

# HEATHKIT<sup>®</sup> MANUAL

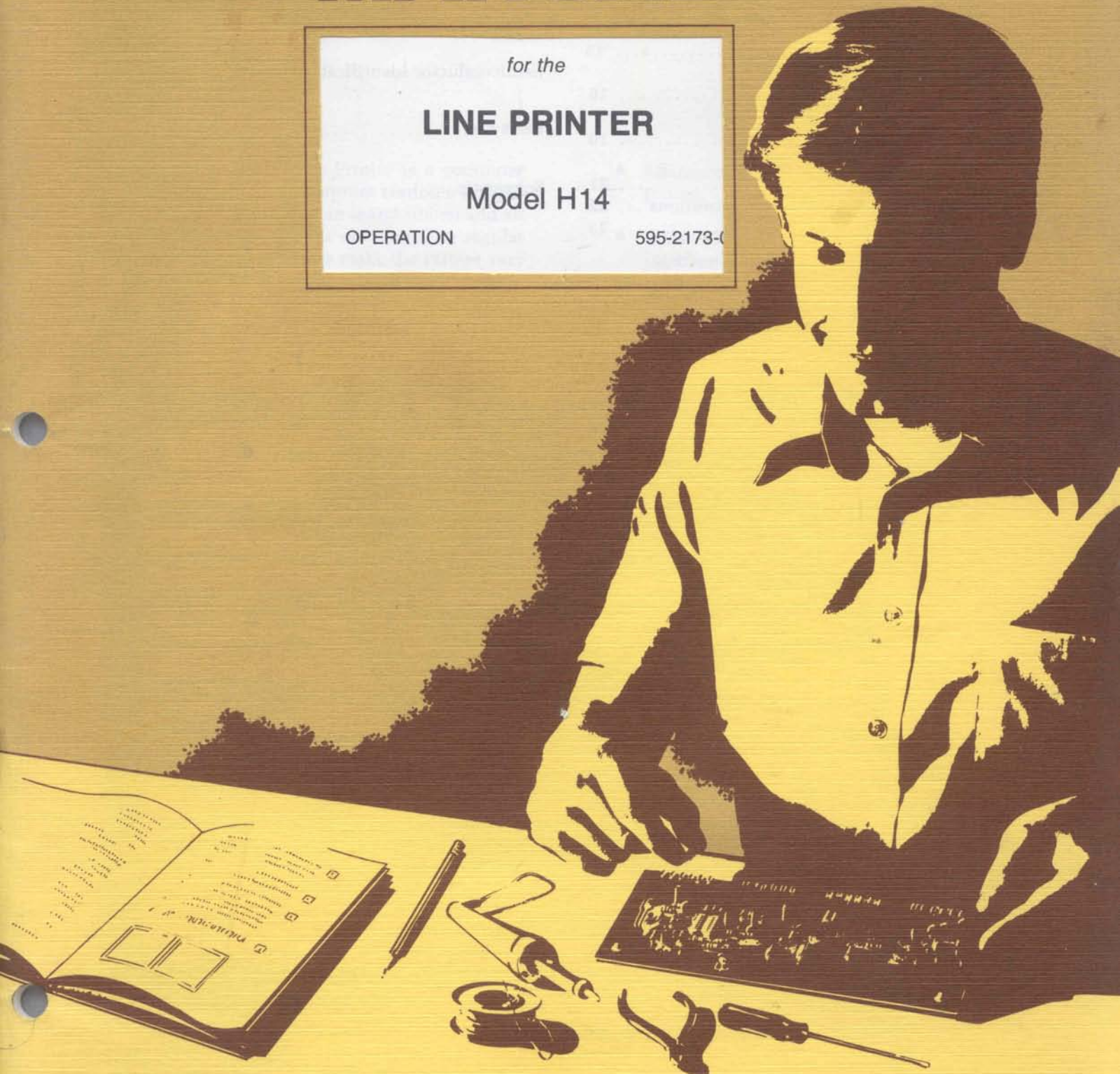
for the

## LINE PRINTER

Model H14

OPERATION

595-2173-0



HEATH COMPANY • BENTON HARBOR, MICHIGAN



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If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

# Heathkit® Manual

*for the*

## LINE PRINTER

Model H14

OPERATION

595-2173-02



HEATH COMPANY  
BENTON HARBOR, MICHIGAN 49022

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# INTRODUCTION

The Heath Model H14 Line Printer is a computer peripheral that provides computer readouts in hard copy form. The Printer uses an inked ribbon and an impact-type printer to print a dot matrix on regular paper. The following features make the Printer very versatile:

- Both upper and lower case characters.
- Full 96-character ASCII font.
- Sprocket paper feed with adjustable spacing.
- Paper out and jammed detectors that prevent damage, or loss of data, or both.

- Microprocessor controlled functions and timing.
- Either RS-232C or 20 mA current loop serial interface (user selectable).
- Handshake control signals.
- Electronic form controls.

The modern design assures excellent reliability, and the handsome styling complements the Heath Computer Series.

For system configuration  
(how to connect your Printer to your Computer)  
information, see Page 6.



# SPECIFICATIONS

## PRINTOUT

Character Set .....	96 character ASCII, upper and lower case.
Character Format .....	5 × 7 dot matrix.
Printing Method .....	Impact. Uses 0.5 inch wide nylon inked ribbon on 2 inch diameter spools.
Character Height .....	0.110 inches.
Line Spacing .....	6 lines per inch. 8 lines per inch selectable by software.
Character Spacing .....	10 characters/inch (80 columns). 12 characters/inch (96 columns). 16.5 characters/inch (132 columns). 10 and 16.5 characters/inch are both hardware and software selectable. 12 characters/inch is software selectable only.
Printing Speed .....	Initial time per full line is approximately 1.75 seconds on 60 Hz power line and 2.1 seconds on 50 Hz power line. Print head temperature is monitored after each line and then limited by slowing or stopping the printing. The maximum throughput is determined by print density and ambient temperature. The maximum instantaneous printing rate is 165 c.p.s.



## PAPER

Paper Type .....	Edge-punched fanfolded forms, 3.0" to 9.5" wide and maximum thickness of 0.006".
Paper Feed .....	Sprocket, with adjustable width.
Forms Control .....	11" form is selected at power up. Any form depth from 0.021" to 1365" may be electronically selected.

## INTERFACE

Electrical .....	Serial RS-232C or 20 mA current loop. Handshake control signals (reverse channel or busy signal).
Connector .....	25 pin male EIA connector on 6 foot cable.
Data Format .....	Asynchronous bit serial; 1 start, 8 data, 2 stop bits on 110 baud and 1 stop bit on all others.
Character Code .....	ASCII.
Line Buffering .....	256 Characters.
Baud Rates .....	110, 150, 300, 600, 1200, 2400, or 4800.

## PHYSICAL

Overall Dimensions .....	18-1/3" W × 14-1/3" D × 4-4/5" H (46.5 cm W × 36.3 cm D × 12.1 cm H) less paper tray.
Net Weight .....	25 lbs. (11.3 kgs.).
Ambient Temperature .....	10°C to 40°C.
Power Requirements .....	100-135 volts 50-60, or 200-270 volts 50-60 Hz, 100 watts maximum.

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The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

# SYSTEM CONFIGURATION

## HEATH SYSTEM CONFIGURATION

Your Line Printer communicates with your computer through a serial I/O card and may be operated at either RS-232C signal levels (see Pictorial 2, Page 9) or at 20 mA current loop levels (see Page 7). The 25-pin "D" connector conforms to RS-232C standards and will mate with most equipment which conforms to this standard. Adaptor cables to convert from earlier Heath equipment connectors to the RS-232C connectors are available from the Heath Company.

Set the Line Printer baud rate (4800 is recommended). Then set the Line Printer and the computer I/O card (do not use the H8-5 Serial I/O card; the H8-4 Multipoint Serial I/O card is recommended) for the same type signal levels (RS-232C or 20 mA current loop) as described in the following sections (RS-232C is recommended).

Refer to your serial interface manual for information on how to set baud rates, addressing, vector interrupts, and signal levels on the serial card. Refer to your Software Manual under "System Configuration" for information on where to set the serial and address (PQRT) and vector interrupt to communicate with this Line Printer.

### PRINTER BAUD RATE SELECTION

To select a desired baud rate, place sections 5, 6, and 7 of switch SW102 (located on the circuit board inside your Printer) in the proper positions as indicated below. The baud rate will be updated upon going from "off line" to "on line," or during power up.

<u>BAUD RATE</u>	<u>SWITCH SECTION</u>		
	5	6	7
110	1	1	1
150	0	1	1
300	1	0	1
600	0	0	1
1200	1	1	0
2400	0	1	0
4800	1	0	0
9600 (Do not use)	0	0	0

### PRINTER SIGNAL LEVELS SELECTION

Wire your Printer for either RS-232C or 20 mA current loop operation as described below.

#### RS-232C Operation

To use the Printer on RS-232C operation, you must install jumper wires between circuit board holes J114 and J115, and J109 and J110.

Proceed to the "Operation" section.





## 20 mA Current Loop

To use the current loop, install jumper wires between circuit board holes J113 and J114, and J110 and J111.

Current loop operation of data terminal equipment is normally done in the passive mode. This requires the installation of jumper wires between J101 and J102, and J105 and J106.

The Schematic Diagram and previous cable lead identification chart indicate the polarity of current loop signals for passive operation. For active operation, the polarities of these signals are reversed. Remove the passive loop jumper wires and then install jumpers between:

J101 and J103	}	Input
J102 and J104		
J105 and J107	}	Output
J106 and J108		

Operating levels for current loop operation are:

### Transmitter

Voltage drop (marking)	2.0 volts max.
Spacing current	2.0 mA max.
Marking current	20 mA min.

### Receiver

Voltage drop (marking)	2.7 volts max.
Spacing current	3.0 mA max.
Marking current	15 mA min.

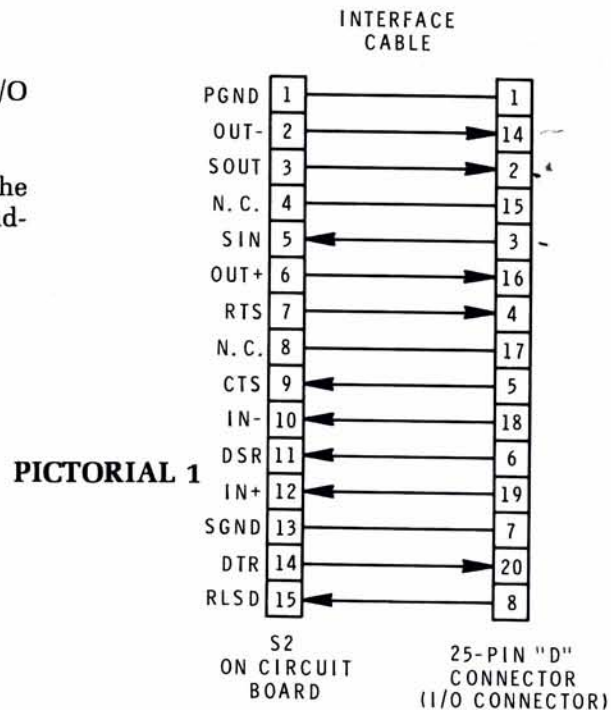
Proceed to the "Operation" section.

