# FDCX4

## DOUBLE DENSITY UPGRADE BOARD

## MANUAL AND INSTALLATION GUIDE

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## FDCX4 DESCRIPTION

The FDCX4 consists of a small circuit board which plugs into the 1771 socket on a Cromemco 4FDC disk controller board and upgrades the 4FDC to full double density capability for both 8" and 5" diskettes. One other chip on the 4FDC is replaced with a header assembly which is supplied with the FDCX4 and is connected to the FDCX4 by a short cable. Only one solder joint is necessary to install the FDCX4 (no soldering at all is required if only 5" drives are used), and NO TRACES ON THE 4FDC ARE CUT. Therefore, the FDCX4 may easily be installed or removed in seconds.

The FDCX4 has a reliable phase-locked loop double/single density data separator and, in addition, the FDCX4 has write precompensation circuitry to allow reliable double density operation using any disk drive, including the PerSci 277 disk drives supplied with many Cromemco systems. Since the PLL separator is used for all modes, any problems caused by the use of the internal data separator of the 1771 for 5" drives will be eliminated. Also, people wishing to connect Shugart type 8" drives can use the less expensive drives which lack an internal data separator.

A buffered TG43* (an asterisk after a signal name indicates that the signal is low true) signal is available on the FDCX4 for use with non-PerSci 8" disk drives, such as Shugart, etc. The write precompensation may be disabled for use with read compensated PerSci 299 drives, and the write precompensation may be enabled for 5" drives if desired.

## PRELIMINARY TO INSTALLATION

In order to operate in double density with 8" disks the ZPU 2/4 Mhz. switch must be in the 4 Mhz. position. If you are using some other Z80 processor board, it must be at least a 4 Mhz. processor. Also, no memory wait states are allowed for double density operation.

Many older 4FDC boards were manufactured with a 1K ohm resistor pack installed as RN2 (between the 2 large chips on the board.) This resistor network should be a 4.7K ohm network. All later model 4FDC's have a 4.7K network installed. Note that your 4FDC manual and the silkscreened marking on the 4FDC both identify RN2 as a 1K network. If your 4FDC has a 1K network it should be changed to 4.7K, whether or not you are installing an FDCX4. The 1K pack can cause many problems, usually of the "ILLEGAL JUMP" type. Sometimes it can prevent the board from working at all.

Before installing your FDCX4, you should be aware that the 4FDC with the FDCX4 installed may not be able to read diskettes formatted under certain early versions of the INIT program. Problems may also occur with double sided diskettes initialized around the wrong index hole. This is not a peculiarity of the FDCX4 but is inherent in the design of the 179X family of disk controller chips, which are used in the FDCX4, Cromemco 16FDC, and most other high quality double density disk controllers.

Therefore, before installing your FDCX4, you should make sure that you have a good system disk to boot up the system with afterward. A good system disk is one that is initialized under INIT Version 2.15 or later, and was initialized with the correct index hole exposed.( The index hole could be a problem if you are using double-sided 8" drives with disks which have 2 index holes punched in the jacket, one for single sided and one for double sided. One of these should be covered before initializing the disk. This does not apply to "flippy" type floppys which are punched to allow them to be inserted backwards so as to use both sides, one at a time.)

Your good system disk should also contain the system (written with WRTSYS or CDOSGEN), CDOS.COM,INIT.COM(Ver. 2.15 or later), and STAT.COM. Test the disk by coldbooting your system with it. (Coldbooting consists of causing a hardware reset by means of the reset button or switch, or turning the power off then on again, then bringing up CDOS as in a normal start from a power off condition. This process causes CDOS to be read into memory from the disk in drive A. Typing control-C only causes a warmboot which does not replace the present CDOS in memory.)

If, after installing the FDCX4 you find you have disks that can't be read then it will be necessary to remove the FDCX4 from the 4FDC and copy the unreadable disks to properly initialized diskettes using XFER or a proprietary track by track copy program. Of course, if you have access to another system (using a 4FDC disk controller) then you can copy the disks on that system instead. If you have access to a newer Cromemco system which has a 16FDC controller you can precheck your disks on that system. If the 16FDC will read the disk so will the 4FDC and FDCX4 combination. If you can't read the disk using the 16FDC then copy the disk to a properly initialized disk using the 4FDC before installing the FDCX4.

## CAUTIONS AND WARNINGS (READ BEFORE BEGINNING INSTALLATION)

1.) Never remove or install any computer board with power applied to the system.

2.) Both the FDCX4 and the 4FDC contain MOS devices. Although modern MOS devices incorporate protection devices internally, these devices can still be damaged or destroyed by static electrical discharges. In fact almost every board in your computer contains MOS devices so the following handling rules should be followed whenever handling any board.The rules:

A.) Electrically discharge yourself (touch the case of the

computer) before removing or replacing any board in the computer.

B.) If possible touch a ground (water faucet,grounded electrical appliance, computer frame or case, etc.) before handling a board or MOS component that is not installed in a computer.

C.) Do not remove the conductive foam pad on the connector of the FDCX4 until ready to install.

D.) Use common sense. Static damage occurs when that little spark goes through the board or device to ground. Simply prevent the electronics from being in this discharge path and you will have no problems.

## INSTALLLING THE FDCX4

PLEASE READ ALL INSTALLATION INSTRUCTIONS
BEFORE STARTING THE INSTALLATION PROCEDURE.

1.)Remove the ribbon cables from the 4FDC board and remove it from your computer. Check to see that there will be two empty adjacent slots for the 4FDC to be replaced into since, when the FDCX4 is installed on the 4FDC, the slightly increased height on the component side does not allow a board to be plugged in immediately adjacent to the component side of the 4FDC. If not, rearrange boards as necessary to make room.

2.)Remove IC11 (the 1771 controller chip) and IC8 (74LS00) from the 4FDC. To remove a chip, pry gently on one end at a time with a small screwdriver, rocking the chip back and forth, removing it slowly. This will enable you to remove the chip without bending the leads. See FIGURE 1 for the positions of the I.C.'s to be removed. Some 4FDC boards were supplied with a protective cover covering the entire wiring side of the board. If your 4FDC has this cover on it, and you are planning to use your FDCX4 with 8" maxi size disks then remove the cover at this time, saving the hardware and noting how it was installed for future reinstallation. If only 5" disks are used on your system then it will not be necessary to remove this cover.

3.) Remove the conductive foam pad from the connector on the FDCX4 board and plug the two chips just removed from the 4FDC into the foam. Precondition the 40 pin socket on the 4FDC using the two pin preconditioning tool included. Plug the 2 pins into all 40 socket positions of the IC 11 socket. Starting at one corner, plug the two pins into two adjacent holes. The black plastic strip shold touch, or almost touch, the plastic of the socket. Then go to the next 2 holes and repeat. This means that you will plug the pins in 20 times (once for each 2 holes in the socket.) This procedure should take only a minute or so. PRECONDITIONING IS REQUIRED ONLY ONCE. It is neither necessary nor desirable to precondition the socket if the FDCX4 is removed and replaced for any reason. The reason for this preconditioning step is that some 4FDC's have very tight sockets, requiring excessive force to install an FDCX4.

