

MEMORANDUM

DATE: AUGUST 8, 1985

SUBJECT: HIGH PERFORMANCE DISK DRIVES

FROM: S. BLIGHTMAN

TO: D. SMITH

CC: A. ABBOTT
J. CARROLL
T. FRANEY

C. KARZAG
S. VINELLA
H. WALLACE

With the coming of the S114, and probably future controllers supporting 3 megabytes/second, the subject of how we test these is going to become more of an issue. I don't know how expensive the new drives are going to be but I suspect the price will be substantial.

I noticed that you budgeted three new Fujitsu 2333 drives at a cost of \$6,000.00 each for the testing of our 2.5 megabytes/second controllers. I suspect that you have already purchased the first one, but I suggest that we talk about a solution that may save us having to buy one or both of the other drives and also solve the 3 megabytes/second problem at the same time.

I suggest we look at designing and building a disk emulator in the vein of the Tapeworm. It would seem to me that the disk emulator would be a very simple project and could be done with no intelligence in the architecture. I imagine using a 64K or 128K byte buffer to emulate maybe two cylinders of two tracks each. The memory could be accessed byte wide and the data passed through a serializer/deserializer for conversion to the SMD interface. The high order address bits would be driven by the cylinder and head registers, and the low order bits supplied by a free running counter to simulate a rotating disk. Refresh could be performed on sector boundaries while transmitting the sector pulse. In order to test the high order bits of the SMD bus, we may have to play some games but I think that can be done too.

In order to support the ECL drivers and receivers for the enhanced SMD interface, we would have to include both a +5V and a -5V supply. However, since it would not have any intelligence, I think the cost of this device should be no more than the Tapeworm.

Providing we all agree this is a sensible thing to do, and since, as you know, Engineering resource is in high demand at the moment, I wondered whether you may have someone who might like to do this. Engineering would, of course, be willing to supply some guidance in this project.

Let me know what you think.

/rhs

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/rhs

Rework For 503 Emulator Proto Build
W/O # 5003A00-0007 (5 boards)

The following is a list of additional and replacement parts required to rework 5 boards:

<u>P/N</u>	<u>Description</u>	<u>Qty</u>
1400019	Res, 20KΩ	10
1800005	Cop, 6.8 uF	10
3100008	Socket, 14P, DIP	10
Q00006	Header, 26P	10

SPECTRALOGIC

ENGINEERING CHANGE ORDER

Form 4-860003, 9/84

REWORK ADDITIONS For W/O #500? AOO-0007 ONLY			Page 3 of 3	ECO # WA
No.	From	To	Notes	
1	3R-7	3S-7		
2	3R-14	4R-14		
3	5R-7	5S-7		
4	5R-14	5P-16		
5	4M-6	4M-1		
6	4M-7	2K-7		
7	1D-9	6M-13		
8	7J-11	6N-1		
9	6N-2	6M-12		
10	6N-11	3J-5		
11	4N-11	CRY-2(-)	connect to feed thru directly above square pad on CRY	
12	4N-9	3J-9		
13	4N-19	4P-10		
14	6N-7	6N-8	connect ^{IC Pin 7} to ground via	
15	@ R1	Add component	{ 20K (14-19)	
16	@ R2		{	
17	@ C3		{ 6.8 uF (18-05)	
18	@ C7		{	
19	@ 3R		{ 14 Pin Dip socket (31-08)	
20	@ 5R		{ Remove pins 2-6 and 9-13	
21	@ DS1-DS5		{ 26 Pin Header (32-06)	
22	@ DS9-DS16	V	{ cut to size - NOTE: Headers to be installed on sober side	

TAPE WORM MOD (for S24)

Remove wire from 12A-11 to 2A-13

Add 1K SIP - Pin 1 to 14E-20
74LS08 + socket to location 1C

Change PK011s in 2B, 4B, 4C, 7B, 9B to revision A2.

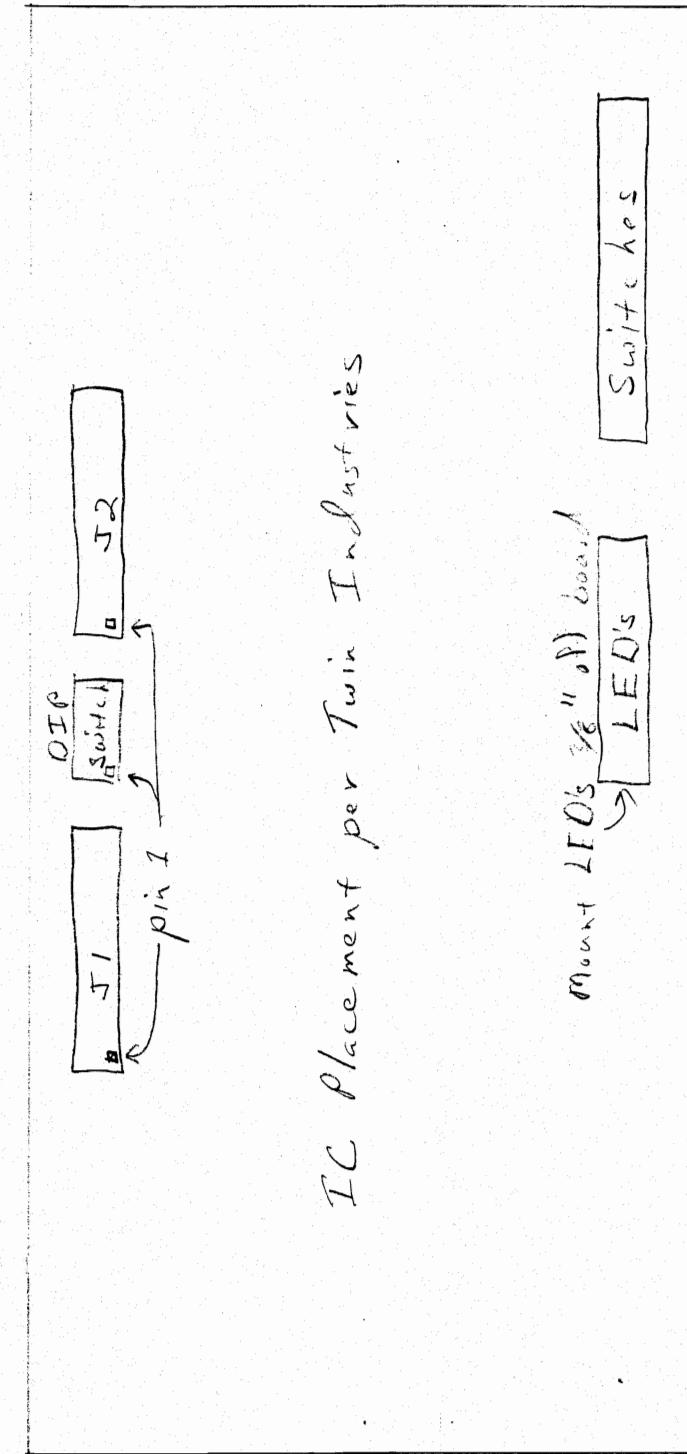
Add wire 12A-11 to 1C-2
2A-6 1C-1
1C-3 14A-13
CERSW-2 GND
CERSW-3 4E-19
14E-19 16A-10
16A-9 16A-12
16A-11 16A-14
16A-8 22C-11
22C-10 J2-42
HERSW-2 GND
HERSW-3 14E-18
14E-18 16A-13
16A-11 22C-13
22C-12 J2-4
J2-26 J2-40

Switch on front panel that was Transport Address 3 is now PARITYREF.

Switch contact 2 is tied to ground, as it was.
Switch contact 3 is connected to 22C-6.

Tape worm Switch, LED & Header Placement
2-22-85 DLS

243
1



ERROR LOG

① 3A pin 1
 20B s 10
 9C s 16
 10C s 16
 17B pin 2
 18B pin 2
 19B s 2
 7B s 24
 9B s 24
 4D pin 10
 12D pin 10
 14D pin 10
 20D pin 40
 13A s 14
 8C s 14
 3A pin 11

CONNECT TO 5V ↑
 (Nearest)

② 2B pin 12
 4B s 12
 7B pin 12
 9B pin 12
 4E pin 12
 17B pin 8
 18B s 8
 19B s 8
 9A pin 1, 19
 10A pin 1, 19
 2D pin 30
 4D pin 30
 14D s 30

↑ CONNECT To Gnd
 (Nearest)

③ 3A pin 16 cut trace
 Delete CONNECT To Gnd

④ 2C pin 11 CONNECT To 19B
 pin 1

⑤ 2C pin 1 CONNECT To 12A
 pin 6

- ⑥ 2A is wrong Socket (See Corrections to wire list)
- ⑦ 12D pin 20 is wrong should go to pin 30
pin 20 is CONNECT To G (See Corrections to wire List)
- ⑧ 14 A pin 13 missing. Wiring to 22A pin 5

ERROR Log

SIB

① 3A pin 1 ✓ 3A-1 to 3A pin 20

20B pin 1 ✓ 20B-1 to 20B-20

9C pin 16 ✓ 7C-16 → 9C-16

10C pin 16 ✓ 9C-16 → 10C-16

17B pin 2 ✓ 20B-20 → 19C-2

18B pin 2 ✓ 19B-2 → 18B-2

19B pin 2 ✓ 18B-2 → 19C-2

7B pin 24 ✓ 12B-24 → 7B-24

9B pin 24 ✓ Should apply 5V

② 2B pin 12 -

4B pin 12 /

7B pin 12 /

9B pin 12 /

4C pin 12 - should connect to Ground

③ 2A Wrong Socket (and wiring is wrong
in the back)

+ pin 8 → GND

④ Sip Socket Pin 8 Gnd

S03 Master Diskette

The S03 Master Diskette contains the following files : -

S03P1.SCH - S03P10.SCH

These files are the PCAD schematic files for each of the 10 pages.

S03P1.PLT - S03P10.PLT

These files are the PCAD plot files for each of the 10 pages in HP format.

S03PANEL.SCH

This file is the PCAD schematic file for the front panel.

S03PANEL.PLT

This file is the PCAD plot file for the front panel in HP format.

S03A.REW

This file contains the rework instructions for revision A of the artwork of the S03 PCB.

S03.BOM

This file is the Bill of Material file generated by running the PCNETS extract program on the 10 schematic sheets.

S03.TEL

This file is the package and net list file generated for the TELESIS system by running the PCNETS extract program on the 10 schematic sheets.

S03.MAN

This file is the manual describing the product. It has been generated using WORDSTAR and must be printed using WORDSTAR.

S03_2EA0.PAL, S03_2KA0.PAL, S03_2VA0.PAL, S03_2WA0.PAL

These files are the PALASM source files for the 4 PALS.

S03_2EA0.PIN, S03_2KA0.PIN, S03_2VA0.PIN, S03_2WA0.PIN

These files are the pin files generated by PALASM for the 4 PALS.

S03_2EA0.JED, S03_2KA0.JED, S03_2VA0.JED, S03_2WA0.JED

These files are the JEDEC files generated by PALASM for the 4 PALS. They can be downloaded directly to the DATAIO programmer to blow the fuses in the 4 PALS. If transferred to the PDP11 first, the files must be transferred using XMODEM since the files contain special control characters.