## NONHEATH SYSTEM CONFIGURATION

### INTERFACING

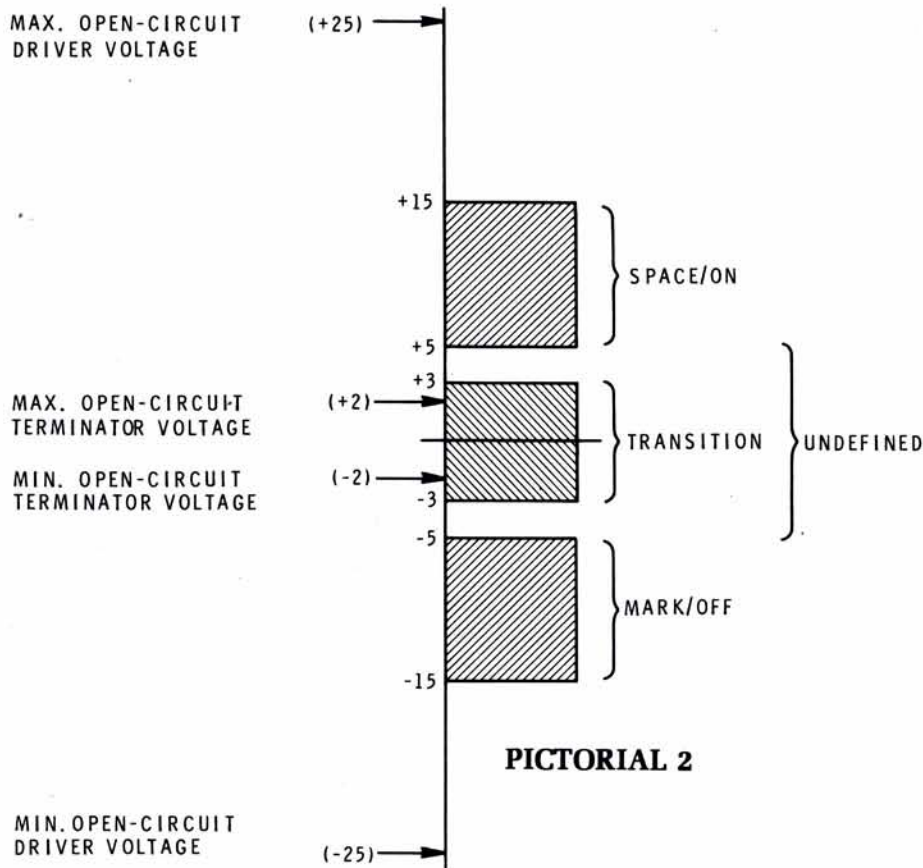
The following chart describes the leads of the I/O cable. Also, see Pictorial 1.

NOTE: If you use a baud rate higher than 110, the system must use handshaking. See "Printer Handshaking" below.



<u>I/O Pin #</u>	<u>LEAD COLOR</u>	<u>SIGNAL NAME</u>
1	Black	Protective ground (P GND)
2	Red	RS-232C Serial Output (S OUT)
3	Orange	RS-232C Serial Input (S IN)
4	Black-white	Request to send (RTS) Output (Printer Busy)
5	Black-green	Clear to send (CTS) Input*
6	Black-blue	Data set ready (DSR)*
7	White-red	Signal ground (SGND)
8	White-blue	Received Line Signal Detect (RLSD)*
9	Not Used	
10	Not Used	
11	Not Used	
12	Not Used	
13	Not Used	
14	White	Current loop output - (OUT-)
15	Green	Not used
16	Blue	Current loop output + (OUT+)
17	Black-red	Not used
18	Black-orange	Current loop input - (IN -)
19	White-black	Current loop input + (IN +)
20	White-green	Data terminal ready (DTR) output
21	Not Used	
22	Not Used	
23	Not Used	
24	Not Used	
25	Not Used	

\*These lines not required for Printer operation.



All control signals are at RS-232C levels. (See Pictorial 2.) All controls are "on" in the space condition (binary 0). All I/O signals are at "mark" during all intervals between valid data transfers.

## PRINTER HANDSHAKING

### Request to Send (RTS)

RTS (Pin 4) may be used as a printer busy signal. This allows data to be transmitted at baud rates greater than 110 without a chance of losing characters, and still allows the system to operate at its maximum rate. When the Printer's line buffer is full, the RTS line goes to the "on" state and will remain there until the buffer can accept more characters. When RTS goes "on," there is room for sixteen more characters in the buffer.

An additional handshake signal is generated in the form of control Q and control S, which is transmitted on the regular data output channel. When the line buffer is full, the RTS output goes to the "on" state and the control S signal will be sent. When more data can be accepted, the Printer will send "Control Q" and the RTS will go "off."

NOTE: If the Printer stops unexpectedly, restart by using the "Off Line" switch. No characters will be missed.

### Data Terminal Ready (DTR)

The DTR signal is "on" whenever the AC power is on.

## PRINTER BAUD RATE AND SIGNAL LEVELS SELECTION

Refer to "Printer Baud Rate Selection" and "Printer Signal Levels Selection" on Page 6.



# OPERATION

Refer to Pictorial 3 for a description of the front panel switches.

**WIDE CHARACTER switch (SW5):** When pushed "in," approximately 10 characters per inch are printed (maximum of 80 characters per line). When "out," approximately 16.5 characters per inch are printed (maximum of 132 characters per line). The above is true on power up. Additionally, either side of the switch may be serially programmed to 80, 96, or 132 characters. Character pitch will not change during the printing of a line.

**HIGH TEMP LIGHT (LED2):** Lights when maximum print head temperature is reached and printing will stop. It is normal for this LED to flicker when printing is being done.

**POWER indicator (LED1):** Lights when AC power is turned on.

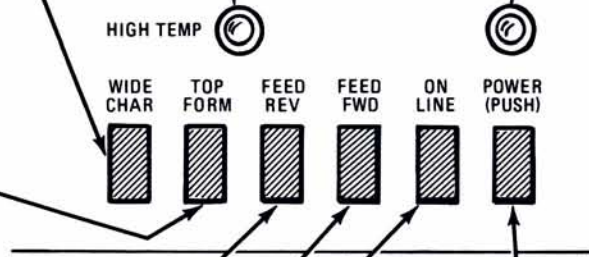
**TOP FORM switch (SW8):** When power is turned on, "top of the form" is initialized. The Printer assumes that the paper is positioned at the top of the next form. Use the FEED switches and advance the form to the desired position for the top of the form. Pressing and releasing the switch will cause the paper to advance to the top of the next form. (Upon power up, the form depth is set to 11 inches.) To modify the form depth:

1. Press in and hold this switch.
2. Feed the form to the desired length using the FEED switches.
3. Release the TOP FORM switch.

This switch is operative only when "off line." It is necessary to reset the form parameters whenever power is interrupted.

**FEED REVERSE switch (SW7):** Pull lightly on the paper to prevent jamming. Operation is the same as FEED FWD except for the direction of feed.

**FEED FWD (forward) switch (SW6):** Momentarily depressing this switch causes the paper to advance approximately .02 inches and stop. Holding the switch down causes the paper to advance to the next line. Further holding of the switch will cause the paper to advance one full line at a time.

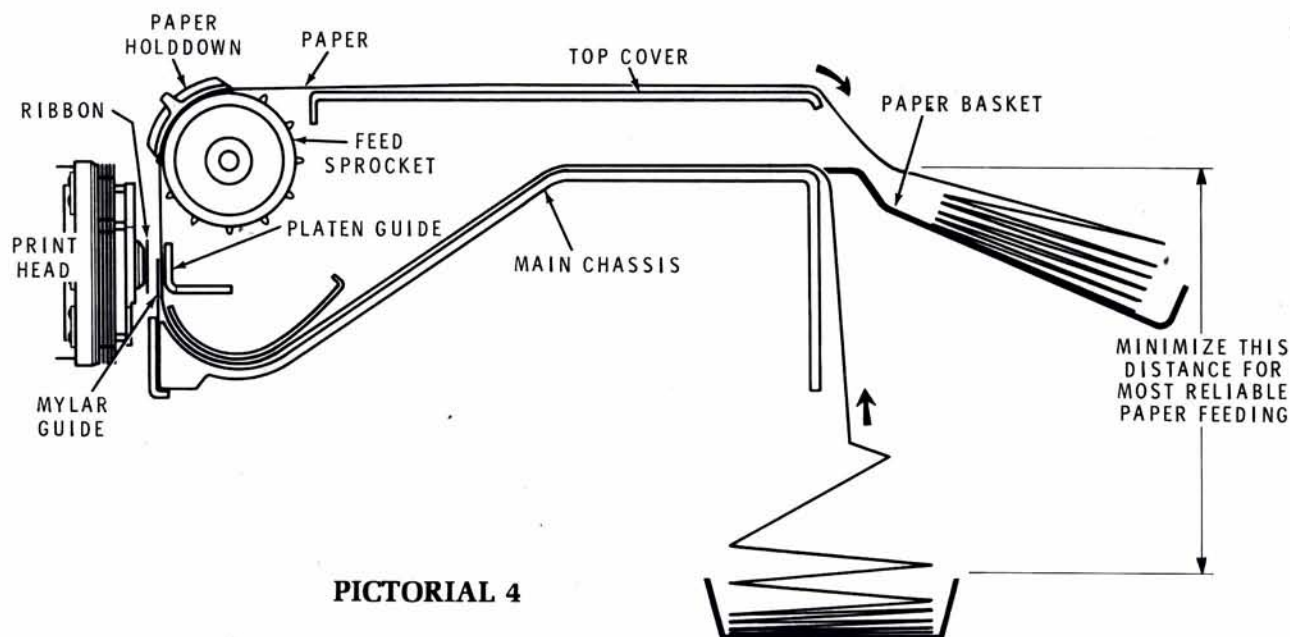


**POWER switch (SW1):** Push it in to turn the Printer on.

**ON LINE switch (SW4):** When pushed in, the Printer will receive information from the I/O and process it. When out, the Printer will continue to receive information only until the line buffer is full. CTL-S will be sent and hardware handshaking will indicate busy when nearing "buffer full," just as when "on line." The other manual switches are operative only in this "off line" condition. NOTE: A line that is being printed when taken "off line" will be completed. Any remaining characters will be held in the line buffer until the Printer is put back "on line" again.

**PICTORIAL 3**

Push "off line" and then back "on line" to restart after paper jamming or running out of paper.



PICTORIAL 4

## POWER LINE CONSIDERATIONS

If you change the position of the rear panel 120/240 switch, be sure you change fuse F1 to the proper value as follows:

For 120 VAC, use a 1-ampere, 125-volt, slow-blow fuse.

For 240 VAC, use a 1/2-ampere, 250-volt, slow-blow fuse.

Be sure the NOR/LOW switch is set in its proper position to match your line voltage as follows:

NOR range — 115 V to 135 V rms or 230 V to 270 V rms.

LOW range — 100 V to 120 V rms or 200 V to 240 V rms.

NOTE: If you do not know the value of the line voltage in your area, set the NOR/LOW switch to NOR.

