latest release of these operating systems. A return reply card will be distributed from the Home Office announcing their availability.

A separate Marketing Release is planned to announce this to our sales force.

Please inform your users and vendors about the availability of these revised operating systems.

[Signature]
Tom Camp

TC:pn

Attachment
Several things make the 2280 different than previous 2200 disks.

(1) More than 32768 sectors.
(2) More than 2 platters per drive.
(3) Device type D.
(4) Incompatibility with B, C, T series CPU.

These points are interrelated, but it is important that they be understood.

I. The CPU and the Disk Controller.

The 2280 disk drive will work with the 2200VP Release 1.9 or later, and with the 2200MVP Release 1.7 or later. It will not work properly with earlier releases, nor with a 2200 B, C, S, or T CPU.

In addition, the system bootstrap (which loads the operating system from disk) must be at least version R1 (ECN 9772) in order to be able to load from the 2280. One easy way to tell if an older machine has this bootstrap is to watch the screen while loading a system file. The older bootstrap displays the function key number on the top line, while the newer bootstrap displays the file name and device address. The system bootstrap can only load the operating system from the removable or 1st fixed platter of a 2280.

The drive needs to be cabled to the CPU via a 22C11 dual printer/disk or a 22C03 single disk controller. The present triple controller (22C31) should not be used, and the 2230 MXA is not supported at the present time. If an older 22C03 is used, a check should be made that it has the ECN 8051 made for the MVP, even if the 2280 will be used with a VP.

II. The Platter Size.

Floppy and hard disk platters that were created on a B, C, S, or T may not in general be COPYed to the 2280 and used. The MOVE statement or its software equivalent should always be used for the initial transfer. The same precautions may apply when transferring data from a platter on which the index was created or modified by DATSAVE BA statements.

The potential problem occurs because on all previous drives, the '8000' bit of all sector addresses in the index was ignored. This gave a 15 bit sector address which sufficed until the 2280, larger which has a platter size. When a platter is MOVEd from another disk to the 2280, the operating system will reconstruct the high order bit to conform to the 16 bit structure of the 2280.
In addition to platter transfer, two similar or other potential problems can arise from software that uses DATASAVE BA and DATALOAD BA. On the 2280, for the first time, the high order bit of the two byte alpha sector address actually is used as part of the 16 bit sector address. It is conceivable, but not likely, that some software may assume otherwise. A more likely problem is existing utilities (including Wang's ISS) that deal directly with index sectors will deliberately strip off the highest order bit of each sector address before using it. These utilities must be changed before being used on the 2280. ISS Release 5.0 is 2280 compatible.

III. Device Type D

The 2280 is our first drive with more than 2 platters at a single address. (The triple floppy was accommodated by treating the 3rd platter as a single platter of a secondary drive). For this reason the concept of 3XX, BXX to address the two surfaces had to be extended. Device type D has been defined, and will normally be used for all 2280 operations. For all disk statements, if type D is specified, then a new meaning is assigned to the other two digits. The controller for the 2280 should be set at either 10, 20 or 30 and D10, D20 or D30 is the address to use to specify the removable platter of the drive. If the low order digit of a type D device address is non zero, it does not refer to the hardware (switch selectable) address, but to a specific platter. Thus the six platters of a 2280 at address 10 are referred to as D10, D11, D12, D13, D14, and D15. Note that a separate device (normally a printer) may be at 215 with no conflict at all since, for example, /D15 enables device 10 not 15. If two drives are daisy chained together the second may be address by D50, D51, D52, D53, D54, and D55. Note also that the F and R parameters may not be used when type D is selected; T must be used. For a more complete description of 2280 platter addressing refer to the "Model 2280 Disk Drive User Manual".

For disk controllers set to address 10, 20, or 30 the following device addresses are equivalent:

/310 <-> /D11
/B10 <-> /D10
/320 <-> /D21
/B20 <-> /D20
/330 <-> /D31
/B30 <-> /D30

for any 2200 disk on a 2200VP or MVP.

The biggest impact this has on existing software is that the choice of possible platter addresses has been greatly expanded. It is primarily for this reason that a new variation of the SELECT statement has been introduced:

SELECT #n < A$ >

which allows the device address to be specified as the value of an alpha variable.

For details see the release memo for VP Release 1.9 or MVP Release 1.7 or the new reference manual.
If $GIO$ is used with an external address of type D, the same interpretation is made. Thus SELECT TAPE/D12:$GIO (...) and SELECT #3/D14:$GIO #3 (...) and $GIO/D11 (...) will all enable the disk controller at address 10. The $GIO$ address commands 71xx and 73x0, when used with the 2280, must use the physical addresses 10, 20, 30, 50, 60 or 70 since there is no device type available to indicate that the low 4-bits specify a platter. The effects of any previously tried sequences can not be guaranteed at this time. Wang does not support any $GIO$ sequences to the 2280 except $GIO$ hog and unhog, and that should be replaced by a $OPEN$ whenever possible. If and when it becomes advisable to support other sequences, they will be published as specific to the 2280.
Release 1.7 of 2200 MVP BASIC-2 replaces all previous MVP BASIC-2 releases. Release 1.7 is required for any MVP with 2280 disk drives. This release also provides all MVP systems with several new features and corrects all known system anomalies. Listed below are the system changes since Release 1.6. The following files on the system platter differ from Release 1.6:

"@"  -  MVP OS & BASIC-2 interpreter.
"@MOVE"  -  Move system file utility.
"@FORMAT"  -  Format disk utility.