S03_2XA0.PLE, S03_6ZA0.PLE

These files are the PLEASM source files for the two miscellaneous PROMs.

S03_2XA0.HEX, S03_6ZA0.HEX

These files are the HEX format files generated by PLEASM for the two PROMs. They can be downloaded directly to the DATAIO programmer to blow the fuses in the two PROMs.

S03TA0.MAC

This file is the source for the firmware of the tape emulator. This source may be used by the meta-assembler on the PDP11.

S03TA0.LST

This file is the list file of the firmware of the tape emulator.
It is generated by running the meta-assembler on the PDP11.

S03TDEF.MAC

This file is the definition source file for the tape emulator.

S03TDEF.LST

This file is the list file of the firmware definitions of the tape emulator. It is generated by running the meta-assembler on the PDP11.

S03TA0.PRM

This file is the PROM object file generated by running the meta-assembler on the PDP11. It can be used by the DATAIO program to download the PROM information for the tape emulator to the DATAIO programmer.

READ.ME

This file.

SPECTRA TAPEWORM

INTRODUCTION

The Spectra Tapeworm is a high speed 1/2" tape emulator. Using bit slice technology and 64K of dynamic RAM, it performs most functions of a formatted tape drive with a Pertec standard interface. Self diagnostics are executed upon reset or power-up. An S02 test panel may be connected to the Tapeworm to further identify controller failures by monitoring the Tapeworm firmware.

THEORY OF OPERATION

Three 2901 ALU's control the flow of 8 data bits, end of record flag, bus parity flag, and filemark between the controller interface and on board dynamic RAM. An additional RAM is included for internal parity checking for a total of 12 64k x 1 DRAM's. A TI 4500 DRAM controller handles the address multiplexing. The Tapeworm understands fourteen basic tape commands: read forward/reverse, write, space forward/reverse, file search forward/reverse, rewind/unload, write EOF, read/write edit, and erase fixed/variable. Hard error will be set on the interface if an illegal (unknown) command is received. Likewise, hard error will set if an attempt is made to go beyond the physical EOT. The EOT marker sets at approximately 48k, which leaves 16k of storage before the end of the reel. The Tapeworm can be made to look like either a 800 or 1600 BPI drive, although the actual bit density remains unchanged.

FRONT PANEL

The following is a list of the indicators and switches on the Tapeworm front panel and their functions:

INDICATORS

DIAG FAIL

This is lit during self diagnostics. If it stays on, there is an internal failure in the Tapeworm.

DIAG PASS

The self diagnostics have passed.

BOT

The Tapeworm is at beginning of tape.

SELECTED

The Tapeworm is being addressed by the controller.

FPT

File protect switch is set.

ONLINE

The Tapeworm is online.

EOT

The Tapeworm is at the end of tape.

RAM ERROR

There has been a DRAM failure in the Tapeworm.

SWITCHES

CER

UP - Normal operation.

DOWN - Forces corrected error (CER) on the interface.

PARITY

UP - Tapeworm uses its own internal parity on a write.

DOWN - Tapeworm uses controller supplied bus parity bit (WP) on a write.

REWIND (MOMENTARY)

Depress for rewind to BOT.

DENSITY

UP - Density is determined by controller.

MIDDLE - PE (1600 BPI)

DOWN - NRZ (800 BPI)

(Note: Only status indications are changed. Actual bit densities remain the same.)

FPT

UP - Normal operation.

DOWN - Write protect bit is set.

(Note: This switch does not prevent Tapeworm from being written to. That is the responsibility of the controller.)

ONLINE (Momentary)

Alternately sets and resets the online status.

RESET (Momentary)

Forces a hardware reset. Self diagnostics are executed.

HER

UP - Normal operation.

DOWN - Forces hard error (HER) on the interface.

TA1

UP - Least significant transport address is set.

DOWN - Least significant transport address is reset.

TA2

UP - Most significant transport address is set.

DOWN - Most significant transport address is reset.

(Note: TA1 and TA2 allow the tape unit to be assigned an address of 0 - 3.)

PARITY ERROR

UP - Forces the read parity bit (RP) to ground, causing a read parity error.

DOWN - Normal operation.

400KB/300KB/100KB

The tape transfer rate will be the slowest of the three switches in the up position. If all three are down the transfer rate will be 556 Kbytes/second.

DISABLE EOT

UP - The EOT marker is never set, making the Tapeworm look like an infinitely long tape.

DOWN - Normal operation.

FROM:- STEVE BLIGHTMAN
TO:- WHOM IT MAY CONCERN
DATE:- NOVEMBER 17, 1982

PROPOSAL:- TO BUILD SPECTRA LOGIC TAPEWORM
A VERY FAST 1/2" TAPE TRANSPORT EMULATOR

There are some problems in Manufacturing in testing the 1/2" tape parts of our multifunction controllers. These are mainly:-

1. Cost of having so many tape transports in Manufacturing. We currently buy CIPHER streamers for Manufacturing because these are some of the cheapest transports available at approximately \$2000 each.
2. Because we buy streamers, Manufacturing has difficulty in 'scoping problems because the transport spends most of the time re-positioning.
3. The diagnostics can take a long time to run, and the tests that test for correct functioning of "WRITE RING" and "ON LINE" are particularly tedious since they require unloading and loading the tape. The CIPHER streamers compound this problem as the auto-load procedure tends to be long and unreliable.
4. Typically the software diagnostics require error free tape, especially close to the beginning of tape. The tapes tend to wear out in this area since they are used so extensively and it is often difficult to decide whether the controller is faulty or the tape has a media defect.

This proposal is to make a 1/2" tape emulator for use mainly in Manufacturing. This tape emulator, to be called the TAPEWORM, would be built around a memory array of probably 12 64K dynamic RAM chips. 8 OF these chips would enable us to emulate a tape with a capacity of 64K bytes. The other 4 bits of memory would be used for byte parity, file mark indicator, inter-record gap marker, and overall parity. No error correction would be done on the memory, but the overall parity would verify the integrity of the 12 chips.

With 64K bytes at 1600 b.p.i. we are emulating a tape that is effectively only about 40 inches long. This however does not take into account inter-record gaps which will be very short on the TAPEWORM and so with small records the length of tape emulated will be quite a bit greater. It is felt that this would probably be enough memory to run the tape diagnostics on the SPECTRA 20, 21, 25, & 26.

There are 3 possible architectures that may be used to build the TAPEWORM. These are :-

- A. A MOS microprocessor design
- B. A Bit-slice design
- C. A Sequencer design

The microprocessor or bit-slice designs would give us the advantage that we could have micro-diagnostics in the TAPEWORM to increase the confidence and simplify fault finding in the TAPEWORM itself. This may be particularly important due to the failure rate of the 64K dynamic RAMs. The microprocessor approach may be more expensive to develop if we have to buy or rent a development system. The sequencer design would be the cheapest to build and probably the easiest to develop, but it would have no self-diagnostic capability. This proposal recommends a 4 or 8 bit bit-slice design.

The very rough manufacturing cost estimates are :-

	DESIGN A	DESIGN B	DESIGN C
DYNAMIC RAMS	\$120	\$120	\$120
RAM CONTROLLER	\$ 60	\$ 60	\$ 60
OTHER PARTS	\$100	\$175	\$ 75
BARE WIRE WRAP BOARD	\$175	\$200	\$175
WIRE WRAP SOCKETS	\$ 50	\$ 60	\$ 50
6 AMP POWER SUPPLY	\$ 75	\$ 75	\$ 75
MOUNTING BOX	\$ 50	\$ 50	\$ 50
TOTAL:	\$630	\$740	\$605

These costs obviously do not include assembly and test. The number of ICs used will be approximately 50 for designs A and C or 60 for design B. The higher cost estimate for "OTHER PARTS" of design B reflects the higher costs of 2901s and PROMs.

J5 power connector

-5V — O₁₂ — -5V SENSE

GND — D₃₄ —

+5V — O₅₆ — +5V SENSE

DS 1 USED Green

2 Rdy Green

3 WR PROT Red

4 OFF CYL Red

5 FAULT Red

6 SEEK ERR Red

7 RGATE Green

8 WGATE Green

9 BOT Green

10 EOT Red

11 Wr Prot Red

12 On Line Green

13 Unit Sel Green

14 Mem Err Red

15 Diag Fail Red

16 Diag Pass Green

J8

1	GND	2
3	OffLine*	4
5	Wr prot*	6
7	SECSW1	8
9	SECSW2	10
11	UNIT A2*	12
13	UNIT A1*	14
15		16
17		18
19	GND	20
21-26	unused	

J7

1	GND	2
3	MRES*	4
5	WR PROT	6
7	455KB*	8
9	365KB*	10
11	100KB*	12
13	DIS EOT*	14
15	SCER	16
17	SHER	18
19	SINT PAR*	20
21-26	unused	

J5 power connector

-5V —— O₁ 2 —— -5V SENSE

GND —— D₃ 4 ——

+5V —— O₅ 6 —— +5V SENSE

DS 1	USED	Green
2	Rdy	Green
3	WR PROT	Red
4	OFF CYL	Red
5	FAULT	Red
6	SEEK ERR	Red
7	RGATE	Green
8	WGATE	Green

9	EOT	Green
10	EOT	Red
11	Wr Prot	Red
12	On Line	Green
13	Unit Sel	Green
14	Mem Err	Red
15	Diag Fail	Red
16	Diag Pass	Green

1	GND	2
3	Offine*	4
5	Wr prot*	6
7	SECSW1	8
9	SECSW2	10
11	UNIT A2*	12
13	UNIT A1*	14
15		16
17		18
19	GND	20

21-26 unused

1	GND	2	
3	MRES*	4	STAB0
5	For PARER*	6	STAB1
7	455KB*	8	SFAB
9	365KB*	10	SONL*
11	100KB*	12	SOFL*
13	DIS EOT*	14	SRBN*
15	SCER	16	SHDN*
17	SHER	18	SRDN*
19	SINTPAR*	20	SFT

21-26 unused

J5 power connector

-5V —— O₁₂ —— -5V SENSE

GND —— D₃₄ ——

+5V —— O₅₆ —— +5V SENSE

DS 1	USED	Green
2	Rdy	Green
3	WR PROT	Red
4	OFF CYL	Red
5	FAULT	Red
6	SEEK ERR	Red
7	RGATE	Green
8	WGATE	Green
9	EOT	Green
10	EOT	Red
11	Wr Prot	Red
12	On Line	Green
13	Unit Sel	Green
14	Mem Err	Red
15	Diag Fail	Red
16	Diag Pass	Green

J8	1	GND	2
	3	Offline*	4
	5	Wr prot*	6
	7	SECSW1	8
	9	SECSW2	10
	11	UNIT A2*	12
	13	UNIT A1*	14
	15		16
	17		18
	19	GND	20

21-26 unused

J7	1	GND	2
	3	MRES*	4
	5	WR PROT*	6
	7	455KB*	8
	9	365KB*	10
	11	100KB*	12
	13	DIS EOT*	14
	15	SCER	16
	17	SHER	18
	19	SINTPAR*	20

21-26 unused

(Material list created from emul.CMP and emul.WRL)

(emul.BOM created)

(Date: 09-17-1986 Time 16:17:22)

