Altair 680

FDC

User's Manual

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Introduction

The Peripheral Technology FDC supports single density drives in the 500KHZ Altair. Altair computers with the 1MHZ modification will support double density operation. The FDC also works with the 2MHZ PT main board.

If you have the MIO board with a SWTBUG date of 03-31-26 or newer, your system is ready to boot. You have the option of using the “D” command to boot from a diskette with the boot sector contained in sector 0 or “U” command to boot from a diskette with the boot sector in sector 1. Usually “U” was used to boot from GoTek images but there are now GoTek images that can use the “D” command.

If you don’t have the MIO board, your system needs to have memory at A000-BFFF and memory from 0000-2FFF. Memory at 2400 is required since the FLEX bootstrap loads at address 2400. If you have sufficient memory, you have a couple of ways to boot from the floppy. You can enter a bootstrap loader from the keyboard by entering the hex codes. If you use a terminal program such as Tera Term you can upload an S-Record file containing the bootstrap loader. Another option is to assemble the bootstrap loader at an address which could be burned into a 1702. Assuming you put the bootstrap at FC00, the command “J FC00” from the Altair monitor would boot FLEX.

FDC MEMORY MAP

```
F0B0 - F0B3             DRIVE SELECT, DENSITY, SIDE REGISTER
F0B4                    WD2797 – STATUS REGISTER / COMMAND REGISTER
F0B5                    WD2797 – TRACK REGISTER
FOB6                    WD2797 – SECTOR REGISTER
B0B7                    WD2797 – DATA REGISTER

F0B8-F0B9 MC6850 ACIA
```

Should a different address be needed, it will be necessary to modify the GAL. It would seem unlikely that these addresses would have already been used in an existing system.

MC6850 ACIA RS232

The MC6850 provides a serial port. Baud rates are selectable by jumper. Available baud rates are 300, 1200, 9600, 19200, 38400, and 57600. A DB9F is located at the rear corner of the FDC and is wired so common DB9M to USB serial adapter cables are a direct plug in.

Jumper Options

JP3 Baud Rates – Only install one jumper. Baud rate selections are 300, 1200, 9600, 19200, 38400, and 57400.

JP4 DCD Enable. Jumper connects Pin 4 from the DB9F to control the DCD line on the MC6850. If not shorted there is a pull up resistor that forces DCD to always be enabled.

JP5 CTS Enable. Position 1 forces CTS on. Position 2 allows pin 7 of the DB9F to control the CTS pin on the MC6850.

JP6 Shorted – Place 2797 in test mode for data separator adjustment.
For normal operation this jumper cannot be installed.

JP9 Write Precompensation

JP10 Probe connection for scope and frequency counter.

JP12 Shorted – Feed +5V to pin 9 on the DB9F – Intended for a power source to an EPS32 file server used with serial FLEX.

Setup and Alignment of WD-2797 Data Separator

Alignment is performed by Peripheral Technology on assembled FDC boards. Alignment/setup is not required or recommended unless the user replaces the WD2797. The user should have technical experience and the use of an oscilloscope. It is not possible to adjust the data separator by trial and error.

Data Separator

1) Power up and issue a manual reset.
2) Install a shorting shunt on test jumper JP6.
3) Observe the pulse width on JP10 labeled 1000ns.
4) Adjust R14 (50K POT) for 1000ns pulse width.
5) Observe the frequency on JP10 labeled 125KHZ.
6) Adjust C18 for 125 KHZ (8uS period with scope)
7) Remove the test jumper on JP6.