4.) Position the FDCX4 as shown in FIGURE 2 and very carefully plug it into the IC11 socket on the 4FDC. Note that looking at the 4FDC from the top edge is a good way to see that the 40 pins of the FDCX4 connector are mating properly with the 40 pin socket on the 4FDC. This plug must be firmly plugged in. When viewed from the top edge of the 4FDC, the black plastic strips which hold the gold plated contact pins in place must be almost touching the plastic part of the IC11 socket on the 4FDC. While plugging in the board a point where mechanical resistance increases may be reached before the plug is fully seated. It may be necessary to continue pressing on the top of the FDCX4 until the plug "pops" in. Pressing on the top of the FDCX4 should be done near the center of the rectangle formed by the 40 gold plated pins. This procedure is very difficult to describe, but very easy to do.

5.) Remove the foam pin protector from the IC header assembly which is attached to the FDCX4 by the 3 wire ribbon cable. Plug this IC header assembly into the IC8 socket on the 4FDC, making sure that it is plugged in firmly. The cable must come off the bottom of the chip as shown in FIGURE 2.

6.) THIS STEP AND THE FOLLOWING STEP ARE ONLY NECESSARY IF YOU WILL BE USING 8" FLOPPY DISKS ON YOUR SYSTEM. IF ONLY 5" MINI DISKS ARE TO BE USED THEN GO TO STEP 8. Remove and discard the heat shrink tubing used to hold the thin white wire in a neat coil. Route the single thin wire towards J2. Suggested routing is shown as a fairly thick white line on FIGURE 2.The wire runs over the top edge of the board. The destination of this wire is J2 pin 46. See FIGURE 3 for location of J2 pin 46. Routing is not critical.

7.) Solder the end of the thin wire to J2-46. This is not difficult. The end of the wire is shaped in a small loop and already has a tiny amount of solder on it. Just place this "dot" over the J2 pin 46 pad on the 4FDC and touch a small pencil type soldering iron to it. As soon as the solder is melted, remove the iron and hold the wire in place while the solder joint cools. This should only take a second or two. If it should be necessary to ever remove the FDCX4 from the 4FDC, just reverse the process, that is, touch the joint with the iron until the solder melts and remove the wire. If the FDCX4 is installed and removed repeatedly it may be necessary to feed a little (very little) solder into the joint, then remove the iron and hold the wire in place for a second or two until it cools. The FDCX4 is now properly installed on the 4FDC.

8.) Installation of the FDCX4 is now complete. Replace the protective back cover if your controller had one. You may wish to tape down the thin wire (especially where it passes over the top edge of the 4FDC) to prevent it from snagging while the board is being handled. If you are using 5" drives only, and don't plan to connect 8" drives to your system then you can remove and discard the coil of thin wire since it is unnecessary for 5" drives. To remove the wire, just break or cut it where it attaches to the FDCX4.

9.) Reinstall the 4FDC in your computer. Plug the cables back in. Ohboy,DOUBLE DENSITY AT LAST!!!!

## USING THE FDCX4/4FDC COMBINATION

After installing the FDCX4, boot up your system using the previously mentioned good system disk. Now, using CDOSGEN generate a new system but when CDOSGEN asks about single or dual density, tell it D (for dual density). Answer the other questions as you normally would. You may write this system to the same disk you are using, or to another disk as you desire. Any disk used for this must be properly initialized as already mentioned.

Coldboot your system using the newly generated dual density CDOS. Note that this dual density CDOS is still on a single density disk at this point. You may now initialize disks in double density. Using INIT (Version 2.15 or later) initialize a disk in double density. Now use STAT/L to label the double density disk BEFORE copying any files to it. If you don't use STAT/L on an 8" single-sided disk, the DIR command will return incorrect size data about the amount of storage available. The symptom is DIR returns a size of 252K. A properly labeled single-sided double density 8" disk has a space of 504K. (Note: The very latest version of INIT at this writing, Version 2.71, automatically labels the disk for you.)

You may now write the system to the new double density disk using WRTSYS and XFER or CDOSGEN the same as always. One good way to check out the disk and controller is to fill the disk by copying files using XFER/V until there is no more room on the disk. This allows verification of the inner tracks of the disk where problems with data reliability would most likely occur.

Your FDCX4 was extensively tested before being shipped and was required to perform multiple inner track writes and reads (on both 8" and 5" drives) without any hard or soft errors. These tests were done with known good media and drives.

A Special note to PerSci users:- CDOS V2.53 through 2.56 apparently don't support the fast seek option. We have heard rumors that the VC option will be put back in. However, in the meantime, some PerSci's don't work well when stepped at slow seek rates. We suggest using CDOS V2.52 (or V2.36) if problems are found. Typical symptoms are that the drive gets "stuck" and perhaps makes a loud clunking or chattering noise. The problem is intermittent and usually shows up when doing an "XFER" with a *.* fliespec, or when XFERing a large number of files. We have only heard of the problem occurring on PerSci 277's, and maybe 299's are immune.

## REGISTER (I/O PORT) CHANGES

Most of the register bit definitions in the 4FDC remain unchanged. These definitions are given in the 4FDC manual chap. 3. The following are the changed bit definitions only. These changes make the 4FDC/FDCX4 combination compatible with software written for the Cromemco 16FDC or 64FDC.

04 OUT AUXILIARY DISK COMMAND

D6 -was EJECT LEFT. Now is EJECT. Will eject the selected disk in either side of the PerSci type drives. Has no effect on other type drives.

D5 -was EJECT RIGHT. Now is DRIVE SELECT OVERRIDE NOT. A zero in this bit will activate the drive select outputs from the 4FDC board. It also drives J2 pin 32 low as before. Actually there is no hardware change involved in this signal, but only the way it is used.

34 IN DISK FLAGS-

D4 -was unassigned. Now is INHIBIT INIT NOT.This bit now contains the status of switch 4. If switch 4 is on then this bit is a zero and diskette initialization is prevented by the INIT program. Thus switch 4 works just as on an unmodified 4FDC when using Cromemco software.

D3 - was unassigned. Now is MOTOR ON. A one in this bit indicates that the drive motors are being requested to run. A zero indicates that the drive motors have been turned off.

D2 - was unassigned. Now is MOTOR TIMEOUT. Since the 4FDC has no timeout counter, this bit will always be zero.

D1 -was unassigned. Now is AUTOWAIT TIMEOUT. Since the 4FDC doesn't have a timeout counter, this bit is always zero.

34 OUT - DISK CONTROL

D6 -was unassigned. Now is DOUBLE DENSITY. Writing a one to this bit will select double density for subsequent read, write and format operations. Writing a zero to this bit will select single density operation.

## FDCX4 AND 4FDC OPTIONS

A.) FDCX4 WRITE PRECOMPENSATION SELECT- As supplied, the FDCX4 supplies approximately 175 nSec. of write precompensation in maxi (8") double density mode. This is the proper optioning for the vast majority of users and should be left alone unless you really have a good reason to change it. When doing writes in 8" single density, and either single or double density mini (5") write precompensation is disabled. Write precompensation may be enabled or disabled for any of these modes by cutting traces and jumpering on the FDCX4. See FIGURE 4 for jumper identification. Basically, enabling write precompensation is done by connecting the appropriate input of U3 to VCC. Disabling precomp is done by grounding the input. If you are using the PerSci 299 double sided drives with read compensation enabled, then you may wish to cut the jumper for DDMAXI and connect to ground as shown. Or else, you may disable the read compensation in the PerSci 299's by strapping H3 to H4 and unstrapping H1 to H2 in the PerSci 299. See your PerSci manuals for further information. Before making any changes, we suggest that you try out the FDCX4 with the 299's. Probably, no changes will be necessary.