Upper Assembly ~~50000000~~

2	1100013	2KX4PRM;27S185	2X;6Z	2X 150	= .300
5	1100017	1KX8PRM;27S281	3K;3L;3M;3N;3P	5X 185	= .925
3	1100019	16L8;16L8	2E;2V;2W ^{MW}	3X 120	= .540
1	1100036	16R6;16R6	2K	120	= .120
1	3500001	JUMPER2;.1"	W1		

Lower Assembly ~~6200071~~

3	1000008	7416;7416	1G;1H;1K	3X 51	= .153
1	1000018	74139;74S139	4J	90	= .090
2	1000032	74251;74S251	5K;6K	2X 85	= .170
3	1000042	7400;74LS00	3S;3Z;4AA	3X 4.4 ma	= .013
2	1000043	7402;74LS02	2AA;5J	2X 54	= .0102
1	1000044	7404;74LS04-	5H	6.6	= .0066
1	1000046	7408;74LS08	3J	8.8	= .0082
1	1000048	7411;74LS11	3Y	6.6	= .0066
1	1000050	7432;74LS32	6M	9.8	= .0098
3	1000052	7474;74LS74	3A;3AA;3W	3X 8	= .024
6	1000060	74174;74LS174	2G;2H;2U;4A;4K;4M	6X 26	= .156
4	1000064	74240;74LS240	1B;1D;1E;7J	4X 50	= .200
2	1000065	74244;74LS244	4N;7T	2X 54	= .108
1	1000067	74253;74LS253	3T	4	= .014 → 2.9156
3	1000068	74257;74LS257	2A;4Z;5Z	3X 19	= .057
2	1000069	74273;74LS273	4L;4P	2X 27	= .054
2	1000073	74373;74LS373	5C;6C	2X 40	= .080
6	1000074	74374;74LS374	2B;2C;2D;3H;5A;6A	6X 40	= .240
2	1000076	74393;74LS393	5AA;6AA	2X 26	= .052
150	5	1000082	3450;3450*	5e5x30	= .300
270	3	1000083	3450;3450*	75e3x90	= .150
2	1000087	74259;74LS259	5N;5P	2X 36	= .072
1	1000090	26S02;26S02*	3BB	69	= .069
1	1000094	74113;74S113	5L	25	= .025
3	1000104	74280;74S280	1A;5B;6B	3X 105	= .315
2	1000113	2952;2952*	5U;6U	2X 245	= .550
2	1000128	74299;74F299*	5T;6T	2X 95	= .190 → 5.06%
1	1000129	7421;74H21*	5BB	32	= .032
2	1000133	7485;74S85	2F;3X	2X 110	= .220
1	1000138	7474;74F74-	3U	16	= .016
1	1000139	7408;74F08*	4S	13	= .013
2	1000143	7438;7438	1J;2J	2X 54	= .108
2	1000147	74174;74F174*	2S;4T	45	= .045
1	1000152	7404;74F04*	4U	15	= .015
2	1000153	7402;74F02*	4R;5S	2X 13	= .026
1	1000162	74163;74AS163	3V	40	= .040
2154	1	1000163	10192;10192*	5e154	= .052
40	1	1000165	10125;10125*	5 40	
72	1	1000169	10124;10124*	5e72	= .025
626	3	1100004	2911;2911A	2L;2M;2N	3X 130 = .390
3	1100015	2901;2901	3C;3E;3F	3X 265 = .795	
4	1300003	DIODE;1N914	CR1;CR2;CR3;CR4		
2	1400009	RES;470	R3;R4		6.8466
3	1400011	RES;1K	R1;R2;R9		1.9
1	1400017	RES;10K	R5		
1	1400020	RES;33K	R6		
3	1500011	9RSIP;1K	RP19;RP20;RP26		
12	1500013	4RSIP;470	RP10;RP11;RP12;RP13;RP14;RP15;	+ Resistors & led	
2	1500022	9RSIP;3.3K	RP16;RP17;RP18;RP25;RP8;RP9		
2	1500024	9RSIP;4.7K	RP23;RP24		
8	1600003	SSIDELED;RED	DS10;DS11;DS14;DS15;DS3;DS4;		
8	1600004	SSIDELED;GREEN	DS1;DS12;DS13;DS16;DS2;DS7;		

			DSG; DSY	
1	1700003	OSC; 25.00MHZ	3R	
2	1800001	CAPTANTR; 1.0UF	C4; C5	50 ma
2	1800006	CAPTANTA; 10UF	C1; C2	
2	1800008	CAPTANTR; 0.1UF	C3; C7	
67	1900006	CAPDIP; .01UF	C[70-74]; C[8-69]	
2	3100002	2KX4PRM; 27S185	2X; 6Z	
4	3100003	16L8; 16L8	2E; 2V; 2W; 2K	
5	3100006	1KX8PRM; 27S281	3K; 3L; 3M; 3N; 3P	
3	3200001	26PHDR; 5002	J2; J7; J8	
1	3200003	60PHDR; 5202	J1	
1	3200010	20PHDR; 6002	J6	
2	3500002	JUMPER2; .1"	W1[1-2]	
1	1000073	4500; 4500	3B	140 ma
28	1100050	256KDRM; 150NS	4V; 4W; 4X; 4Y; 5D; 5E; (64K) 12x 45 ma	
			5F; 5G; 5V; 5W; 5X; 5Y;	
			6D; 6E; 6F; 6G; 6V; 6W;	
			6X; 6Y; 7D; 7E; 7F; 7G;	
			7V; 7W; 7X; 7Y	(256K) 16x 70
			RP1; RP2; RP3; RP4; RP5	= 1.120
5	1500039	15RDIP; 56	1C; 1F	
2	1500040	14RNDIPA; 220/330	J5	
1	3200033	CONN6;	5R	
1	1700011	OSC; 20.00MHZ		
2		16PHDR	DSI-8, DSQ-16?	50 ma

= .050

= .140

= .540

= 1.120

= .050

1.9

.093" (2,36mm) Diameter Connectors



3191 Series

Grid Patterns



Series No. → 3191-1

Order No → 19-09-X01X



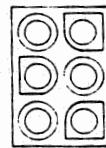
3191-2
19-09-X02X



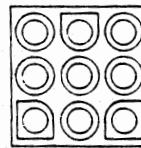
3191-3
19-09-X03X



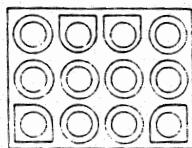
3191-4
19-09-X04X



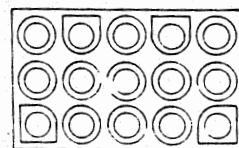
3191-6
19-09-X06X



3191-9
19-09-X09X



3191-12
19-09-X12X



3191-15
19-09-X15X

Ordering Information 3191

Circuits	Receptacle	Plug		Electrical		Circuits	Receptacle	Plug		Electrical	
	Available only without Mounting Ears	with Mounting Ears	without Mounting Ears	Max. Amps.	Max. Volts		Available only without Mounting Ears	with Mounting Ears	without Mounting Ears	Max. Amps.	Max. Volts
1	19-09-1019	19-09-2018	19-09-2019	12	600	6	19-09-1069	19-09-2068	19-09-2069	9	600
2	19-09-1029	19-09-2028	19-09-2029	12	600	9	19-09-1099	19-09-2098	19-09-2099	8	600
3	19-09-1039	19-09-2038	19-09-2039	11	600	12	19-09-1129	19-09-2128	19-09-2129	7	600
4	19-09-1049	19-09-2048	19-09-2049	9	600	15	19-09-1159	19-09-2158	19-09-2159	6	600

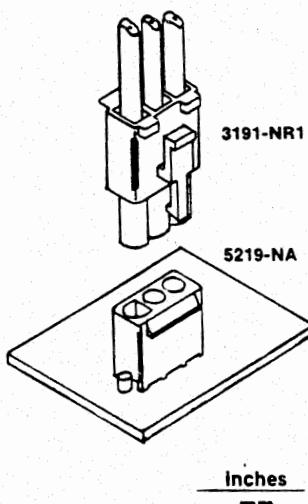
Polarizing Key 3191-K 19-09-1101 (Use in plug only)

5219 Series

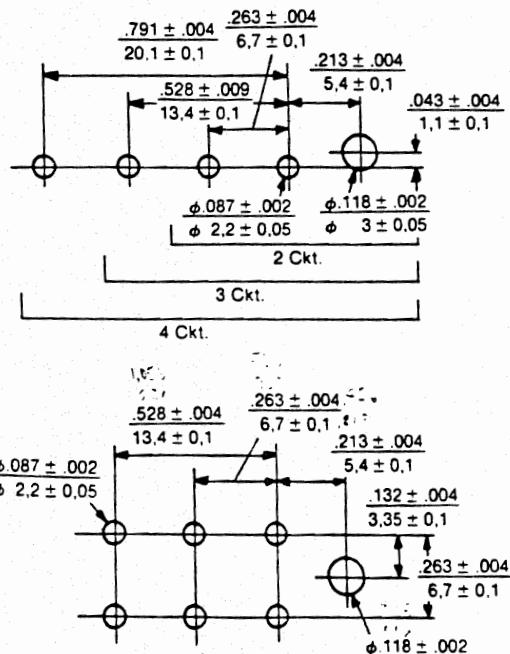
.093" (2,36mm) Header for 3191 Wire to Board Applications

Features/Dimensions:

- 2, 3, 4, 6 Circuits available
- Locks with PCB for flow soldering
- Polarization to PCB mounting
- Locking ramp for 3191 positive locking
- Integrally molded polarization to 3191
- Terminals factory assembled
- Terminal material tin plated brass
- .264" (6.71 mm) grid pattern
- Height above PCB $.590 \pm .012$
 $14.99 \pm .31$
- Width across end $.323 \pm .012$
 $8.20 \pm .31$
- Length of PC tail $.138$
 3.51



Inches
mm



P.C. Board Hole Dimensions
Layout provides press fit

Ordering Information

Circuits	Rating	Order No.
2	12A	600V 15-31-1026
3	11A	600V 15-31-1036
4	9A	600V 15-31-1046
6	9A	600V 15-31-1066

CON 6/263

(E. Ial list created from emul.CMP and emul.WRL)
(e S0M created)
(Date: 09-17-1986 Time 16:17:22)

Upper Assembly ~~S000A00~~

2	1100013	2KX4PRM;27S185	2X;CZ - socket
5	1100017	1KX8PRM;27S281	3K;3L;3M;3N;3P - "
3	1100019	16L8;16L8	2E;2V;2W - Pn
1	1100036	16R6;16R6	2K - Pn
1	3500001	JUMPER2;.1"	W1