Inside your Printer, set section two of circuit board switch SW102 as follows:

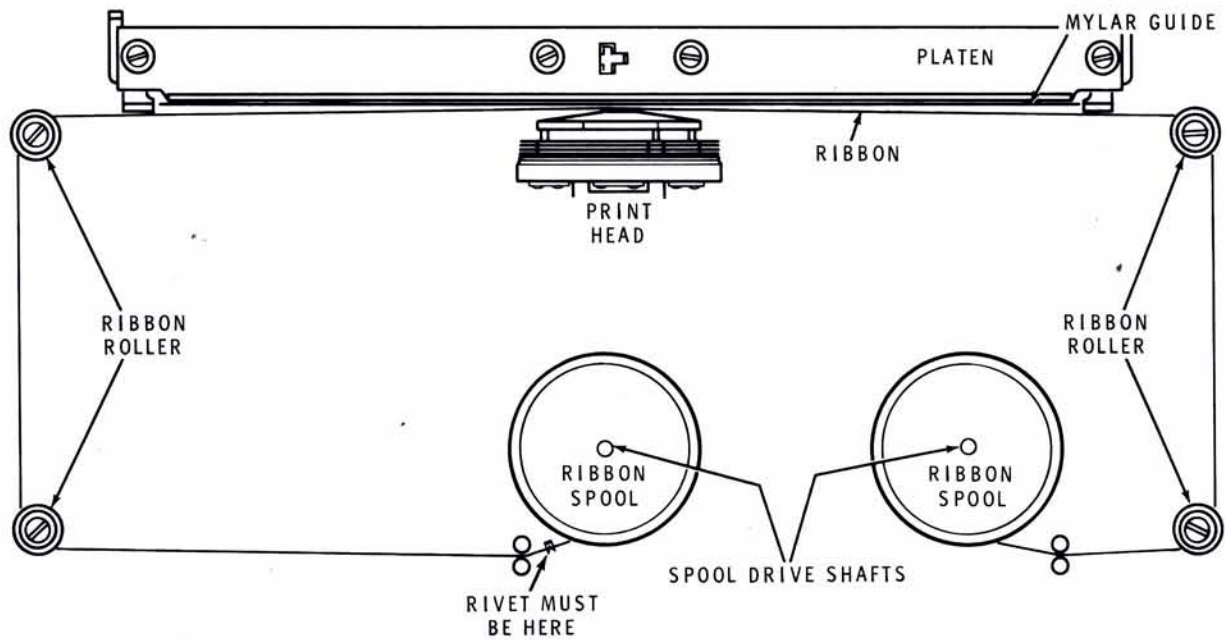
<u>LINE FREQUENCY</u>	<u>SET SWITCH TO</u>
60 Hz	1
50 Hz	∅

## LOADING PAPER

Feed the paper between the paper basket and the chassis. You can then use the basket to collect the printed paper. Be sure there are no sharp corners for paper to catch on, and do not allow a large amount of printed paper to pile up on the paper supply.

To load paper, refer to Pictorial 4 and:

1. Lift the top cover.
2. Open the paper hold-downs by lifting them away from the center of the paper.
3. Place the paper as shown and feed it through the opening at the rear of the top cover, under the paper guide, and between the ribbon and platen. NOTE: Using multiple-copy forms is not recommended.
4. Place the sprocket holes of the paper onto the left-hand sprocket and close the paper hold-downs.
5. If necessary, adjust the sprocket spacing on the drive shaft by loosening the knurled thumbscrew and sliding the right sprocket and paper hold-down assembly sideways on the shaft to a position which matches the sprocket holes in the paper. Then retighten the thumbscrew. Close the right paper hold-down.



PICTORIAL 5

### PAGE LENGTH

When power is turned on, the Printer sets the form depth to 11 inches. To modify the form depth:

1. Press the ON LINE switch to the OUT ("off line") position.
2. Press in and hold the TOP FORM switch.
3. Use the FEED FWD switch and advance the form to the desired length.
4. Release the TOP FORM switch.
5. Press the ON LINE switch to the IN position.

The form depth has now been reset.

### RIBBON INSTALLATION

To install a ribbon:

1. Turn off the Printer.
2. Refer to Pictorial 5 and manually move the print head to the approximate center of the platen.
3. Remove the old ribbon by lifting the two spools from the two spool drive shafts and pulling the ribbons from the mechanism.
4. Place a new ribbon on the spool drive shafts and thread it as shown.





**PAPER OUT/JAMMED DETECTOR**

If the Printer is out of paper or the paper is jammed, all printing will stop. This detector is active only when the Printer is "on line" and requires approximately one inch of "would be" paper travel before detection.

To reset the Printer, push the ON LINE switch to the OUT position and then to the IN position.

**TEST**

Section 4 of switch SW102 is in parallel with TEST switch SW101 and will cause continuous test lines to be printed when in the "0" position. Momentarily touching TEST switch SW101 will cause only one line of test data to be printed.

Use Test switch SW101 to check for print alignment on the form. Use switch SW102 for troubleshooting. Both switches are active only when the Printer is "off line."

**AUTOMATIC LINE FEED**

When section 3 of switch SW102 is in the "0" position, a line feed will be internally generated after a carriage return. With this switch in the "1" position, it will be necessary to give a line feed or form feed to advance the paper. In either case, a line feed or form feed will generate a carriage return. This switch is sampled only during power-up. The "1" position is recommended for Heath systems.

**PROGRAMMING INFORMATION**

The following control codes are recognized and executed by the Printer. All other control codes are disregarded.

**LF — (Line Feed)** Causes the paper to be advanced one line. It also performs the CR (carriage return) function prior to advancing the paper.

**FF — (Form Feed)** Causes carriage return functions; then it advances the paper to the head of the next form.

**CR — (Carriage Return)** Causes the data which has been entered prior to this command to be printed. If auto line feed has been selected by SW102, the paper will advance to the next line.

**ESC, lower case u — (Change column width)** The code to change to a new column width (which changes the width of each character) is shown in Chart 1.

**CHART 1**

WIDTH CODE	SWITCH POSITION		WIDTH CODE	
	WIDE (characters/inch)	NARROW (characters/inch)	DECIMAL values	OCTAL values
ESC u CTL-A	80	80	27 117 1	033 165 001
ESC u CTL-D	80	96	27 117 4	033 165 004
ESC u CTL-H	80	132	27 117 8	033 165 010
ESC u CTL-P	96	80	27 117 16	033 165 020
ESC u CTL-T	96	96	27 117 20	033 165 024
ESC u CTL-X	96	132	27 117 24	033 165 030
ESC u SPACE	132	80	27 117 32	033 165 040
ESC u \$	132	96	27 117 36	033 165 044
ESC u (	132	132	27 117 40	033 165 050

DECIMAL VALUE	ASCII WORD	MNEMONIC	DESCRIPTION	DECIMAL VALUE	ASCII WORD	MNEMONIC	DESCRIPTION
0	000 0000	NUL	Null	64	100 0000	@	At Sign
1	000 0001	SOH	Start of Heading	65	100 0001	A	Letter A
2	000 0010	STX	Start of Text	66	100 0010	B	Letter B
3	000 0011	EXT	End of Text	67	100 0011	C	Letter C
4	000 0100	EQT	End of Transmission	68	100 0100	D	Letter D
5	000 0101	ENQ	Enquiry	69	100 0101	E	Letter E
6	000 0110	ACK	Acknowledge	70	100 0110	F	Letter F
7	000 0111	BEEP	Bell	71	100 0111	G	Letter G
8	000 1000	BS	Backspace	72	100 1000	H	Letter H
9	000 1001	HT	Horizontal Tabulation	73	100 1001	I	Letter I
10	000 1010	LF	Line Feed	74	100 1010	J	Letter J
11	000 1011	VT	Vertical Tabulation	75	100 1011	K	Letter K
12	000 1100	FF	Form Feed	76	100 1100	L	Letter L
13	000 1101	CR	Carriage Return	77	100 1101	M	Letter M
14	000 1110	SO	Shift Out	78	100 1110	N	Letter N
15	000 1111	SI	Shift In	79	100 1111	O	Letter O
16	001 0000	DLE	Data Link Escape	80	101 0000	P	Letter P
17	001 0001	DC1	Device Control 1	81	101 0001	Q	Letter Q
18	001 0010	DC2	Device Control 2	82	101 0010	R	Letter R
19	001 0011	DC3	Device Control 3	83	101 0011	S	Letter S
20	001 0100	DC4	Device Control 4	84	101 0100	T	Letter T
21	001 0101	NAK	Negative Acknowledge	85	101 0101	U	Letter U
22	001 0110	SYN	Synchronous Idle	86	101 0110	V	Letter V
23	001 0111	ETB	End of Transmission Block	87	101 0111	W	Letter W
24	001 1000	CAN	Cancel	88	101 1000	X	Letter X
25	001 1001	EM	End of Medium	89	101 1001	Y	Letter Y
26	001 1010	SUB	Substitute	90	101 1010	Z	Letter Z
27	001 1011	ESC	Escape	91	101 1011	[	Open Brackets
28	001 1100	FS	File Separator	92	101 1100	\	Reverse Slash
29	001 1101	GS	Group Separator	93	101 1101	]	Close Brackets
30	001 1110	RS	Record Separator	94	101 1110	^	Up Arrow/ Caret
31	001 1111	US	Unit Separator	95	101 1111	_	Underscore
32	010 0000	SP	Space	96	110 0000	`	Open Quote
33	010 0001	!	Exclamation Point	97	110 0001	a	Letter a
34	010 0010	"	Quotation Marks	98	110 0010	b	Letter b
35	010 0011	#	Number Sign	99	110 0011	c	Letter c
36	010 0100	\$	Dollar Sign	100	110 0100	d	Letter d
37	010 0101	%	Percent Sign	101	110 0101	e	Letter e
38	010 0110	&	Ampersand	102	110 0110	f	Letter f
39	010 0111	'	Apostrophe	103	110 0111	g	Letter g
40	010 1000	(	Open Parenthesis	104	110 1000	h	Letter h
41	010 1001	)	Close Parenthesis	105	110 1001	i	Letter i
42	010 1010	*	Asterisk	106	110 1010	j	Letter j
43	010 1011	+	Plus Sign	107	110 1011	k	Letter k
44	010 1100	,	Comma	108	110 1100	l	Letter l
45	010 1101	-	Hyphen/Minus Sign	109	110 1101	m	Letter m
46	010 1110	.	Period	110	110 1110	n	Letter n
47	010 1111	/	Slash	111	110 1111	o	Letter o
48	011 0000	0	Number 0	112	111 0000	p	Letter p
49	011 0001	1	Number 1	113	111 0001	q	Letter q
50	011 0010	2	Number 2	114	111 0010	r	Letter r
51	011 0011	3	Number 3	115	111 0011	s	Letter s
52	011 0100	4	Number 4	116	111 0100	t	Letter t
53	011 0101	5	Number 5	117	111 0101	u	Letter u
54	011 0110	6	Number 6	118	111 0110	v	Letter v
55	011 0111	7	Number 7	119	111 0111	w	Letter w
56	011 1000	8	Number 8	120	111 1000	x	Letter x
57	011 1001	9	Number 9	121	111 1001	y	Letter y
58	011 1010	:	Colon	122	111 1010	z	Letter z
59	011 1011	;	Semicolon	123	111 1011	{	Left Brace
60	011 1100	<	Less Than	124	111 1100		Vertical Bar (broken)
61	011 1101	=	Equal Sign	125	111 1101	}	Right Brace
62	011 1110	>	Greater Than	126	111 1110	~	Tilde
63	011 1111	?	Question Mark	127	111 1111	DEL	Delete (rub out)

This setting will remain until power down or until it is changed through one of the above software commands. The width of characters cannot be changed within a line.

When you change the width by using a console terminal escape code, type the code with no spaces. Example: To type ESC u CTL-A; press the escape key (ESC), press the u key, and then push down the control (CTL) and shift keys and strike an a.

**ESC, lower case x** — (Set line spacing to 6 lines per inch) This is the normal line spacing, which will be activated upon power up. Use this code to return to this normal spacing after modifying the spacing to 8 lines per inch by a previous software command.

**ESC, lower case y** — (Set line, spacing to 8 lines per inch) This code, when received, will cause the printed lines to be spaced to 8 lines per inch.

### Print Controls

(For proper operation, shaded commands should not be sent to the Printer except as part of the ESC-u sequence as described above.)