B.) NON-VOICE COIL 8" DRIVE USE- Some 8" drives (not PerScis) require a signal to tell them when the head is positioned past track 43 towards the center of the disk. These drives use this signal to determine whether to use full write current (outer tracks) or reduced write current (inner tracks). TG43* (track greater than 43 not sometimes called low current not) is available at U2 pin 13 and a pad adjacent to U2. See FIGURE 2. If your 4FDC is not already modified to supply this signal, then jumper this pad to the 4FDC connector J2 pin 2. Some 4FDC boards are modified to use this pin as SIDE SELECT NOT. This modification is not compatible with the TG43* modification. See Appendix A for more information.

Also note that non-voice coil 8" drives are considered "slow-seek" drives by CDOS therefore, when CDOSGEN (V2.36)asks what kind of drive you have L or S you must answer "X". CDOSGEN will then ask further questions. For CDOS Version 2.52 and later,CDOSGEN will give you a choice of seek speeds, and the "X" option is not necessary.

C.) SIDE SELECT OPTION. Later model 4FDC boards come from the factory wired for double sided drives. This modification does nothing for you unless you have double sided drives. To modify earlier boards, jumper J4 pin 21 to J2 (the MAXI plug) pin 2 and to J3 pin 32. Note that this modification is NOT compatible with the TG43* modification for use with some non voice coil 8" drives mentioned earlier. (Most non-VC double sided drives use pin 14 as side select. Pin 14 is used by the PerSci type drives as EJECT. To use non-voice coil double sided 8" drives the best solution might be to cut the EJECT line to pin 14 on the 4FDC board and jumper J4 pin 21 to J2 pin 14. Then connect TG43* to J2 pin 2 as previously noted.)

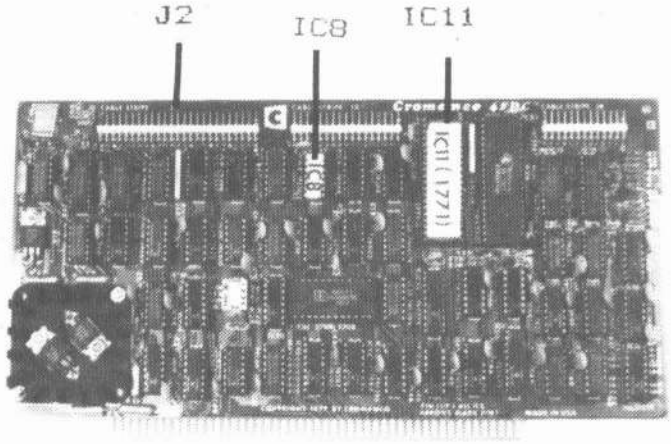
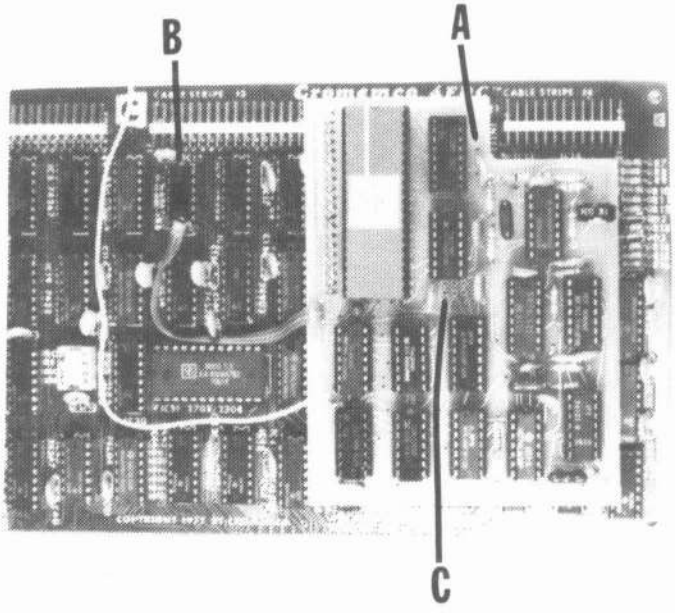



FIGURE 1.- Showing the location of IC8 and IC11.

FIGURE 2.-Showing the FDCX4 installed on the 4FDC. A. is TG43* (for use with some non-voice coil type drives). B. is the new IC8 assembly installed in proper position. C. is the front side of the write precompensation option area (shown in detail in FIGURE 4).



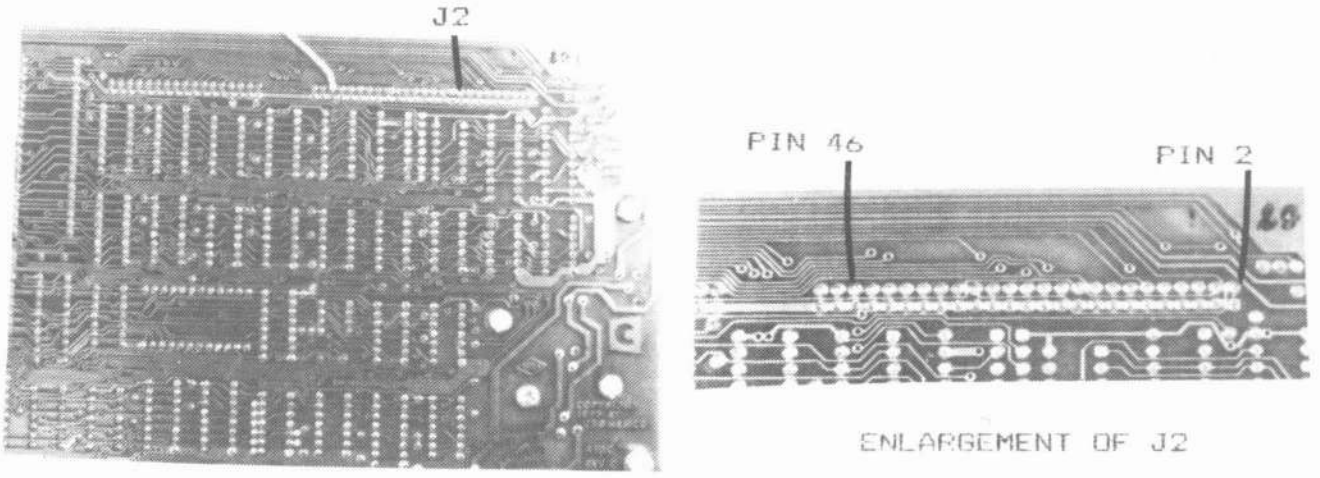



FIGURE 3.- Showing the location of J2 and the position of J2-46 (the connection point for the thin wire) and J2-2 (TG43*). The heavy white wire is connected to J2 pin 46. This large wire was used to make it stand out better in the photograph. This is where the thin wire from the FDCX4 connects. The enlargement shows the location of the pins. Note that the upper right pin on J2 is pin 2 and the upper left is pin 50. Odd numbered pins are on the bottom.

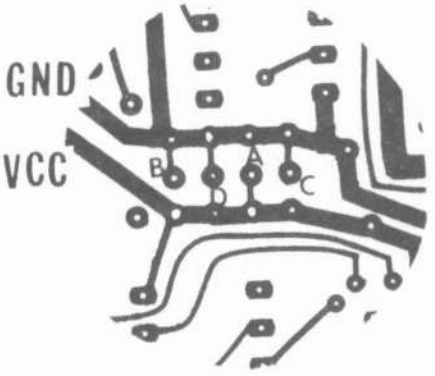



FIGURE 4.- Showing write precompensation jumpers. These jumper traces are on the reverse side of the FDCX4. Cutting a jumper which is presently grounded and connecting it to VCC will enable precompensation for the associated mode. A. is Double density maxi, B. is single density maxi, C. is double density mini and D. is single density mini. We do not suggest changing these jumpers without a good reason to do so.