Lower Assembly ~~6200071~~

1	1000008	7416;7416	1G;1H;1K
2	1000018	74139;74S139	4J
2	1000032	74251;74S251	5K;6K
2	1000042	7400;74LS00	3S;3Z;4AA
2	1000043	7402;74LS02	2AA;5J
+	1000044	7404;74LS04	5H
+	1000046	7408;74LS08	3J
1	1000048	7411;74LS11	3Y
+	1000050	7432;74LS32	6M
1	1000052	7474;74LS74	3A;3AA;3W
1	1000060	74174;74LS174	2G;2H;2U;4A;4K;4M
1	1000064	74240;74LS240	1B;1D;1E;7J
2	1000065	74244;74LS244	4N;7T
1	1000067	74253;74LS253	3T
3	1000068	74257;74LS257	2A;4Z;5Z
2	1000069	74273;74LS273	4L;4P
2	1000073	74373;74LS373	5C;6C
2	1000074	74374;74LS374	2B;2C;2D;3H;5A;6A
2	1000076	74393;74LS393	5AA;6AA
5	1000082	3450;3450	1BB;1U;1W;1Y;1Z 30
3	1000083 m	3453;3453 65	2T;2Y;2Z 90
2	1000087	74259;74LS259	85 150
1	1000090	26S02;26S02	5AA;6AA
1	1000094	74113;74S113	3BB
3	1000104	74280;74S280	5L
2	1000113	2952;2952	1A;5B;6B
2	1000128	74299;74F299	5U;6U
1	1000129	7421;74H21	5T;6T
2	1000133	7485;74S85	5BB
1	1000138	7474;74F74	2F;3X
1	1000139	7408;74F08	3U
2	1000143	7438;7438	4S
2	1000147	74174;74F174	1J;2J
1	1000152	7404;74F04	2S;4T
2	1000153	7402;74F02	4U
1	1000162	74163;74AS163	4R;5S
1	1000163	10192;10192 rro	3V
1	1000165	10125;10125 30	1P 154
1	1000169	10124;10124 53ma	1S 44
3	1100004	2911;2911A	2R 72
3	1100015	2901;2901	2L;2M;2N socket
4	1300003	DIODE;1N914	3C;3E;3F socket
2	1400009	RES;470	CR1;CR2;CR3;CR4
3	1400011	RES;1K	R3;R4.
1	1400017	RES;10K	R1;R2;R9
1	1400020	RES;33K	R5
3	1500011	9RSIP;1K	R6
12	1500013	4RSIP;470	RP19;RP20;RP26
2	1500022	9RSIP;3.3K	RP10;RP11;RP12;RP13;RP14;RP15;
2	1500024	9RSIP;4.7K	RP16;RP17;RP18;RP25;RP8;RP9
8	1600003	SSIDELED;RED	RP23;RP24
8	1600004	SSIDELED;GREEN	RPC;RP7

10 30
44 72
154 72
44 72
max 690 mA

473mA typ

32-10

			LSD; LSD
1	17000003	OSC; 25.00MHZ	3R
2	13000001	CAPTANTR; 1.0UF	C4; C5
2	- 18000006	CAPTANTA; 10UF	C1; C2
2	13000008	CAPTANTR; 0.1UF	C3; C7
67	19000006	CAPDIP; .01UF	C[70-74]; C[8-69]
2	31000002	2KX4PRM; 27S185	2X; 6Z <i>socket</i>
4	31000003	16L8; 16L8	2E; 2V; 2W; 2K <i>socket</i>
5	31000006	1KX8PRM; 27S281	3K; 3L; 3M; 3N; 3P <i>socket</i>
3	32000001	26PHDR; 5W02	J2; J7; J8
1	32000003	60PHDR; 5202	J1
1	32000010	20PHDR; 6002	J6
2	35000002	JUMPER2; .1"	W1[1-2]
1	1000173	4500; 4500	3B
28	1100050	256KDRM; 150NS	4V; 4W; 4X; 4Y; 5D; 5E; TMS 4164-15NL 5F; 5G; 5V; 5W; 5X; 5Y; 6D; 6E; 6F; 6G; 6V; 6W; 6X; 6Y; 7D; 7E; 7F; 7G; 7V; 7W; 7X; 7Y
			RP1; RP2; RP3; RP4; RP5
5	1500039	15RDIP; 56	1C; 1F
2	1500040	14RNDIPA; 220/330	J5
1	3200033	CONN6;	5R
1	1700011	OSC; 20.00MHZ	
2		16P HDR	DS1-8, DS9-16?

2.49 - MM50256 P-15

CTS PIN

Molex #? 15-31 1066

Power supply specs... conn?

Pin 1 common
16 pin DIP
RP4K S62 - 1539
16 pin DIP
RP4K
A resistor network
8 & 16 Conn
20/30

- (1) 16 pos t. conn.
(1) 16 double row pckmt.
Breakaway head
(1) 20 pos double row

J5 power connector

-5V —— O₁₂ —— -5V SENSE

GND —— D₃₄ ——

+5V —— O₅₆ —— +5V SENSE

DS 1	USED	Green
2	Rdy	Green
3	WR PROT	Red
4	OFF CYL	Red
5	FAULT	Red
6	SEEK ERR	Red
7	RGATE	Green
8	WGATE	Green
9	EOT	Green
10	EOT	Red
11	Wr Prot	Red
12	On Line	Green
13	Unit Sel	Green
14	Mem Err	Red
15	Diag Fail	Red
16	Diag Pass	Green

J8

1	GND	2
3	Offline *	4
5	Wr prot *	6
7	SECSW1	8
9	SECSW2	10
11	UNIT A2 *	12
13	UNIT A1 *	14
15		16
17		18
19	GND	20
21-26	unused	

J7

1	GND	2
3	MRES*	4
5	for PAPER*	6
7	455KB*	8
9	365KB*	10
11	100KB*	12
13	DIS EOT*	14
15	SCER	16
17	SHER	18
19	SINTPARK*	20
21-26	unused	SFTP

J5 power connector

-5V —— O₁₂ —— -5V SENSE

GND —— D₃₄ ——

+5V —— O₅₆ —— +5V SENSE

DS 1	USED	Green
2	Rdy	Green
3	WR PROT	Red
4	OFF CYL	Red
5	FAULT	Red
6	SEEK ERR	Red
7	RGATE	Green
8	WGATE	Green
9	EOT	Green
10	EOT	Red
11	Wr Prot	Red
12	On Line	Green
13	Unit Sel	Green
14	Mem Err	Red
15	Diag Fail	Red
16	Diag Pass	Green

J8

1	GND	2
3	Offline*	4
5	Wr prot*	6
7	SECSW1	8
9	SECSW2	10
11	UNIT A2*	12
13	UNIT A1*	14
15		16
17		18
19	GND	20
21-26	unused	

J7

1	GND	2
3	MRES*	4
5	WR PROT*	6
7	455KB*	8
9	365KB*	10
11	100KB*	12
13	DIS EOT*	14
15	SCER	16
17	SHER	18
19	SINTPAR*	20
21-26	unused	

(Material list created from emul.CMP and emul.WRL)

(emul.BOM created)

(Date: 09-17-1986 Time 16:17:22)

Upper Assembly ~~50000000~~

2	1100013	2KX4PRM;27S185	2X;6Z	2X 150	= .300
5	1100017	1KX8PRM;27S281	3K;3L;3M;3N;3P	5X 185	= .925
3	1100019	16L8;16LS	2E;2V;2W ^{MH}	3X 120	= .540
1	1100036	16RG;16RC	2K	120	= .180
1	3500001	JUMPER2;.1"	W1		

Lower Assembly ~~6200071~~

3	1000008	7416;7416	1G;1H;1K	3X 51	= .153
1	1000018	74139;74S139	4J	90	= .090
2	1000032	74251;74S251	5K;6K	2X 85	= .170
3	1000042	7400;74LS00	3S;3Z;4AA	3X 4.4 ^{ma}	= .013
2	1000043	74C2;74LS02	2AA;5J	2X 54	= .0102
1	1000044	7404;74LS04-	5H	6.6	= .0066
1	1000046	7408;74LS08	3J	8.8	= .0082
1	1000048	7411;74LS11	3Y	6.6	= .0066
1	1000050	7432;74LS32	6M	9.8	= .0098
3	1000052	7474;74LS74	3A;3AA;3W	3X 8	= .024
6	1000060	74174;74LS174	2G;2H;2U;4A;4K;4M	6X 26	= .156
4	1000064	74240;74LS240	1B;1D;1E;7J	4X 50	= .200
2	1000065	74244;74LS244	4N;7T	2X 54	= .108
1	1000067	74253;74LS253	3T	:4	= .014 → 2.9156
3	1000068	74257;74LS257	2A;4Z;5Z	3X 19	= .057
2	1000069	74273;74LS273	4L;4P	2X 27	= .054
2	1000073	74373;74LS373	5C;6C	2X 40	= .080
6	1000074	74374;74LS374	2B;2C;2D;3H;5A;6A	6X 40	= .240
2	1000076	74393;74LS393	5AA;6AA	2X 26	= .052
150	5	1000082	3450;3450*	5X 5X 30	= .300
270	3	1000083	3450;3450*	1BB;1U;1W;1Y;1Z	= .150
2	1000087	74259;74LS259	5N;5P	2X 36	= .072
1	1000090	26S02;26S02*	3BB	69	= .069
1	1000094	74113;74S113	5L	25	= .025
3	1000104	74280;74S280	1A;5B;6B	3X 105	= .315
2	1000113	2952;2952*	5U;6U	2X 275	= .550
2	1000128	74299;74F299*	5T;6T	2X 95	= .190 → 5.0696
1	1000129	7421;74H21*	5BB	32	= .032
2	1000133	7485;74S85	2F;3X	2X 110	= .220
1	1000138	7474;74F74*	3U	16	= .016
1	1000139	7408;74F08*	4S	13	= .013
2	1000143	7438;7438	1J;2J	2X 54	= .108
2	1000147	74174;74F174*	2S;4T	45	= .045
1	1000152	7404;74F04*	4U	13	= .015
2	1000153	7402;74F02*	4R;5S	2X 13	= .026
1	1000162	74163;74AS163	3V	40	= .040
2154	1	1000163	10192;10192*	50154 ^{ma} 1P	
40	1	1000165	10125;10125*	S 40	
72	1	1000169	10124;10124*	5072	
626	3	1100004	2911;2911A	2L;2M;2K	3X 130 = .390
3	1100015	2901;2901	3C;3E;3F	3X 265 = .795	
4	1300003	DIODE;1N914	CR1;CR2;CR3;CR4		
2	1400009	RES;470	R3;R4	6.8466	
3	1400011	RES;1K	R1;R2;R9	1.9	
1	1400017	RES;10K	R5		
1	1400020	RES;33K	R6		
3	1500011	9RSIP;1K	RP19;RP20;RP26		
12	1500013	4RSIP;470	RP10;RP11;RP12;RP13;RP14;RP15;RP16;RP17;RP18;RP25;RP8;RP9	+ resistors 100	
2	1500022	9RSIP;3.3K	RP23;RP24		
2	1500024	9RSIP;4.7K	RP6;RP7		
8	1600003	SSIDELED;RED	DS10;DS11;DS14;DS15;DS3;DS4;DS5;DS6		
8	1600004	SSIDELED;GREEN	DS1;DS12;DS13;DS16;DS2;DS7;		

