HOW TO INSTALL 3.5" STANDARD IBM FLOPPY DRIVES IN A RADIO SHACK MODEL III OR MODEL IV

My goal is to get two 3.5” Standard IBM Style Floppy drives working on my Model IV, without modifying the actual 3.5” drive. I have decided that it would be acceptable to modify the existing Floppy Interface cable, or make a new one. Temporarily, I have modified an old Edge Connector to 34 Pin DIN Adapter for my initial testing. (Basically I just lifted the following Pins on the Adapter : 2, 10, 12, and soldered a 1K OHM Resistor from Pin 1 to Pin 2, making the perfect Drive 1 test adapter. Drive 0 will require further modifications as shown later in a detailed image.)

The Radio Shack Model III & IV Floppy Disk Controller (FDC) has the following Signals routed to Connectors J1 (EXTERNAL) and J4 (INTERNAL), each capable of supporting two INTERNAL and two EXTERNAL 5.25” Floppy's at 40 Track, 80 Track, Single Density, Double Density, or Aerocomp FLIPPY Drives (Allowing Storage on the Back Side of TRS-80 Model 1 & 3 Drives) .

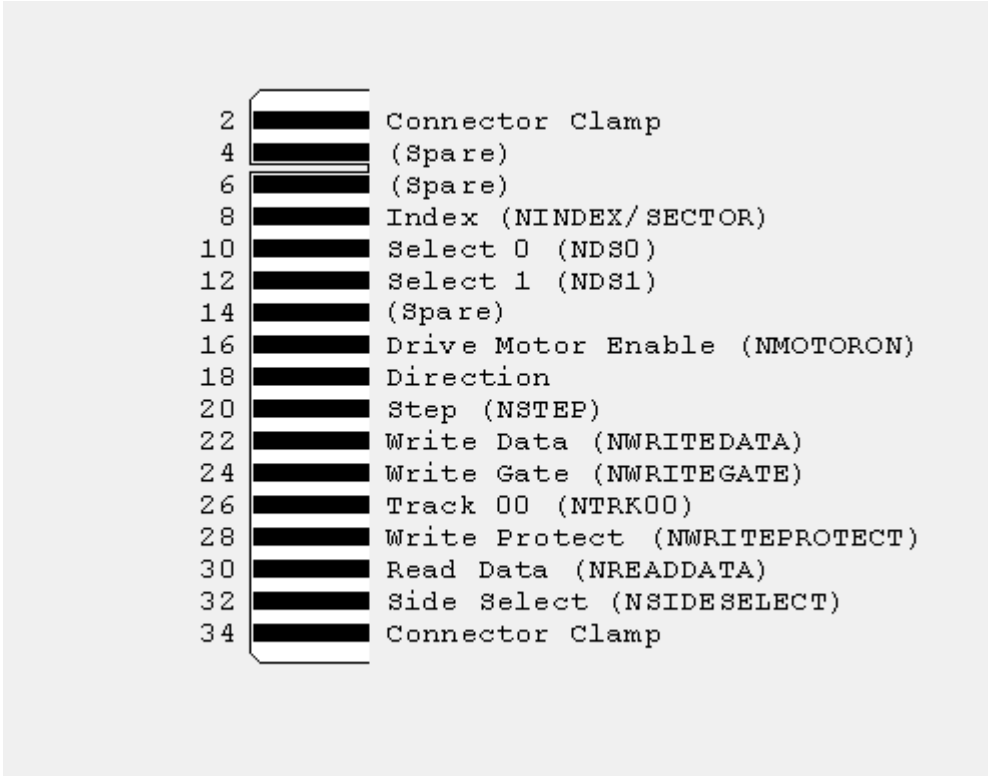


Image referenced above is from: http://pinouts.ru/Storage/5_12_floppy_pinout.shtml

NOTES:

Some Drives use External Terminator Resistors to PULLUP the signals to the + Power Supply Rail. If you are going to be installing (Model 1) drives that have the terminators installed, they must be removed for use with the Model 3 or Model 4 as the FDC already has the Pullup Resistors installed.

