

## **NAS-GEM-80 FDC CARD**

### **Instruction Manual & Functional Description**



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## 1 Introduction

This card has been designed to be a form, fit and function replacement for the Nascom Floppy Disk Controller, which is proving to be a very difficult item to source for the Nascom / Gemini retro community.

The card has been tested against original Teac FD-50E/F drives without observed issues under NAS-DOS 1.4

Further testing with CP/M and PolyDos is planned

**Note:** The card is designed to handle 5.25-inch drives. Support for 8-inch drives has been removed  
*(Did anyone ever use this?)*

## 2 Components

Reference	Quantity	Value
<b>Capacitors</b>		
C1 (Tantalum)	1	1uF
C2	1	33pF
C3	1	150pF
C4 (Polyester Film)	1	4n7
C5	1	1nF
C6 (Tantalum)	1	100uF
C7 (Tantalum)	1	22uF
C8, C9, C101 - C106 (Tantalum)	8	10uF
DC1 - DC24 – Decoupling caps	25	10nF
<b>Resistors</b>	<b>Quantity</b>	<b>Value</b>
R1	1	100K
R2	1	5K6
R3	1	4K7
R4	1	10K
R5	1	22K
R6	1	1M
R7	1	1M
R8	1	15K
R9	1	1K
R10	1	4K7
R11	1	150
R12	1	150
R13	1	150
R14	1	150
R15	1	150
R16	1	10K
R17	1	10K
R18	1	10K
R19	1	10K
R20	1	10K
R21	1	10k
R22	1	10K
R23	1	10K
R24	1	10K
R25	1	10K
R26	1	4K7

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R27	1	4K7
R28	1	220K
R29	1	150K
R30	1	1K0
R31	1	470
<b>IC's</b>	<b>Quantity</b>	<b>Value</b>
U1 – DIP 20	1	74LS245
U2 – DIP 16	1	74LS138
U3 – DIP 14	1	74LS10
U4 – DIP 14	1	74LS04
U5 – DIP 16	1	74LS365
U6 – DIP 16	1	74LS163
U7 – DIP 16	1	74LS257
U8 – DIP 16	1	74LS257
U9 – DIP 14	1	74LS32
U10 – DIP 14	1	74LS32
U11 – DIP 14	1	74LS02
U12 – DIP 16	1	74LS195
U13 – DIP 20	1	74LS273
U14 – DIP 40	1	WD1793
U15 – DIP 14 (Static sensitive)	1	4013B
U16 – DIP 14	1	7407
U17 – DIP 14	1	74LS04
U18 – DIP 16	1	74LS123
U19 – DIP 14	1	7438
U20 – DIP 16 (Static sensitive)	1	4046B
U21 – DIP 14 (Static sensitive)	1	4016
U22 – DIP 14	1	74LS14
U23 – DIP 14	1	7406
U24 – DIP 16	1	74LS123
<b>Other Items</b>	<b>Quantity</b>	<b>Value</b>
D1 – LED	1	LED 3mm
LK1, LK3, LK4 (optional)	3	Switch SPST Slide, 6.7x4.1mm, W7.62mm, P2.54mm
LK2	1	Switch DPDT, 3 pins, P2.54mm
RV1	1	50K, Cermet type potentiometer
SW1	1	Switch or header, x8, W7.62mm_Socket
LKB2	1	Switch SW_DIP_x10, W7.62mm_Socket
PL1	1	Connector, Header 2x17, P2.54mm

## 3 Construction

### 3.1 Before you start construction

Inspect the PCB for any visible signs of damage

Plug the board into an 80-BUS and power it up.

- Verify no latent shorts exist
- Verify correct voltages on power rails

Select your components:

- Turned pin sockets are recommended due to robustness and reliability
- Tantalum capacitors can be temperamental. Make sure they are inserted with the correct polarity, are of good quality and are overrated voltage wise.

U15, U20 & U21 are static sensitive. Handling precautions need to be observed.