**NOTE:** When you operate your Printer, the paper drive motor may appear to become excessively warm. This condition is normal.

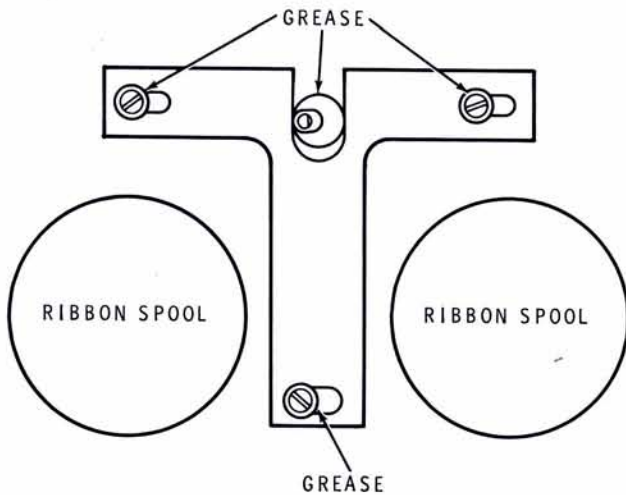


# MAINTENANCE

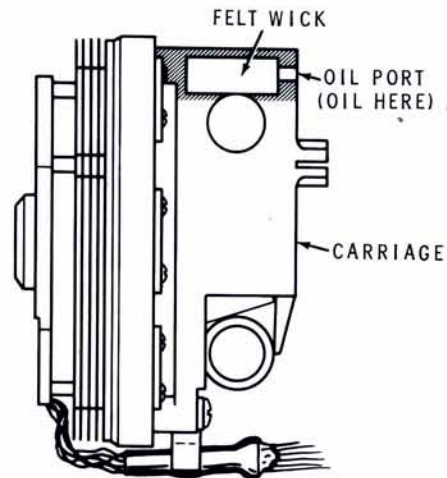
After each 100 hours of operation (1 carton of paper) grease the ribbon mechanism at the points shown in Pictorial 6. Use a light grease such as Heath grease, part number 352-14.

At this time, also clean any accumulation of dust and dirt from the head support shafts, head cooling fins, and the curved area between the paper guide and chassis near the paper out detector (left end of guide).

After each 500 hours of operation (5 cartons of paper), oil the head carriage as shown in Pictorial 7. Use a high grade light machine oil.



PICTORIAL 6



PICTORIAL 7



# CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (on fold-in) as you read the following information.

Serial input signals are converted to TTL levels by U101 or U103 and applied to the UART (U105). (UART output signals are converted by U102 and U104 to either 20 mA or EIA output signals.) The UART changes the serial input signals to parallel data, generates programmable baud rates and other control signals, and applies its data to the CPU (U106). The CPU (as controlled by the clock; crystal Y101 and gates U108A, B, and D) controls all the timing and command functions of the Printer and has an internal ROM which contains the complete operating program. The outputs from the CPU are applied through buffers U114, U115, and U116 to the print head drive circuits and the motor drive circuits. Input buffers U109 and U110 allow the sensing of the various switches and detectors, and U117 senses the print head temperature and keeps it from overheating.

## INPUTS/OUTPUTS

20 mA serial input signals are applied to optical coupler U101. U101 changes the signals to TTL levels and applies the signals to the UART. This loop is isolated from ground when used in its passive mode and supplies 20 mA of current when used in its active mode.

EIA input signals are converted to TTL levels by U103. U102 converts TTL output signals into 20 mA loop signals and U104 converts TTL output signals into EIA output signals.

## UART

The UART is a programmable device that is controlled by microcontroller U106. It uses the 2 MHz clock signal from divider U107 and generates selected baud rates by its internal programmable divider. After receiving a serial character, the UART sends a signal to the microcontroller. The microcontroller will then finish any timing that it is doing and take the input character. The character is then loaded into the line buffer RAM (U112 and U113).

## ADDRESS LATCH

The address latch (U111) holds the RAM address or the UART control bus address while information is being entered or retrieved by the microcontroller.

## MICROCONTROLLER (CPU)

All the control functions of the Printer are controlled by integrated circuit microcontroller (U106). This IC has its own internal ROM and programmable timer. The ROM contains the complete operating program and character font, and the timer performs all the timing functions of the Printer. The microcontroller also has four, 8-bit, I/O ports. Two ports drive the seven head solenoids, head drive motor, ribbon drive motor, and paper drive stepper motor; one port is a printer data bus; and one port is a device select port.





## PRINT HEAD DRIVERS

Because the seven driver circuits are identical, only one driver circuit will be described.

Buffer U114D is an open collector TTL inverter. It interfaces the microcontroller output with driver transistor Q103. With logic "1" on the input of U114D, its output will be less than 0.4 volts. This turns Q103 off, which in turn, turns Q104 off. A logic "0" at the input of U114D turns on Q103 and Q104, and current flows through the print head solenoid. Diodes ZD101 and D103 provide arc suppression. ZD101 also makes the solenoid current decay more quickly by forcing the solenoid voltage to reach several volts before it zeners. Current peaks are supplied by capacitor C4.

## HEAD AND RIBBON MOTOR DRIVERS

Because the three drivers are identical, only one of them will be described.

A logic "1" at the input of U115A causes its output to be held at less than 0.4 volts. This causes diode D111 to be off, no gate current flows in triac Q117, so Q117 is off or turns off when the motor current goes through zero. With a logic "0" at the input of U115A, its output goes high. This allows current to flow through D111 to the gate of Q117 and turn it on. Capacitor C109 makes Q117 less susceptible to noise pulses.

## PAPER MOTOR DRIVERS

Again, because the four drivers are identical, only one of them will be described.

A logic "1" at the input of U116B causes its output to be a logic "0". Its output is connected to the input of U203E, which causes the output of U203E to be high. This allows current to flow in the emitter-base circuit of Q204, turning it on. When a "0" is input to U116B, the logic levels are reversed and Q204 turns off. D204 is used for arc suppression.

Inputs to U201D and U201A are always complements of each other. Whenever the inputs change state, one of the inputs to U201D or A is delayed by the R/C circuit (R203/C201 or R205/C202). This delay causes the inputs to be the same for a short time. When this occurs, a pulse is output from U201D or A. These pulses are coupled to U202 by U201C. U202 is a retriggerable, one-shot multivibrator with a time constant of 10 milliseconds.

The signal from U202 is coupled to U203F, which turns on Q205. Q205 supplies 35 volts to the paper drive motor when it is required to turn. R216 and R217 limit the current to the motor. The operation of U203F, Q206, and Q205 is identical to the head drivers.

D205 supplies a holding current to the paper drive motor while the motor is at rest.

## PRINT HEAD TEMPERATURE CONTROL

U117A and B are comparators which are configured to measure the resistance of the copper winding of a print head solenoid. The temperature coefficient of copper wire is approximately 0.4%/°C. Therefore, this method is very effective in determining the solenoid temperature.

The temperature is sensed in two levels. When the first level is exceeded, U117A's output will change to a "0" logic level. This signal is connected to the microcontroller through U109 and is tested during the time the head is returning home. If the head temperature continues to rise due to high ambient temperatures or very dense printing, U117B will be triggered and the controller will cause printing to stop and LED2 (High Temp lamp on the front panel) will light continuously. Note: It is normal for this lamp to flicker during active printing.

The voltage which the comparators are referenced to appears across a precision voltage divider formed by R191 through R194. The head solenoid is placed in series with R189 and R195 across the same supply as divider R191 through R194. This makes the circuit insensitive to supply changes. To calibrate this circuit, the comparator reference is temporarily connected to a point in the divider string which corresponds to the cold resistance of the head solenoid. The current through this solenoid is adjusted by R195 to produce a voltage across it which is equal to the calibration reference. This is indicated by High Temp lamp LED2.

## PAPER OUT/JAM DETECTOR

LED3 and Q2 form an optical switch. LED3 is on one side of the paper and Q2 is on the other side, and in line with the sprocket holes. Therefore, Q2 changes state when a sprocket hole appears and detects that the paper is moving. The logic levels from Q2 are tested by U106 (the microprocessor) through input buffer U109. If a level change is not detected by the time the processor has output enough pulses to the paper drive stepper motor to move the paper approximately one inch, the processor stops all printing.

## POWER SUPPLIES

### 35-Volt Head Supply

Full-wave bridge rectifier D118, D119, D121, and D122 supplies approximately 45 volts. Transistors Q1 and Q125 form a Darlington pair pass element. Transistors Q126 and Q127 form a differential amplifier which compares a portion of the 35-volt output to the 5-volt supply and drives the pass element to maintain the 35-volt output. Transistor Q124 senses an over-current condition and turns on when the voltage across R169 exceeds approximately 0.7 volts. This causes the differential amplifier to make the pass element conduct less and limits the current to a safe value.

### +12 Volt

Diodes D123 and D125 full-wave rectify the current, and capacitor C2 filters it. The supply is unregulated.

### -12 Volt

Diode D124 half-wave rectifies the current, and capacitor C113 filters it. The supply is unregulated.

### +5 Volt

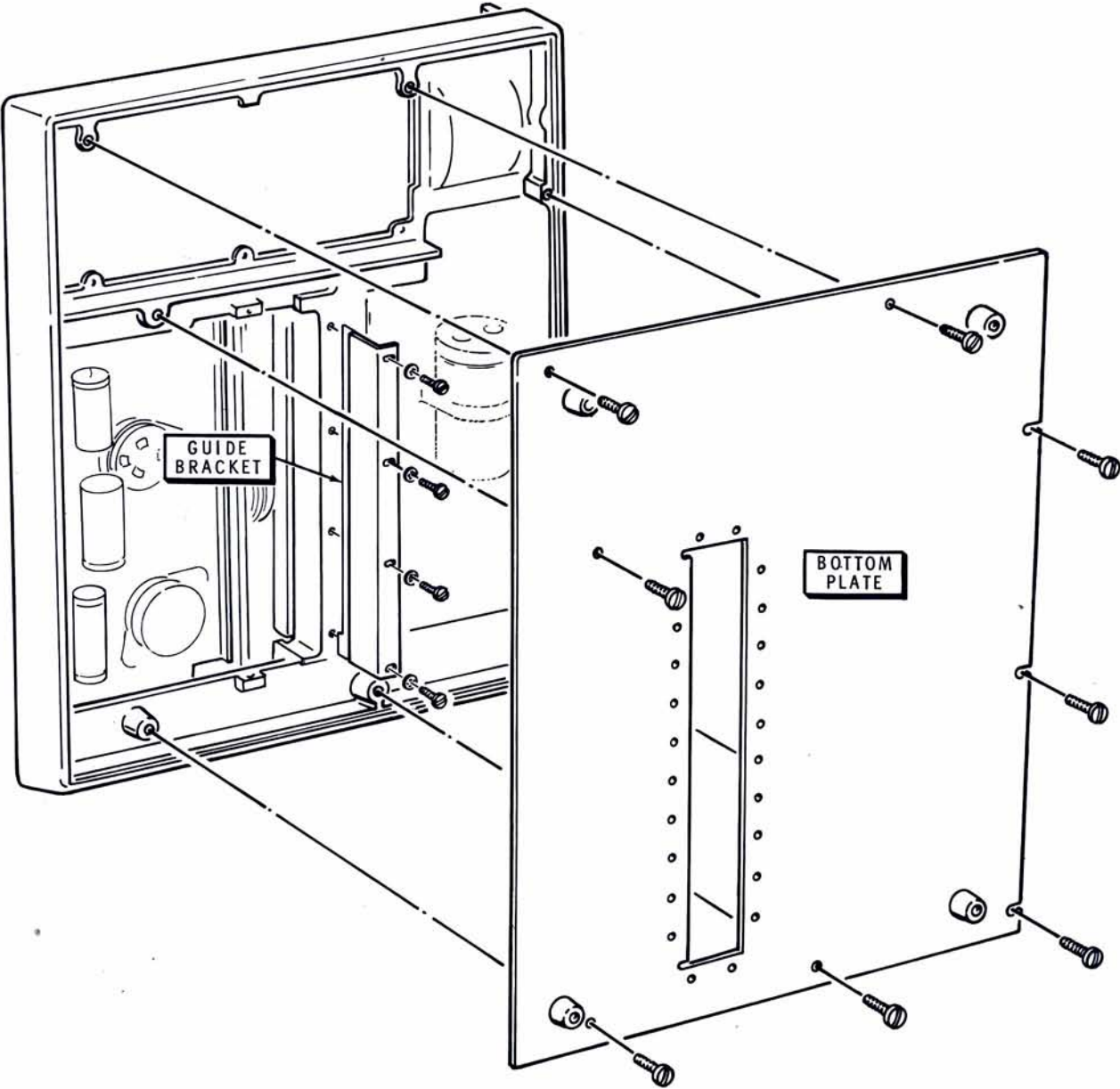
U1 is a three-terminal device that changes the +12 volts to +5 volts and limits its output to one ampere.

