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POTTER LINE PRINTER MODEL LP 3000
AND INTERFACE TO THE
DDP-116 SITE COMPUTERS

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Introduction

Two medium speed line printers for use off-line with the DDP-116 site computers for computer diagnostics and program debugging have been procured. The specifications are as follows:

Speed	Up to 135 lines per minute
Print Positions	132 print positions per line
Ribbon	Conventional 3/4-inch horizontal tabulation
Forms	Accepts standard pin-feed forms up to 15 inches wide with 1/2 inch hole centers, up to 3 parts thickness.
Print Area	13 1/4 inches wide.
Character Spacing	10 characters per inch.
Line Spacing	6 lines per inch.
Line Print Cycle Time	385 milliseconds
Character Type	Open gothic, 35 dot matrix arranged as 5 columns and 7 rows with 2 blank columns and 5 blank rows between characters.
Paper Shift Speed	1/4 inch per second during printing; 2 1/2 inches per second between lines; 10 inches per second during line feed (FDXXLN).

The instruction set is arranged as follows:

- OCP' 0006 End of line. Force prints a line when less than 132 characters have been loaded into the printer line memory by filling blanks in all unused character positions. This instruction should not be issued when 132 characters are loaded into the line memory since the printer automatically prints after 132 characters are loaded.
- OCP' 0106 Top of form. Advances paper to next top of form. This instruction should only be used following an interrupt or an SKS 006.

SKS' 0006 Skip if ready to receive a character.

SKS' 0106 Skip if printer is on line. The printer will initially be off line when power is applied. A front panel pushbutton sets the printer on line. The printer will go off line if the paper, ribbon, or carriage is out. If the printer goes off line after a portion of a line has been loaded, then the line may be completed and printed but no more interrupts will occur until the printer is manually returned to on line status.

OTA' 0120 Set mask. If bit 9 of the A-register is set the line printer interrupt mode will be masked on, allowing an interrupt to occur at the end of each print cycle or when the printer is set on line. When an interrupt occurs, the computer generates a jump and store location instruction indirectly through location 00040.

OTA' 0006 Output to line printer. If the printer is ready to receive a character, the next instruction will be skipped, and the contents of the output bus will be sent to the line printer buffer memory. Bits 9 through 16 form the character to be transferred according to the following table:

Octal Character Code	Potter LP 3000	Teletype ASR 33
0 0	@	FD64LN
0 1	A	FD63LN
0 2	B	FD63LN
0 3	C	FD61LN
0 4	D	FD60LN
0 5	E	FD59LN
0 6	F	FD58LN
0 7	G	FD57LN
1 0	H	FD56LN
1 1	I	FD55LN
1 2	J	FD54LN
1 3	K	FD53LN
1 4	L	FD52LN
1 5	M	FD51LN
1 6	N	FD50LN

	0, 2, 3	1	0	1	2	3
1 7	O	FD49LN			S1	O
2 0	P	FD48LN			DC ₀	P
2 1	Q	FD47LN			Start Code (X-On)	Q
2 2	R	FD46LN			Tape Aux On	R
2 3	S	PD45LN			Stop Code (X-Off)	S
2 4	T	FD44LN			Tape Aux Off	T
2 5	U	FD43LN			Error	U
2 6	V	FD42LN			Sync	V
2 7	W	FD41LN			LEM	W
3 0	X	FD40LN			S ₀	X
3 1	Y	FD39LN			S ₁	Y
3 2	Z	FD38LN			S ₂	Z
3 3	[	FD37LN			S ₃	[
3 4	\	FD36LN			S ₄	\
3 5	]	FD35LN			S ₅]
3 6	⌋	FD34LN			S ₆	⬆
3 7	_ Underline	FD33LN			S ₇	⬅
4 0	Blank	FD32LN			Blank	
4 1	!	FD31LN			!	
4 2	" Quote	FD30LN			" Quote	
4 3	#	FD29LN			#	
4 4	\$	FD28LN			\$	
4 5	%	FD27LN			%	
4 6	& Ampersand	FD26LN			& Ampersand	
4 7	' Apostrophe	FD25LN			' Apostrophe	
5 0	(	FD24LN			(
5 1	)	FD23LN)	
5 2	*	FD22LN			*	
5 3	+	FD21LN			+	
5 4	, Comma	FD20LN			, Comma	
5 5	- Dash	FD19LN			- Dash	
5 6	. Period	FD13LN			. Period	
5 7	/	FD17LN			/	
6 0	0	FD16LN			0	
6 1	1	FD15LN			1	
6 2	2	FD14LN			2	
6 3	3	FD13LN			3	
6 4	4	FD12LN			4	
6 5	5	FD11LN			5	
6 6	6	FD10LN			6	
6 7	7	FD9LN			7	
7 0	8	FD8LN			8	
7 1	9	FD7LN			9	
7 2	: Colon	FD6LN			: Colon	
7 3	; Semicolon	FD5LN			; Semicolon	
7 4	<	FD4LN			<	Ack
7 5	=	FD3LN			=	Alt Mode
7 6	>	FD2LN			>	ESC
7 7	?	FD1LN			?	Rub Out

