

## NOTES for Herb Johnson

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## **NVRAM for SBC-200 Operation**

### *MOST IMPORTANT*

You must be sure the NVRAM write gate, on pin 21, NEVER has a low signal applied, unless you are reprogramming it. It can be wiped out by runaway code in an instant.

### Protecting The NVRAM

The NVRAM will fit into any 24 pin socket wired for a standard EPROM.

The NVRAM can be inserted into the ROM0 socket (U36). Refer to the SD Systems SBC-200 manual, sheet 3 of 3 in the diagram section, for the remainder of this discussion. Note that the NVRAM should be the only device in a ROM socket under normal operational conditions. In addition, it has been programmed in only the first 1K of address space, even though it is a 2K device.

On the diagram, notice that all ROM's have pins 18, 19 & 21 available for additional strapping options. The traces from these pins go to the strapping header noted as "ROM TYPE". We can use this strapping header for a lot of the NVRAM selection and protection settings. Here are the options to consider:

1 - Using an ohm meter, check that the ROM TYPE header has the following trace connections intact (someone may have made trace changes at some time)

- pin 2 is connected to the +5V power trace
- pin 10 is connected to the GND power trace

2 - Now check that these traces are jumped as follows-

- pin 2 is shorted to pin 7, and from there, pin 7 meets pin 21 of U36
- pin 10 is shorted to pin 5, and from there, pin 5 meets pin 18 of U36

3 - On U36, pin 19, or A10, is used to select the second 1K within the NVRAM. Since this is not to be used, you can just check that U36 pin 19 goes to the ROM TYPE header at pin 3, and that pin 3 is shorted to pin 4. If at power-on the ROM seems not to be working, remove the jumper from pin 3 & pin 4, and jumper pin 3 to pin 5 or pin 10. This will select only the first 1K, where the monitor code resides.

What all this has accomplished

With U36 pin 21 at +5V it will be impossible to alter the contents of the NVRAM, since pin 21 is the write gate, and it must be brought low to enable writing. With U36 pin 18 set low, the NVRAM is enabled, and an address decode on pin 20 will allow reading of the monitor code.

### **A More Conservative Strapping**

This requires some soldering

- Disconnect the jumper from pin 7 to pin 2 on the header. On the pin 2 side, or U36-21, solder a 2.2K to 4.7K resistor to +5V.
- Disconnect pin 5 from pin 10 on the header. Solder a wire from U36-20 to U36-18 so that the NVRAM is only enabled when the address decoder is true.

### NOTE

If your present settings have address E000H set for some other ROM socket, feel free to use that one. Just be sure that RAM is available up at FFFFH and several bytes below that, as that is stack for the monitor routines. If your onboard RAM is not used, that is OK also, so long as main memory provides several bytes of RAM up to FFFFH.

### *Address Space Settings for RAM & ROM*

You can ignore a lot of this detail provided that, using the SD Systems SBC-200 manual, you are able to:

- Set the RAM starting at FC00H, or at least ending at FFFFH (with or without address wrap around, as noted further on), or you have main memory in that space.
- Set a ROM socket to start at E000H and place the NVRAM into it.

The default SBC-200 strapping seems to be for 2K devices, which means that U19 & U20 scratch ram will wrap around into a 2K space. THIS IS NOT IMPORTANT, and will not affect the NVRAM monitor operation.

### *Working with the Default SBC-200 Strapping Options*

Using the default strapping shown for the BANK SELECT header on page 3 of the diagrams we get the following:

Scratch RAM (U19 & U20) at F800H to FFFFH with a jumper from pin 15 to pin 16 on ROM SELECT header.

ROM0 (U36) at E000H to E7FFH using a jumper from pin 9 to pin 10 on ROM SELECT header.

THE ABOVE IS OK FOR USING THE SUPPLIED NVRAM.

### *Optional Setting for BANK SELECT Header to Give 1K Address Spaces*

NOTE - This option is not required, and if it causes conflicts with any ROM setting that may be used from time to time, do not bother to do it.

