

U-4 Disc User Manual

'make it easy on yourself'

U-MICROCOMPUTERS

01.223 May 83

U-4 Disc User Manual

U-Microcomputers Ltd
Winstanley Industrial Estate
Long Lane
Warrington
Cheshire
England

Tlx 629279 U-MICRO G
Tel 0925 54117

U-Microcomputers Inc
300 Broad Street
Stamford
Connecticut 06901
USA

Tlx 965999 O&S STD
Tel 203 359 4236
T.Free 800 243 2475

Notice: This manual, the U-4DISC Card and the firmware supplied
on the card are copyright (C) U-Microcomputers 1983.

Manual issue A.

U-4DISC USER MANUAL

Introduction

The U-4DISC is a cost effective way of connecting up to four Apple Disc II or Disc II compatible disc drives to an Apple II+, Apple //e or Apple compatible computer. It supplies both control signals, and power to the disc drive. Existing diskettes may be used without any change.

Contents

Introduction

Installation

Operation

Technical description

Appendix 1 Source code listing of driver

Appendix 2 Circuit diagram

Installation

The U-4DISC is simple to install but in case of difficulty consult your supplier.

- 1) Switch off the computer.
- 2) Remove lid.
- 3) Decide into which slots you are going to install the U-4 DISC main board (marked UFDC4) and auxillary board (see operation section). To just test things and in most cases anyway the main U-4 DISC board will go into slot 6 and the auxillary board into slot 5. NOTE: If only two drives are to be connected then the auxillary board need not be installed.
- 4) The auxillary board should be received already connected by cable to the main board. If it has been detached then connect it now if you wish to use the auxillary board. The wire from the auxillary board connected to the pad just below the word "FRONT" printed on the board should be connected as indicated in Figure 1.
- 5) Plug the main board into its chosen slot and then the auxillary board as indicated in Figure 2. The end of the auxillary board marked "FRONT" should be nearest the front (ie keyboard end) of the computer.
- 6) Now connect from 1-4 disk drives to the U-4 DISC main board. **IMPORTANT** - the cable should stick out at right angles from the card if the cable is correctly plugged in. **IMPORTANT** - the plug must also be correctly inserted eg displacing the connector to the right or left so that some pins are not plugged in will damage the card or disc drive. Refer to figure 4.
- 7) The card is now ready for use. On power up the disc drive attached to the connector marked "1" will switch on and attempt to boot a disc. To test the card just boot a DOS 3.3 disc.

Fig 1 (a)

Paddle board

connections

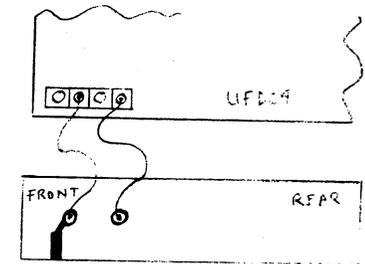
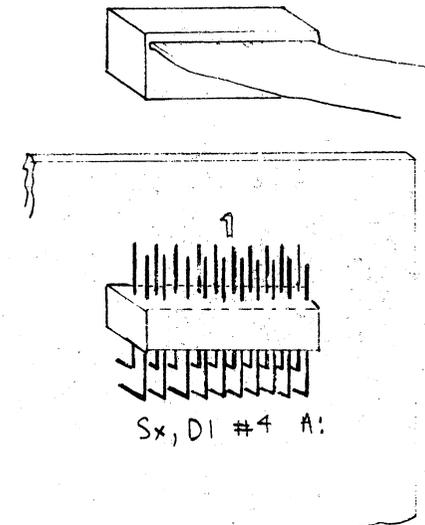


Fig 1 (b)

