

PARALLEL PRINTER INTERFACE CARD

INSTALLATION AND OPERATING MANUAL



TM

Apple Intelligent Subsystem

APPLE II
PARALLEL PRINTER
INTERFACE CARD (A2B0002X)
INSTALLATION AND OPERATING MANUAL

**PLEASE READ THIS MANUAL BEFORE ATTEMPTING TO
INSTALL THE PRINTER INTERFACE CARD INTO THE APPLE II.
INCORRECT WIRING COULD CAUSE PERMANENT DAMAGE
TO BOTH THE PRINTER INTERFACE CARD AND THE APPLE II.**

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APPLE II PARALLEL PRINTER INTERFACE CARD

INTRODUCTION

The Parallel Printer Interface Card allows the Apple II to produce hardcopy (printed) output on a wide variety of printers. This compact board not only provides a complete electronic link between the printer and the Apple II motherboard, but in addition it contains a powerful firmware package to handle:

- Interpretation of program commands for the printer,
- Compensation for varying printer line lengths,
- Special control characters peculiar to a given printer.

Using this built-in subroutine package, a user can easily control the printer from BASIC or the Monitor, to produce:

- Program listings
- Printed records and reports
- Debug listings and memory dumps

The Interface Card can be quickly adapted to most printers equipped with a 7- or 8-bit parallel interface. It can operate them at speeds up to 5000 char/second (3700 lines/minute at 80 char/line), or the maximum rated speed of the printer-- whichever is lower. It can print 40 to 255 characters/line, determined by the printer.

The Printer Card is also useful in non-printer applications as a general purpose, 8-bit parallel output port. See Section 4 for information on using the board in this mode.

I INTERFACING TO THE PRINTER

The Apple II Parallel Printer Card is designed to interface with a variety of printers; but the user must "customize" it to interface with the selected printer by:

1. Connecting the ribbon cable (delivered with the Parallel Printer Card) to the proper connection points in the printer, and;
2. Wiring the jumper configuration block for the "handshake" (communications) procedure recognized by the printer.

Connecting the Cable

The twenty-wire interconnecting cable is illustrated at the end of this section. Ten to twelve wires (depending on the selected printer) must be connected to the printer. Cable connector diagrams for the Axiom EX800, the Centronics, and the SWTP PR40 printers are given on the pages following the cable illustration. For all other printers, use the twenty-wire cable illustration (Figure 2) and the interconnect information in the printer manufacturer's manual to develop your connector diagram (use the form in Figure 6). Connect the wires in the following order:

Step		Cable Wire(s)	
1	Connect both Grounds	1 & 20	to the printer "circuit" or "logic" ground pins. (Do not use "chassis" or "AC" ground)
2	Connect Data Lines	10-17	to the appropriate data input pins in the printer.

Notes: Data Line DP0 (cable wire 10) must go to the lowest numbered signal name (Least Significant Bit) in the printer. The lowest signal name is usually number 0; but it may be number 1, depending on the printer. (The printer signal names, which are specified in the printer manual, may not correspond to the connector pin numbers, so go by the signal names.)

Data Lines DP1-DP7 (cable wires 11-17) connect to sequentially higher numbered printer signal names. Some printers only utilize seven data lines (e.g. Axiom and PR40). Other printers utilize eight data lines (e.g. Centronics). If only seven data lines are utilized, leave printer cable wire 17 (DP7) unconnected.

- | | | | |
|---|-------------|---|----------------------------|
| 3 | Connect ACK | 2 | to the printer output pin. |
|---|-------------|---|----------------------------|

Notes: ACK (ACKnowledge) should be connected to the printer output pin (labeled ACK, DATA ACCEPTED, or a similar name) which denotes the printer accepting data from the interface card.

Either ACK or $\overline{\text{ACK}}$ polarity is acceptable, depending on the configuration of the jumper block.

- | Step | Cable Wire(s) |
|------|--|
| 4 | Connect STROBE 8 to the printer input pin. |
- Notes: STROBE should be connected to the printer input pin (labeled STROBE, DATA READY, or a similar name) which denotes the interface card telling the printer that data is ready for acceptance.
- Either STROBE or $\overline{\text{STROBE}}$ polarity is acceptable, depending on the configuration of the jumper block.
- 5 Tape all unconnected wires from the cable to avoid unintentional shorts.

Wiring the Jumper Block

The jumper configuration block must be wired for the "handshake" procedure the printer recognizes. To wire the jumper block, take the following steps:

Step

- 1 Locate the jumper block (in the lower right corner of the Parallel Printer Board-location B1).
- 2 Note the position of the jumper block in location B1. The upper left corner of the jumper lock is notched, denoting pin #1. The jumper block must be re-inserted so the notched upper left corner matches the notched upper left corner of the socket.
- 3 Remove and wire the jumper block.

Notes: Wiring diagrams for the Axiom, Centronics, and SWTP PR40 printers are illustrated at the end of this section.

For all other printers, take the following steps:

- A. Determine whether the printer requires STROBE (positive-going) or $\overline{\text{STROBE}}$ (negative-going) strobe edge.
- B. Determine whether the printer output is an ACK (negative-going) or an $\overline{\text{ACK}}$ (positive-going) signal edge.
- C. Select the diagram in Figure 1 below that matches the STROBE/ACK "handshake" determined in A and B above.
- D. Wire the jumper block according to the appropriate diagram.