## POWER UP/DOWN CIRCUIT

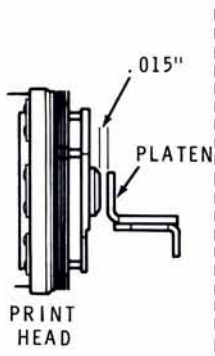
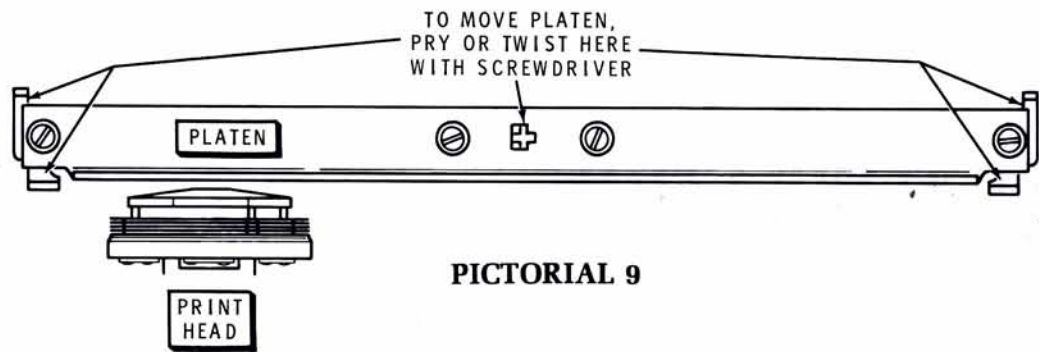
This circuit keeps power from being applied to the head and motor drive circuits until the 5-volt supply reaches 4.2 volts. Capacitor C125 delays the voltage on the base of transistor Q128 as the 5-volt supply comes up. The emitter of Q128 is held at 3.6 volts by ZD109. When the base voltage of Q128 exceeds 4.2 volts, Q128 turns on. This turns on Q129 and supplies 12 volts to the pullup resistors of the drive circuits. Then when the 5-volt supply drops below 4.2 volts at turnoff, Q128 quickly turns off and removes power from the pullup resistors.



# RECALIBRATION



PICTORIAL 8

**PART A****PART B****PICTORIAL 9****Electrical**

Note: The print head should be at approximately 25°C (no printing should have been done for the previous one hour).

Remove the jumper from between J118 and J119 and place it from J117 to J118.

Turn the High Temp Adj control (R195) fully counterclockwise.

Turn on the POWER switch.

Slowly rotate control R195 clockwise until the HIGH TEMP front panel light comes on.

Turn off the POWER switch.

Replace the jumper between J118 and J119.

**Mechanical (Head to Platen Spacing)**

Remove the ribbon.

Refer to Pictorial 8 and remove the bottom plate.

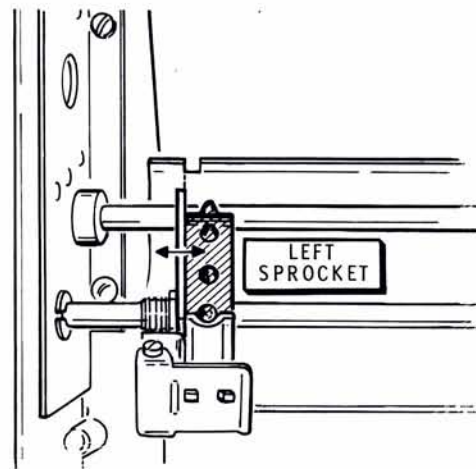
Remove the four 4-40 screws and the guide bracket they hold.

Loosen the four platen screws slightly but leave them still snug. (If necessary, first loosen the paper sprockets and slide them out of the way.) Move the print head sideways as necessary and insert the .015" feeler gauge between the nose of the print head and either end of the platen. (See Part A of Pictorial 9.) Use a screwdriver and adjust the platen. (See Part B of the Pictorial.) The feeler gauge should slide between the print head and platen, but there should be a slight drag on it.

As before, adjust the other end of the platen for .015".

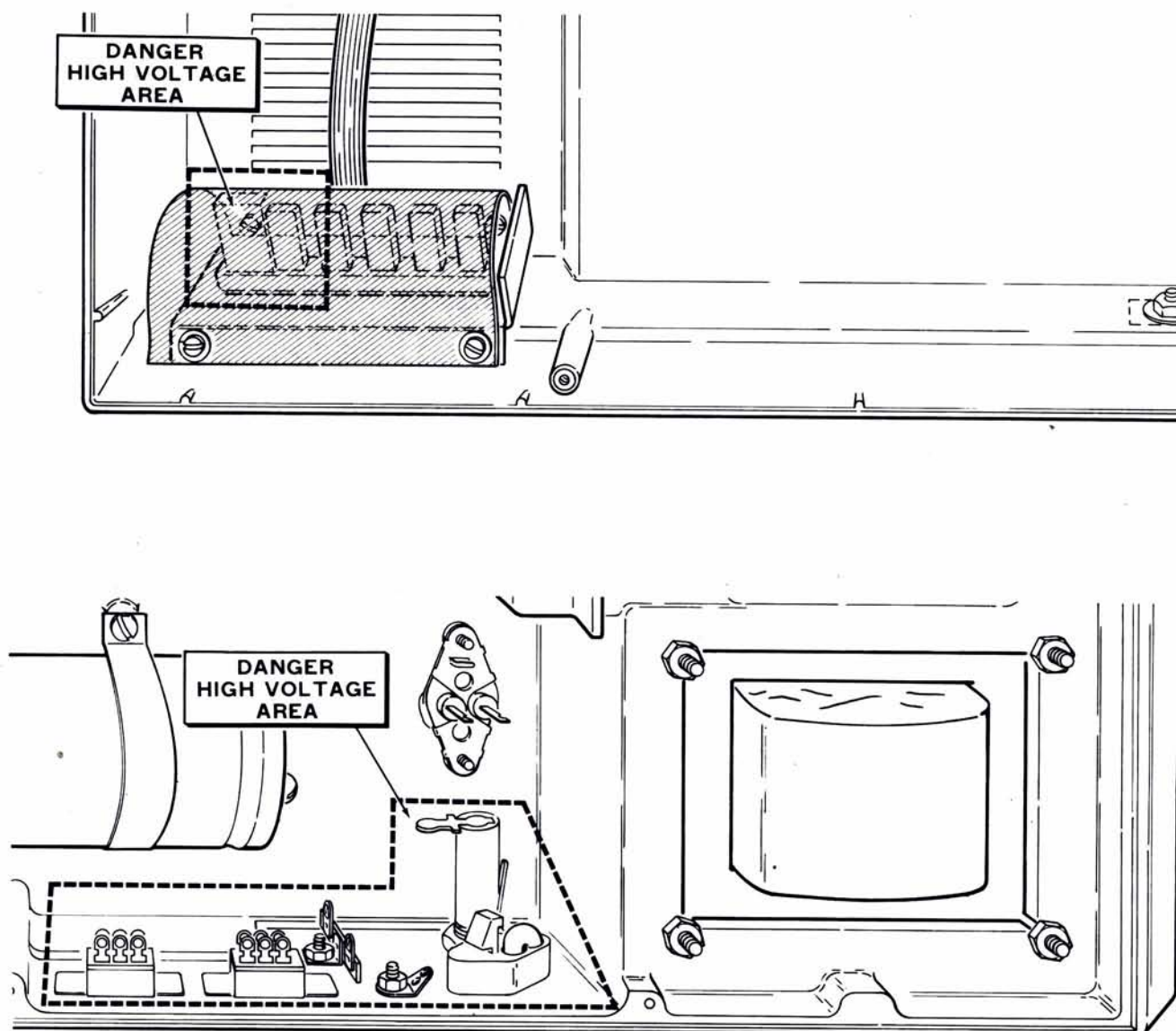
Adjust the center of the platen of .015".

Recheck the three dimensions, tighten the platen screws, and replace the guide bracket and bottom plate. (If you loosened the paper sprockets, realign the left sprocket as shown in Pictorial 10. Adjust the right sprocket to the width of your paper.)

**PICTORIAL 10**

## IN CASE OF DIFFICULTY

**WARNING:** When the line cord is connected to an AC outlet, hazardous voltages are present at several places inside your Printer. See Pictorial 11.



PICTORIAL 11



This section of the Manual is divided into three parts. The first part, titled "Troubleshooting and Repair Precautions," points out the care what you should use when you service the unit to prevent damaging components.

The second part, titled "Troubleshooting Chart" gives difficulties and likely causes.

The third part, titled "Step-by-Step Testing" gives you a systematic method of locating the problem.

If the "Step-by-Step Testing" does not help you locate the problem, read the "Circuit Description" and refer to the Schematic Diagram (fold-in) to help you determine where the trouble is.

Refer to the "Circuit Board X-Ray Views" Pages 29 and 30 for the physical location of parts on the circuit boards.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your warranty is also located inside the rear cover.

## TROUBLESHOOTING AND REPAIR PRECAUTIONS

1. Make sure you do not short any adjacent terminals or foils when you make tests or voltage measurements. If a probe or test lead slips, for example, and shorts together two adjacent connections, it is very likely to damage one or more of the transistors, diodes, or IC's.
2. Be especially careful when you test any circuit that contains an IC or a transistor. Although these components have an almost unlimited life when used properly, they are much more vulnerable to damage from excess voltage and current than many other parts.
3. Do not remove any components while the unit is turned on.
4. Use a voltmeter with a high input impedance when you measure voltages.
5. Never apply +5 volts or ground potentials to the output of any IC.
6. When you make repairs, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged resistor, be sure you find out what damaged the resistor. If the cause is not eliminated, the replacement resistor may also become damaged when you put the unit back into operation.

7. In several areas of the circuit boards, the foil patterns are quite narrow. When you unsolder a part to check or replace it, avoid excessive heat while you remove the part. A suction-type desoldering tool (or solder braid) makes part removal easier.

### COMPONENTS

To remove faulty resistors or capacitors; first clip them from their leads, then heat the solder on the foil and allow each lead to fall out of its hole. Preshape the leads of the replacement part and insert them into the holes in the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

You can remove transistors in the same manner as resistors and capacitors. Make sure you install the replacement transistor with its leads in the proper holes. Then solder the leads quickly to avoid heat damage. Cut off the excess lead lengths.