The 3.5" Standard IBM Style Floppy Drive uses Pin 2 Reduced Write Current (/REDWC) from the controller to the drive to control the Density. The Model III & IV do not support this functionality, and the Drive's electronics are Pulled LOW via a 1K Resistor to Common (Pin 1) forcing LOW Density.

TRS-80 Model III Floppy Disk Controller Signals to Radio Shack Drives

Pin No.	Signal Name	Description
1	Ground	--
2	N/C	Connector Clamp (Not used on TRS-80 Model III/IV Floppy Disk Controller FDC)
3	Ground	--
4	N/C	Reserved (Not used on TRS-80 Model III/IV Floppy Disk Controller FDC)
5	Ground	--
6	N/C	Reserved (Not used on TRS-80 Model III/IV Floppy Disk Controller FDC)
7	Ground	--
8<--	/Index	NINDEX/SECTOR (0=Index)
9	Ground	--
10-->	/NDS1	0=Drive Select 0 (Physical Drive 1 = Internal)
11	Ground	--
12-->	/NDS2	0=Drive Select 1 (Physical Drive 2 = Internal)
13	Ground	--
14-->	N/C	(Not used on Model III FDC)
15	Ground	--
16-->	/MOTEB	0=Motor Enable Drive 1
17	Ground	--
18-->	/DIR	0=Direction Select
19	Ground	--
20-->	/Step	0=Head Step
21	Ground	--
22-->	/WDATA	Write Data
23	Ground	--
24-->	/WGATE	Floppy Write Enable, 0=Write Gate
25	Ground	--
26<--	/TRK00	0=Track 00
27	Ground	--
28<--	/WPT	0=Write Protect
29	Ground	--
30<--	/RDATA	Read Data
31	Ground	--
32-->	/SDSEL1	TRS-80 Model III & IV Floppy Disk Controller this is Side Select for the Read Head
33	Ground	--
34	N/C	Connector Clamp (Not used on TRS-80 Model III/IV)

Pins 2, 4, 6, 14, 34 SPARE in J1 (EXTERNAL) & J4 (INTERNAL)

TRS-80 Model IV Floppy Disk Controller Signals to Radio Shack Drives

Pin No.	Signal Name	Description
1	Ground	--
2	N/C	Connector Clamp (Not used on TRS-80 Model IV Floppy Disk Controller FDC)
3	Ground	--
4	N/C	Reserved (Not used on TRS-80 Model IV Floppy Disk Controller FDC)
5	Ground	--
6	N/C	Reserved (Not used on TRS-80 Model IV Floppy Disk Controller FDC)
7	Ground	--
8<--	/Index	NINDEX/SECTOR (0=Index)
9	Ground	--
10-->	/NDS1	0=Drive Select 0 (Physical Drive 1 = Internal)
11	Ground	--
12-->	/NDS2	0=Drive Select 1 (Physical Drive 2 = Internal)
13	Ground	--
14	N/C	(Not used on TRS-80 Model IV Floppy Disk Controller)
15	Ground	--
16-->	/MOTEB	0=Motor Enable Drive 1
17	Ground	--
18-->	/DIR	0=Direction Select
19	Ground	--
20-->	/Step	0=Head Step
21	Ground	--
22-->	/WDATA	Write Data
23	Ground	--
24-->	/WGATE	Floppy Write Enable, 0=Write Gate
25	Ground	--
26<--	/TRK00	0=Track 00
27	Ground	--
28<--	/WPT	0=Write Protect
29	Ground	--
30<--	/RDATA	Read Data
31	Ground	--
32-->	/SDSEL1	TRS-80 Model III & IV Floppy Disk Controller this is Side Select for the Read Head
33	Ground	--
34	N/C	Connector Clamp (Not used on TRS-80 Model III/IV)

Pins 2, 4, 6, 14, 34 SPARE in J1 (EXTERNAL) & J4 (INTERNAL)

3.5" Standard IBM Style Floppy Drive A Pin Out (On Twisted Cable - IBM Style Drives shipped Strapped for Drive 1)

