

Subject: SYSTEM TIMING MODIFICATION FOR ALTAIR 88-DCDD FLOPPY DISK

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From: MITS ENGINEERING DEPARTMENT

To: FLOPPY DISK USERS

To increase diskette interchangeability from drive to drive and minimize Disk I/O errors, we have re-evaluated two time constants on the 88-DCDD Controller Board #1. The effect of the timing change is to center the data within the sector to allow a greater tolerance of Disk Drive misalignment.

Note that a diskette written with the new write delay should be marked with "NWD" for identification purposes. All Basic and DOS diskettes shipped from MITS after August 31, 1977 are written with the new write delay, and are marked "NWD". All diskettes written with the new write delay are compatible with the unmodified systems. To take advantage of the new write delay, one must also change the Read Clear Timing. Please follow the procedure below if you are making the modification. If your system does not require diskette interchangeability and you have not had difficulty with Disk I/O errors, the complete modification is not mandatory, although, we do recommend changing the write delay as in step IIA. The modification is strongly recommended for multiple drive systems or single drive systems where diskette interchange is required.

A modification kit is available at no charge to owners of Altair 88-DCDD Floppy Disk Systems. If you do not have the facilities for performing the modification, return your Controller Board #1 for special modification at no charge. The board will be modified except for replacement of R5, the Read Clear one shot timing resistor. The correct resistor for R5 will be returned with your board and should be installed after completion of re-writing or copying your diskettes as indicated in Section III of the modification procedure.

An important part of the modification includes changing the timing I.C. to 74LS221. This was done because 74LS221 is more stable and predictable than the 74123, and eliminates the need for trimming or adjusting the timing resistors.

I. PARTS REQUIRED (Included in the FDSK Mod. Kit.)

2 each	74LS221 I.C.	MITS PART # 101466	(F1, F4)
1 "	6.65K 1% resistor	" " # 102225	(R5)
1 "	12.1K 1% "	" " # 102226	(R12)
1 "	4.3K 5% "	" " # 101995	(R11)
1 "	8.2K 5% "	" " # 102090	(R6)

SYSTEM TIMING MODIFICATION FOR ALTAIR 88-DCDD FLOPPY DISK (Cont'd)

II MODIFICATION PROCEDURE (Controller Board #1 Only)

- A. Change the Write Clear one shot timing from 290us to 389us
 1. Remove R11 and R12
 2. Install a 4.3K, 5% resistor in the R11 position, and a 12.1K, 1% in the R12 position.
 3. Remove I.C. F4, install a 74LS221 in its place*
 4. If available, use an oscilloscope to measure the positive pulse width at TP8 (I.C. F4, pin 5). This step is not mandatory due to the timing predictability of 74LS221. The pulse width should be in the range of 355us to 425us (389us NOM \pm 10%) when the drive is enabled and a diskette installed.

- B. Copy all diskettes using the procedure listed in Section III. If you are not changing the Read Timing, it is not necessary to copy your diskettes.

- C. Change the Read Clear one shot timing from 140us to 214us.
 1. Remove R5 and R6
 2. Install a 6.65K, 1% resistor in the R5 position and an 8.2K, 5% resistor in the R6 position.
 3. Remove I.C. F1, install a 74LS221 in its place*
 4. If available, use an oscilloscope to measure the positive pulse width at TP5 (I.C. F1, pin 13). This step is not mandatory due to the timing predictability of the 74LS221. The pulse width should be in the range of 195us to 230us (214us NOM \pm 10%) when the drive is enabled and a diskette is installed.

- D. Change Schematic notation to coincide with the modification.

* If I.C.'s F1 and F4 are not socketed, remove the soldered in I.C.'s by cutting all the pins, then carefully removing each pin one by one. Clean the holes by using solder wick or a solder removing tool, being careful not to remove the plated portion of the hole. When soldering the new I.C.'s in place, solder each pin on both sides of the P.C. board to insure proper feed-through connection.

III COPY/REWRITE PROCEDURE

The Following procedures are recommended for copying disk software for the new Disk Read/Write modification:

CAUTION - All disk software copying should be done AFTER the Write modification has been made, but BEFORE the Read modification is made.