Scratch RAM from FC00H to FFFFH with a jumper from pin 15 to pin 16 on ROM SELECT header.

ROM0 from E000H to E3FFH with a jumper from pin 1 to pin 2 on ROM SELECT header.

The following options should set U11 to provide 8 decoded outputs, each occupying a 1K space.

#### *BANK SELECT Header*

Pin 1 to pin 2  
Pin 3 to pin 4  
Pin 5 to pin 6

The above sets up the basic 1K decoding. Now set upper page locations as follows.

Pin 7 to pin 8  
Pin 9 to pin 10  
Pin 11 to pin 12

REMOVE CONNECTION BETWEEN PIN 8 & PIN 10

## Monitor Functions

At system power up, the monitor will sign on with:

SBC200 V 2.2 Ready

It will accept the following keyboard commands and respond as indicated-

A boot from floppy drive A: - relocated boot  
B boot from floppy drive B: - relocated boot  
1 boot from floppy drive A:  
2 boot from floppy drive B:

A & B initiate a relocated boot, which means that the bootstrap routine is placed into main memory starting at location 4000H. Control is transferred to 4000H, and the bootstrap turns off the onboard SBC-200 RAM/ROM so that all of memory is available for CP/M use.

1 & 2 boot from within the monitor, so onboard RAM/ROM is not switched out.

In both cases, sector 1 of track 0 is read into main memory, starting at 0000H, and ending at 01FFH. That represents the first 512 byte sector. The bootstrap then transfers control to the system loader at 0000H.

If you use 1 or 2, you must ensure that the system loader turns off onboard RAM/ROM, or use a CP/M that fits within the main memory available when RAM/ROM is present. I have set up your CPMHJXX.COM Sysgen images to turn off RAM/ROM during system load, in any case.

### *Additional Monitor Commands*

D ssss eeee

Dump hex data from start address ssss to end address eeee in hex with ASCII decodes to right.

E mmmmm

Examine a memory location in hex at mmmmm. By hitting the space bar the monitor will increment to the next location. Press ESCape to stop.

I pp

Input from hex port pp and show the data input in hex.

O pp dd

Output to the specified port pp the hex data dd

P

Program, that is, allow hex code programming from the location specified in the Examine mode. You enter 2 hex nibbles, then the monitor will increment to the next location and wait for the next code to be entered. To terminate programming press the ESCape key.

R

Run a program from the current location specified in the examine code.

The next few pages are a reprint from the main document regarding the use of 3.5" and 5.25" HD drives and cable options.

## **The Strange World of 3.5" Media**

"Prepare your minds for a new scale of physical scientific values, gentlemen"  
Dr. Morbius to Commander J.J. Adams and Lt. Ostraw in the movie "Forbidden Planet"

All the following works with 1.44 Mbyte floppy drives only. Because these drives are so versatile, it is not necessary to use 720K drives.

### *720K Floppy Diskette Tricks*

Is it 720K or 1.44 Mbytes?

You can make it format for both, just be ready to punch a hole.

The 720K media pretty well emulates the media used on old mini-floppies. You can use 720K media in a 1.44 Mbyte drive, and select 5" diskette sizes from V2FORMAT and get useable mini-floppy type disks in that 3.5" drive. But, 720K media likely will be of interest only to try out mini-floppy formats, should you wish to see how they work (slow!), or if you want to modify the V2FORMAT program for newer versions of the mini-floppy formats to meet the needs of some mini-floppy drives not supported with the default selections. In this way you can change V2FORMAT, format, test and verify, before committing to the actual mini-floppy drive.

If you now try an 8" diskette format on the 720K media it will always FAIL on the read-verify routine during format. It will also be unreadable under CP/M.

Now carefully drill a hole in the 720K diskette casing, where the second hole is found on a 1.44 Mbyte diskette. Reformat using a 8" option and you will have a working diskette. Try to format it with a 5" option and it will FAIL. Cover the second hole on the bottom side of the diskette case, so the micro-switch in the floppy drive cannot move up into the hole. It will now pass 5" formats and fail 8" formats.