## IN CASE OF TROUBLE

The FDCX4 should work for many years without problems. No preventative maintenance is required.

If you should encounter problems while using the FDCX4 we suggest that you return it to JVB Electronics for service. The information that follows is aimed towards a technically qualified computer service person in order to facilitate field analysis and troubleshooting of disk controller related problems.

## FDCX4 THEORY OF OPERATION

The FDCX4 can be viewed as four separate systems, disk controller, data separator, write precompensator, and miscellaneous support logic.

### DISK CONTROLLER-

The disk controller chip used is the Fujitsu MB8876A (FD1791B02) which is the same as the 1793B02 used on the Cromemco 16FDC except for an inverted data bus. This MOS LSI chip contains all the features of the 1771 used on the 4FDC plus the added features needed to read, write, and format double density (MFM) diskettes. Of particular interest is the fact that the MB8876A supplies two signals, EARLY and LATE which allow the implementation of an effective write precompensation scheme. Complete information on this chip (as well as the 1771) is available in the Western Digital Product Handbook.

### DATA SEPARATOR

The data separator used on the FDCX4 is an analog type phase-locked loop separator. The data separator circuit supplies a signal (RCLK) which tells the MB8876A whether the current transition on the RAWRD* input is clock or data. The RCLK signal is divided down from the 2Mhz. output of the 74LS624 (or 74LS628) VCO (U2). The VCO output is divided by 2 (double density 8"), 4 (single density 8" and double density 5"), or 8 (single density 5") by U1 and U6. Mux U3 selects the division ratio depending on the state of DDEN* and MINI*. The second half of U6 causes a 90 degree phase shift in RCLK to allow the data and clock transitions to fall as close as possible to the center of their respective windows.

One section of U5 is used as a phase comparator. It compares the phase of the output of one half of U7 with phase 1 of the 2XCLK signal which is double the frequency of RCLK. The output of U7 is RAWRD* inverted and stretched to 350nSec, 1uSec, or 2uSec depending on the type of disk in use. The output of the phase comparator is a pulse string which will have an average 50% duty cycle if either no pulses are occurring on RAWRD* or the leading edge of RAWRD* is occurring at the midpoint between transitions of 2XCLK phase 1. R9 pulls up the output of U5 to improve the centering of the resultant pulse string. The loop filter comprised of R10, C5, R14, C8, and C6 (5" only) integrates the pulse string into a control voltage for the VCO. This control voltage will cause the frequency of the VCO to vary such that the leading edge of RAWRD* will occur at or near the midpoint between 2XCLK phase 1 transitions. CMOS transmission gate U9 enables C6 for mini drives only. VR1 and R13 supply a bias voltage which sets the free running frequency of the VCO.

### WRITE PRECOMPENSATOR-

Write precompensation is accomplished by using a one-shot with adjustable delay. When WDIN goes high it latches a high at U11 pin 2 which triggers U7. If EARLY is high or the disk in use is not a double density maxi disk, then the output of U3 will

cause an immediate clearing of U7. The transition of U7 pin 12 will trigger U10 causing a write data pulse to be outputted.

If neither EARLY nor LATE is high then CMOS TG U9 pin 10 is effectively connected to VCC and U7 will time out approximately 175 nSec later than if EARLY were true. If LATE is high then CMOS TG U9 pin 10 is floating and U7 times out approximately 350 nSec later than it would have if EARLY were true.

In each case, the conclusion of the U7 timing interval triggers U10 which issues a write data pulse. This means that if EARLY is true the write pulse occurs 175 nSec before it would have is neither EARLY nor LATE were true, and if LATE is true then the write pulse occurs 175 nSec after the nominal pulse position.

Note that U11 is cleared by the Q* output of U7. U11 may also be cleared if WG is low and U11 pin 6 is low. This condition can not occur during operation, it only can only occur during power up when the state of U11 might come up set. This would be a logic hangup with no recovery. U4 pin 8 is always floating while writing is occurring.

MISCELLANEOUS LOGIC-

U13 is used as to latch DDEN and MOTORON. DDEN* is connected directly to the MB8876A and DDEN is used in various places on the FDCX4. MOTORON is only used to respond to interrogation as to the state of the motor control. Four sections of U12 are used to place MOTORON, INHIBIT INIT, AUTOWAIT TIMEOUT, and MOTOR TIMEOUT on the inverted data bus when requested. Since the 4FDC doesn't have timeout counters, the timeout signals are always a logical zero. Three sections of U5 (an XOR) are used as inverters by connecting one input to VCC (A XOR 1 =A*). Other logic functions are straightforward and should be obvious from the schematic.

## ADJUSTMENT

There is only one adjustment on the FDCX4. The potentiometer, VR1, adjusts the free running frequency of the Phase Locked Loop (PLL). A frequency counter is necessary to make this adjustment, an oscilloscope is NOT accurate enough. Since the free running frequency is somewhat affected by temperature, the adjustment should be made just after the computer is turned on. Since the frequency will tend to drift down as the circuitry warms up, the frequency is adjusted so as to be about 1% high, that is, 2.02 Mhz. at U2 pin 6 or TP1.

# PARTS LIST FOR THE FDCX4

| QUAN. | | DESIGNATOR(S) | DESCRIPTION |
|---|---|---|---|
| | | **INTEGRATED CIRCUITS** | |
| 4 | EA. | U1,6,11,13 | SN74LS74AN DUAL D FF |
| 1 | EA. | U2 | SN74LS624N (OR 74LS628N) |
| 1 | EA. | U3 | SN74LS153N DUAL MUX. |
| 1 | EA. | U4 | SN74LS125N QUAD NON-INV. BUF |
| 1 | EA. | U5 | SN74LS86N QUAD XOR |
| 2 | EA. | U7,U10 | SN74LS221N DUAL 1-SHOT |
| 1 | EA. | U8 | SN74LS02N QUAD NOR |
| 1 | EA. | U9 | CD4066B QUAD ANALOG SWITCH |
| 1 | EA. | U12 | SN74LS368N HEX INV BUF |
| 1 | EA. | U14 | MB8876AP FLOPPY CONTROLLER |
| | | **RESISTORS** | |
| 1 | EA. | R1 | 30.1K,1/4W,1% |
| 3 | EA. | R2,11,17 | 7500,1/4W,1% |
| 1 | EA. | R3 | 27.4K,1/4W,1% |
| 2 | EA. | R4,12 | 13.0K,1/4W,1% |
| 1 | EA. | R5 | 15.0K,1/4W,1% |
| 2 | EA. | R10,18 | 22.1K,1/4W,1% |
| 1 | EA. | R13 | 33.2K,1/4W,1% |
| 1 | EA. | R14 | 6190,1/4W,1% |
| 1 | EA. | R16 | 604 ,1/4W,1% |
| 2 | EA. | R6,8 | 2.2 K,1/4W,5% |
| 1 | EA. | R7 | 150 OHM ,1/4W,5% |
| 1 | EA. | R9,R15 | 1K,1/4W,5% |
| 1 | EA. | VR1 | 1K POTENTIOMETER |
| | | **CAPACITORS** | |
| 1 | EA. | C1 | 100 PF. DIPPED MICA |
| 3 | EA. | C2,4,15 | 39PF NPO 10% DISK |
| 1 | EA. | C3 | 120 PF. 5% DIPPED MICA |
| 2 | EA. | C5,6 | 0.001UFD 100V NON-INDUCTIVE |
| 1 | EA. | C7 | 4.7 UFD.10V TANTALUM |
| 1 | EA. | C8 | 0.005UFD 100V NON-INDUCTIVE |
| 6 | EA. | C9 THRU 14 | 0.1 UFD. 12V CERAMIC |
| | | **CONNECTOR, CONNECTOR STRIPS AND HEADER ASSY.** | |
| 2 | EA. | | SAMTEC TS-120-G-D-1-1 PIN STRIP |
| 1 | EA. | | 40 PIN IC SOCKET (DISK CONTROLLER) |
| | | **IC8 ASSEMBLY COMPONENTS** | |
| 1 | EA. | | SAMTEC LCP-314G 14 PIN DIP HEADER |
| 1 | EA. | | SAMTEC LCC-314H .4" HIGH DIP HDR COVER |
| 1 | EA. | | SN74LS00N QUAD NAND IC |
| 4 | INCHES | | 3 CONDUCTOR RIBBON CABLE |