Pin No.	Signal Name	Description
1	Ground	--
2--->	/REDWC	Density Select 0=Low/1=High
3	Ground	--
4	N/C	Reserved
5	Ground	--
6	N/C	Reserved
7	Ground	--
8<---	/Index	0=Index
9	Ground	--
10-->	/MOTEA	0=Motor Enable Drive 0
11	Ground	--
12-->	/DRVSB	Drive Select 1
13	Ground	--
14-->	/DRVSA	Drive Select 0
15	Ground	--
16-->	/MOTEB	0=Motor Enable Drive 1
17	Ground	--
18-->	/DIR	0=Direction Select
19	Ground	--
20-->	/Step	0=Head Step
21	Ground	--
22-->	/WDATE	Write Data
23	Ground	--
24-->	/WGATE	Floppy Write Enable, 0=Write Gate
25	Ground	--
26<--	/TRK00	0=Track 00
27	Ground	--
28<--	/WPT	0=Write Protect
29	Ground	--
30<--	/RDATA	Read Data
31	Ground	--
32-->	/SIDE1	0=Head Select
33	Ground	--
34<--	/DSKCHG	1=Disk Change/0=Ready

Standard IBM Style Floppy Drive A/B Twist Pinout

--	Controller	Drive A	Drive B	Description
Wire 1-9	1-9	1-9	1-9	No Change
Wire 10	10	16	10	Motor Enable Drive 0/1
Wire 11	11	15	11	Ground, No Change
Wire 12	12	14	12	Drive Select 0/1
Wire 13	13	13	13	Ground, No Change
Wire 14	14	12	14	Drive Select 0/1
Wire 15	15	11	15	Ground, No Change
Wire 16	16	10	16	Motor Enable Drive 0/1
Wire 17-34	17-34	17-34	17-34	No Change

TYPICAL INTERCONNECT WIRING

TRS-80 FDC Controller		PC-AT Style Controller		3.5" disk drive Based on TEAC FD235HF		
Sig Name	Sig	Sig. Name		Sig Name	Sig	Ground
Connector Clamp * #	02	0=Double/1=High Density	----->>----------	REDWC	02	01
Spare *	04	N/C	->>-		04	03
Spare *	06	N/C	->>-		06	05
Index **	08	Index	----------<<----------	Index	08	07
Select 0	10	Motor Enable A	---------->>----------	Motor Enable 0	10	09
Select 1	12	Drive Select B	---------->>----------	Drive Select 1	12	11
Spare *	14	Drive Select A	---------->>----------	Drive Select 0	14	13
Motor Enable	16	Motor Enable B	---------->>----------	Motor Enable 1	16	15
Direction	18	Direction Select	---------->>----------	Direction Select	18	17
Step	20	Head Step	---------->>----------	Head Step	20	19
Write Data	22	Write Data	---------->>----------	Write Data	22	21
Write Gate	24	Write Gate	---------->>----------	Write Gate	24	23
Track 00 **	26	Track 00	----------<<----------	Track 00	26	25
Write Protect **	28	Write Protect	----------<<----------	Write Protect	28	27
Read Data **	30	Read Data	----------<<----------	Read Data	30	29
Side Select	32	Side Select	---------->>----------	Side Select	32	31
Connector Clamp * ##	34	Disk Change/Ready	----------<<----------	DC/Ready	34	33

Notes:
Signals denoted in BLUE need to be modified for Drive 0 & Drive 1 (Internal & External)
* - This Signal is not used on the Model III & IV
** - These Signals have Pullup Resistors Installed on the FDC for Internal and External Connectors, so drives that have Terminator resistors installed need them removed.
# - This Signal needs to be Pulled LOW through a 1K Resistor for Double Density (2D) versus High Density (HD).
- This Signal doesn't need to be connected since it isn't used.

This Chart depicts what needs to be done to interconnect all the signals properly, but gets confusing about exactly what is required. So, I've drawn out each interconnecting cable showing the exact wiring for each drive.