			DSG; DSV		
1	17000003	OSC; 25.00MHZ	3R	50 ma	= .050
2	18000001	CAPTANTR; 1.0UF	C4; C5		
2	18000006	CAPTANTA; 10UF	C1; C2		
2	18000008	CAPTANTR; 0.1UF	C3; C7		
67	19000006	CAPDIP; .01UF	C[70-74]; C[8-69]		
2	31000002	2KX4PRM; 27S185	2X; 6Z		
4	31000003	16L8; 16L8	2E; 2V; 2W; 2K		
5	31000006	1KX8PRM; 27S281	3K; 3L; 3M; 3N; 3P		
3	32000001	26PHDR; 5002	J2; J7; J8		
1	32000003	60PHDR; 5202	J1		
1	32000010	20PHDR; 6002	J6		
2	35000002	JUMPER2; .1"	W1[1-2]		
1	10000173	4500; 4500	3B	140 ma	= .140
28	11000050	256KDRM; 150NS	4V; 4W; 4X; 4Y; 5D; 5E; 5F; 5G; 5V; 5W; 5X; 5Y; 6D; 6E; 6F; 6G; 6V; 6W; 6X; 6Y; 7D; 7E; 7F; 7G; 7V; 7W; 7X; 7Y	(64K) 12x 45 ma	= .540
			(256K) 16x 70		= 1.120
5	1500039	15RDIP; 56	RP1; RP2; RP3; RP4; RP5		
2	1500040	14RNDIPA; 220/330	1C; 1F		
1	3200033	CONN6;	J5		
1	1700011	OSC; 20.00MHZ	5R		
2		16PHDR	DSI-8, DSP-16?	50 ma	= .050

1.9

3003
 0801
 0603
 0001
 100002
 100003
 31000003
 32000001
 32000003
 32000010
 35000002
 1000173
 1100050
 1500039
 1500040
 3200033
 1700011
 16P HDR

OSC; 25.00MHz
 CAPTANTR; 1.00UF
 CAPTANTA; 1.00UF
 CAPDIP; .01UF
 2KX4PRM; 27S185
 16L8; 16L8
 1KX8PRM; 27S281
 26PHDR; 5002
 26PHDR; 52J2
 JUMPER2; .1"
 450W; 450W
 256KDRM; 150NS

15RDIP; 56
 14RNDIPA; 220/330
 CONN6;
 OSC; 20.00MHz

C4; C5
 C1; C2
 C3; C7
 C[70-74]; C[8-69]
 2X; 6Z
 2E; 2V; 2W; 2K
 3K; 3L; 3M; 3N; 3P
 J2; J7; J8
 J1
 J6
 W1[1-2]
 3B
 4V; 4W; 4X; 4Y; 5D; 5E;
 5F; 5G; 5V; 5W; 5X; 5Y;
 6D; 6E; 6F; 6G; 6V; 6W;
 6X; 6Y; 7D; 7E; 7F; 7G;
 7V; 7W; 7X; 7Y
 RP1; RP2; RP3; RP4; RP5
 1C; 1F
 J5
 5R

DS1-8, DSP - 16?

140ma
 (6A) 12x45ma
 (256k) 16x70
 50ma

= .140
 = .540
 = 1.120
 = .050
 1.9

537 001A0 ;
538 001A0 ;FILE SEARCH FORWARD
539 001A0 ;CONTINUES UNTIL FILEMARK IS ENCOUNTERED OR, AFTER EOT,
540 001A0 ;FMK OR LWD IS DETECTED.
541 001A0 ;
542 001A0 D0B00001F2 FSFWD: JSR ,,,SFREQ ;GET STROBE FREQUENCY
543 001A1 1CB88107000 ALUF ,CA,MOV,R1,RLDP ;LOAD MSB ADDR
544 001A2 100B380000 ALU ,,RTOQ,R3 ;
545 001A3 90140601A3 FSF2: JCF ,,DECQ,,EQUAL,\$;DELAY LOOP
546 001A4 108B00D000 ALUF ,,MOVR,R0,SALE ;LOAD LSB ADDR
547 001A5 10800B0000 ALU ;
548 001A6 280E005000 ALUF MEMRD,DOUT,DT0Q,,RALE ;READ DATA OUT
549 001A7 908401A5DC JCTF ,,MOVQ,,PARERR,SRFRQ,PERR ;PARITY ERROR?
550 001A8 90B00A25C1 JCTF ,,,,DEST10,RRFRQ,FSF7 ;CHECK FMK
551 001A9 1080009000 ALUF ,,,SRS ;SET READ STROBE
552 001AA 11B90B0000 ALU ,,INCR,R0 ;INCREMENT LSB
553 001AB 90083711A3 JCFF ,,RTOQ,R3,COUT,RRS,FSF2 ;LSB=FFF ?
554 001AC 30EA1B000C ALU CONST,,DXR,R1,H#00C ;MSB=C?
555 001AD 90800601B1 JCF ,,,,EQUAL,FSF4 ;IF YES, SET EOT
556 001AE 90800C01B1 JCF ,,,,ENBEDT,FSF4 ;CHECK EOT DISABLE SW
557 001AF 108000E000 ALUF ,,,SEOT ;SET EOT
558 001B0 90440001B3 JMP ,,ZERB,,FSFB ;GOTO CHECK FMK/LWD
559 001B1 1DB91B0000 FSF4: ALU ,CA,INCR,R1 ;INC MSB
560 001B2 90083001A3 JMP ,,RTOQ,R3,FSF2 ;CONTINUE
561 001B3 90140601B3 FSF8: JCF ,,DECQ,,EQUAL,\$;DELAY LOOP
562 001B4 108B00D000 ALUF ,,MOVR,R0,SALE ;LOAD LSB ADDR
563 001B5 10800B0000 ALU ;
564 001B6 280E005000 ALUF MEMRD,DOUT,DT0Q,,RALE ;READ DATA OUT
565 001B7 90800AA5C1 JCTF ,,,,DEST10,SRFRQ,FSF7 ;CHECK FMK
566 001B8 90840195DC JCTF ,,MOVQ,,PARERR,SRS,PERR ;PARITY ERROR?
567 001B9 90B00825C1 JCTF ,,,,DESTB,RRFRQ,FSF7 ;CHECK LWD
568 001BA 11B9001000 ALUF ,,INCR,R0,RRS ;INCREMENT LSB
569 001BB 90083701B3 JCF ,,RTOQ,R3,COUT,FSFB ;WAS LSB=FFF ?
570 001BC 30EA1B000F ALU CONST,,DXR,R1,H#00F ;MSB=F ?
571 001BD 90800601BF JCF ,,,,EQUAL,FSF9 ;IF NO,KEEP READING
572 001BE 90800C05E1 JCT ,,,,ENBEDT,EERR ;CHECK EOT DISABLE SW
573 001BF 1DB91B0000 FSF9: ALU ,CA,INCR,R1 ;INC MSB
574 001C0 90083001B3 JMP ,,RTOQ,R3,FSFB ;CONTINUE
575 001C1 11B9001000 FSF7: ALUF ,,INCR,R0,RRS ;INCREMENT LSB
576 001C2 90800721E3 JCFF ,,,,COUT,RRFRQ,RDEND ;END SEARCH IF NO CARRY
577 001C3 D0B00001FB JSR ,,,,ADC ;ADDRESS CHECK
578 001C4 9D891001E3 JMP ,,CA,INCR,R1,RDEND ;INC MSB & END SEARCH

580 001C5 ;
581 001C5 ;FILE SEARCH REVERSE
582 001C5 ; CONTINUES UNTIL FILEMARK OR LOADPOINT IS ENCOUNTERED.
583 001C5 ;
584 001C5 108B0080000 FSREV: ALU ,,MOVR,RO ;LSB=0 ?
585 001C6 9C881601C9 JCF ,CA,MOVR,R1,EQUAL,FSR0 ;IF NOT, START FS REV
586 001C7 90800605DB JCT ,,,EQUAL,BERR ;IF MSB=0 GOTO BOT ERROR
587 001C8 1D98180000 ALU ,CA,DECR,R1 ;DECREMENT MSB
588 001C9 D1980001F2 FSRO: JSR ,,DECRL,RO,SFREQ ;GET STROBE FREQUENCY
589 001CA 90140601CA FSR2: JCF ,,DECQ,,EQUAL,\$;DELAY LOOP
590 001CB 108B00D000 ALUF ,,MOVR,RO,SALE ;LOAD LSB ADDR
591 001CC 108B0080000 ALU ;
592 001CD 280E005000 ALUF MEMRD,DOUT,DTQ,,RALE ;READ DATA OUT
593 001CE 908401A5DC JCTF ,,MOVQ,,PARERR,SRFRQ,PERR ;PARITY ERROR?
594 001CF 90800A25C1 JCTF ,,,DEST10,RRFRQ,FSF7 ;CHECK FMK
595 001D0 1080009000 ALUF ,,,SRS ;SET READ STROBE
596 001D1 119B0B0000 ALU ,,DECR,RO ;DECREMENT LSB
597 001D2 90083715CA JCTF ,,RTDQ,R3,COUT,RRS,FSR2 ;WAS LSB=0 ?
598 001D3 108B180000 ALU ,,MOVR,R1 ;MSB=0?
599 001D4 90800605D7 JCT ,,,EQUAL,FREND ;IF YES, GOTO FREND
600 001D5 1D98180000 ALU ,CA,DECR,R1 ;DEC MSB
601 001D6 90083001CA JMP ,,RTDQ,R3,FSR2 ;CONTINUE
602 001D7 90800C01D9 FREND: JCF ,,,ENBDET,FR6END ;CHECK EDT DISABLE SW
603 001D8 918900F1E3 JMPF ,,INCR,RO,SLDP,RDEND ;INC LSB TO 0 & END RD
604 001D9 119B180000 FR6END: ALU ,,DECR,R1 ;INC MSB
605 001DA 90083001CA JMP ,,RTDQ,R3,FSR2 ;CONTINUE

607 001DB ;
608 001DB ;ERROR ROUTINES
609 001DB ;
610 001DB 108000F000 BERR: ALUF ,,,,SLDP ;TRIED TO RD REV FROM LDP
611 001DC 1080005004 PERR: ALUF ,,,,RALE,RW ;RESET ALE & WRITE
612 001DD 1080002000 ALUF ,,,,RRFRQ ;RESET REFRESH REQ
613 001DE 1080001000 ALUF ,,,,RRS ;RESET READ STROBE
614 001DF 108000B009 ALUF ,,,,RBSY,SHER ;PARITY ERROR
615 001E0 9080003050 JMPF ,,,,RRBSY,IDLE1 ;RETURN TO IDLE LOOP
616 001E1 119800B009 EERR: ALUF ,,,DEC,R0,RBSY,SHER ;PAST END OF REEL
617 001E2 9080003050 JMPF ,,,,RRBSY,IDLE1 ;RETURN TO IDLE LOOP
618 001E3 ;
619 001E3 ;END OF READ ROUTINE
620 001E3 ;
621 001E3 208E002000 RDEND: ALUF MEMRD,,MOVD,,RRFRQ ;NRZ OR PE ?
622 001E4 90800B11EF JCFF ,,,,DEST11,RRS,WTEND ;IF PE, SKIP CCG ROUTINE
623 001E5 300E0B0002 ALU CONST,,DTDQ,,H#2 ;LOOP COUNT=2
624 001E6 1080000008 RE1: ALUF ,,,,SCCG ;SET CCG
625 001E7 1080009000 ALUF ,,,,SRS ;SET READ STROBE
626 001EB 10140B0000 ALU ,,DECQ ;DEC LOOP COUNT
627 001E9 90B00611E6 JCFF ,,,,EQUAL,RRS,RE1 ;SENT TWO RD STROBES?
628 001EA 1080000003 ALUF ,,,,RCCG ;
629 001EB 90800001EF JMP ,,,,WTEND ;
630 001EC ;
631 001EC ;WRITE END
632 001EC ;
633 001EC 90800721EF WREN: JCFF ,,,,COUT,RRFRQ,WTEND ;
634 001ED D0B00001FB JSR ,,,,ADC ;
635 001EE 1DB91B0000 ALU ,CA,INCR,R1 ;
636 001EF ;
637 001EF ;WAIT 100US END GAP
638 001EF ;
639 001EF D1C4400207 WTEND: JSR ,,,ZERR,R4,WAIT ;WAIT 100US END GAP
640 001F0 108000B006 ALUF ,,,,RBSY,RDE ;
641 001F1 9080003050 JMPF ,,,,RRBSY,IDLE1 ;