Disc cable

connection



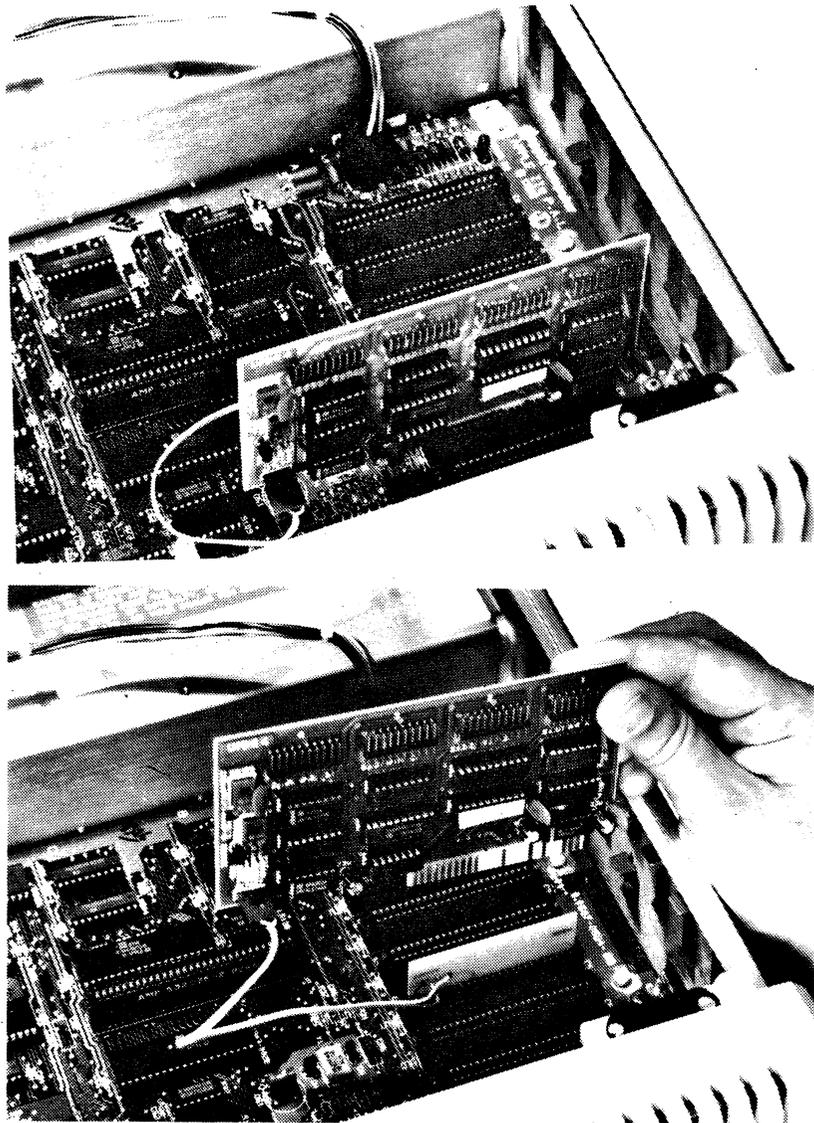


Fig 2

Installation

Operation

The U-4 DISC card is designed to be completely compatible with Apple software written using DOS 3.3, UCSD or CP/M operating systems. Special or own written operating systems should also work satisfactorily provided their low level software operate in the same way as the above mentioned operating systems.

These operating systems refer to the physical disc drives by different nomenclature. DOS 3.3 allows any slots to be used by disc drives whereas PASCAL and CP/M reserve slots for functions. Table 1 relates the drive designations to connectors on the U-4 DISC. For example if your CP/M program says - "Put diskette in drive C:" this means put the disc in the drive connected to connector 3 of the U-4 DISC main board. To make it easy the connectors are marked as well. For all ready written software the table and this explanation should be all you need to know.

However if you are writing new disk operating systems or enhancing existing ones beware that the U-4 DISC PROM is compatible but not the same inside. If your software enters at odd places things probably won't work. But don't despair. A source listing is given at the end of this manual.

Table 1 - Disc Designations

U-4 DISC Slot	AUXILLARY board slot	U-4 DISC connectors	DOS 3.3	UCSD	CP/M
6	5	1	S6, D1	#4:	A:
		2	S6, D2	#5:	B:
		3	S5, D1	#11:	C:
		4	S5, D2	#12	D:
5	4	1	S5, D1		E:
		2	S5, D2		F:
		3	S4, D1		na
		4	S4, D2		na

Technical Description

Introduction

The U-FDC4 disk controller card in conjunction with a small paddle card in an adjacent peripheral expansion slots enables the user to control up to 4 floppy disk drives and is completely compatible with the Apple II 16 sector disk format.