A. System Enhancements

The following enhancements are also available with VP BASIC-2 Release 1.9.

1. 2280 Disk Drives

Release 1.7 supports the 2280 disk drives; previous releases should not be used. For details concerning 2280 operations, see the "2280 Disk Drive User Manual".

2. Disk Platter Formatting

A format disk platter utility, "@FORMAT", for formatting 2260C, 2260BC, and 2280 disk platters resides on the system diskette. To format a disk platter, LOAD RUN "@FORMAT" and respond to the prompts as requested. The format utility makes use of the new $FORMAT DISK statement to format the specified disk platter (see following description of $FORMAT DISK).

3. Variable Device Address Specification

Device addresses used in SELECT statements can now be specified by the value of an alpha variable as well as explicitly by 3 hexdigits. Device addresses in SELECT statements have the following format:

\[
\text{device address} = \begin{cases} 
\text{hexdigit hexdigit hexdigit} \\
\langle \text{alpha-variable} \rangle 
\end{cases}
\]

where the value of the alpha variable must be 3 ASCII hexdigits representing the device type and address.

Examples:

A$ = "320": SELECT #3<A$>  selects #3 to disk 320

A$ = "215": SELECT PRINT <A$>(132)  selects print to device 215 with a line width of 132 characters.
$FORMAT DISK

<table>
<thead>
<tr>
<th>General Form:</th>
</tr>
</thead>
<tbody>
<tr>
<td>$FORMAT DISK platter file # disk-address</td>
</tr>
</tbody>
</table>

Purpose:

The $FORMAT DISK statement issues a command to the disk processing unit to format the specified disk platter. This statement can only be used with disks that support formatting under software control (e.g., 2260C, 2260BC, 2280). Formatting on certain 2200 disks (e.g., 2270) is initiated by pressing the format button located on the disk unit.

Before a platter can be used for the storage and retrieval of data by the user, the platter must be formatted. Formatting involves recording a unique address for each sector on the disk platter, along with other control information used by the disk processing unit when accessing a sector. All data within the sector is zeroed.

!Caution: Formatting a disk platter overwrites all! data that may previously have been stored on the ! platter. It is recommended that the Wang supplied! format utility be used, to prevent the accidental! formatting of the wrong disk platter.

Examples of valid syntax:

10 $FORMAT DISK T/310
20 $FORMAT DISK T/D11
30 $FORMAT DISK R#2
Release 2.0 of BASIC-2 replaces all previous VP BASIC-2 releases. This release fixes one problem introduced in Release 1.9. Since Release 1.9 was not widely distributed, the documentation for Release 1.9 is included here. All description of Release 1.9 applies also to Release 2.0.

The following files on the system platter(s) differ from Release 1.9:

"@O"  -  VP OS & BASIC-2 interpreter
"@MOVE"  -  Move system file utility.

A. Corrected Anomaly

1. LIST T did not work in Release 1.9. This has been corrected in Release 2.0.
Release 1.9 of 2200VP BASIC-2 replaces all previous VP BASIC-2 releases. Release 1.9 is required for any VP with 2280 disk drives. This release also provides all VP systems with several new features and corrects all known system anomalies. Listed below are the system changes since Release 1.8. The following files on the system platter differ from Release 1.8:

"@@" - VP OS & BASIC-2 interpreter.
"@MOVE" - Move system file utility.
"@FORMAT" - Format disk utility.
"@A", "@B", "@C" - System diagnostics

A. System Enhancements

The following enhancements are also available with MVP BASIC-2 Release 1.7.

1. 2280 Disk Drives

Release 1.9 supports the 2280 disk drives; previous releases should not be used. For details concerning 2280 operations, see the "2280 Disk Drive User Manual".

2. Disk Platter Formatting

A format disk platter utility, "@FORMAT", for formatting 2260C, 2260BC, and 2280 disk platters resides on the system diskette. To format a disk platter, LOAD RUN "@FORMAT" and respond to the prompts as requested. The format utility makes use of the new $FORMAT DISK statement to format the specified disk platter (see following description of $FORMAT DISK).

3. Variable Device Address Specification

Device addresses used in SELECT statements can now be specified by the value of an alpha variable as well as explicitly by 3 hexdigits. Device addresses in SELECT statements have the following format:

device address = \{hexdigit hexdigit hexdigit\}
<alpha-variable>

where the value of the alpha variable must be 3 ASCII hexdigits representing the device type and address.