Write Precompensation

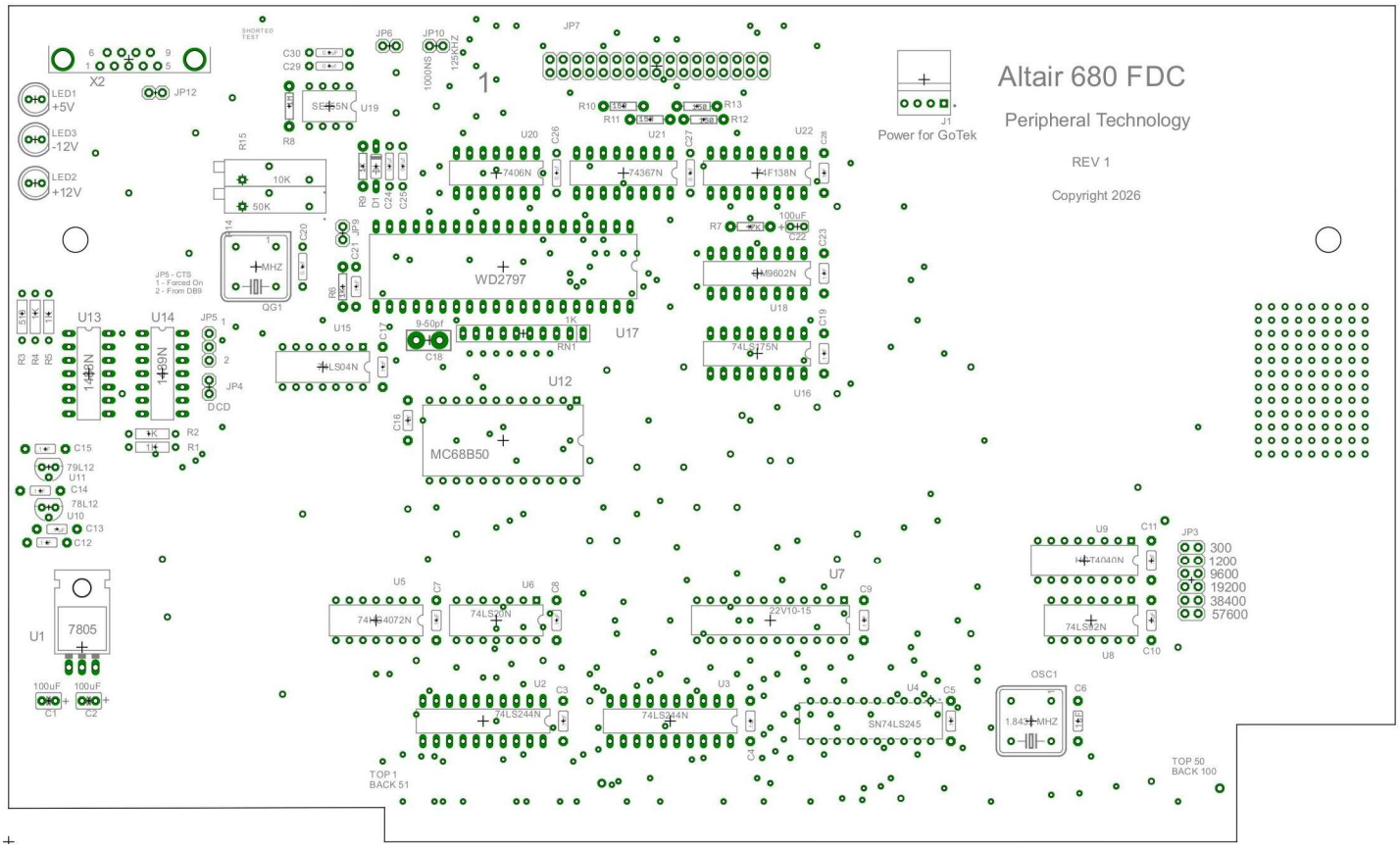
1) Issue a manual reset.
2) Install a test jumper on JP6.
3) Observe the pulse width on pin 31 of the WD2797.
4) Adjust R15 for desired pulse width (write pre-compensation value)
5) Remove the test jumper on JP6.