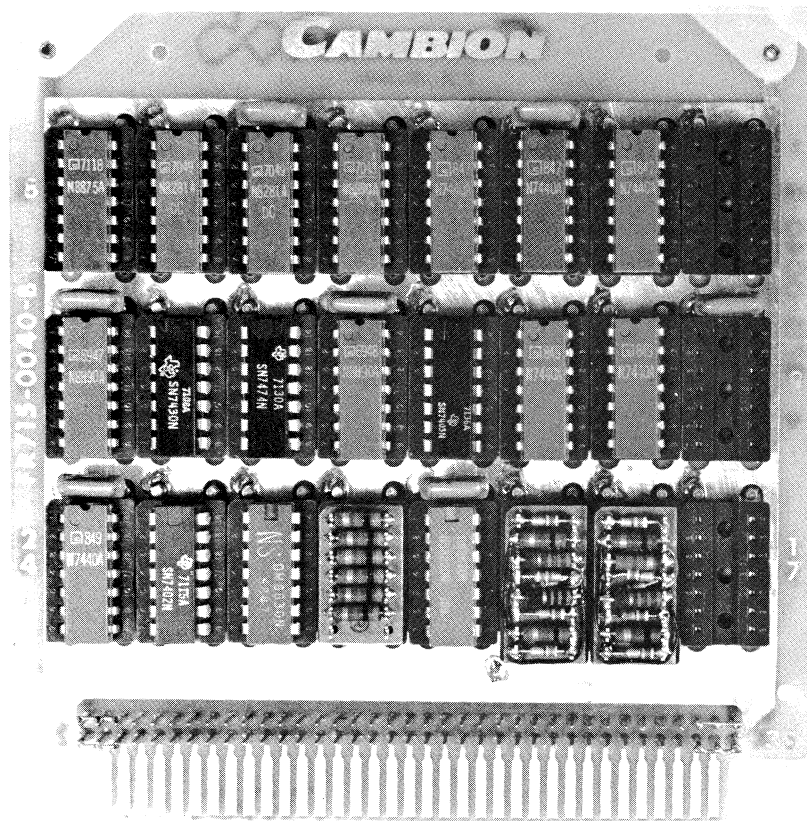
In the table, a comparison of the teletype and line printer 8-bit character codes is given. Along the left most column is presented a 2-digit code 00 to 77, representing the 6 least significant bits of the A-register. In the teletype two additional bits 9 and 10 are used to define which column (2 or 3) is printed. Columns 0 and 1 have no meaning in the teletype output. The character codes have been set up for the Potter line printer so that any alphanumeric character that has been set up to be printed on the teletype may also be sent to the line printer for printing with only two character changes. They are the ↑ which has been changed to ▮ and the ← which has been changed to the (underline). Control characters of the teletype are not used. If, however, one of these characters is sent to the line printer, a printed output of the character with the same 2-digit octal code as the control character will be printed.

In the Potter line printer with the options procured with it, only one line feed may be issued between print cycles. To skip more than one line it is necessary to force print blank lines at print cycle speed which is slow compared to the paper slew speed, 1/3 I. P. S. vs. 10 I. P. C. Accordingly, a simple logic scheme has been planned which employs a line counter which may be preset with a 6-bit 2's complement octal code defining the number of lines to be skipped. According to column 1 of the table, from 1 to 64 lines may be skipped at slew speeds by loading the A-register with the proper 1XX code and executing the standard OTA'0006 character load instruction. The paper slew sequence (FDXXLN) should only be issued immediately following an interrupt.

A special demand case of the above line skip feature occurs when it is desired to issue both top of form and FDXXLN instructions in succession as would be the case if it is desired to skip down a few lines from the top of the form such as in a title page. The proper sequence is to issue a top of form instruction followed by an end of line instruction, then waiting for the interrupt that occurs after the print cycle to issue the FDXXLN instruction with XX being equal to the number of lines to skip minus one for the forced printed blank line. This sequence is required in this special case since both FDXXLN and top of form instructions have the requirement that they only be issued immediately following an interrupt through location 00040.