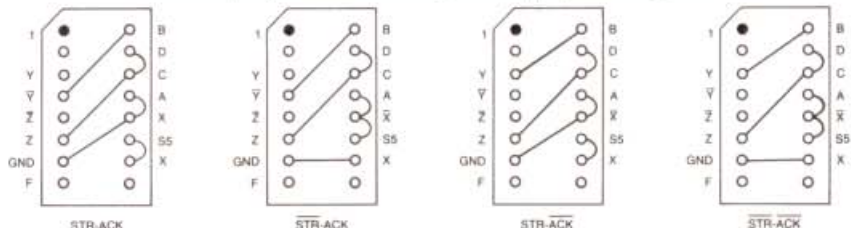
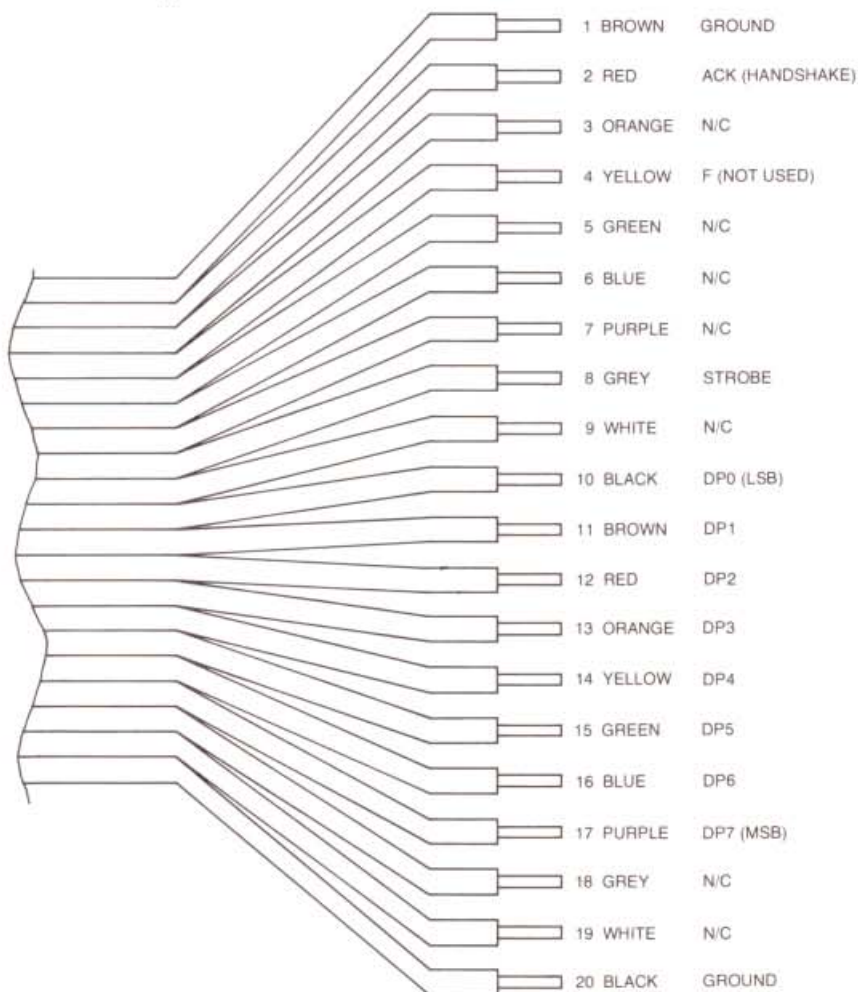


Figure 1. Jumper Block Diagrams

The STROBE/ACK specifications are usually found in the manual describing the printer. The names used to identify STROBE and ACK signals may vary.

If the STROBE/ACK signals are not defined, as a last resort try each wiring diagram in Figure 1. The Apple II will control the printer properly when the correct configuration is found. (Attempting to use the printer with an incorrect configuration will not damage the printer or the Apple II.)

- 4 Re-insert the jumper block in location B1 on the Parallel Printer Card. The notched upper left corner of the jumper block must match the notched upper left corner of the socket.



1 N/C = NO CONNECTION
 2 LSB = LEAST SIGNIFICANT DATA BIT OUT
 3 MSB = MOST SIGNIFICANT DATA BIT OUT

Figure 2. Interconnecting Cable Diagram

Cable Connector Table

Axiom EX800 Printer

The Axiom EX800 uses a DB-25 male connector (ITT-Cannon Part #DB25P). The DB-25 male connectors are widely used in RS-232 interface devices.

Apple II	Printer Board Pin	Wire Color	EX800 Pin
GND	1	Brown	7
ACK	2	Red	14
STR	8	Grey	24
DP0	10	Black	15
DP1	11	Brown	16
DP2	12	Red	17
DP3	13	Orange	18
DP4	14	Yellow	19
DP5	15	Green	21
DP6	16	Blue	23
GND	20	Black	7

Jumper Configuration Block Wiring Diagram

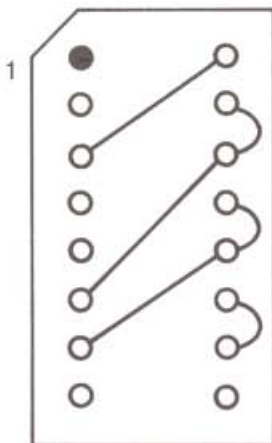


Figure 3. Axiom EX800 Example

Cable Connector Table

Centronics Printers

All standard Centronics printers use the same interface. Centronics printers require an Amphenol type 47, part #47-30360 connector.

Apple II	Printer Board Pin	Wire Color	Centronics Pin
GND	1	Brown	14
ACK	2	Red	10
STR	8	Grey	1
DP0	10	Black	2
DP1	11	Brown	3
DP2	12	Red	4
DP3	13	Orange	5
DP4	14	Yellow	6
DP5	15	Green	7
DP6	16	Blue	8
DP7	17	Violet	9
GND	20	Black	16

Jumper Configuration Block Wiring Diagram

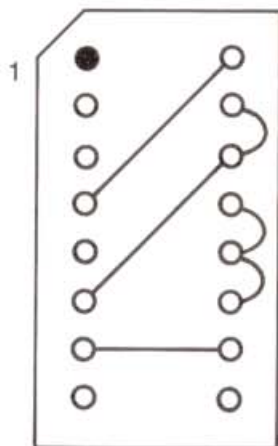


Figure 4. Centronics Example

Cable Connector Table

SWTP PR40 Printer

The SWTP requires a Molex receptacle, #03-09-1122. The connector uses both male and female pins and is wired as follows:

Apple II	Printer Board Pin	Wire Color	PR40 Pin	PR400 Pin Type
GND	1	Brown	1	Female
ACK	2	Red	2	Female
STR	8	Grey	3	Male
	—	N.C.	4	Female
DP5	15	Green	5	Female
DP6	16	Blue	6	Female
	—	N.C.	7	Male
DP3	13	Orange	8	Female
DP4	14	Yellow	9	Female
DP0	10	Black	10	Female
DP1	11	Brown	11	Female
DP2	12	Red	12	Male
GND	20	Black	1	Female