Operation

Each slot of the Apple II is assigned to two floppy disk drives and the purpose of the small jumper pcb is to connect the NIOSEL and NDEVSEL signals from another slot into the U-FDC4 card which is typically installed in slot 6. This enables the card to control a total of four drives.

These two jumpered signals are OR'ed with the NIOSEL and NDEVSEL signals that are direct into the U-FDC4 card by means of the two 74LS08 AND gates.

P2 is a 256 by 8 bit ROM which holds the Boot 0 program used by the computer monitor when the computer is switched on or reset. The monitor accesses this program at address Cn00 which activates the NIOSEL line. The power to this ROM is conserved by the two pnp transistors which remove the +5v. line from the ROM while NIOSEL is inactive.

The 556 is a dual timer. One half generates a reset pulse when power is applied, this signal is duplicating the reset signal generated on the main Apple II processor board. The other half is a monostable with a one second time constant. The output of this timer is used to enable the floppy drive motor and is constantly retriggered during a disk access which involves the transfer of many data bytes since data is accessed via NDEVSEL which is the timer trigger. The effect of this is to stop the drive motor and LED flashing on and off rapidly and also causes the motor to continue running for approx. one second after a disk access has been completed.

The 74LS74 D-type flip flop is set and reset by the jumpered NDEVSEL or the direct NDEVSEL and indentifies which two of the four drives is being accessed. The 74LS259 is an addressable latch driven off the lower four bits of the address bus and enabled motor directly via four phases 00 to 03. It also controls selection of one of two drives.

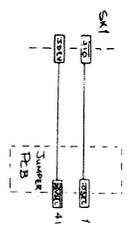
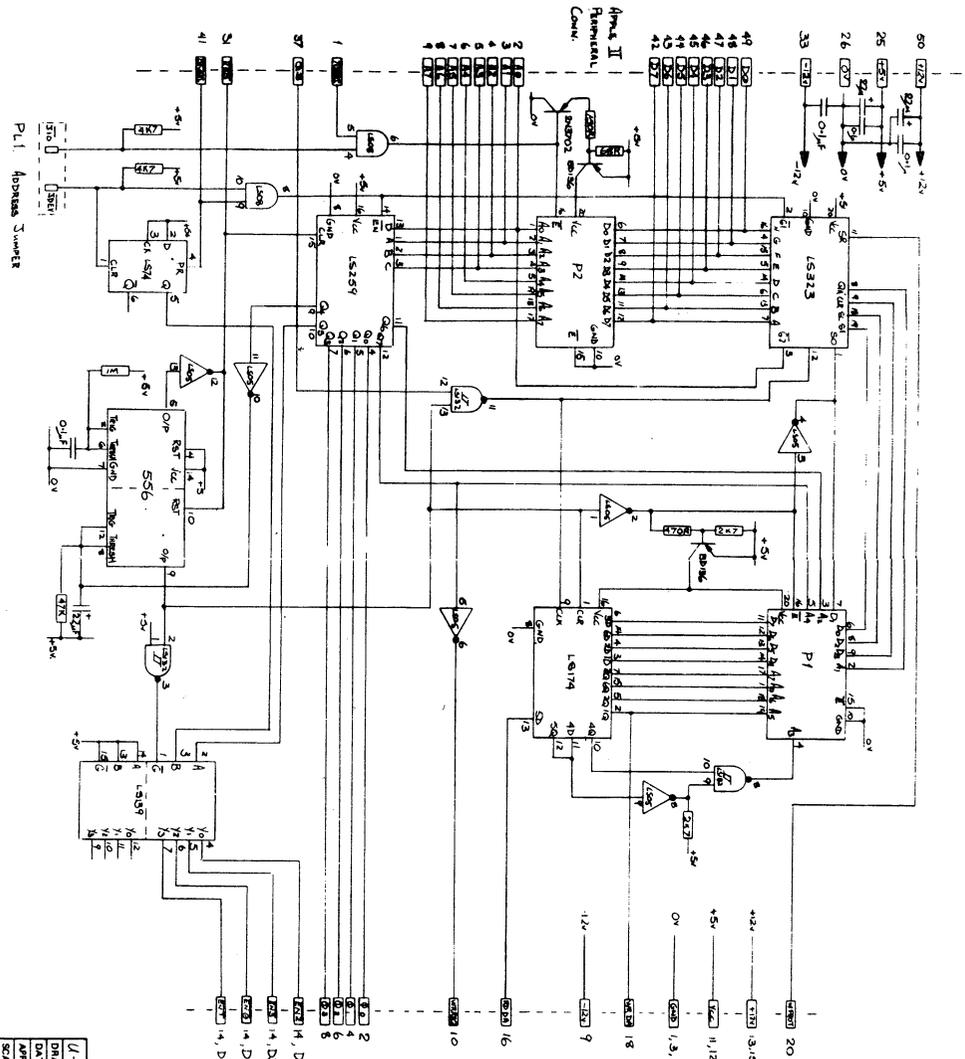
Appendix 1 - Source Code Listing