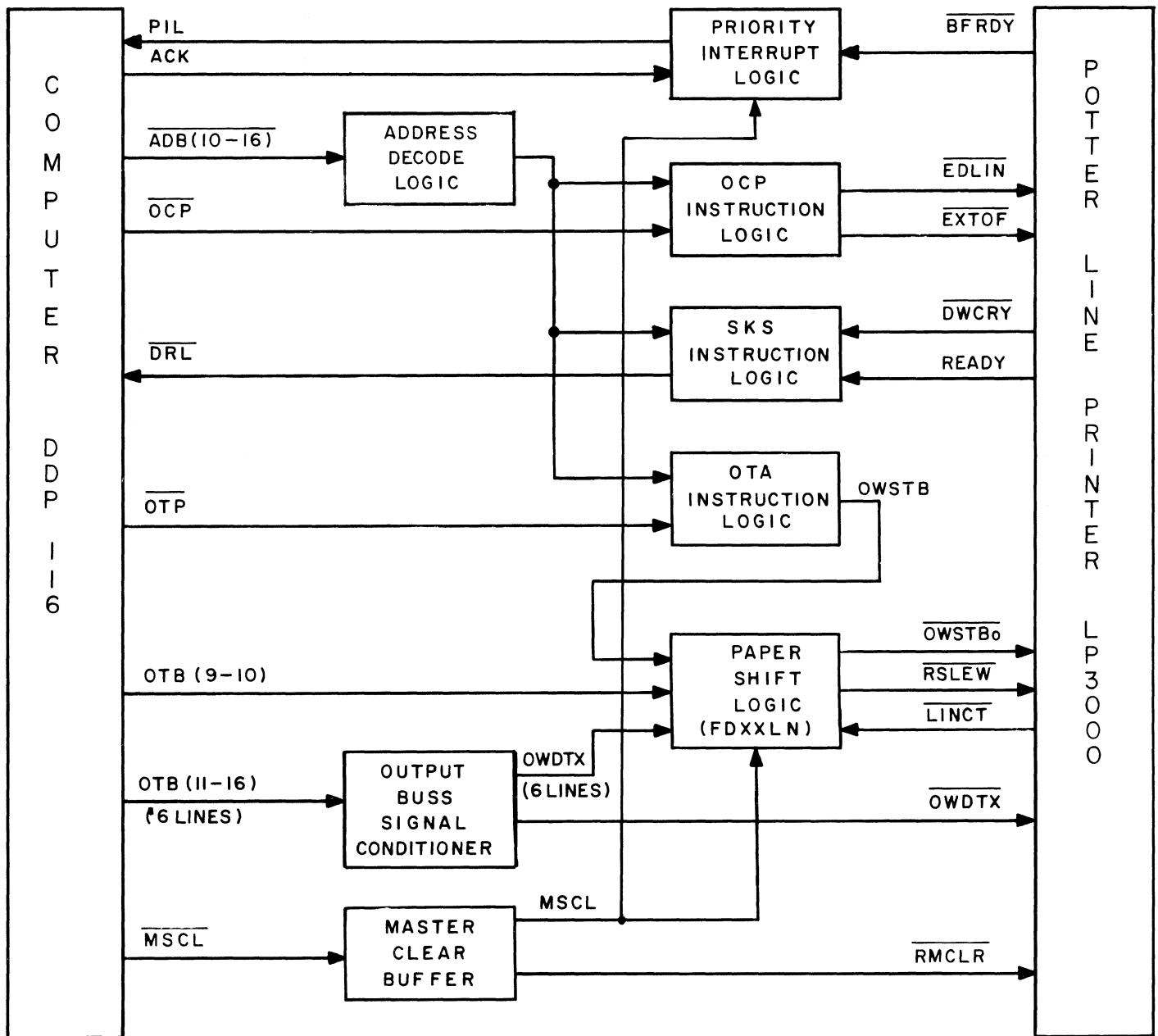


Line Printer and DDP-116 Computer



Interface Electronics Card

Description: All active control signals are shown in the following block diagram:



POTTER LINE PRINTER COMPUTER INTERFACE
BLOCK DIAGRAM

FIG. A

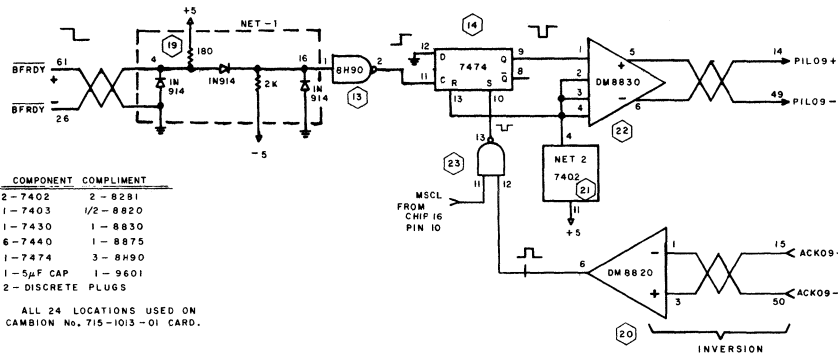
The operation is sequential as follows: (See Block Diagram.)

When the printer buffer register is empty, $\overline{\text{BFRDY}}$ goes low and a PIL is issued to the DDP-116 computer from the priority interrupt logic. As soon as the computer "sees" the signal the program is interrupted and control jumps indirect through memory cell 40_8 containing the pointer to the line printer interrupt service subroutine (ISS). At this time the computer automatically issues the ACK (acknowledge) pulse back to the PIL logic thus clearing the PIL. The above sequence occurs when the printer has finished printing a line. The (ISS) now refills the character buffer by setting up the proper address as controlled by the 7 LSB's of the instruction register through ADB 10-16 which accordingly enables the OCP logic to advance paper, SKS printer status test logic, or the OTA character output to printer buffer or control to paper shift logic (FDXXLN).

The computer output buss is buffered and sent to the paper shift logic or line printer data receiver lines. DDP-116 master clear initializes the printer.

Circuit Description

Standard TTL logic is employed in the circuits which are self-explanatory to those skilled in computers. Signals are transmitted wherever possible by twisted pair cable thus minimizing ground system problems. The circuit schematics are presented on the next pages.



COMPONENT COMPLIMENT

2 - 7402	2 - 8291
1 - 7403	1/2 - 8820
1 - 7430	1 - 8830
6 - 7440	1 - 8875
1 - 7474	3 - 8H90
1 - 5μF CAP	1 - 9601
2 - DISCRETE PLUGS	

ALL 24 LOCATIONS USED ON CAMBION No. 715-1013-01 CARD.

FIG. B PRIORITY INTERRUPT LOGIC

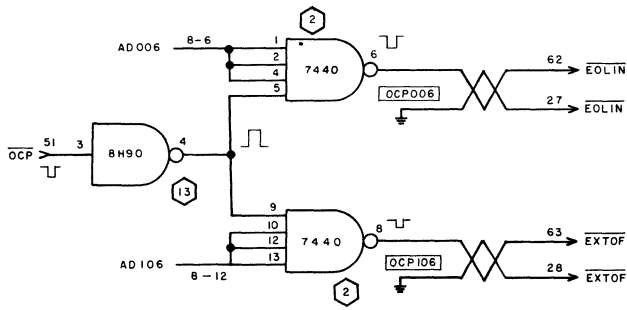
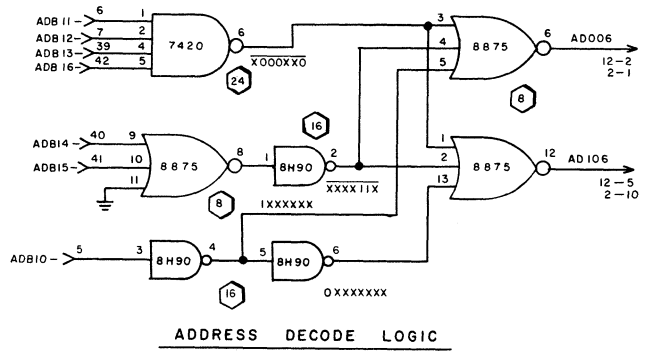