Jumper Configuration Block Wiring Diagram

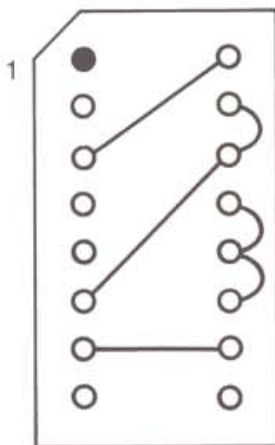


Figure 5. SWTP Example

Cable Connector Table

User's Printer Worksheet

Apple II	Print Board Pin	Wire Color	Printer Pin
GND	1	Brown	_____
ACK	2	Red	_____
STR	8	Grey	_____
DP0	10	Black	_____
DP1	11	Brown	_____
DP2	12	Red	_____
DP3	13	Orange	_____
DP4	14	Yellow	_____
DP5	15	Green	_____
DP6	16	Blue	_____
GND	20	Black	_____

Jumper Configuration Block Wiring Diagram

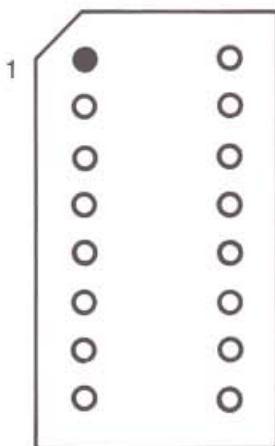


Figure 6. User's Cable and Configuration Block Diagram

II INSTALLING THE PRINTER CARD

To install the Parallel Printer Card, take the following steps:

Step

- 1 Turn the Apple II off.

Note: Power should always be off when inserting or removing a card. If the power is on, removal or insertion of a card could cause permanent damage to both the card and the Apple II.

- 2 Take off the lid and look at the row of eight connectors at the rear. Each connector is numbered (0-7) just in back of the connector. The numbered connectors are called slots.
- 3 Plug the Parallel Printer Card into any slot except slot #0.

Note: Slot #0 is reserved for future expansion and cannot be utilized by the Parallel Printer Card.

We recommend that you plug the card into slot #1, because the commands in the following section use slot #1.

When you sit at the keyboard, the component side of the Printer Card will be to your right when you insert it.

- 4 Gently plug the 20-pin flat cable connector into the mating connector on the Parallel Printer Card.

Note: The connector should be inserted so the flat cable comes out of the connector away from the board (not next to the board).

- 5 Drape the cable over the back of the case (with the lid off) and put the lid on.

Note: The pressure between the lid and the case acts as a cable clamp, preventing a tug on the cable from putting stress on the connector or Parallel Printer Card.

- 6 Plug the other end of the cable into the printer I/O connector.

III PRINTER OPERATION

Accommodating Different Printers

Interpretation of Carriage Return and Line Feed character sequences varies from printer to printer. The following table summarizes the possible interpretations.

Method	Character Interpreted	Action
1	Carriage Return Line Feed	Causes carriage return and advances line. Causes no action.
2	Carriage Return Line Feed	Causes carriage return. Advances line.
3	Carriage Return Line Feed	Causes no action. Causes carriage return and advances line.
4	Carriage Return Line Feed	Causes carriage return and advances line. Advances line.

The Apple II adds a Carriage Return to the end of every line, and; the Parallel Printer Card adds a Line Feed character to the end of each line.

Therefore, each line sent to the printer is terminated by a Carriage Return and a Line Feed.

If the printer automatically adds another Line Feed character to the end of each line, double spacing of the printed lines may occur. If desired a command described below may be used to turn off the automatic printer Line Feed.

The number of columns (characters) per line also varies from printer to printer. When using a printer with a TV monitor, the line width is set to 40 columns, the width of the TV monitor. When using the printer alone, the line may be set to any width from 40 to 255 columns (depending upon the printer's capacity). The Parallel Printer Card is configured to accommodate the following Apple BASIC conventions:

- BASIC Listings will be formatted to prevent splitting command words at the end of the line.
- The TAB command and PRINT "comma" command formats will be printer dependent, regardless of line width.

In other words, setting the line width also sets the TAB, PRINT "comma," and BASIC Listing conventions to accommodate the new line width.

Starting to Use Your New Printer—An Example

Once the Parallel Printer Card is configured to match the printer and installed in a slot, it is ready for use.

The Printer Commands in the examples below are in Apple II BASIC. Apple Monitor I/O Commands and Apple Basic Program I/O Commands are listed at the end of this section.

Command

RESET B^C RETURN

> PR#1

Explanation

Interrupts any program execution and transfers control to BASIC.

Turns Parallel Printer Card on. All data displayed on the TV monitor screen is also sent to the printer with the following exceptions:

- Graphic data is not printed
- Backward TABs and VTABs do not work. (Forward TABs work correctly.)

Notes: I/O slot 0 cannot be entered.

If the incorrect slot number is typed, all output will go to the wrong slot and no data will be displayed or printed. Depress RESET, and the computer will return to TV monitor display only.

If the printer is not plugged in, turned ON, and ready to print, it will look BUSY to the system; which will "hang up" waiting for it. To clear this waiting state, get the printer ready to print (see its manual), then depress Apple II's RESET key (to clear the busy flag). The program may then be re-started.

>PRINT 6+7
RETURN

The statement and its result should appear on both the printer and the monitor screen.

Notes: Most printers wait for a Carriage Return and then print the entire line.

Since the TV monitor display is designed for 40 characters per line, the printer will behave like a 40 column (40 characters per line) printer as long as the monitor screen display is on.

On some printers, several lines must be printed before the paper advances far enough for the first line to be seen.

If at this point, data does not print at the printer:

1. Verify the Parallel Printer Card is plugged into slot #1 (specified in the PR#1 command). Slot #1 is the **second** slot from the left.

2. Verify that the wiring of the cable and jumper block are correct.
3. Verify that PR#1 was typed correctly.
4. Verify that the printer is turned on, and that the system has been RESET since.

If the printer still does not print, ask your local Apple dealer for assistance.

Printer Commands

The Parallel Printer Card Commands begin with CTRL I (I^C). The command conventions are:

LOWER CASE WORDS Enter the data identified by the word.

UPPER CASE
CHARACTERS Type the character(s) or number(s) shown.

CONTROL
CHARACTERS Control characters are indicated by a superscript C; e.g.: I^C. A control character is entered by depressing the CTRL key and the character key simultaneously. (Similar to using the shift key to type a capital letter.)

SPACING Spacing in the command format is for legibility only. Spaces are not required when the command is entered.

For example, I^Cn N RETURN means:

1. Type I while holding the CTRL key down.
2. Enter a number at the keyboard.
3. Type N at the keyboard.
4. Depress RETURN.

