MS-DOS SLAVE PROCESSOR MODEL SP-188

PRELIMINARY DOCUMENTATION

CONTENTS

Morrow
600 McCormick St.
San Leandro, CA 94577

IMPORTANT WARRANTY INFORMATION

LIMITED WARRANTY

Morrow Designs, Inc. warrants its products to be free from defects in workmanship and materials for the periods indicated below. This warranty is limited to the repair and replacement of parts only.

This warranty is void if, in the sole opinion of Morrow Designs, Inc., the product has been subject to abuse or misuse, or has been interconnected to other manufacturer's equipment for which compatibility has not been established in writing.

Circuit boards - Parts, including the printed circuit board, purchased as factory assemblies, are warranted for a period of ninety (90) days from the original invoice/purchase date.

Electro-mechanical peripherals - Peripheral equipment such as floppy or hard disk drives, etc., not manufactured by Morrow Designs, Inc., are included in the limited warranty period of 90 days from the original invoice date when sold as part of a Morrow system.

Exception - Expendable items such as printer ribbons, software media, and printwheels are not covered by any warranty.

Software/Firmware - Morrow Designs, Inc. makes no representations or warranties whatsoever with respect to software or firmware associated with its products and specifically disclaims any implied or expressed warranty of fitness for any particular purpose or compatibility with any hardware, operating system, or software/firmware. Morrow Designs, Inc. reserves the right to alter or update any program, publication or manual without obligation to notify any person of such changes.

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WARRANTY RETURN PROCEDURE

Should a buyer experience a defect in either workmanship or materials during the warranty period, any Morrow Authorized Service Center will replace or repair the product at its expense only if the product is promptly returned to the dealer or Service Center with dated proof of purchase.

Should factory repair be necessary, the Service Center shall contact Morrow Customer Service for a Return Materials Authorization (RMA) number.

1. INTRODUCTION

NOTE: This version of the SP-188 manual assumes you are using a Morrow TRICEP computer and the udos MS-DOS emulator program.

Morrow Designs' SP-188 board provides the capability of running MS/DOS applications in the TRICEP UNIX environment. It is equipped with 128K or 512K of dual ported, dynamic memory. The board is designed to comply with the IEEE 696 (S-100) bus standard and will run in systems with clock speeds up to 10 Mhz.

The SP-188 board significantly increases the scope of applications program available to the TRICEP UNIX users by providing the capability of running MS/DOS applications as a UNIX task. The onboard 8 Mhz 80188 processor provides maximum performance while running the MS/DOS applications. In addition, the UNIX software can support up to eight of these applications processors in the TRICEP system.

Although the board is extremely flexible in its design, it is simple to install into the TRICEP system. We think you'll be pleased with the performance and reliability of this latest Morrow Designs S-100 product.

HARDWARE FEATURES

The SP-188 offers the following features:

1. Dual ported memory consisting of 128K (with 64K DRAMs) to a maximum of 512K (with 256K DRAMs).

2. Onboard 8 Mhz, 80188 processor for optimum execution speeds.

3. 4K bytes of onboard EPROM (may be replaced with RAM) for special applications.

4. Full compliance with the IEEE 696 standards at speeds up to 10 Mhz.

5. Dirty bit logic for increased performance in systems where process swapping is necessary.

6. Onboard I/O and Memory expansion connectors for future expansion capability and optimum flexibility.

MANUAL ORGANIZATION

This manual has been designed for users of the SP-188 board as well as OEM customers who are perhaps building custom systems with the board. Chapter 2 describes the general board functions and factory jumper settings for the Morrow TRICEP environment. Chapter 3 contains the installation details which all users are advised to read BEFORE plugging in the board.

Chapter 4 summarizes the "udos" MS-DOS emulator used in TRICEP systems. Chapter 5 describes maintenance procedures and diagnostic routines available on the board. Chapter 6 contains information detailing all the jumper options on the board which may be relevant to custom installations but are superfluous to TRICEP users. Chapter 7 contains a brief theory of operation for users who wish to know "the rest of the story". The appendices contain technical specifications, schematics, parts list and quick reference chart.

Generally speaking, the TRICEP users of the SP-188 should need only to read chapters 2 and 3 before installing the board. OEM customers are advised to read the entire manual.

2. SP-188 BOARD OVERVIEW

The SP-188 board provides up to 512K of dual ported memory to the S-100 bus. Being a memory board, the SP-188 memory must respond to a particular memory address. This address is determined by onboard jumpers. In addition, the board has 2 onboard I/O control ports and an Interrupt I.D. port which must be set correctly.

FACTORY JUMPER SETTINGS

Your SP-188 board comes ready to install as the first MS/DOS applications processor for the Morrow TRICEP system. The board is set up to occupy 1 Mbyte of address space residing at 700000h to 7FFFFFh and three I/O address locations from 5Fh - 61h. It is set up to generate a vectored interrupt on the S-100 bus VI1 line.

There are 2 jumper blocks which are relevant to memory addressing: JB4, JB5. In addition there is one jumper block relevant to I/O port addressing: JB12. The Interrupt I.D. port is determined by prom U26 (port 5Fh standard).

The SP-188 board can generate an S-100 vectored interrupt requesting service from the host processor. The particular vectored interrupt level is determined by JB8, JB9 and JB10.

(NOTE: If you are installing the SP-188 into a TRICEP which already has an SP-188 board, refer to the addressing charts in Appendix A.)