Examples:

A$ = "320": SELECT #3 <A$> selects #3 to disk 320

A$ = "215": SELECT PRINT <A$>(132) selects print to device 215 with a line width of 132 characters.
4. System Diagnostics

The system diagnostics, accessible immediately after power on, have been rewritten to support the larger memory configurations and to provide better memory diagnosing with more consistent error messages and improved displays.

5. MOVE/COPY

The MOVE and COPY disk operations now make more efficient use of memory for buffering; these operations are now up to 15% faster.

6. $RELEASE PART

The syntax for the MVP $RELEASE PART statement is supported; however, the statement is ignored if executed.

7. Reloading System Software

Executing $INIT "SYSTEM" in immediate mode, allows the system to be reloaded with BASIC-2 or a system diagnostic without powering the system off and then back on. When $INIT "SYSTEM" is executed, control is passed to the system bootstrap. The bootstrap message

MOUNT SYSTEM PLATTER
PRESS RESET

is displayed and the system can be loaded, as if the system had just been turned on. Note that the program and data in memory are cleared when $INIT "SYSTEM" is executed.

B. Corrected Anomalies

1. If the ERROR statement was used to recover from an error within a subroutine called from a special function key, the system lost the subroutine return information. This would result in ERR P41 when RETURN was executed.

2. The system did not always detect the illegal occurrence of alpha array elements where numeric variables were expected.

3. If variables were used to specify array dimensions (e.g., DIM X(R,C)) during program overlaying, erroneous memory overflow errors (ERR A02) might be reported by the system. This could only happen if the program text being overlayed was larger than that of the overlay loaded, more variables were defined in the overlay than existed in the original program, and most of memory was used.
4. A PACK statement with an exponential image could modify the values of the variables containing the data to be packed. If an exponential image in a PACK statement did not have exactly 1 integer digit specified and the data to be packed was specified by a numeric array designator (e.g., N()), the result of the pack would be correct but the exponents of the values in the numeric array would be changed.

5. MVP global variables (e.g., @X$) were listed by LIST V as local variables (e.g., X).

6. SELECT P timing was approximately 10% fast.

7. $CLOSE disk did not release (unhog) the specified disk unit. $CLOSE /xyy should have been equivalent to $GIO /xyy (4400) disk unhog.
$FORMAT DISK

General Form:

$FORMAT DISK platter [file #] [disk-address]

Purpose:

The $FORMAT DISK statement issues a command to the disk processing unit to format the specified disk platter. This statement can only be used with disks that support formatting under software control (e.g., 2260C, 2260BC, 2280). Formatting on certain 2200 disks (e.g., 2270) is initiated by pressing the format button located on the disk unit.

Before a platter can be used for the storage and retrieval of data by the user, the platter must be formatted. Formatting involves recording a unique address for each sector on the disk platter, along with other control information used by the disk processing unit when accessing a sector. All data within the sector is zeroed.

!Caution: Formatting a disk platter overwrites all! data that may previously have been stored on the ! platter. It is recommended that the Wang supplied! format utility be used, to prevent the accidental ! formatting of the wrong disk platter.

Examples of valid syntax:

10 $FORMAT DISK T/310
20 $FORMAT DISK T/D11
30 $FORMAT DISK R#2
### PHOENIX

**16 MEGABYTE/SURFACE**
- 54 SECTORS/TRACK
- 823 TRACKS/SURF.

<table>
<thead>
<tr>
<th>Track</th>
<th>CDC</th>
<th>22,800V</th>
<th>2280</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32 msc</td>
<td>30 msc</td>
<td>27 msc</td>
</tr>
<tr>
<td>2</td>
<td>64</td>
<td>60</td>
<td>56</td>
</tr>
<tr>
<td>3</td>
<td>96</td>
<td>90</td>
<td>80.5</td>
</tr>
</tbody>
</table>

**DATA TRANSFER RATE**
- **584 TPI**
- 3600 RPM ± 2.5% - 3.5%
- 1F & 1R HEAD
- 3F & 1R HEAD

**3 FIXED SURFACE & 1 REMOVABLE BUZZTER**
- 6 WIRING S.R.E.
- 2 SERVO S.R.E.

**Seek Time (0-822)**
- 55 msc

**Outer Track 0**
- 4038 BPI
- 136 mpm

**Inner Track 822**
- 6038 BPI
- 98 mpm

**Power**
- 120V ± 8-18
- 60 Hz ± 0-1

**Major Assemblies**
- Elec. Module
  - 1/0 Bro
  - CNTRL/MUX
  - SERVO COARSE
  - Align. Ext.
  - OFF NOT USED
  - SERVO FINE
  - R/W
- R/W & SERVO PREAMP
- Receiver Assy
  - CARTRIDGE IN PLACE
  - INTERLOCK
  - RECEIVER IN PLACE INTERLOCK
- Deck Assy
  - DECK DOWN INTERLOCK
  - Actuator Assy
  - SPINDLE & MOTOR
  - SPINDLE SPEED