The Printer Commands are shown below. They may be used in the command mode from either BASIC or the Monitor (except for PR# and P^C commands—see explanations).

Command	Explanation
I ^C n N RETURN	Turns off monitor screen and prints n columns per line on printer. The number of columns may be any number from 40 to 255.
I ^C I RETURN	Returns output to TV monitor screen as well as to printer.
I ^C K RETURN	Turns off automatic printer Line Feed.

I ^C letter ^C RETURN	Changes printer command control character recognized by printer. For example I ^C A ^C changes the control character recognized by the printer.
letter ^C I ^C RETURN	Changes printer control character back to I ^C . For example, A ^C I ^C .
PR# slot no. RETURN	Turns Printer Card on from BASIC. The slot number must identify the slot in which the Parallel Printer Card is inserted. Any number from 1 to 7 may be entered.
PR#0 RETURN	Turns the Parallel Printer Card off from BASIC.
slot no. P ^C	Turns on Printer Card from the Monitor. The slot number must identify the slot in which the card is inserted.
OP ^C	Turns the Printer Card off from the Monitor.

Notes: For users of Applesoft BASIC on cassette tape:
 Applesoft BASIC does not yet allow "PR#" commands (which are used in Apple Integer BASIC to turn the printer ON and OFF). Therefore, the printer must be controlled as follows:

To turn ON, type

POKE 54, 0: POKE 55, 192 + slot no.

To turn OFF, type

POKE 54, 240: POKE 55, 253

These commands must be entered on a single line, as shown. They will work from the Monitor and Apple BASIC as well as from Applesoft BASIC, but are not required.

All other commands, using I^C, work from Applesoft BASIC.

Using Printer Commands in BASIC Programs

Printer control within BASIC programs is accomplished by embedding the commands (shown above) in PRINT statements.

>10 PR#1	Turns off Printer Card.
>20 PRINT "I ^C no. N";	Turns off TV monitor screen display and prints n columns per line at the printer
>30 PRINT "I ^C I";	Returns output to TV monitor screen as well as printer.
>40 PRINT "I ^C K";	Turns off the Line Feed code.
>50 PRINT "I ^C A ^C ";	Changes I ^C to A ^C for printer listing of BASIC program.

>60 PRINT "A^CI^C";

Restores I^C as the printer control command character.

Example Of Control From a BASIC Program

Here is a typical BASIC program using the printer control commands.

10 PR #1

Turn on Printer Card.

(20 PRINT "I^CK";)

Only if printer advances line on Line Feed code.

30 PRINT "I^C80N";

Output on printer only.

40 PRINT "PRINTER"

50 PRINT "I^CI";

Output on screen and printer.

60 PRINT "SCREEN AND PRINTER"

70 PR #0

Turn off printer card.

80 PRINT "SCREEN ONLY"

90 END

Listing Programs Containing Print Commands

To list a BASIC program containing printer control commands, take the following steps:

Command

Explanations

> PR#1

Turns Parallel Printer Card on.

>I^CK RETURN

Only if printer advances line on Line Feed code.

>I^CA^C RETURN

Changes I^C character to A^C character. The printer treats I^C command sequences in a BASIC Program listing as a command and changes printer operation as specified in the command. To avoid this problem the I^C must be changed to another character, e.g.: A^C.

>A^C80N RETURN

Turns off TV monitor screen and outputs on 80 column printer.

>LIST

LIST is not displayed because the TV monitor display is off.

>A^CI^C RETURN

Enter after the listing is complete to restore I^C as the printer control command character.

OPERATING HINTS

The three techniques detailed below will guard against the most common printing problems.

1. Before using the printer in your program (PR#1 statement), be sure to HOME the cursor and clear the screen. (A CALL-936 statement in your program does this.)
2. If you are printing more than 40 characters per line, be sure to re-set the line length to 40 characters per line before using the PR#0 command (which turns off the printer interface).
3. Before using the printer to list a program that has printer control commands embedded in it, change the control character from I to some other character. Then re-set I as the control character before running the program.

IV USING THE PRINTER CARD AS A GENERAL-PURPOSE, PARALLEL OUTPUT PORT

The Parallel Printer Card can be used as a general-purpose, 8-bit parallel output card to drive music synthesizers, digital-to-analog converters, etc.

If data is stored at location $\$C080 + \$N0$ (where N is the slot number), then the data will appear on Printer Board Data Lines (DP0-DP7), and will remain until the next "STORE" instruction to that location is executed.

From BASIC this data transfer may be accomplished by typing:

```
POKE (-16256+N16), DATA
```

N is the slot number of the Printer Card, and DATA is the Data to be put out.

Each time a byte is sent to the Printer Card, a strobe will be generated on the STR line. The strobe polarity may be set as described earlier for strobes to printers.

V HARDWARE DESCRIPTION

Board Layout

The Printer Board contains a 6309 (256 × 8) PROM for printer firmware, an 8-bit data register, and handshake and configuration logic at the following board locations:

Location	Package Component	Function
B1	16-Pin DIP Header	Sets handshake logic levels.
B2	74LS74	Forms response detection from printer.
B3	74LS298	A. Two bits of 8-bit register are latched into two sections. B. An output strobe or level for handshake is formed using the other two sections.
A4	74LS174	Six bits of 8-bit data register latched into 74LS174.
A1	74LS00	Performs PROM address alteration. (A response signal alters the address range of the PROM; thus altering the firmware program.)

Handshake Procedure

The Parallel Printer Interface Card will accommodate a variety of handshake procedures. The following description of the more common two-line handshake should enable the engineer/user to design other handshake procedures.

STROBE/Edge Handshake

Pulse (STR or STR) to printer indicates data transfer ready. Edge (ACK or ACK) response from printer indicates printer ready to accept data.

Note: Although many printer documents describe the acknowledge signal as a level, careful inspection will often show the critical timing of the acknowledge signal to be on edge.

The Strobe/Edge Handshake is the most common handshake. Figure 7 illustrates the relative timing and defines the level for the handshake signals.