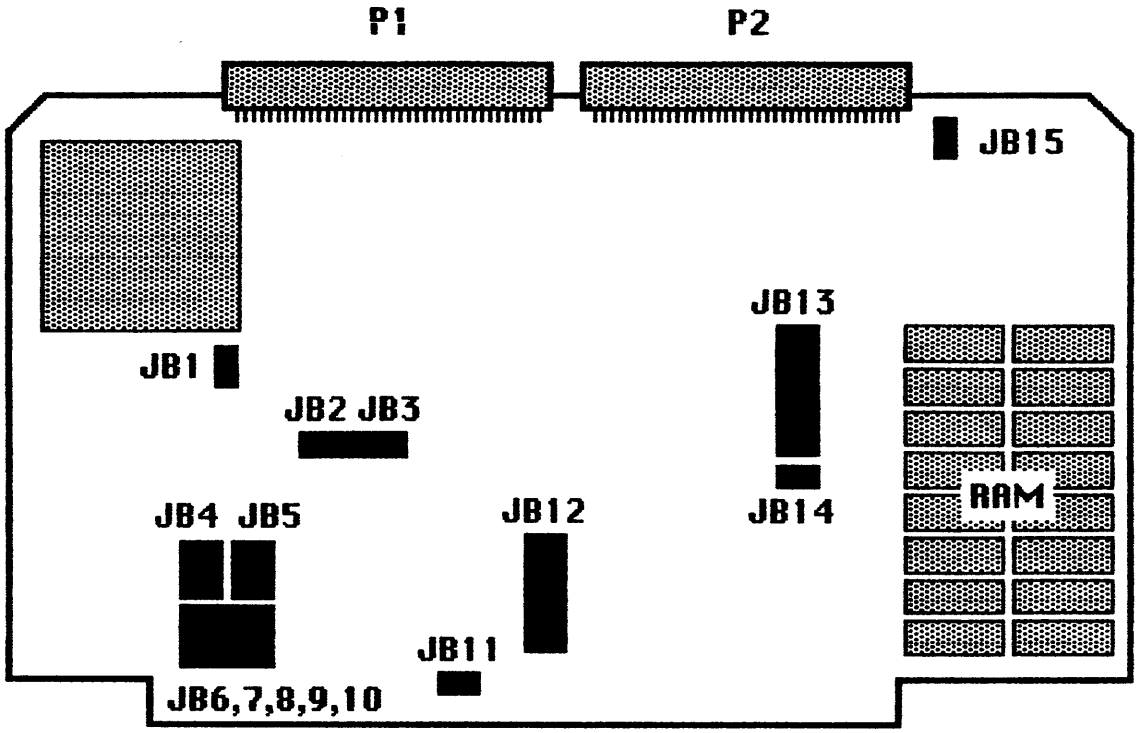


Figure 1. SP-188 Jumper Locations

MEMORY ADDRESS:	700000h - 7FFFFFh
I/O ADDRESS:	60h - 61h
INTERRUPT I.D. DATA BIT:	0
INTERRUPT VECTOR:	1

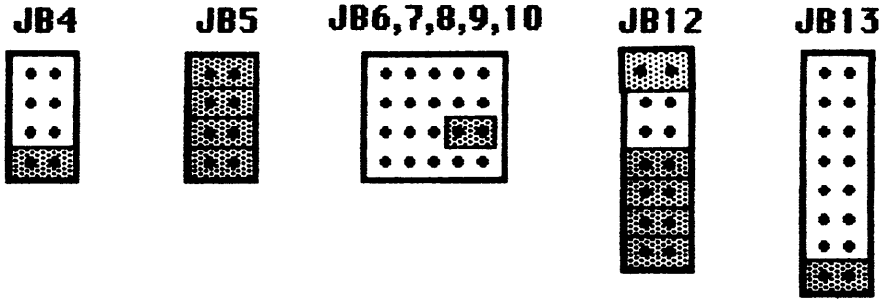


Figure 2. Factory Settings for First SP-188

Onboard Memory (JB3)

The SP188 board is designed to support either 64K or 256K DRAM chips. If the board contains 64K DRAMs, the maximum onboard memory is 128K. If the board contains 256K DRAMs, then the maximum onboard memory is 512K. There is one jumper header which selects which type of DRAM is to be used on the board, JB14. When the jumper is installed, 256K DRAMs must be used. Remove the jumper for 64K DRAM selection.

The factory setting for JB14 should match the memory chips as shipped from Morrow. You may verify the setting by checking the RAM chips for a 64 or 256 embedded in the part numbers.

NOTE: No other jumpers should be installed on the board. For complete detailed information on the other jumpers and configurations, see page 11.

3. INSTALLING THE SP-188

All computer boards must be handled with care, since the components on them may be damaged by bending or bumping. Also, the RAM chips may become displaced from their sockets if the board is mishandled.

You should be especially careful of static electricity when you handle the SP-188 board, since some of the chips onboard are susceptible to damage from static discharge. Always be sure that you have grounded yourself before handling the pc board.

INSPECTING THE BOARD

Inspect the SP-188 board for shipping damage. Be sure that the traces (the foil patterns on the front and back of the pc board) are not scratched or damaged. Also be sure that none of the onboard components appear to be broken.

Check the RAM chips in the lower right hand corner of the board (Figure 1). Since they are socketed, be sure that all chips are firmly seated in their sockets. If one end of a chip or the whole chip is higher than the other RAM chips, gently press down on it to reseat it.

Also be sure that all the jumpers are in place (see pages 3, 11, and Appendix C).

If the board is damaged from shipping, notify the carrier, and follow the Warranty Return Procedure at the front of this manual.

INSTALLING THE BOARD

Once you are certain that the board is in good condition and the jumpers set correctly, it is time to install the board into the computer. Be sure the power to your computer is off and the computer is unplugged from the AC outlet.

Remove the Tricep top cover by removing the four phillips screws shown in Figure 3. Turn the Tricep back on its feet and slide the top cover to the front and remove it completely from the chassis.

Find an empty slot in the S100 card cage to plug the circuit card into. NOTE: Whenever possible, keep the circuit boards as separated as possible to insure maximum airflow for cooling.