### *1.44 Mbyte Diskette Tricks*

The 1.44 Mbyte diskettes work with all the 8" options. Formatting with a 5" option results in a verify failure. Cover the second hole, as above, it will pass on 5" format options, and fail on 8" format options. Remove the temporary cover and you can pass on 8" format options again.

## **Conclusions**

Examination of the specification sheets for a number of 3.5" micro-floppy drives shows that since the introduction of the 1.44 Mbyte diskette drive, most are of the "Three-Mode" class. In the 720K and 1.44 Mbyte mode they rotate at 300 RPM. There is a 1.6 Mbyte mode, with 360 RPM spindle speed as well, but I have no use for this, since even at 300 RPM they perform flawlessly as 8" emulators, and give a good amount of additional formatted storage to boot.

Suffice to note, electronics within the 1.44 Mbyte disk drive determine, from the presence or absence of the media flagging hole, what writing bias to use for formatting a diskette. Likely an embedded DSP circuit takes care of the reading and writing, and the data is conditioned and filtered according to the presence or absence of the media-type hole.

## Diskette Drives Supported by V2BIOS and V2FORMAT

The V2BIOS for CP/M-80 and the V2FORMAT disk format software both support the following Drives and Media:

3.5" DD PC floppy (720K)  
3.5" HD PC floppy (1.44 Mbytes)  
5.25" mini-floppy (many formats and capacities)  
5.25" HD PC floppy ( 1.2 Mbyte, and 360K capable)  
8" Single and Double Sided, Single and Double Density

Please note that support of a drive and media does not entail support of the MSDOS file system in the case of PC type drives. Throughout this document the terms 'mini-floppy' and '5"' drive, (or disk) refers to the older 5.25" floppy drives that made an appearance, starting around 1975, to about 1984. Exceptions would be 5.25" drives like the Mitsubishi M4854 which was a 5.25" emulation of the earlier 8" drives. Mini-floppy drives typically used recording frequencies of 125 kHz MF and 250 kHz MFM. Formatted capacities could be as low as 70 kilobytes, and up to 800 kilobytes. They came in packages that were designated as 'full height' (3-5/16"), "half-height" and some "one-third height". They had a spindle rotation of 300 RPM and track-to-track seek times as slow as 20 milliseconds. You may come across this type of drive from time to time, and you may wish to read some of the diskettes supported by these drives. V2BIOS can read a number of them, and you can set it up to read many more. V2FORMAT covers a lot of the formats used on those early drives, so you can produce 'new' diskettes and duplicate old formats you discover.

The introduction of the 5.25" HD drive for the IBM AT in 1984 marked the end of the older mini-floppy concept. The HD drives act like 8" drives. They use recording frequencies of 250 kHz FM and 500 kHz MFM, and rotate at 360 RPM just like 8" drives. You get up to 1.2 Mbytes formatted capacity, like a double-sided 8" drive. They can read and write the old 360K IBM PC 'standard' mini-floppy diskettes as well.

The introduction of the 3.5" 720K drive was a regression. With a 300 RPM spindle speed and data frequencies of 125 kHz MF and 250 kHz MFM, it was a mini-floppy made small. The nice feature was that the media came in a hard case you could fit in a shirt pocket.

Finally, the 3.5" HD drive was introduced, and it seems to have marked the end of the popular floppy disk concept. Most 3.5" HD drives are actually "three-mode" drives. They handle 720K media at the same RPM and recording frequencies, and they got back to 8" drive data frequencies of 250 kHz FM and 500 kHz MFM, giving 1.44 Mbytes capacity at 300 RPM. They can actually run at 360 RPM, giving 1.2 Mbytes capacity, but that seems to be little used. While a 2.88 Mbyte 3.5" drive was later introduced, it is seldom seen in mass marketed systems.