Q5 of the LS259 and Q of the LS74 are decoded by the 74LS139 to select one of four drives by the NEN0 to NEN3 signals.

The 74LS323 is a universal shift register operating as a parallel to serial register during a write cycle and as serial to parallel register during a disk read. Parallel data to or from this register is read or written by the Apple cpu over the data lines D0 to D7.

Data on the floppy disk is held in a complex encoded serial format. P1 and the 74LS174 form a state machine which either encodes the serial data from the LS323 during a write cycle or decodes during a read cycle. P1 is a 256 by 8 bit ROM which holds a series of encoding and decoding bit patterns.

Q6 and Q7 of the LS259 select either a read or write cycle and control the direction of operation of both shift register and the state machine. The pnp transistors powers down both of the state machine ic's. while no disk accesses are taking place.



U-Microcomputers Ltd.	Long Lane, Warwick
Drawn Photonic	All DIMA in
DATE 31 MAY 82	TITLE U-FDC4
APPROVED	SCALE
MATERIAL	4 DRIVE DISC CONTROLLER
SHEET	SCHEMATIC
SHEET	DRG. NO.

SOURCE FILE: DISC CONTROLLER FROM

----- NEXT OBJECT FILE NAME IS DISC CONTROLLER FROM.OBJO

```

0000:          1      ORG  $0000
FF58:          2 IORTS EQU  $FF58
0000:A9 20      3      LDA  ##20      ;FIRST 8 BYTES MUST BE
0002:A2 00      4      LDX  ##00      ;$20,$??,$00,$??,$03,$??,$3C
0004:A0 03      5      LDY  ##03      ;TO SATISFY AUTOSTART ROM
0006:84 3C      6 L1   STY  $3C
0008:06 3C      7      ASL  $3C      ;DYNAMICALLY BUILD READ TRANSLATE

000A:98          8      TYA          ;TABLE IN MEMORY FROM $3CD UPWARDS
000B:25 3C      9      AND  $3C      ;FOR CONVERTING DISC BYTES TO
000D:F0 11     10     BEQ  L3      ;6-BIT HEX...THI TABLE IS ARRANGED
000F:98     11     TYA          ;SO THAT THE VALUE OF THE DISC BYTE
0010:05 3C     12     ORA  $3C      ;CAN BE USED DIRECTLY AS A MODIFIER
0012:49 7E     13     EOR  ##7E     ;IN 'OPER,X' ADDRESSING BELOW
0014:29 7E     14     AND  ##7E     ;TO OBTAIN THE EQUIVALENT HEX CODE
0016:B0 08     15 L2   BCS  L3      ;IN A SINGLE LOOKUP OPERATION
0018:4A     16     LSR  A
0019:D0 FB     17     BNE  L2
001B:8A     18     TXA
001C:99 56 03  19     STA  $0356,Y
001F:EB     20     INX
0020:C8     21 L3   INY
0021:10 E3     22     BPL  L1
0023:20 58 FF  23     JSR  IORTS      ;FIND WHICH SLOT DISC CONTROLLER
0026:BA     24     TSX          ;CARD OCCUPIES
0027:BD 00 01  25     LDA  $100,X      ;LOAD A WITH $CN WHERE N=SLOT NO
002A:85 2C     26     STA  $2C      ;SOMETHING FOR BIT TO SET V WITH
002C:0A     27     ASL  A
002D:0A     28     ASL  A
002E:0A     29     ASL  A
002F:0A     30     ASL  A      ;MANUFACTURE $NO
0030:AA     31     TAX
0031:86 2B     32     STX  $2B      ;AND PRESERVE FOR FUTURE USE
0033:5D 8E C0  33     EOR  $C08E,X      ;SELECT DRIVE 1,ENABLE READ
0036:5D 8C C0  34     EOR  $C08C,X      ;LATCH,TURN MOTOR ON
0039:1D 8A C0  35     ORA  $C08A,X
003C:1D 89 C0  36     ORA  $C089,X
003F:A0 80     37     LDY  ##80      ;RECALIBRATE THE DISC BY
0041:1D 80 C0  38 L4   ORA  $C080,X      ;SEEKING OUTWARDS AT LEAST 40 TRACKS
0044:98     39     TYA          ;EACH OF 4 PHASES 0-3 OF THE STEPPE
MOTOR
0045:29 07     40     AND  ##07      ;MUST BE TURNED ON THEN OFF. DONE IN
0047:05 2B     41     ORA  $2B      ;ASCENDING ORDER THIS SEEKS INWARD.
0049:AA     42     TAX          ;DONE IN DESCENDING ORDER THIS SEEK
OUTWARD
004A:5D 81 C0  43     EOR  $C081,X      ;THIS CODE IS TIME-CRITICAL
004D:A9 56     44     LDA  ##56
004F:20 A8 FC  45     JSR  $FCAB      ;MONITOR S/R TO WASTE
0052:88     46     DEY          ;(26+27*A+5*A*A)/2 MICROSECS
0053:88     47     DEY
0054:10 EB     48     BPL  L4
0056:85 3D     49     STA  $3D
0058:A9 08     50     LDA  ##08
005A:85 27     51     STA  $27