A. With a two or more disk drive system:

METHOD I - Using Disk BASIC "PIP" Utility Program. If you have Disk BASIC, versions 3.3, 3.4, 4.0, or 4.1, use the PIP utility program provided on the system diskette to copy onto a new diskette. A listing of PIP and instructions on its use are included at the end of this article.

- STEP 1:** Load Disk BASIC. Initialize the system for at least two disk drives, i.e. HIGHEST DISK NUMBER? should be answered with 1 or higher.
- STEP 2:** MOUNT the diskette with BASIC and PIP on it. Do not attempt to MOUNT a diskette that is brand new (never add BASIC or files on it).
- STEP 3:** LOAD PIP and type RUN.
- STEP 4:** Use the PIP Copy command to copy the old diskette (the one with BASIC and your files) onto the new diskette. COP takes approximately 30 minutes, so have patience.
- STEP 5:** Check the new diskette by re-loading BASIC (from the new diskette), MOUNTing, printing a directory of files to make sure everything was copied okay.
- STEP 6:** Now make the disk Read modification.

METHOD II - Using Disk BASIC "PIP" and DOS. If you have DOS (Disk Operating System) and Disk BASIC, you can use Disk BASIC and PIP to copy your DOS diskette. Follow the procedure in Method I, except:

- STEP 3:** LOAD "PIP" but UNLOAD the diskette with BASIC on it before RUNing PIP. Place the DOS diskette in the drive where BASIC was. You don't have to MOUNT to copy with PIP. Now RUN PIP, and proceed with STEP 4 of Method I.
- STEP 5:** Check the new diskette by loading DOS, MOUNTing, issuing a DIR command and possibly run a couple of the programs, and proceed with STEP 6 of Method I.

SYSTEM TIMING MODIFICATION FOR ALTAIR FLOPPY DISK

IMPORTANT

If assembling a new unit, disregard the component removal instructions and install new components in place of the components provided with the 88-DCDD kit.

I. Introduction

To increase Diskette interchangeability from Drive to Drive and minimize Disk I/O errors, two time constants on the 88-DCDD Controller Board #1 have been reevaluated. The effect of the timing change is to center the data within the Sector, allowing a greater tolerance of Disk Drive misalignment.

A Diskette written with the new write delay should be marked "NWD" for identification purposes. All BASIC and DOS Diskettes shipped from MITS after August 31, 1977, are written with the new write delay and are marked "NWD." All Diskettes written with the new write delay are compatible with unmodified systems. The Read Clear Timing must be changed to take advantage of the new write delay modification. When Diskette interchangeability is not required and there is no difficulty with Disk I/O Errors, the complete modification is not mandatory; however, changing the Write Delay as in Section II, Step A is recommended. The modification is strongly recommended for multiple Drive systems or single Drive systems where Diskette interchange is required.

If facilities for performing the modification are not available, return Controller Board #1 for special modification at no extra charge. The board will be modified except for replacement of the Read Clear One Shot timing resistor, R5. The correct resistor for R5 will be returned with the board and should be installed after all Disk software copying or rewriting is completed as indicated in Section IV of the modification procedure.

An important modification includes changing the timing IC to 74LS221. This is done because the 74LS221 is more stable and predictable than the 74123, and eliminates the need for trimming or adjusting the timing resistors.

The modification procedure is outlined in Section II and IC installation and identification instructions are provided in Section III. The recommended procedure for copying Disk software for single and multiple Drive systems is explained in Section IV.

The following is a list of the parts included in the modification kit:

<u>Quantity</u>	<u>Value</u>	<u>MITS Part #</u>	<u>Component Location</u>
2	74LS221 IC	101466	F1, F4
1	6.65K \pm 1% resistor	102225	R5
1	12.1K \pm 1% resistor	102226	R12
1	4.32K \pm 1% resistor	102227	R11
1	8.45K \pm 1% resistor	102228	R6