**USB Pin 14 to U39 Pin 2**
- 16 CUT ETCH, DRIVE SELECTED AS #1
- POWER ON
- INSTALL - REMOVABLE 2 BOLTS
- Disconnect AIPI (Probe Unit) 5x10 min
- AC APPLIED (CO)
- ALL INTERLOCKS CLOSED
- NO FAULTS

**Serial # A876700** - Any park with # below this don't use

**Spindle Speed**
- Checked every 20 min/Sec
- Sensing by Light Emitting Diode & Sensing Resistor

**Power Supply**
- Ferris Drive
- Field
- Dual Mains Voltage Device
- ±20 ± 15 ± 12 ± 6V

**-12 Microprocessor + Mem. Circ.**
- ±5 Logic
- ±32 Voice Ctrl + Emu. Rtrn
VELOCITY GAIN ADJ. WAIT FOR READY, THEN PUT SW.8 ON ON CTRL MUX SERVO COARSE (RED UP ON)
THEN USING CR3 - CR7 TURN POT ON SERVO COARSE BRD FLIPPING SW ON CTRL MUX UNTIL CR5 STAYS ON, ADJ. TO MID POINT

SERVO COARSE
1. POSITION VELOCITY OFFSET COMMAND GENERATOR
2. ACTUATOR DRIVE CIRC.
3. SERVO SYS. VELOCITY FEEDBACK
4. ACCELERATION
5. ACTUATOR RETRACT (UNLOAD OF BURDS)
6. COMPENSATION CIRC.
7. TRACK CTRL. DETECTION CIRC.
8. CYL. PULSE GENERATOR
9. ENG. OF TRAVEL DETECTION
10. SPINDLE SPEED PULSES

SERVO FINE
11. VARIOUS CIRC. GEN. BY PHASE LOCK LOOP CIRC.
12. SERVO POSITIONING ERROR SIGNAL
13. AGC ACTIV - NOT ACTIV (ACTIVE WHEN CABLE DOWN)
14. INDEX PULSE, SECTOR SYNCR & INHIBIT LOGIC SIGNALS
15. VOLUME SELECT
16. HEAD SIGNALS (ALIGNMENT)
17. R/W
18. R/W OPERATIONS
19. PURZ TO FFM ENCODER
20. WRITE PROTECT

MICROPROCESSOR FUNCTIONS (SERVO COARSE BRD)
1. SPINDLE START/STOP & SPEED MONITORING (20mils)
2. SERVO COARSE POSITIONING
3. SERVO HEAD CHANGE
4. SELF DIAG. OF MICROPROCESSOR
5. CONTROLS FAULTS W/LEDS

40 PIN CHIP
16 BIT MEM. ADDR. (64K OF RAM OR ROM)
8 BIT DATA BUS
I/O PORT ADDRESSING CAPABILITY 256 IN & OUT
TTL COMPATIBLE

I/O BOARD "A" CABLE
1. I/O LATA & LATE STRDoE
2. SELECT LINE
3. CLEAR FAULT STATUS
4. CYL. ADDRESSES
5. SEEK
6. RTZ

CTRL MUX "B" CABLE
1. B CABLE SIGNALS
2. READY FAULT LED - LED ACTIVE
3. HEAD SELECT
ECL Logic

Supply Voltage 5.2 Vee
Logic 0 -1.7 V
Logic 1 .6 V

1. Outputs must not be tied HI or LOW
2. Susceptible to static
3. ECL tends to heat up in IDLE mode

8085 Microprocessor Error Correction 12.8.75/Sec

Loads off of Removable Servo

Alignment

Change to Fixed Servo
Adj. R servo to 1st M pattern tightened to 6 lb/in
Go to track 404, adj. to \( \leq 50 \text{ mV} \)
800, \( \leq 350 \text{ mV} \)
8, \( \leq 350 \text{ mV} \)
Tighten to 12 lb/in

R. 0
1. S1 of servo fine in S
2. S2 of align ext. in FD
3. Ho. align, Bro. SWA-N SWB-R/W SW3-X1
4. Loosen R heads to 6 lbs/in
5. Align, R servos head to track 0
6. Seek to 404 - adj. to \( \leq 50 \text{ mV} \)
7. Tighten servos head to 12 lb/in & recheck 404 after RTZ

R. DATA
8. Check tracks 8 & 800 \( \leq 350 \text{ mV} \)
9. S1 of servo fine in D
10. S2 of align ext. in NORMAL
11. Ho. align bro. servos as step 3