### FOIL REPAIR

To repair a break in a circuit board foil, bridge solder across the break. Bridge large gaps in the foil with bare wire. Lay the wire across the gap and solder each end to the foil. Carefully trim off any excess bare wire.



## TROUBLESHOOTING CHART

The following chart lists conditions and possible causes of several specific malfunctions. If a particular part is mentioned (Q7 for example) as a possible cause, check that part and other components connected to that part to see that they are installed and/or wired correctly. Also check for solder bridges and poor connections in the surrounding area. It is also possible, on rare occasions, for a part to be faulty and require replacement.

PROBLEM	POSSIBLE CAUSE
Printer completely dead. Power lamp not lit.	<ol style="list-style-type: none"> <li>1. No power at wall outlet, line cord.</li> <li>2. SW1, F1, T1, D123, D125.</li> </ol>
Printer completely dead. Power lamp lit.	<ol style="list-style-type: none"> <li>1. U1, Q128, Q129, U108, U106.</li> <li>2. Printer "on line" with no signal received.</li> </ol>
Head moves normally, but does not print.	<ol style="list-style-type: none"> <li>1. F101, Q1, Q125, Q126, Q127, Q124.</li> <li>2. D118, D119, D121, D122, U106.</li> </ol>
Upon power up, head moves to the right; then returns to left-hand stop, motor keeps running (clutch slipping).	<ol style="list-style-type: none"> <li>1. Q3, U109, U106.</li> <li>2. Motor lead connections.</li> </ol>
Upon power up, head moves to the right and then stops. Does not return to left margin.	<ol style="list-style-type: none"> <li>1. Q3, U109, U106, U115A, Q117, D111.</li> <li>2. Head motor.</li> </ol>
Top row of dots missing in printed characters.     :.... :....	<ol style="list-style-type: none"> <li>1. U114D, U106, Q103, Q104.</li> <li>2. Print head.</li> </ol>
Second row of dots missing in printed characters.   :.... :....	<ol style="list-style-type: none"> <li>1. U114E, U106, Q105, Q106.</li> <li>2. Print head.</li> </ol>
Third row of dots missing in printed characters.     :.... :....	<ol style="list-style-type: none"> <li>1. U114F, U106, Q107, Q108.</li> <li>2. Print head.</li> </ol>
Fourth row of dots missing in printed characters.    :.... :....	<ol style="list-style-type: none"> <li>1. U114C, U106, Q109, Q110.</li> <li>2. Print head.</li> </ol>
Fifth row of dots missing in printed characters.     :.... :....	<ol style="list-style-type: none"> <li>1. U114B, U106, Q111, Q112.</li> <li>2. Print head.</li> </ol>
Sixth row of dots missing in printed characters.     :.... :....	<ol style="list-style-type: none"> <li>1. U114A, U106, Q113, Q114.</li> <li>2. Print head.</li> </ol>
Bottom row of dots missing in printed characters.    :.... :....	<ol style="list-style-type: none"> <li>1. U115C, U106, Q115, Q116.</li> <li>2. Print head.</li> </ol>
Ribbon motor does not run, or runs when no active printing is being done.	<ol style="list-style-type: none"> <li>1. U115B, U106, D113, Q119.</li> <li>2. Ribbon drive motor.</li> <li>3. Out of paper or head is hot and data is in buffer.</li> </ol>
Print head does not move to the right at any time.	<ol style="list-style-type: none"> <li>1. U115D, U106, Q118, D112.</li> <li>2. Head motor.</li> </ol>



## Troubleshooting Chart (Cont'd.)

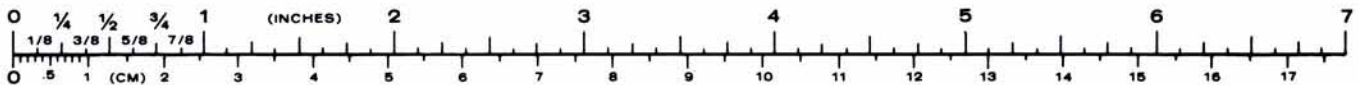
PROBLEM	POSSIBLE CAUSE
Head motor buzzes but head does not move in either direction.	<ol style="list-style-type: none"> <li>1. C5.</li> <li>2. Head motor.</li> </ol>
Paper moves backwards.	<ol style="list-style-type: none"> <li>1. Two windings on paper drive motor reversed (wiring).</li> </ol>
Paper does not move, or moves erratically.	<ol style="list-style-type: none"> <li>1. U115F, U116A, B, or F, Q201, Q202, Q203, Q204.</li> <li>2. Improper gear mesh (motor gear to sprocket shaft).</li> <li>3. Binding in area of sprocket shaft.</li> <li>4. Paper drive motor.</li> <li>5. U106.</li> </ol>
Paper "Feed FWD" does not cause the paper to feed forward.	<ol style="list-style-type: none"> <li>1. "On line," switch depressed.</li> <li>2. SW6.</li> <li>3. U110.</li> </ol>
Paper "Feed REV" does not cause the paper to move backwards 1 line width.	<ol style="list-style-type: none"> <li>1. "On line" switch depressed.</li> <li>2. SW7.</li> <li>3. U110.</li> </ol>
"Wide Char" switch does not change character width.	<ol style="list-style-type: none"> <li>1. SW5, U109, U106.</li> <li>2. Both sides of switch programmed the same.</li> </ol>
5 or 6 lines are printed when "on line;" then printing stops. Paper supply is adequate and not jammed.	<ol style="list-style-type: none"> <li>1. LED3, Q2, U109.</li> <li>2. Incorrect alignment of left-hand paper drive sprocket to paper guide.</li> <li>3. Paper too transparent.</li> </ol>
Printer will not go "off line."	<ol style="list-style-type: none"> <li>1. SW4, U109.</li> </ol>
High Temp LED is on, Printer will not print, print head is cold.	<ol style="list-style-type: none"> <li>1. Jumper from J118 to J119 is installed from J118 to J117 (calibrate position).</li> <li>2. U117B.</li> <li>3. Print head.</li> </ol>
Test works but no printing is done "on line" connected to RS-232 source.	<ol style="list-style-type: none"> <li>1. U103, U105.</li> <li>2. Signal source and Printer on different baud rate.</li> <li>3. Incorrect I/O wiring, no signal from source, defective I/O cable.</li> <li>4. Jumper from J114 to J115 is connected between J113 and J114.</li> <li>5. Printer is off line.</li> </ol>
Operates properly with 110 baud signal, but loses characters when operating at higher baud rates.	<ol style="list-style-type: none"> <li>1. U104, U105, (U102, Q101, Q102, 20 mA loop option).</li> <li>2. Jumper between J109 and J110, or J110 and J111 in the incorrect position.</li> <li>3. Signal source not recognizing the handshaking signals. Incorrect I/O wiring or defective cables.</li> </ol>
Operates properly on RS-232 signals but does not operate on 20 mA loop signals.	<ol style="list-style-type: none"> <li>1. U101.</li> <li>2. Incorrect position of jumper between J113 and J114, or J114 and J115, both 20 mA loops setup for active or passive operation.</li> <li>3. Incorrect I/O connection or defective cables.</li> </ol>





## Troubleshooting Chart (Cont'd.)

PROBLEM	POSSIBLE CAUSE
Some characters print correctly, others print incorrectly but consistent.	1. U111, U112, U113.
Characters are inconsistent and incorrect.	1. Baud rates set differently on source and Printer.
All dots in a character are not the same darkness top to bottom.	1. New print head (may require some running). 2. Bent platen. 3. Worn or dried ribbon.
Uneven character spacing.	1. Head motor clutch, head motor. 2. Q118, Q117. 3. Binding on head carriage or loose drive cable.
Characters are not of uniform darkness across a line.	1. Incorrect adjustment of platen to head spacing. 2. Bent platen or head support shafts. 3. Ribbon not in place. 4. Worn or dried ribbon.



## STEP-BY-STEP TESTING

- ( ) Be sure the line cord is unplugged.
- ( ) Carefully remove U106 from its socket and set it aside.
- ( ) Unplug the print head plug from socket S101.

NOTE: In the following step, you will turn the Printer on and check for overheating of parts. If there is evidence of overheating, disconnect the power plug immediately and check for short circuits in the circuitry where the overheating occurred.

WARNING: When the line cord is plugged in, the full AC line voltage is present at the POWER switch.

- ( ) Plug the line cord into an AC outlet and push the POWER switch to the ON position.
- ( ) Remove 1/4" of insulation from a 5" wire. Then insert one end of the wire into the pin connector at J112.

If you have a voltmeter, complete the three following voltage tests.

- ( ) Connect the meter common lead to the 5" wire. Leave the lead connected to the 5" hookup wire for the three following voltage tests.
- ( ) Connect the voltmeter test lead to either lead of resistor R169 (.33  $\Omega$ , orange-orange-silver). The meter should read between 45 to 60 volts. If not, check D118, D119, D121, D122, C3, and the wiring of transformer T1.
- ( ) Connect the voltmeter test lead to either clip of fuse F101. The voltmeter should read between 32 to 38 volts DC. If not, check Q1, Q124, Q125, Q126, D127, and U101 (5-volt supply).
- ( ) Connect the voltmeter test lead to pin 40 of socket U106. The voltmeter should read between 4.7 to 5.3 volts DC. If not, check C2, D123, D125 (12-volt supply), U101, and C115.

This completes the voltage tests. Disconnect the voltmeter.

- ( ) Momentarily connect the free end of the 5" wire to pin 31 of socket U106. The print head should move from left to right. If not, check U115D, D118, D112, C5, T1, and the head motor.
- ( ) Momentarily connect the free end of the 5" wire to pin 32 of socket U106. The print head should move from right to left. If not, check U115A, Q117, D111, C5, and the head motor.
- ( ) Momentarily connect the free end of the 5" wire to pin 33 of socket U106. The ribbon motor should run. If not, check U115B, Q119, D113, T1, and the ribbon motor.
- ( ) Prepare an 11" wire and insert one end into the pin connector at TP-101.
- ( ) Momentarily touch the free end of the 11" wire to the collector of Q201, Q202, Q203, and Q204. As you touch each collector, LED101 should not glow.
- ( ) Connect the free end of the 5" hookup wire coming from J112 to pin 29 of U106; then connect the free end of the 11" hookup wire to the collector (C) lead of Q203. LED101 should light. If it does not, check U115F and Q203.
- ( ) Connect the 5" hookup wire to pin 28 of U106; then connect the 11" hookup wire to the collector (C) lead of Q201. LED101 should light. If it does not, check U116F and Q201.
- ( ) Connect the 5" hookup wire to pin 27 of U106; then connect the 11" hookup wire to the collector (C) lead of Q202. LED101 should light. If it does not, check U116A and Q202.
- ( ) Connect the 5" hookup wire to pin 26 of U106; then connect the 11" hookup wire to the collector (C) lead of Q204. LED101 should light. If it does not, check U116B and Q204.
- ( ) Connect the free end of the 11" hookup wire to pin 9 of print head socket S101. LED101 should not light. Then, with the 11" hookup wire still connected, connect the free end of the 5" hookup wire to pin 14 of U106. LED101 **should not** light. If it does, check U114D, Q103, and Q104.





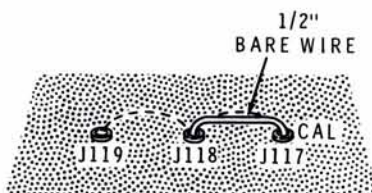
Using the procedure in the previous step, complete the steps in the following chart.