II. Modification Procedure

- A. Change the Write Clear One Shot timing from 280 μ s to 389 μ s.
1. Remove resistors R11 and R12. Be careful not to damage the plated portion around the holes in the PC board.
 2. Install a 4.32K ohm ($\pm 1\%$ tolerance) resistor in the R11 position and a 12.1K ohm ($\pm 1\%$ tolerance) resistor in the R12 location, according to the following instructions.
 - a. Using needle-nose pliers, bend the leads of the resistors at right angles to match their respective holes in the PC board.
 - b. Install the resistors into the correct holes in the silkscreened side of the board.
 - c. Holding the resistor in place with one hand, turn the board over and bend the two leads slightly outward.
 - d. Solder the leads to the foil pattern on the back side of the board. Then clip off any excess lead lengths.
 3. Remove IC F4 from its socket and install the 74LS221 IC in its place according to the installation instructions in Section III, Part C. If IC F4 is installed directly into the board, follow the removal and installation instructions in Section III, Part B.
 4. If available, use an oscilloscope to measure the positive pulse width at TP-8 (IC F4 pin 5). This step is not mandatory due to the timing predictability of the 74LS221 IC. The pulse width should be in the range of 355 μ s to 425 μ s (389 μ s nominal $\pm 10\%$) when the Drive is enabled and a Diskette installed.
- B. Copy all Diskettes using the procedures and instructions listed in Section IV. If the Read Timing is not to be changed, it is not necessary to copy the Diskettes.

- C. Change the Read Clear One Shot timing from $140\mu\text{s}$ to $214\mu\text{s}$.
1. Remove R5 and R6 being careful not to damage the plated portion around the holes in the PC board.
 2. Install a 6.65K ($\pm 1\%$ tolerance) resistor in the R5 position and an 8.25K ($\pm 1\%$ tolerance) resistor in the R6 position according to the resistor installation procedures followed in Part A, Step 2 of this section.
 3. Remove IC F1 from its socket and install the 74LS221 IC in its place according to the installation instructions in Section III, Part C. If IC F1 is installed directly into the board, follow the removal and installation instructions in Section III, Part B.
 4. If available, use an oscilloscope to measure the positive pulse width at TP-5 (IC F1 pin 13). This step is not mandatory due to the timing predictability of the 74LS221 IC. The pulse width should be in the range of $195\mu\text{s}$ to $230\mu\text{s}$ ($214\mu\text{s}$ nominal $\pm 10\%$) when the Drive is enabled and a Diskette is installed.
- D. Change the schematic to coincide with the modification.