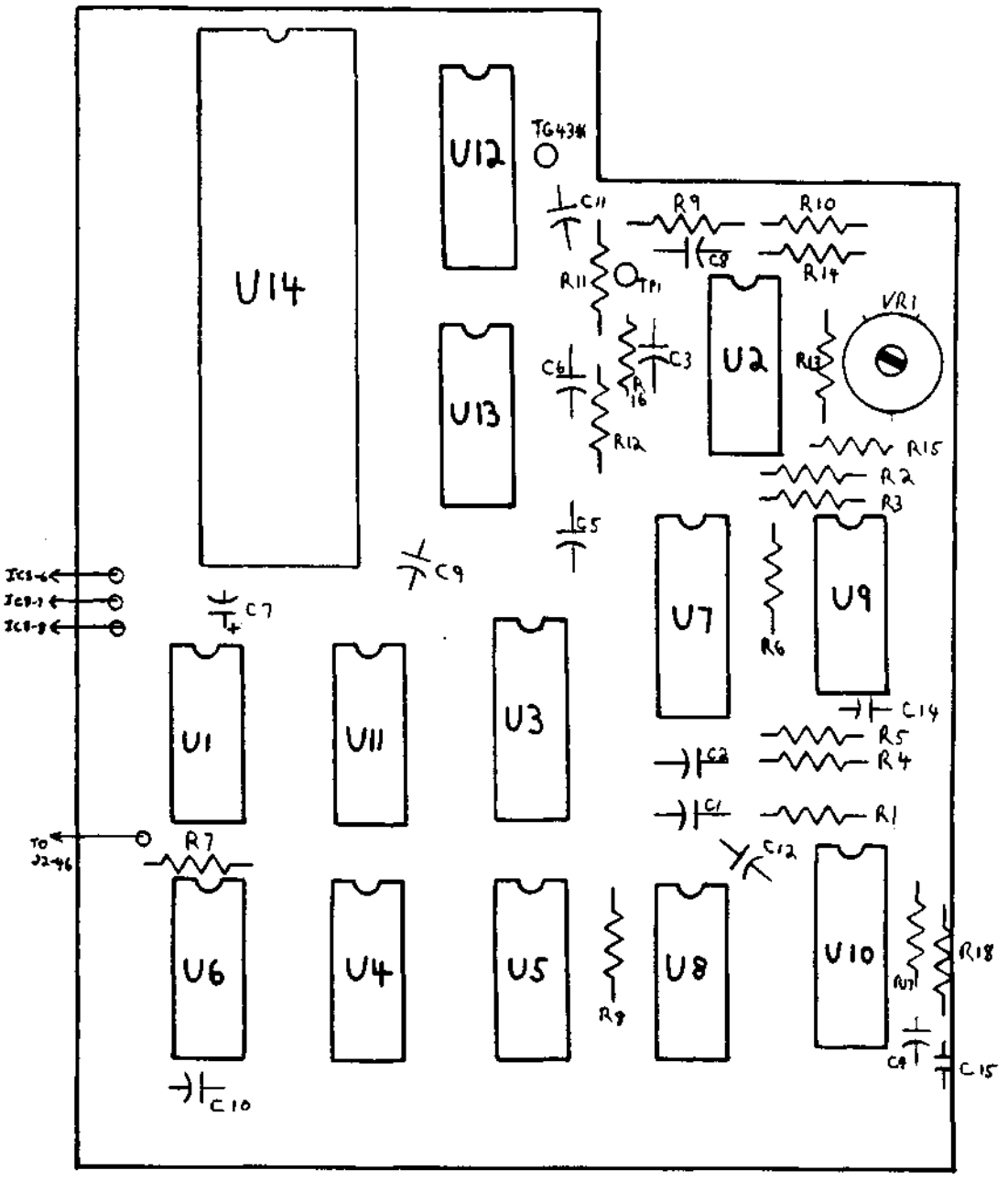
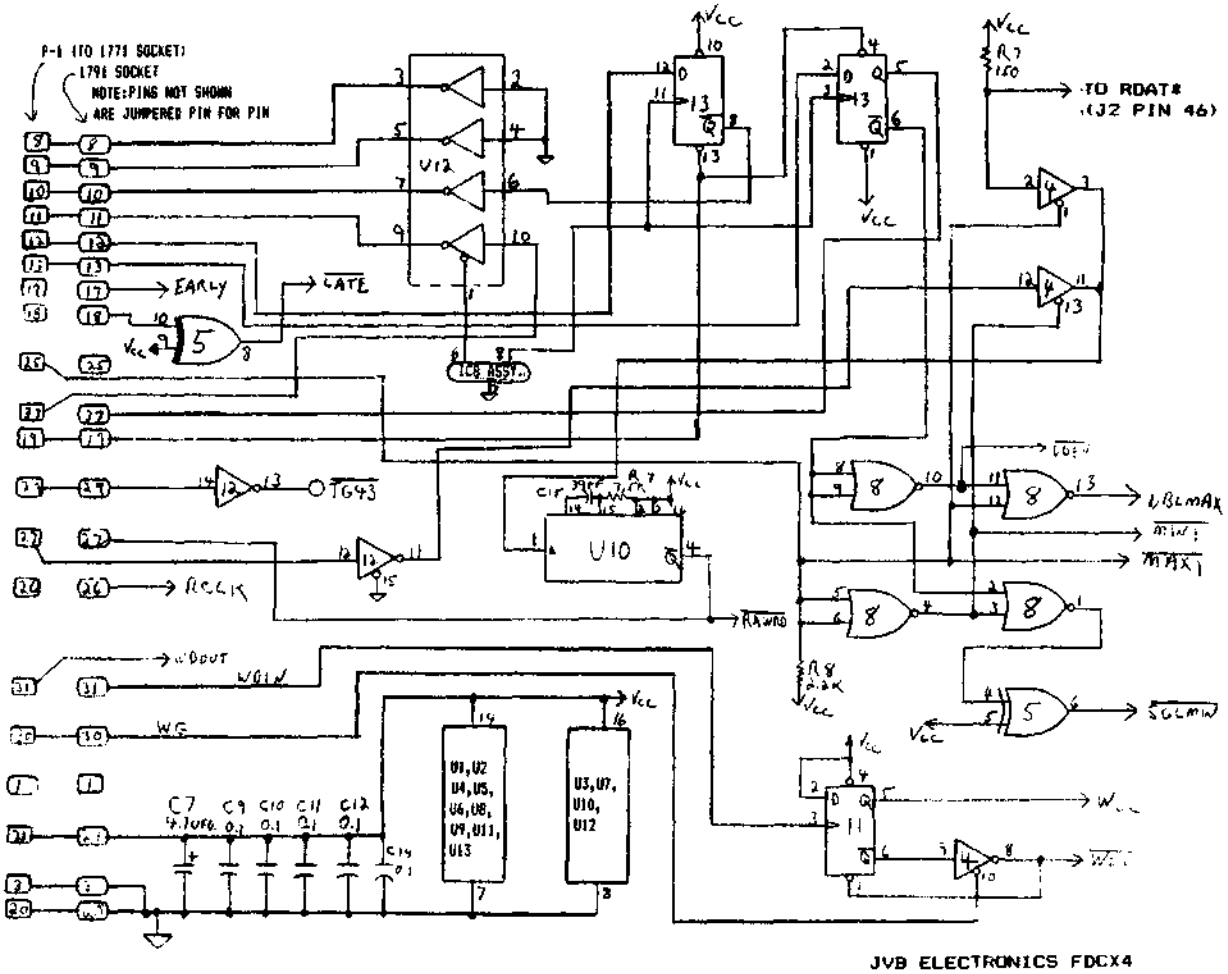