- ( ) Remove the 11" hookup wire from TP101 and connect one end to TP102.
- ( ) Momentarily connect the free ends of the 5" and 11" hookup wires together and note the brightness of LED102. Now connect the 11" hookup wire to pin 16 of U105. LED102 should glow at a reduced brightness. If not, check U107, U108, and Y101.

	CONNECT 11" WIRE TO S101 PIN (LED101 SHOULD NOT LIGHT)	THEN CONNECT 5" WIRE TO U106 PIN (LED101 SHOULD LIGHT)	POSSIBLE CAUSE IF LED101 LIGHTS
( )	10	13	U114E, Q105, Q106
( )	14	12	U114F, Q107, Q108
( )	15	11	U114C, Q109, Q110
( )	13	10	U114B, Q111, Q112
( )	12	9	U114A, Q113, Q114
NOTE: Unsolder and disconnect one lead of R189 before you perform the following test. Then reconnect and resolder the resistor lead.			
( )	11	8	U115C, Q115, Q116

- ( ) Connect the 5" wire to pin 37 of socket U106, connect the 11" wire to pin 16 of U106, and manually push the print head to the left. LED102 should not light. Then move the print head at least 2" to the right. LED102 should now light. If not, check U109 and Q3.
- ( ) Connect the 11" wire to socket U106 pin 5 (with the 5" wire still connected to U106 pin 37). LED102 should light. Now insert a piece of paper, with the sprocket holes removed, into the paper feed channel. Push the paper as far to the left as possible. LED102 should now go off. If it does not, check LED3, Q2, and U109.
- ( ) With the 5" wire still connected to pin 37 of socket U106, connect the 11" wire to pin 17 of U106 and press the ON LINE switch. LED102 should light. Release the ON LINE switch and LED102 should go off. If not, check U109 and SW4.
- ( ) Connect the 5" wire to pin 36 of socket U106, connect the 11" wire to pin 17 of U106, and press the ON LINE switch. LED102 should light. Release the ON LINE switch and LED102 should go off. If not, check U110 or SW4.
- ( ) With the 5" wire still connected to pin 36 of U106, connect the 11" wire to pin 19 of U106 and place section 4 of SW102 in the 1 position. LED102 should be off. Press TEST switch SW101; LED102 should light. If not, check U110, SW101, and SW102.
- ( ) Press the POWER switch to the OFF position.
- ( ) Turn R195 fully counterclockwise (CCW).
- ( ) Plug the print head plug into socket S101.





**PICTORIAL 12**

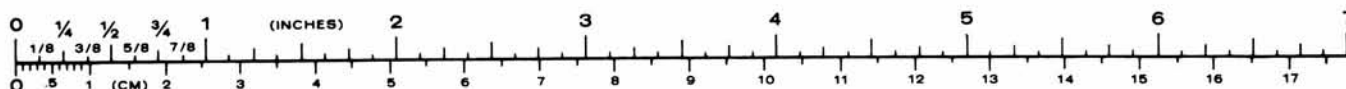
- ( ) Prepare a 1/2" bare wire. Refer to Pictorial 12 and install this wire between J118 and J117 on the circuit board.
- ( ) Press the POWER switch to the ON position. The HIGH TEMP indicator (LED102) on the front panel should be off. Slowly rotate R195 clockwise until the HIGH TEMP indicator lights.
- ( ) Press the POWER switch to the OFF position and reconnect the 1/2" bare wire between J118 and J119.
- ( ) Press the POWER switch to the ON position. The HIGH TEMP indicator should not light. If it does light, check U117, U116D, and U116E.
- ( ) Connect the 5" wire to pin 37 of socket U106. Then alternately connect the 11" wire to pin 3 and pin 4 of U106. LED102 should not light for either of these tests.
- ( ) Unplug the print head plug and repeat the tests in the previous step. Now LED102 should light for both tests. If not, check U109.
- ( ) Press the POWER switch to the OFF position.

- ( ) Remove the 5" and 11" wires.
- ( ) Set the top panel switches as follows:

POWER	OFF (out)
ON LINE	OFF (out)
WIDE CHAR	WIDE (out)

- ( ) Install the paper in your Printer.
- ( ) Press the POWER switch to the ON position. The print head should move from left to right for a short period of time; then it should return to the left margin and stop. If not, check U106.
- ( ) Press the TEST switch (SW101) momentarily. A line of test information should be printed. If not, check U106.
- ( ) Momentarily press the FEED FWD switch. The paper should move forward approximately .02 inches (one step). Then hold the FEED FWD switch down. The paper should continue to advance in full-line steps after a short delay. If not, check U109, U106, and SW6.
- ( ) Press the FEED REV switch. The paper should move back in the same mode as it moved forward. If not, check U106, U109, and SW7.
- ( ) Momentarily press the TOP FORM switch. The paper should advance 11". If not, check SW7, U110, and U106.
- ( ) Press the POWER switch to the OFF position.

This completes the Tests.





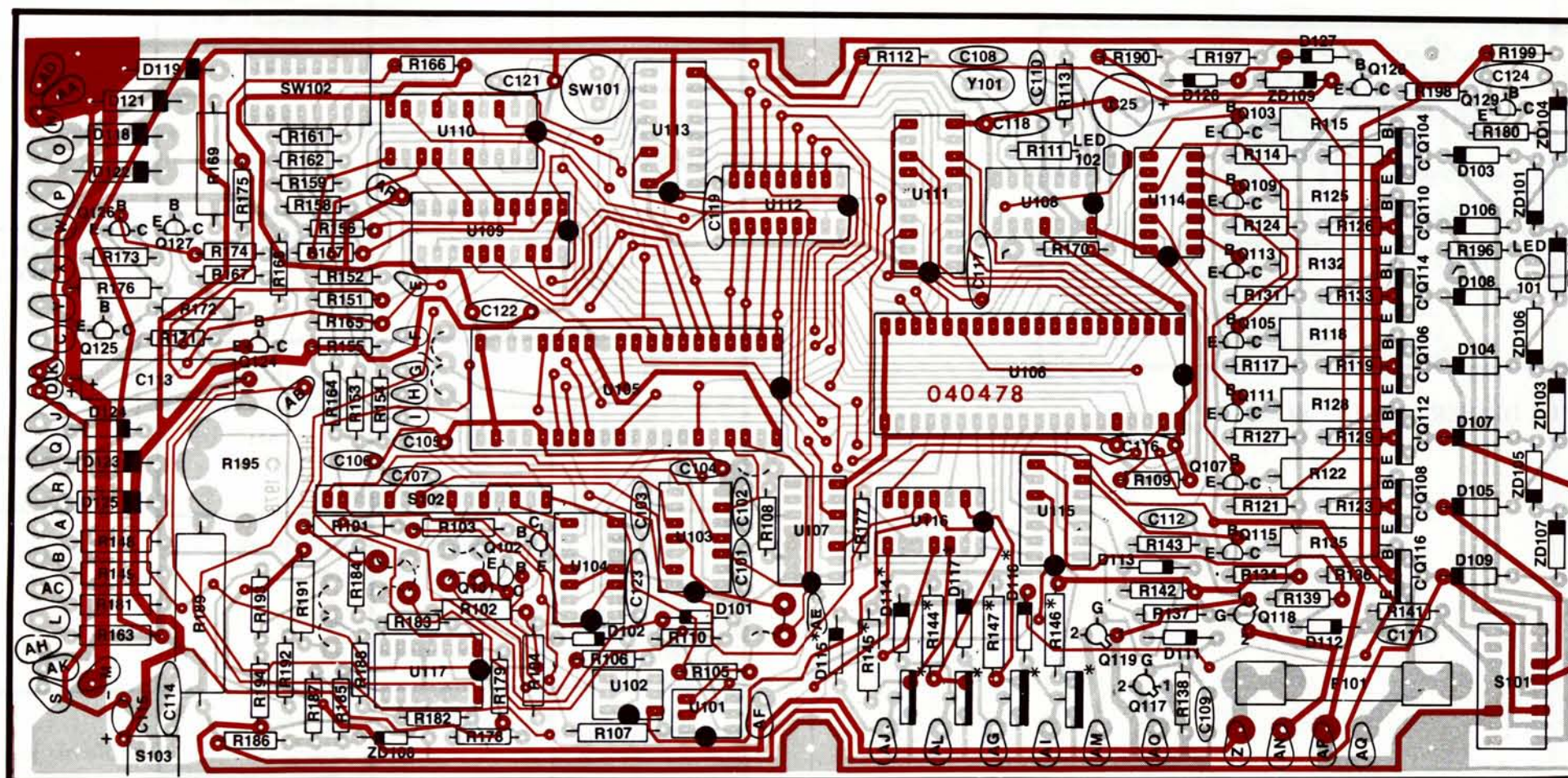
# CIRCUIT BOARD X-RAY VIEWS

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

- A. Find the circuit component number (R5, C3, U1, etc.) on the X-Ray view.
- B. Locate this same number in the "Circuit

Component Number" column of the "Parts List" in the front of this Manual.

Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

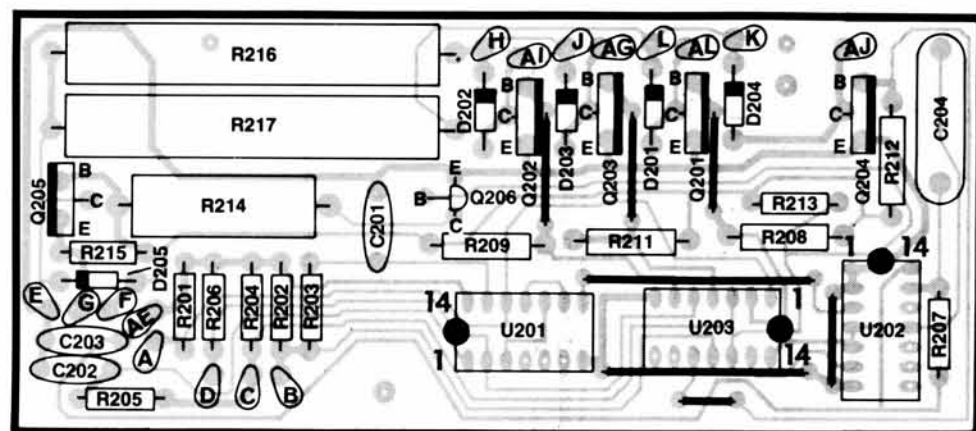


\* These components are not installed in your circuit board.

**MAIN CIRCUIT BOARD**  
(Viewed from the component side.)



# SEMICONDUCTOR IDENTIFICATION CHARTS



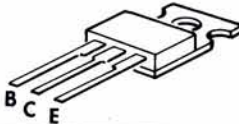


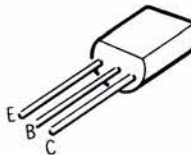
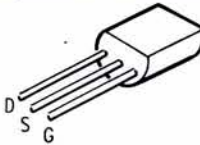
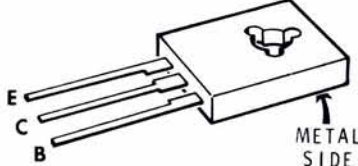
**STEPPER DRIVER CIRCUIT BOARD**  
(Viewed from the component side.)