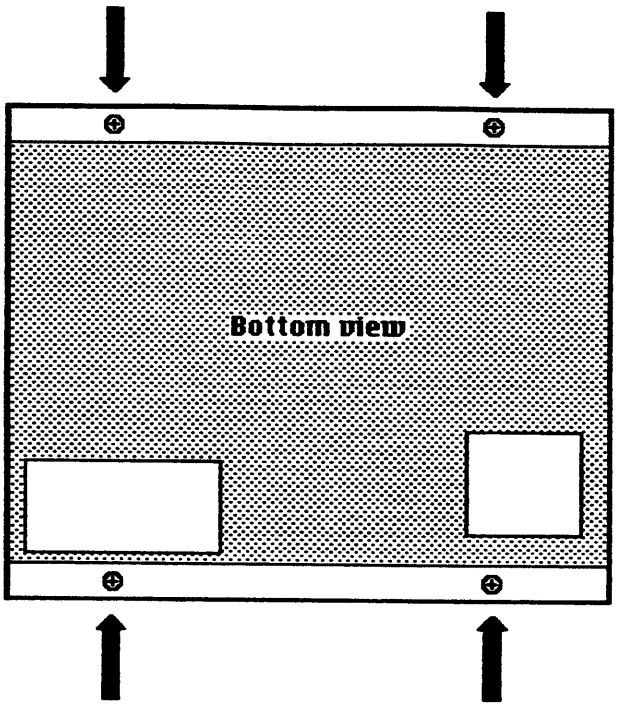


Figure 3. Tricep Cover Screw Locations

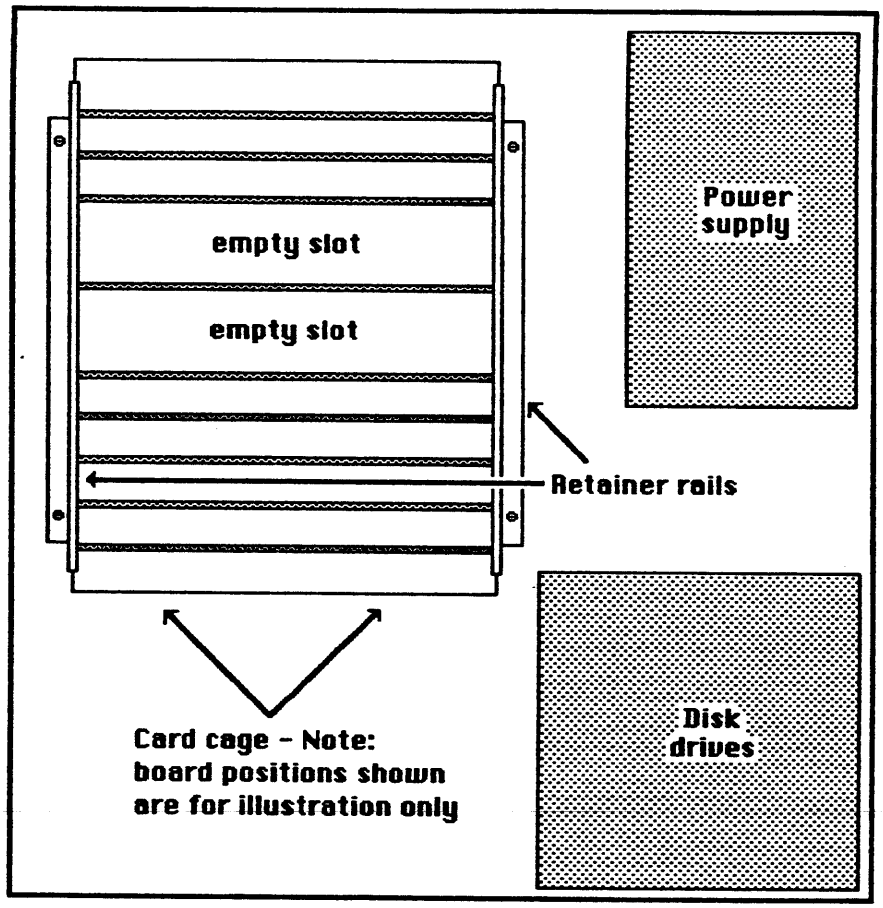


Figure 4. Location of the Board Retainer Rails

Loosen the four screws that hold the board retainer rails in place (Figure 4). It is probably not necessary to remove these screws completely. Remove the board retainer rails.

Slide the board into the slot, being sure the components face forward. Use the other boards in the system as examples. Gently push the top of the board so the bottom (the edge-connector) fits snugly into the S100 connector on the main board (motherboard). This usually makes a snapping sound when seated correctly.

The top of the SP-188 board should now be level and flush with the tops of the other boards. Replace the retainer rails and tighten their screws.

Your computer is now ready to operate with the SP-188 board, so replace the topcover and re-install the four screws. If you should ever need to remove the SP-188 board, pull gently at the top of the board and rock it from side to side until the board slides out.

CHECKOUT

Bring your Tricep system up in single user mode (**telinit s**) and invoke the /usr/bin/udos program from the /usr/dos directory as follows:

cd /usr/dos <CR>
udos <CR>

The standard MS-DOS (udos) A> prompt will now appear on the terminal. If it does not appear, the shell will notify you as to whether there is a problem with the SP-188 or you have mistyped the command. If there is a problem, see the Maintenance and Diagnostics section, page 10.

You may now use the built in udos functions (see page 9) or copy and run any MS-DOS program you wish to install. See also **dar** in the TRICEP Installation Manual.

When you wish to return back to the unix shell, type:

exit <CR>

and your Unix shell prompt will return.

4. UDOS SUMMARY

For complete details on udos, see the last section of the TRICEP Installation Manual.

Terminal Emulation

Select this option by including the -t flag on the udos command line. This allows you to install your MS-DOS software for the common ADM-31 terminal. Unix then translates the control codes for the terminal reflected in /etc/ttytype or .cshrc.