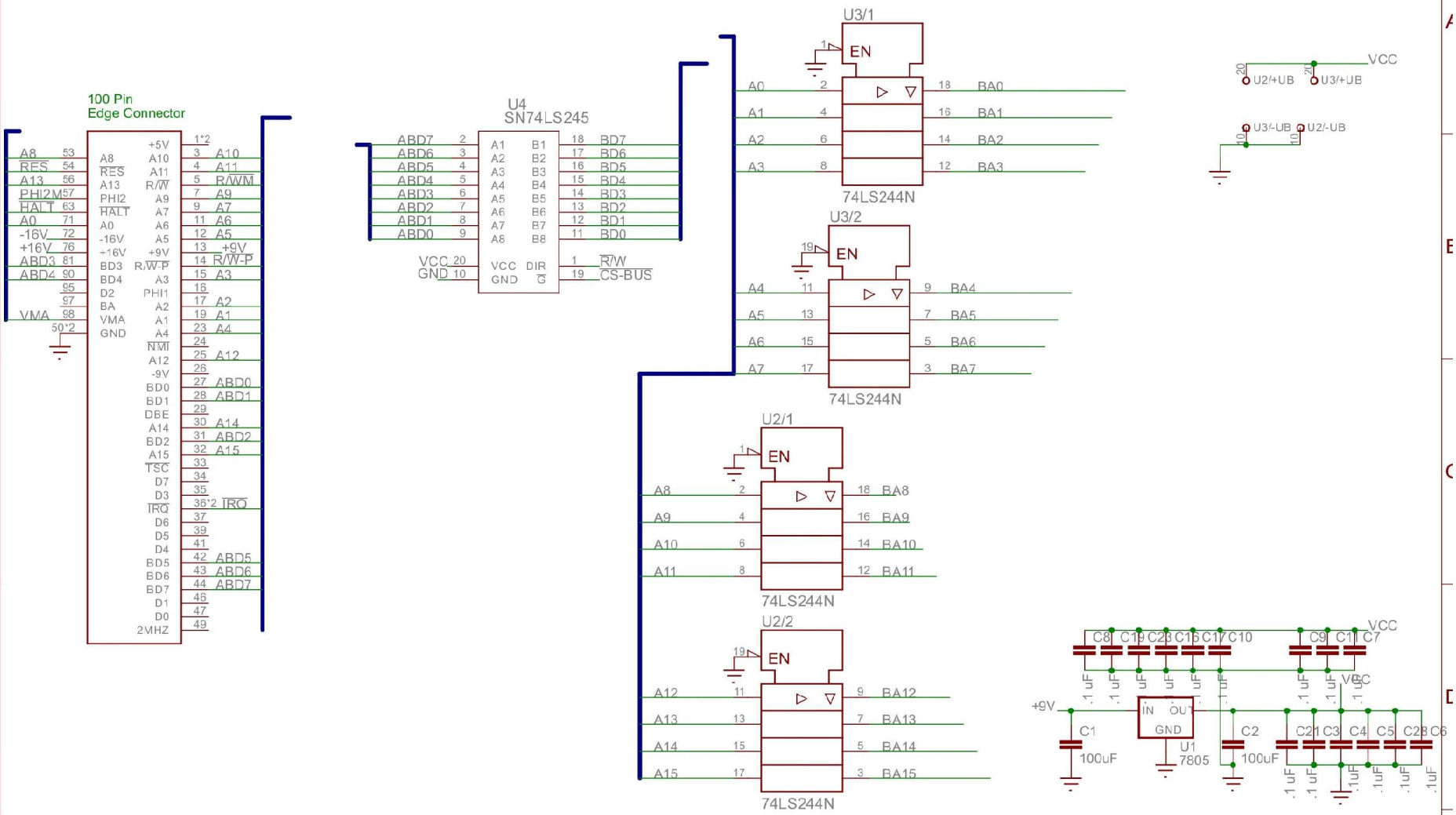
680 FDC PARTS LIST

QUANTITY	DESIGNATION	DESCRIPTION
1	U1	DC-DC CONVERTER – RBT10W24S05 – DO NOT USE A 7805
1	U2,U3	74LS244
2	U4	74LS245
1	U5	CD74HC4002
2	U6	74LS20
1	U7	ATF22V10C-15PU
1	U8 *	74LS92
1	U9 *	CD4040 OR 74HC4040 OR 74HCT4040
1	U10 *	78L12
1	U11 *	79L12
1	U12 *	MC68B50P OR MC6850P FOR 500KHZ OR 1MHZ SYSTEM
1	U13 *	1488
2	U14 *	1489
1	U15	74LS04
1	U16	74LS175
1	U17	WD2797PL-02
1	U18	9602
1	U19	555
1	U20	7406
2	U21	74LS367
1	U22	74F138
1	OSC1 *	1.8432 MHZ ½ SIZE OSCILLATOR
1	QG1	1.0 MHZ ½ SIZE OSCILLATOR
3	LED1-LED3	GENERIC T-1-3/4 LED – ANY COLOR
6	R1-R2,R4-R6,R9	1K OHM 1/4 WATT
6	R3	470 OHM 1/4 WATT
1	R7	47K OHM 1/4 WATT
1	R8	1M OHM 1/4 WATT
4	R10-R13	150 OHM 1/4 WATT
1	R14	50K POT – 3006P-1-503
1	R15	10K POT – OPTIONAL – NEEDED ONLY FOR WRITE PRECOMP
3	C1,C2,C22	100UF 16V
23	C3-C21,C23-C30	0.1UF 25V
1	C18	9-50 PF VARIABLE CAPACITOR- JAMECO - 136979
1	J1	FLOPPY POWER CONNECTOR – TE AMP 171826-4
1	JP3 *	6X2 HEADER STRIP
2	JP4,JP12 *	2X1 HEADER STRIP
1	JP5 *	3X1 HEADER STRIP
3	JP6,JP9,JP10	2X1 HEADER STRIP
1	JP7	17X2 SHROUDED HEADER KEYED
5		SHORTING SHUNTS
1	X2 *	DB9F CONNECTOR
1		8 PIN IC SOCKET
7		14 PIN IC SOCKET
5		16 PIN IC SOCKET
4		20 PIN IC SOCKET
1		24 PIN IC SOCKET .3” WIDTH
1	U12 *	24 PIN IC SOCKET .6” WIDTH
1		40 PIN IS SOCKET

