mits

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THE FOLLOWING INFORMATION IS A PRELIMINARY RELEASE ONLY.

THE COMPLETE THEORY OF OPERATION WILL BE ADDED TO THE
ASSEMBLY MANUAL AT A LATER DATE.   THE OPERATORS MANUAL
AND DOS DOCUMENTATION WILL BE DEVELOPED IN A SINGLE
MANUAL ALSO.   BOTH OF THESE, AND ANY UPDATES TO THIS
ENTIRE SYSTEM DOCUMENTATION WILL BE SENT IMMEDIATELY
UPON THEIR PRINTING DATE.

I.   DESCRIPTION OF SYSTEM

    A)   DISK SPEC SHEET

    B)   DISK SYSTEM BLOCK DIAGRAM DESCRIPTION

        1.   CONTROLLER BOARD 1:

           Controller Board 1 does all input functions to the ALTAIR
           bus (Read Data, Sector Data, Status Information), as well
           as Control Addressing of all Disk to ALTAIR I/O.

        2.   CONTROLLER BOARD 2:

           Controller Board 2 performs all output functions from the
           ALTAIR bus (Write Data, Disk Control, Disk Enable and
           Drive Selection).

        3.   INTERCONNECT CABLE:

           An 18 pair flat cable with two 37 pin connectors, a male
           on one end, a female on the other. This cable connects the
           Disk Drive to the ALTAIR Disk Controller and "Daisy Chains"
           one Disk Drive to another in multiple Disk systems.

        4.   DISK DRIVE CABINET:

           a)   POWER SUPPLY:

               The Disk Drive Cabinet contains a power supply for powering
               the Disk Buffer and Disk Drive.

           b)   THE DISK BUFFER:

               The Disk Buffer board contains the necessary line drivers
               and receivers for interconnection with long cables to the
               Disk Drive. In addition, it contains the Disk Drive Address
               circuitry that allows the Controller to select one of 16
               Disk Drives.

               The Disk Buffer board also contains the line drivers for
               connection of multiple Disk Systems.

           c)   THE DISK DRIVE:

               The Disk Drive, a Pertec FD-400, contains the mechanism and
               electronics that actually reads and writes data on the Diskette.

II. CONNECTION OF DISK SYSTEM:

A) CONTROLLER BOARDS:

1. Items Supplied:

   a) CONTROLLER BOARD 1 (white vert strips)
   b) CONTROLLER BOARD 2 (with short cable wired to it)
   c) CONTROLLER CABLE (with 37 pin on one end, 3 Molex connec-
      tors on the other end)
   d) Connector Mounting Bracket and Hardware

2. Connection of Controller Boards

   a) Take cover off ALTAIR (power off!)
   b) Feed Molex (flat) connector ends of Controller cable through
      hole in back of ALTAIR on connector panel: (37 pin con-
      nector outside chassis, molex connectors inside chassis).
   c) Lay board 1 flat in front of you on the ALTAIR chassis with
      components up and stab connector to your right (as facing
      the front of the ALTAIR).
   d) Take the short wired cable of board 2 and connect it to the
      20 pin connector on board 1 (note polarization key of
      connector and missing pin on the PC board).
   e) Place board 2 flat, to the left of board 1.
   f) Connect 20 pin Molex connector on the Controller cable to
      the 20 pin connector on board 2. Note Keying.
   g) Take the 10 pin connector on the Controller cable with the
      orange and yellow wires connected to it and connect it
      to the 10 pin connector on board 2. Note Keying.
   h) Take the remaining 10 pin connector on the Controller cable
      with white and gray wires on it and connect it to the
      10 pin connector on board 1. Note Keying.
   i) Take both boards, hold together and slide into slots, with
      board 1 on right, board 2 on the left. Be sure wires
      from connector go out between card guides, and do not
      catch on card guides.
   j) Push cards firmly into connector in ALTAIR mother board.
   k) Install 37 pin connector in bracket and on back of ALTAIR,
      straddling 2 connector holes. Use #4-40 x 5/16 screws,
      lockwashers and #4-40 nuts.

B) DISK DRIVE CONNECTION TO ALTAIR:

   Take the 6 ft. flat cable with 1 male and 1 female connector;
   connect male end to Disk Controller connector on ALTAIR, and
   female end to connector on the Disk Drive marked "To Controller".

THE ALTAIR FLOPPY DISK SYSTEM

The *ALTAIR Disk* offers the advantage of nonvolatile memory, plus relatively fast access to data. The *ALTAIR Disk Controller* consists of two PC boards (over 60 I.C.s) that fit in the *ALTAIR* chassis. They inter-connect to each other with 20 wires and connect to the disk through a 37-pin connector mounted on the back of the *ALTAIR*. Data is transferred to and from the disk serially at 250K bits/sec. The disk controller converts the serial data to and from 8-bit parallel words (one word every 32 μ sec). The *ALTAIR CPU* transfers the data, word by word to and from memory, depending on whether the disk is reading or writing. The disk controller also controls all mechanical functions of the disk as well as presenting disk status to the computer. All timing functions are done by hardware to free the computer for other tasks. Since the *floppy diskette* is divided into 32 sectors, a hardware interrupt system can be enabled to notify the CPU at the beginning of each sector. Power consumption is approximately 1.1 amperes from the +8v (VCC) line for the two boards.

The Disk Drive unit, using a PERTEC FD400 mounted in an Optima case (5½" high—same depth and width as computer), includes a *power supply PC board* and a *Buffer Address, Line Driver P.C. Board*. A cooling fan maintains low ambient temperature for continuous operation. The disk drive cabinet has two 37-pin connectors on the back panel, one is the input from the disk controller, the other is the output to additional disk drives. Up to 16 drives may be attached to one controller.

The 88-DCDD consists of the disk controller and one disk drive with an interconnect cable. The 88-Disk is one disk drive for adding storage capability to the 88-DCDD and includes the interconnect cable.

The *ALTAIR Disk Format* allows storage of over 300,000 bytes. Since the disk is hard sectored (32 sectors for each track), we write 137 bytes on each sector, 9 of which are used internally (track#, checksum) leaving 128 data bytes per sector, 4096 per track. One floppy diskette is supplied with each drive; extra floppies are available for purchase. A *software driver* for the floppy disk is available at no charge and is supplied with the disk as a source listing. The disk operating system—which has a complete file structure and utilities for copying, deleting and sorting files—costs extra. *Extended BASIC*, which uses random and sequential file access for the floppy disk, is also available.

Specifications

Rotational Speed	360 rpm (166.7 ms/rev)
Access Times	Track to track, 10 ms Head settle, 20 ms Head load, 40 ms Average time to read or write, 400 ms Worst case, 1 sec
Head Life	Over 10,000 hours of head to disk contact
Disk Life	Over 1 million passes/track
Data Transfer Rate	250K bits/sec
Power Consumption	117VAC 110W
Diskette	Hard sectored, 32 sectors + index, Dysan 101 floppy disk, 77 tracks

DISK SYSTEM BLOCK DIAGRAM

```
┌────────────────────────────────────────────────────────────┐
│                         ALTAIR  BUS                          │
└────────────────────────────────────────────────────────────┘
         ↕                                        ↕
┌─────────────────────────────┐    ┌─────────────────────────────┐
│          BOARD I            │    │          BOARD 2            │
├─────────────────────────────┤    ├─────────────────────────────┤
│ I. ADDRESS  SELECTION.      │    │ I. DISK ENABLE  CIRCUIT     │
│ 2. SECTOR  CIRCUITRY.       │←→  │ 2. WRITE  CIRCUITRY.        │
│ 3. READ  CIRCUITRY.         │    │ 3. DISK DRIVE  CONTROL      │
│ 4. STATUS  OUTPUT.          │    │    CIRCUITRY.               │
└─────────────────────────────┘    └─────────────────────────────┘
         ↑                                        ↑
─────────────────────── ALTAIR CABINET ───────────────────────
         │                                        │
              ◯──▷ I8 PAIR CABLE
                         ↕
┌─────────────────────────────────────────────────────────────┐
│ DISK DRIVE CABINET                                          │
│                                                             │
│  ┌──────────┐   ┌──────────────┐   ┌──────────────┐        │
│  │          │   │    DISK       │   │              │        │
│  │  POWER   │   │   BUFFER      │   │   PERTEC     │        │
│  │  SUPPLY  │   │   BOARD       │   │   FD 400     │        │
│  │          │   │  (ADDRESS     │   │   DRIVE      │        │
│  │          │   │ LINE DRIVERS) │   │              │        │
│  └──────────┘   └──────────────┘   └──────────────┘        │
│                         ↑                                   │
└─────────────────────────────────────────────────────────────┘
                         ↕
                TO NEXT DISK DRIVE
```

DISK DRIVE

PERTEC FD-400

DOOR OPEN
HEAD CURR SW
TRIM ERASE
WRITE ENABLE
WRITE DATA
STEP IN
STEP OUT
HEAD LOAD
INDEX
DRIVE MOTOR ON
TRACK Ø
READ DATA

POWER SUPPLY

117 VAC

+5V -5V +24V

HEAD LOAD
DISK ENABLE
POWER

INDICATORS

DISK BUFFER

TRI STATE
LINE DRIVERS
AND
RECEIVERS

DISK POWER
HEAD CURRENT SW
TRIM ERASE
WRITE ENABLE
WRITE DATA
STEP IN
STEP OUT
HEAD LOAD
INDEX
TRACK O
READ DATA

5 SEC TIMER

DISK
ADDRESS
AND
ENABLE

88 DISK BLOCK DIAGRAM

FROM NEXT DISK

TO CONTROLLER

DISK ADDRESS A
B
C
D
DISK ENABLE

DISK CONTROLLER BLOCK DIAGRAM

SHEET I EXTERNAL CONNECTIONS AND ADDRESS SELECT

DISK CONTROLLER BLOCK DIAGRAM
SHEET 2 INTERNAL CONNECTIONS

BOARD 1

DISK ENABLE   (DE)

DISABLE STATUS INFO

VALID SECTOR DATA

DISK CONTROLLER ADDRESS SELECT CIRCUITS

SECTOR REQUEST

BOARD 2

SECTOR/ INDEX CIRCUIT

DISABLE SECTOR INFO

WRITE DATA ENABLE (WDE)

START OF SECTOR CLEAR (SOS)

WRITE CIRCUIT

READ CLEAR

WRITE ENABLE

READ CIRCUIT

DISK DRIVE SELECT CIRCUIT

DISK ENABLE

NRDA

STATUS CIRCUIT

(DE)   (WE)

DISK FUNCTION CONTROL CIRCUIT

INTERUPT OUTPUT   (INT)
HEAD STATUS   (HS)
MOVE HEAD   (MH)
ENTER NEW WRITE DATA (ENWD)

A. Address codes for I/O

	Address	Mode	
1.	Ø1Ø	Out	Select, latches and enables controller and disk drive.
2.	Ø1Ø	In	Indicates status of disk drive and controller.
3.	Ø11	Out	Controls disk function.
4.	Ø11	In	Indicates sector position of disk.
5.	Ø12	Out	Write data.
6.	Ø12	In	Read data.

B. Definitions (In order as listed above)

   1. Selection of Disk Drive "OUT" on CH #Ø1Ø

   DØ LSB
   D1   Enables 1 of 16 drives (each drive has a unique ad-
   D2   dress, selected by 4 jumper wires) and enables con-
   D3 MSB   troller (on disk drive buffer P.C. card).

   D4
   D5   Not used, don't care.
   D6

   D7   Clears disk control if set to 1 (D0-D6 don't care).
               Disables disk control. Disk control also cleared
               by opening door of disk drive or turning disk drive
               power off.

   NOTE: a) If disk drive door is open, drive and controller
              cannot be enabled.

          b) If disk power is off, drive and controller cannot
              be enabled.

          c) If disk interconnect cable is not connected between
              the controller and the drive, drive and controller
              cannot be enabled.

C) MULTIPLL DISK DRIVE CONNECTION:

1. With multiple Disk Drives, the Disks should have sequential addresses (i.e., for a 3 drive system you should have Disks with addresses 0, 1, and 2). They may be connected in any order. There serial # sticker has the Disk Address written on it. The Disk Address is determined by four jumper wires in the Disk Buffer P.C. card inside the Drive, and may be changed.

2. Connect the Disks by using the 6 ft. flat cable. Connect the male connector to the connector marked "From Next Disk" on the Disk Drive connected to the Controller. The other end of the cable connects to the next Disk Drive connector marked "To Controller". This procedure is repeated for added Disk Drive.

III. USING THE DISK DRIVE:

A) DISKETTE INFORMATION:

1. Always keep Diskette in envelope when not in use.
2. Keep Diskette away from heat, magnetic fields (flourescent lights, power transformers, etc.) and dust and dirt.
3. Never touch recording surface of Diskette (opposite label side).
4. Always mark your Diskette with what is on them. Use adhesive labels, but don't write on them after they are attached to the Diskette.
5. The Diskette used is hard Sectored (32 Sector holes, 1 index hole). Blank Diskettes are available from MITS for $15.00 each. The Diskettes are not IBM compatible.

B) OPERATING THE DISK DRIVE:

1. Open door to Disk Drive by pulling out and down.
2. Insert Diskette into Drive with label side up, making sure it catches on retaining tab.
3. Close door to Disk Drive.
4. If Disk power is on, wait 10 seconds, after closing door before activating any programs to access the Disk. Wait 10 seconds after turning power on with Diskette in Drive before activating any programs to access the Disk. This is to allow motor speed to stabilize.
5. NEVER: open Disk Drive door or turn power off when Disk Enable and Head Load lights are on. There would be a good possibility that you would interrupt the software during a write function, and destroy data on the Diskette.
6. Consult software documentation on methods used to load basic or use software. For applications where the user wishes to write his own software. See last section, "Controller I/O Information".

2. Status (Ø1Ø - INP) indicates disk status when drive and controller enabled. Also gives valid "INTE" status (D5) from the ALTAIR bus when controller enabled.

True condition = 0, False = 1.

All false if disk and controller are not enabled, and all false if no disk in drive.

DØ - ENWD - Enter new Write data - indicates write circuit is ready for new data byte to be written. It occurs every 32 µs and starts 280 µs after sector true (when Write enabled). It is reset by outputting to the Write data channel (012).

D1 - Move Head - Indicates head movement allowed when true (step IN, step OUT,). Goes false for 10 ms, true 1 ms, false 20 ms after step command. May step every 10 ms. Goes false for 40 ms after head load. Goes false during Write and 475 µs after Write to allow completion of trim erase.

D2 - HS - Head Status - True 40 ms after head loaded or step command (if stepping with head already loaded). Indicates when head is properly loaded for reading and writing. Also enables sector position channel when true.

D3 - Not Used, = Ø.

D4 - Not Used, = Ø.

D5 - INTE - Indicates interrupt enabled.

D6 - TRACK 0 - Indicates when head is on outermost track.

D7 - NRDA - New read data available - indicates that the read circuit has 1 byte of data ready to be taken from the read data channel (012). After the SYNC* bit is detected, it occurs every 32 µs and is reset by an input instruction on channel Ø12. The byte containing the SYNC bit is the first byte read from the disk.

* See "Write Enable"

3. Control (Ø11 - Out) - Controls Disk operations when disk drive and controller enabled. A true signal, logic 1, on a data line will control the disk as follows:

DØ - Step IN - steps disk head in one position to higher numbered track.

D1 - Step OUT - steps disk head out one position to lower numbered track.

D2 - Head Load - loads head onto disk - enables sector position status.

D3 - Head Unload - removes head from disk surface, may be unloaded immediately after "Write Enable" (write and trim erase circuits hold head loaded until through).

D4 - IE - Interrupt Enable - enables interrupts to occur when SRØ true (see sector definition).

D5 - ID - Interrupt Disable - disables interrupt circuit. Interrupt circuit also disabled by clearing disk control.

D6 - HCS - Head Current Switch - must be true when outputting a write instruction with the head on tracks 43-76. This reduces head current and optimizes resolution on inner tracks (automatically reset at end of writing a sector).

D7 - Write Enable - initiates write sequence as follows:

1. Disk selected and enabled, head loaded, enabling sector status.

2. (Sector True) detected for desired sector, write circuit enabled by software.

3. 200 μs from Write Enable, trim erase automatically turned on. 280 μs from start of sector, "ENWD" goes true, sync byte written by software.

4. First byte written always has most significant (D7) bit A "1" (SYNC Bit) (most sifnificant bit written first).

5. ENWD goes true every 32 μs. MAX. no. of data bytes per sector 137 (including SYNC).

6. Last or 138th byte written must be a 000. This will be written for the remainder of the sector. Ignore "ENWD" from this point to end of sector.