As far as V2BIOS and V2FORMAT are concerned, the drives are classified as follows:

Designation	Drive Types	R/W Frequency
mini-floppy	old mini-floppies	125 kHz FM 250 kHz MFM
mini-floppy	3.5" 720K drive	125 kHz FM 250 kHz MFM
HD Drive	HD 3.5" & 5.25"	250 kHz FM 500 kHz MFM
HD Drive	8"	250 kHz FM 500 kHz MFM

Thus, 5.25" HD and 3.5" HD drives (with HD media) are treated as 8" drives. As far as the Versafloppy II controller is concerned, both these drives, without any alterations, are 8" drives. Even though the 3.5" drive rotates at 300 RPM, by default, the WD179X controller chip on the Versafloppy II is unaware of this fact. Note that a 3.5" HD drive with 720K media, is seen as a mini-floppy by V2BIOS and V2FORMAT & the WD179X.

## Floppy Drive and Media Notes

Be sure to read a following section "The Strange World of 3.5" Media"

### *8" Drives*

Connect to J1. Strap each drive on the drive PCB for a unique address. Look for the DS, or Drive Select header area, and place a jumper for the necessary drive position. You will usually see DS1 to DS4, or DS0 to DS3, allowing for up to four drives. Some drives also support a Binary Select option. In that case four jumper pairs are used to select drive 0 to 15. V2BIOS is written for the original DS selection. If, when you boot up, or read the drive, you get hung up or have excessive read or write errors, check your Floppy Disk Drive User Guide and be sure that options have been set such that the heads load and contact the media whenever a read, write or seek command is executed. Remember to use a terminator as needed, on the last drive. For maximum storage capacity you will need double density, double sided media. The so-called single density diskettes seem to work fine at double density. In any case you can even convert them to double sided. With a single-hole paper punch, make holes in the dust jacket, front and rear, where the double-density index holes are located. Then use an opaque sticker to cover over the original index hole for the single-sided media. Note that some single-sided 8" media was not 'finished' on the second side, so that a format would not 'take'.

### *5-1/4" Drives, Old Style Mini-Floppy*

This includes 180K or 360K drives from old IBM PC's and clones. Connect to J2. Now just use the same notes for the 8" drives in the above paragraph. You might notice that only three drive select jumper options are available. In any case, J2 only supports three drives. This is a common feature of 5-1/4" drive connectors. You can format diskettes in these drives at single or double density, but use the 5" drive option in the V2FORMAT program to do so.

### *3.5" and 5.25" IBM PC and Clone High Density (HD) Drives.*

This covers so called 1.44 Mbytes and 1.2 Mbytes drives.

### *HD Drive Rules In Brief - So you can skip reading the detailed notes*

#### *3.5" & 5.25" HD drives as 8" Emulators*

Media to Use - High Density for both 8" SD and DD formats  
Special Mods - None (unless using PC cables, see next section)  
Reliability - Excellent

#### *3.5" and 5.25" HD drives as mini-floppy emulators*

Media to Use - 720K or 360K for both mini-floppy SD and DD formats  
Special Mods - None (unless using PC cables, see next section)  
Reliability - Excellent  
Compatibility - can't place 5.25" media, as formatted, into "real" mini-floppy drives

The 1.44 Mbytes drives are still available, and I use them pretty much exclusively, unless I have to read an actual 8" diskette. I will cover a bit more detail here, since I moved to these drives long ago, have had no problems with them, and in fact, with the 3.5" drives, I have noted the most reliable operation. I also like the plastic case of the 3.5" diskettes and the small amount of storage space they consume when not in use.



### *3.5" and 5.25" HD Drives as 8" Emulators*

Special Considerations for 8" Emulation - None except use of HD media  
Modifications Needed to FDC Card - None - see option note on using PC cables  
Reliability - Excellent, and better than 8" drives

For both drives, insert the correct HD media. HD 3.5" media has two square holes at the handling end. Be sure the write-protect tab is moved to cover it's hole so that you can format or write to it. Run V2FORMAT and set the drive size as 8". You can now select any other option and you will get perfect results. If you format the 3.5" drive, containing HD media, as Single Sided, Single Density, 128 byte sectors, and to "S" or Standard format, you will produce a diskette which is 3740 compatible with the original DRI software distribution standard.