643 001F2 ;
644 001F2 ;STROBE FREQUENCY SELECT
645 001F2 ;
646 001F2 318EB80002 SFREQ: ALU CONST,,DTOR,R8,H#2 ;
647 001F3 90440D05F5 JCT ,,ZERQ,,SF1,SFR1 ;
648 001F4 71BE3B0029 RTS CONST,,DTOR,R3,H#29 ;XFER RATE=100KB/S(SF1)
649 001F5 91C43E01FB SFR1: JCF ,,ZERR,R3,SF2,SFR3 ;XFER RATE=385KB/S(SF2)
650 001F6 90800F01F9 JCF ,,,SF3,SFR4 ;XFER RATE=455KB/S(SF3)
651 001F7 50083B0000 RTS ,,RTOQ,R3 ;XFER RATE=556KB/S(DEF)
652 001FB 10008B0000 SFR3: ALU ,,QPRQ,R8 ;SET UP STROBE FREQ IN R3
653 001F9 10008B0000 SFR4: ALU ,,QPRQ,R8 ;
654 001FA 51843B0000 RTS ,,DTOR,R3 ;
655 001FB ;
656 001FB ;CHECK ADDRESS AGAINST LOGICAL AND PHYSICAL EOT
657 001FB ;
658 001FB 90800C0201 ADC: JCF ,,,,ENBEDT,ADC1 ;J IF DISABLE EOT
659 001FC 30EA1B000C ALU CONST,,DXR,R1,H#00C ;IS MSB=C ?
660 001FD 90800601FF JCF ,,,,EQUAL,ADC2 ;IF NOT, JUMP
661 001FE 508000E000 RTSF ,,,,SEOT ;SET EOT
662 001FF 30EA1B000F ADC2: ALU CONST,,DXR,R1,H#00F ;MSB=F?
663 00200 90800605E1 JCT ,,,,EQUAL,EERR ;IF YES, GOTO ERROR
664 00201 5080080000 ADC1: RTS ;
665 00202 ;
666 00202 ;WAIT FOR 800US RAMP DELAY
667 00202 ;
668 00202 31BECB0008 WAIT1: ALU CONST,,DTOR,R12,H#8 ;
669 00203 D1C4400207 W2: JSR ,,ZERR,R4,WAIT ;
670 00204 1198CB0000 ALU ,,DECR,R12 ;
671 00205 9080070603 JCT ,,,,COUT,W2 ;
672 00206 5080080000 RTS ;
673 00207 ;
674 00207 ;WAIT 100 MICROSECONDS
675 00207 ;
676 00207 118948000A WAIT: ALU ,,,INCR,R4,SFRQ ;INCREMENT COUNTER
677 00208 1080002000 ALUF ,,,,RRFRQ ;
678 00209 1088480000 ALU ,,,MOVR,R4 ;
679 0020A 9080020207 JCF ,,,,DEST7,WAIT ;128 TIMES
680 0020B 51C44B0000 RTS ,,,ZERR,R4 ;RETURN
681 0020C END

TOTAL ASSEMBLY ERRORS = 0

CROSS REFERENCE TABLE

LABEL	TYPE	VALUE	REFERENCES							
ADC	A	001FB	205	216	233	245	256	264	350	383
			407	418	437	456	466	477	480	577
			634	-658						
ADC1	A	00201	658	-664						
ADC2	A	001FF	660	-662						
ALU	D		30	36	45	46	48	51	53	55
			56	58	59	61	62	63	68	69
			70	71	72	73	74	75	83	84
			87	92	94	97	98	99	101	103
			108	110	119	163	197	206	226	231
			234	235	238	243	246	249	258	260
			261	262	273	276	277	279	288	297
			299	301	304	307	311	318	321	329
			330	334	343	346	348	351	352	355
			362	364	366	367	368	370	371	373
			374	375	376	379	384	385	387	399
			403	408	414	419	421	424	426	432
			435	439	449	453	457	459	463	469
			474	481	491	494	495	497	506	507
			509	514	520	525	530	544	547	552
			554	559	563	570	573	584	587	591
			596	598	600	604	623	626	635	646
			652	653	659	662	668	670	676	678
ALUF	D		85	86	88	89	90	91	100	102
			105	106	118	120	122	127	128	129
			135	136	138	139	188	198	199	200
			202	203	207	208	210	211	213	225
			227	229	237	239	248	250	251	252
			278	280	291	292	293	303	310	312
			313	314	323	327	331	336	342	344
			345	347	353	354	356	361	377	378
			380	381	398	400	401	402	404	409
			410	412	413	415	427	428	430	431
			433	447	448	450	451	458	460	461
			468	470	471	472	482	496	498	500
			508	510	512	519	521	522	523	532
			543	546	548	551	557	562	564	568
			575	590	592	595	610	611	612	613
			614	616	621	624	625	628	640	677
BERR	A	001DE	275	493	586	-610				
CA	A	00003	84	96	98	112	198	207	224	234
			246	257	265	274	276	288	304	307
			324	342	351	361	384	398	409	427
			447	457	467	478	481	492	494	506
			518	533	543	559	573	576	585	587
			600	635						
CMD1	A	00057	140	-163						
CMD2	A	0005F	167	-171						
CMD3	A	00061	166	-173						

CMD4	A	00064	164	-176							
CMD5	A	00069	177	-181							
CMD6	A	0006C	165	176	-184						
CONST	A	00003	30	36	45	46	51	53	55	59	
			63	68	69	70	71	94	99	110	
			197	260	301	321	329	334	343	352	
			364	371	419	424	439	530	554	570	
			623	646	648	659	662	668			
COUT	A	00007	47	49	93	109	204	215	232	244	
			255	263	298	319	332	349	365	372	
			382	406	417	436	455	465	476	479	
			515	527	553	569	576	597	633	671	
DAB	A	000CC	0								
DAE9	A	0004C	0								
DAER	A	001CC	0								
DAR	A	000CA	0								
DARE	A	0004A	53								
DARR	A	001CA	102								
DATIN	A	00000	210	404	415						
DEC8	A	00014	209	236	290	411	429	545	561	589	
			626								
DEC9	A	0019B	276	277	288	289	297	304	307	318	
			324	331	337	494	495	501	506	507	
			514	518	526	533	587	588	596	600	
			604	616	670						
DEST10	A	0000A	34	40	164	187	241	282	295	315	
			550	565	594						
DEST11	A	0000B	35	41	167	173	179	182	186	259	
			328	363	622						
DEST7	A	00002	31	37	168	169	171	178	181	184	
			679								
DEST8	A	00008	32	38	165	176	214	228	242	254	
			281	294	316	405	416	434	454	464	
			475	501	511	526	567				
DEST9	A	00009	33	39	166	177	185				
DGEND	A	0004D	-127								
DIAG1	A	00000	-30								
DIAG2	A	0000C	-45								
DIAG3	A	00020	-68								
DIAG4	A	00029	-83								
DIAG5	A	00048	111	-118							
DM1	A	0004E	0								
DM2	A	000AD	0								
DM6G	A	0002D	0								
DM8R	A	001AD	0								
DM9R	A	0002B	51	59	63						
DMRR	A	001AB	0								
DO89	A	0003C	0								
DO9F	A	001B8	0								
DOR9	A	0003A	55								
DORR	A	001BA	0								
DOUT	A	00002	135	227	239	250	260	280	293	312	
			329	344	353	450	460	470	498	510	

			521	548	564	592				
DP1	A	0008F	0							
DPQ	A	0008C	0							
DPRQ	A	0000C	0							
DPRR	A	001BC	0							
DPR	A	0008A	0							
DPRQ	A	0000A	46	364	371					
DPRR	A	0018A	0							
DTQB	A	0000E	30	36	210	227	239	250	280	293
			312	343	352	450	460	470	498	510
					521	548	564	592	623	
DTOR	A	0018E	45	68	69	70	71	99	163	197
			439	646	648	668				
DXRQ	A	0006C	0							
DXRR	A	001EC	0							
DXR	A	000EA	94	110	301	321	334	419	424	530
			554	570	659	662				
DXRQ	A	0006A	0							
DXRR	A	001EA	0							
EERR	A	001E1	572	-616	663					
ENBEDT	A	0000C	286	306	325	504	517	529	556	572
			602	658						
EQUAL	A	00006	50	52	54	57	60	64	76	95
			104	111	209	236	274	275	284	285
			290	300	302	320	322	333	335	386
			388	411	420	425	429	492	493	502
			503	516	528	531	545	555	561	571
			585	586	589	599	627	660	663	
ERF	A	0010A	365	-367						
ERF1	A	0010D	363	-370						
ERF2	A	00114	369	-377	386	388				
ERF3	A	00111	372	-374						
ERF5	A	0011C	382	-385						
ERFIX	A	00104	181	-361						
ERV1	A	0012E	406	-409	417	422				
ERV2	A	0013C	420	-423						
ERV3	A	0014C	425	-439						
ERV5	A	0013D	405	-424	436	438				
ERV6	A	00140	-427	440						
ERVAR	A	00121	178	-396						
FBSY	A	00005	140							
FR6END	A	001D9	602	-604						
FREND	A	001D7	599	-602						
FSF2	A	001A3	-545	553	560					
FSF4	A	001B1	555	556	-559					
FSF7	A	001C1	550	565	567	-575	594			
FSF8	A	001B3	558	-561	569	574				
FSF9	A	001BF	571	-573						
FSFWD	A	001A0	174	-542						
FSR0	A	001C9	585	-588						
FSR2	A	001CA	-589	597	601	605				
FSREV	A	001C5	173	-584						
IDLE1	A	00050	-135	141	189	483	615	617	641	