7. At end of sector, the write circuit automatically disabled, trim erase disabled 475 μs later.

NOTE: a) Write circuit will continue writing last byte out-
putted on CH #Ø12 to the end of that sector.

b) Head may be unloaded anytime during write cycle if no
read or write function is expected after current write
cycle. Once Write is enabled, it holds the head loaded
for the required time. (For writing and trim erase).

4. Sector Position (Ø11 - INP) with disk drive and controller enabled,
and 40 ms after head is loaded, the sector information is as follows:

DØ - SRØ - Sector True - True when = 0, and is 30 µs long. The
write mode should begin as close as possible to the time that DØ
goes true. Write data will be requested 280 µs after DØ goes
true. Read data will be available 140 µs after SRØ goes true.

SECTOR #	Ø	1	2	3...............................31
D1-SR1-	Ø	1	Ø	1...............................1
D2-SR2-	Ø	Ø	1	1...............................1
D3-SR3-	Ø	Ø	Ø	Ø...............................1
D4-SR4-	Ø	Ø	Ø	Ø...............................1
D5-SR5-	Ø	Ø	Ø	Ø...............................1

5. Write Data (Ø12-OUT) Outputted on the "ENWD" status request.

6. Read Data (Ø12-IN) Inputted on the "NRDA" status flag.

READ/WRITE TIMING
DURING READ OR WRITE FUNCTION

NEW READ DATA AVAILABLE (NRDA)
or
ENTER NEW WRITE DATA (ENWD) J4-6 (Board 2) F4-4

SECTOR TRUE (BOARD 1) F4-5

WRITE DATA ENABLE (BOARD 1)

WRITE ENABLE F.F. (BOARD 2) E2-9

ENWD (Board 2) J4-6

TRIM ERASE (BOARD 2) J4-9

READ CLEAR (BOARD 1) F1-4

NRDA (BOARD 1) B3-13

32 μs — 32 μs
false
true
DOWN TIME DEPENDENT ON SOFTWARE CYCLE TIME
30 μs
5.2 MS
280 μs
200 μs
475 μs
140 μs
280 μs

*********** ERRATA SHEET ***********

***** ALTAIR FLOPPY DISK *****

DRIVE & CONTROLLER - HARDWARE DOCUMENTATION

March 1976

THE FOLLOWING CHANGES HAVE BEEN MADE TO THE ABOVE
TITLED MANUAL ON THE PAGES INDICATED.

PAGE 32: No heat-sink should be used for either X1 or X3. Mount both
of these regulators directly to the board.

PAGE 95: Use a length of wire and connect the two pads labeled +8V to-
gether along the bottom edge of the board.

IT IS GENERALLY A GOOD IDEA TO GO THROUGH
YOUR MANUAL AND MARK THESE CHANGES ON THE
PAGES INDICATED BEFORE BEGINNING THE ACTUAL
PROCESS OF ASSEMBLING YOUR UNIT.

MITS, Inc.
3/16/76

disk controller assembly procedure

ASSEMBLY HINTS

Before beginning the construction of your unit, it is important that you read
the "MITS Kits Assembly Hints" booklet included with your kit. Pay particular
attention to the section on soldering, because most problems in the Altair
occur as the result of poor soldering. It is essential that you use the cor-
rect type of soldering iron. A 25-30 watt iron with a chisel tip (such as an
Ungar 776 with a 7155 tip) is recommended in the assembly hints booklet.

Some important warnings are also included in the hints booklet. Read them
carefully before you begin work on your unit -- failure to heed these warnings
could cause you to void your warranty.

Check the contents of your kit against the enclosed parts list to make sure
you have all the required components, hardware and parts. The components are
in plastic envelopes; do not open them until you need the components for an
assembly step. You will need the tools called for in the "Kits Assembly
Hints" booklet.

As you construct your kit, follow the instructions in the order they are
presented in the assembly manual. Always complete each section before going
on to the next. Two organizational aids are provided throughout the manual
to assist you: 1) Boxed-off parts identification lists, with spaces provided
to check off the components as they are installed; 2) Reproductions of the
silk screens showing a) previously installed components, b) components being
installed and c) components yet to be installed. (see below)

1

COMPONENT INSTALLATION METHODS

This section of the manual describes the proper pro-
cedures for installing various types of components
in your kit.

Read these instructions over very carefully and
refer back to them whenever necessary. Failure to
properly install components may cause permanent
damage to the component or the rest of the unit;
it will definitely void your warranty.

More specific instructions, or procedures of a
less general nature, will be included within the
assembly text itself.

Under no circumstances should you proceed with an
assembly step without fully understanding the pro-
cedures involved. A little patience at this stage
will save a great deal of time and potential "head-
aches" later.

INTEGRATED CIRCUITS (IC's) CAN COME WITH ANY ONE OF, OR A COMBINATION OF, SEVERAL DIFFERENT MARKINGS. THESE MARKINGS ARE VERY IMPORTANT IN DETERMINING THE CORRECT ORIENTATION FOR THE IC's WHEN THEY ARE PLACED ON THE PRINTED CIRCUIT BOARDS. REFER TO THE ABOVE DRAWING TO LOCATE PIN 1 OF THE IC's, THEN USE THIS INFORMATION IN CONJUNCTION WITH THE INFORMATION BELOW TO PROPERLY ORIENT EACH IC FOR INSTALLATION.

WARNING: INCORRECTLY ORIENTED IC's MAY CAUSE PERMANENT DAMAGE!

THE DRAWING ON THE LEFT INDICATES VARIOUS METHODS USED TO SHOW THE POSITION OF IC's ON THE PRINTED CIRCUIT BOARDS. THESE ARE SILK-SCREENED DIRECTLY ON THE BOARD. THE ARROWHEAD INDICATES THE POSITION FOR PIN 1 WHEN THE IC IS INSTALLED.

3

IC Installation

All ICs must be oriented so that the notched end is toward the end with the arrowhead printed on the PC board. Pin 1 of the IC should correspond with the pad marked with the arrowhead. If the IC does not have a notch on one end, refer to the chart on the preceeding page for the identification of Pin 1.

To prepare ICs for installation:
All ICs are damaged easily and should be handled carefully — especially static-sensitive MOS ICs. Always try to hold the IC by the ends, touching the pins as little as possible.

When you remove the IC from its holder, CAREFULLY straighten any bent pins using needle-nose pliers. All pins should be evenly spaced and should be aligned in a straight line, perpendicular to the body of the IC itself.

1. Orient the IC so that Pin 1 coincides with the arrowhead on the PC board.

2. Align the pins on one side of the IC so that just the tips are inserted into the proper holes on the board.

3. Lower the other side of the IC into place. If the pins don't go into their holes right away, rock the IC back, exerting a little inward pressure, and try again. Be patient. The tip of a small screwdriver may be used to help guide the pins into place. When the tips of all the pins have been started into their holes, push the IC into the board the rest of the way.

4. Tape the IC into place on the board with a piece of masking tape.

5. Turn the board over and solder each pin to the foil pattern on the back side of the board. Be sure to solder each pin and be careful not to leave any solder bridges.

6. Turn the board over again and remove the piece of masking tape.

Resistors have four (or possibly five) color-coded bands as represented in the chart below. The fourth band is gold or silver and indicates the tolerance. NOTE: In assembling a MITS kit, you need only be concerned with the three bands of color to the one side of the gold or silver (tolerance) band. These three bands denote the resistor's value in ohms. The first two bands correspond to the first two digits of the resistor's value and the third band represents a multiplier.

For example: a resistor with red, violet, yellow and silver bands has a value of 270,000 ohms and a tolerance of 10%. By looking at the chart below, you see that red is 2 and violet 7. By multiplying 27 by the yellow multiplier band (10,000), you find you have a 270,000 ohm (270K) resistor. The silver band denotes the 10% tolerance. Use this process to chose the correct resistor called for in the manual.

2ND BAND VIOLET

1ST BAND RED

4TH BAND SILVER

3RD BAND YELLOW

RESISTOR COLOR CODES

COLOR	BANDS 1&2	3rd BAND (Multiplier)
Black	0	1
Brown	1	10
Red	2	10^2
Orange	3	10^3
Yellow	4	10^4
Green	5	10^5
Blue	6	10^6
Violet	7	10^7
Gray	8	10^8
White	9	10^9

Use the following procedure to install the resistors onto the boards. Make sure the colored bands on each resistor match the colors called for in the list of Resistor Values and Color Codes given for each board.

1. Using needle-nose pliers, bend the leads of the resistor at right angles to match their respective holes on the PC board.

2. Install the resistor into the correct holes on the silk-screened side of the PC board.

3. Holding the resistor in place with one hand, turn the board over and bend the two leads slightly outward.

4. Solder the leads to the foil pattern on the back side of the board; then clip off any excess lead lengths.

5

A. Electrolytic and Tantalum Capacitors

Polarity requirements must be noted on the electrolytic capacitors and the tantalum capacitor before they are installed.

The electrolytic capacitors contained in your kit may have one or possibly two of three types of polarity markings. To determine the correct orientation, look for the following.

ELECTROLYTIC
CAPACITOR

One type will have plus (+) signs on the positive end; another will have a band or a groove around the positive side in addition to the plus signs. The third type will have an arrow on it; in the tip of the arrow there is a negative (-) sign and the capacitor must be oriented so the arrow points to the negative polarity side.

The tantalum capacitor is metallic in appearance and smaller than the electrolytic capacitors. Its positive end has a plus sign on it or a red dot.

Refer to the chart included for each board for correct Capacitor Values and install the electrolytic capacitors and tantalum capacitors using the following procedure.

1. Bend the two leads of the capacitor at right angles to match their respective holes on the board. Insert the capacitor into the holes on the silk-screened side of the board. Be sure to align the positive polarity side with the "+" signs printed on the board.

2. Holding the capacitor in place, turn the board over and bend the two leads slightly outward. Solder the leads to the foil pattern and clip off any excess lead lengths.

B. Ceramic Disk Capacitors

Refer to the chart included for each board for correct Capacitor Values, and install the ceramic disk capacitors using the following procedure.

1. Choose the correct value capacitor and straighten the two leads as necessary to fit their respective holes on the PC board.

2. Insert the capacitor into the correct holes from the silk-screened side of the board. Push the capacitor down until the ceramic insulation almost touches the foil pattern.

3. Holding the capacitor in place, turn the board over and bend the two leads slightly outward.

4. Solder the two leads to the foil pattern on the back side of the board; then clip off any excess lead lengths.

Transistor Installation

To install transistors, use the following instructions.

NOTE: Always check the part number of each transistor before you install it. (See listing of Transistor Part Numbers for each board.) Some transistors look identical but differ in electrical characteristics, according to part number. If you have received substitute part numbers for the transistors in you kit, check the Transistor Identification Chart which follows these instructions to be sure you make the correct substitutions.

NOTE: Always make sure the transistor is oriented so that the emitter lead is installed in the hole on the PC board labeled with an "E." To determine which lead is the emitter lead, refer to the Transistor Identification Chart.

1. After the correct transistor has been selected and the leads have been properly oriented, insert the transistor into the holes on the silk-screened side of the board.

2. Holding the transistor in place, turn the board over and bend the three leads slightly outward.

3. Solder the leads to the foil pattern on the back side of the board; then clip off any excess lead lengths.

Diode Installation

NOTE: Diodes are marked with a band on one end indicating the cathode end. Each diode must be installed so that the end with the band is oriented towards the band printed on the PC board. Failure to orient the diodes correctly may result in permanent damage to your unit.

Use the following procedure to install diodes onto the board. Refer to the list of Diode Part Numbers included for each board to make sure you install the correct diode each time.

1. Bend the leads of the diode at right angles to match their respective holes on the board.

2. Insert the diode into the correct holes on the silk screen, making sure the cathode end is properly oriented. Turn the board over and bend the leads slightly outward.

3. Solder the two leads to the foil pattern on the back side of the board; then clip off any excess lead lengths.

SMALL FLAT	FLAT	FLAT	FLAT	FLAT
EN2907* CS4438 CS4439 CS4437 CS4410 2N4250 2N3642 2N3645 (NO FLAT)	MPF-105 MPF-III	TIS98 TIS 92	DI3T2 2N6028	ST2907 ST98 S38473 2N5210 2N4410 EN4410 PN2907 2N2907 EN2907*

IN THE ILLUSTRATION ABOVE THE OUTLINE OF EACH TYPE OF TRANSISTOR IS SHOWN OVER THE PADS ON THE CIRCUIT BOARD WITH THE CORRECT DESIGNATION FOR EACH OF THE THREE LEADS. USE THIS INFORMATION TOGETHER WITH THE INFORMATION IN THE ASSEMBLY MANUAL FOR THE CORRECT ORIENTATION OF THE TRANSISTORS AS YOU INSTALL THEM.

THE FOLLOWING IS A LIST OF POSSIBLE SUBSTITUTIONS: IF ANY OTHERS ARE USED YOU WILL RISK DAMAGING YOUR UNIT:
    2N4410 = EN4410 = CS4410 = CS4437, CS4438, TIS98, ST98, S38473 (NPN)
    EN2907 = 2N2907 = PN2907 = ST2907, CS4439 (PNP)
WHEN MAKING SUBSTITUTIONS, REFER TO THE ILLUSTRATION TO DETERMINE THE CORRECT ORIENTATION FOR THE THREE LEADS.

*Configuration of the leads on EN2907 may vary.

disk drive assembly procedure

Remove the top from the Disk Drive case
by withdrawing the two screws indicated
in the drawing below. Slide the case
top backwards, lifting the back slightly,
to remove it entirely from the chassis.

Also remove the 4 screws in the side of
the case bottom, and remove the entire
chassis assembly.

CASE
TOP

BACK-PANEL

(2)#6-32 SCREWS

11

DISK DRIVE BACK PANEL ASSEMBLY

Remove the back panel from the case by
withdrawing each of the four screws in
the corners of the panel. These four
screws are shown inserted in the draw-
ing below.

Save these four screws for remounting
the back panel later in the assembly
procedure.

Terminal Block Installation

Mount the terminal block to the back panel as shown in the drawing below. Use the screw sizes and other hardware indicated in the drawing.

NOTE: Be sure that the back panel is oriented as shown; be careful not to mount the terminal block on the wrong side of the panel.

Tighten all four screws firmly into place.

13

Transformer Installation

There are two transformers included in this kit. The larger of the two will be refered to as T1, the smaller as T2.

Wire Preparation

Before mounting these transformers, the wires must be cut to the proper length and screw-mount crimp terminals attached to each of them. There are also three wires which will not be used at all, and will be cut off at the transformer coil.

- Refering to the drawing on the opposite page, cut the wires on transformers T1 and T2 to the lengths indicated. The three unused wires should be cut off at the point where they enter the transformer coil itself.

Next, as indicated in the bottom of the drawing, strip exactly 1/2" of insulation from each of the eleven wires and bend the exposed portion in half to 1/4".

There are several screw-mount crimp terminals included with this kit. These have a slot in one end and an insulated portion on the other end (usually red) for attaching wires. One of these crimp terminals must be attached to each of the eleven transformer wires.

Insert one of the wires into one of the terminals as shown in the drawing. Push the wire in as far as it will go without distorting it or pushing it all the way through.

The wire should then be permanently connected to the terminal by either soldering it in place or crimping. To crimp the terminal use a crimping tool, if available, or else flatten the insulated portion of the terminal as tightly as possible using pliers.

Prepare each of the eleven transformer wires in the above manner.

Mounting

Refering to the drawings following the "Transformer Wire Preparation" drawing, mount transformers T1 & T2 to the back panel.

NOTE: For proper orientation, transformer T1 should have the two yellow wires towards the top of the panel (with reference to the drawings), and T2 should have the two black wires towards the top of the panel.

Be sure to install a terminal lug on transformer T1 as shown in the drawing. This is a solder type lug, and not the screw-mount type used for the transformer wires.

Use the hardware indicated in the drawings to mount the transformers and tighten the screws firmly into place.

NOTE: Save all wires that you cut off for later use.

14

cut off
YELLOW/GREEN

YELLOW
5 1/2"

YELLOW
4 1/2"

T1

BLACK
2 3/4"

BLACK
2"

BLACK
5"

BLACK
4 3/4"

cut off
BLUE

T2

WHITE
2"

RED
2"

ORANGE
2"

RED
2"

WHITE
2"

TRANSFORMER WIRE PREPARATION

STRIP
1/2"

BEND
1/4"

TERMINAL

15

BACK PANEL

(2)#6-32X1/2" SCREWS

T1

TERMINAL LUG

(3)#6 LOCKWASHERS

(2)#6-32 NUTS

(2)#6-32X1/2" SCREWS

T2

(4)#6 LOCKWASHERS

(2)#6-32 NUTS

BACK PANEL

16

Fuse Holder Installation

Refering to the drawing below, mount the
fuse holder to the back panel using the
rubber washer and nut provided. Tighten
it firmly into place.