MICROPROCESSOR
L567 T HEATSINK, 210-7415 RD, 210-7424 R1, 210-7423 R1 (R2 PRINT)
210-7421 (I/O BOARD TO CPU) PRINTER CABLE
210-7422 TO DRIVE (COLOR CABLE BLACK BOTTOM, ON DRIVE BLACK TOP)
On 111 RIBBON CABLE MIDDLE SLOT, BLUE DOWN, ON DRIVE BLACK UP
PHOENIX

TAG 2 0,1,2 DATA HEADS 4 SERVO HEAD

BP4 - DECK DOWN - MAGNETIC REED SWITCH. CAN LIFT WITHOUT MOVING CARD CAGE

BP5 - NO AIR SENSOR (SAME AS BP4) + A LO AIR (FILTER WARNING/STILL RUNS)

MICROPROCESSOR - 8080A

CONTROLS: DIRECT SEEK, RTZ, LOAD, UNLOAD, OFFSET (FROM CONTROLLER), RPM, SERVO HEAD CHANGE, SPINDLE START/STOP, SECTOR PULSE GENERATION, E.R.

FAULT LITES

MODE 1 (NO ACTUATION)

MODE 2 (1 ACTUATION)

MODE 3 (4 ACTUATION)

MODE 4 (5 ACTUATION)

READOUT COMPLETES
**Extender Board**
F/N
F - Track off fixed
N - Track off removable

**Alignment Board**
S/RW S - looking at servo head w/ scope tracking on
RW - look at rpm, data or servo according to servo fine

**Servo Fine**
D/S
D - looking at data head
S - looking at servo head
ADVANCED DISK

Tues - Intro / CDC circuitry / 300 Power Supply
Wed - 1st Seek / Direct Seek / Servo Surface / FTU
Thur - Finish Servo / I/O / Clk
Fri - R/W
Mon - 75 Major Differences
Tues -
Wed - Rx - Microprocessor
Thur - Troubleshooting

C01L - 3.4 Ωs
75 MEG Alignment Disk - ONLY 330 Servo Tracks then Guard Band
75 MEG - Voice Coil Bearings should be checked when removed or replaced
Adj. - 2 div change from center to either end
75/300 - ≤ 200 grams to move carriage
75 MEG - Bearing Adj. Tool - ≤ 2 div movement for ctrl to either end
Rail Adj. Tool
Spindle Adj. Tool - for 75 + 300
TPA + 2 always ground - B6/7

BOARD Type CkFV
SEEK ERRORS - 4 causes Must RTZ to clear
1. Max Address Fault
2. Hit Guard Band by Mistake
3. Too Long to Accomplish Seek (Must be within 500 msec) 80 msec on P
4. Fine Position Analog V. > 1.01 V for 800 μsec.

EMERGENCY RETRACT - only 2 reasons
1. Voltage Fault 2. Loss of Speed
MPI - MAGNETIC PERIPHERAL Inc. (70% CDC 16% Honeywell 14% Univar)

P  (80)
9448 BP3/4

Fixed Heads: Labels - 0-4
Rem. Head - 0

75 Meg (65v-1)
9760/62
BK4xxx - 40 MB (Not Used by WAX)
BK5xxx - 80 MB
BK4 5 - EQUIP. ID
XXX - TYPE ID (Options)
BJ - MUX INTERFACE (Not Used by W)
5 PLATTERS TOP & BOT. PROTECTION PLATTES

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0
1
5
2
3
4

XXX - C2A
120V/60 Hz
80 MB SINGLE CHANNEL
60 PIN A CABLE
INDEX & SECTOR MARKS

VS - 9 SECTOR  INDEX MARK IS RDI MARK SPEC. 59° - 90° F (60-80) HUMIDITY 20%-80% (40-60) 823 CYL.  384 TRK/IN.
TRK SPACING -.0026" CTR-CTR  TRK WIDTH -.002"  
OUTER TRK - CYL 0  4038 BPI  INNER TRK - CYL 822  6038 BPI
DATA RATE - DRIVE ↔ CONTROLLER  967 Meg Hz  1,209,600 BYTES/SEC.
VOCIL COIL/SERVO - (closed loop)  MAX SEEK 0-822  55 MIL SEC

MIN SEEK 1 TRK  6 MIL SEC  AVE SEEK 30 MIL SEC
AVERAGE LATENCY TIME - 8.33 MIL SEC (TIME FROM 0 TRK TO DATA UNDER HEAD)
3600 RPM  16 DRIVES/CONTROLLER
FMD - should be left in computer environment 2 days before install. Purge 2-3 hours.

Head Crash - HDI (head disk interference)
Area - Pack inspector - checks balance and surfaces
75+P heads - same 300 has cable coming off other side - otherwise same
Bruin KO Head 160 compared to 125 stiffer head load spring
White head pad - indented surfaces

Cleaning Heads
1. Blow off head w/ air duster...
2. Moisten spot on IBM card.
   Zig-zag from spot with head
   Move against angle on head
3. Dust head

Blower Motor - cooling/positive air pressure should be on when changing platters as blows dust up & out should be on 24 hr.
Does not affect heads flying.