FIGURE 4. Component locations on the FDCX4.




JVB ELECTRONICS FDCX4
REV. D SH. 1 OF 2 (8/82)
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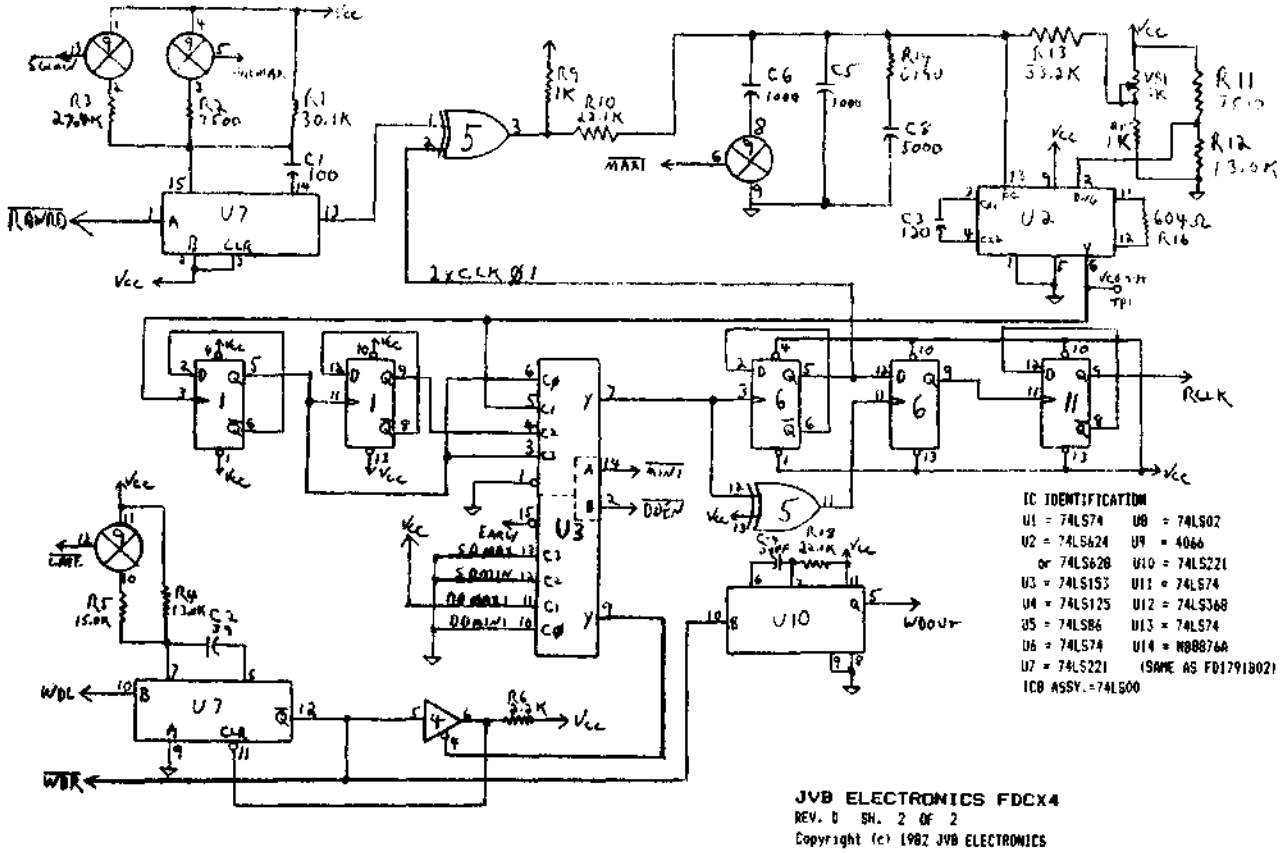


JVB ELECTRONICS FDCX4
REV. D SH. 2 OF 2
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# APPENDIX A.

## MODIFYING THE 4FDC FOR USE WITH TANDON 848-2 DRIVES

One of the questions we have been frequently asked since we started offering the FDCX4 is "How can I connect an 8" Tandon (or Remex, or Shugart) to the 4FDC?". Our answer has been to compare the pinout on the drive and the 4FDC and make an appropriate cable. This avoids cutting up the 4FDC and is a "safe" way to proceed. However, now that Cromemco has stopped using PerSci drives, some users may wish to permanently modify their 4FDC to be a "standard" 50 pin interface, compatible with most drives (except PerSci of course). This modification is presented for the Tandon TM848-2 but will work with most popular drives. Note that in the process of modifying the 4FDC several traces are cut and restoring the board to its original configuration would be difficult. Also, the board will NOT work with Tandon 848-2 drives (or most other drives) unless the FDCX4 is installed, since most of these drives don't have data separators. This modification does not affect 5" drives and 5" and 8" may still be used simultaneously after modification. If you want to use PerSci AND Tandon (or other) 8" drives at the same time, DO NOT PERFORM THE MODIFICATIONS, see the end of this appendix for cabling required.

The first thing we should do is compare the pinout of the 4FDC with the FDCX4 installed to the pinout of the Tandon drives. The following is a tabular representation of this comparison.

| Pin # | 4FDC Function | Tandon Function |
|---|---|---|
| 2 | Side Select (Note 1.) | Write Current Switch (TG43*) |
| 4 | DS3 | Motor Off Control 1 (Note 5.) |
| 6 | N.C. | Motor Off Control 2 (Note 5.) |
| 8 | N.C. | Motor Off Control 3 (Note 5.) |
| 10 | Seek Complete (input) | Two Sided (output) |
| 12 | Restore | Disk Change |
| 14 | Eject Left | Side Select |
| 16 | N.C. | Activity Indicator |
| 18 | DS4 | Motor Start (or Headload) |
| 20 | Index | Index |
| 22 | Ready | Ready |
| 24 | Motor On (Note 4.) | Motor Off Control 4 (Note 5.) |
| 26 | DS1 | DS1 |
| 28 | DS2 | DS2 |
| 30 | N.C. | DS3 |
| 32 | Eject Right | DS4 |
| 34 | Direction | Direction |
| 36 | Step | Step |
| 38 | Write Data | Write Data |
| 40 | Write Gate | Write Gate |
| 42 | Track 0 | Track 0 |
| 44 | Write Protect | Write Protect |
| 46 | Read Data (Note 2.) | Read Data |
| 48 | Sep Data (Note 3.) | Alternate I/O (N.C.) |
| 50 | Sep Clk (Note 3.) | Alternate I/O (N.C.) |

Note 1. Side Select on pin 2 is a Cromemco modification to the 4FDC and may or may not be present.
Note 2. Pin 46 is Read Data when the FDCX4 is installed.
Note 3. Pins 48 and 50 are ignored when the FDCX4 is installed.
Note 4. Low for motor run, high for stop.
Note 5. High for motor run, low for stop.