Drive Name Assignments

When you enter the udos command, drive A: is assigned to your current directory by default, or to the path of an MS-DOS command file if you include one on the command line that is outside of the current directory. In the latter case drive B: is assigned to your current directory.

Drive assignments can be made and changed at the udos system prompt in the format **c:=/usr/bin.**

Internal Commands

udos supports these standard MS-DOS internal commands:

date time type del dir cd ren

date and time report these statistics but cannot change them.
copy can be simulated with **alias copy !cp.**
mkdir and rmdir must be aliased as above.

Aliases and Other Routine Commands

Routine commands may be established in /usr/lib/dosrc, in the user's home directory in .dosrc, or interactively at the udos system prompt.

Installing MS-DOS Software

The recommended procedure consists of creating subdirectories in the /usr/dos directory, and using dar to copy the necessary files into the subdirectory. See the TRICEP manual for details.

See udos in the TRICEP manual also for Printer Considerations and Emergency Exit from udos.

5. MAINTENANCE AND DIAGNOSTICS

This section yet to be written...

6. JUMPER OPTIONS

The following is a list of all the jumper blocks on the SP-188, and a brief description of their functions. The factory settings are shown with an asterisk before them. See Figure 1 for jumper locations. See page ?? for proper settings when installing the second or later SP-188.

JB1

  Installed - RAM appears in 64K windows
* Removed - entire 1 Mb RAM appears on bus

JB2 (Slave Present)

* Installed - slave present bit low
  Removed - slave present bit high

JB3 (Bank Enable)

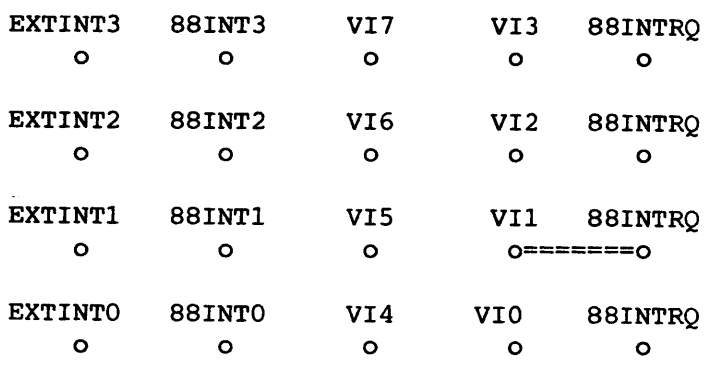
  Installed - bank select operation
* Removed - full Mb operation

JB4 - JB5 (S100 Memory Address)
Set at factory for first board: 700000H

```
JB4
o  o      Memory address A20
o  o      Memory address A21
o  o      Memory address A22
o==o      Memory address A23

JB5
o==o      Memory address A16
o==o      Memory address A17
o==o      Memory address A18
o==o      Memory address A19
```

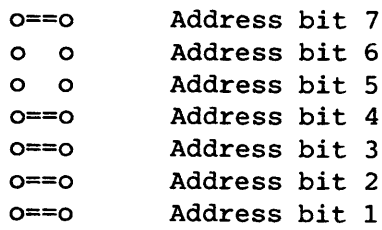
JB6 - JB10 (Interrupt Matrix)



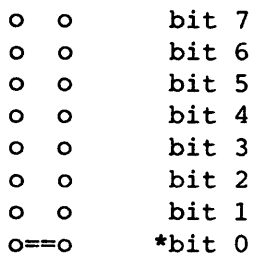
JB11 (Phantom Enable)

Installed - Board responds to S100 PHANTOM signal
* Removed - Board ignores S100 PHANTOM signal

JB12 (S100 I/O Port Address)
Set at factory for first board: 60H



JB13 (Interrupt ID data bit)



JB14 (RAM Option)

Installed - 256K DRAMS
* Removed - 64K DRAMS

JB15 (EPROM / SRAM)

UPPER to MIDDLE - static RAM select
* MIDDLE to LOWER - EPROM select

7. THEORY OF OPERATION

This section yet to come...

APPENDIX A: Additional Jumper Configuration Tables

Second Tricep SP-188:

MEMORY ADDRESS:	600000h - 6FFFFFh
I/O ADDRESS:	62h - 63h
INTERRUPT I.D. DATA BIT:	1
INTERRUPT VECTOR:	VI1

JB4	JB5	JB12	JB13	JB6	7	8	9	10
o==o	o==o	o==o	o o	o	o	o	o	o
o o	o==o	o o	o o	o	o	o	o	o
o o	o==o	o o	o o	o	o	o	o==o	
o==o	o==o	o==o	o o	o	o	o	o	o
		o==o	o o					
		o==o	o o					
		o o	o==o					
			o o					

Third Tricep SP-188:

MEMORY ADDRESS:	500000h - 5FFFFFh
I/O ADDRESS:	64h - 65h
INTERRUPT I.D. DATA BIT:	2
INTERRUPT VECTOR:	VI1

JB4	JB5	JB12	JB13	JB6	7	8	9	10
o o	o==o	o==o	o o	o	o	o	o	o
o==o	o==o	o o	o o	o	o	o	o	o
o o	o==o	o o	o o	o	o	o	o==o	
o==o	o==o	o==o	o o	o	o	o	o	o
		o==o	o o					
		o o	o==o					
		o==o	o o					
			o o					

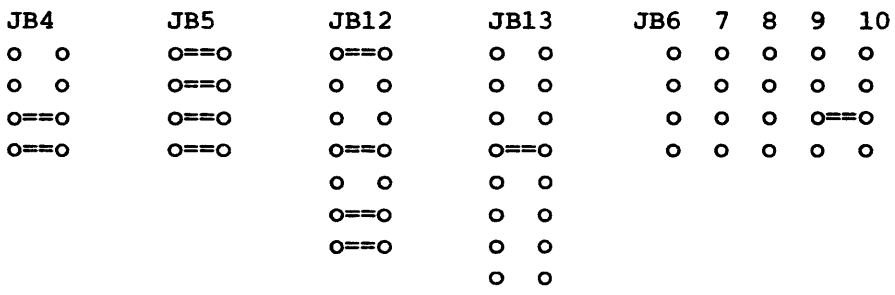
Fourth Tricep SP-188:

MEMORY ADDRESS:	400000h - 4FFFFFh
I/O ADDRESS:	66h - 67h
INTERRUPT I.D. DATA BIT:	3
INTERRUPT VECTOR:	VI1

JB4	JB5	JB12	JB13	JB6	7	8	9	10
o==o	o==o	o==o	o o	o	o	o	o	o
o==o	o==o	o o	o o	o	o	o	o	o
o o	o==o	o o	o o	o	o	o	o==o	
o==o	o==o	o==o	o o	o	o	o	o	o
		o==o	o==o					
		o o	o o					
		o o	o o					
			o o					

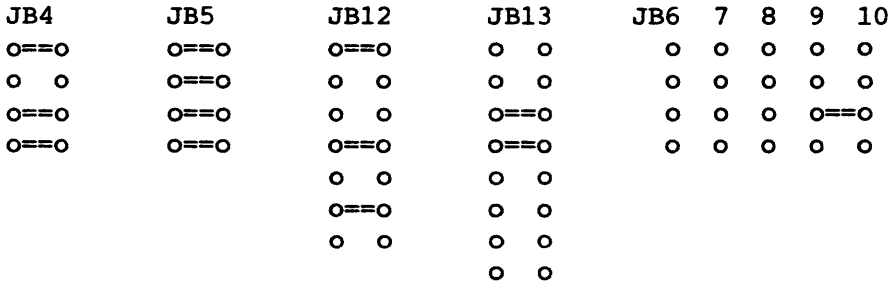
Fifth Tricep SP-188:

MEMORY ADDRESS: 300000h - 3FFFFFh
I/O ADDRESS: 68h - 69h
INTERRUPT I.D. DATA BIT: 4
INTERRUPT VECTOR: VI1



Sixth Tricep SP-188:

MEMORY ADDRESS: 200000h - 2FFFFFh
I/O ADDRESS: 6Ah - 6Bh
INTERRUPT I.D. DATA BIT: 5
INTERRUPT VECTOR: VI1



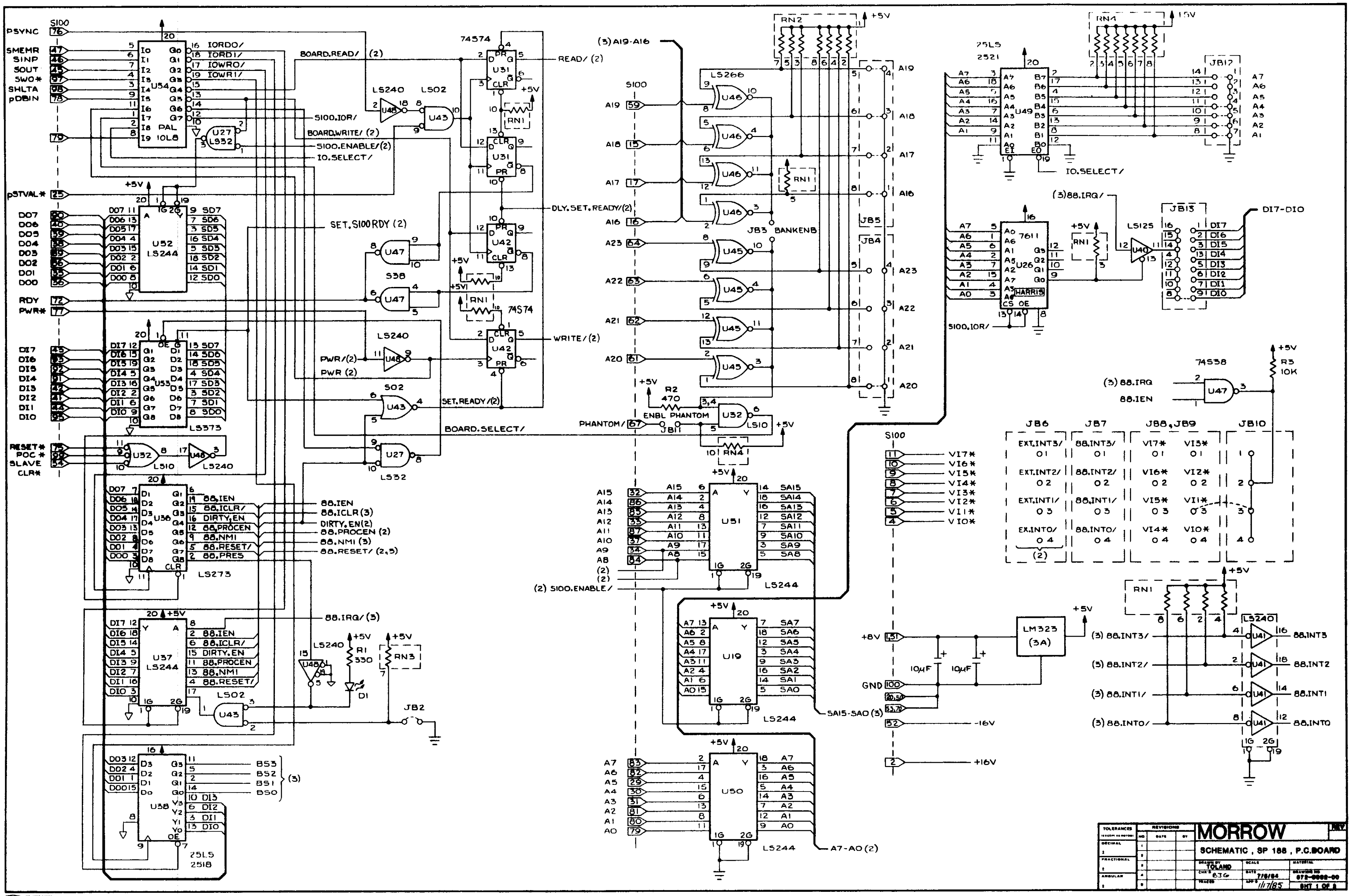
APPENDIX B: Expansion Connector Pin Definitions