### 3.2 Order of construction

The recommended order of construction is:

- Resistors
- Sockets
- Decoupling capacitors
- Tantalum capacitors
- Switches
- LED
- Wire header
- Insert IC's

## 4 Functionality

### 4.1 Links

The board contains 4 links, which can be implemented as switches or hard wired with links depending on the user's preference.

Link (Default)	Usage
LK1 Open	Ready
LK2 A -> C	Side Select. Set A -> C for 1793 Side Select
LK3 Open	Spare – Port x4 Bit 5
LK4 Open	Spare – Port x4 Bit 7

### 4.2 SW1 – Base Port Select

This allows the board to be mapped to ports 0x20, 0x40, 0x60, 0x80, 0xA0, 0xC0, 0xE0. The default is 0xE0. User options are to either hard wire a link, use a link block or use an 8-way DIL switch.

Connect Pins	Port Base Address
1 to 16	N/A
2 to 15	0x20
3 to 14	0x40
4 to 13	0x60
5 to 12	0x80
6 to 11	0xA0
7 to 10	0xC0
8 to 9 (Default)	0xE0

### 4.3 LKB2 – Configuration Switch

This is implemented as a 10-way DIL switch. The switch settings are as follows:

Switch	Usage	2MHz Default	4MHz Default
SW1	Set write pre-compensation	Off	Off
SW2	Set write pre-compensation	Off	On
SW3	Set write pre-compensation	Off	Off
SW4	Clock divide by 2 (For 2MHz systems)	On	Off
SW5	Clock divide by 4 (For 4MHz systems)	Off	On
SW6	Clock divide by 4 (For 2MHz systems), VCO=500KHz	On	Off
SW7	Clock divide by 8 (For 4MHz systems), VCO=500KHz	Off	On
SW8	Select single /. double density	On	On
SW9	Disable / enable track 43 pre-compensation	On	On
SW0	Disable write pre-compensation	On	Off

#### Notes on write pre-compensation:

For 2MHz systems, SW1 is set to on, giving 500ns pre-compensation

For 4MHz systems, SW2 is set to one giving 250ns pre-compensation **OR** SW3 is set to on giving 500ns pre-compensation

Only one of SW1, SW2 or SW3 should be selected at any time. If all are deselected then SW0 must be selected (disables write pre-compensation)

### 4.4 Ports

The board uses six ports, selected from the base port (Default 0xE0). These are:

Port	Read	Write
0xE0	1793 Status register	1793 Command register
0xE1	1793 Track register	1793 Track register
0xE2	1793 Sector register	1793 Sector Register
0xE3	1793 Data register	1793 Data register
0xE4	Drive selection	Drive select control
0xE5	INTRQ / DRQ status	N/A



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### 4.4.1 For port 0xE4

Bit	Read	Write
0	Drive select 0	Drive select 0
1	Drive select 1	Drive select 1
2	Drive select 2	Drive select 2
3	Drive select 3	Drive select 3
4	Side select	Side select (When LK2 A->C)
5	LK3	Motor 0=off, 1=on
6	Density (0=low, 1 = high)	Density (0=low, 1 = high)
7	LK4	N/A

### 4.4.2 For port 0xE5

Bit	Read	Write
0	1793 INTRQ	N/A
1	0=Ready, 1=Not Ready	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
6	N/A	N/A
7	1793 DRQ	N/A

## 5 Configuration

Once the board has been built and configured via links options and switches, the VCO center frequency needs to be set. This can be done in two ways:

### 5.1 Without A Scope

The following steps are required to perform the configuration:

1. Ensure the board is disconnected from any drives (Disconnect PL1)
2. Turn the potentiometer at VR1 anti-clockwise until the LED illuminates
3. Turn the potentiometer at VR1 a quarter turn clockwise

### 5.2 With A Scope

The following steps are required to perform the configuration:

1. Ensure the board is disconnected from any drives (Disconnect PL1)
2. Observe the signal at U20 Pin 3
3. Turn the potentiometer until a 500KHz square wave is observed

## 6 Notes on Components

All the components used have been selected at time of design to be readily available via eBay and other sources.