#### ***3.5" Drive - Bonus Storage Option.***

If you format a 3.5" drive with HD media and select 1024 byte sectors, you can specify from 9 to 11 sectors per track. In that order you will get 1.3, 1.55 and 1.66 Mbytes formatted capacity with these sector options. Because the 3.5" drive rotates at 300 RPM, and not the 360 RPM of the 5.25" and 8" drive, there is space (in time) for one or two extra sectors beyond the nine maximum for 5.25" or 8" drives.

### *3.5" and 5.25" HD Drives as mini-floppy Emulators*

Both the 3.5" and 5.25" HD drives can be used to format diskettes to old mini-floppy SD and DD standards. You may want to do this to experience the restrictions of formats that provided space as small as 70K per diskette! Note that V2FORMAT does not at present double-step on mini-floppy formats, to produce track spacing needed to be insatiable into a real mini-floppy. It assumes you have connected an actual mini-floppy drive. In any case, insert 720K media into a 3.5" HD drive, and 360K media into a 5.25" HD drive. Now run V2FORMAT and select the 5" drive option and select the rest of the options to suit your needs.

Remember to see the following section on cables and connectors for using PC floppy, or other cables on the 3.5" and 5.25" drives.

### **Other Drives**

You can connect older mini-floppy drives to the VF-II. You just have to insert the correct media. In addition, you will have to set the SPDTAB in the BIOS to a value of 83H for the actual drive position (drive 0 to 3) Note that only 3, not 4, drive select lines are available on the mini-floppy connector, J2. This was normal, but there is no reason you could not wire in a fourth line, but the next logical position, pin 16, is used for the head-load signal. You will have to refer to the FDC diagrams and select an unused line.

## Cables and Connectors for 3.5" and 5.25" HD PC Drives

### 5.25" Drives

When you examine the drive PC board you will often notice silk screening for drive selections from 0 to 3 or 1 to 4. For the 0 - 3, drive 1 is always selected. For 1 - 4 it is drive 2. The twist in the PC floppy cable ensures that the drive on the last cable connection is drive 0, and the next one is drive 1. Sometimes the drive selections are just soldered or they can even fixed copper traces, and sometimes they are jumpers. Also, many drives have jumpers only for positions 0 and 1 (or 1 & 2), with the PCB 2 & 3 positions not having headers in place. V2BIOS supports up to four drives. You will have to decide how to cable up the number of drives you want. Here are some options:

#### *Use straight-thru cable (no PC twist)*

You will set each drive jumper for a unique position. If you use more than two drives, be prepared for the possibility of having to solder a jumper wire across pads that do not have a header in place.

Floppy Jumper      CP/M Drive

DS0 or DS1	A	Note that, with V2BIOS you can re-assign
DS1 or DS2	B	logical drives to any physical drive.
DS2 or DS3	C	The CPM48, CPM48B, CPM48C and CPM48D
DS3 or DS4	D	do that.

#### *Use PC cable*

Have each drive set as the second drive, that is DS1 or DS2, depending upon the designation scheme seen on the drive PCB. This is the default setting for PC drives. Now refer to the cable diagram section for information on minor cable modifications needed to allow for operation of an A: and B: drive.

Modify the 5" (J2) connector as follows-

If you just want to keep the cable intact, you can modify a trace on the rear of the VF-II board, for J2. Here I will deal with connector positions, each position consisting of a vertical pair of pins, so you don't have to check actual pin numbers. On the rear, count over 7 positions from pin 1. Cut the trace going from the upper pin, midway between the J2 connector pad and the plate-thru above it. Connect a short jumper from that J2 pad to the upper J2 pad at position 5 (two places to the right of position 7). This gives you CP/M drives A and B on the J2 connector. You have just joined pin 10 to pin 14.

### 3.5" drives

Some older 3.5" drives have user-settable jumpers, but most are hard wired as the second drive, and that hard wiring is not accessible. If you have jumpers, you can set up with a straight-thru cable as with the 5.25" drives. If not just use a PC cable and modify it, or make the J2 cut and jump as above, on pins 10 & 14.