Floppy Disk Controller Pin Out for TRS-80 Model III & IV Drive 0 INTERNAL or EXTERNAL

TRS-80 Signals					IBM Style Drive Signals	
Pin No.	Signal Name	Description		Pin No.	Signal Name	Description
		X 1K Resistor to Common		2-->	/REDWC	Density Select 0=Low/1=High
				4	N/C	Reserved
				6	N/C	Reserved
8<--	/Index	NINDEX/SECTOR (0=Index)	----------	8<--	/Index	0=Index
10-->	/NDS1	0=Drive Select 0	--------| |---	10-->	/MOTEA	0=Motor Enable Drive 0
12-->	/NDS2	0=Drive Select 1	X | |	12-->	/DRVSB	Drive Select 1
14	N/C	Not used on TRS-80 Model IV FDC	X |----	14-->	/DRVSA	Drive Select 0
16-->	/MOTEB	0=Motor Enable Drive 1	----------|	16-->	/MOTEB	0=Motor Enable Drive 1
18-->	/DIR	0=Direction Select	----------	18-->	/DIR	0=Direction Select
20-->	/Step	0=Head Step	----------	20-->	/Step	0=Head Step
22-->	/WDATA	Write Data	----------	22-->	/WDATE	Write Data
24-->	/WGATE	Floppy Write Enable, 0=Write Gate	----------	24-->	/WGATE	Floppy Write Enable, 0=Write Gate
26<--	/TRK00	0=Track 00	----------	26<--	/TRK00	0=Track 00
28<--	/WPT	0=Write Protect	----------	28<--	/WPT	0=Write Protect
30<--	/RDATA	Read Data	----------	30<--	/RDATA	Read Data
32-->	/SDSEL1	Side Select for the Read Head	----------	32-->	/SIDE1	0=Head Select
			X	34-->	/DSKCHG	1=Disk Change/0=Ready

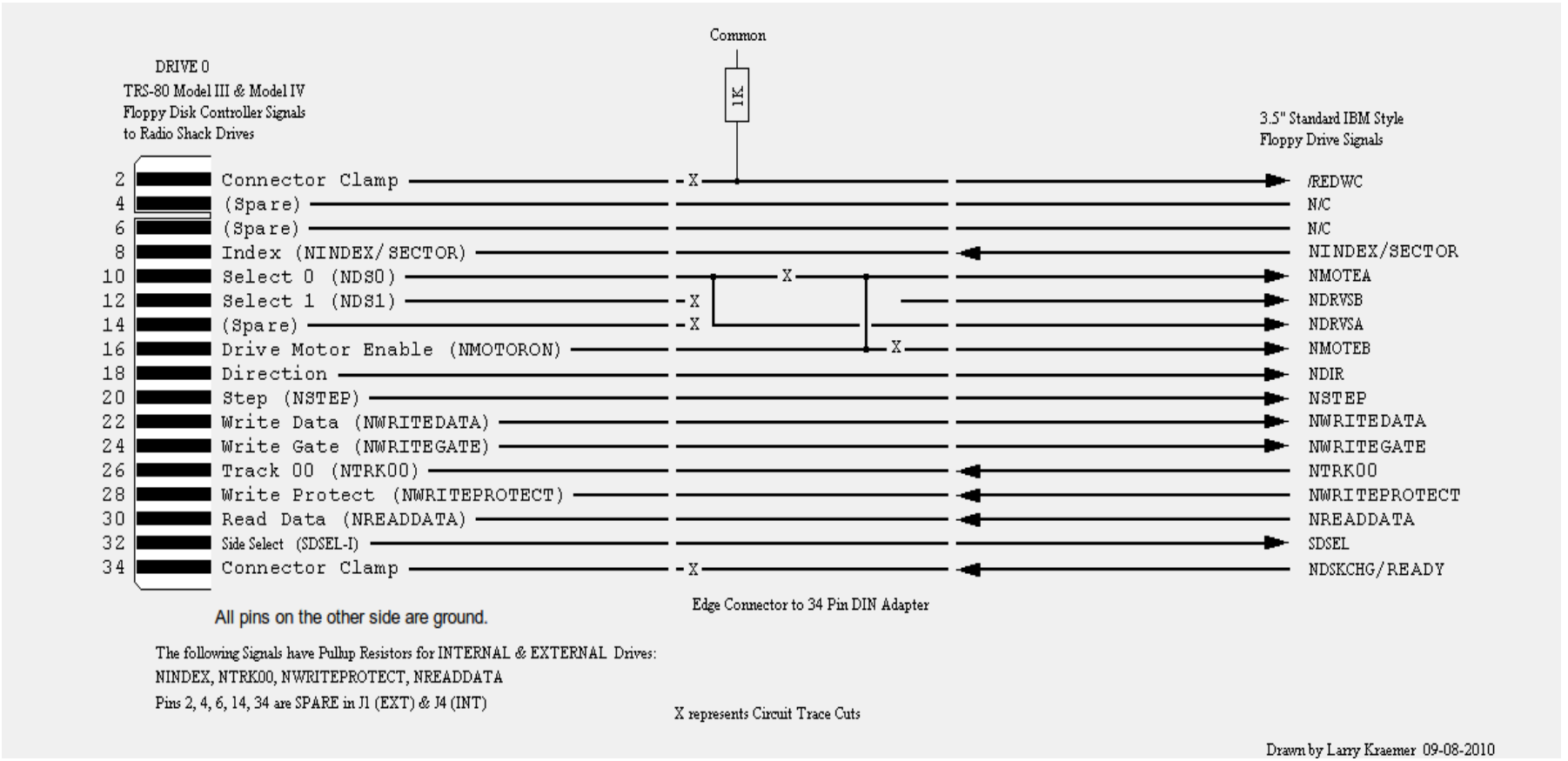
Pins 2, 4, 6, 14, 34 SPARE in J1 (EXTERNAL) & J4 (INTERNAL)
X represents Circuit Trace Cut