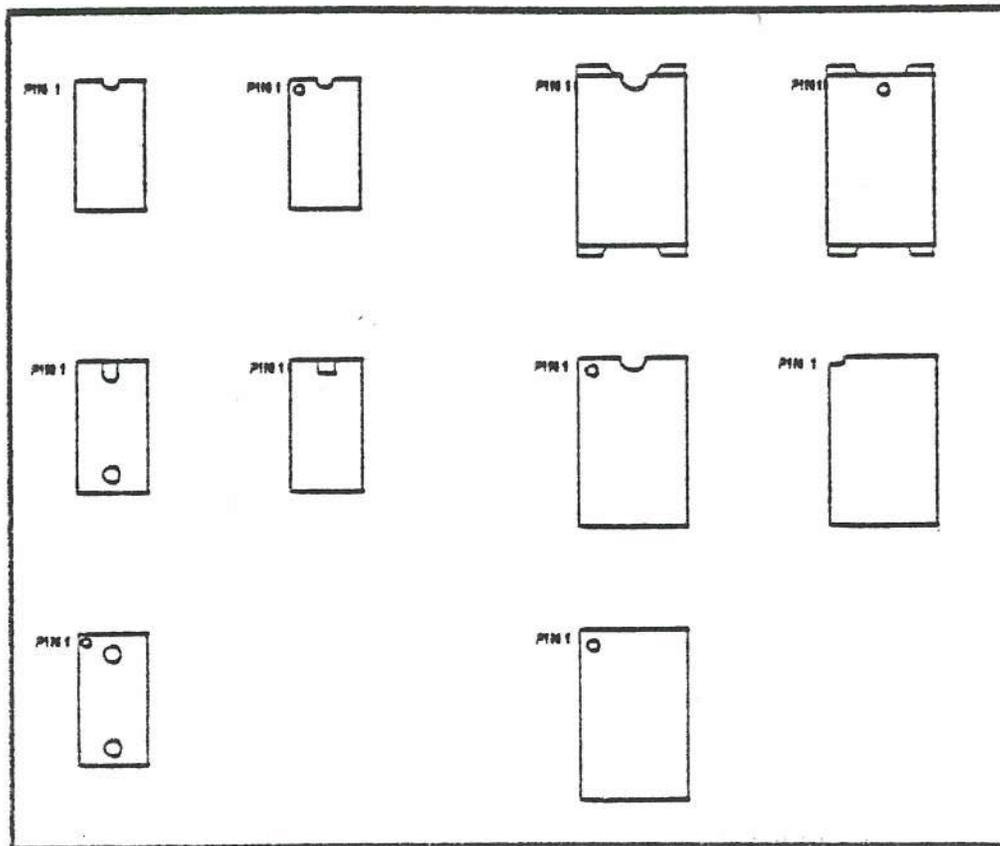
III. IC Identification and Installation

A. IC Identification Instructions.

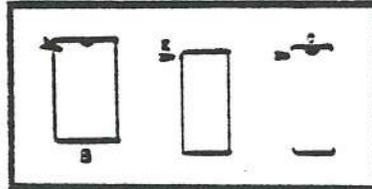
All integrated circuits (ICs) must be oriented so that the notched end is toward the arrowhead printed on the PC board. Pin 1 of the IC should correspond with the pad marked with the arrowhead. If the IC does not have a notch on one end, refer to the IC Identification Chart to identify pin 1.

ICs may have any one, or a combination, of several different markings which are very important in determining correct orientation when the ICs are placed on the printed circuit boards. Incorrect orientation of ICs may cause permanent damage.

IC Identification Chart



The chart below indicates the various methods used to show the position of ICs on the printed circuit boards. These outlines are silkscreened directly on the board. The arrowhead indicates the pin 1 position.



All ICs can be easily damaged and should be handled carefully. Always try to hold the IC by the ends, touching the pins as little as possible. When removing the IC from its holder, carefully straighten any bent pins with 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.

B. Removal and Installation of ICs Without Sockets.

1. Cut all the pins and carefully remove each pin one by one.
2. Clean the holes by using solder wick or a solder removing tool. Be careful not to remove the plated portion of the hole.
3. To install the new IC, orient the IC so that pin 1 coincides with the arrowhead on the PC board.
4. Align the pins on one side of the IC so that just the tips are inserted into the proper holes on the board.

5. Lower the other side of the IC into place. If the pins cannot be easily inserted into their holes, rock the IC back, exert 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 all the way. Tape the IC to the board with masking tape.
6. Turn the board over and solder each pin to the foil pattern on the back of the board. Turn the board over and again solder each pin on the component side of the board to insure proper feed-through connection. Be sure each pin is soldered and there are no solder bridges.

WARNING

Make sure none of the pins have been pushed underneath the IC during insertion.

- C. Installing ICs in Socket.
 1. After removing the old IC from the socket, orient the IC to be installed over the socket so that pin 1 coincides with the arrowhead on the PC board.
 2. Align the pins on one side of the socket so that just the tips are inserted into the holes.
 3. Lower the other side of the IC into place. If the pins cannot be easily inserted into their holes, rock the IC back, exert a little inward pressure, and try again. Be patient. When the tips of all the pins have been started into their holes, push the IC into the socket all the way.

IV. Copy/Rewrite Procedures

The following procedures are recommended to copy Disk software for the new Disk Read/Write modifications.

CAUTION

All Disk software copying should be done AFTER the Write modification has been made, but BEFORE the Read modification is made.

A. With a Two or More Disk Drive System.

METHOD I - If using Disk BASIC versions 3.3, 3.4, 4.0 or 4.1, the PIP Utility Program provided on the system Diskette may be utilized to copy onto a new Diskette. A listing of PIP and instructions on its use are included in Section IV, Part C.

STEP 1. Load Disk BASIC. Initialize the system for at least two Disk Drives, i.e., HIGHEST DISK NUMBER? should be answered with 1 or higher.