FIG. D OCP INSTRUCTIONS LOGIC



ADDRESS DECODE LOGIC

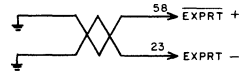
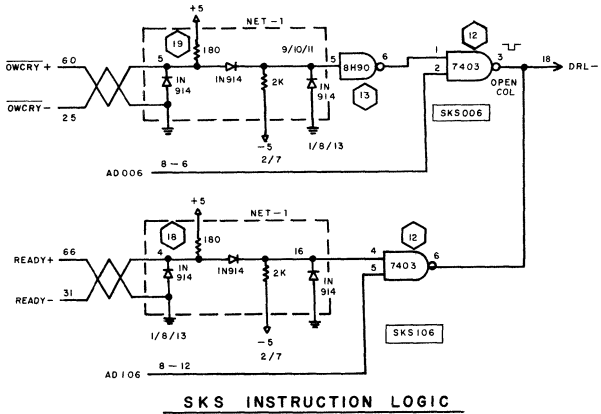
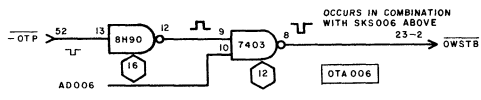


FIG. C EXTERNAL PRINT LOGIC



SKS INSTRUCTION LOGIC



OTA INSTRUCTION LOGIC

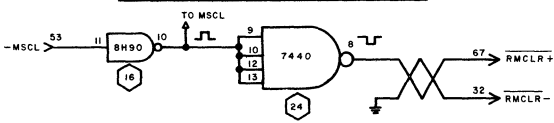


FIG. E MASTER CLEAR BUFFER

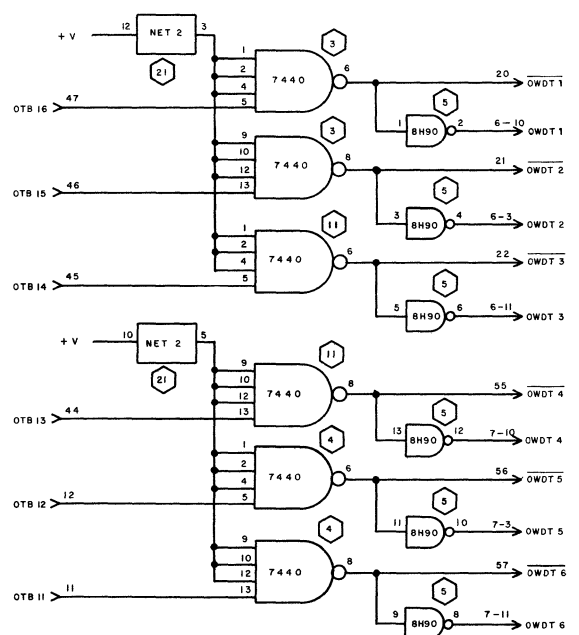


FIG. F OUTPUT BUSS SIGNAL CONDITIONER

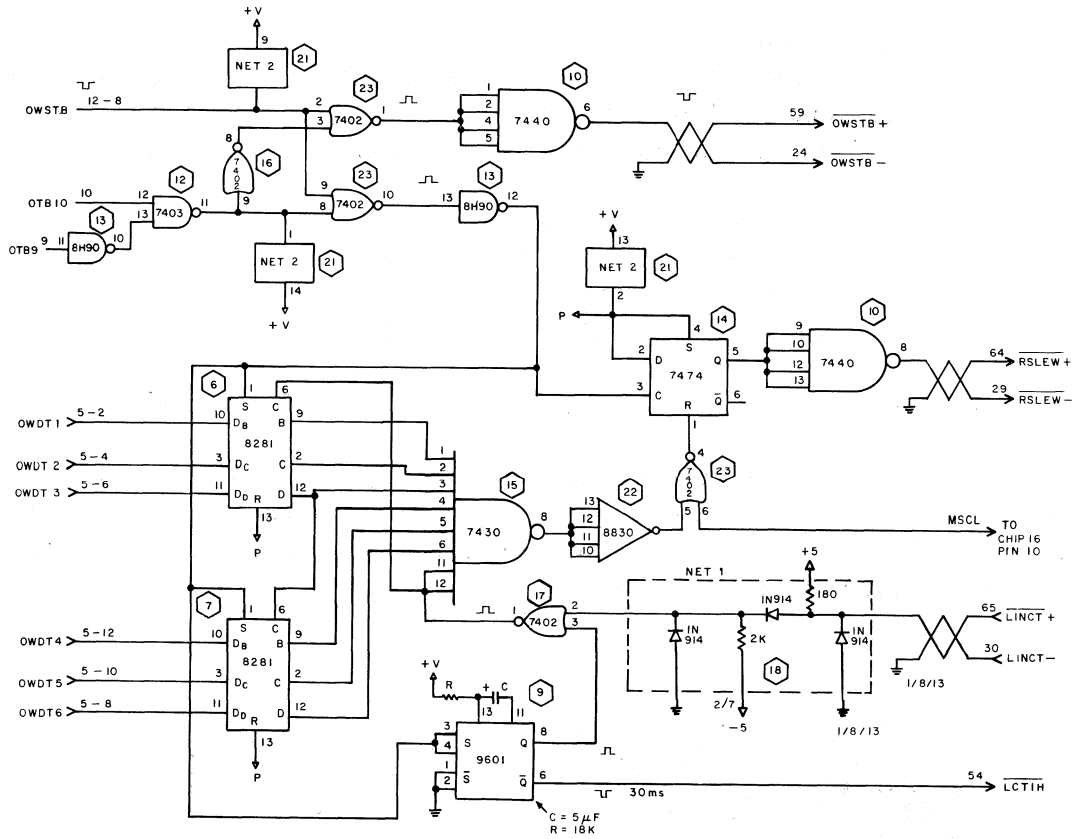


FIG.G PAPER SHIFT LOGIC (FDXXLN)