IDLE2	A	00055	137	-140							
ILLCMD	A	00070	170	175	180	183	184	185	-188		
INCR	A	00005	48	56							
		00189	92	96	108	112	203	206	214	217	
			231	234	243	246	254	257	262	265	
			309	326	348	351	357	366	370	373	
			381	384	405	408	416	421	422	423	
			426	435	438	454	457	464	467	475	
			478	481	505	535	552	559	568	573	
			575	578	603	635	676				
JCF	D		37	38	39	40	41	49	50	52	
			54	57	60	64	76	93	104	109	
			121	169	179	182	228	232	236	255	
			259	274	281	286	290	302	322	325	
			328	335	349	363	365	372	386	388	
			454	455	465	476	479	492	501	502	
			503	504	516	528	531	545	555	556	
			561	569	571	585	589	602	649	650	
			658	660	679						
JCFF	D		137	204	209	215	244	263	284	285	
			382	406	411	417	429	436	553	576	
JCT	D		622	627	633						
			31	32	33	34	35	47	95	107	
			111	140	164	165	166	167	168	171	
			173	176	177	178	181	184	185	186	
			187	201	212	253	254	275	300	306	
			315	316	317	319	320	333	420	425	
			464	473	475	493	513	515	517	524	
			526	527	529	572	586	599	647	663	
			671								
JCTF	D		214	230	240	241	242	282	283	294	
			295	296	298	332	405	416	434	452	
			462	499	511	549	550	565	566	567	
			593	594	597						
JMP	D		96	112	113	141	170	172	174	175	
			180	183	189	217	247	257	265	287	
			305	308	309	324	337	369	389	422	
			423	438	440	467	478	518	533	558	
			560	574	578	601	605	629			
JMPF	D		326	357	483	505	534	535	603	615	
			617	641							
JSR	D		195	196	205	216	233	245	256	264	
			289	350	383	397	407	418	437	456	
			466	477	480	542	577	588	634	639	
			669								
JSRF	D		224	396							
MEMRD	A	00002	102	120	227	239	250	258	280	293	
			312	327	362	450	460	470	498	510	
			521	548	564	592	621				
MEMWR	A	00001	85	199	210	343	352	377	401	412	
			430								
MOVED	A	0008E	258	260	327	329	362	404	415	621	
MOVEQ	A	00084	31	32	33	34	35	37	38	39	

			40	41	49	213	240	241	253	281
			294	314	315	316	344	353	451	453
			461	463	472	474	499	500	525	549
			566	593						
MOVR	A	0008B	85	86	113	118	164	165	166	167
			168	169	170	171	172	173	174	175
			176	177	178	179	180	181	182	183
			184	185	186	187	188	189	198	199
			200	207	211	224	225	237	248	273
			274	278	283	284	291	299	310	319
			332	342	345	354	361	378	398	402
			409	413	427	430	431	433	447	448
			458	468	491	492	496	502	508	515
			519	527	543	546	562	584	585	590
			598	678						
DNEQ	A	00072	0							
DNER	A	001F2	0							
ONES	A	000F2	0							
PARERR	A	00001	107	121	201	212	230	240	253	283
			296	317	452	462	473	499	513	524
			549	566	593					
PERR	A	001DC	201	212	230	240	253	283	296	317
			452	462	473	499	513	524	549	566
			593	-611						
QAR	A	000C0	0							
QARE	A	00040	101							
QARR	A	001C0	0							
QMD	A	0009D	0							
QMDE	A	0001D	0							
QMDR	A	0019D	0							
QMR	A	00091	385	387						
QMRE	A	00011	0							
QMRR	A	00191	0							
QORE	A	00030	0							
QORR	A	001B0	0							
QPR	A	00080	0							
QPQE	A	00000	73	74	75	368	375	652	653	
QPQR	A	001B0	0							
QTOR	A	001B4	365	369	372	376	654			
QXR	A	000E0	103							
QXRE	A	00060	0							
QXRR	A	001E0	0							
R0	A	00000	83	85	86	92	97	100	108	113
			118	128	138	200	203	211	214	225
			231	237	243	248	254	262	273	277
			278	283	289	291	297	309	310	318
			326	331	345	348	354	357	364	371
			378	381	385	402	405	413	416	431
			435	448	454	458	464	468	475	491
			495	496	501	505	507	508	514	519
			526	535	546	552	562	568	575	584
			588	590	596	603	616			
R1	A	00001	45	46	51	53	55	58	59	61

			62	63	68	72	84	94	96	98
			110	112	129	139	198	206	207	217
			224	234	246	257	265	274	276	284
			288	299	301	304	307	319	321	324
			332	334	337	342	351	361	368	375
			384	387	398	408	409	422	423	427
			438	447	457	467	478	481	492	494
			502	506	515	518	527	530	533	543
			554	559	570	573	578	585	587	598
			600	604	635	659	662			
R10	A	0000A	399	430	433	439				
R11	A	0000B	0							
R12	A	0000C	668	670						
R13	A	0000D	0							
R14	A	0000E	0							
R15	A	0000F	0							
R2	A	00002	69	73	163	164	165	166	167	168
			169	170	171	172	173	174	175	176
			177	178	179	180	181	182	183	184
			185	186	187	188	189			
R3	A	00003	208	232	235	244	247	298	305	308
			410	428	544	553	560	569	574	597
			601	605	648	649	651	654		
R4	A	00004	70	74	195	396	639	669	676	678
			680							
R5	A	00005	365	372	382					
R6	A	00006	363	366	367	369	370	373	374	376
			386							
R7	A	00007	99	101	102	103	397	419	421	424
			426							
R8	A	00008	71	75	646	652	653			
R9	A	00009	197	199						
RALE	A	00005	88	102	120	202	213	227	239	250
			280	293	312	347	356	380	404	415
			433	450	460	470	498	510	521	548
			564	592	611					
RBSY	A	0000B	482	614	616	640				
RCC6	A	00003	628							
RD1	A	00039	-99	109	112					
RDCMD	A	00001	163							
RDE	A	00006	91	208	381	410	428	640		
RDEND	A	001E3	263	265	287	294	309	326	332	576
			578	603	-621					
RDERR	A	00047	104	-113						
RDF2	A	00095	232	-236	244	247	254			
RDF5	A	000A1	228	-248	255	257				
RDFE4	A	000AB	241	-258						
RDFE5	A	000AF	242	259	-262					
RDFWD	A	00089	169	-224						
RD6OK	A	00007	0							
RDR0	A	000B7	274	-277						
RDR1	A	000BB	-278	337						
RDR2	A	000C4	-290	298	305	308				


```
1 TITLE SPECTRA 03 TAPE EMULATOR FIRMWARE DEFINITIONS
2 ;
3 ;
4 ;PAUL WASSENBERG
5 ;
6 ;JANUARY 6, 1983
7 ;NOVEMBER 26, 1986 MODIFICATIONS FOR S03
8 ;
9 ; THIS FILE DEFINES THE INSTRUCTIONS USED IN THE FIRMWARE FOR THE
10 ; SPECTRA TAPEWORM.
11 ; 12 INSTRUCTIONS ARE DEFINED AND HAVE THE FOLLOWING FORM:
12 ;
13 ; ALU SOURCE, DESTINATION, ALU OP, REGISTER ADDRESS, CONSTANT
14 ; ALUF SOURCE, DESTINATION, ALU OP, REGISTER ADDRESS, FLAG2,FLAG1
15 ; RTS SOURCE, DESTINATION, ALU OP, REGISTER ADDRESS, CONSTANT
16 ; RTSF SOURCE, DESTINATION, ALU OP, REGISTER ADDRESS, FLAG2,FLAG1
17 ; JMP SOURCE, DESTINATION, ALU OP, REGISTER ADDRESS, JUMP ADDRESS
18 ; JMFF SOURCE, DESTINATION, ALU OP, REG ADDR, FLAG2, JUMP ADDRESS
19 ; JSR SOURCE, DESTINATION, ALU OP, REG ADDR, JUMP ADDRESS
20 ; JSRF SOURCE, DESTINATION, ALU OP, REG ADDR, FLAG2, JUMP ADDRESS
21 ; JCT SOURCE, DESTINATION, ALU OP, REG ADDR, COND SEL, JMP ADDRESS
22 ; JCTF SOURCE, DESTINATION, ALU OP, REG ADDR, COND SEL, FLG2, JMP ADDR
23 ; JCF SOURCE, DESTINATION, ALU OP, REG ADDR, COND SEL, JMP ADDRESS
24 ; JCFF SOURCE, DESTINATION, ALU OP, REG ADDR, COND SEL, FLG2, JMP ADDR
25 ;
26 ;
27 ;
28 WORD 40
29 ;
30 ALUOP: SUB 10V%#0010000000 ;ALU OPERATION
31 SRC: SUB 2V%#01 ;SOURCE ADDRESS
32 DST: SUB 2V%#00 ;DESTINATION ADDRESS
33 ;
34 ;
35 ;INSTRUCTIONS
36 ALU: DEF B#00,SRC,DST,ALUOP,4V%H#0,BH#80,12V%H#000
37 ALUF: DEF B#00,SRC,DST,ALUOP,4V%H#0,4H#0,4V%H#0,BH#00,4V%H#0
38 RTS: DEF B#01,SRC,DST,ALUOP,4V%H#0,BH#80,12V%H#000
39 RTSF: DEF B#01,SRC,DST,ALUOP,4V%H#0,4H#0,4V%H#0,BH#00,4V%H#0
40 JMP: DEF B#10,SRC,DST,ALUOP,4V%H#0,BH#00,B#00,10V$
41 JMFF: DEF B#10,SRC,DST,ALUOP,4V%H#0,4H#0,4V%H#0,B#00,10V$
42 JSR: DEF B#11,SRC,DST,ALUOP,4V%H#0,BH#00,B#00,10V$
43 JSRF: DEF B#11,SRC,DST,ALUOP,4V%H#0,4H#0,4V%H#0,B#00,10V$
44 JCT: DEF B#10,SRC,DST,ALUOP,4V%H#0,4V%H#0,4H#0,B#01,10V$
45 JCTF: DEF B#10,SRC,DST,ALUOP,4V%H#0,4V%H#0,4V%H#0,B#01,10V$
46 JCF: DEF B#10,SRC,DST,ALUOP,4V%H#0,4V%H#0,4H#0,B#00,10V$
47 JCFF: DEF B#10,SRC,DST,ALUOP,4V%H#0,4V%H#0,4V%H#0,B#00,10V$
48 ;
```

```
50 ;
51 ;SOURCE DEFINITIONS
52 ;
53 DATIN: EQU B#00          ;ENABLE TAPE WRITE DATA
54 RDCMD: EQU B#01          ;ENABLE TAPE COMMAND
55 MEMRD: EQU B#10          ;ENABLE RAM DATA
56 CONST: EQU B#11          ;ENABLE FIRMWARE CONSTANT
57 ;
58 ;
59 ;DESTINATION DEFINITIONS
60 ;
61 MEMWR: EQU B#01          ;LOAD RAM WRITE DATA
62 DOUT: EQU B#10           ;LOAD TAPE READ DATA
63 CA:   EQU B#11           ;LOAD UPPER NIBBLE OF COLUMN ADDRESS
64 ;
65 ;
66 ;
67 ;ALU OPERATION DEFINITIONS
68 ; IB,I7,I6,I5,I4,I3,I2,I1,I0,CN
69 ;
70 MOVD: EQU B#0010001110  ;MOVE D
71 MOVR: EQU B#0010001000  ;MOVE R
72 MOVQ: EQU B#0010000100  ;MOVE Q
73 DTOR: EQU B#0110001110  ;D => R
74 DTOB: EQU B#00000001110 ;D => Q
75 RTDQ: EQU B#00000001000 ;R => Q
76 QTDR: EQU B#0110000100  ;Q => R
77 DPQQ: EQU B#00000001100 ;D + Q => Q
78 DPRQ: EQU B#0110001100  ;D + Q => R
79 DPE:  EQU B#0010001100  ;D + Q
80 DPRQ: EQU B#00000001010 ;D + R => Q
81 DPRR: EQU B#01100001010 ;D + R => R
82 DPR:  EQU B#00100001010 ;D + R
83 QPRQ: EQU B#00000000000 ;Q + R => Q
84 QPRR: EQU B#01100000000 ;Q + R => R
85 QPR:  EQU B#00100000000 ;Q + R
86 RP1Q: EQU B#00000001001 ;R + 1 => Q
87 RM1Q: EQU B#00000011000 ;R - 1 => Q
88 DMQQ: EQU B#00000101101 ;D - Q => Q
89 DMQR: EQU B#0110101101  ;D - Q => R
90 DMR:  EQU B#0010101101  ;D - R
91 DMRQ: EQU B#00000101011 ;D - R => Q
92 DMRR: EQU B#01101010111 ;D - R => R
93 QMDQ: EQU B#00000011101 ;Q - D => Q
94 QMDR: EQU B#0110011101  ;Q - D => R
95 QMD:  EQU B#0010011101  ;Q - D
96 QMRE: EQU B#00000010001 ;Q - R => Q
97 QMRR: EQU B#0110010001  ;Q - R => R
98 QMR:  EQU B#00100010001 ;Q - R
99 RMDQ: EQU B#00000011011 ;R - D => Q
100 RMDR: EQU B#01100110111 ;R - D => R
101 RMD:  EQU B#00100110111 ;R - D
102 RMR:  EQU B#0110100001  ;R - Q => R
```