```

```

005C:          52 *   THE FOLLOWING CODE IS ALSO
005C:          53 *   USED AS A SUBROUTINE BY THE
005C:          54 *   2ND STAGE BOOTSTRAP AND SO
005C:          55 *   MUST BEGIN AT $5C
005C:A9 00     56     LDA  #0
005E:85 26     57     STA  $26
0060:85 40     58     STA  $40
0062:88     59 L5   CLV          ;TO $800 UPWARDS
0063:BD 8C C0  60 L6   LDA  $C08C,X      ;WATCH READ DATA LATCH BIT 7
0066:10 FB     61     BPL  L6      ;WHEN 1,DATA BYTE PRESENT
0068:C9 D5     62 L7   CMP  ##D5      ;IS IT START OF HEADER?
006A:D0 F7     63     BNE  L6      ;NO,KEEP LOOKING
006C:BD 8C C0  64 L8   LDA  $C08C,X      ;POSSIBLY,WHAT'S NEXT?
006F:10 FB     65     BPL  L8
0071:C9 AA     66     CMP  ##AA      ;IS IT SECOND BYTE OF A HEADER?
0073:D0 F3     67     BNE  L7      ;NO,TRY AGAIN
0075:BD 8C C0  68 L9   LDA  $C08C,X
0078:10 FB     69     BPL  L9
007A:C9 96     70     CMP  ##96      ;IS IT AN ADDRESS HEADER?
007C:F0 08     71     BEQ  L10      ;YES
007E:50 E3     72     BVC  L6      ;1ST OR SECOND PASS THRU THIS CODE?
0080:49 AD     73     EOR  ##AD      ;ARE WE READING SECTOR DATA?
0082:F0 26     74     BEQ  L14      ;YES
0084:D0 DC     75     BNE  L5      ;NO,TRY AGAIN
0086:A0 FD     76 L10  LDY  ##FD      ;HANDLE A SECTOR ADDRESS
0088:85 41     77 L11  STA  $41      ;READ IN 6 BYTES,AND COMBINE THEM TO G
IVE
008A:BD 8C C0  78 L12  LDA  $C08C,X      ;VOLUME,TRACK AND SECTOR OF SECTOR CUR
RENTLY
008D:10 FB     79     BPL  L12      ;BEING READ
008F:2A     80     ROL  A
0090:85 3C     81     STA  $3C
0092:BD 8C C0  82 L13  LDA  $C08C,X
0095:10 FB     83     BPL  L13
0097:25 3C     84     AND  $3C
0099:C8     85     INY
009A:D0 EC     86     BNE  L11      ;COMPARE SECTOR FOUND WITH SECTOR
009C:45 3D     87     EOR  $3D      ;REQUIREDIF NO MATCH KEEP TRYING
009E:D0 C2     88     BNE  L5
00A0:A5 41     89     LDA  $41      ;DITTO TRACK
00A2:45 40     90     EOR  $40
00A4:D0 BC     91     BNE  L5
00A6:24 2C     92     BIT  $2C      ;SET V-BIT TO INDICATE 2ND PASS THRU C
ODE
00A8:70 B9     93     BVS  L6
00AA:A0 56     94 L14  LDY  ##56      ;GET SECTOR DATA
00AC:84 3C     95     STY  $3C
00AE:BC 8C C0  96 L15  LDY  $C08C,X      ;READ IN 85 BYTES OF SECONDARY
00B1:10 FB     97     BPL  L15      ;DATA TO $300-$355
00B3:59 D6 02  98     EOR  $02D6,Y
00B6:C6 3C     99     DEC  $3C
00B8:A4 3C     100    LDY  $3C
00BA:99 00 03  101    STA  $300,Y
00BD:D0 EF     102    BNE  L15
00BF:BC 8C C0  103 L16  LDY  $C08C,X      ;READ IN 256 BYTES OF PRIMARY DATA
00C2:10 FB     104    BPL  L16      ;TO ADDRESS AREA POINTED TO BY ($26,$2
7)