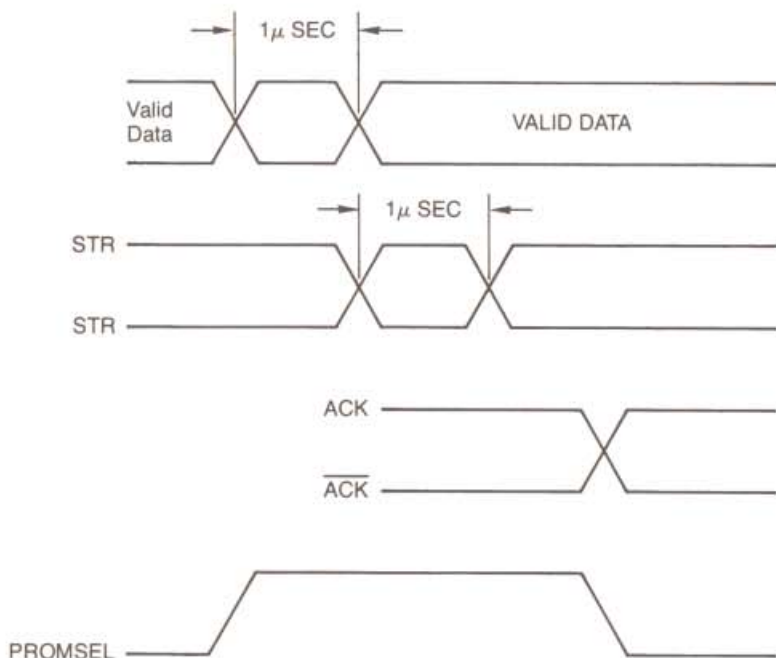
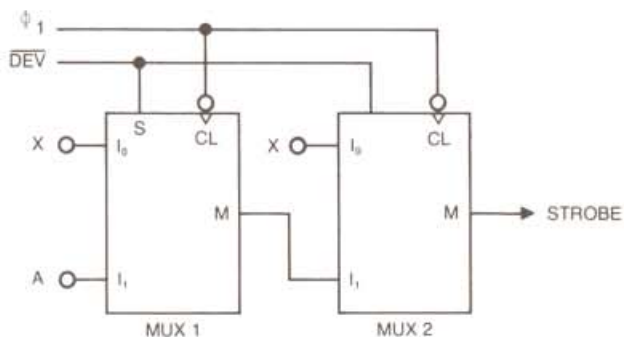


Figure 7. Strobe/Edge Timing

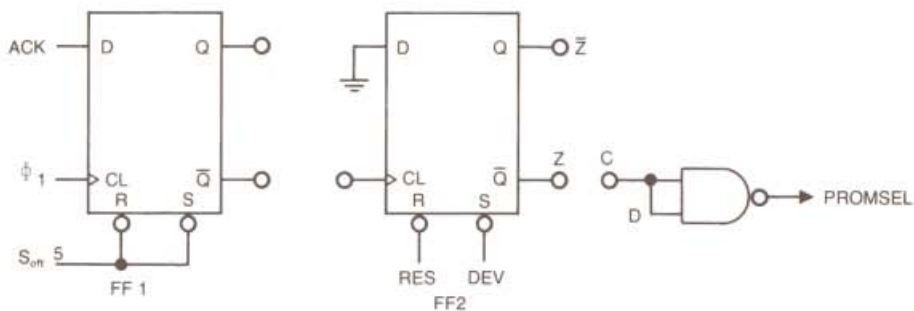
In Figure 8, FF1 is used to synchronize the incoming ACKnowledge signal to the Apple II system timing. The output of FF1 is connected to the clock input of FF2 to reset FF2 when the desired acknowledge edge occurs. (FF2 has been previously set by the DEV signal that occurred when the last data was sent to the printer.) Thus, output Z (Q of FF2) will be high causing PROMSEL to be low from the time a data word is sent until the acknowledge edge is received. When PROMSEL is low, the PROM is in its Printer-Not-Available program mode.

When a data word is sent to the printer, MUX1 will switch from the A input to the X input. (These are complementary for a strobe pulse response.) Thus, output M1 of MUX1 will change state. Since X is sent to the same state as A, the output STR of MUX2 will not change state with the DEV signal. On the next Φ_1 clock, STR will return to its rest state, completing the STR pulse generation. The deliberate delay in STR from the first DEV input is necessary because an indexed store operation from the 6502 will cause a false DEV the cycle prior to the legitimate store operation. Figures 9 and 10 show a functional block diagram of the Printer Card, and the actual schematic.



Strobe Pulse

$\overline{\text{STR}}$	A = $S_{\text{off}} 5$	STR	A = GND
	X = $S_{\text{off}} 5$		X = GND
	X = GND		X = $S_{\text{off}} 5$



Edge Response

$\overline{\text{ACK}}$	B = Y	ACK	B = \overline{Y}
-------------------------	-------	-----	--------------------