Remove the cap and place the fuse provided
with your kit into the holder, then replace
the cap.

BACK PANEL

FUSE HOLDER

RUBBER WASHER

NUT

90° ANGLE CLIP INSTALLATION

The drawing below illustrates the hard-
ware and orientation for mounting the
90° angle clip included with this kit.

NOTE: One side of the clip is slightly
shorter than the other. The
shorter side should be mounted
against the back panel with the
longer side extending at 90°.

Install the clip as shown below and tighten
the screws firmly into place. Be sure that
clip remains "square" with the panel when
tightening the screws.

BACK PANEL

#6-32 X 3/8"
SCREW

#6-32 NUT

(4) #6 LOCKWASHER

#6-32 NUT

ANGLE CLIP

#6-32 X 3/8"
SCREW

18

Fan Installation

Before the cooling fan is installed onto
the back panel, two lengths of wire must
be prepared and connected to it.

There is some black wire included with
the kit; cut two 6 1/2 inch lengths of
this wire. Strip 1/2 inch of insulation
from one end of each of the wires, and
1/4 inch of insulation from the other.

In the same manner as described on page
, attach a screw-mount crimp terminal
to the 1/2" stripped end of each of the
two wires. Tin the 1/4" stripped ends
of the wires by applying a thin coat of
solder.

There are two terminals on the fan in one
of the corners. Solder the ends of the
two wires opposite the crimp terminals to
the terminals on the fan.

Refering to the drawing below, mount the
fan and screen to the back panel using
the hardware indicated. For proper
orientation, the terminals with the two
wires attached should be towards the
bottom on the side nearest the terminal
block. The arrow printed on the fan
to indicate airflow should be facing
towards the screen. The screen itself
has a bump on one side in each of the
four corners. The side with the bumps
should be towards the fan.

(4) #6-32 X 2" FLATHEAD
SCREWS

(4) CLIP-ON NUTS

FAN

PROTECTIVE
SCREEN

BACK PANEL

(4)#6 FLATWASHERS
(4)#6 LOCKWASHERS

(4) #6-32 NUTS

19

Power Cord Installation

There is a 3-wire power cord included with this kit which must be prepared as follows before installation.

1) Strip 4" of the cord casing from the wires by cutting a circle 4" from the end and pulling off the black insulation. Be careful not to cut into the insulation on any of the wires inside.

2) The green wire inside should already be at the correct length of 4 inches. Cut the white wire to 3 1/2 inches, and the black wire to 1 1/4 inches. Strip 1/4 inch of insulation from the ends of each of the three wires.

3) Tin the exposed 1/4" of the black wire by applying a thin coat of solder.

4) Solder or crimp screw-mount crimp terminals to the white and green wires.

Place the strain relief, included with the kit, over the power cord. Be sure that the larger diameter end of the relief is towards the male plug end of the cord.

Be sure that there is approximately three inches of the cord's black insulation case extending beyond the strain relief*, then snap it into place on the back panel as shown below.

* The black wire should reach to the center of the fuse holder when the cord & strain relief are in place.

20

Wire Preparation

Using the wire supplied with this kit, and the length of yellow/green wire cut from transformer T1, prepare the power supply interconnect wires according to the following instructions.

To avoid confusion, it would be best to prepare these wires one at a time.

The list on the right indicates the color of each wire, the length to which it should be cut, and a reference "tag".

Use the following steps to prepare each wire:

1) Cut the specified color wire to the length indicated.

2) Strip 1/2 inch of insulation from one end and 1/4 inch from the other.

3) Tin the wire exposed 1/4 inch by applying a thin coat of solder.

4) According to the instructions on page   , connect a screw-mount crimp terminal to the 1/2 inch stripped end.

5) Approximately 5 inches from the 1/4 inch tinned end of the wire label it, using masking tape, with the reference tag indicated.

An additional length of BLACK wire should be cut to 22 1/2 inches and 1/4 inch of insulation stripped from <u>each</u> end. Tin both ends by applying a thin coat of solder. Label this wire "FUSE".

Interconnect Wires

COLOR	LENGTH		TAG
Yellow/ Green*	2	inches	3
Black	22 3/4	"	3
Black	17 3/4	"	9
Black	17 1/2	"	10
Black	25	"	1
White	18	"	6
White	17 3/4	"	8
Orange	17 3/4	"	7
Orange	18 1/2	"	4
Orange	18 1/4	"	5

*From transformer T1, This wire need not be labeled.

Back Panel Wiring

The disk back panel assembly may now be completed by connecting all of the wires to their appropriate locations.

(See drawing page 23)

Three solder connections are necessary and should be made first. These include the black power cord wire, the yellow/green wire and the black 22 1/2 inch wire labeled "FUSE".

1) Solder the 1/4 inch tinned end of the yellow/green wire to the solder lug on transformer T1.

2) Solder the black power cord wire to the center terminal on the fuse holder.

3) Solder one end of the black "FUSE" wire to the other fuse holder terminal.

The remaining connections will be made to the terminal block.

The drawing (P.23) shows the proper orientation and connections for all of the wires on the back panel. The "tags" on the wires you prepared earlier refer to the numbers shown on the terminal block.

WARNING: The power supply is a critical part of any electronic system. Check the wiring here several times to be sure you have it correct. Be sure that each of the wires is in the proper location and that all of the screws on the terminal block are tight.

Use the drawing below for reference and connect all of the wires as indicated. Match the "tags" on the wires prepared earlier with the numbered positions on the terminal block. There should be a total of 25 crimp terminal connections made to the block.

NOTE: Where two terminals are to be connected to the same screw, place them "back to back". In this position they will fit flat together, and make a much more solid connection.

The ON-OFF Switch may also be soldered in at this time. Use the free end of the black "FUSE" wire and the free end of the wire labeled "1" to connect to the switch terminals. There are three terminals on the switch. Use the center terminal and one to either side of it. (The switch position towards the side where the connections are made will be its OFF position.

Install the 4 tie wraps in the positions shown in the top drawing on page 23.

22

WIRE ROUTING & TIE WRAPS

POWER CORD

FAN

*TIE WRAPS (4)

BACK PANEL WIRING

AC POWER CORD

110 VAC

YEL

YEL

BLK

BLK

SEC

T1

PRI

PRI

T2

SEC

BLK

BLK

FAN

FUSE

BLK

BLK   BLK   BLK   YEL/ORN   YEL   YEL   WHT   ORN   WHT   RED   RED

BLK   WHT   BLK   ORN   BLK   ORG   ORG   WHT   ORN   WHT   BLK   BLK

TERMINAL BLOCK

BLK   BLK
OFF·ON SW.

23

DISK POWER SUPPLY BOARD ASSEMBLY

NOTE: Save all component leads clipped
       off during assembly until the
       entire unit is complete. Some
       of the leads will be used during
       the assembly process.

RESISTOR INSTALLATION

Install the following 2 resistors
according to the instructions listed
on page 5 .

RESISTOR VALUES AND COLOR CODES

( ) R1 is 33 ohm (orange-orange-
     black) 1/2 W

( ) R2 is 7.5 ohm, 5 W (this may
     be color coded, violet-green-
     3rd band white or gold; or it
     may be a solid body color, with
     the value printed directly on
     the resistor itself.

MITS
DISK POWER SUPPLY

R2

R1

25

Install the following 3 ceramic
disk capacitors according to the
instructions on page 6 .

CAPACITOR VALUES

( ) C2 = .1uf, 50V

( ) C5 = .1uf, 50V

( ) C8 = .1uf, 50V

MITS
DISK POWER SUPPLY

R2

R1

C2

+

+

+

+

+

C5

C8

+

+

DI

D2

CAPACITOR INSTALLATION

Install the following 6 electrolytic
capacitors according to the instruc-
tions listed on page 6 .

CAPACITOR VALUES

(↖) C1 = 2200uf, 50V

(↖) C3 = 33uf, 50V

(↖) C4 = 3300uf, 16V

(↖) C6 = 33uf, 50V

(↖) C7 = 1000uf, 25V

( ) C9 = 33uf, 50V

MITS
DISK POWER SUPPLY

R2

C9 +

R1

C2

C4 +   C6 +   C7 +   C1 +   C3 +

C5   C8

D1   D2

<u>DIODE INSTALLATION</u>

Install the following 2 diodes
according to the instructions
on page 7 .

( ) D1 = 1N4004

( ) D2 = 1N4004

**MITS
DISK POWER SUPPLY**

R2

R1

+   +   +   +   +

D1   D2

VOLTAGE REGULATOR INSTALLATION

There are 2 voltage regulators to be
installed on the silk-screened side of
the power supply board, X1 & X3.

These are to be installed according
to the following procedure.   (see
drawing-right)

    (1)   Set the regulator in place
        over the board so that the
        mounting hole in the regu-
        lator and the board align.

    (2)   Use a pencil to mark the point
        on each of the regulator's
        three leads directly over
        its corresponding hole in the
        board.

    (3)   Bend the three leads, using
        needle-nose pliers, at right
        angles from the printed side
        of the component.

NOTE: Use heat-sink grease when in-
        stalling this component. Apply
        it to the surface where the reg-
        ulator & board come in contact.

    (4)   Referring to the drawing, set
        the regulator in place on the
        silk-screened side of the board.
        Secure it to the board using a
        #6-32 nut and screw. Hold the
        regulator in place as you
        tighten the nut to keep from
        twisting the leads.

    (5)   Turn the board over and solder
        the three leads to the foil
        pattern on the back side of
        the board. Be sure not to
        leave any solder bridges.

    (6)   Clip off any excess lead lengths.

use the above procedure to install both
of the regulators, X1 & X3.

#6-32 x ¼"

X1 & X3

#6-32

32

( ) X1 = 7824

( ) X3 = 7805

MITS
DISK POWER SUPPLY

X1

B C E

R1 C2

R2

C9 +

X3

B C E

C4 +   C6 +   C7 +   C1 +   C3 +

33

BRIDGE RECTIFIER INSTALLATION

There are two bridge rectifiers, BR1 & BR2, to be installed on the power supply board.

WARNING: Read the following instructions closely. Proper orientation of these two components is absolutely critical.

These two components are indicated on the silk-screen by broken lines. This is to indicate that they are to be mounted on the bottom (non-silk-screened) side of the board.

You will observe a "+" sign printed near one corner of the rectifier. The lead nearest this "+" sign is the positive lead of the rectifier. This lead must be inserted into the hole marked on the silk-screen with a "+" sign.

NOTE: There is also a "-" sign printed on the regulator. The lead nearest this sign is the negative lead of the rectifier, and should be diagonally opposite the "+" lead on the board.

BE ABSOLUTELY SURE THAT THE PROPER ORIENTATION IS USED WHEN INSTALLING THESE TWO COMPONENTS.

Install the rectifiers according to the following procedure:

(1) Insert the four leads of the BR1 rectifier into their respective holes from the non-silk-screened side of the board. Be sure the "+" lead of the rectifier is inserted in the hole labeled "+" on the silk-screened side of the board.

(2) Insert the BR2 rectifier in the same manner. Be sure both rectifiers are pushed all the way against the board.

(3) There is a 90° angle bracket included with your parts. Each of the two sides has two holes in it.

Using the side with the two holes the furthest apart, set the angle bracket over the two rectifiers. The holes in the bracket, the rectifiers, and the board should align.

Temporarily attach the bracket & rectifiers to the board through these holes using #6-32 & 5/8" screws and nuts.

(4) Check the orientation once more, then solder all four leads of each rectifier to the board on the silk-screened side.

(5) Clip off any excess lead lengths. Leave the angle bracket in place for the next procedure.

NOTE: Apply heat-sink compound to all mating surfaces.

BRIDGE RECTIFIER INSTALLATION

( ) BR1 = VJ048

( ) BR2 = VJ048

C4 |+   C6|+   C7 |+   X3   C1 | +   C3| +

B   E
C

C5   C8

BR2   D1   D2   BRI

35

DISK BUFFER BOARD
ASSEMBLY

IC INSTALLATION

Install the follow-
ing 7 ICs onto the
Disk Buffer Board
according to the
method described on
page 4 .

IC SILK-SCREEN
DESIGNATIONS AND
PART NUMBERS

( ) A, B, D, & E = 8T97

( ) C   = 8T98

( ) F   = 74L30

( ) G   = 9601

37

RESISTOR INSTALLATION

Install the following 39 resistors
according to the instructions listed
on page **5** .

RESISTOR VALUES AND COLOR CODES

( ) R9, R7, R5 are 220 ohm
  (red-red-brown) 1/2 W

( ) R10, R8, R6 are 330 ohm
  (orange-orange-brown) 1/2 W

( ) R12, R14, R16 are 330 ohm
  (orange-orange-brown) 1/2 W

( ) R11, R13, R15 are 220 ohm
  (red-red-brown) 1/2 W

( ) R33 is 220 ohm
  (red-red-brown) 1/2 W

( ) R34 is 330 ohm
  (orange-orange-brown) 1/2 W

( ) R31, R29, R27, R25 are 220 ohm
  (red-red-brown) 1/2 W

( ) R32, R30, R28, R26 are 330 ohm
  (orange-orange-brown) 1/2 W

( ) R36, R35, R37 are 150 ohm
  (brown-green-brown) 1/4 W

( ) R40 is 330 ohm
  (orange-orange-brown) 1/2 W

( ) R39 is 220 ohm
  (red-red-brown) 1/2 W

( ) R38 is 1K ohm
  (brown-black-red) 1/2 W

( ) R41 is 39K ohm
  (orange-white-orange) 1/2 W

( ) R20, R22, R24 are 330 ohm
  (orange-orange-brown) 1/2 W

( ) R19, R21, R23 are 220 ohm
  (red-red-brown) 1/2 W

( ) R4 & R18 are 330 ohm
  (orange-orange-brown) 1/2 W

( ) R3 & R17 are 220 ohm
  (red-red-brown) 1/2 W

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Insert Page

ALTAIR FLOPPY DISK

Disk Drive Assembly Procedure

Resistor Value Changes, page 38

R39 should be 330 ohms

R40 should be 220 ohms

R9 R10 R7 R8 R5 R6

R12 R11 R14 R13 R16 R15

R33 R34

R31 R32 R29 R30 R27 R28 R25 R26

R36 R35

R4 R3

R18 R17

R20 R19 R22 R21 R24 R23

R40 R39 R38

R41

R37

39

DIODE INSTALLATION

Install diode D6 according to the
instructions on page 7 .

( ) D6 = 1N914

CAPACITOR INSTALLATION

Capacitor C14 is an electrolytic
capacitor. Capacitors C10, C11, C12,
and C13 are ceramic disk capacitors.

Install these components according
to the instructions listed on page 6 .

CAPACITOR VALUES

(Different voltages may be sub-
stituted in some cases.)

( ) C14 = 500 uf, 25V electrolytic

( ) C10, C11, C12 & C13 are .1 uf,
    12V ceramic disks.

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R9 R10 R7 R8 R5 R6
C10
A
R4 R3
M
R12 R11 R14 R13 R16 R15
R18 R17
D
C11
B
R33 R34
R20 R19 R22 R21 R24 R23
C
C14
G
C12
D6
F
R41
E
R31 R32 R29 R30 R27 R28 R28 R26
R40 R39 R38
R36
R35
R37
C13
43
+

Ribbon Cable Preparation

There are three ribbon cable assemblies to be prepared for installation in the disk drive unit. A 12' length of 18-twisted pairs cable has been provided for this purpose.

First, cut the 12' length of cable into two 18-inch lengths and one 25-inch length. The remainder of the cable should be saved for later use.

The following two pages contain diagrams for the proper lengths and arrangement for the three cable pieces you have just cut. The two 18" lengths will be prepared identically.

The cable sheath itself may be cut using scissors, and can be stripped by simply pulling it apart. You will note that the plastic sheath has "welds" approximately every inch between the twisted pairs. Try not to make any cuts on the welds themselves.

Each time a 1/4" of insulation is stripped from the wires themselves, the bare ends should be tinned by applying a thin coat of solder.

Study the diagrams on the next two pages and prepare the three cable assemblies as shown. Be careful to cut the wires precisely as indicated, and do not damage the wire insulation when cutting the cable sheath.