### 6.1 LKB2 Configuration Switch

It is recommended to fit a 20-pin socket and use a 10-way DIL switch

### 6.2 SW1 Decode Header

The socket at SW1 is recommended to be of the turned pin variety so as to allow easier insertion of the header. The default header is a 16-way DIL header.

An alternative is to use Single-In-Line (SIL) Turned Pin Socket 0.1 Inch Pitch strips which are readily available instead of a header. These are then snipped down to the required number of pins before being inserted into the socket and the desired wire links being made. An 8-way DIL switch may also be used if one is available.

A second alternative is to insert and solder a wire link between the required PCB pads if the ability to change the base address is not required.

### 6.3 C4

This capacitor is of the film type in the original design. I have used an *Axial Polypropylene Film Capacitor* here without issue. Other types (e.g. ceramic) may work but that configuration is untested.

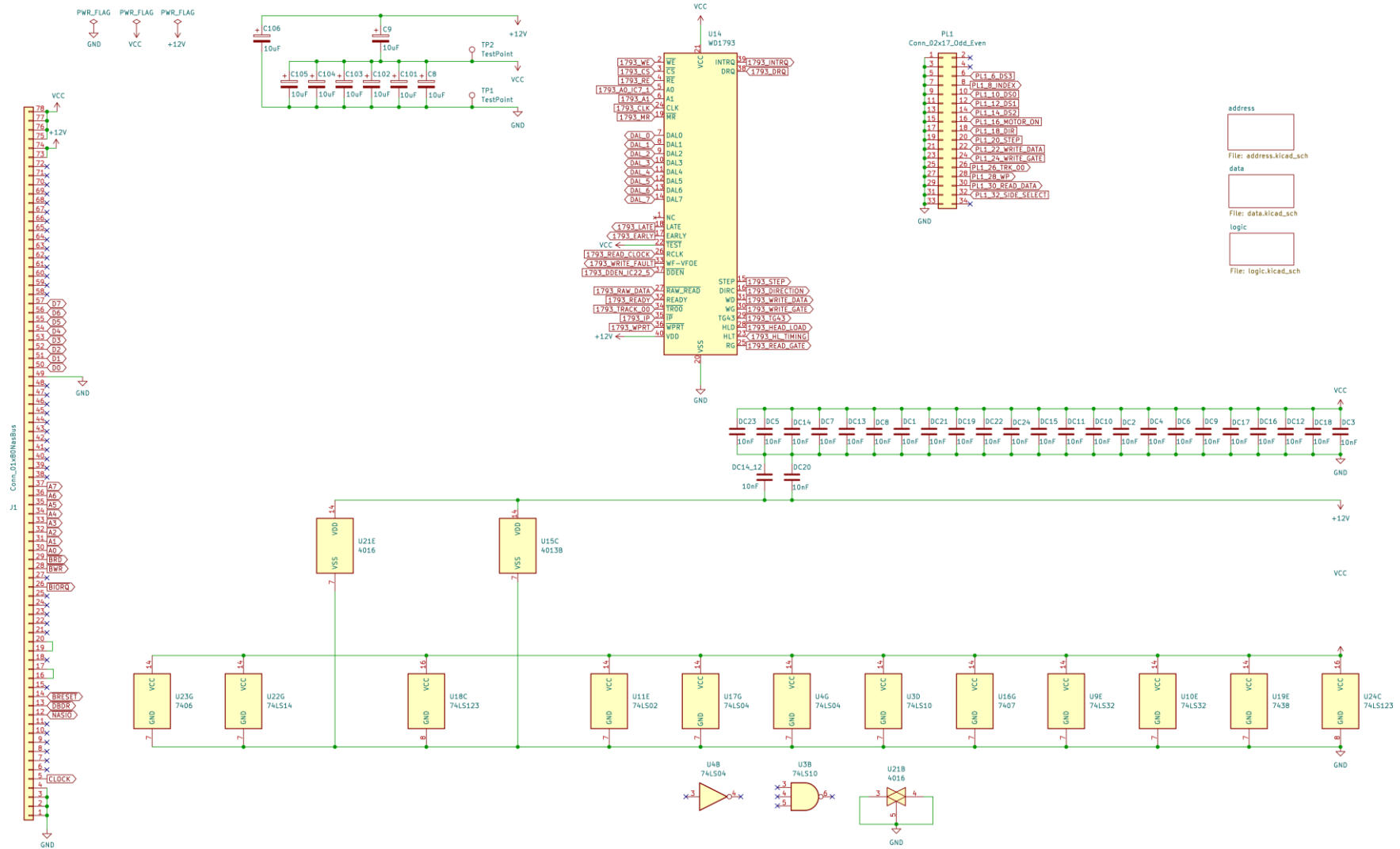
### 6.4 IC's U15, U20, U21

These parts are static sensitive. Handling precautions need to be observed.

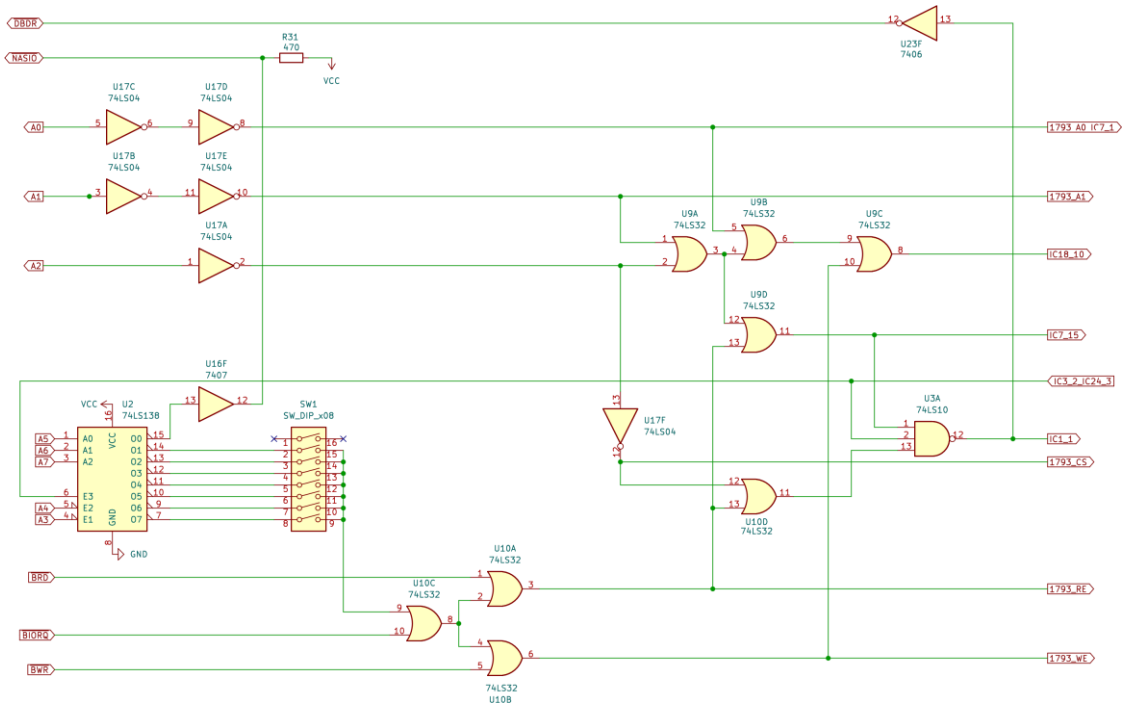
### 6.5 1793 FDC Controller

A 1797 controller, in theory, may be substituted, but this configuration is untested. To use the 1797 Side-Select feature, set LK3 to B -> C