PARTS MARKED * ARE OPTIONAL – FOR RS232 OPTION

Parts Placement





Peripheral Technology

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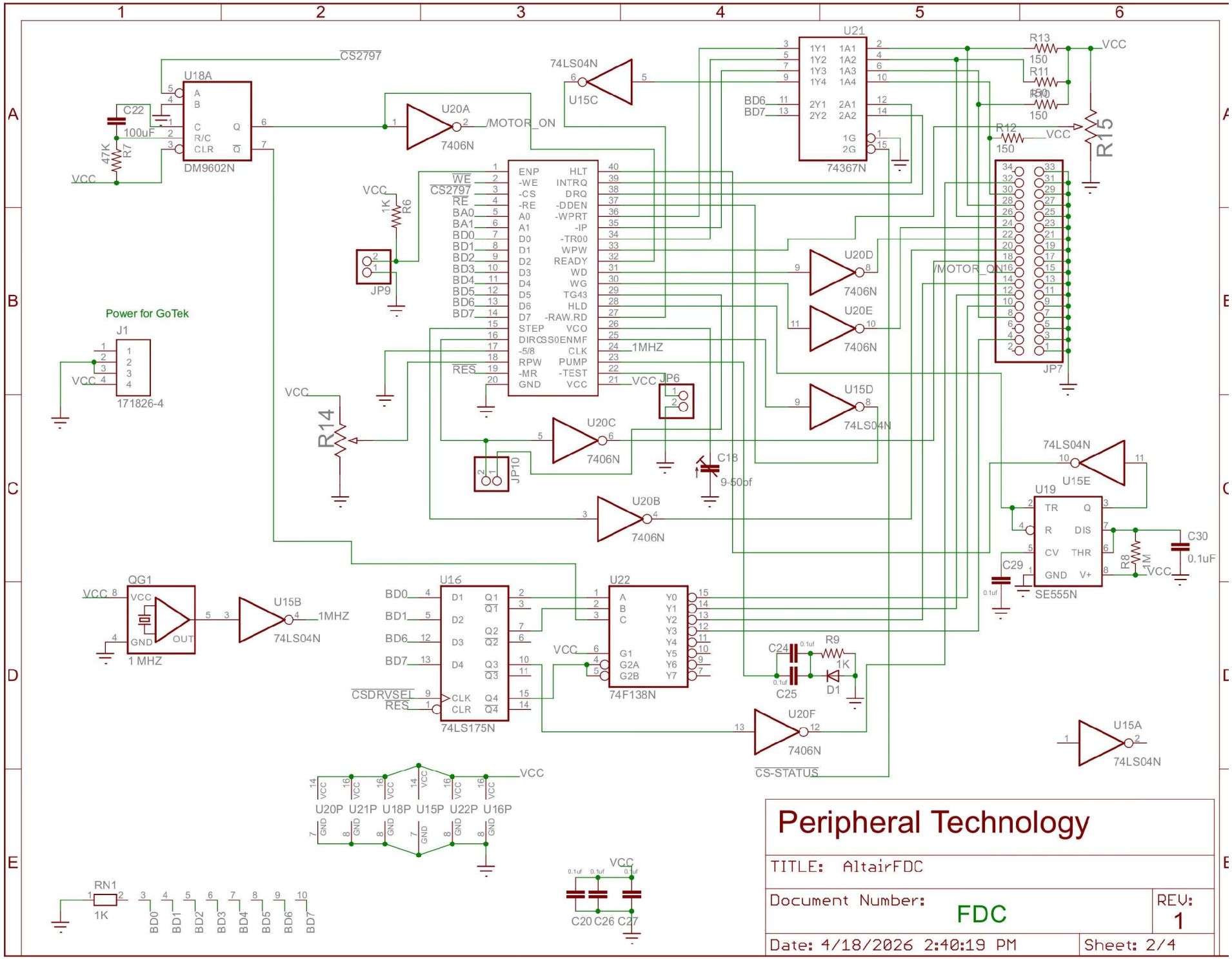
Power for GoTek
J1
171826-4
U18A
DM9602N
C22
100uF
47K
R7
CS2797
U20A
7406N
/MOTOR_ON
74LS04N
U15C
U21
74367N
R13
150
R11
150
R12
150
R15
VCC
JP9
1K
R6
WE
CS2797
RE
BA0
BA1
BD0
BD1
BD2
BD3
BD4
BD5
BD6
BD7
ENP
-WE
-CS
-RE
A0
A1
D0
D1
D2
D3
D4
D5
D6
D7
STEP
DIR
-5/8
RPW