44

18 INCH RIBBON CABLES

CUT TO 2" : STRIP 1/8" & TIN

18"

14"

6 "

2 Pr.

"

"

"

"

"

"

"

"

STEP CASING EVENLY
APPROX. EVERY INCH

CUT TO 2"
STRIP 1/4" & TIN

45

CUT TO 5" : STRIP 1/2" & TIN
4 PAIR

CUT TO 2" : STRIP 1/4" & TIN

2"

6"

10"

25"

18"

1   7

7 PAIR

Pr. #	CUT TO
1	10"
2	10"
3	8"
4	8"
5	7"
6	8"
7	7"

STRIP 1/4" & TIN

2 PAIR

2 PAIR

2 PAIR

2 PAIR

2 PAIR

1 PAIR

STEP CASING EVENLY
APPROXIMATELY 1 1/2"
STEPS

CUT TO 2 1/4"
STRIP 1/4" & TIN

46

There are several 37-pin connectors in this kit. One male connector and one female connector will be used now to connect onto one end of each of the two 18 inch lengths of ribbon cable that you have just prepared. The other end of the two cables will connect directly to the Disk Buffer board.

Connector Preparation

The two 37-pin connectors must first be prepared for attaching to the cables. It may be helpful to solidly mount the connectors to some steady object during this and the following procedures.

1) Place the connector in front of you with the hollow solder pins facing upwards.

2) Using your soldering iron, very carefully heat each pin one at a time and fill the hollow space with solder. The solder should not quite fill the pin and should have a slightly concave surface.

Prepare all 37 pins on one male and one female connector in this manner. Be sure not to leave any solder bridges between the pins, and be careful not to melt any of the nylon insulation around them.

WARNING

During the following procedure, and later steps involving ribbon cable, be sure that you fully understand all of the instructions before you begin. These points are the most likely areas for assembly errors to occur.

Cable Assembly

The following procedure should be used for assembling both of the 18 inch cables. In order to minimize the possibility of error, the cables will be attached to the 37-pin connectors and the Disk Buffer board during the same procedure. Read this entire procedure over carefully before beginning.

You will note that the pins on the 37-pin connectors are all numbered. Note also that the numbers on the male connector are the reverse of the female. The male connector will be wired to the rows of pads on the buffer board labeled "TO". The female connector will be wired to the rows of pads labeled "FROM". The numbers on the connector pins correspond directly with the numbers that label the pads on the buffer board.

The following pages contain drawings of both the 37-pin connectors, and the Disk Buffer board silk-screen. There is a space provided to "check-off" each of the twisted-pair wires as they are connected. Double arrows are also shown to indicate the connection points for each of the twisted-pairs.

Orient one of the 18 inch cables so that the "stepped" edge of the cable casing is along the rows of pads on the buffer board labeled "TO". The longest wires should be near the pads labeled "19 & 37" and the shortest wires near the pads labeled "1 & 20". Place the MALE 37-pin connector near the other end of the cable.

Begin with the shortest twisted-pair of wires, nearest the outside edge of the cable casing, on the buffer board end.

Separate the two wires slightly, then solder them into the two pads labeled "1 & 20" on the buffer board. Do this by inserting the wires from the silk-screened side of the board and soldering them on the back. Be careful not to push any of the wire insulation into the holes. Clip off any excess wire from the connections and then check-off the appropriate space on the silk-screen drawing.

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The same twisted-pair of wires should now be connected to the pins numbered "1 & 20" on the 37-pin connector.

Observe the color of the wire now connected to the pad on the buffer board labeled "1". Be sure to connect this same wire to the pin numbered "1" on the connector. Do the same with pad "20" and pin "20".

Make the connections by re-melting the solder in the pins and inserting the wires up to their insulation. Remove the heat from the pins while still holding the wires in place until the solder cools. Check-off the appropriate space on the connector drawing.

Move to the next twisted-pair of wires in the ribbon cable and use the same procedure to connect pads "2 & 21" with pins "2 & 21". Continue in this manner, moving across the ribbon cable one pair at a time, until all 18 twisted-pairs are in place. Be sure that you do not connect any wires to pin "12" on the connector.

NOTE: Take your time and be careful while soldering the wires to the connectors. Do not melt any of the wire insulation or leave any solder bridges.

Check your work as you go along and be <u>sure</u> that 1 is connected to 1, 2 to 2, 3 to 3, etc., because corrections will be very difficult later.

Use this procedure to assemble both of the 18 inch cables. Be sure that the MALE 37-pin connector goes to the pads labeled "TO" and the FEMALE connector to the pads labeled "FROM". Refer to the drawing on page   to get a rough idea of how these and the next cable will appear when connected to the board.

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37-PIN MALE CONNECTOR

PIN 12 NOT USED

( ) 19 & 37   ( ) 15 & 33   ( ) 11 & 30   ( ) 7 & 26   ( ) 3 & 22
   ( ) 17 & 35 ( ) 13 & 31   ( ) 9 & 28   ( ) 5 & 24   ( ) 1 & 20

( ) 16 & 34   ( ) 10 & 29   ( ) 6 & 25   ( ) 2 & 21
( ) 18 & 36   ( ) 14 & 32   ( ) 8 & 27   ( ) 4 & 23

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50

37-PIN FEMALE CONNECTOR

PIN 12 NOT USED

( ) 1 & 20   ( ) 5 & 24   ( ) 9 & 28   ( ) 13 & 31   ( ) 17 & 35

( ) 3 & 22   ( ) 7 & 26   ( ) 11 & 30   ( ) 15 & 33   ( ) 19 & 37

( ) 4 & 23   ( ) 8 & 27   ( ) 14 & 32   ( ) 18 & 36

( ) 2 & 21   ( ) 6 & 25   ( ) 10 & 29   ( ) 16 & 34

51

Due to its complexity, the 25 inch length of ribbon cable will be assembled in a slightly different manner.

The following two pages contain drawings of one end of the ribbon cable and the 44-pin edge connector included with this kit. These connections, on one end of the ribbon cable only, will be made first.

> NOTE: Be sure to observe that the orientation of the edge connector is not the same in all of the drawings. Use the pin designations themselves for any reference when making connections.

Orient the 25 inch ribbon cable as shown in the drawing on page 46 . The end that is shown at the top of this drawing will be attached to the 44-pin edge connector. The Connection Chart on the following page also refers to this drawing for the proper orientation. Twisted-pair #1 is the pair furthest to the right in the drawing, and pair #18 is furthest to the left. It is very important to begin numbering from the correct side when making the connections.

The Connection Chart on the following page indicates where on the edge connector each twisted-pair should be attached. The pin designations in the chart and in the drawings refer to those stamped into the plastic of the connector itself. Be sure that you connect the proper wires to the correct pins according to the designations stamped on the connector.

In most cases a single wire will connect to a single pin on the connector. Make these connections by first making a good mechanical connection, and then soldering the wire into place. Be careful not to leave any solder bridges, or to melt any insulation.

For twisted-pair #12, and pair #13, you will connect both wires of the pair to a single pin instead of each to a separate one.

For twisted-pairs #15 & #16, all four of the wires should first be twisted together and then all four attached to both of the pins A & B. Do the same for pairs #17 & #18 to connect them to pins D & E. Be sure that there is a solid electrical connection between both of the pins in each case. (see drawing below)

A*=pairs #15 & #16
B*=pairs #17 & #18
18 → V

Be sure to check-off the appropriate space on the chart as you make each of the connections.

Use a small piece of ribbon cable wire to connect pin 18 to pin V on the edge connector.

Insert the plastic key, packaged with the edge connector, into the slot between pins 5 & 6 as shown in the drawing on the bottom of page .

CONNECTION CHART

PAIR #	CONNECTOR PIN(S)		PAIR #	CONNECTOR PIN(S)	
1	6 & F	( )	10	19 & W	( )
2	7 & H	( )	11	20 & X	( )
3	8 & J	( )	12	21	( )
4	9 & K	( )	13	Y	( )
5	10 & L	( )	14	22 & Z	( )
6	11 & M	( )	15 }	A & B	( )
7	15 & S	( )	16		
8	16 & T	( )	17 }	D & E	( )
9	17 & U	( )	18		

( ) Jumper 18 to V

EDGE CONNECTOR

PIN 22

PIN 1

14 TWISTED PAIRS

4 TWISTED PAIRS
(A* & B*)

CABLE
SHEATH

54

Handwritten annotations (top): WHITE, GRAY, PURPLE, BLUE, GREEN, YELLOW, ORANGE, RED/BROWN, WHITE, BLUE/BLACK, GREEN

6 7 8 9 10 11   15 16 17 19 20   D* J*

-5 to +5 Power Sup

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

A B C D E F H J K L M N P R S T U V W X Y Z

YELLOW ORANGE

F H J K L M   S T U   W X

A*   B*

RED PURPLE

F* H*

† - NOT USED

* - POWER SUPPLY BOARD

** - JUMPER WIRE (18 to V)

**

PURPLE & BLACK

ALL BLACK

PLASTIC KEY

5 6

55

The other end of the ribbon cable will connect to both the Disk Buffer board and the Power Supply board.

When making these connections, the same numbering system will be used for the twisted-pairs as previously. That is, the pair furthest to the right in the drawing on page   will be refered to as pair #1.

Page   contains silk-screen drawings of both PC boards, with arrows to indicate the twisted-pair connections and a space to check-off each as it is completed.

The first eleven twisted-pairs will connect to the remaining row of pads on the Disk Buffer board. Make these connections in the same manner as the previous ribbon cable connections to this board.

Begin with pair #1 and connect one of its wires to pad 6 and the other to pad 7 on the board. Observe the color of the wires connected to the equivalent pins on the edge connector. Be sure you connect pin 6 to pad 6, F to F, etc., as when making the previous connections. Continue the connections through the first eleven of the twisted-pairs in this manner, checking-off the appropriate space as each is completed.

The next seven twisted-pairs will connect to the Power Supply board in nearly the same manner, except that all but two of the connections involve more than one of the wires.

The two wires of pair #12 should be twisted together and both connected to pad D. Pair #13 should connect to pad F in the same manner.

Twisted-pairs #15 & #16 should have all four wires (2 each) twisted together and connected to pad A. Pairs #17 & #18 should be connected to pad B in the same manner.

Only twisted-pair #14 should be separated and connected to pads J & H in the same manner as the first eleven pair.

Make all of the Power Supply board connections as described, checking-off the appropriate space as you complete each of them.

Starting approximately 1 inch from the cable casing, and moving along the Power Supply cable wires, attach a tie-wrap approximately every inch until 5 of them are used. Do these as necessary to make a neat, tight cable.

There are two other wires which should be installed at this time. Using the same wire that you used when making the connections to the terminal block, cut one 8 inch length of orange wire and one 8 inch length of black wire. Strip 1/4 inch of insulation from both ends on each of them and tin the exposed portion.

Connect the orange wire between pad C on the Power Supply board and pad C on the buffer board.   +5V

Insert the wire from the silk-screened side of the board and solder it on the bottom.

Connect the black wire between E and E in the same manner.   GND

E
GND
C
+5V

( )

( )

C10

FROM

20

6

( )

F

7

( )

H

8

( )

J

9

( )

K

10

( )

L

11

( )

M

15

( )

3

16

( )

T

17

( )

U

19

( )

W

20

( )

X

B

( )

X1

A

( )

B C E

R1

C2

F

( )

E

( )

D

( )

C

( )

C3 +

H

( )

J

BR1

+

A

R4 R3

R16 R17

B

R20 R19 R22 R21 R24 R23

C14

G

D6

C12

R41

F

+

R40 R39 R38

R37

19

37

57

SHOULDER WASHER

(2)#4-40XI/2 FLAT HEAD SCREW

MICA INSULATOR

HEATSINK COMPOUND

(2)#4-40 NUT

VOLTAGE REGULATOR
INSTALLATION

The next two components will be mounted on the bottom side of the Power Supply board. These components will also be mounted to the 90° angle bracket, as with BR1 & BR2, in the two remaining holes.

When installing these components refer to the drawing above and orient them so that the markings on the components face away from the bracket.

Insert the two regulators from the bottom side of the board as shown. *Use heatsink compound between all mating surfaces. Be sure to place the mica insulating washer between Q1 and the bracket, and the shoulder washer between Q1 and the mounting nut.

Tighten the mounting screws firmly, being sure not to twist the component leads as you do so.

Solder all three leads of both components to the board on the silk-screened side.

Clip off the excess lead lengths; then remove the two screws used earlier to mount BR1 & BR2. The screws mounting X2 & Q1 should remain.

VOLTAGE REGULATOR INSTALLATION

( ) X2 = 7805

( ) Q1 - TIP 145 (w/Mica insulating washer and shoulder washer)

DISK CHASSIS ASSEMBLY

The next step in the assembly procedure is to prepare the chassis itself for mounting the boards and drive unit.

1) Refering to the drawing on the following page, mount the cross beam as shown using the existing screws now holding it in place. Note the number of holes for proper placement.

2) To make the following procedures as simple as possible, remove the front panels at this time. Save the screws used to mount the panel to the chassis.

3) Refering to the same drawing again, mount the rail as shown in the 2nd hole from the front. Be sure to include the 2 spacers as shown on each side.

There are 6 additional screws to be added to the chassis members, 4 on the beam and 2 on the rail.

4) Install two #6-32 x 3/4" screws onto the rail in the positions indicated on the same drawing. Insert them from the bottom and tighten them firmly using #6-32 lockwashers and nuts.

5) Install two 4-40 x 1" screws and two 6-32 x 1" screws on the cross beam as shown using the indicated hardware.

(4) #6-32 NUT

(4) SPACER
5/16" LONG

2 HOLES

RAIL

13 HOLES

13 HOLES

13 HOLES

(2) WASHER

(2) #6-32 X 1"
SCREW

CROSS BEAM

(4) EXISTING
SCREW

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BACK PANEL MOUNTING

Mount the back panel to the rear of the chassis as shown below using the same screws previously used to mount it.

Be careful not to catch any wires between the chassis and the panel.

BACK PANEL

CHASSIS

(4) EXISTING
SCREWS

POWER SUPPLY BOARD MOUNTING

Refering to the drawing on the following page, mount
the Power Supply board to the 90° angle clip and bracket
as shown. Study the drawing carefully before beginning.

NOTE: The #4-40 screw shown are those installed earlier.

Be careful not to disturb the wire connects previously
made between this board and the buffer board and cables.

#6-32 NUT

#6 LOCKWASHER

(2)#4-40 NUT

(2)#4 FLATWASHER

(2)5/32"SPACER(.15)

HEATSINK
SPACER BAR

HEATSINK COMPOUND
BOTH SIDES

(2)#4-40 NUT

(2) #4 FLATWASHER

(2)#4-40 X1"SCREW

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DISK BUFFER BOARD MOUNTING

Refering to the drawing on the following page, mount the Disk Buffer board as shown.

Again, study the drawing carefully before beginning. The screws shown have already been installed.

The connectors on the three cables should face towards the back panel.

(2)5/16"SPACER (.3125)

(4)"6-32 NUT

(4)"6 LOCKWASHER

(2)"6-32 X 3/4 SCREW

(4)"6-32 NUT

(4)"6 LOCKWASHER

(2) 5/8" SPACER (.6)

(2)"6-32 X 1" SCREW

67

Refering to the silk-screen drawing be-
low, and the wiring diagram on the fol-
lowing page, connect the wires from the
terminal block to the pads on the Power
Supply board.

Use the following procedure:

1) All of the wires should be
   connected to the pads on the
   board marked with the same
   designation as the tags placed
   on them earlier.

2) Insert all of the wires from
   the silk-screened side of the
   board, almost to the insulation.
   Add solder from the same side
   of the board except wire "3-G",
   and then continue applying heat
   while pushing the wires down as
   far as possible until the insu-
   lation just touches the solder.
   Be careful not to melt any insu-
   lation.

3) Turn the board over to solder
   wire "3-G" and then clip off
   all excess lead lengths.

Check this wiring over again carefully,
and then remove the tags from the wires.

B
A
3.G

ALTAIR FLOPPY DISK DRIVE

POWER SUPPLY WIRING DIAGRAM

69

CONNECTOR MOUNTING

Refering to the drawing below, mount the two 37-pin connectors to the back panel as shown.

Be sure to mount the male connector into the slot labeled "TO" and the female connector into the slot labeled "FROM".

On both connectors pin 1 should be towards the top.

(2) #4-40 X 5/16 SCREW

CONNECTOR —
(TO CONTROLLER)

(2) #4-40 NUT
(2) #4 LOCKWASHER

FRONT PANEL MOUNTING

The front sub panel and dress panel can now be re-installed.
Use the same four screws previously used to mount the sub
panel to re-mount it to the chassis as shown in the drawing
below.

Note when setting the dress panel in place that it is a
"floating" panel. Installing the power switch, as shown,
at this time will temporarily hold it in place.

Be sure the lettering on the dress panel is facing outwards.

