Tarbell 1011 Disk Controller as Set Up for PerSci 270 Disk Drive
As defined on Page 4-2e-1 of the Tarbell Floppy Disk Interface manual
M. Eberhard   Version 1.02   5 August 2020

J1 Interface

J1 to	Related Jumpers	Tarbell 1011 Function	J1 Pin	Dir.	PerSci 270 Function
E24		DEXT<4> = Unit Select	2	Out	Disk Select -Left/+Right
E20	E40-E41	Head Load 1	4	Out	-Head Load 1
R2	E43-E44	WD1771 Ready	6	In	-Ready 1
R4		WD1771 -IP	8	In	-Index 1
E27	E47-E48	DEXT<7> = 1: CPU wait on seek	10	In	-Seek Complete
E26	E33:E34	DEXT<6> = Restore	12	Out	-Restore
		N/C	(14)	Out	(-Remote Eject 0) *
		N/C	(16)	In	-Spindle Position Pulses
E19	E51-E53, E40-E41	Head Load 0	18	Out	-Head Load 0
R3		WD1771 -IP	20	In	-Index 0
R1	E44-E43	WD1771 READY	22	In	-Ready 0
E30		GND (Motor always on)	24	Out	-Spindle Motor Enable
E25	E38-E52, E39-E40	DEXT<5> = Drive Select 0/1	26	Out	-Drive Select 2
E23	E54-E55	DEXT<5> = Drive Select 0/1	28	Out	-Drive Select 1
R6		WD1771 WPRT	30	In	(-Write Protect 1) *
		N/C	(32)	Out	(-Remote Eject 1) *
E22	E1-E13,E3-E11	WD1771 DIRC	34	Out	-Direction Select
E21	E7-E14, E5-E10	DEXT=01h causes Step	36	Out	-Step
E15		WD1771 WD	38	Out	-Write Data
E16		WD1771 WG	40	Out	-Write Gate
R8		WD1771 -TR0	42	In	-Track 00
R5		WD1771 -WPRT	44	In	(-Write Protect 0) *
R11		Disk data to data separator	46	In	-Read Data
		N/C	(48)	In	-Separated Data
		N/C	(50)	In	-Separated Clock

Tarbell 1011 I/O Ports

Address	Direction	Name	Function
F8	Out	DCOM	WD1771 Disk Controller Command
F8	In	STAT	WD1771 Disk Controller Status
F9	In/Out	TRACK	WD1771 Track Register
FA	In/Out	SECT	WD1771 Sector Register
FB	In/Out	DATA	WD1771 Data Register
FC	In	WAIT	Signals when data is available for reads, and when data is required for writes
FC	Out	DEXT	Disk Extended Command (See below.)

DEXT Port Encoding

Bits 2:0 control the function of bits 7:4. Bit 3 is not used.

Bits 2:0	Function	Note
000	No Operation	Goes to E32, which is not connected for PerSci 270 drive setup
001	Step	Head stepping is done by software when configured for PerSci drives. (The WD1771 STEP output is not used.)
010	Control Latch	Latches bits 7:4
011-111	No Operation	

DEXT Control Latch (When bits 2:0 = 010)

Bit	Function	Reset State	Note
4	-Right/Left	1	0 for right disk, 1 for left disk
5	-Drive 0/Drive 1	1	0 for drive 1, 1 for drive 0
6	-Restore	1	0 restores to track 0. Must be set to 1 when done.
7	-Seek Wait Enable	1	Write 0 to set up for wait for seek to complete. Write 1 to set up for wait for WD1771 done

DEXT Commands

These are the useful DEXT port commands, as derived from the above two tables.

Hex	Function
F1	Step previously selected drive
F2	Select drive 0 left disk
E2	Select drive 0 right disk
D2	Select drive 1 left disk
C2	Select drive 1 right disk
B2	Select and restore drive 0 left disk
A2	Select and restore drive 0 right disk
92	Select and restore drive 1 left disk
82	Select and restore drive 1 right disk
72	Wait for drive 0 left seek complete
62	Wait for drive 0 right disk seek complete
52	Wait for drive 1 left disk seek complete
42	Wait for drive 1 right disk seek complete