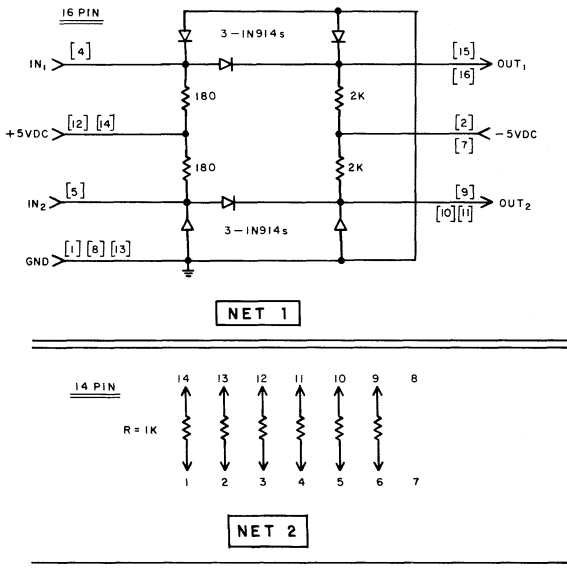


FIG.H NETWORKS

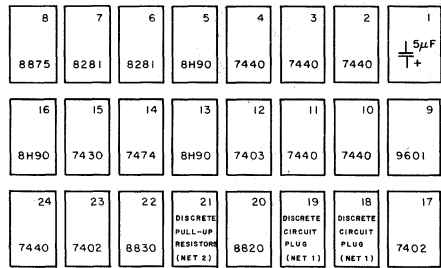


FIG.I FRONT OF BOARD

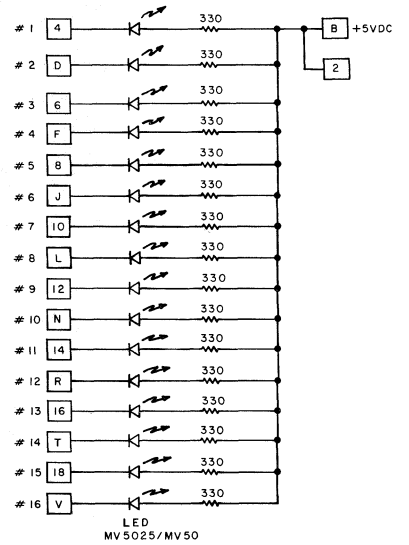


FIG.J DISPLAY CARD FOR INTERFACE TEST SET

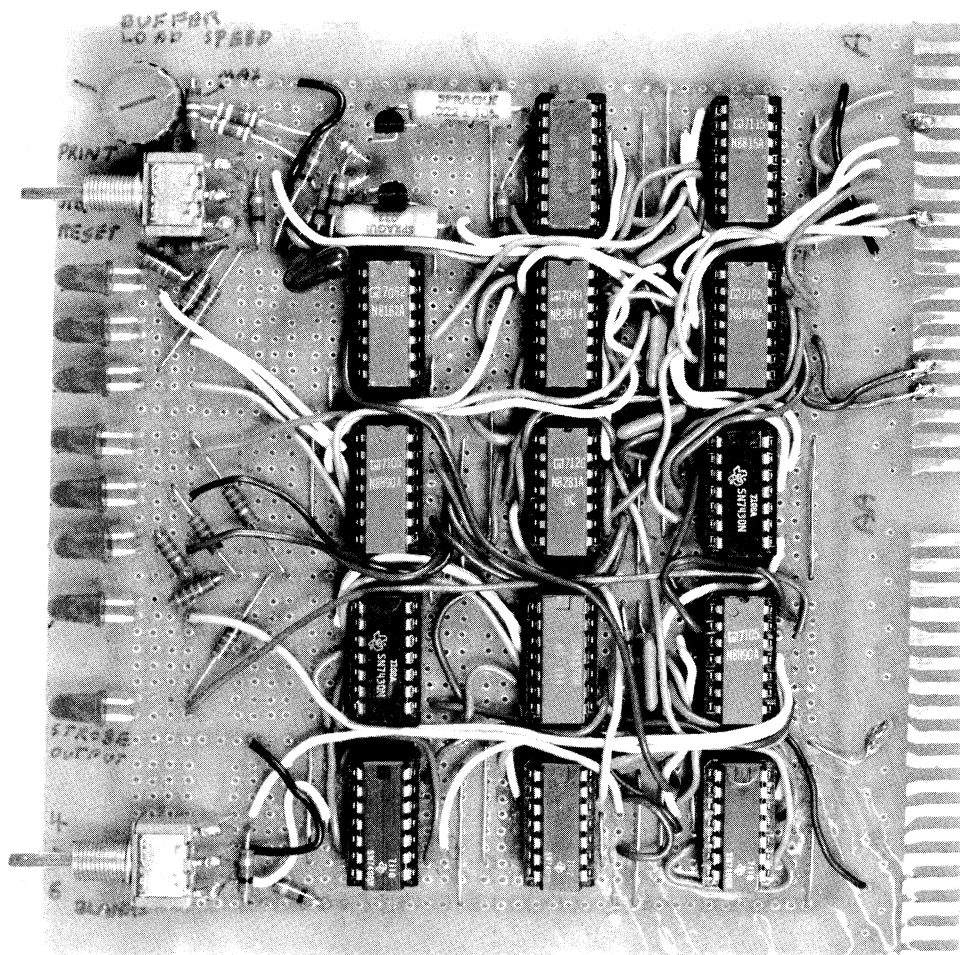
Printer Diagnostic Test Card

An exerciser card is available to test the printer. It may be installed in the line printer card file by removing the back cover from the line printer and inserting the card in place of the computer interface cable. With the printer "on line" three patterns may be printed which sequence through every possible character printable as shown.