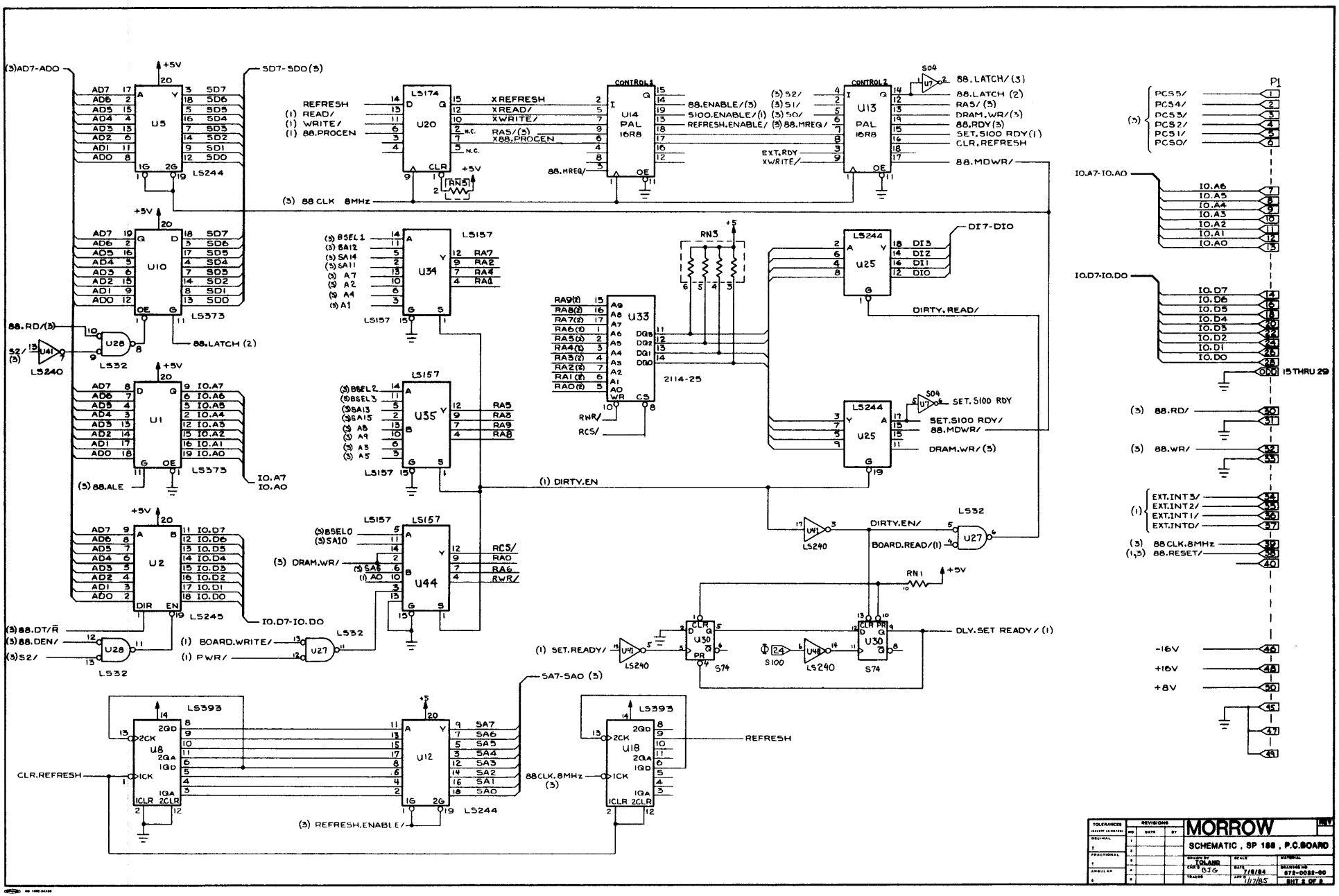
P1 I/O Expansion Bus

1	PCS5/	16	IOD6	31	GND
2	PCS4/	17	GND	32	88 WR/
3	PCS3/	18	IOD5	33	GND
4	PCS2/	19	GND	34	EXTINT3
5	PCS1/	20	IOD4	35	EXTINT2
6	PCS/0	21	GND	36	EXTINT1
7	IOA6	22	IOD3	37	EXTINT0
8	IOA5	23	GND	38	88 RESET/
9	IOA4	24	IOD2	39	8 MHZ CLK
10	IOA3	25	GND	45	GND
11	IOA2	26	IOD1	46	-16V UNREG
12	IOA1	27	GND	47	GND
13	IOA0	28	IOD0	48	+16V UNREG
14	IOD7	29	GND	49	GND
15	GND	30	88 RD/	50	+8V UNREG