STEP 2. MOUNT the Diskette with BASIC and PIP on it. Do not attempt to MOUNT a Diskette that is brand new (never had BASIC or files on it).

STEP 3. LOAD PIP and type RUN.

STEP 4. Use the PIP Copy command to copy the old Diskette (the one with BASIC and your files) onto the new Diskette. COP takes approximately 30 minutes, so have patience.

STEP 5. Check the new Diskette by re-loading BASIC (from the new Diskette), MOUNTing, printing a directory of files to make sure everything was copied correctly.

STEP 6. Now make the Disk Read modification.

METHOD II - When using DOS (Disk Operating System) and Disk BASIC, Disk BASIC and the PIP Utility Program can be used to copy the DOS Diskettes. Follow the procedure in Method I, except:

STEP 3. LOAD "PIP" but UNLOAD the Diskette with BASIC on it before RUNNING PIP. Place the DOS Diskette in the Drive where BASIC was. It is not necessary to MOUNT to copy with PIP. Now RUN PIP, and proceed with STEP 4 of Method I.

STEP 5. Check the new Diskette by loading DOS, MOUNTING, issuing a DIR command and possibly running a couple of the programs. Proceed with STEP 6 of METHOD I.

B. With a Single Drive System.

METHOD I - If Disk BASIC versions 3.3, 3.4, 4.0 or 4.1 are being used, the following program is used to copy a Diskette onto itself by changing the write delay timing with which each Sector of the Diskette is written. The program is necessary in order to take advantage of the changes to the Read and Write time delays on the Altair 88-DCDD Disk Controller cards. Together, the program and hardware modifications change the physical position within a Sector of a Diskette where the data is written to and read from.

The program works by buffering an entire track of data at a time. This is done by allocating one element to the string array A\$ for each Sector on a track. The data on a specific track is then read into this array and verified by rereading each Sector to make sure it was read correctly the first time. If for some reason the data for a given Sector will not verify, the Sector is read back into the array again and reread a second time. This process is repeated until verification occurs. Once an entire track has been read and verified, the data is then written back onto the same physical track of the Diskette. In order to insure that the entire operation is done correctly, the newly written data is reread and compared against the original data. Again, if a specific

Sector will not verify, it is rewritten from the original data and reread to verify the write. This process continues until all rewritten data on the track is verified.

The program should work without encountering many REREAD or REWRITE errors if the Disk Drive is in correct operating condition and there is nothing wrong with the Diskette. If a large number of these errors are encountered, there is usually something physically wrong with the Drive (alignment, transport, etc.) or the Diskette.

To use the program, first make the modifications to the write time delay circuit on Controller Board #1 as described in Section II, Part A. Then bring up BASIC and enter the program. It can be saved on the Diskette. Now the program must be run on all Diskettes containing programs or data for future use. Once this is done, make the modifications to the read time delay circuitry on Controller Board #1 as described in Section II, Part C. This entire procedure should greatly reduce the frequency of Disk I/O Errors due to Drive alignment problems.

NOTE

This program takes about 30 minutes to run. It can be made to run faster by increasing the amount of string space cleared in line 100. Currently, a minimum 4658 (137*34) bytes are cleared. This should be changed to clear as much string space as there is memory available after the program is loaded. Make sure the Diskette is up to speed before typing "RUN."

```

100 CLEAR 137*34
110 PRINT:PRINT"DISK SELF COPY"
120 / GET TO TRACK ZERO
130 OUT8,0
140 IF (INP(8)AND 64) <> 0 THEN WAIT8,2,2:OUT9,2:GOTO140
150 / DO IT FOR ALL 77 TRACKS
160 FORT=0T076
170 PRINT:PRINT"READ T";T
180 DIM A$(31)
190 FOR S=0 TO 31  READ & COMPARE ALL SECTORS
200 A$(S)=DSKI$(S)
210 B$=DSKI$(S)
220 IF B$ <> A$(S) THEN PRINT"REREAD T";T;"S";S:GOTO 200
230 NEXT S
240 PRINT:PRINT"WRITE T";T
250 FOR S=0 TO 31  WRITE NEW TRACK
260 DSKO$A$(S),S
270 NEXT S
280 FOR S=0 TO 31  CHECK NEW DATA
290 B$=DSKI$(S)
300 IF A$(S)<>B$ THEN PRINT"REWRITE T";T;"S";S:DSKO$A$(S),S:GOTO 290
310 NEXT S
320 / GOTO NEW TRACK
330 ERASE A$
340 IF T=76 THEN 360
350 WAIT 8,2,2:OUT 9,1
360 NEXT T
370 CLEAR 200
380 PRINT:PRINT"THAT SHOULD DO IT"
390 END