ABCDE	ABCDE	EFGHI
BCDEF	ABCDE	DEFGH
CDEFG	ABCDE	CDEFG
DEFGH	ABCDE	BCDEF

4 — Rotate left. 5 — Stationary. 6 — Rotate right.

Two toggle switches and a pot are on the card. A toggle selects either pattern 4, 5, or 6 by logically inserting 4, 5, or 6 extra blanks when character 140₈ is detected. The other switch resets, stops, or prints. The pot controls the character buffer re-fill speed thus controlling the printing speed.



Printer Exerciser Test Card.

The test card schematic, printer wiring tables, and interface card test procedure follow.

Line Printer Interface Card Pin Out

	Name	From	To		Name	From	To
1	Ground			36	+5		
2	Ground			37	+5		
3				38			
4				39	ADB 13		
5	ADB 10			40	ADB 14		
6	ADB 11			41	ADB 15		
7	ADB 12			42	ADB 16		
8				43			
9	OTB 09			44	OTB 13		
10	OTB 10			45	OTB 14		
11	OTB 11			46	OTB 15		
12	OTB 12			47	OTB 16		
13				48			
14	PIL09+			49	PIL 09-		
15	ACK09+			50	ACK09-		
16				51	OCP-		
17				52	OTP-		
18	DRL-			53	MSCL-		
19				54			
20	OWDT1			55	OWDT4		
21	OWDT2			56	OWDT5		
22	OWDT3			57	OWDT6		
23	* EXPRT-			58	EXPRT+		
24	* OWSTB-			59	OWSTB+		
25	* OWCRY-			60	OWCRY+		
26	* BFRDY-			61	BFRDY+		
27	* EOLIN-			62	EOLIN+		
28	* EXTOF-			63	EXTOF+		
29	* RSLFW-			64	RSLFW+		
30	* LINCT-			65	LINCT+		
31	* READY-			66	READY+		
32	* RMCLR-			67	RMCLR+		
33	-5 V DC			68	GND		
34	Ground			69	+5		
35	Ground			70	+5		

FRONT
(Socket Side)

BACK
(Wire Wrap Pin Side)

* Single ended signal
 - = Return)
 + = Signal) on twisted pair

POTTER LINE PRINTER INTERFACE CABLE

<u>Wire Color</u>	<u>Elco Connector</u>	<u>Potter Card 01</u>	<u>Wire Color</u>	<u>Elco Connector</u>	<u>Potter Card 01</u>
Blk	A	6	Red	Y	Gnd
Brn	B	7	Grn	Z	NN
Blk	C	5	Red	AA	Gnd
Red	D	S	Blu	BB	31
Blk	E	J	Red	CC	Gnd
Orn	F	R	Wht	DD	28
Blk	H	Gnd	Grn	EE	
Yel	J	35	Brn	FF	
Blk	K	Gnd	Grn	HH	
Grn	L	8	Orn	JJ	
Blk	M	Gnd	Grn	KK	
Blu	N	9	Yel	LL	
Blk	P	Gnd	Grn	MM	
Wht	R	26	Blu	NN	
Red	S	Gnd	Grn	PP	
Brn	T	D	Wht	RR	
Red	U	Gnd	Blu	SS	V
Orn	V	27	Wht	TT	Gnd
Red	W	Gnd			
Yel	X	12			

NOTE: 1. Except for pairs AB, CD, EF, the return conductor (gnd designation of each pair) should be connected to nearest ground hole in Potter Card 01.

PRINTER INTERFACE CARD TO LINE PRINTER LINK TO CONNECTOR

<u>Cable Elco</u>	<u>Card Edge Connector</u>		<u>Cable Elco</u>	<u>Card Edge Connector</u>	
A	20	$\overline{\text{OWDT1}}$	AA	32	$\overline{\text{RMCLR-}}$
B	55	$\overline{\text{OWDT4}}$	BB	67	$\overline{\text{RMCLR+}}$
C	21	$\overline{\text{OWDT2}}$	CC	23	$\overline{\text{EXPRT-}}$
D	56	$\overline{\text{OWDT5}}$	DD	58	$\overline{\text{EXPRT+}}$
E	22	$\overline{\text{OWDT3}}$	EE)	
F	57	$\overline{\text{OWDT6}}$	FF	)	SPARE
H	24	$\overline{\text{OWSTB-}}$	HH)	
J	59	$\overline{\text{OWSTB+}}$	JJ	)	SPARE
K	25	$\overline{\text{OWCRY-}}$	KK)	
L	60	$\overline{\text{OWCRY+}}$	LL	)	SPARE
M	26	$\overline{\text{BFRDY-}}$	MM)	
N	61	$\overline{\text{BFRDY+}}$	NN	)	SPARE
P	27	$\overline{\text{EOLIN-}}$	PP)	
R	62	$\overline{\text{EOLIN+}}$	RR	)	SPARE
S	28	$\overline{\text{EXTOF-}}$	SS	33	-5 V DC
T	63	$\overline{\text{EXTOF+}}$	TT	68	GND
U	29	$\overline{\text{RSLEW-}}$			
V	64	$\overline{\text{RSLEW+}}$			
W	30	$\overline{\text{LINCT-}}$			
X	65	$\overline{\text{LINCT+}}$			
Y	31	$\overline{\text{READY-}}$			
Z	66	$\overline{\text{READY+}}$			

19 PAIR CABLE

EXAMPLE OF PAIRS: A-B, C-D, E-F, etc.