-MR
GND
HLT
INTRQ
DRQ
-DDEN
-WPRT
-IP
-TR00
WPW
READY
WD
WG
TG43
HLD
-RAW.RD
VCO
SS0
ENMF
CLK
PUMP
-TEST
VCC
1MHZ
JP6
JP7
U20D
U20E
U15D
U20C
U20B
7406N
74LS04N
JP10
C18
9-50pf
R14
U15E
U19
SE555N
TR
Q
R
DIS
CV
THR
GND
V+
R8
1M
C30
0.1uF
C29
QG1
1 MHZ
U15B
74LS04N
U16
74LS175N
U22
74F138N
CSDRVSEL
RES
C24
C25
R9
1K
D1
U20F
CS-STATUS
U15A
U20P U21P U18P U15P U22P U16P
RN1
1K
C20 C26 C27
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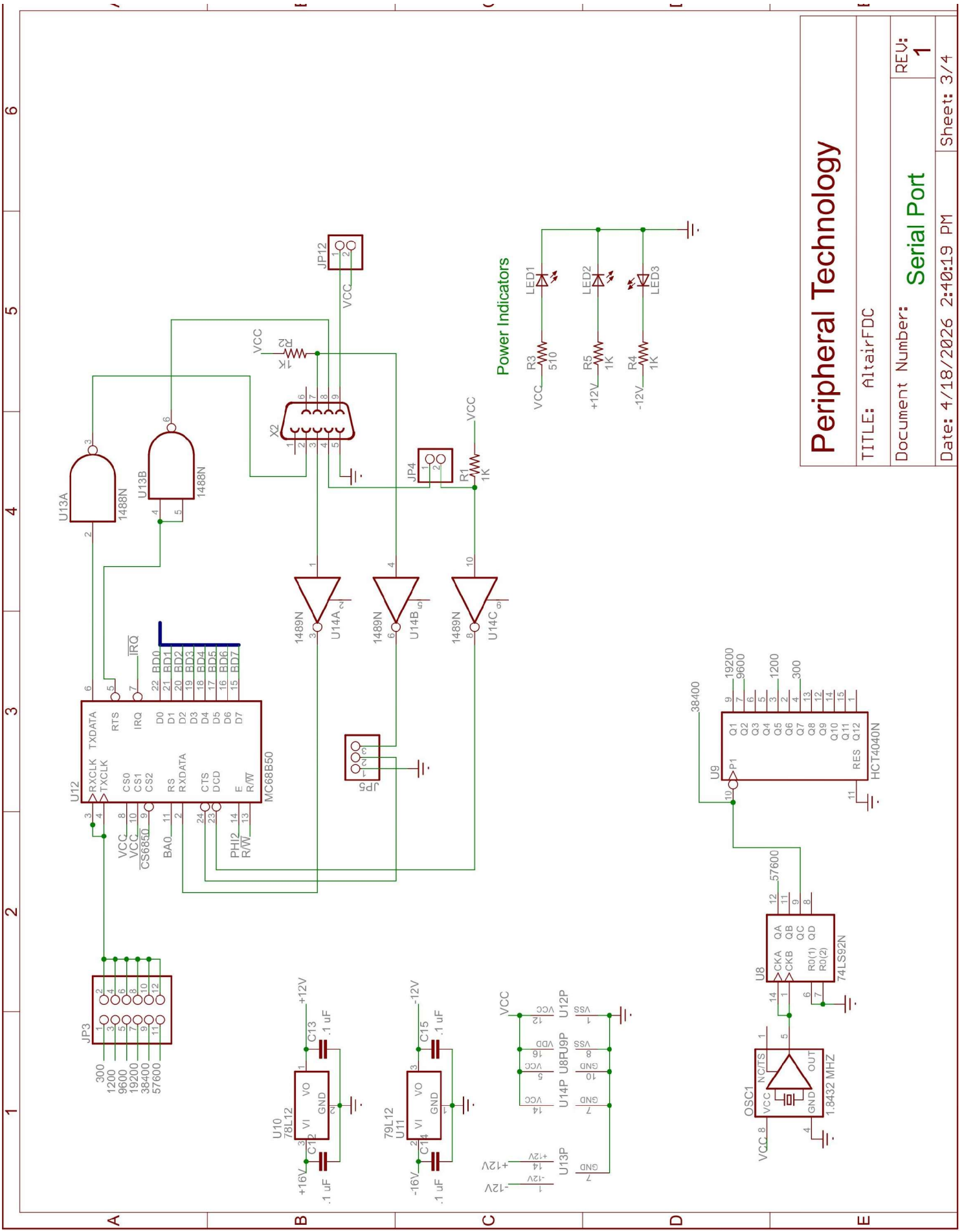