Figure 8. Jumper Configuration Block Connections

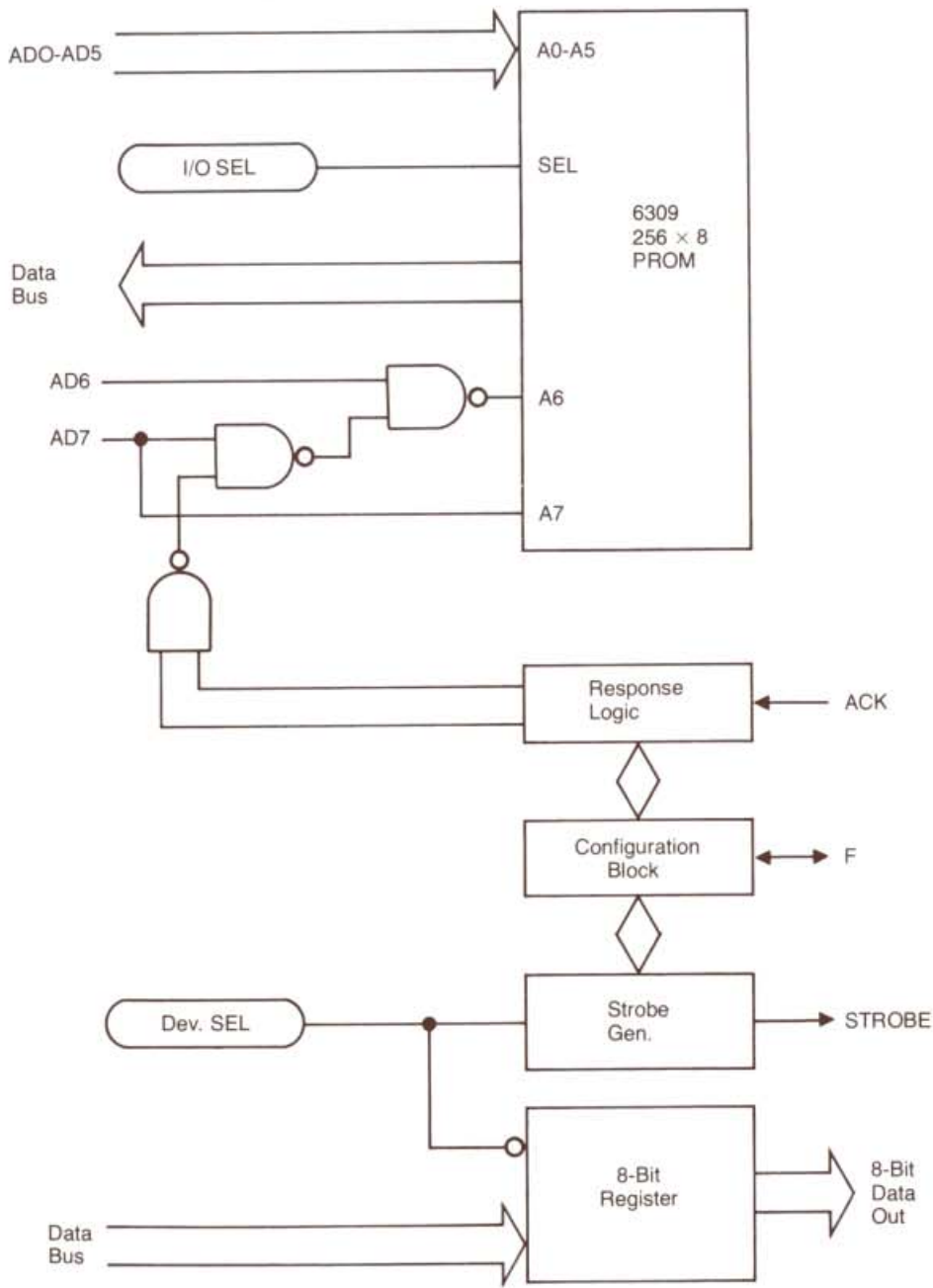
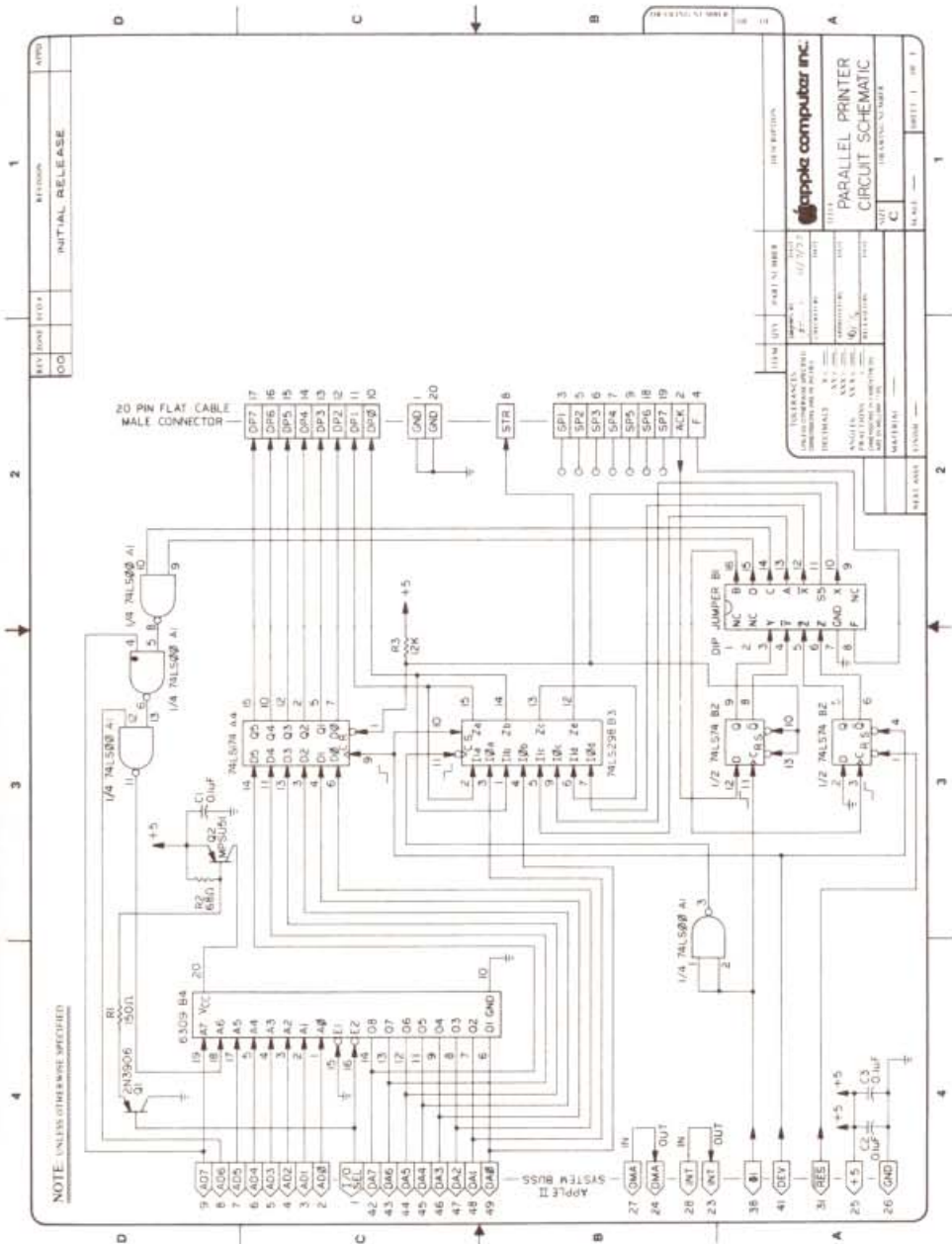


Figure 9. Parallel Printer Board Block Diagram



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PARALLEL PRINTER
CIRCUIT SCHEMATIC

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	74LS174	NLS298A
2	2	74LS175	NLS298B
3	1	74LS10	NLS298A
4	2	74LS174	NLS298B

DATE: 11/80

DESIGNED BY: [blank]

CHECKED BY: [blank]

APPROVED BY: [blank]

DATE: 11/80

SCALE: 1:1

DRWING NUMBER: [blank]

SHEET 1 OF 1

Figure 10. Parallel Printer Card Schematic

VI FIRMWARE DESCRIPTION

The commented firmware listing on the following pages fully describes the Apple II Parallel Printer Interface Card Firmware. The listing contains four sections:

- Address Transformation Information

Note: The Firmware listing provides the apparent address of the printer card to the CPU. Due to address mapping, the apparent address and the real PROM address do not agree.