```

```

00C4:59 D6 02 105      EOR  $02D6,Y
00C7:A4 3C          106      LDY  $3C
00C9:91 26          107      STA  ($26),Y
00CB:C8            108      INY
00CC:84 3C          109      STY  $3C
00CE:D0 EF          110      BNE  L16
00D0:BC 8C C0      111 L17     LDY  $C08C,X
00D3:10 FB          112      BPL  L17
00D5:59 D6 02      113      EOR  $02D6,Y ;VERIFY DATA SUMCHECK VALID
00D8:D0 88          114 L18     BNE  L5
00DA:A8            115      TAY
00DB:A2 56          116 L19     LDX  ##56
00DD:CA            117 L20     DEX
00DE:30 FB          118      BMI  L19
00E0:B1 26          119      LDA  ($26),Y
00E2:5E 00 03      120      LSR  $0300,X ;NIBBILISE PRIMARY AND SECONDARY
00E5:2A            121      ROL  A ;DATA TOGETHER
00E6:5E 00 03      122      LSR  $0300,X
00E9:2A            123      ROL  A
00EA:91 26          124      STA  ($26),Y
00EC:E6 26          125      INC  $26
00EE:D0 ED          126      BNE  L20
00F0:E6 27          127      INC  $27
00F2:E6 3D          128      INC  $3D
00F4:A5 3D          129      LDA  $3D
00F6:CD 00 08      130      CMP  $0800 ;ARE MORE SECTORS TO BE READ?
00F9:A6 2B          131      LDX  $2B ;ONLY IF BOOTING FROM A 'BASICS' DISKE
TTE
00FB:90 DB          132      BCC  L18
00FD:4C 01 08      133      JMP  $0801 ;START TO EXECUTE SECOND STAGE BOOTSTR
AP

```

Appendix 2 - Circuit Diagram

*** SUCCESSFUL ASSEMBLY: NO ERRORS

```

FF58 IORTS          06 L1          86 L10          88 L11
 8A L12             92 L13          AA L14          AE L15
 BF L16             D0 L17          D8 L18          DB L19
 16 L2              DD L20          20 L3           41 L4
 62 L5              63 L6          68 L7           6C LB
 75 L9

```

```

06 L1              16 L2          20 L3           41 L4
 62 L5              63 L6          68 L7           6C LB
 75 L9              86 L10         88 L11          8A L12
 92 L13             AA L14          AE L15          BF L16
 D0 L17             D8 L18          DB L19          DD L20
FF58 IORTS

```


U-MICROCOMPUTERS

U-Microcomputers Ltd.
Winstanley Industrial Estate,
Long Lane, Warrington, Cheshire WA2 8PR
Telephone 0925-54117/8
Telex 629279 UMICRO G