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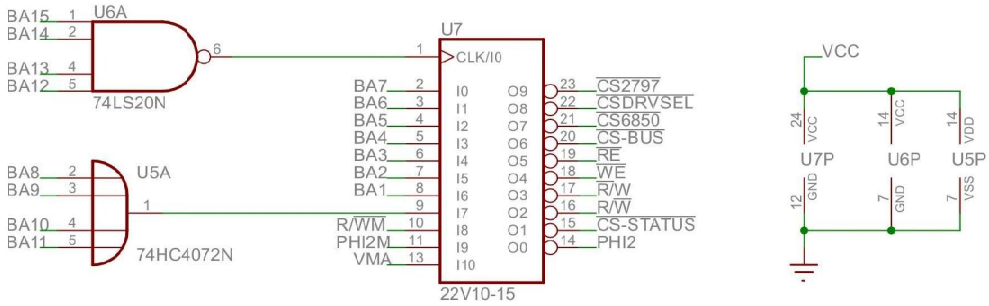
Power Indicators
LED1
LED2
LED3
R3 510
R5 1K
R4 1K
R1 1K
R2 1K
U12 MC68B50
CS6850
U13A 1488N
U13B 1488N
U14A 1489N
U14B 1489N
U14C 1489N
U9 HCT4040N
U8 74LS92N
OSC1 1.8432 MHZ
U10 78L12
U11 79L12
U14P U8RU9P U12P
U13P
C13 .1 uF
C15 .1 uF
C1 .1 uF
C14 .1 uF
JP3
JP4
JP5
JP12
X2
38400
19200
9600
1200
300
57600
+12V
-12V
+16V
-16V
VCC