Floppy Disk Controller Pin Out for TRS-80 Model III & IV Drive 1 INTERNAL or EXTERNAL

TRS-80 Signals					IBM Style Drive Signals	
Pin No.	Signal Name	Description		Pin No.	Signal Name	Description
		X 1K Resistor to Common		2-->	/REDWC	Density Select 0=Low/1=High
				4	N/C	Reserved
				6	N/C	Reserved
8<--	/Index	NINDEX/SECTOR (0=Index)	----------	8<--	/Index	0=Index
10-->	/NDS1	0=Drive Select 0	X	10-->	/MOTEA	0=Motor Enable Drive 0
12-->	/NDS2	0=Drive Select 1	----------	12-->	/DRVSB	Drive Select 1
14	N/C	Not used on TRS-80 Model IV FDC		14-->	/DRVSA	Drive Select 0
16-->	/MOTEB	0=Motor Enable Drive 1	----------	16-->	/MOTEB	0=Motor Enable Drive 1
18-->	/DIR	0=Direction Select	----------	18-->	/DIR	0=Direction Select
20-->	/Step	0=Head Step	----------	20-->	/Step	0=Head Step
22-->	/WDATA	Write Data	----------	22-->	/WDATE	Write Data
24-->	/WGATE	Floppy Write Enable, 0=Write Gate	----------	24-->	/WGATE	Floppy Write Enable, 0=Write Gate
26<--	/TRK00	0=Track 00	----------	26<--	/TRK00	0=Track 00
28<--	/WPT	0=Write Protect	----------	28<--	/WPT	0=Write Protect
30<--	/RDATA	Read Data	----------	30<--	/RDATA	Read Data
32-->	/SDSEL1	Side Select for the Read Head	----------	32-->	/SIDE1	0=Head Select
			X	34-->	/DSKCHG	1=Disk Change/0=Ready

Pins 2, 4, 6, 14, 34 SPARE in J1 (EXTERNAL) & J4 (INTERNAL)
X represents Circuit Trace Cut

REF:
http://pinouts.ru/pin_Storage.shtml
http://pinouts.ru/Storage/InternalDisk_pinout.shtml
http://pinouts.ru/Storage/5_12_floppy_pinout.shtml



All pins on the other side are ground.