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LED INSTALLATION

There are three RL-21 Light-Emitting-
Diodes (LED's) to be installed on the
Disk Buffer Board. These LED's have
a cathode and anode lead on each of
them which must be properly oriented
for installation on the board. The
diagram below shows you how to deter-
mine the cathode and anode leads of an
RL-21. Hold the LED up to a light and
you will be able to see inside. The
larger of the two elements inside the
plastic casing is the cathode.

The silk-screen on the board itself
has the cathode leads for the three
LED's marked with a "K". The anode
lead is marked with an "A". When you
install these components, make sure that
the cathode leads are in the pads marked
"K" and the anode leads in the pads
marked "A". Improper orientation when
installing LED's may cause permanent
damage to the component.

As is shown in the drawing on this page,
these three components also require
special spacing and bending of the leads
in order to fit the unit properly.

    1) Set the LED's in place one
       at a time and bend as neces-
       sary to fit as shown in draw-
       ing [3].

    2) Cut the leads as shown in [2]
       and place the LED's on the
       board properly.

    3) Solder them in place from the
       top side of the board. LED's
       are very heat sensitive, so
       use a minimum of heat for the
       shortest amount of time possible
       to make the connection.

When properly installed, the LED's should
fit as shown in the drawing below.

[1] SET THE LED IN PLACE
     AND MARK THE LEADS

BEND
LINE

CUT $\frac{1}{8}"$

[2] CUT THE EXCESS LEAD
     TO LEAVE 1/8 INCH

[3] SOLDER TO FIT IN PLACE
     AS SHOWN

RL-21 LED's are very sen-
sitive to heat. Use a
minimum application of
heat with your iron when
making these solder con-
nections.

LED Installation

( ) D3 = RL-21 LED

( ) D4 = RL-21 LED

( ) D5 = RL-21 LED

DISK DRIVE UNIT INSTALLATION

The Disk Drive unit itself can now be installed into the chassis.

1) The first step in this process is to set the chassis on end, with the front panel facing upwards.

2) Remove the screws and rubber feet that were factory installed on the bottom of the drive unit.

3) Being careful not to catch any of the wires or cables, slowly lower the drive unit into the chassis. Refer to the drawing on the following page for the proper orientation.

4) Refering again to the drawing on the following page, insert the two mounting screws and lockwashers on the front side of the drive unit. Do not tighten the screws down at this time.

5) Refering to the same drawing, install the spacer bar and mounting hardware for the rear end of the drive unit.

   Tighten all four mounting screws firmly.

6) The 44-pin edge connector should now be plugged into the rear of the drive unit. Line up the connector with the finger pads on the units PC board and align the plastic key between pins 5 & 6 with the slot in the board. Push the connector firmly into place.

Insert Page

Disk Drive Assembly Procedure

addendum to page 74, Disk Drive Unit Installation

A.   Before beginning the steps listed on page 74, the mounting holes in the Disk Drive Unit must be threaded. Use the following procedure to thread the four mounting holes:

1. Place the unit upside down. Place a strip of masking tape under each mounting hole to catch any metal particles.

2. Install a #6-32 x 3/4" self tapping screw (MITS part number 100957, Bag 7) into each hole.

3. Remove the screws and the masking tape.

B. Step #2 of the instructions given on page 74 may be omitted.

C.   If difficulty is encountered while installing the Disk Drive Unit into the chassis, remove the upper right-hand flat heat screw near the bezel on the Disk Drive Unit. When the Disk Drive Unit has been properly installed, be sure to put the flat head screw back into place.

DISK DRIVE UNIT

(4) "6 LOCKWASHER

(2) 6-32 X 3/8" SCREW

(2) "6-32 X 1/2" SCREW

1/2 X 1/4 X 9" SPACER BAR

Insert Page

Disk Drive Assembly Manual

Addendum to page 75, Disk Drive Unit Installation

The instructions on page 75 refer to a 1/2" x 1/4" x 9" spacer bar (Part No. 101841) that is to be installed in the rear of the chassis. This spacer bar has been replaced with either a 1/2" x 1/4" x 1" rectangular spacer or a 5/8" x 1/4" round spacer. The new spacer will be installed in the right rear mounting hole only.

This spacer allows the PERTEC FD-400 to be mounted at three points on the chassis, instead of four, thus avoiding the possibility of warping the FD-400 drive chassis.

The part number for the new spacer is 101841.

1. With no diskette in drive and the chassis unit not installed in cabinet, and
    no address jumpers installed, turn power on.

    A) Fan and disk drive motor should turn.

    B) Power indicator should light.

2. If voltmeter is available, measure:

    A) +24 volt supply at + end of C3 (with respect to chassis) on the power
        supply board.

    B) +5 volt supply at + end of C6 on the power supply board.

    C) -5 volt supply at point "J" of the power supply board.

    All voltages should be within 5% of rated output. If the disk drive motor
    does not start up, or the power indicator does not light, or the power supply
    voltages are wrong, consult the Theory of Operation and recheck wiring.

3. A) With a cliplead, ground to chassis wire #13 (Disk Enable) on the left edge
        of the buffer board (Pin 13 of "To Controller").

        The Disk Enable light should come on.

    B) Now open disk drive door. The drive motor should stop and Disk Enable light
        should turn off. Close the door and the motor should start up. 5-10 seconds
        later, the Disk Enable light should turn on (timing controlled by IC G).

    C) With another cup lead, test the mechanical disk functions by grounding (on
        the left edge of board)

        1. Wire #8 (Head Load)
            The Head Load solenoid should energize as long as #8 is grounded,
            and Head Load light should turn on.

        2. Wire #6 (Step In)
            The track stepping motor shaft should turn as point #6 is inter-
            mittantly grounded, simulating stepping pulses. The head carriage
            should move towards the front of the Disk Drive.

        3. Wire #7 (Step Out)
            The track stepping motor shaft should turn as Point #7 is inter-
            mittantly grounded, simulating stepping pulses. The head carriage
            should move towards the rear of the Disk Drive.

    This completes the preliminary check out of the Disk Drive.

    Remove the clip leads, and install the disk address jumpers as indicated
    on page 77 .

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ADDRESS SELECTION

There are four jumper wires to be installed on the buffer board in order to select the I/0 address.

Use component leads saved earlier for this purpose. Install them from the silk-screened side of the board and solder them on either side.

To comply with MITS software, the board should be jumpered to address Ø unless it is a part of a multiple disk drive system.

Refering to the silk-screen drawing on the right, jumper as follows for address Ø:

PAD	TO	PAD
1	——	$\overline{A}$
2	——	$\overline{B}$
3	——	$\overline{C}$
4	——	$\overline{D}$

Consult the jumper chart in the Theory of Operation section if a different address is desired.

FINAL ASSEMBLY

The chassis assembly can now be installed into the outer case.

Refer to the drawing on the following page and mount the chassis as shown.

To insert it, start by setting it slightly towards the back of the case, and then slide it forward until the screw holes align. Tighten the four screws firmly.

CHASSIS ASSEMBLY

CASE

(4) EXISTING SCREW

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CASE TOP INSTALLATION

Re-install the case top onto the unit as shown below. Do
not, however, use the same screws which held it originally.

Use #6-32 x 1/4" screws to secure the case top.

COVER

The Disk Controller will now be assembled.
This consists of two PC boards and inter-
connecting cables.

The Disk Controller mounts directly into
the computer main-chassis and uses two
slots.

Install the following 31 capacitors according to the instructions on page 6 . Note that all capacitors are installed in the same manner, <u>except</u> for electrolytic capacitors.

CAPACITORS

( ) C1, .001 uf   ( ) C17, .1 uf

( ) C2, .001 uf   ( ) C18, .1 uf

( ) C3, 1.0 uf   ( ) C19, .1 uf

( ) C4, .22 uf   ( ) C20, .1 uf

( ) C5, electrolytic, 4.7 uf   ( ) C21, .1 uf

( ) C6, electrolytic, 10 uf   ( ) C22, .1 uf

( ) C7, .1 uf   ( ) C23, .1 uf

( ) C8, .1 uf   ( ) C24, .1 uf

( ) C9, electrolytic, 35 uf   ( ) C25, .1 uf

( ) C10, .1 uf   ( ) C26, .1 uf

( ) C11, .1 uf   ( ) C27, .1 uf

( ) C12, .1 uf   ( ) C28, .1 uf

( ) C13, .1 uf   ( ) C29, .1 uf

( ) C14, .1 uf   ( ) C30, .1 uf

( ) C15, .1 uf   ( ) C31, electrolytic, 35 uf

( ) C16, .1 uf

Diode Installation

Install the following two diodes according
to the instructions on page 7 .

DIODES

( ) D1, 1N914

( ) D2, 1N914

Install the voltage regulator according
to the instructions on page **32** .

VOLTAGE REGULATOR

( )   7805

Connector Installation

There are two "boxes" marked on the silk-screen. These are to indicate the positions for a 10-pin and a 20-pin male connector.

The drawing below illustrates the installation of a typical connector of this type.

10-PIN MALE CONNECTOR

Refering to the drawing, install the two male connectors onto the silk-screened side of the board. The long 90° bent pins should point towards the right side of the board. The 10-pin connector goes between "CC1" & "CC10"; while the 20-pin connector goes between "CD1" & "CD20".

Two pins should now be cut off. These are the 2nd pin from the top on the 10-pin connector, and the 4th from the top on the 20-pin connector. Cut them off right at the plastic body of the connector. (These pins are both labeled "KEY" on the silk-screen.)

There is a row of 20 pads along the right edge of the board labeled CB1 through CB20.

Remove 10 twisted-pairs of wire from an 8 inch length of ribbon cable. Leave the two wires in each pair twisted together. Strip 1/4 inch of insulation from both ends of all of the wires and tin the exposed portions.

Beginning with the bottom pad on the board, connect one of the twisted-pairs to pads CB1 & CB2. Continue up the row of pads, connecting a twisted-pair to each two pads as you go along.

NOTE: The twisted-pairs each have one wire the same color in each of them (usually black or white). Make the connection to pad CB1 with this wire on the 1st pair, and use this wire for the 1st connection on each of the following pairs as you go up the row of 20 pads.

Insert all of the wires from the silk-screened side of the board and solder them of the bottom side. Clip off any excess lead lengths.

Cut the free ends of all 20 wires so that only 1/8 inch of tinned wire is exposed beyond the insulation.

Jumper Installation

Use a length of wire to jumper together the two pads labeled +8V on the bottom edge of the board. Keep it as short as possible and install it on the silk-screened side.

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A 20-pin female connector will now be attached to the free ends of the 20 wires.

First, connector pins must be attached to the ends of all of the wires. The drawings below illustrate a typical connector of this type, and the method for attaching and inserting the pins.

Connect a pin to each of the wires* as shown, and solder them carefully into place. Do not use too much solder or the pins will not fit into the connector properly.

NOTE: Two of the wires, both labeled CB17 on the PC board (see silk-screen), should be attached to a single pin.

Pins 1 & 20 are marked on the plastic body of the female connector. Refering to the silk-screen, insert the pins into the connector so that pad CB1 goes to pin 1, CB2 to pin 2, CB3 to pin 3, etc., being sure not to insert any wires into pin 15 on the connector. A plastic key should be inserted into pin 15 of the female connector, inserting it from the opposite side as the wires.

Place a tie-wrap approximately in the center between the connector and the board to hold the wires together. Place another tie-wrap around the wires and also through the holes in the PC board just to the right of the 20 pads.

10-PIN FEMALE CONNECTOR

10-PIN MALE CONNECTOR

IC Installation

Install the following 31 ICs according to the instructions on page **4** .

ICs

Silk Screen Designation		Number	Silk Screen Designation		Number
( )	A1	74123	( )	F2	74L73
( )	A2	74L02	( )	F3	74L73
( )	A3	74L20	( )	F4	74123
( )	A4	74L10	( )	F5	74L30
( )	A5	74L10	( )	G1	74164
( )	B1	93L16	( )	G2	74L00
( )	B2	74L74	( )	G3	74L75
( )	B3	74L73	( )	G4	7493
( )	B4	74L11	( )	G5	74L04
( )	B5	74L04	( )	H1	74L75
( )	E1	74123	( )	H2	8T97
( )	E2	74L00	( )	H3	8T97
( )	E3	74L73	( )	H4	8T97
( )	E4	74L04	( )	H5	8T97
( )	E5	74L00	( )	J3	74L04
( )	F1	74123			

Insert Page

Disk Controller Assembly Procedure

Addendum to Page 98, IC INSTALLATION

Before installing IC "B3" on Disk Controller Board #1, bend pin 7 up so that it does not go into the PC Board.

After all of the ICs have been installed, connect a jumper wire from pin 7 of IC "B3" to the pad labelled "SSC" (pin 9 of IC "B5"). (There should be nothing connected directly to the pad under pin 7 of IC B3.)

Make a note on the schematic for Disk Controller Board #1, sheet 1 of 3, for IC "B3", pin 7. The "J" input of the flip-flop (pin 7) now connects to pin 9 of IC "B5" on sheet 2 of 3 ($\overline{HS}$ - not head status).

Install the following 16 resistors according
to the instructions on page **5** .

RESISTORS

( ) R1, Orange-Orange-Brown, 1/4 or 1/2 W.

( ) R2, Red-Red-Brown, 1/4 or 1/2 W.

( ) R3, Brown-Black-Orange, 1/4 or 1/2 W.

( ) R4, Red-Black-Orange, 1/4 or 1/2 W.

( ) R5, Brown-Black-Orange, 1/4 or 1/2 W.

( ) R6, Red-Black-Orange, 1/4 or 1/2 W.

( ) R7, Green-Blue-Red, 1/4 or 1/2 W.

( ) R8, Brown-Black-Orange, 1/4 or 1/2 W.

( ) R9, Orange-Orange-Brown, 1/4 or 1/2 W.

( ) R10, Red-Red-Brown, 1/4 or 1/2 W.

( ) R11, Brown-Black-Orange, 1/4 or 1/2 W.

( ) R12, Red-Black-Orange, 1/4 or 1/2 W.

( ) R13, Red-Red-Brown, 1/4 or 1/2 W.

( ) R14, Orange-Orange-Brown, 1/4 or 1/2 W.

( ) R15, Brown-Black-Red, 1/4 or 1/2 W.

( ) R16, Brown-Black-Red, 1/4 or 1/2 W.

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Install the following 25 capacitors according to the
instructions on page 6 . Note that all capacitors
are installed in the same manner, except for electrolytic
capacitors.

CAPACITORS

( ) C1, .1 uf   ( ) C14, .1 uf

( ) C2, .68 uf   ( ) C15, .1 uf

( ) C3, .047 uf   ( ) C16, .1 uf

( ) C4, .68 uf   ( ) C17, .1 uf

( ) C5, 430 pf   ( ) C18, .1 uf

( ) C6, 910 pf   ( ) C19, .1 uf

( ) C7, electrolytic, 33 uf   ( ) C20, .1 uf

( ) C8, .01 uf   ( ) C21, .1 uf

( ) C9, .047 uf   ( ) C22, .1 uf

( ) C10, .1 uf   ( ) C23, .1 uf

( ) C11, .1 uf   ( ) C24, .1 uf

( ) C12, .1 uf   ( ) C25, electrolytic, 35 uf

( ) C13, .1 uf

103

Install the voltage regulator according
to the instructions on page **32** .

VOLTAGE REGULATOR

( )   Kl, 7805

105

Jumper Installation

There are 13 jumper wires to be installed on board #1.

Install these jumper wires by inserting them on the silk-screened side of the board and soldering them on the back side. Clip off any excess lead length.

The drawing below shows the proper way to route the wires across the board. Pay close attention to this as it is very important. Pads labeled 1 below route through arrow 1, 2 through 2, and 3 through 3.

Cut the wires to the necessary length, and install them through the paths as shown. Use ribbon cable wires for the two twisted pair connections. The "GND" pad for the twisted pairs is the one closest to the other connection stated.

Connect the following jumpers:

IND to IND
GND to GND
RD to RD
GND to GND
WDS to WDS
CD to CD
DCL to DCL
SOS to SOS
SSC to SSC
+8V to +8V
SY to SY
SR to SR
SRI to INT*

*or to VI7 (see Theory of Operation)

106

107

Connector Installation

Install a 10-pin and a 20-pin female
connector onto the board in the same
manner as described on page 94 for
board #2.

NOTE: The only exception to the above
       statement is that pin 6 is to be
       cut off instead of pin 4 on the
       20-pin connector.

Bus Strip Installation

The drawing below illustrates the method
for installing the 6 bus strips onto the
board.

Note that the last pin (on the bottom side
of the board) is to be cut off before in-
stalling the strips.

Be careful when installing these strips,
that you do not push the strips down
tight enough to damage the jumper wires
or to short any of the PC lands.

Insert them as shown below and solder them
on the non-silk-screened side of the board.