```

METHOD II - A program to update the Write Timing on a Diskette which runs under DOS using only a single Floppy Disk Drive is now available free of charge to those who purchased a copy of DOS prior to December 1, 1977. Send a copy of the invoice or proof of purchase of DOS to MITS and request the DOS Rewrite Diskette.

When the DOS Rewrite Diskette is received, perform the following procedure. This procedure assumes only one Disk Drive is available.

- STEP 1. Perform the modifications to the Write Circuits of the Disk Controller (reference Section II, Part A).
- STEP 2. Put your old DOS Diskette in Drive 0. Bootstrap and perform initialization as usual. Do not MNT it.
- STEP 3. Remove old DOS Diskette from Drive 0.
- STEP 4. Place Diskette containing Write Time Delay update program in Drive 0.
- STEP 5. Issue the command MNT 0.
- STEP 6. Run the Write Time Delay program by typing TIMING in response to the "." (prompt). If you have more than one Drive and the Diskette is in a Drive other than 0, the command is RUN TIMING n, where n is the Drive number.
- STEP 7. The program will type out CHANGE WRITE TIME DELAY ENTER DEVICE NBR. Type 0. Do not hit RETURN.
- STEP 8. Remove the Diskette from Drive 0. Place the Diskette to be rewritten in Drive 0.
- STEP 9. Hit RETURN. The program will begin executing. First it will DSM the Diskette, then it will go around a loop 77 times; once for each track into memory. Then the entire track will be compared with the contents of memory. Any Sector which does not compare will be reread and compared again until they do match. Then the entire

track will be rewritten with the new Write Time Delays. The entire track will be compared with memory. Any Sector which does not compare will be rewritten and recompared. When this is complete, the program will go on to the next track. When the last track is done, the Diskette is MNT'd. This execution takes approximately 3 minutes.

STEP 10. If you have more than one Diskette to update, perform a DSM 0 command. Go to Step 4.

STEP 11. Perform the modifications to the Read Circuits of the Disk Controller.

C. PIP Utility Program.

A BASIC Utility program has been provided to perform such common functions as printing directories, initializing disks, copying disks, etc.

NOTE

Some of the PIP commands (LIS, DIR) require that one <file number> be configured during the Disk BASIC initialization dialog. This is done by answering the "HOW MANY FILES?" question with a value greater than zero. If an attempt is made to perform a LIS or DIR without following this procedure, a BAD FILE NUMBER error will occur.

Once the BASIC Diskette has been mounted, type the following command:

```
RUN "PIP"<carriage return>
(PIP will type)
```

*

PIP is now ready to accept commands. To exit PIP, type a carriage return to the prompt asterisk. To initialize the Floppy Disk in Drive 0, type:

```
*INI0
```

PIP will type "DONE" when it is finished. Any Disk number may be substituted for the \emptyset in the above command and PIP will format the Diskette in that Drive. Any previous files on the Diskette initialized will be lost. If you wish to use blank Diskettes with Disk BASIC, they must be initialized in this fashion before they can be MOUNTed.

NOTE

Do not initialize the Disk with Disk Extended BASIC on it. This will wipe out all the files provided on the Disk.

The COP command is used to copy a Diskette placed in one Drive to a Diskette on another Drive. Neither Diskette need be MOUNTed for the COP command to work properly.

Syntax:

COP<old Disk number>,<new Disk number>

Before the copy is done, PIP verifies the action by printing the following message:

FROM<Disk number>TO<Disk number>

Typing Y followed by a carriage return causes execution to proceed. Any other response aborts the command. Example:

*COP \emptyset ,1 FROM \emptyset TO 1? Y<carriage return> DONE *