75 Megs - only 330 servo tracks then guard band

FTU - TB216
Device Codes: Pk - 8905 BK5 - 0905 BK9 - 0919
Last two numbers represent # of heads - Pk + BK5 = # Heads
First 2 numbers - 8 - CMD
8 - Index & Sector pulses on B cable
1 - 823 cylinders

Write Enable FTU
1. Data Entry - B key 5754
2. Data Entry - E (top row 5th from left on only)
   Key display, bit 1, load
3. Write Protect - Off
4. Data Pattern - E36C
SERVO SURFACE

PURPOSES
1. Cylinder Crossing
2. Fine Positioning
3. Keep on Cylinder
4. RETF Detection
5. Generates Clocks 806 KHz (13440 DIBITS at 3600 rpm)

DIBITS

Positive - Odd
Negative - Even

Track has 6720 all positive DIBITS at intervals of 6720 all negative DIBITS at intervals along track

SERVO Track - center between Pos & Neg DIBIT TRACKS
Outer Guard Band - 24 Pos. DIBIT TRACKS
Inner Guard Band - 36 Neg Even DIBITS

On Initial Load 350 mL sec. to start seeing DIBITS when heads start turning

I/O
Bus - 10 Lines 0-9
3 Tag Lines TAG 1 - CYL. Address on bus TAG 2 - Heat Addr. on bus TAG 3 - Control
MFM - '0' - NO FLUX REVERSAL MIDDLE OF CELL

'1' - FLUX REVERSAL MIDDLE OF CELL BIT

CLICK BETWEEN 2 '0' CELL BITS
1. A Series Code 18 SMD can be replaced by a Series Code 10 SMD.
   A. True
   B. FALSE

2. The Speed Transducer on the 80 MB disk produces approximately?
   A. 3600 Pulses/min.
   B. 3600 Pulses/hour
   C. 7200 Pulses/hour
   D. 7200 Pulses/min.

3. Given the following Rules, which pattern is correct for the following Data Bits? 1 1 0 1 0 0 1 1

   RULES: There is a flux transition for each "1" bit at the time of the "1".

   There is a flux transition between each pair of "0" bits.

   There is no flux transition between the bits of a "10" or "01" combination.

   \[
   \begin{array}{cccccccc}
   1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\
   \hline
   & | & | & | & | & | & \\
   & 1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\
   \hline
   \end{array}
   \]

   A. \[
   \begin{array}{cccccccc}
   1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\
   \hline
   1 & 1 & | & | & | & 1 & | & \\
   \end{array}
   \]

   B. \[
   \begin{array}{cccccccc}
   1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\
   \hline
   1 & | & | & | & | & 1 & | & \\
   \end{array}
   \]

   C. \[
   \begin{array}{cccccccc}
   1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\
   \hline
   1 & | & | & | & | & | & \\
   \end{array}
   \]

   D. \[
   \begin{array}{cccccccc}
   1 & 1 & 0 & 1 & 0 & 0 & 1 & 1 \\
   \hline
   1 & | & | & | & | & | & \\
   \end{array}
   \]
4. What three (3) functions are accomplished in proper order during the Power-On sequence in the 80 MB disk?

A. Brake power is disabled, AC to the drive motor, heads are loaded.
B. AC to the drive motor, heads are loaded, brake power is disabled.
C. Heads are loaded, AC to the drive motor, brake power is disabled.
D. Brake power is disabled, heads are loaded, AC to the drive motor.

5. What Condition has happened if Bus Bits 0, 2, 6 and 9 are TRUE and TAG 1 is received?

A. Cylinder 581 octal has been selected
B. Head 5 has been selected
C. Cylinder 581 decimal has been selected
D. Illegal combination of tag and bits.

6. What is TAG 2 used for?

A. Head select
B. Cylinder select
C. Control select
D. Unit select

7. In the 80 MB Disk, what is the name of the signal on A2B06-02B?

A. Nn signal present
B. -CH 1 Control select
C. +DIFF Bit 7
D. + T = 256

8. The position on a pin that a wire is wrapped is referred to as the ________?

A. Level 1
B. Level 2
C. Z Level
D. V Level

0759A - 2
9. In what Cable is the Index Pulse located?
   A. "A" cable
   B. "B" cable
   C. "C" cable
   D. "Ground" cable

10. What two (2) conditions will retract the heads with Emergency Power?
    A. Low speed, write fault
    B. Low speed, no head select
    C. Low speed, voltage fault
    D. Low speed, no dibits

11. The recordable surface beneath one head is called?
    A. Track
    B. Cylinder
    C. Sector
    D. Index

12. How many Filters does the SMD have?
    A. 1
    B. 2
    C. 3
    D. None

13. If Dibits are not detected within 350 Mséc after Head Load, what would be the result?
    A. Disk drive would power down
    B. Heads would load
    C. Heads would unload
    D. Nothing