BUS STRIP

110

Controller Cable Assembly

Refering to the drawing on the following page, and to the previous instructions beginning on page 44, cut a 21 inch length of ribbon cable and prepare it as shown in the drawing.

The 37-pin connector shown at the top of the drawing is one of the FEMALE connectors included with your kit. The 10 & 20 pin connectors shown at the bottom of the drawing are of the same type as that on page 97 (female connectors), and should be assembled in the same manner.

Use the drawing on the following page, and the chart and drawing following after that, to construct this cable in the same relative manner as the previous ribbon cables.

37-PIN CONNECTOR

STRIP 1/8 INCH & TIN

2"

13"

RIBBON CABLE SHEATH

21"

6"

STRIP 1/8 INCH
& TIN

| 1 | | 20-PIN | 1 | | 1 |
10-PIN | | | | | 10-PIN

The drawing below illustrates the pin positions where each
of the 18 twisted-pairs should be attached to the 37-pin
connector. Be sure to use a female connector. This portion
of the assembly is essentially identical with that shown on
page 51.

Use the orientation for this process shown on page 113. It
would be adviseable to connect the varied colored wires from
each pair to pins 1 through 19, and the same colored wire
from each pair to pins 20 through 37.

37-PIN FEMALE CONNECTOR

NOT USED

18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

The drawing on the right illustrates
the same three female connectors as
shown on the bottom of the drawing on
page 113. The orientation in the
drawing on the right is the same as
that on page 113, only rotated 90°
counterclockwise.

The first step in this assembly pro-
cess is to attach connector pins to
the ends of each of the wires. Do
this in the same manner as described
on page 97. Note that two of the
twisted-pairs have both of their wires
attached to a single connector pin.

Once this is completed, the pins can
be inserted into the female connectors.
The numbers in the drawing on the
right refer to the 37-pin connector
pin numbers. Use the same procedure
as with the previous ribbon cables
and insert the pins into the connec-
tors, correlating the 37-pin connec-
tor pin numbers on the right with the
with the proper wires and positions
on the 3 female connectors.

Insert the the plastic keys in the
positions shown. Be sure to insert
them from the opposite side that
the wires are inserted from.

19 & 37
18 & 36
30
11
29
10
*
28
9
KEY

35
17
34
16
33
15
32
14
31
13
27
8
26
7
25
6
*
24
5
KEY

23
4
22
3
21
2
20
1
*
KEY

* NO WIRE CONNECTION

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CONTROLLER/DRIVE INTERCONNECT CABLE ASSEMBLY

There is one more cable to be assembled for the disk system.
This cable will be used to connect the Disk Drive unit with
the ALTAIR containing the controller.

1) The first step is to cut a 6 foot length of ribbon cable
    and remove 2 inches of the cable sheath from each end.

2) There are two grey plastic connector covers included in
    your kit. Slip one of these over each end of the cable,
    with the small holes towards the center of the cable and
    the larger holes towards the free ends. Push the covers
    down at least a foot so that they will not interfere with
    the rest of this procedure.

3) Strip 1/8 inch of insulation from both ends of each of
    the cable wires and tin the exposed portion.

4) Prepare the two remaining 37-pin connectors (one male &
    one female) in the same manner as the previous 37-pin
    connectors.

5) For this cable the connections will simply run pin-to-pin.
    That is, connect pin 1 of the male connector to pin 1 of
    the female connector. BE SURE NOT TO CONNECT ANY WIRES
    TO PIN 12 OF EITHER CONNECTOR.

6) Once all 36 wires have been
    connected on both ends, push
    the ends of the cable into a
    fold as shown on the right,
    and secure it with a double
    wrap of masking tape. Keep
    the fold as close as possible
    to the connector itself.

7) Push the connector covers into place over the two con-
    nectors. Do not use any of the hardware supplied with
    the covers by the factory. Simply mount the 37-pin
    connectors to the covers using standard 4-40 X 5/16 "
    screws.

DISK/COMPUTER INTERFACE

Refer to the preliminary documentation release
included with this manual for a description of
how to hook-up and operate this system.

The above mentioned documentation includes an
abreviated version of both the theory and the
operation of the ALTAIR FLOPPY DISK SYSTEM.

An updated, complete version of this documention
will be sent at a later date, as described in the
front of this manual.

DISK CONTROLLER CHECK OUT
WITH DISK DRIVE

A) Preliminary Test

This tests the primary functions of the Disk Drive and Disk Con-
troller.

Enter the following program and then single step through (with
Controller and Drive connected).

Address	Instruction		
000,000	076	MVI A	
1	000	Disk Drive Addr (∅)	
2	323	Output	NOTE 1
3	010	Disk Enable Channel	
4	076	MVI A	
5	004	Head Load (Bit D2=1)	
6	323	Output	NOTE 2
7	011	Disk Control Channel	
10	333	Input	NOTE 3
11	011	Sector Position Channel	
12	333	Input	NOTE 4
13	010	Disk Status Channel	

Note 1

Disk Drive should be enabled at the end of these 4 instructions.

Note 2

Disk Drive Head should be loaded at the end of these 4 instructions.

Note 3

After single stepping these two instructions, the ALTAIR data lights
should indicate as follows:

        D∅ on all the time
        D1 on all the time (flashing very fast)
        D2 on all the time (flashing very fast)
        D3 flashing very fast
        D4 flashing slower
        D5 flashing slowest
        D6 on-not used
        D7 on-not used

The flashing lights indicate the index/sector circuits are functioning
properly.

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Note 4

The last two instructions, when single stepped through, indicate the status or the disk on the data lights as follows:

```
DØ - (ENWD) - On
D1 - (MH) - Off
D2 - (HS) - Off
D3 - Not used - Off
D4 - Not used - off
D5 - (INTE) - On if "INTE" on front panel off
D6 - (TRACK Ø) - Off if disk head on track Ø
D7 - (NRDA) - Flickering, half on - indicates that
     read circuit is OK.
```

B) Testing Individual Functions

To test individual disk functions, an output of the correct data pattern must be done on Channel 011.

For example, to step the head in, use this program. Note--The disk must be enabled before doing any disk functions.

Address	Instruction	
000,000	076	MVI A
1	000	Disk Drive Addr.
2	323	Output
3	010	Disk Enable Chan.
4	333	Input
5	377	From Sense SW
6	323	Output
7	011	Disk Control Channel

Set Sense Switch 8 up, others down when single stepping this program. Change switch pattern to control other functions.

SERVICE

Should you have a problem with your unit, it can be returned to MITS
for repair. If it is still under warranty any defective part will be
replaced free of charge. The purchaser is responsible for all postage.
In no case should a unit be shipped back without the outer case fully as-
sembled.

If you need to return the unit to us for any reason, remove the top cover
of the drive unit and install the wood block over the door mechanism as
it was shipped to you. Secure cover and pack the unit in a sturdy card-
board container and surround it on all sides with a thick layer of pack-
ing material. You can use shredded newspaper, foamed plastic or excelsior.
The packed carton should be neatly sealed with gummed tape and tied with a
stout cord. Be sure to tape a letter containing your name and address, a
description of the malfunction, and the original invoice (if the unit is
still under warranty) to the outside of the box.

Mail the carton by parcel post or UPS--for extra fast service, ship by air
parcel post. Be sure to insure the package.

SHIP TO: MITS, Inc.
             2450 Alamo SE
             Albuquerque, NM 87106

All warranties are void if any changes have been made to the basic design of
the machine or if the internal workings have been tampered with in any way.

ALTAIR DISK
TEST PROGRAMS

Listed below are some Altair Disk Test programs that will check out all the normal functions of the Disk Drive. These check-out procedures will also be included in the Altair Disk Theory of Operation manual.

A. Disk Read/Write Test Program

This program writes data on disk on sector $\emptyset$ of the track it is positioned on, then reads the data back, stores it in memory, then outputs it to an I/O device. It is used for testing all read/write functions.

WRITE: The number of write data bytes is set by the position of the sense switches (maximum of $22\emptyset_8$). Write data consists of:

> 1st byte = 377_8 (D7 = 1 - sync bit)
> 2nd byte = data on sense switch
> 3rd byte = 2nd - 1
> 4th byte = 2nd - 2
>
> .
> .
> .
>
> "n"th byte = 001
> last byte = 000

If sense switch is set to $\emptyset\emptyset\emptyset$, program will stop.

READ: The read data is stored in memory, starting at address $001,236_8$ and consists of the data written by the write program

OUTPUT: After the read program, the data is outputted to a terminal (Teletype, CRT, etc.). The output program is set to output on channel 1. To obtain a useful output pattern, change the sense switches until a desirable pattern is printed. The characters printed will consist of all printable ASCII characters in reversed order (as in 987654321 and zyxwvu . . .). This pattern repeats itself and is easily observed for errors.

B. Stepping Program

This program steps the disk head out 77 times to track $\emptyset$ and then in 77 times to track 76, continuously repeating with the computer in the run mode.

This program is useful for testing the disk enable, MII status, track
Ø status, and stepping functions of the disk.

While stepping with this program, the head is unloaded, so it may
be run continuously without wear on the read/write head surface.
A squeaking sound caused by the head load mechanism is normal in
this test.

To loop with the read/write program, see next section.

For stepping program, disk drive address of ØØØ is used. To change
disk drive tested, the address is contained in location (001,001).

Looping With Stepping Program

To check the read/write and step functions simultaneously,
the two programs may be run together by changing:

1) Data in locations (000,154) and (000,155) to 037, 001
as indicated.

2) Data in location (001,034) to 303 as indicated.

Start the program at (001,000), the start of the stepping
program.

The disk head will step out to track Ø.

The head will then load and a write/read will occur.
The head will then unload and output will take place.
After output, the head will step in once, starting
the write/read sequence again. After this repeats
76 times, the head is stepped out to track Ø, and it
begins again. ✳✳

NOTE: 1) For read/write program, disk drive address of
✳✳   ØØØ is used. To change disk drive tested, the
         address is contained in location (000,001) and
         (000,150).

       2) Output device addresses are in locations (000,133)
          (status) and (000,141) (data).

READ/WRITE/OUTPUT PROGRAM

TAG	MNEMONIC	ADDRESS	OCTAL CODE	EXPLANATION
	MVI(A)	000,000	076	
		1	000	Disk drive address
	OUT	2	323	
		3	010	Disk controller enable channel
LDHD	MVI(A)	4	076	
		5	004	Load head bit
	OUT	6	323	
		7	011	Disk function control channel
WRTLP	IN	10	333	Input # of bytes to be written
		11	377	Sense switch
	MOV(C)←(A)	12	117	Store in "C" reg.
	MVI(D)	13	026	Store in "D" reg.
		14	377	First write byte
	MVI(B)	15	006	Store in "B" reg.
		16	001	"ENWD" status mask
WSECT	IN	17	333	Write sector test
		20	011	Sector position channel
	CPI	21	376	
		22	300	# sector
	JNZ	23	302	Jump if not start of # sect.
		24	017	in "WSECT"
		25	000	
	MVI(A)	26	076	
		27	200	Write enable bit
	OUT	30	323	
		31	011	Disk function control channel
FBYT	IN	32	333	First byte test
		33	010	Disk status channel
	ANA(A)/(B)	34	240	Test for "ENWD" status
	JNZ	35	302	Jump if "ENWD" false (≠1)
		36	032	in "FBYT"
		37	000	
	MOV(A)(D)	40	172	Move 377 into accum.
	OUT	41	323	Output first byte
		42	012	Disk data channel
WDAT	IN	43	333	Start of write data sequence
		44	010	Disk status channel
	ANA	45	240	Test for "ENWD" status
	JNZ	46	302	Jump if "ENWD" false (≠1)
		47	043	to "WDAT"
		50	000	
	MOV(A)←(C)	51	171	Move "DATA" byte to accum.
	OUT	52	323	
		53	012	Disk data channel
	DCR(C)	54	015	Decrement "DATA" byte
	JNZ	55	302	Jump if data byte ≠ 0.
		56	043	to "WDAT", write another byte
		57	000	
WZT	IN	60	333	Start of zero byte
		61	010	Output sequence
	ANA(A)←(B)	62	240	Test "ENWD" (last byte written)
	JNZ	63	302	Jump if "ENWD" false
		64	060	To WZT
		65	000	
	SRA(A)(A)	66	257	Zeros accumulator
	OUT	67	323	Output zero byte
		70	012	Disk data channel (end of write, start of read)
	LXI	71	041	Load H+L reg. with:
		72	236	Starting addr. to store read data
		73	001	

TAG	MNEMONIC	ADDRESS	OCTAL CODE	EXPLANATION
	MVI(B)	74	006	Store in "B" reg.
		75	200	"WRDA" mask
	NOP	76	000	
	NOP	77	000	
RSECT	IN	100	333	Read sector test
		101	011	Sector position channel
	CPI	102	376	
		103	300	# sector
	JNZ	104	302	Jump if not start of # sect.
		105	100	to "RSECT"
		106	000	
RDTST	IN	107	333	Start of "WRDA" test
		110	010	Disk status channel
	ANA(A)/(B)	111	240	Test for "WRDA" status
	JNZ	112	302	Jump if "WRDA" false (≠1)
		113	107	to "RDTST"
		114	000	
	IN	115	333	Input read data
		116	012	Disk data channel
	MOV(M)←(A)	117	167	Store data in memory (H+L)
	INR(L)	120	054	Increment L reg. (mem addr)
	JNZ	121	302	Jump if L reg. ≠ 0
		122	107	to RDTST
		123	000	
	MOV(A)←(D)	124	172	Move 377 byte to accum.
	OUT	125	323	Disenable disk by output logic 1 on
		126	010	D7 to disk enable chan. (end of read start of output)
	LXI(H+L)	127	041	Load H+L with:
		130	236	Starting addr of data stored by read program
		131	001	
OTST	IN	132	333	Test output device for busy
		133	000	Status chan. of terminal
	RLC	134	007	Test bit #, rotate into carry
	JC	135	332	Jump if carry (bit # = 1)
		136	132	to "OTST"
		137	000	
	MOV(A)←(M)	140	176	Move data from mem(H+L)
	OUT	141	323	Output data
		142	001	Data channel for term
	INR(L)	143	054	Increment L register
	JNZ	144	302	Jump if L reg ≠ 0, output another byte
		145	132	to "OTST"
		146	000	
	MVI(A)	147	076	
		150	000	Enable disk
	OUT	151	323	
		152	010	
NOTE	JMP	153	303	
		*154	004	To "LDHD"
		*155	000	
		156		
		157		

*--For R/W-step loop change
Data at (000,154) to 037
Data at (000,155) to 001

STEPPING PROGRAM

Flowchart labels (STEP OUT PROGRAM):

- (START) (001,000)
- ENABLE DISK INITIALIZE "E" REGISTER WITH # OF STEPS + 1
- (001,006) IS "MH" STATUS TRUE ? NO / YES
- (001,015) STEP HEAD OUT 1 TIME
- (001,021) DECREMENT "E" REGISTER
- (001,022) IS "E" REG = 0 ? NO / YES
- (001,025) IS TRACK # STATUS TRUE ? NO / YES
- FOR STEP ONLY — TO STEP IN PROGRAM
- (001,034) JUMP TO R/W PROGRAM — FOR RW/STEP LOOP

Flowchart labels (STEP IN PROGRAM):

- FROM STEP OUT PROG. OR OUTPUT PROG.
- (001,037) IS "MH" STATUS TRUE ? NO / YES
- (001,046) STEP HEAD IN 1 TIME
- (001,052) INCREMENT "E" REGISTER (STEP COUNTER)
- (001,053) IS E REG = 76 ? NO / YES
- (001,061) JUMP TO BEGINNING OF STEP OUT PROGRAM

TAG	MNEMONIC	ADDRESS	OCTAL CODE	EXPLANATION
STEP	MVI(A)	001,000	076	
		1	000	Disk drive addr #
	OUT	2	323	Output (data-000) to
		3	010	Disk CTRL enable channel
NOS	MVI(E)	4	036	Initialize E register
		5	115	+77 (number of steps + 1)
SOUT	IN	6	333	Test "MH" status bit (move head)
		7	010	Disk status channel
	ANI	10	346	Test
		11	002	D1 mask
	JNZ	12	302	Jump if "MH" false (D1=1)
		13	006	To "SOUT"
		14	001	
	MVI(A)	15	076	
		16	002	Bit D1=1 (step out)
	OUT	17	323	Output (data 002) to
		20	011	Disk function control channel
	DCR(E)	21	035	Decrement step counter (E reg.)
	JNZ	22	302	Jump if E reg ≠ 0
		23	006	to "SOUT"
		24	001	
TI	IN	25	333	Test for track # status
		26	010	Disk status channel
	ANI	27	346	Test
		30	100	D6 mask
	JNZ	31	302	Jump if track # false (D6=1)
		32	025	to "TI"
		33	001	
LOOP	NOP	*34	000	
	NOP	35	000	
	NOP	36	000	
SIN	IN	37	333	Test "MH" status bit (move head)
		40	010	Disk status channel
	ANI	41	346	Test
		42	002	D1 mask
	JNZ	43	302	Jump if "MH" false (D1=1)
		44	037	to "SIN"
		45	001	
	MVI(A)	46	076	
		47	001	Bit D0 = 1
	OUT	50	323	Output (Data 001) to
		51	011	Disk function control channel
	INR(E)	52	034	Add 1 to "E" register
	MVI(A)	53	076	
		54	114	76 steps
	CMP(A)/(E)	55	273	Compare "E" reg. to 76
	JNZ	56	302	Jump if "E" reg. ≠ 76
		57	034	To "Loop"
		60	001	to "Loop"
	JMP	61	303	Jump if "E" reg. = 76
		62	004	to "NOS"
		63	001	
		64		
		65		
		66		
		67		

*--Change to 303 for Step + R/W loop

PRELIMINARY DOCUMENTATION RELEASE

This manual is incomplete in its present form. This
page and an additional section will be sent to you
within a short period for insertion.