I use PC cables, and put my third and fourth drives on the J1, or 8" drive cable. They must be strapped as drive 3 & 4 if I use a pair of 3.5" drives on J2. If I want an 8" drive as #1, I strap it for DS0 or DS1 (that scheme again) and remove the 3.5" 'A' drive to stop double selecting.

### 3.5" Floppy Drive Signals and Cable Options

*STRAIGHT TRU CABLE FOR DRIVES WITH USEABLE "DS" JUMPERS*

CONTROLLER	DRIVE CONNECTOR(S)
J2	1 TO 4 CONNECTORS
<>	O-----O 1 - 33 GND ALL ODD PINS
>	O-----O 2 REDUCE WRITE
	O-----O 4 NC
>J1-32	O-----O 6 DS3
<	O-----O 8 INDEX
>	O-----O 10 DS0
>	O-----O 12 DS1
>	O-----O 14 DS2
>	O-----O 16 MOTOR
>	O-----O 18 DIRECTION
>	O-----O 20 STEP
>	O-----O 22 WRITE DATA
>	O-----O 24 WRITE GATE
<	O-----O 26 TRACK 0
<	O-----O 28 WRITE PROTECT
<	O-----O 30 READ DATA
>	O-----O 32 SIDE SEL
<	O-----O 34 DISK CHANGE

-= J1-32 NOTE, - ALL CABLES =-

YOU CAN SOLDER A JUMPER FROM J1-32 TO J2-6 TO ENABLE SELECTION  
OF A FOURTH DRIVE ON THE MINI-FLOPPY CONNECTOR

# STANDARD PC TWISTED CABLE

CONTROLLER		DRIVE CONNECTORS			
J2		S.C.		T.C.	
<>	O-----O	1	- 33 GND ALL ODD PINS		
>	O-----O	2	REDUCE WRITE	2	REDUCE WRITE
	O-----O	4	NC -----	4	NC
> NC	O-----O	6	DS3 -----	6	DS3
<	O-----O	8	INDEX -----	8	INDEX
>	O-----O	10	DS0 -----	16	MOTOR
>	O-----O	12	DS1 -----	14	DS2
>	O-----O	14	DS2 -----	12	DS1
>	O-----O	16	MOTOR -----	10	DS0
>	O-----O	18	DIRECTION ---	18	DIRECTION
>	O-----O	20	STEP -----	20	STEP
>	O-----O	22	WRITE DATA --	22	WRITE DATA
>	O-----O	24	WRITE GATE --	24	WRITE GATE
<	O-----O	26	TRACK 0 -----	26	TRACK 0
<	O-----O	28	WRITE PROTECT-	28	WRITE PROTECT
<	O-----O	30	READ DATA ----	30	READ DATA
>	O-----O	32	SIDE SEL -----	32	SIDE SEL
<	O-----O	34	DISK CHANGE --	34	DISK CHANGE

S.C. = STRAIGHT THRU CABLE SECTION

T.C. = TWISTED CABLE SECTION

A look at the schematics for the disk adapter in the IBM publication "AT Technical Manual" shows that pin 10 is actually connected to a second MOT EN 1 - (Motor Enable 1) circuit, and not to a DS0 line. Further, pin 14 on their controller is designated DS1, while pin 12 is designated DS2. While IBM designates pin 6 as DS3, it is not connected to any circuit on their controller.

MODIFIED PC CABLE FOR STANDARD PC HD DRIVES (EACH DRIVE SET TO DS1)