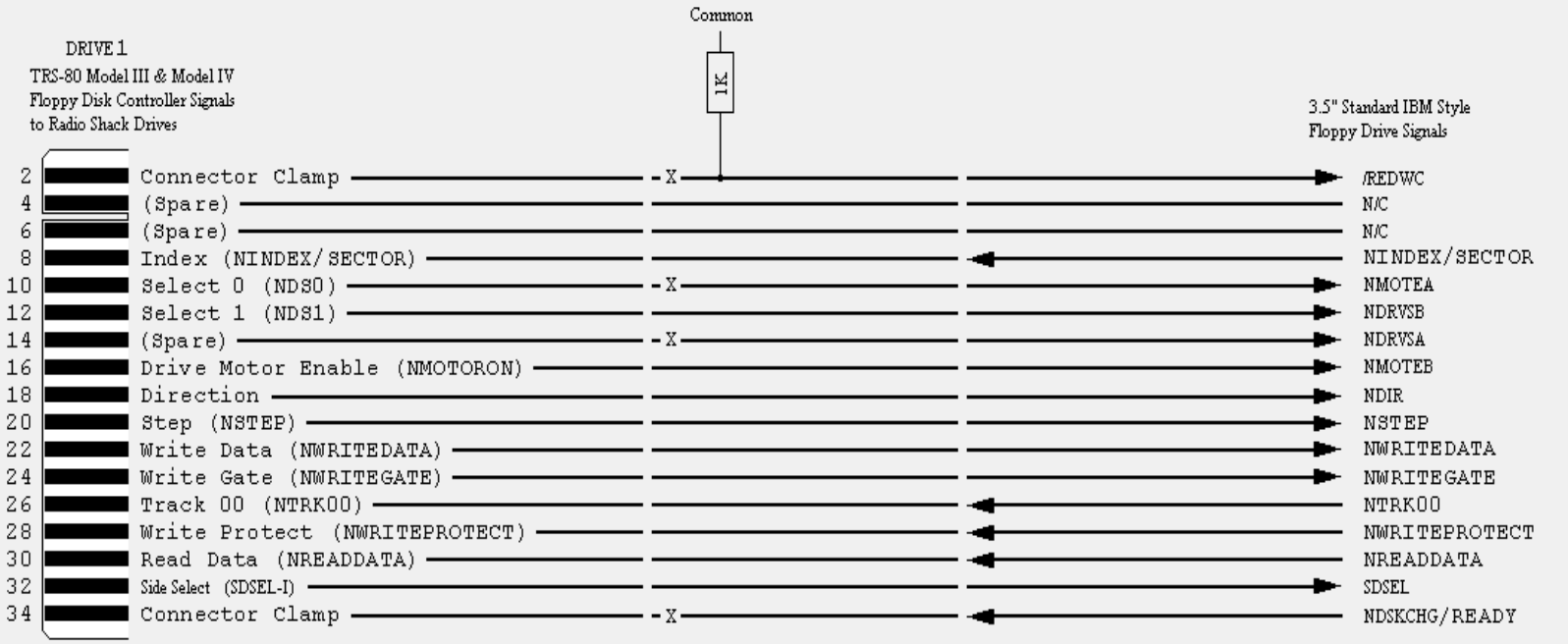
Edge Connector to 34 Pin DIN Adapter

The following Signals have Pullup Resistors for INTERNAL & EXTERNAL Drives:
NINDEX, NTRK00, NWRITEPROTECT, NREADDATA

Pins 2, 4, 6, 14, 34 are SPARE in J1 (EXT) & J4 (INT)