- Printer Card Equates
- Printer Card Firmware Listing
- Symbol Cross - Reference Table

The PR# BASIC Command or the P^C Monitor Command are not required to access the printer board firmware.

For direct output,

- a) preset MSTRT (\$5F8+\$N)
MODE (\$678+\$N)
ESCHAR (6F8+\$N)
FLAGS (\$778+\$N)

- b) enter the program once at \$CN00. (The normal entry point is \$CN02).

Data in the accumulator is output on the data lines with STR when the responding device is ready.

The firmware program exits by an RTS or a JMP COUT1, depending on B7 of the MODE word in memory. The accumulator, X and Y registers, and stack pointer are not affected.

0000			0010	*****				
0000			0020	*		*		
0000			0030	*	PRINTER CARD I FIRMWARE	*		
0000			0040	*		*		
0000			0050	*	WDZ 11/1/77	*		
0000			0060	*	APPLE COMPUTER INC.	*		
0000			0070	*	ALL RIGHTS RESERVED	*		
0000			0080	*		*		
0000			0090	*****				
0000			0100	WINDWTH	EGU	%21 WINDOW WIDTH (MARGIN)		
0000			0110	CH	EGU	%24 CURSOR HORIZONTAL INDEX		
0000			0120	CSWL	EGU	%36 LOW ORDER COUT SWITCH BYTE		
0000			0130	MSTRT	EGU	%53B MARGIN START		
0000			0140	MODE	EGU	%58B AFTER ESC CHAR IN B7		
0000			0150	ESCHAR	EGU	%63B CURRENT ESC CHAR		
0000			0160	FLAGS	EGU	%68B B7=VID-ALSO, B0=CRLF		
0000			0170	COL	EGU	%73B COLUMN COUNT		
0000			0180	DEV	EGU	%C0B0 +*NO ACTIVATES THE DEV LINE		
0000			0190	CDUTI	EGU	%FDF0 VIDED OUTPUT ENTRY		
0000			0200	IORTS	EGU	%FF5B FIXED RTS INSTUCTION		
0000			0210	*				
0000			0220	*				
0000	18		2	0230	ENT0	CLC		DEFAULT ENTRY
0001	80	00	2*	0240	BCS	*		
0003				0250	DRG	*-1		
0002	38		2	0260	ENT1	SEC		NORMAL ENTRY
0003	48		3	0270	PHA			
0004	8A		2	0280	TXA			
0005	48		3	0290	PHA			SAVE REGISTERS ON STACK
0006	98		2	0300	TYA			
0007	48		3	0310	PHA			
0008	08		3	0320	PHP			
0009	78		2	0330	SEI			DISABLE INTERUPTS
000A	20	5B	6	0340	JSR	IORTS		RETURNS %CN ABOVE STACK
000D	8A		2	0350	TSX			(N IS SLOT NUMBER)
000E	68		4	0360	PLA			
000F	68		4	0370	PLA			
0010	68		4	0380	PLA			
0011	68		4	0390	PLA			
0012	AB		2	0400	TAY			CHAR TO Y-REGISTER
0013	CA		2	0410	DEX			
0014	9A		2	0420	TXS			GET %CN FROM ABOVE STACK
0015	68		4	0430	PLA			
0016	28		4	0440	PLP			RESTORE STATUS
0017	AA		2	0450	TAX			%CN TO REG X
0018	90	47	2	0460	BCC	DEFAULT		
001A	8D	8B	4*	0470	LDA	MODE, X		AFTER ESC CHAR?
001D	10	4E	2*	0480	BPL	ESCTST		NO...
001F	98		2	0490	TYA			CHAR TO REG-A
0020	29	7F	2	0500	AND	##7F		MASK OUT BIT 7
0022	49	30	2	0510	EOR	##30		ALTER BITS
0024	C9	0A	2	0520	CMF	##A		"0"- "9"?
0026	90	29	2*	0530	BCC	DIG		BRANCH IF YES
0028	C9	78	2	0540	CMF	##7B		"H"- "0"?
002A	80	06	2*	0550	BCC	SETFLG		YES, SET OR CLR FLAGS
002C	98		2	0560	TYA			GET ORIGINAL CHAR AGAIN
002D	9D	38	5	0570	STA	ESCHAR, X		STORE NEW ESC CHAR
0030	90	16	2*	0580	BCC	DONE1		BRANCH ALWAYS TAKEN
0032	4A		2	0590	SETFLG	LSR		A
0033	6A		2	0600	ROR			B0 -> B7, B2 -> B0, B1 -> CARRY
0034	80	08	2*	0610	BCS	CLRFLG		CLR FLAGS IF B1 WAS ONE
0036	1D	8B	4*	0620	DRA	FLAGS, X		SET FLAGS SELECTIVELY
0039	10	0A	2*	0630	BPL	NEWFLG		
003B	A0	28	2	0640	LDY	##2B		IF IN VIDEO ALSO THEN SET
003D	84	21	3	0650	STY	WINDWTH		WINDOW WIDTH (MARGIN)=40
003F	90	04	2*	0660	BCC	NEWFLG		BRANCH ALWAYS TAKEN
0041	3D	8B	4*	0670	CLRFLG	AND		FLAGS, X
0044	18		2	0680	CLC			INDICATE 'NOT AFTER ESC CHAR'
0045	9D	8B	5	0690	NEWFLG	STA		B7=VIDEO-ALSO, B0=CRLF
0048	7E	8B	7	0700	DONE1	ROR		CARRY INTO B7 FOR
0049	68		4	0710	DONE2	PLA		'AFTER ESC CHAR' MODE
004C	AB		2	0720	TAY			
004D	68		4	0730	PLA			RESTORE REGISTERS
004E	AA		2	0740	TAX			
004F	68		4	0750	PLA			THEN RETURN
0050	60		6	0760	RTS			
0051				0770	*			
0051				0780	*			
0051	A0	0A	2	0790	DIG	LDY	##A	
0053	7D	3B	4*	0800	DLOOP	ADC	MSTRT, X	ADD 10*MSTRT TO DIG AND STORE
0056	88		2	0810	DEY			IN WINDOW WIDTH (MARGIN)
0057	D0	FA	2*	0820	BNE	DLOOP		