This documentation contains the entire assembly and
check-out information for both the disk controller
and drive units. The Theory of Operation and some
additional information will be in the insertation.

mits **Altair Floppy Disk**

drive & controller · hardware documentation

BAG 1

1	74L30	101082
2	7805	101074
1	7824	101079
4	8T97	101040
1	8T98	101045
1	9601	101033

BAG 2

4	.1mf 12v	100348
3	.1mf 50v	100312
3	33mf 50v	100311
1	500mf 15-25v	100310
1	1000mf 25v	100365
1	2200mf 50v	100376
1	3300mf 16v	100315

BAG 3

3	150 ohm ½w	101915
17	330 ohm ½w	101926
1	1k ½w	101928
1	39k ½w	101967
1	7.5 ohm 5w	101987
1	33 ohm ½w	101921

BAG 4

17	220 ohm ½w	101925
3	RL21	100702
2	VJ048	100711
2	IN4004	100718
1	TIP 145 or 146	102820
1	IN914	100705
1	Mica Washer &	

BAG 5

	Bushing	
1	12ft. 18 Pair Cable	103066
2	6ft. #20 Black	103062
3	2ft. #20 Orange	103063
2	3ft. #26 White	103060

BAG 6

8	#4-40 x 5/16" Screw	100912
2	#4-40 x ½" Screw Flat Head	100903
2	#4-40 x 1" Screw	100913
10	#4-40 Nut	100932
8	#4 Lock Washer	100941
4	#4 Flat Washer	100940
6	#6-32 x 3/8" Pan Head Screw	100925
6	#6-32 x ½" Pan Head Screw	100918
4	#6-32 x 5/8" Pan Head Screw	100916
2	#6-32 x 3/4" Pan Head Screw	100935
4	#6-32 x 1" Pan Head Screw	100919
4	#6-32 x 2" Flat Head Screw	100937
27	#6-32 Nut	100933
35	#6 Lock Washer	100942
1	#6 Ground Lug	101801
2	.15" Spacer	101823
6	5/16" Spacer	101829
2	.6" Spacer	101824
4	#6 Flat Washer	100943
2	#6-32 x ¼" Screw	100917

BAG 7

1	Heat Sink	101775
1	Heat Sink Spacer 5½"	101835
1	Disk Drive Spacer 9"	101841
1	Right Angle Bracket	101717
1	Strain Relief	101719
1	Terminal Block	101868
30	Insulated Terminals	101803
1	Fuse Holder	101813
2	DC37S Connector	102114
2	DC37P Connector	102115
2	DC37 Connector Cover	101799
1	Toggle Switch ST1-1C	101879
1	44 Pin Edge Conn. & (Key Pin 101660)	101800
15	Fastwrap	103037
1	Heat Sink Grease	
1	Fuse 2ASB 3AG	101762

MISC:

1	Power Cord 3 Wire	101742
1	Disk Mechanism (Pertec)	FD-400
1	Case	100511
1	Disk Rail	101862
1	Fan Filter	101757
1	Fan and (4) clips	101869
1	P-8388 Transformer	102612
1	Programmer Transformer	102609
1	Diskette	101712
1	Power Supply PC Board	100171
1	Buffer PC Board	100172
1	"ALTAIR DISK" Nameplate	101808
1	Serial Number Sticker	101833
1	Assy. Theory, OP Manual	101531

BAG 1

5	74L00	101080
6	74L02	101072
8	74L04	101073
3	74L10	101081
1	74LS11	101089
1	74L20	101039
1	74L30	101082
7	74L73	101084
2	74LS74	101088
5	74L75	101075
1	7493	101030
8	74123	101060
1	74164	101091
1	74166	101092
3	93L16	101093
5	8T97	101040
1	8T98	101045
2	7805	101074

BAG 2

37	.1mf 12v 20%	100348

BAG 3

1	430pf 500v 5%	100322
1	910pf 500v 5%	100356
2	.001mf 1kv 20%	100328
1	.01mf 16v 20%	100321
2	.047mf 100v 5%	100332
2	.1mf 100v 5%	100339
1	.22mf 100v 5%	100349
2	.68mf 100v 5%	100343
1	1.0mf 100v 5%	100373
1	4.7mf 16v	100351
1	10mf 16v	100350
4	33mf 16v	100326

BAG 4

4	220ohm ½w 5%	101925
4	330ohm ½w 5%	101926
5	1k ½w 5%	101928
1	5.6k ½w 5%	102091
1	6.8k ½w 5%	101931
7	10k ½w 5%	101932
2	15k ½w 5%	102083
1	16k ½w 5%	101942
3	20k ½w 5%	101940
1	39k ½w 5%	101967

BAG 5

2	IN914	100705
10	∅6-32 x 3/8" Screw	100925
2	∅6-32 Nut	100933
2	∅6 Lock Washer	100942
4	∅4-40 x 3/8" Screw	100908
4	∅4-40 Nut	100932
4	∅4 Lock Washer	100941
1	3ft. 18 Pair Cable	103066
1	37 Pin Adapter Bracket	101795

BAG 6

6	Buss Strips	101805
2	100 Pin Edge Connector	101864
1	DC37S Connector	102114
2	10 Pin Right Angle Wafer	101798
2	20 Pin Right Angle Wafer	101788
2	10 Pin Connector	101720
2	20 Pin Connector	101789
70	Terminal Pins	101723
4	Polarizing Keys	101791
2	Fastwrap	103037
1	Heat Sink Grease	
2	Heat Sink (large)	101870
4	Card Guides	101714

MISC:

1	Controller PC Board 1	100173
1	Controller PC Board 2	100174

DISK DRIVE POWER SUPPLY

* HEATSINK ON CHASSIS

Disc PC Card

DISK BUFFER PC CARD SCHEMATIC

REF/SPARE	TYPE	VCC	GND
A,B,D,E	8T97	16	8
C	8T98	16	8
F	74LS0	14	7
G	9601	14	7

NOTE:
"IN" CONNECTOR LABELED "TO CONTROLLER".
"OUT" CONNECTOR LABELED "FROM NEXT DISK".

NOTE.1.

C13 .1UF
C12 .1UF
C11 .1UF
C10 .1UF

220Ω
330Ω
VCC

IN
VCC
GND
IN

READ DATA
READ DATA

GND X
GND

R23
R24

HEAD LOAD LED D5 R37 150Ω
DISK ENABLE LED D4 R35 150Ω
POWER ON LED D3 R36 150Ω

1N914 D6
C14 500UF
R41 39K
VCC
VCC

R30 1K VCC

R25 R27 R29 R31
R26 R28 R30 R32
R34
R35 VCC

STEP OUT
HEAD LOAD
INDEX
TRACK Ø
READ DATA OUT
DA-A
DA-B
DA-C
DA-D
DE
DISK

REVISIONS

REV. NO	REVISION	DATE	INITIALS

mits

TITLE: DISK BUFFER PC CARD SCHEMATIC
DRAFTSMAN: A.C. ROECKUS
DATE: 6-17-75
DRAWING NO: DD-101

Disc 1-1

Disc 1-2

10 PIN MOLEX CONN CA (FROM DISK DRIVE)
20 PIN MOLEX CONN CB (FROM BOARD 2)   DC-37 PIN

E4-11 O ───────────── CA10 O ── INDEX   9/28
GND O ──────────────● CA9   O ── GND ───────
      O ───────────── CA8   O ── KEY
      O ───────────── CA7   O ── BLANK
H2-2 O ─────────────● CA6   O ── TRACK Ø   10/29
           ─────────● CA5   O ── GND ───────
E5-4 O ─────────────● CA4   O ── READ DATA   11/30
GND O ──────────────● CA3   O ── GND ───────
           ─────────● CA2   O ── GND   18/36
     ── ── ── ── ──● CA1   O ── GND   19/37
A4-6 O ─────────────● CB20 O ── WDS
           ─────────● CB19 O ── GND
A5-6 O ─────────────● CB18 O ── CD
           ─────────● CB17 O ── SND
B5-6 O ─────────────● CB16 O ── DE
           ─────────● CB15 O ── KEY
A5-12 O ────────────● CB14 O ── DCL
           ─────────● CB13 O ── GND
E2-8 O ─────────────● CB12 O ── SOS
           ─────────● CB11 O ── GND
H4-14 O ────────────● CB10 O ── INT
           ─────────● CB9   O ── GND
H3-12 O ────────────● CB8   O ── MH
           ─────────● CB7   O ── GND
H3-14 O ────────────● CB6   O ── ENWD
           ─────────● CB5   O ── GND
F4-12 O ────────────● CB4   O ── WDE
           ─────────● CB3   O ── GND
B5-9 O ─────────────● CB2   O ── HS
                     CB1   O ── GND

+5V   ╔════╗   +5V
UNREGULATED   ╢1,51╟───●──────●──────
               ╚════╝
                              C12   +C25
                              4UF   35UF
GND ╔══════╗
     ║50,100║
     ╚══════╝

NOTES:
1. ALL DIODES IN914 UNLESS OTHERWISE SPECIFIED.
2. ALL RESISTORS IN OHMS, /2 W UNLESS
   OTHERWISE SPECIFIED.
3. ALL CAPACITORS IN UF UNLESS OTHERWISE SPECIFIED.
4.
   A. >──── ALTAIR BUSS INPUT TO BD.
   B. ──→── ALTAIR BUSS OUTPUT FROM BD.
   C. >──── DISK CONNECTOR INPUT TO BD.
   D. ──○── DISK CONNECTOR OUTPUT FROM BD.
   E. ──▶── INTERBOARD OUTPUT.
   F. ◼── INTERBOARD INPUT.
   G. ●──── ON BOARD CONNECTION
   H. [41] ALTAIR BUSS™
   I. (250/c) ONE SHOT TIME CONSTANT ±10%.
   J. ●──── JUMPER
5. A. VCC O──WW──O VHA
              R15
              1K
   B. VCC O──WW──O VHB
              R16
              1K

Disc 1-3

POWER SU
REF/SPARE
B5,E4,G5,J3
E2,E5,G2
B4
A4,A5
A5
F5
A2
H2,H3,H4,H5
B5,E3,F2,F3
A1,E1,F1,F4
G4
B1
B2,J2
G3,H1
G1
K1

Disc 2-1

Disc 2-2

10 PIN MOLEX CONN CC / 20 PIN MOLEX CONN CD ——— TO DISK DRIVE

DC-37 PIN

Signal	Pin
CC10 0 — BLANK	
CC9 0 — KEY	
CC8 0 — DISK PWR	(1/20)
CC7 0 — GND	(2/21)
CC6 0 — HEAD CURR SW	(3/22)
CC5 0 — GND	
CC4 0 — TRIM ERASE	(3/22)
CC3 0 — GND	
CC2 0 — WRITE EN	(4/23)
CC1 0 — GND	
CD20 0 — WRITE DATA	(5/24)
CD19 0 — GND	
CD8 0 — BLANK	
CD7 0 — KEY	
CD16 0 — STEP IN	(6/25)
CD15 0 — GND	
CD14 0 — STEP OUT	(7/26)
CD13 0 — GND	
CD12 0 — HEAD LOAD	(8/27)
CD11 0 — GND	
CD10 0 — DISK EN	(9/31)
CD9 0 — GND	
CD8 0 — DA-A	(4/32)
CD7 0 — GND	
CD6 0 — DA-B	(5/33)
CD5 0 — GND	
CD4 0 — DA-C (4/34)	(4/34)
CD3 0 — GND	
CD2 0 — DA-D (17/35)	(17/35)
CD1 0 — GND	

Signals (right side):

Name	Connection
WDS	E3-5
CD	J1-9
DE	E4-2
DCL	E3-3
SDS	D4-9
INT	E4-7
MH	E4-8
ENWD	J4-6
WDE	J4-2
HS	F4-4

20 / 20 WIRES

NOTES:
1. ALL RESISTORS 1/2 W UNLESS SPECIFIED.
2. ALL CAPAC TORS IN UF.
3. ALL DIODES IN34.
4. ▷ ——◁ IS A BUSS INPUT TO BD.
5. ◁ ——▷ IS A BUSS OUTPUT FROM BD.
6. ↗ DISK CONNECTOR (J2,3 TO BD.
7. DISK CONNECTOR (J2,3) FROM BD.
8. ↑ INTERBOARD OUTPUT.
9. INTERBOARD INPUT.
10. ● ON BOARD CONNECTION.
11. ※ J1, 4, 7 & 5 JUMPER.
12. R11 1/2 SHOT TIME CONSTANT : 0%.

VCC 0 —WW— C-1 HA   R11
VCC 0 —WW— C-1 1B   R12
VCC 0 —WW— 0 V-1 C   R13

Disc 2-3

(OUTPUT-DISK CONTROL LATCH STROBE)

(OUTPUT-WRITE DATA STROBE)

(OUTPUT-CONTROL DISK STROBE)

(INPUT-READ DATA STROBE)

(INPUT-STATUS STROBE)

(INPUT-SECTOR STROBE)

(HEAD STATUS)

(READ CLR)

(START OF SECTOR CLR)

(WRITE DATA ENABLE)

DISK CONTROLLER BOARD #1   SHEET 1 OF 3

ADDRESS CONTROL & INDEX/SECTOR CIRCUIT

READ DATA CIRCUIT & DISK STATUS CIRCUIT

Power supply regulator schematic: input 5V through 7805 (K1) pins 1(B), 2(E), 3(C) to output VCC +5V REGULATED. Capacitors C12 .1UF, C25 35UF, C7 35UF, C10-C24 .1UF, GND.

POWER SUPPLY CONNECTIONS			
REF/SPARE	TYPE	VCC	GND
B5,E4,G5,J5	74L04	14	7
E2,E5,G2	74L00	14	7
B4	74L11	14	7
A4,A5	74L10	14	7
A5	74L20	14	7
F5	74L30	14	7
A2	74L02	14	7
H2,H3,H4,H5	8T97	16	8
B5,E3,F2,F3	74L73	4	11
A1,E1,F1,F4	74123	16	8
G4	7495	5	10
B1	93L16	16	8
B2 f2	74L74	14	7
G3,H1	74L75	5	12
G1	74164	14	7
K1	7805	2	3

DISK CONTROLLER BOARD #2   SHEET 1 OF 3

WRITE DATA & DISK ENABLE CIRCUITS

DISK CONTROLLER BOARD #2   SHEET 2 OF 3

DISK DRIVE CONTROL

20 PIN MOLEX
20 WIRES TO BOARD 1 CONN "B"

WDS —o E3-5 ————— CB20 o———→ CONN "B"
                   CB19 o———→
CD —o J1-9   CB18 o———→
                   CB17 o———→
DE —o 54-2   CB16 o———→
                   CB17 o——— (KEY CB15)
DCL —o F3-5   CB14 o———→
                   CB13 o———→
SOS —o 54-9   CB12 o———→
                   CB11 o———→
INT —o E4-12   CB10 o———→
                   CB9 o———→
MH —o 54-6   CB8 o———→
                   CB7 o———→
ENWD —o J4-6   CB6 o———→
                   CB5 o———→
WDE —o J4-2   CB4 o———→
                   CB3 o———→
HS —o F4-4   CB2 o———→
                   CB1 o———→

POWER CONNECTIONS			
REF	TYPE	VCC	GND
F1,F3,F4,H1,J1	74L02	14	7
E1,E3	74L00	14	7
B4,G2,G4,H4	74L04	14	7
J2	8T98	16	8
E4	74L10	14	7
H2	74166	16	8
G3,H3,J3	74L75	5	12
A3,A4	93L16	16	8
J4	74L74	14	7
A2,E2,F2	74L73	4	11
A1,B1,B2,B3	74123	16	8
K3	8T97	16	8
L1	7805	2	3

+5V
L1 7805 B C E
C16 .1UF
C31 35UF
C9 35UF
C30 .1UF
C10-C17 C19-C29 .1UF
VCC +5V REGULATED

DISK CONTROLLER BOARD #2   SHEET 3 OF 1

REVISIONS

REV	DESCRIPTION	DATE	DR	CHK	APPR
A	GEN 100 CP PROD REL				
B	PCN 301 TE				
C	PCN				
D	ECU 3032				
E	ECU 3195				

DETAIL A
(CIRCUIT SIDE)

CUT ETCH BETWEEN
R29 AND ANODE CR1

G68-0605
2 PLACES

915-0127
REF

500162
REF

		PERTEC PERIPHERAL EQUIPMENT
		TITLE PCBA FLEXIBLE DISK DRIVE ELECTRONICS BASIC 1A
		E	CC0191	C

CUT PIN 4 NEXT TO
COMPONENT CASE PRIOR TO
INSERTION IN PCBA.