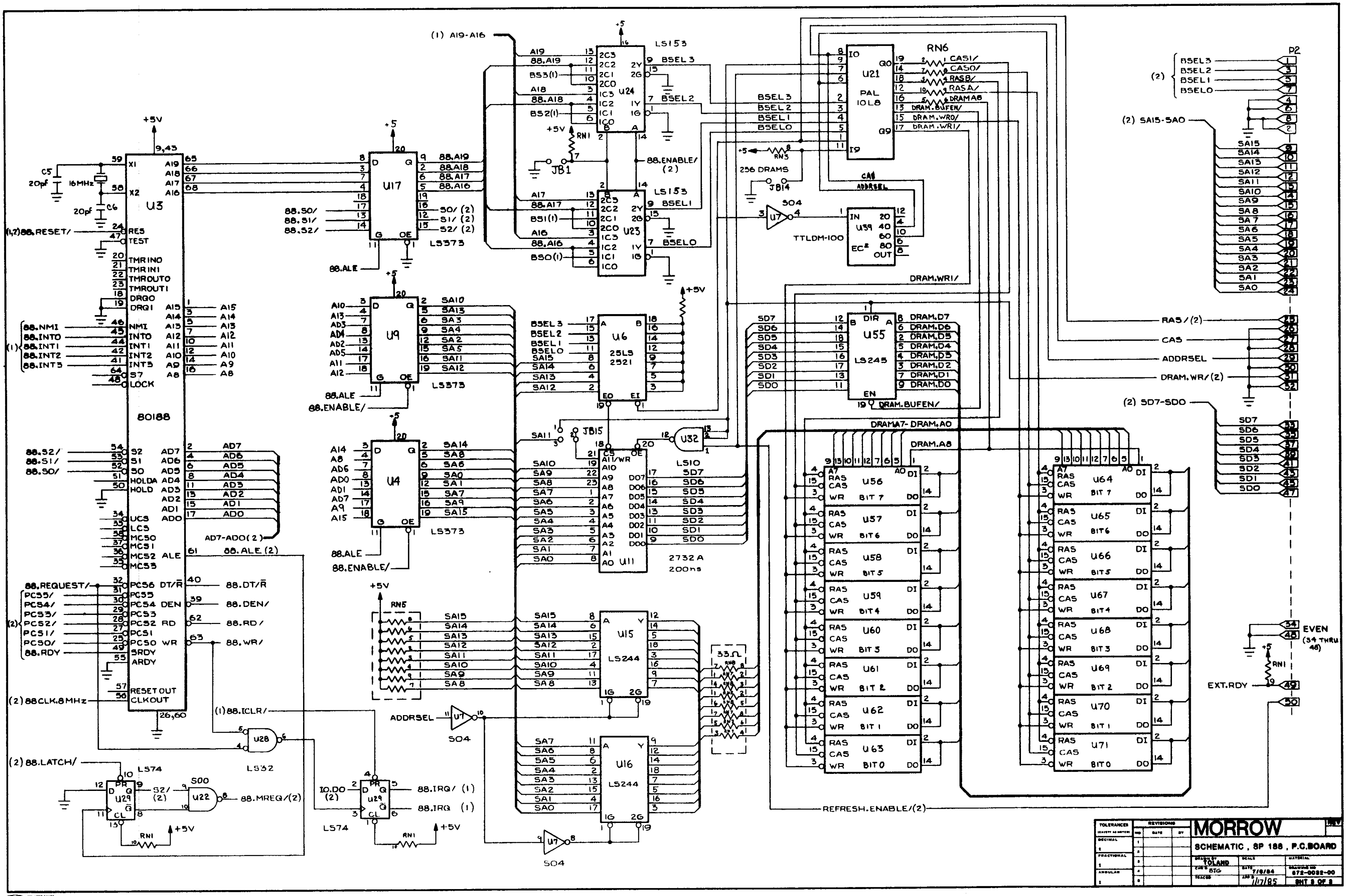
P2 Memory Expansion Bus

1	BSEL3	18	SA6	35	SD6
2	GND	19	SA5	36	GND
3	BSEL2	20	SA4	37	SD5
4	GND	21	SA3	38	GND
5	BSEL1	22	SA2	39	SD4
6	GND	23	SA1	40	GND
7	BSEL0	24	SA0	41	SD3
8	GND	25	RAS/	42	GND
9	SA15	26	GND	43	SD2
10	SA14	27	CAS/	44	GND
11	SA13	28	GND	45	SD1
12	SA12	29	ADDRSEL	46	GND
13	SA11	30	GND	47	SD0
14	SA10	31	DRAM WRITE/	48	GND
15	SA9	32	GND	49	EXT RDY
16	SA8	33	SD7	50	REFRESH ENABLE/
17	SA7	34	GND		


S100
PSYNC
SMEMR
SINP
SOUT
SWO*
SHLTA
pDBIN
pSTVAL*
PAL 10L8
U54
U27 LS32
S100.IOR/
BOARD.WRITE/ (2)
S100.ENABLE/(2)
IO.SELECT/
BOARD.READ/ (2)
LS240
LS02
74S74
READ/ (2)
DLY.SET.READY/(2)
SET.S100RDY (2)
WRITE/ (2)
SET.READY/(2)
BOARD.SELECT/
U52 LS244
U53 LS373
U36 LS273
U37 LS244
U38 25LS 2518
88.IEN
88.ICLR(3)
DIRTY.EN(2)
88.PROCEN
88.NMI (3)
88.RESET/ (2,3)
88.IRQ/ (3)
BS3
BS2
BS1
BS0
RESET*
POC*
SLAVE
CLR*
RDY
PWR*
PWR/(2)
PWR (2)
(3) A19-A16
LS266
BANKENB
JB3
JB4
JB5
ENBL PHANTOM
PHANTOM/
U51
U19
U50
SA15-SA0 (3)
A7-A0 (2)
(2) S100.ENABLE/
25LS 2521
U49
IO.SELECT/
(3)88.IRQ/
LS125
DI7-DI0
7611
HARRIS
S100.IOR/
74S38
(3) 88.IRQ
88.IEN
R3 10K
JB6
JB7
JB8, JB9
JB10
EXT.INT3/
EXT.INT2/
EXT.INT1/
EX.INT0/
88.INT3/
88.INT2/
88.INT1/
88.INT0/
VI7*
VI6*
VI5*
VI4*
VI3*
VI2*
VI1*
VI0*
LM323 (3A)
+8V
GND
-16V
+16V
10μF
(3) 88.INT3/
(3) 88.INT2/
(3) 88.INT1/
(3) 88.INT0/
88.INT3
88.INT2
88.INT1
88.INT0
MORROW
SCHEMATIC, SP 188, P.C.BOARD
TOLAND
7/8/84
1/17/85
SHT 1 OF 3