Seeking

Seeking is done via software, not using the WD1771's seek capability. This allows for fast-seek on the PerSci drives. The seek algorithm must work something like this:

```
TARGET = target track number
Read 1771 TRACK register into CURRENT      /* What track are we on?
STEPCOUNT = TARGET – CURRENT     /* How many tracks to go?

IF STEPCOUNT=0 THEN done            /* Already on track?

/* Persuade the 1771 to set its DIRC output correctly
IF STEPCOUNT>0 THEN                  /* Which direction?
            /* Step inward
            Issue STEPIN command to WD1771, max step rate, no verify
      ELSE
            /* Step outward
            Issue STEPOUT command to WD1771, max step rate, no verify
            STEPCOUNT = -STEPCOUNT
      ENDIF

/* Step the disk drive head now. Max rate is 500 KHz.
FOR I = 1 to STEPCOUNT
      /* send one step pulse
      OUT DEXT,0F1h
      NEXT I

/* Wait for the 1771 to complete its STEPIN or STEPOUT command
IN WAIT                              /* CPU hangs until 1771 is done

/* Update current track and 1771 TRACK register
CURRENT = TARGET
Write CURRENT to 1771 TRACK register

/* Wait for the disk drive to complete its seek
TEMP = 72h,62h,52h,42h for drive A,B,C,D   /* Seek Complete value for selected drive
OUT DEXT,TEMP                        /* Enable wait-on-Seek Complete
IN WAIT                              /* CPU hangs until Seek Complete from PerSci

/* Put the DEXT port back
TEMP = 0F2h,0E2h,0D2h,0C2h for drive A,B,C,D       /* Selected drive
OUT DEXT,TEMP                        /* Disable wait-on-Seek Complete
                                     /*(enables wait-on-1771-done)
```

Tarbell 1011 Configuration

This is copied/corrected from page 4-2e-1 of the Tarbell Floppy Disk Interface manual

Pad	Name	Pad	Name
E19	HLD0*	J1-18	-Head Load 0
E20	HLD1*	J1-4	-Head Load 1
R3	INDX0*	J1-20	-Index 0
R4	INDX1*	J1-8	-Index 1
R1	RDY0*	J1-22	-Ready 0
R2	RDY1*	J1-6	-Ready 1
E23	DS0*	J1-28	-Drive Select 1
E24	DS1*	J1-2	Disk Select -Left/+Right
E25	HLD3*	J1-26	-Drive Select 2
E26	RST*	J1-12	-Restore
E27	SCMP*	J1-10	-Seek Complete
E22	SO*	J1-34	Direction Select
E21	SI*	J1-36	-Step
E15	WD*	J1-38	-Write Data
E16	WG*	J1-50	-Write Gate
R7	TR00*	J1-42	-Track 0
R8	TR01*	J1-42	-Track 0 (remove/disconnect resistor R8)
R5	WRPT0*	J1-44	-Write Protect 0
R6	WRPT1*	J1-30	-Write Protect 1
R11	RDAT0*	J1-46	-Read Data
R12	RDAT1*	J1-46	-Read Data (remove/disconnect resistor R12)
E30	GND	J1-24	-Spindle Motor Enable
E48		E46	-PRDY
E1		E13	Direction Select from WD1771 DIRC
E3		E11	Pullup for U61-12
E5		E10	Pullup for U61-10
E7		E14	Fast Seek via DEXT port
E29		E31	Use multiplexor for 2 units (left/right)
E33		E34	Enable DEXT Restore bit
E39		E40	Pullup for U42-10
E41		E40	Pullup so HLD0 and HLD1 alternate
E52		E38	Connect Drive Select 2
E43		E44	Connect ready lines to WD1771
E51		E53	Connect Head Load signals
E54		E55	Connect Drive Select 1

PerSci 270 Configuration

According to The Tarbell manual page 4-2e-2, the following jumpers should be installed on the PerSci 270 disk drive:

Rev G or Lower	Rev H or higher	Comment
A-B	A-B	Use off-board data separator
D-E	D-E	270 setup
F-G	F-G	270 setup
H-J	H-J	270 setup
M-P	M-P	270 setup
AT-AY	AT-AY	Separate remote eject (doesn't matter)
R-S	R-S	270 setup
AH-AJ	AH-AJ	Soft Sectored Disks
AB-AX	AB-AC	Soft Sectored Disks
W-X	W-X	Soft Sectored Disks
AD-AE	AD-AE	Soft Sectored Disks
BA-BC		Separate index signals
	BA-BB	Combined index signals
AL-AM *	AL-AM	Remote spindle motor enable
W1	W1	Signal ground = chassis ground
BD-BE	BD-BE	Enable fast-seek
	BK-BM	Combined index signals
	AV-AW	J1-4 to U11 (doesn't matter)

* I would suggest that a better configuration would connect AM-AN instead of AL-AM. This would cause the spindle motor to turn off when no disk is installed in the drive.

If the Tarbell controller is connected to just one PerSci 270 drive, then U11 should be empty. For CP/M, the left drive will be Drive A, and the right drive will be Drive B. If there are two PerSci 27- drives, then U11 should be set up on each drive as follows, so that the second PerSci 270 will have CP/M drives C and D:

Drives A&B	Drives C&D	Comment
7-8	7-8	Active-low select signals
5-10		Drive 1
	3-12	Drive 2