REF BOTTOM VIEW
2N3686

5 TYPICAL IC PACKAGE INSTALLATION
DOT INDICATES PIN 1.
4 [ ] DEPICTS DIODE SHADED END INDICATES
CATHODE. EX. SI DEPICTS CR5 ▶.
3 NUMBER STAMP PART NO. 600191 INCLUDING
VERSION NO. AND VERSION ISSUE LETTER.
2 THIS ASSEMBLY SHALL BE MADE FROM PROCESS
CARD 600192-01 REV C.
1 ASSEMBLE PER STANDARD MFG METHODS.
NOTES

ISOLATION   INPUT PROTECTION   AMPLIFIER   LOW + FILTE

D

+5V

L5
100 UH
±5%

+5VF

C22
.1

C21
3.3
±20%
15V

R74
22K

Q15-C
SH 4

R50
1K±5%
1/2 W

R77
22K

CR18 CATHODE
SH 4

CR25   CR26

L1
100 UH
±5%

P3 J3

C

START   BK   5   5

CR21   CR19

R73
22K

ERASE   RD   3   3   R49
SH 4

C20
470PF
±5%
500V

R68
6.8K

C25
1000
PF±10%
100V

FINISH   WH   1   1

CR22

10

1

7

NE592
U1

8

GN   2   2   TP34

R71
6.8K

R69
1.8K±5%
1/2 W

14

5   4   11

L2
100 UH
±5%

4   4

SEE DWG 602030
MAGNETIC REC HEAD

READ GAIN CONTROL

CR23 CATHODE
SH 4

CR27   CR20

C23
3.3
±20%
15V

R92
47

R100
2K ±10%
3/4 W

B

J1

L6
100 UH
±5%

-5V   22

-5

C24
.1

GND (-5V)   2

A

AMPLIFIER
DIFFERENTIATOR

COMPARATOR
ONE SHOT

D

C28
3.3
±20%
15V

C33
.015
±10%
100V

R88
1K

C37
3.3
±20%
15V

TP1

C26
.1

UH

R79
1.5K

R95
100

R84
2.7K

TP3

TP7

7406

J1

R75
220

TP4

R80
1.5K

TP5

16 15

U7

20 I READ DATA

C

NE592
U2

C34
.015±10%
100V

5

2 U3

11 11 10

R76
220

1

10

+ 7

14

8

12

C40
100 PF
±5%
500V

4 11

13

8T20

5

R87
820

C32
750PF
±5%
500V

14

UH

C27
.1

R96
100

6

Q̄ 10

X RETURN

C30
3.3
20%
15V

TP35

R97
4.7K

C41
47PF
±5%
500V

1 3 4 8

C39
3.3
±20%
15V

B

600190 D

-5V

U8-10
SH 4

TP2

-5V

A → D
READ AMPLIFIER

A

SIZE	CODE IDENT NO	DWG NO		REV
D		600190		D
SCALE NONE		DO NOT SCALE DWG	SHEET 5 OF 5	

WR CURRENT CONTROL

D

R48
10 K

R54
6.81K
±1%
¼W

VR1
1N4736A

R62
1.62K
±1%
1/4 W

R63
680

R64
82±5%
1W

ERASE DRIVER

CR11

CR13

CR14

R60
100

Q14
2N4037

TP39

Q10
2N4125

R61
820
±5%
1W

Q11
2N4125

C29
.01
10%
100V

CR31

R49
150±5%
2W

CR10

R58
470

Q12
2N4125

J3-3   SH 5

C

CR15

R55
10 K

WR DRIVER

CR18

START

J3-5

1V

+ 24V

R72
470±5%
1W

R56
10 K

R59
470

R27B
820
±5%
1/2W

R65
100K

R67
27K

16

Q13
2N4125

-5VF

CR17

R94
100K

CR28

WR DRIVER

CR30

FINISH

J3-1

CR29

CR23

B

R57
2.2K

VR2
1N4740A

D

Q15
2N4125

600190

R53
10 K

R50   SH 5

U12-5
SH-3

A

J1

1   I WRITE BUSY

3   RETURN

3
5

WRITE AMPLIFIER

SIZE D	CODE IDENT NO	DWG NO. 600190	REV D
SCALE NONE		DO NOT SCALE DWG	SHEET 4 OF 5

SEP CLOCK- SEP DATA
TO STROBE- DATA
DECODER

WRITE PULSE WIDTH 1μS

ADDRESS HOLD .5μS

FLOPPY WRITE DATA
PULSE WIDTH 250NS

DOUBLE FREQUENCY ENCODER

WRITE DATA

SUPER-SIMPLE FLOPPY
BUFFER CONTROL LOGIC

5/21/76 CHAMBERLIN
PAGE 3

SUPER-SIMPLE FLOPPY
COMMAND LOGIC

5/20/76 CHAMBERLIN

PAGE 2

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ON ALL IC'S PIN NO. 7 IS GND AND
   PIN NO. 14 IS +5V.

2. FOR PCBA SEE DWG NO. 600191
   FOR WIRE LIST ———— 600154
   FOR ASSEMBLY ———— 600125

3. ALL RESISTOR VALUES ARE IN OHMS, ± 5%, 1/4 W.

4. ALL CAPACITOR VALUES ARE IN MICROFARADS, ± 10%, 35 V.

5. ALL DIODES ARE IN4446.

DISK MOTOR DRIVER

SIZE	CODE IDENT NO.	DWG. NO.	REV
D		600190	D
SCALE	NONE	DO NOT SCALE DWG. SHEET 2 OF 5	

HEAD STEPPER CKTS

D

+ TRACK ZERO XS800

— DISK CHANGE

+ WRITE PROTECT XS800

— WRITE PROT   44

+ PULL UP XS800

— READY   22

— INDEX   20

C

— SECTOR   24

TP10

+5VT

— READ DATA   46

TP16

— SEP DATA   48

B

— SEP CLOCK   50

+5V

+ WRITE PROT LED   R5

+ TRK 00 LED   R3

+ INDEX LED   R4

A

— TRACK ZERO

R6

R13
22K

R16
10K

R19
470K

TP26

3B [10] 14

1G

D

— DEV SEL INT
X5800

+ WRITE PROTECT L4 TP25

R20
33K

R21
10K

R22
470K

1G

3B [10] 14

+ DRV SEL INT
X5800

— DOOR CLOSED
X5800

2G

— POR
X5800

+5V R15
510

+ INDEX/SECTOR R7

R17
10K

1G

TP12

R18
470K

C36

R14
390

C

+5V R26
12K

C6
.1
100V
10%

C7
1.0
35V
10%

[10] 3B

14

O/S

3G

3G

O/S

SECTOR SEPERATOR

USED ON
ASSEMBLY
25106
25107

3F

O/S

+5VA R71
20K

R66
3K

CR13

L7
270

L8
56

TP1 C21

—5VA

R58,49.9
1/8W,1%

R68
9.09K
1/8W
1%

CR12

1G

R67
523
1/8W
1%

R63
24

C23
430pf
500V
5%

C24
180pf
500V
5%

R62
698
1/8W
1%

6E

B

+ READ/WRITE (1)
X5800

+5VA

R64
523
1/8W
1%

C26
.47
100V
10%

—5VA

+5VA

R61
698
1/8W
1%

R59,49.9
1/8W,1%

+ READ/WRITE (2)
X5800

CR11

1G

L6
270

L9
56

TP2

R60,59
1/8W,1%

28G
33K

R6A
9.09K
1/8W
1%

CR14

R65
3K

—5VA

R55
33K

R51,50K
3/4W,
10%

C22,750pf
500V,5%

C20

R70
20K

+5VA

— READ GATE
X5800

—5VA

DATA
SEPERATOR

USED ON
ASSEMBLY

25104
25105
25106
25107

—15V

R52,5K
3/4W,10%

R50
5.1K

R49
5.1K

C10
1200pf
100V
5%

A

5A

O/S

O/S

X5801

SHUGART ASSOCIATES

TITLE: SCHEMATIC DIAGRAM DISKETTE 800 SERIES

SC 25100-1

— WRITE DATA ✗ 3B

+ WRITE PROT XSB01

— WRITE GATE ✗ 40

+ PULL UP XSB01

— DRIVE SELECT 1 ✗ 26
         1 ✗ 28
         3 ✗ 30
         4 ✗ 32

CUSTOMER INSTALLED OPTION

+ TRACK ZERO XSB01

— HEAD LOAD (JUMPER OPTIONABLE I/O) ✗
— DOOR CLOSED L6
— IN USE (JUMPER OPTIONABLE I/O) ✗
+ 24V
+ 24V RETURN
+ 5V
GROUND
— 5V OR -7V TO -16V
— STEP ✗ 36
+ DIRECTION SELECT ✗ 34

R23 100Ω,1/2W

+24V +24VA +24V RTN +5VT +5VA +5V -5VA -5VT

NOTES, UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%.
2. ALL CAPACITORS ARE IN MICROFARADS, 50V, +80,-20%.
3. ALL INDUCTORS ARE 100MH, 10%.
4. ALL DIODES ARE 1N414B.
5. ALL TRANSISTORS ARE 2N2907A.
6. O-O INDICATES CUT-TRACE OPTION.
7. O O INDICATES JUMPER OPTION.
8. CONNECTOR SYMBOL REFERENCES;
   (X) = J1, (▽) = J2, (▽) = J3, (▽) = J5, (▽) = J6.
9. I.C. LOCATION 4B IS A RESISTOR PACK, 150Ω, 1/2W 5%.
10. I.C. LOCATION 3B IS A RESISTOR PACK, 2K, 1/4W, 5%.
11. ADD JUMPER L FOR -7V TO 16V ON ASSEMBLIES;
    25103, 25105, 25107.
12. PINS 8 AND 9 OF IG ARE GROUND.

[13] SHORTING PLUG INSTALLED.
[14] REMOVE JUMPER FROM 800 AND INSTALL IN 801.

REFERENCE DESIGNATION	
LAST USED	NOT USED
C40	C2B (RESERVED)
CR14	CR10
L9	
Q8	
R74	R4B
TP27	TP8,9,13,14,15,17-20,22,23.
VR1	

TYPE	POSITION	UNUSED ELEMENTS
7400	5C,2B,5F	2E1,4,5F2,4
7402	4B	4E3
7404	3E	
7405	4D	4D2,3
7407	4G	
7410	5B,2C	5B1
7438	3C,4C	
7474	2D,3D,5D,4F	
7476	3F	
7486	2G	2G4

XSB00

Disk Hardware Notes

By Tom Durston

If you are having difficulties with your 88-DCDD hardware,
follow these guidelines for servicing:

A. Controller Boards:

1. On Controller Board #1 be sure the bus strips are
    soldered on both the top and bottom of the P.C.
    Board. Do not apply pressure to bus strips after
    installation.

2. On Controller Board #1 jumper the top end of R16
    (VHB) to the track from pin 7 of IC F2 (on back of
    card). This ties floating inputs of sector logic
    high to prevent noise pickup.

3. On Controller Board #1 check the track from Pin 9
    of IC H1 where it goes through the board on the
    plated hole. Some P.C. Cards had shorts to the
    adjacent track on the back of the card.

4. On Controller Board #1 check jumper wires to be
    sure there are no shorts to bus strips (insulation
    on wires melted), and check jumper wires for cor-
    rect wiring.

5. On both Board 1 and 2 check Stab Connector for
    shorts on fingers. File at an angle along the
    length of the Stab Connector and the bevel edge
    of the card to remove any shorts.

6. Be sure all interconnect cables are wired correctly
    and the pins are making good contact.

7. Check one shot timing on both boards as follows,
    using the Disk Test Program that appeared in April
    '76 Computer Notes, pages 12 and 13.

    a) Controller Board #1:

FUNCTION	IC and PIN #	POSITIVE PULSE WIDTH RANGE
Read Clock Mask	IC A1 Pin 13	0.7us to 1.2us
Read Data Window	IC A1 Pin 5	2.6us to 2.9us
Sector Pulse Mask	IC E1 Pin 13	150us to 600us
Index Pulse Window	IC E1 Pin 5	3.3ms to 4.5ms
Read Clear	IC F1 Pin 13	130us to 150us
Index Pulse Verification	IC F1 Pin 5	3.3ms to 4.5ms
Sector True	IC F4 Pin 13	20us to 40us
Write Data Enable	IC F4 Pin 5	250us to 300us

b) Controller Board #2:

FUNCTION	IC and PIN #	POSITIVE PULSE WIDTH RANGE
Repeat Step OK (Status)	IC A1 Pin 13	0.4ms to 0.8ms
Step Inhibit 1 (Status)	IC A1 Pin 5	9.5ms to 11.5ms
Head Settle	IC B1 Pin 13	35ms to 70ms
Step Inhibit 2 (Status)	IC B1 Pin 5	17ms to 30ms
Trim Erase Start Delay	IC B2 Pin 13	180us to 225us
Trim Erase End Delay	IC B2 Pin 5	420us to 520us
Disk Enable Timer	IC B3 Pin 13	1.5us to 4.5us
Disk Power Disable	IC B3 Pin 5	1.5us to 4.5us

    c) If the measured time constants are not within the specified tolerance, vary the resistor value for the one shot affected.

    d) We have had difficulty using National 74123 ICs for B3 on Board #2. Replace with Signetics or TI ICs if you suspect problems.

8. If you are using 4K Dynamic cards, be sure they are using only one wait state. See May '76 Computer Notes, pages 9 and 10.

9. Check the Power Supply to be sure the negative peaks of the +8V unregulated do not go below +7V.

B. Disk Drive Chassis:

1. On the Buffer Card the most common difficulty is incorrect wiring or incorrectly installed ICs.

2. On the Power Supply Board be sure X1 and X3 are properly installed as indicated on the errata sheet.

3. If you suspect difficulty with the Disk Drive, DO NOT attempt to service it. Any work done on the Pertec FD-400 will void the warranty. Typical service charges for customer damaged FD-400's are $100.00.

4. Do not plug the FD-400 connector in backwards. Be sure to install the polarizing key as the instructions indicate. Plugging in the connector backwards will destroy 5-10 ICs and will cost at least $100.00 for repair.

5. If you must ship the Pertec FD-400 or complete Disk Drive Unit, reinstall the Disk door block or strap. Any damage to the mechanism as a result of incorrect shipping typically costs the customer $100.00 in repair charges.

6. Our dealers now have Pertec FD-400 service manuals. If you suspect difficulty with the FD-400, contact your nearest dealer for his advice and service.

7. If you can't remedy the difficulty, don't try to save postage by just returning the FD-400 alone. Please return your complete 88-DCDD including Cables, Controller Boards, and Drive Chassis. This will allow us to check your system out completely and save you time, money, and hassle.

DISK SECTORING PROBLEM

1. Problem caused by switching from one drive to another. If
    sector pulses from second drive occur too soon after last
    sector pulse from first drive, a false index pulse generated.

2. Problem occurs if first disk sector output is just detecting
    index and second disk sector output is just detecting sector $\emptyset$

3. Solution: Prevent valid index detection for at least 10 ms
    after disk enabled.

4. Fix: On controller Board #1 connect head load status line
    to index detect circuit. This prevents valid index from being
    detected until 45 ms after head is loaded.

5. Correction: For units already assembled - Cut pin 7 of I.C.
    B3 and lift up from board. Connect jumper wire from pin 7 of
    I.C. B3 to pad labled "SSC" (pin 9 of I.C. B5). For units to
    be assembled bend pin 7 of I.C. B3 up before installing in board.
    Connect jumper wire as indicated before.