POTTER PRINTER INTERFACE LOGIC CARD
TEST PROCEDURE

1. Priority Interrupt Logic Test

- A. Reset switch 10.
- B. Set switch 5.
- C. Reset switch 6.
- D. Toggle switch 10.
- E. Observe state of lamps to be 1 - on, 2 - off.
- F. Toggle both switches 5 and 6 together.
- G. Observe that lamps 1 and 2 change state.
- H. Repeat steps D through G.

2. Address Decode Logic Test 006

- I. Set switches 11, 14, 15, 16, and 17.
- J. Reset switches 12 and 13.
- K. Proceed to OCP 006 test and if passed then this test is also passed.

3. Address Decode Logic Test 106

- L. Set switches 11, 14, 15, and 16.
- M. Reset switches 12, 13, and 17.
- N. Proceed to OCP 106 test and if passed then this test is also passed.

4. OCP 006 Test

- O. Set switch 7.
- P. Do steps I and J above.
- Q. Observe lamp 11 is off.
- R. Observe that when switch 7 is reset, lamp 11 comes on.
- S. With switch 7 reset, toggle switches 11 thru 17 one at a time and observe that lamp 11 goes off each time a switch is toggled. (This step fully static tests address logic 006 and if passed, then logic 006 is good under static conditions.)

5. OCP 106 Test

- T. Do step O above.
- U. Do steps L and M above.
- V. Observe lamp 12 is off.
- W. Observe that when switch 7 is reset, lamp 12 comes on.
- X. Do step S above and if passed then address 106 is good under static conditions.

POTTER PRINTER INTERFACE LOGIC CARD TEST PROCEDURE (continued):

6. SKS 006 Test

- Y. Set switch 9.
- Z. Do steps I and J above.
- AA. Observe lamp 3 is off.
- AB. Observe that when switch 9 is reset, lamp 3 comes on.
- AC. With switch 9 reset, toggle switches 11 thru 16 one at a time and observe that lamp 3 goes off each time a switch is toggled.

7. SKS 106 Test

- AD. Reset switch 20 and do steps L, M, and AA above.
- AE. Observe that when switch 20 is set lamp 3 comes on.
- AF. With switch 20 set, toggle switches 11 thru 16 one at a time and observe that lamp 3 goes off each time a switch is toggled.

8. OTA 006 Test

- AG. Set switch 8.
- AH. Do steps I and J above.
- AI. Reset switch 4.
- AJ. Reset switch 3.
- AK. Observe that lamp 10 is off.
- AL. Observe that when switch 8 is reset, lamp 10 goes on.
- AM. With switch 8 reset, toggle switches 11 thru 17, and 3 and observe that lamp 10 goes off each time a switch is toggled.

9. Output Buss Signal Conditioner Test

- AN. Reset switches 1 and 2.
- AO. Observe that lamps 4, 5, 6, 7, 8, and 9 are not lit.
- AP. Toggle switch 1 and observe that each time it is set, lamps 4, 6, and 8 come on.
- AQ. Toggle switch 2 and observe that each time it is set, lamps 5, 7, and 9 come on.

10. Master Clear Test

- AR. Set switch 18.
- AS. Observe that lamp 14 is off.
- AT. Toggle switch 18 and observe that lamp 14 comes on each time it is reset.