TOLERANCES UNLESS OTHERWISE SPECIFIED: ORIGINAL / FRACTIONAL ± / ANGULAR ±	REVISIONS: NO. DATE BY	MORROW	
		SCHEMATIC , SP 188 , P.C.BOARD	
		DRAWN BY: TOLAND	SCALE: NONE
		CHK'D: BJG	DATE: 7/8/84
		TRACED	APP'D: 1/7/85
		DRAWING NO: 672-0082-00	SHT 2 OF 2


MORROW
SCHEMATIC , SP 188 , P.C.BOARD
TOLAND
7/8/84
872-0082-00
U3
80188
U17
LS373
U9
U4
U24
U23
LS153
U21
PAL
10L8
RN6
U39
TTLDM-100
U6
25LS
2521
U55
LS245
U11
2732A
200ns
U15
LS244
U16
U32
LS10
U28
LS32
U29
LS74
U22
U7
S04
U56
U57
U58
U59
U60
U61
U62
U63
U64
U65
U66
U67
U68
U69
U70
U71
P2
DRAMA7-DRAM.A0
REFRESH.ENABLE/(2)
EXT.RDY
EVEN
256 DRAMS
JB1
JB14
JB15
16MHz
+5V

APPENDIX D: Parts List

Part Number	Description	Location	Quantity
500-0059-00	Assembled SP-188 board		
125-0032-00	SP-188 PCB		
126-0257-00	I.C. 80188	U3	1
126-0026-00	I.C. 2114-L RAM 250ns	U25	1
126-0312-00	I.C. 25LS2518	U38	1
126-0028-00	I.C. 25LS2521 or 74LS688	U49, U6	2
126-0041-00	I.C. 4164 RAM 150ns (128K model)	U56 - U71	16
126-XXXX	I.C. XXXX RAM 150ns (512K model)	U56 - U71	16
126-0151-00	I.C. 74S00	U22	1
126-0078-00	I.C. 74LS02	U43	1
126-0316-00	I.C. 74S04	U7	1
126-0082-00	I.C. 74LS10	U10	1
126-0127-00	I.C. 74LS32	U27, U28	2
126-0165-00	I.C. 74S38	U47	1
126-0170-00	I.C. 74S74	U30, U31, U42	3
126-0147-00	I.C. 74LS74	U29	1
126-0086-00	I.C. 74LS125	U40	1
126-0095-00	I.C. 74LS153	U23, U24	2
126-0098-00	I.C. 74LS157	U34, U35, U44	3
126-0106-00	I.C. 74LS174	U20	1
126-0111-00	I.C. 74LS240	U41, U48	2
126-0113-00	I.C. 74LS244	U5, U12, U15, U16, U19, U25, U37, U50, U51, U52	10
126-0114-00	I.C. 74LS245	U2, U55	2
126-0120-00	I.C. 74LS266	U45, U46	2
126-0122-00	I.C. 74LS273	U36	1
126-0133-00	I.C. 74LS373	U1, U4, U9, U10, U17, U53	6
126-0141-00	I.C. 74LS393	U8, U18	2
126-0313-00	Delay Line TTLDM-100	U39	1
127-0052-00	I.C. 2732A EPROM 200ns	U11	1
127-0053-00	PAL 16R8	U13	1
127-0054-00	PAL 16R8	U14	1
127-0055-00	PAL 10L8	U21	1
127-0056-00	I.C. 7611 PROM	U26	1
127-0057-00	PAL 10L8	U54	1
128-0034-00	LED SBR5101	D1	1
129-0031-00	TRANSISTOR LM323K	Q1	1
130-0028-00	RES 330 ohm .25 w 5%	R1	1
130-0036-00	RES 470 ohm .25 w 5%	R2	1
130-0005-00	RES 10K ohm .25 w 5%	R3	1

130-0147-00	SIP 33 ohm 1/8 w 5% (8pin)	RN7, RN8	2
130-0190-00	SIP 33 ohm 1/8 w 5% (10pin)	RN6	1
130-0130-00	SIP 10K ohm 1/8 w 5% (8pin)	RN2, RN3	2
130-0131-00	SIP 10K ohm 1/8 w 5% (10pin)	RN1, RN4, RN5	3
133-0028-00	CAP .1 uf Monolithic	Bypass caps (* on board)	53
133-0038-00	CAP 20 pf Silver mica	C5, C6	2
133-0076-00	CAP 1 uf @ 35V Tantalum	C2-C4, C7-C9	6
140-0003-00	SOCKET 16pin lowprofile	U26, U56-U71	17
140-0004-00	SOCKET 18pin lowprofile	U33	1
140-0005-00	SOCKET 20pin lowprofile	U13, U14, U54	3
140-0007-00	SOCKET 24pin lowprofile	U11	1
140-0012-00	SOCKET 68pin carrier	U3	1
143-0001-00	HEADER SIP STR 2pin	JB1, JB11, JB14	3
143-0004-00	HEADER SIP STR 4pin	JB2/3, JB10, JB15	3
143-0008-00	HEADER DIP STR 8pin	JB4, JB5, JB6/7 JB8/9, JB13 (2)	6
143-0024-00	HEADER DIP RT 50pin	P1, P2	2
144-0001-00	SHUNTS for PCB headers		
200-0013-00	SCREW Panhead 3/8 Phillips 632		2
205-0008-00	NUT Hex 632 5/16 head		2
210-0012-00	WASHER Flat #6		2
240-0022-00	HEATSINK TO-3	Q1	1