Address Decoding



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APPENDIX

Assembly Notes:

When sourcing parts do not use a 7805 for a voltage regulator. The Altair provides an extremely high voltage of nearly 10 volts. This can potentially overheat and reduce the life of the regulator. You should use a DC-DC convertor. A part number for one example is given in the parts list. The DC-DC regulator typically runs 10-20 degrees F above ambient temperature. A 7805 can run near 100C. A one AMP regulator is sufficient. The part number listed in the parts list can be obtained from Digikey.

PAL .JED files can be downloaded for U7. It is recommended to use an ATMEL brand GAL of the speed listed in the parts list. Other brands and speeds have not been tested and may not work properly. Don't potentially waste many hours troubleshooting a board because you substituted a different brand of GAL or a different speed. The Atmel part is typically in stock at Mouser or Digikey,

Serial DB9F Pinouts

The DB9F connector works with common USB to DB9M cables. There are many brands of these cables, and they are sold by many online sellers. One brand is OIKWAN AQ-17. OIKWAN is sold by AMAZON US.

Pin		
2	TxD	Transmit Data from 6850
3	RXD	Received Data to 6850
4	DCD	Input to 6850 – Enabled by JP4
5	GND	
7	CTS	Input 6850 – Controlled by JP5
8	RTS	Output from 6850
9	+5V	Enabled by JP12

CTS – CTS can be fed from the DB9-Pin 7 or forced on by jumper JP5. Position 1 of JP5 forces CTS on. Position 2 feeds Pin 9 through a 1489 to the CTS input of the 6850.

DCD – To use DCD short JP4. If JP4 is not shorted DCD is always forced on to the 6850.

PAL EQUATIONS

PAL equations are provided should you wish to modify the PAL code. If you want to replace a damaged GAL you can download .jed files to program a GAL. It is not necessary to compile this source.

U7

```
Name     Altair 680 FDC decoding ;
PartNo   U7 ;
Date     02/19/26 ;
Revision 0 ;
Designer Frederic Brown ;
Company  Peripheral Technology ;
Assembly None ;
Location None ;
Device   p22v10 ;

/* *************** INPUT PINS *********************/

PIN 1   =  F0SEL                  ; /*  Address Fxxx decode           */
PIN 2   =  BA7                    ; /*                                */
PIN 3   =  BA6                    ; /*                                */
PIN 4   =  BA5                    ; /*                                */
PIN 5   =  BA4                    ; /*                                */
PIN 6   =  BA3                    ; /*                                */
PIN 7   =  BA2                    ; /*                                */
PIN 8   =  BA1                    ; /*                                */
PIN 9   =  F1SEL                  ; /*  Address x0xx decode           */
PIN 10  =  RWM                    ; /*  R/!WM Schematic               */
PIN 11  =  PHI2M                  ; /*                                */
PIN 13  =  VMA                    ; /*                                */

/* *************** OUTPUT PINS *********************/

PIN 14  =  PHI2             ; /* PHI2M Buffered                     */
PIN 15  =  CSSTATUS         ; /* !CS-STATUS DRQ/IRQ Register        */
PIN 16  =  RW               ; /* Buffered R/W                       */
PIN 17  =  NRW              ; /*                                    */
PIN 18  =  WE               ; /*  WE to 2797                        */
PIN 19  =  RE               ; /*  RE to 2797                        */
PIN 20  =  CSBUS            ; /*  CS Data Bus driver                */
PIN 21  =  CS6850           ; /*  CS 6850                           */
PIN 22  =  CSDRVSEL         ; /*  CS Drive select Register          */
PIN 23  =  CS2797           ; /*  CS2797                            */


/** Logic Equations **/

!RE = RWM & PHI2M ; /* RE for 2797 */

!WE = !RWM & PHI2M ;  /* WE for 2797 */

RW = RWM ; /* buffer R/W from S100 Connector */

!NRW = RWM ;

PHI2 = PHI2M ; /* Buffered PHI2 from S100 Connector */

!CSSTATUS = !F0SEL & F1SEL & BA7 & !BA6 & BA5 & BA4 & !BA3 & !BA2 & VMA & PHI2M & RWM ; /* Status Register F0B0 - F0B3  */

!CSBUS  =    !F0SEL & F1SEL & BA7 & !BA6 & BA5 & BA4 & VMA & PHI2M;  /* Enable Data Buffer for F0Bx */

!CS6850 = !F0SEL & F1SEL & BA7 & !BA6 & BA5 & BA4 & BA3 & !BA2 & !BA1 & VMA ; /* 6850 Address F0B8 - F0B9  */

!CSDRVSEL = !F0SEL & F1SEL & BA7 & !BA6 & BA5 & BA4 & !BA3 & !BA2 & VMA & PHI2M & !RWM ; /* Drive Select Register F0B0 - F0B3 */

!CS2797 = !F0SEL & F1SEL & BA7 & !BA6 & BA5 & BA4 & !BA3 & BA2 & VMA & PHI2M ; /* 2797 Address F0B4 - F0B7  *
```