X represents Circuit Trace Cuts

Drawn by Larry Kraemer 09-08-2010


Common
1K
DRIVE 1
TRS-80 Model III & Model IV
Floppy Disk Controller Signals
to Radio Shack Drives
3.5" Standard IBM Style
Floppy Drive Signals
2 Connector Clamp
4 (Spare)
6 (Spare)
8 Index (NINDEX/SECTOR)
10 Select 0 (NDS0)
12 Select 1 (NDS1)
14 (Spare)
16 Drive Motor Enable (NMOTORON)
18 Direction
20 Step (NSTEP)
22 Write Data (NWRITEDATA)
24 Write Gate (NWRITEGATE)
26 Track 00 (NTRK00)
28 Write Protect (NWRITEPROTECT)
30 Read Data (NREADDATA)
32 Side Select (SDSEL-I)
34 Connector Clamp
X
/REDWC
N/C
N/C
NINDEX/SECTOR
NMOTEA
NDRVSB
NDRVSA
NMOTEB
NDIR
NSTEP
NWRITEDATA
NWRITEGATE
NTRK00
NWRITEPROTECT
NREADDATA
SDSEL
NDSKCHG/READY
Edge Connector to 34 Pin DIN Adapter
All pins on the other side are ground.
The following Signals have Pullup Resistors for INTERNAL & EXTERNAL Drives:
NINDEX, NTRK00, NWRITEPROTECT, NREADDATA
Pins 2, 4, 6, 14, 34 are SPARE in J1 (EXT) & J4 (INT)
X represents Circuit Trace Cuts
Drawn by Larry Kraemer 09-08-2010

At this point the FDC to Drive hardware wiring setup should be complete. The FDC Signals to the 3.5” Drive Connector are wired correctly, but some drives allow multiple jumper settings to route these signals to different pins or allow changing signal states. If the STANDARD jumper settings for an IBM Style drive are used, the 3.5” Drive should function properly. There is a possibility of using a 3.5” 720K Drive, 3.5” 1.44K Drive, 720K Diskettes, 1.44K Diskettes (with the Density Hole covered for LOW Density), 40 Track configuration settings, or 80 Track Configuration Settings. I used Montezuma Micro CP/M ver 2.31, and configured my EXTERNAL 3.5” Drive for 80 Tracks, 1 head, and Double Density in the **CONFIG** software. That gave me an 80 Track, SS, DD, 400K Formatted Floppy. (I left the Drive size at 5.25” since a 3.5” drive selection isn't available and a 3.5” drive will function properly when connected.)

I have tested my wiring on three different drives. TEAC FD 235HF-117-U 720K Drive with a 720K Floppy, TEAC FD-235HF-B291-U5 Drive with a 720K Floppy, and a NEC FD1231H 1.44 Drive with a HD floppy with the Density Hole Covered to make a 720K Floppy.

I did notice that PIP would not copy files from Drives A: or B: to the 3.5” Floppy (D:) on Montezuma Micro CP/M ver 2.3.1. **DUP** will format the Floppys, and I used NSWEEP to copy the files to the 400K 3.5” Floppy. For some strange reason I get an error message stating can't close “Filename.xxx” on A:, when trying to copy to a 80 Track, 2 Head, Double Density Floppy. If you have had success getting a 3.5” 720K Floppy formatted and files copies to a floppy with Montezuma Micro ver 2.31 as 80 Track, 2 Heads, Double Density, I'd like to know what you have done different.

Using NEWDOS-80 (Model 3 version) on my Model 4, I have set the PDRIVE according to the chart below and everything works accordingly.

Drive Type	Drive Size	Density	Sides	SPT	TI	GRANS	GPL
TD=A	5	Single	Single	10	A	77	2
TD=B	8	Single	Single	17	A or D	157	2
TD=C	5	Single	Double	20	A	141	2
TD=D	8	Single	Double	34	A or D	285	2
TD=E	5	Double	Single	18	A	157	2
TD=F	8	Double	Single	26	A or D	317	2
TD=G	5	Double	Double	36	A	285	8
TD=H	8	Double	Double	52	A or D	573	8

TD = Type Drive
TI = Type Interface (Standard or Apparat Disk Controller)
SPT = Sectors per Track
GPL = Grans per Lump
GRANS = Storage size on the formatted Floppy Disk

Pdrive,0 ….....Shows the Disk Parameters for the 10 drives stored in Memory.