14. What controls the velocity of the carriage during an Emergency Retract?
    A. Emergency Retract relay A1K2
    B. Transistor Q9
    C. Transistor Q10
    D. Velocity transducer
15. On Initial Spindle Motor Start of the 80 MB disk, AC is applied to the Start Winding only.
   A. True
   B. False

16. What bus bit is, Servo Offset Positive?
   A. Bit 9
   B. Bit 3
   C. Bit 2
   D. None of the above

17. How many types of Dibits are there?
   A. 1
   B. 2
   C. 3
   D. 823

18. Convert the Hex term 9CF3 to Octal.
   A. 113636
   B. 116363
   C. 937842
   D. 116364

19. By what means in Index detected?
   A. By missing Dibits
   B. By the Index Transducer
   C. By Cylinder Pulses
   D. By software means

20. When data is read from the recording surface, it is destroyed on the surface.
   A. True
   B. False
21. What Write Current Zone would the unit be in if at Cylinder 383?
   A. F  
   B. D  
   C. C  
   D. A  

22. Cylinder Pulses are used to:
   A. Switch from Course to Fine control  
   B. Decrement Cylinder Address Register  
   C. Decrement Difference Counter  
   D. All of the above.  

23. The temperature of the 80 MB Disk Drive Motor is monitored by?
   A. External thermal switch  
   B. Speed transducer switch  
   C. Internal circuit breaker  
   D. Internal thermal switch  

24. How many Servo surfaces does the SMD disk pack have?
   A. 1 on the 80 MB  
   B. 2 on the 300 MB  
   C. Both A and B  
   D. One for each platter  

25. Of the 10 surfaces on the 80 MB Disk Pack, how many are used for data?
   A. 4  
   B. 5  
   C. 6  
   D. 10
Questions 1 thru 18 pertain to the TB 304.

1. How many access modes does the TB304 have?
   A. 5
   B. 3
   C. 9
   D. 4

2. The Disk Format that the FTU writes is compatible with the WANG System Format.
   - A. True
   - B. False

3. During head alignment, in what position should the SEQ/MAN switch on the FTU be placed?
   - A. OFF
   - B. ON
   - C. SEQ
   - D. MAN

4. The Heads Switch on the FTU should be in what position when aligning heads on the SMD Disk Drive?
   - A. LO for BK7XX
   - B. HI for BK5XX
   - C. To correspond to the number of tracks of the drive under test.
   - D. To correspond to the number of heads of the drive under test.

5. Read data is displayed in what bits on the FTU?
   - A. 0-4
   - B. 1-16
   - C. 1-7
   - D. 0-7
6. What is the "OFF" position of the Wrt-Rd Select Switch used for?
   A. Formatting
   B. Read
   C. Head alignment
   D. Write

X. The FTU will operate on 120 or 240 VAC without any modifications.
   A. True
   B. False

8. Pin 1 of P3 corresponds to Pin 16 of A02.
   A. True
   B. False

9. The character-count display provides an indication of how far from Index the error occurred.
   A. True
   B. False

X. What is a segment of a track called?
   A. Sector
   B. Dibit
   C. Index
   D. Format

11. There are sector switches that need to be set on the FTU.
    A. True
    B. False

12. The I/O Bypass Cable can be used on the CMD Disk Drive.
    A. True
    B. False

X. In what slot is the Head Alignment Card installed when aligning the Heads of a 288 MB Disk Drive?
   A. A02
   B. A16
   C. B16
   D. B02
1. What conditions must be met in order to sequence the Disk Drive up from the FTU?
   A. The drive must be in the Remote mode
   B. The drives Start switch must be ON
   C. Power must be available to the drive
   D. All of the above

2. Write Protect is enabled when the Head Alignment Card is installed in the disk drive.
   A. Write protect must be turned on at the operators panel
   B. Only if the "MODE" light is "ON"
   C. True
   D. False

16. Sequential Reverse access mode requires that a address be put in the FTU cylinder address switches.
   A. True
   B. False

17. What is the name of the indicator that tells the HSFV that its input signal is too low to operate?
   A. Power
   B. Input
   C. Mode
   D. Bad Track

18. What is the setting of the FTU sector switches for 64 sectors?
   A. Sector switch 64 ON
   B. Sector switch 64 OFF
   C. Sector switch 1,2,4,8,16,32 OFF; 64 ON
   D. Sector switch 1,2,4,8,16,32 ON; 64 OFF

Questions 19 thru 25 pertain to the TB 216.

19. The Device Type Code for the 288 MB drive is ________.
   A. 0905
   B. 0919
   C. 2265
   D. None of the above.
20. To observe the cylinder address being sequenced, you would place the DATA ENTRY switch in the STATUS BYTES position and then press key ________.
   A. A
   B. B
   C. 1
   D. 2

21. With ERROR OVERRIDE switches down and a WRT/RD FORMAT or WRT/RD test in progress, the tester will stop exercising the drive in the event of a data or address error.
   A. True
   B. False

22. The LOAD button;
   A. Translates lower lights to Octal.
   B. Translates upper lights to Hex.
   C. Transfers contents of lower lights to upper lights.
   D. Transfers contents of upper lights to lower lights.