The whole point of the modification is to make the 4FDC work with the Tandon 848-2 WITHOUT CABLE MODIFICATIONS, that is pin 2 connected to pin 2, etc. To this end it will be necessary to cut several traces on the 4FDC. Cutting traces can be done with a Dremel tool and a SMALL round burr, or, an Exacto knife. If you use an Exacto knife, make 2 cuts separated by an eigth of an inch and use a soldering iron to heat and remove the small piece of trace between the cuts. If this sounds too gruesome, or if you have any doubts about your ability to "operate" on the board, consider making all the mods in the cable instead.

IMPORTANT NOTE: THE FOLLOWING MODIFICATIONS ARE DONE THE WAY THEY ARE TO INTERFACE TO A TM848-2 JUST LIKE IT COMES FROM THE FACTORY. THIS IS NOT NECESSARILY THE OPTIMUM WAY TO USE THE DRIVES. THERE ARE SEVERAL STRAPPABLE OPTIONS WHICH YOU MAY WISH TO EXAMINE FOR INCLUSION ON YOUR INSTALLATION. (Also, all drives may not come optioned the same.)

The TM848-2 is usually shipped with Motor Off Control 1 enabled. Note that the logic sense of the Motor Off Control signal on the Tandon and the Motor On signal on the 4FDC are opposite. We will use one section of IC9 to invert the Motor On signal and feed it to the Motor Off Control 1 (pin 4) on the Tandons. We'll go through the modification process one step at a time:

1.) Cut the following traces. Suggested cut points are given by references to recognizable "landmarks" on the board and are therefore not exact. BE SURE YOU ARE CUTTTING THE RIGHT TRACES!.

A.) Trace to J2 pin 4. Cut where trace curves around J2 pin 20 on back of board. Note: Traces going to pins 4 and 18 on J2 may already be cut. If they are, remove the jumper wires Cromemco soldered to pins 4 and 18 instead of cutting the trace.

B.) Trace to J2 pin 12. Cut is convenient if made where trace is directly above J2 pin 16 on back of board.

C.) Trace to J2 pin 14. This trace starts out from pin 14 on the front of the board and transitions to the back of the board via a feedthru hole located directly above pin 14. Cut the trace on the back of the board near the feedthru.

D.) Trace to J2 pin 18. This trace runs on the front of the board and should be cut just above IC4 pin 1.

E.) Trace to J2 pin 32. This trace runs all over on the back trying to get out of J2! Suggest cutting it where it comes

close to the feedthru which transitioned pin 14 to the back. This makes a neat looking 3 cuts in a row (pins 32,14, and 12).

2.) Install the following jumpers. (J4 is the 26 pin plug for serial and parallel I/O, J3 is the "mini" floppy connector, and J2 is the 8" floppy connector.) PLEASE NOTE: PINS ON J4 ARE COUNTED DIFFERENTLY THAN PINS ON J2 AND J3. Pins 1 thru 13 are on the outside (farthest from the board) and 14 thru 26 are on the inner row. The numbering is clearly marked on the silkscreened legend on the 4FDC card. Pins #s on J2 and J3 are also marked on the top of the 4FDC. Also, see Figure 3 of the manual for pin identification on J2. Jumpers should be #30 wire wrap wire, or equivalent. Watch for shorts! When installing a wire, start with a small hook in the end of the wire. Place this over the pin to be soldered to and solder it. Scotch tape can be handy to hold the wire in place while soldering it. Don't get the tape too close to the joint or you will end up with a sticky mess. Keep the wires short. After you are finished, use some tape to hold the wires in place then use cyanoacrylate glue (or RTV) to tack the wires down. After the adhesive dries remove the tape.

A.) Jumper J4 pin 21 to J3 pin 32 and also to J2 pin 14. This is the side select for double sided drives. J3 pin 32 is side select output for 5" drives. If you never use 5" drives, just jumper J4-21 to J2-14.

B.) Jumper J3 pin 14 to J2 pin 30. This is DS3.

C.) Jumper J3 pin 6 to J2 pin 32. This is DS4.

D.) Jumper J2 pin 18 to J2 pin 17. This grounds pin 18 (Headload on many drives, Motor Start on TM848-2 drives).

E.) Jumper J3 pin 16 to IC9 pin 14. (Motor On to inverter)

F.) Jumper IC9 pin 13 to J2 pin 4.(Motor Off to MC1)

Now we are finished with the mods to the board itself. After installing the FDCX4, you should jumper TG43* to pin J2 pin 2 since the Tandon TM-848-2 does require this signal. See Figure 2 for the location of TG43* on the FDCX4. TG43* is not available on the 4FDC itself.

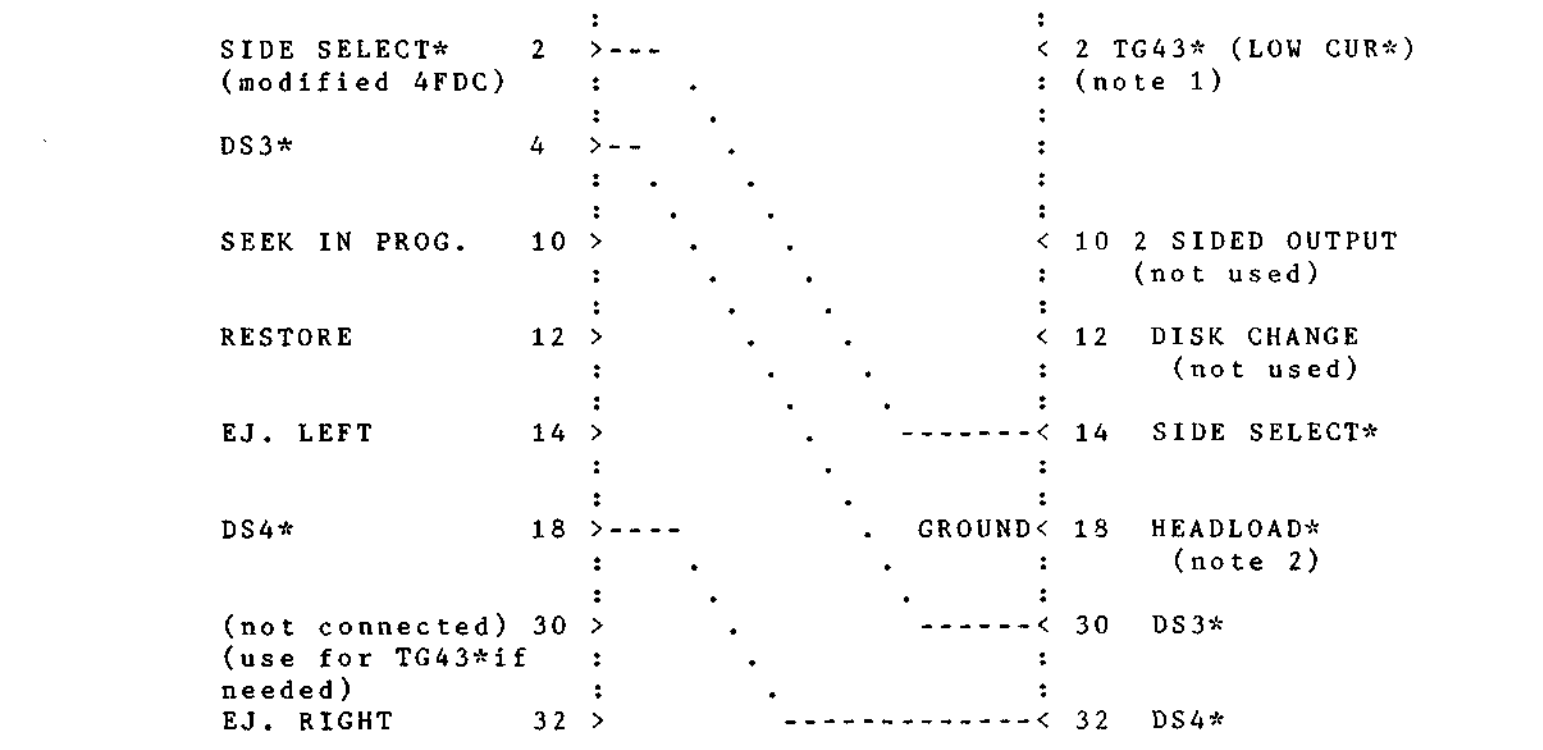
Thats all there is to it. Your 4FDC now is compatible with most industry standard drives (and is no longer compatible with PerSci drives).