This boot program is needed to boot FLEX from an Altair 680 without the MIO board. It may be entered using the Altair monitor AMON. Use the command “J 0100” to execute the program after it is entered. If possible, you should reassemble the program and place it in a 1702.

```
0001                                    NAM BOOTFDC
0002
0003 f0b0                       DRVREG  EQU     $F0B0   DRIVE REGISTER
0004 f0b4                       COMREG  EQU     $F0B4   COMMAND REG 2797
0005 f0b5                       TRKREG  EQU     $F0B5   TRACK REG 2797
0006 f0b6                       SECREG  EQU     $F0B6   SECTOR REG 2797
0007 f0b7                       DATREG  EQU     $F0B7   DATA REG 2797
0008
0009 0100                               ORG $100
0010 0100                       BOOT    EQU *
0011 0100 c6 00                         LDAB #0         Sector to Boot From
0012 0102 b6 f0 b4                      LDAA    COMREG  TURN ON MOTOR
0013 0105 4f                            CLRA            SELECT DRIVE 0
0014 0106 b7 f0 b0                      STAA DRVREG     WRITE TO DRIVE SELECT REGISTER
0015 0109 b6 f0 b4                      LDAA COMREG     READ COMREG TO ALLOW MOTOR TO START
0016 010c ce ff ff                      LDX   #$FFFF    WAIT FOR MOTOR TO START
0017 010f 01                    GOWAIT  NOP             "
0018 0110 01                            NOP             "
0019 0111 09                            DEX             "
0020 0112 26 fb                         BNE GOWAIT      "
0021 0114 86 0b                         LDAA #$0B       ISSUE RESTORE COMMAND
0022 0116 b7 f0 b4                      STAA COMREG     "
0023 0119 8d 26                         BSR GDELAY      WAIT BEFORE READING STATUS REGISTER
0024 011b b6 f0 b4              GWAIT1  LDAA COMREG     WAIT FOR RESTORE TO COMPLETE
0025 011e 84 01                         ANDA #1         "
0026 0120 26 f9                         BNE GWAIT1      "
0027 0122 f7 f0 b6                      STAB SECREG     SET SECTOR TO BOOT FROM
0028 0125 86 9c                         LDAA #$9C       READ SECTOR COMMAND
0029 0127 b7 f0 b4                      STAA COMREG     EXECUTE READ COMMAND
0030 012a 8d 15                         BSR GDELAY      WAIT BEFORE READING STATUS REGISTER
0031 012c ce 24 00                      LDX #$2400      LOAD ADDRESS
0032 012f b6 f0 b0              GREAD   LDAA DRVREG     READ FAST STATUS REGISTER
0033 0132 2b 05                         BMI GREAD1      TEST FOR DRQ?
0034 0134 27 f9                         BEQ GREAD       TEST FOR DISK BUSY
0035
0036 0136 7e 24 00              GJUMP   JMP $2400       EXECUTE LOADED PROGRAM
0037
0038 0139 b6 f0 b7              GREAD1  LDAA DATREG     GET DATA
0039 013c a7 00                         STAA 0,X        STORE IT
0040 013e 08                            INX             BUMP LOAD POINTER TO NEXT LOCATION
0041 013f 20 ee                         BRA GREAD       GET NEXT BYTE
0042
0043                            * Delay routine is suitable for 2MHZ processor speed
0044                            * Don't change this since an upgraded main board supports 2MHZ.
0045
0046 0141 8d 00                 GDELAY  BSR GDLY1       DELAY ROUTINE
0047 0143 8d 00                 GDLY1   BSR GDLY2
0048 0145 8d 00                 GDLY2   BSR GDLY3
0049 0147 8d 00                 GDLY3   BSR GDLY4
0050 0149 39                    GDLY4   RTS
0051
0052                                    END
```