23. In order to run the LAMP TEST, which button is pressed?
   A. START
   B. LOAD
   C. GO
   D. RESET

24. Which is not true about the TR 216 FTU.
   A. It is heavier than the TB 304.
   B. It is more expensive than the TB 304.
   C. It does more than the TB 304.
   D. None of the above.

25. The FIXED VOLUME position of the ACCESS SELECT switch applies to CMD's only.
   A. True
   B. False
1. What component is at location A3L2 in the 80 MB disk?
   A. Heads load switch
   B. Hysteresis brake
   C. Servo capacitor
   D. Velocity transducer

2. On the 80 MB disk drive +5 VDC must be adjusted to?
   A. +5.1 ±0.05 Vdc
   B. +5.1 ±0.05 Vdc
   C. +5.1 ±0.05 Vdc
   D. +5.0 ±0.05 Vdc

3. What is TAG 3 used for?
   A. Cylinder select
   B. Control select
   C. Head select
   D. Unit select

4. The 300 MB Disk Drive Head Alignment track is ______?
   A. 5558
   B. 7538
   C. 6408
   D. 49116

5. In what cable is the Seek Error signal located?
   A. "A" Cable
   B. "B" Cable
   C. "C" Cable
   D. "GROUND" Cable
b. If the 80 MB Disk Drive was unable to complete a seek within 500 Msec., what kind of error will be indicated?
   A. Seek error
   B. Seek end
   C. Track error
   D. Sector error

7. The Outer Guard Band contains __________?
   A. 24 Positive even dibit tracks
   B. 36 Negative even dibit tracks
   C. 24 Positive odd dibit tracks
   D. 36 Negative odd dibit tracks

8. What is the Maximum Count that the Sector Counter will go to before generating a Sector Pulse?
   A. 4095
   B. 13,440
   C. 4096
   D. 3886

9. What condition would the FTU show if you tried to seek to Cylinder 512g on a 80 MB CE pack?
   A. Seek error
   B. Servo Fault
   C. Normal
   D. Normal if cylinder bypass is selected

10. How is the Servo Head selected to see the Dibits when doing a Head Alignment?
    A. By the FTU
    B. By control mode
    C. By the HFSV card
    D. It cannot be selected

11. What is the Full Length Seek Time on a 300 MB disk Drive?
    A. 52 TO 54 Msec
    B. 50 TO 54 Msec
    C. 60 TO 65 Msec
    D. 50 TO 54 Usec
12. The total amount of recording surface available without moving the heads is called a ________?

   A. Track
   B. Cylinder
   C. Disk
   D. Sector

13. In what order are the 300 MB Servo System Adjustments done?

   A. Integrator, Fine Velocity, Coarse Position
   B. Fine Velocity, Integrator, Coarse Position
   C. Coarse Position, Fine Velocity, Integrator
   D. None of the above

14. The Plus and Minus 5 Volt Regulator card of the 300 MB Disk Drive is in location A20.

   A. True
   B. False

15. On the 300 MB Disk Drive, the Head Alignment Card would be plugged into A16.

   A. True
   B. False

16. During "Write Format" with the FTU, Data Errors will not be indicated.

   A. True
   B. False

17. On the 80 MB Disk Drive, what is the signal at A2809-07A called?

   A. +Desired velocity
   B. -On cylinder
   C. -Head alignment
   D. -Forward seek
18. The Disk Motor and Disk Pack on the 80 MB are stopped by _______?
   A. Disk Pads
   B. Two Permanent Magnets
   C. Magnetic Field
   D. Concentric Permeable Bodies

19. How many access modes does the TB304 have?
   A. 5
   B. 3
   C. 9
   D. 4

20. Which of the following Error conditions will NOT turn the FAULT light ON?
   A. Write while Reading
   B. Seek Error
   C. Low Voltage
   D. Select two heads

21. The mode of data transfer from the controller to the disk drive is ________?
   A. Byte Parallel
   B. Bit Parallel
   C. Byte Serial
   D. Bit Serial

22. What condition would the FTU show if you tried to seek to Cylinder 513g on a 300 MB CE pack?
   A. Seek Error
   B. Servo Fault
   C. Normal
   D. Normal if cylinder bypass is selected
23. Where did the signal that is on pin B02-16A originate?
   A. BU102A
   B. BU216A
   C. JA82-08B
   D. JA82-08A

24. Write Protect is enabled when the Head Alignment Card is installed in location A2A02 on the 80 MB drive.
   A. True
   B. False

25. A 300 MB CE Disk Pack can be used to adjust Velocity Gain.
   A. True
   B. False