103 RMO: EQU B#0010100001 ;R - Q
104 DP1: EQU B#0010001111 ;D + 1
105 INCQ: EQU B#00000000101 ;Q + 1 => Q
106 INCR: EQU B#0110001001 ;R + 1 => R
107 DM1: EQU B#0010101110 ;D - 1
108 DECQ: EQU B#00000010100 ;Q - 1 => Q
109 DECR: EQU B#0110011000 ;R - 1 => R
110 RX2R: EQU B#0110000010 ;R * 2 => R R * 2 => DEST BUS
111 SLR: EQU B#1110001000 ;R * 2 => R R => DEST BUS
112 SRR: EQU B#1010001000 ;R / 2 => R R => DEST BUS
113 SELTOR: EQU B#1110000100 ;Q * 2 => R Q => DEST BUS
114 DAQQ: EQU B#0001001100 ;D AND Q => Q
115 DAQR: EQU B#0111001100 ;D AND Q => R
116 DAQ: EQU B#0011001100 ;D AND Q
117 DARQ: EQU B#0001001010 ;D AND R => Q
118 DARR: EQU B#0111001010 ;D AND R => R
119 SLDARR: EQU B#1111001010 ;(D AND R) * 2 => R
120 DAR: EQU B#0011001010 ;D AND R
121 BARQ: EQU B#0001000000 ;Q AND R => Q
122 QARR: EQU B#0111000000 ;Q AND R => R
123 BAR: EQU B#0011000000 ;Q AND R
124 DOQQ: EQU B#0000111100 ;D OR Q => Q
125 DOQR: EQU B#0110111100 ;D OR Q => R
126 DORQ: EQU B#00001111010 ;D OR R => Q
127 DORR: EQU B#01101111010 ;D OR R => R
128 QRQ: EQU B#0000110000 ;Q OR R => Q
129 QRQ: EQU B#0110110000 ;Q OR R => R
130 DXQQ: EQU B#0001101100 ;D EXOR Q => Q
131 DXQR: EQU B#0111101100 ;D EXOR Q => R
132 DXRE: EQU B#0001101010 ;D EXOR R => Q
133 DXRR: EQU B#0111101010 ;D EXOR R => R
134 DXR: EQU B#0011101010 ;D EXOR R
135 QRRE: EQU B#0001100000 ;Q EXOR R => Q
136 QRRE: EQU B#0111100000 ;Q EXOR R => R
137 QXR: EQU B#0011100000 ;Q EXOR R
138 ZERO: EQU B#0011000100 ;ZERO
139 ZERQ: EQU B#0001000100 ;ZERO => Q
140 ZERR: EQU B#0111000100 ;ZERO => R
141 ONES: EQU B#0011110010 ;ONES
142 ONEQ: EQU B#0001110010 ;ONES => Q
143 ONER: EQU B#0111110010 ;ONES => R
144 ;

146 ;
147 ;REGISTER ADDRESS DEFINITIONS
148 ;
149 R0: EQU H#0 ;
150 R1: EQU H#1 ;
151 R2: EQU H#2 ;
152 R3: EQU H#3 ;
153 R4: EQU H#4 ;
154 R5: EQU H#5 ;
155 R6: EQU H#6 ;
156 R7: EQU H#7 ;
157 R8: EQU H#8 ;
158 R9: EQU H#9 ;
159 R10: EQU H#A ;
160 R11: EQU H#B ;
161 R12: EQU H#C ;
162 R13: EQU H#D ;
163 R14: EQU H#E ;
164 R15: EQU H#F ;
165 ;
166 ;
167 ;
168 ;CONDITION SELECT DEFINITIONS
169 ;
170 PARERR: EQU H#1 ;PARITY ERROR(READ OR WRITE)
171 RDY: EQU H#3 ;LOW DURING RAM REFRESH
172 RWD: EQU H#4 ;REWIND CMD
173 FBSY: EQU H#5 ;FMTR BUSY
174 EQUAL: EQU H#6 ;DESTINATION BUS=0
175 COUT: EQU H#7 ;ALU CARRY OUT
176 DEST7: EQU H#2 ;DESTINATION BUS BIT 7
177 DEST8: EQU H#8 ; 8
178 DEST9: EQU H#9 ; 9
179 DEST10: EQU H#A ; 10
180 DEST11: EQU H#B ; 11
181 ENBEDT: EQU H#C ;ENABLE EOT
182 SF1: EQU H#D ;STROBE FREQUENCY 1
183 SF2: EQU H#E ;STROBE FREQUENCY 2
184 SF3: EQU H#F ;STROBE FREQUENCY 3
185 ;

```
187 ;  
188 ;FLAG62 VALUE DEFINITIONS  
189 ;  
190 SRS: EQU H#9 ;SET READ STROBE  
191 RRS: EQU H#1 ;RESET READ STROBE  
192 SRFRQ: EQU H#A ;SET REFRESH REQUEST  
193 RRFRQ: EQU H#2 ;RESET REFRESH REQUEST  
194 RBSY: EQU H#B ;RESET BUSY  
195 RRBSY: EQU H#3 ;RESET RESET BUSY  
196 SWS: EQU H#C ;SET WRITE STROBE  
197 RWS: EQU H#4 ;RESET WRITE STROBE  
198 SALE: EQU H#D ;SET ALE  
199 RALE: EQU H#5 ;RESET ALE  
200 SEOT: EQU H#E ;SET EOT  
201 REOT: EQU H#6 ;RESET EOT  
202 SLDP: EQU H#F ;SET LDP  
203 RLDP: EQU H#7 ;RESET LDP  
204 ;  
205 ;FLAG61 VALUE DEFINITIONS  
206 ;  
207 SHER: EQU H#9 ;SET HARD ERROR  
208 RHER: EQU H#1 ;RESET HARD ERROR  
209 SPT: EQU H#A ;SET PARITY TEST  
210 RPT: EQU H#2 ;RESET PARITY TEST  
211 SCC6: EQU H#B ;SET CCG  
212 RCCG: EQU H#3 ;RESET CCG  
213 SW: EQU H#C ;SET WRITE  
214 RW: EQU H#4 ;RESET WRITE  
215 SRDBAD: EQU H#D ;SET RESET DIAG BAD  
216 RRDBAD: EQU H#5 ;RESET RESET DIAG BAD  
217 SDE: EQU H#E ;SET DATA ENABLE  
218 RDE: EQU H#6 ;RESET DATA ENABLE  
219 SDGOK: EQU H#F ;SET DG OK  
220 RDGOK: EQU H#7 ;RESET DG OK  
221 ;  
222 END
```

TOTAL DEFINITION ERRORS = 0

SYMBOL TABLE

ALU	D	ALUF	D	ALUOP	S	CA	A	00003
CONST	A	00003	COUT	A	00007	DAQ	A	000CC
DAQR	A	001CC	DAR	A	000CA	DARQ	A	0004A
DATIN	A	00000	DEC8	A	00014	DECR	A	0019B
DEST11	A	0000B	DEST7	A	00002	DEST8	A	00008
DM1	A	000AE	DM2	A	000AD	DMQQ	A	0002D
DMRQ	A	0002B	DMRR	A	001AB	DOQQ	A	0003C
DORQ	A	0003A	DORR	A	001BA	DOUT	A	00002
DPQ	A	000BC	DPQQ	A	0000C	DPQR	A	0018C
DPRQ	A	0000A	DPRR	A	001BA	DST	S	0000E
DTOR	A	0018E	DXQQ	A	0006C	DXQR	A	001EC
DXRQ	A	0006A	DXRR	A	001EA	EMBEOT	A	0000C
FBSY	A	00005	INCQ	A	00005	INCR	A	00189
JCF	D	JCT	D	JCTF	D	JMP	D	
JMPF	D	JSR	D	JSRF	D	MEMRD	A	00002
MEMWR	A	00001	M0VD	A	0008E	M0V0	A	00084
ONEQ	A	00072	ONER	A	001F2	ONES	A	000F2
QAR	A	000C0	QARR	A	00040	QARR	A	001C0
QM0Q	A	0001D	QM0R	A	0019D	QMR	A	00091
QMRR	A	00191	QDRQ	A	00030	QDRR	A	001B0
QP0Q	A	00000	QP0R	A	00180	QT0R	A	00184
QXRQ	A	00060	QXRR	A	001E0	R0	A	00000
R10	A	0000A	R11	A	0000B	R12	A	0000C
R14	A	0000E	R15	A	0000F	R2	A	00002
R4	A	00004	R5	A	00005	R6	A	00006
R8	A	00008	R9	A	00009	RALE	A	00005
RCC6	A	00003	RCCMD	A	00001	RDE	A	00006
RDY	A	00003	RE0T	A	00006	RHER	A	00001
RM10	A	00018	RMI	A	0009B	RM0Q	A	0001B
RME	A	000A1	RMR	A	001A1	RP10	A	00009
RRBSY	A	00003	R0DBAD	A	00005	RRFRQ	A	00002
RT0Q	A	00008	RT5	D	RTSF	D	RW	A
RWD	A	00004	RW5	A	00004	RX2R	A	001B2
SCCG	A	0000B	SDE	A	0000E	SD6OK	A	0000F
SF1	A	0000D	SF2	A	0000E	SF3	A	0000F
SLDARR	A	003CA	SLDP	A	0000F	SLGTOR	A	003B4
SPT	A	0000A	SRC	S	SRDBAD	A	0000D	SRFRQ
SRR	A	0028B	SRS	A	00009	SW	A	0000C
ZERO	A	00004	ZERB	A	00044	ZERR	A	001C4