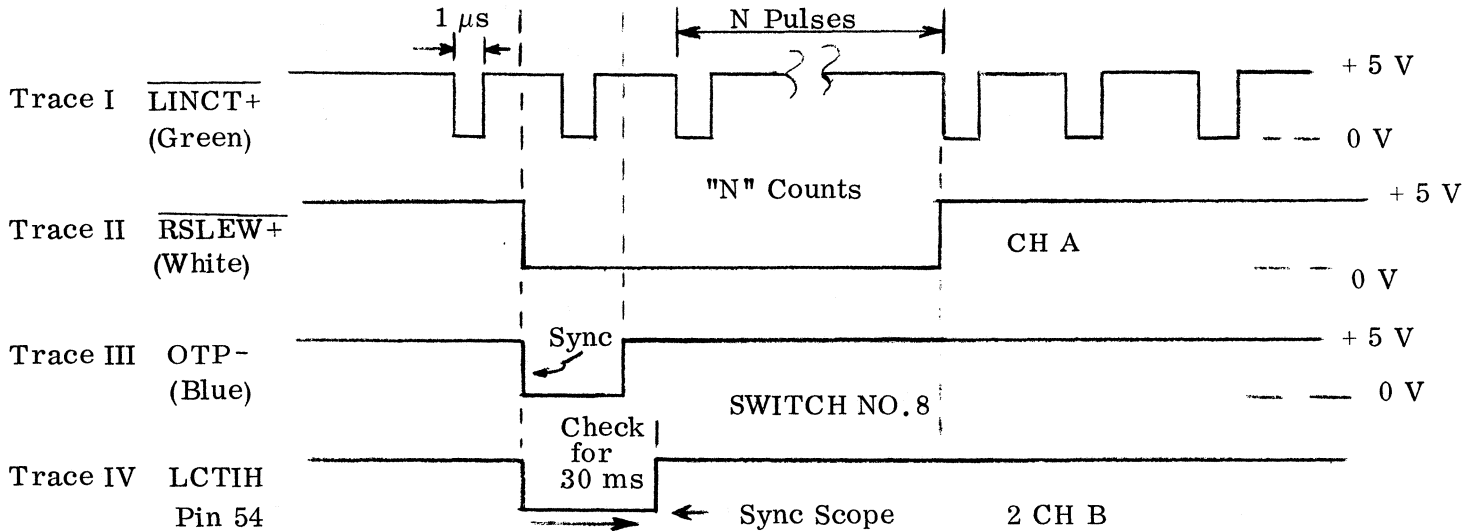
11. External Print Logic Test

- AU. Observe that lamps 15 and 16 are lit.

POTTER PRINTER INTERFACE LOGIC CARD TEST PROCEDURE (continued):

12. Paper Shift Logic Test

AV. Inspect the following diagram where in trace I is a pulse ($\overline{\text{LINCT+}}$) generator with a frequency of 1 kHz connected to the green binding post.



Trace II is the $\overline{\text{RSLEW+}}$ signal as indicated by lamp 13 (on when signal is low) which is also present at the white binding post. Trace III is the OTP- pulse controlled by switch 8 (which is set when signal is high) present at the blue binding post.

SW. Do steps I, J, and AI above.

AX. Set switch 3.

AY. Set up the test equipment according to the diagram of step AV. If two pulse generators are available, trace III may be obtained from the second pulse generator when switch 8 is adjusted to the center position and the pulse generator is set to 10 Hz frequency and 1 μsec pulse negative pulse width.

AZ. Reset switches 1 and 2 and observe that the quantity "N" in the diagram is 64.

BA. Set switch 1 and observe N = 43.

BB. Set switch 2 and observe N = 1.

BC. Reset switch 1 and observe N = 22.

BD. Toggle switches 3, 4, 11, 12, 13, 14, 15, 16, and 17 and observe that trace II above remains high when any switch is toggled.

INTERFACE CARD TEST FIXTURE DATA

From Switches	Elco	To	Comments
1	DX	AP, X, BL	OTB 12, 14
2	E	V, C, AS	OTB 11, 13
3	Z	A	OTB 10
4	AU	DT	OTB 9
5	CU	CP	ACK +
6	DN	DL	ACK -
7	EH	EE	OCP-
8	R	N	OTP-
9	AK	AT	OWCRY +
10	BD	CT	BFRDY +
"1" Pole	CK	BU	BUSS
"0" Pole	DD	H	BUSS
11	DY	DA	ADB 16
12	F	CF	ADB 15
13	AA	BT	ADB 14
14	AV	BA	ADB 13
15	BM	CD	ADB 12
16	CA	BR	ADB 11
17	CV	AY	ADB 10
18	DP	AH	MSCL -
19	EJ	AJ	LINCT +
20	S	BC	SPARE
"1" Pole	AL	BU	BUSS
"0" Pole	BE	H	BUSS
From Jones Strip	Elco	To	Comments
A	BU		+5
B	CL		+12
C	DE		-18
D	DZ	M	
E	H		GND
Binding Post	Elco	To	Comments
Red	AB	EE	OCP-
Blue	AW	N	OTP-
White	BN	P	RSLEW +
Yellow	CB		
Green	CW	AJ	LINCT +

From Douglas Card	Elco	To	Comments
4	DR	BX	PIL +
D	EK	CS	PIL -
6	T	L	DRL -
F	AM	AZ	OWDT1
8	BF	BS	OWDT2
J	BY	CE	OWDT3
10	CM	CH	OWDT4
L	DF	DB	OWDT5
12	EA	DW	OWDT6
N	J	Y	OWSTB +
14	AC	DM	EOLIN +
R	AX	EF	EXTOF +
16	BP	P	RSLEW +
T	CC	CJ	RMCLR +
18	CX	CZ	
V	DS	D	

Cambion	Elco	Comments	Cambion	Elco	Comments
3	K		30	AF	
4	AD		39	BA	ADB 13
5	AY	ADB 10	40	BT	ADB 14
6	BR	ADB 11	41	CF	ADB 15
7	CD	ADB 12	42	DA	ADB 16
8	CY		43	DV	
9	DT	OTB 09	44	C	OTB 13
10	A	OTB 10	45	X	OTB 14
11	V	OTB 11	46	AS	OTB 15
12	AP	OTB 12	47	BL	OTB 16
13	BJ		48	BZ	
14	BX	PIL +	49	CS	PIL -
15	CP	ACK +	50	DL	ACK -
16	DJ		51	EE	OCP -
17	EC		52	N	OTP -
18	L	DRL -	53	AH	MSCL -
19	AE		54	BB	
20	AZ	OWDT1	55	CH	OWDT4
21	BS	OWDT3	56	DB	OWDT5
22	CE	OWDT5	57	DW	OWDT6
23	CZ	EXPRT -	58	D	EXPRT +
24	DU	OWSTB -	59	Y	OWSTB +
25	B	OWCRY -	60	AT	OWCRY +
26	W	BFRDY -	61	CT	BFRDY +
27	AR	EOLIN -	62	DM	EOLIN +
28	BK	EXTOF -	63	EF	EXTOF +
29	BY	RSLEW -	64	P	RSLEW +
30	CR	LINCT -	65	AJ	LINCT +
31	DK	READY -	66	BC	READY +
32	ED	RMCLR -	67	CJ	RMCLR +
33	M	-5 V DC	68	DC	