ALLOWS S.C. SECTION TO BE "B:" DRIVE AND T.C. SECTION TO BE "A:" DRIVE WHEN CONNECTED TO THE VERSAFLOPPY II

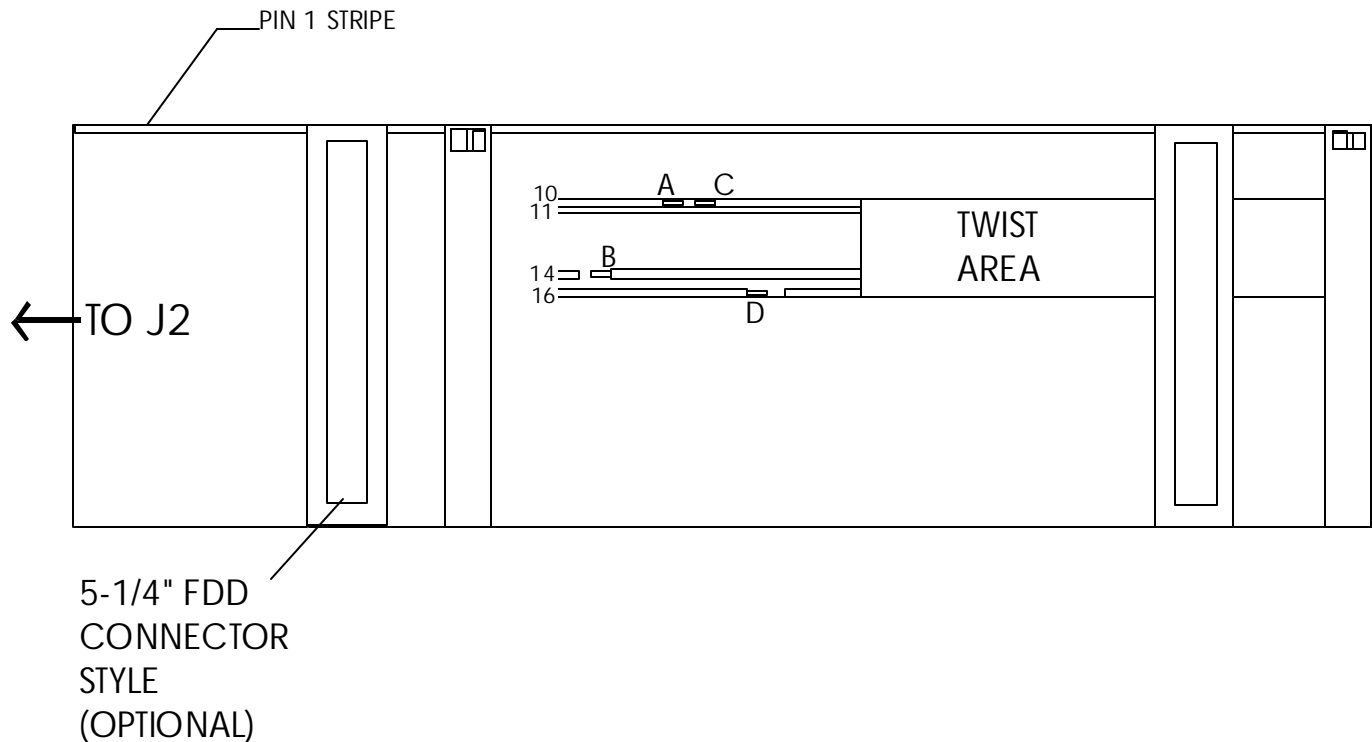
CONTROLLER  
J2

DRIVE CONNECTORS  
S.C. T.C.

```

<> 0-----O 1 - 33 GND ALL ODD PINS

> 0-----O 2 REDUCE WRITE 2 REDUCE WRITE
  0-----O 4 NC ----- 4 NC
>J1-320-----O 6 DS3 ----- 6 DS3
< 0-----O 8 INDEX ----- 8 INDEX
> 0-----O 10 DS0-A C- 16 MOTOR
> 0-----O 12 DS1 ----- 14 DS2
> 0-----O 14 DS2 - B- 12 DS1
> 0-----O 16 MOTOR -D 10 DS0
> 0-----O 18 DIRECTION ---- 18 DIRECTION
> 0-----O 20 STEP ----- 20 STEP
> 0-----O 22 WRITE DATA --- 22 WRITE DATA
> 0-----O 24 WRITE GATE --- 24 WRITE GATE
< 0-----O 26 TRACK 0 ----- 26 TRACK 0
< 0-----O 28 WRITE PROTECT- 28 WRITE PROTECT
< 0-----O 30 READ DATA ---- 30 READ DATA
> 0-----O 32 SIDE SEL ----- 32 SIDE SEL
< 0-----O 34 DISK CHANGE -- 34 DISK CHANGE
  