0059	B5 21	3	0830	STA	WNDWDTH	
0058	9D 38 05	5	0840	MINIT	STA	MSTRT, X
005E	38	2	0850	SEC		UPDATE MARGIN START
005F	B0 E7	2*	0860	BCS	DONE1	INDICATE 'AFTER ESC CHAR'
0061			0870	*		BRANCH ALWAYS TAKEN
0061			0880	*		
0061	A9 89	2	0890	DEFAULT	LDA	##89
0063	9D 38 06	5	0900	STA	ESCHAR, X	DEFAULT CHARACTER (CONTROL-I)
0066	9D 88 06	5	0910	STA	FLAGS, X	VIDEO ALSO, CRLF ON
0069	A9 02	2	0920	LDA	#>ENT1	
006B	B5 36	3	0930	STA	CSWL	SET FOR NORMAL ENTRY
006D	98	2	0940	ESCTST	TYA	MOVE CHAR TO REG-A
006E	5D 38 06	4*	0950	EOR	ESCHAR, X	
0071	0A	2	0960	ASL	A	ESC CHAR? (7 LSB'S)
0072	F0 E7	2*	0970	BEG	MINIT	BRANCH IF YES
0074	5E 88 05	7	0980	LSR	MODE, X	NO, CLR 'AFTER ESC CHAR'
0077	98	2	0990	TYA		
007B	4B	3	1000	PHA		SAVE CHAR ON THE STACK
0079	BA	2	1010	TXA		
007A	0A	2	1020	ASL	A	
007B	0A	2	1030	ASL	A	GENERATE N**10 AS AN INDEX TO
007C	0A	2	1040	ASL	A	THE DEVICE LINE (REG-Y)
007D	0A	2	1050	ASL	A	
007E	AB	2	1060	TAY		
007F	90 40	2*	1070	BCC	PRNT	BRANCH ALWAYS TAKEN
0081	90 FE	2*	1080	BCC	*-2	IMAGE 'WAIT FOR READY'
0083	99 80 C0	5	1090	OUT	STA	DEV, Y
0086	90 39	2*	1100	BCC	PRNT	OUTPUT CHAR TO PRINTER
008B	49 0D	2	1110	EDR	##D	LOOP IF WAS TAB
008A	0A	2	1120	ASL	A	
008B	D0 0D	2*	1130	BNE	FINISH	CARRAGE RETURN IN 7 LSB'S?
008D	9D 38 07	5	1140	STA	COL, X	BRANCH IF NOT CR
0090	BD 88 06	4*	1150	LDA	FLAGS, X	CLEAR COLUMN COUNT
0093	6A	2	1160	RDR	A	FOR CRLF CHECK (B0)
0094	29 80	2	1170	AND	##80	
0096	09 0A	2	1180	ORA	##A	GENERATE LINE FEED
0098	B0 5F	2*	1190	BCS	PRNT2	OUTPUT IF CRLF MODE
009A	BD 88 06	4*	1200	FINISH	LDA	FLAGS, X
009D	10 08	2*	1210	BPL	NOVID	
009F	68	4	1220	PLA		
00A0	AB	2	1230	TAY		
00A1	68	4	1240	PLA		IF VIDEO-ALSO MODE THEN
00A2	AA	2	1250	TAX		RESTORE REGISTERS AND END
00A3	68	4	1260	PLA		WITH VIDEO OUT ROUTINE
00A4	4C F0 FD	3	1270	JMP	COUT1	
00A7	BD 38 07	4*	1280	NOVID	LDA	COL, X
00AA	F0 08	2*	1290	BEG	SETCH	COLUMN COUNT
00AC	E5 21	3	1300	SBC	WNDWDTH	IF ZERO, CLEAR CURSOR HORIZ
00AE	E9 F7	2	1310	SBC	##F7	CHECK FOR WITHIN 8 CHARS OF
00B0	90 99	2*	1320	BCC	DONE2	WINDOW WIDTH (MARGIN)
00B2	69 1F	2	1330	ADC	##1F	IF NO, THEN DONE
00B4	18	2	1340	SETCH	CLC	ADD 32 (FORMING 32-39)
00B5	B5 24	3	1350	STA	CH	FOR NEW CURSOR HORIZ IF
00B7	90 92	2*	1360	BCC	DONE2	NEAR MARGIN (FOR LIST)
00B9	70 FE	2*	1370	BVS	*-2	BRANCH ALWAYS TAKEN
00BB			1380	ORG	**6	IMAGE FOR 'WAIT FOR READY'
00C1	90 21	2*	1390	PRNT	BCC	PRNT1
00C3			1400	ORG	**>21	TAKEN WHEN PRINTER READY
00E4	BD 38 07	4*	1410	PRNT1	LDA	COL, X
00E7	C5 24	3	1420	CMP	CH	
00E9	68	4	1430	PLA		IF COLUMN >= CURSOR HORIZ
00EA	B0 05	2*	1440	BCS	CTLTST	THEN USE CHAR
00EC	48	3	1450	PHA		
00ED	29 80	2	1460	AND	##80	ELSE GEN BLANK (7 LSB'S)
00EF	09 20	2	1470	ORA	##20	FOR TAB CATCH-UP
00F1	2C 58 FF	4	1480	CTLTST	BIT	IORTS
00F4	F0 03	2*	1490	BEG	PRNT2	INCR COLUMN COUNT
00F6	FE 38 07	7	1500	INC	COL, X	IF NOT A CONTROL CHAR
00F9	70 88	2*	1510	PRNT2	BVS	OUT
						TAKEN WHEN PRINTER READY

0024	CH	0041	CLRFLG	0738	COL	FDF0	COUT1
0036	CSWL	00F1	CTLTST	0061	DEFAULT	C080	DEV
0051	DIG	0053	DLOOP	0048	DONE1	0048	DONE2
0000	ENTO	0002	ENT1	0638	ESCHAR	006D	ESCTST
009A	FINISH	0688	FLAGS	FF58	IORTS	0058	MINIT
0588	MODE	0538	MSTRT	0045	NEWFLG	00A7	NOVID
0083	OUT	00C1	PRNT	00E4	PRNT1	00F9	PRNT2
00B4	SETCH	0032	SETFLG	0021	WNDWDTH		

The information contained in this manual is believed to be correct at the time of publication, but Apple Computer Inc. assumes no liability arising from the use of this material.



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