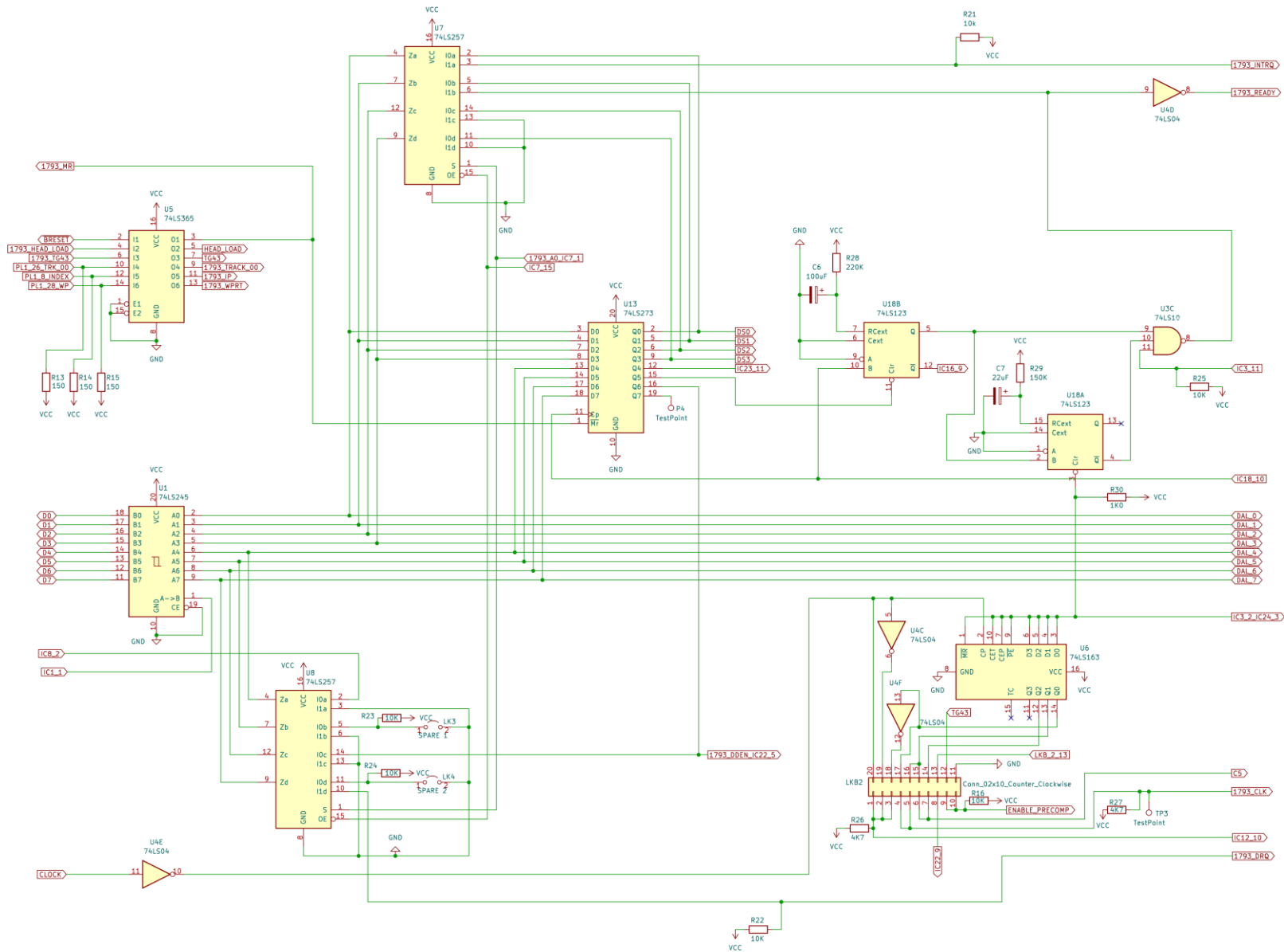
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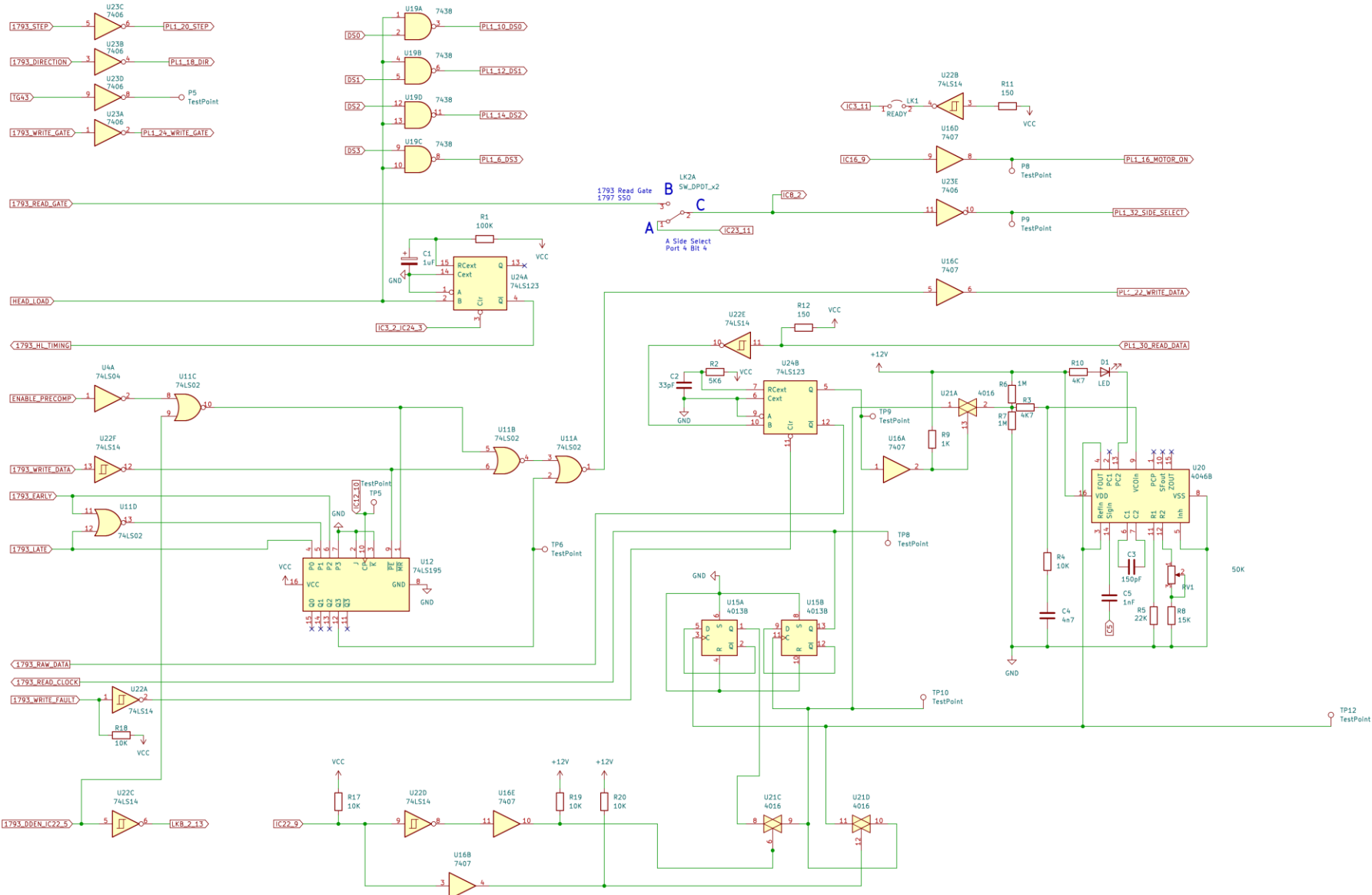
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## 7 Errata

Initial release boards (1.2.0) have an incorrect ground line for C1.

The capacitor at location C1 should be:

1. Mounted on the back of the board
2. The positive leg should go through the existing positive through plated hole for the component
3. The negative leg should go to pin 14 of U24

This modification fixes an issue with the unstable operation of the Head Load monostable





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