Usage:
PDRIVE,SOURCE,DESTINATION,OPTIONS,,OPTIONS,OPTIONS,.....,A

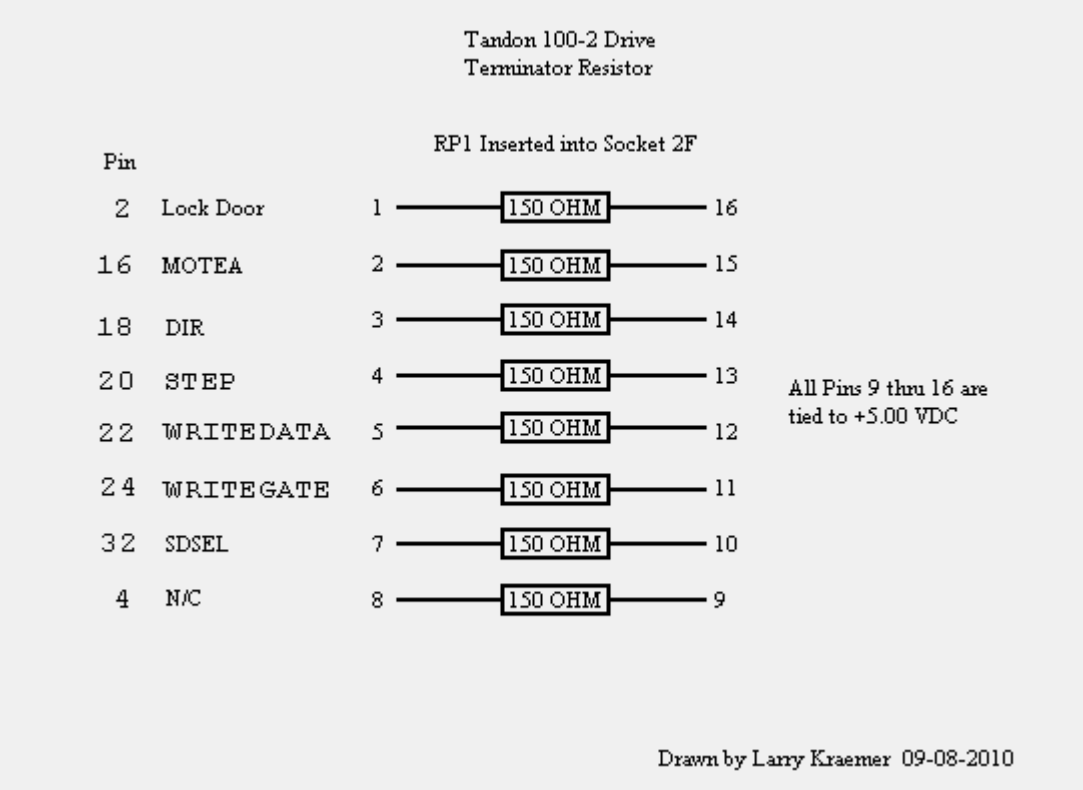
You can change a drives parameters, and read a new disk without a reboot. Use the following command ,A appended at the end:
PDRIVE,0,3,SPT=20,TC=40,A
PDRIVE,0,3=1,A

PDRIVE,0,3,TD=A,SPT=10,TC=40,A
PDRIVE,0,3,TD=G,SPT=36,TC=80,A
(If you don't add the ,A you will need to reboot after changing the PDRIVE Parameters.) PDRIVE Parameters are stored in RAM and will be RESET in the system on a reboot.

AMPRO Little Board Z80 CP/M Computer

The Ampro Little Board Computer supports four Drives. If you are using Drives such as the Tandon 100-2 with the Ampro, the manual states that the Terminator resistor (RP1 in Socket 2F) needs to be REMOVED in all Drives except for the last Drive on the Floppy Cable.

I am including a Photo of what Signals are associated with these PULLUP Resistors. Drive Pins 2, 4, 16, 18, 20, 22, 24 and 32 are PULLED HIGH through a 150 OHM DIP Resistor. So, you should also be able to use a 3.5" Floppy Drive with the Ampro Computer.



ENJOY!

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