## TIPS ON USING PERSCI AND STANDARD 8" DRIVES SIMULTANEOUSLY

Here are some pointers on connecting a Remex 4000 (most other drives are similar) to a Cromemco 4FDC which has an FDCX4 installed while still using PerSci 277's (or 299's). Each installation is probably a little different so use this

information as a guide only. We assume the side select wire is already installed to pin 2 (a standard Cromemco mod.) All pins not shown are connected normally (1 to 1, 3 to 3 etc.). Pins shown but not connected are left open.

If you are not using an FDCX4 with the 4FDC, you MUST have a data separator somewhere, either on the drive, or on a modification board somewhere in the system.




Notes:

1.) If needed, TG43* can be routed thru any unused pin on the 4FDC. TG43* is available on the FDCX4. TG43* IS used by the Remex 4000 drives. Some drives have a strappable option to allow the drive itself to detect Track Greater than 43.

2.) Headload may be floated (ignored) if the drive is optioned for headload from drive select. Grounding this pin allows the drive to be optioned for radial headload and still work. All odd numbered pins are grounded.

3.) When using Tandon TM848-2 drives, the Motor On signal (pin 24 on the 4FDC) can be used to control the motors. Since the logic sense of this signal is incorrect for the drive (as shipped) the drive will have to be optioned (or modified) to use it, or you can use the spare inverter in IC9 on the 4FDC.

Use caution when mixing PerSci 277's and double sided drives. The PerSci 277 won't terminate side select, and the standard double sided drives won't terminate EJECT or RESTORE. A lighter termination (470/680 or so for drives

which use divider terminators, or 330 ohms for pull up type terminators) on BOTH drives may be preferable. Lots of people have double terminated (especially when mixing 5" and 8" drives on 4FDC's) left lines unterminated, etc. and had no problems. Maybe it's just not very important, but it sure seems like it should be.

When optioning the drive, select stepper motor enable from drive select. You DON'T want the unselected drive stepping. Note that stepper motor ENABLE is not necessarily the same as stepper motor POWER.

DS3* and DS4* may be swapped on newer boards, this really doesn't make much difference.

## APPENDIX B

### SOME NOTES ON THE 4FDC

Since beginning shipments of the FDCX4 in February 1982 we have had occasion to troubleshoot several 4FDC boards. The information in this appendix is an attempt to assist anyone who may be troubleshooting a 4FDC. There isn't any apparent order to this information since most of these failures are unrelated.

By far, the most common failure we have seen on 4FDC boards is caused by loose chips. The very first step in troubleshooting a 4FDC should be to lay the board down flat and press all the chips down firmly. If the FDCX4 is installed, remove it to get to the chips underneath. The worst offender is the 5501 (the large 40 pin chip next to the disk controller). Symptoms of this problem are usually that the board won't boot, or, it may not even boot RDOS.

Another source of problems is RN2, which must be changed to 4.7K. If you have this problem and don't have any 4.7K 8 pin SIP resistor networks, send us an SASE and a request and we will send you one free. Symptoms of this problem are "ILLEGAL JUMPS", and general flakiness.

If you upgrade to double-sided operation you may run into two problems. First, make sure IC14 pins 1 and 19 are both grounded. If not, jumper 1 to 19. Second, IC14 may be bad. If anybody ever plugged a standard terminal cable into the DB25 going to the 4FDC, it could have wiped out IC14, or, less likely IC13. Cromemco has a warning about this in the 4FDC manual.

When troubleshooting 4FDC cards, always check the power supply voltages(+5, +12, and -5 Volts). For some reason, the -5V regulator (IC15) seems to fail more often than the others. When it does, it can take the 2708 and the 5501 with it, if it fails to an overvoltage. It can also destroy the 1771 disk controller, but, if the FDCX4 is installed, the MB8876A won't be bothered since it doesn't use -5V.

Three other chips which fail more often than average are IC12 (5501) and IC30 (74S133), and IC33 (74S373). The 74"S" chips

are Schottky (not low power Schottky or "LS") and naturally run warmer.

When cleaning the S-100 edge connector (which you should do whenever you are having problems with the board) use alcohol or a "Freon" type solvent and a clean lint free cloth. You may be surprised at just how dirty the connector is. DO NOT USE AN ERASER ON THE GOLD CONTACTS! An eraser will, when used repeatedly, erase the gold right off the contacts and leave you with a real mess.

Another thing to check is the end of the disk drive cables where they plug into the 4FDC. If the cable ends touch the surface of the 4FDC (after the cable goes through the plug), they may be shorted out, or interfere with the line they are shorting to. If you suspect that this may be a problem, a piece of tape (even scotch tape) over the little frizzy wire ends sticking out of the side of the disk drive plug will eliminate the possibility of shorts. If you have long frizzy wire ends (long enough to short to each other) you will have to clean up the plug. If you don't have any wire ends sticking out of the side of the cable, then this isn't the problem.

## LIMITED WARRANTY

JVB ELECTRONICS warrants this product (FDCX4 Double Density Upgrade Board) against defects in material and workmanship to the original purchaser for a period of ninety (90) days from the date of purchase, subject to the following terms and conditions.

JVB ELECTRONICS (the Seller) will repair or, at Sellers option, replace the product or any part or parts thereof, which prove defective within 90 days of receipt by the purchaser provided that the product is returned to the Seller transportation prepaid.

This warranty does not apply if the defect is the result of accident, misuse, neglect, alteration, improper installation, unauthorized repair, improper testing, or damage during shipping.

The buyer will be responsible for providing proof of the date of purchase in the case of products purchased from or through authorized dealers or agents of the Seller.

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