```

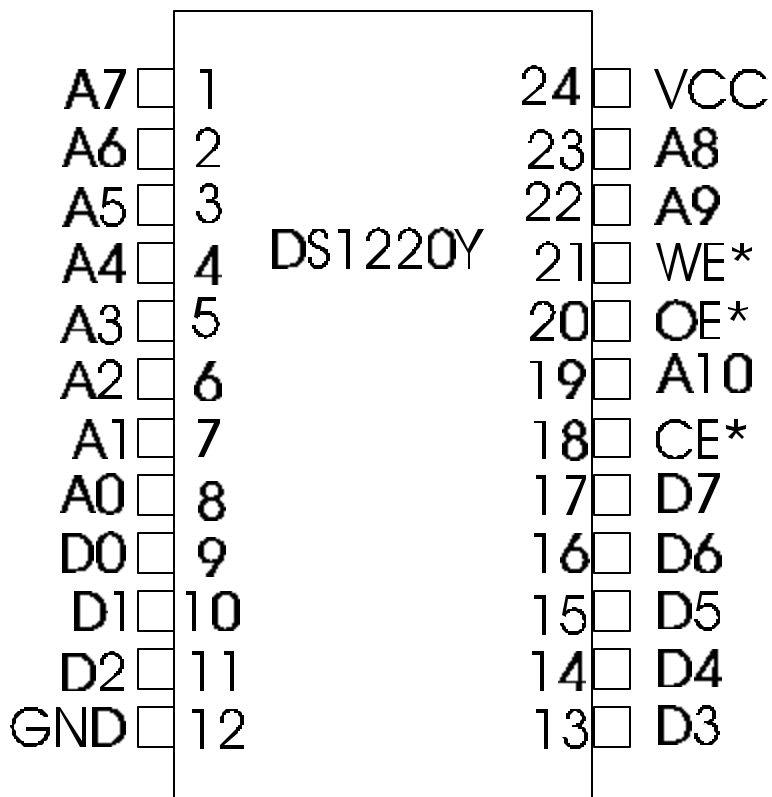


Cut wire 10 at A & C, wire 14 at B and wire 16 at D. Strip ends as shown, then join A to B and C to D. See next page for detailed cable modification notes.

### ***How To Cut and Join The Cable***

Some PC cables have pairs of 3.5" and 5.25" connectors, newer ones usually have just 3.5" connectors, so I will refer to any connector section as "connector(s)". Look for the colored orientation stripe along one edge of the cable. This is the "Pin 1" flag. Examine the cable and you will note that the connector(s) at one end have a twisted section of cable running through them. This is the PC "A:" drive. The farther end is connected to the PC floppy controller header. In our case that will be J2 on the Versafloppy. It is easy to do all the modifications on the straight section of the inter-connector twist. With an Xacto, or similar knife, cut the webbing between wire 10 and wire 11. Next cut the webbing between wire 15 and wire 16. Now cut the webbing on both sides of wire 14. Make your cuts about 3" long if possible. Lift up wire 10 and cut at point A & C. Lift wire 14 and cut at point B. Lift wire 16 and cut at point D. Strip a small section of the insulation off the ends as shown at A, C, B and D. Now join section A to section B, and finally join section C to section D. Solder these two new connections if you can. Cover up the exposed wire with a small square of electrical tape, folded around the wire and adhering to it's own sticky side. The cable now supplies a DS0 signal to the DS1 line on the end floppy connector, and a Motor Enable signal to the correct pin as well.

## DS1220Y NVRAM



\* = ACTIVE LOW

### NOTE

Some packages have a large 'over-hang' top and bottom, so visually check that the pins are lined up in the ROM socket.

Treat the DS1220Y as a 200 nanosecond static ram. +5V operation.

OE\* - low - to enable output for reading

WE\* - low - to enable writing data

CS\* - low - from an address decoder, must be low to effect OE\* and WE\* operations.