## DIODES

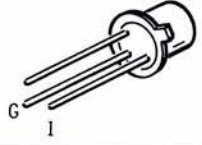
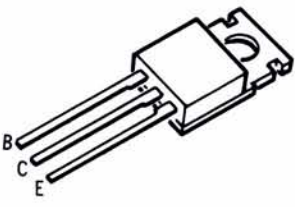
COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION	
ZD109	56-50	DO-7	<p>IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.</p> <p>————— BANDED END</p>	
D101, D102, D111, D112, D113, D126, D127	56-56	1N4149		
ZD101, ZD102, ZD103, ZD104, ZD105, ZD106, ZD107	56-605	1N4746A		
ZD108	56-612	1N5229		
D118, D119, D121, D122, D123, D125	57-42	3A1		
D103, D104, D105, D106, D107, D108, D109, D114, D115, D116, D117, D124	57-65	1N4002		
LED1, LED2, LED101, LED102	412-616	FLV117		
LED3	412-635	TIL-32		



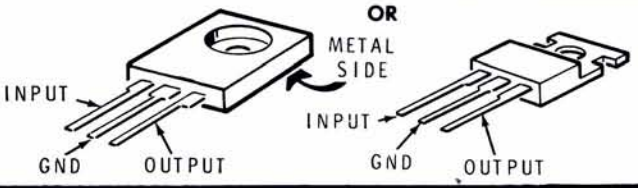
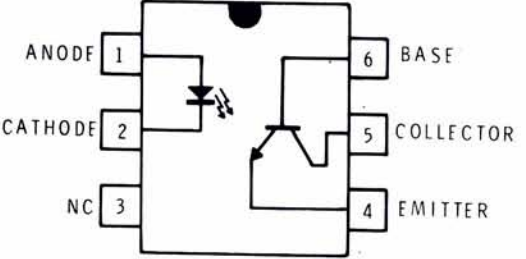
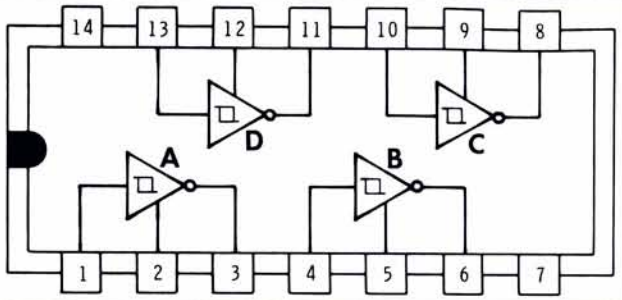
## TRANSISTORS

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q1	417-892	MJE2941	
Q2	417-919	TIL-78	
Q3	150-74	Optron Inc. OPB813, Spectronics Inc. SPX1874-1, HEI Inc. EOS-2A1	
Q101, Q124, Q125, Q129	417-865	MPSA55	
Q103, Q105, Q107, Q109, Q111, Q113, Q115, Q126, Q127	417-864	MPSA05	
Q128	417-801	MPS801	
Q102	417-897	Selected	
Q104, Q106, Q108, Q110, Q112, Q114, Q116	417-263	SIE607	

**Transistors (Cont'd.)**

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q117, Q118, Q119	57-612	T2302F or H103SG	
Q120, Q121, Q122, Q123	417-852	TIP-31	

**INTEGRATED CIRCUITS**

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U1	442-54	7805	
U101, U102	443-808	4N26	
U103	443-795	75189 or 7489	



Integrated Circuits (Cont'd.)

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION																																																																																
U104	443-794	75188 or 1488																																																																																	
U105	443-874	8250	<table border="1"> <tr><td>1</td><td>D0</td><td>VCC</td><td>40</td></tr> <tr><td>2</td><td>D1</td><td>RI</td><td>39</td></tr> <tr><td>3</td><td>D2</td><td>RLSD</td><td>38</td></tr> <tr><td>4</td><td>D3</td><td>DSR</td><td>37</td></tr> <tr><td>5</td><td>D4</td><td>CTS</td><td>36</td></tr> <tr><td>6</td><td>D5</td><td>MR</td><td>35</td></tr> <tr><td>7</td><td>D6</td><td>OUT1</td><td>34</td></tr> <tr><td>8</td><td>D7</td><td>DTR</td><td>33</td></tr> <tr><td>9</td><td>RCLK</td><td>RTS</td><td>32</td></tr> <tr><td>10</td><td>SIN</td><td>OUT2</td><td>31</td></tr> <tr><td>11</td><td>SOUT</td><td>INTRPT</td><td>30</td></tr> <tr><td>12</td><td>CS0</td><td>NC</td><td>29</td></tr> <tr><td>13</td><td>CS1</td><td>A0</td><td>28</td></tr> <tr><td>14</td><td>CS2</td><td>A1</td><td>27</td></tr> <tr><td>15</td><td>BAUDOUT</td><td>A2</td><td>26</td></tr> <tr><td>16</td><td>XTAL1</td><td>ADS</td><td>25</td></tr> <tr><td>17</td><td>XTAL2</td><td>CSOUT</td><td>24</td></tr> <tr><td>18</td><td>DOSTR</td><td>DDIS</td><td>23</td></tr> <tr><td>19</td><td>DOSTR</td><td>DISTR</td><td>22</td></tr> <tr><td>20</td><td>VSS</td><td>DISTR</td><td>21</td></tr> </table>	1	D0	VCC	40	2	D1	RI	39	3	D2	RLSD	38	4	D3	DSR	37	5	D4	CTS	36	6	D5	MR	35	7	D6	OUT1	34	8	D7	DTR	33	9	RCLK	RTS	32	10	SIN	OUT2	31	11	SOUT	INTRPT	30	12	CS0	NC	29	13	CS1	A0	28	14	CS2	A1	27	15	BAUDOUT	A2	26	16	XTAL1	ADS	25	17	XTAL2	CSOUT	24	18	DOSTR	DDIS	23	19	DOSTR	DISTR	22	20	VSS	DISTR	21
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Integrated Circuits (Cont'd.)

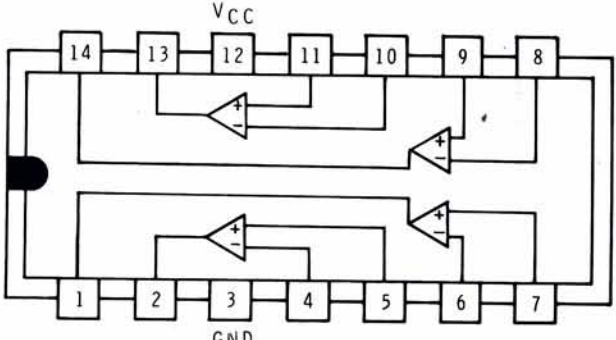
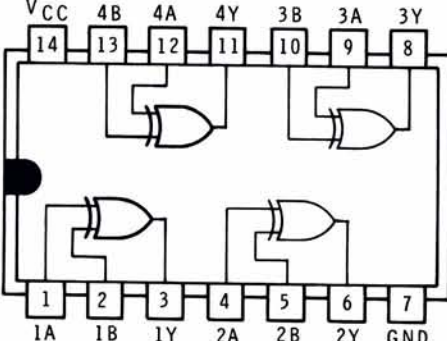
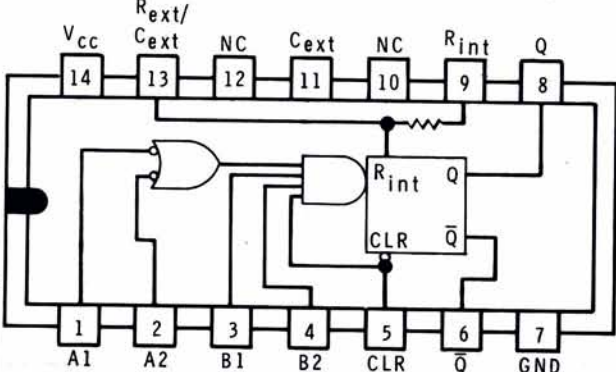
COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION																																																																																
U106	444-31	3870 (available only from Heath Co.)	<table border="1"> <tr><td>1</td><td>XTL1</td><td>VCC</td><td>40</td></tr> <tr><td>2</td><td>XTL2</td><td>RESET</td><td>39</td></tr> <tr><td>3</td><td>PO-0</td><td>EXT INT</td><td>38</td></tr> <tr><td>4</td><td>PO-1</td><td>P1-0</td><td>37</td></tr> <tr><td>5</td><td>PO-2</td><td>P1-1</td><td>36</td></tr> <tr><td>6</td><td>PO-3</td><td>P1-2</td><td>35</td></tr> <tr><td>7</td><td>STROBE</td><td>P1-3</td><td>34</td></tr> <tr><td>8</td><td>P4-0</td><td>P5-0</td><td>33</td></tr> <tr><td>9</td><td>P4-1</td><td>P5-1</td><td>32</td></tr> <tr><td>10</td><td>P4-2</td><td>P5-2</td><td>31</td></tr> <tr><td>11</td><td>P4-3</td><td>P5-3</td><td>30</td></tr> <tr><td>12</td><td>P4-4</td><td>P5-4</td><td>29</td></tr> <tr><td>13</td><td>P4-5</td><td>P5-5</td><td>28</td></tr> <tr><td>14</td><td>P4-6</td><td>P5-6</td><td>27</td></tr> <tr><td>15</td><td>P4-7</td><td>P5-7</td><td>26</td></tr> <tr><td>16</td><td>PO-7</td><td>P1-7</td><td>25</td></tr> <tr><td>17</td><td>PO-6</td><td>P1-6</td><td>24</td></tr> <tr><td>18</td><td>PO-5</td><td>P1-5</td><td>23</td></tr> <tr><td>19</td><td>PO-4</td><td>P1-4</td><td>22</td></tr> <tr><td>20</td><td>GND</td><td>TEST</td><td>21</td></tr> </table>	1	XTL1	VCC	40	2	XTL2	RESET	39	3	PO-0	EXT INT	38	4	PO-1	P1-0	37	5	PO-2	P1-1	36	6	PO-3	P1-2	35	7	STROBE	P1-3	34	8	P4-0	P5-0	33	9	P4-1	P5-1	32	10	P4-2	P5-2	31	11	P4-3	P5-3	30	12	P4-4	P5-4	29	13	P4-5	P5-5	28	14	P4-6	P5-6	27	15	P4-7	P5-7	26	16	PO-7	P1-7	25	17	PO-6	P1-6	24	18	PO-5	P1-5	23	19	PO-4	P1-4	22	20	GND	TEST	21
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U107	443-6	7474	<p>TOP VIEW</p> <p>IC126</p>																																																																																
U108	443-728	74LS00	<p>GND</p>																																																																																



Integrated Circuits (Cont'd.)

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U109, U110	443-791	74LS244	
U111	443-805	74LS273	
U112, U113	443-721	2112-2	
U114, U115, U116	443-73	7416	

## Integrated Circuits (Cont'd.)

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U117	442-616	LM3302, LM2901, $\mu$ A775 (selected)	
U201	443-698	7486N	
U202	443-23	74122	





# PARTS LIST

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
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## RESISTORS

All resistors are 1/4-watt, 5% unless marked otherwise.

R101	6-471	470 Ω, 1/2-watt
R102	6-471	470 Ω, 1/2-watt
R103	6-471	470 Ω, 1/2-watt
R104	6-471	470 Ω, 1/2-watt
R105	6-272-12	2700 Ω
R106	6-683-12	68 kΩ
R107	6-471	470 Ω, 1/2-watt
R108	6-122-12	1200 Ω
R109	6-122-12	1200 Ω
R110	6-221-12	220 Ω
R111	6-561-12	560 Ω
R112	6-122-12	1200 Ω
R113	6-122-12	1200 Ω
R114	6-122-12	1200 Ω
R115	1-20-1	330 Ω, 1-watt, 10%
R116	6-122-12	1200 Ω
R117	6-122-12	1200 Ω
R118	1-20-1	330 Ω, 1-watt, 10%
R119	6-122-12	1200 Ω
R120	NOT USED	
R121	6-122-12	1200 Ω
R122	1-20-1	330 Ω, 1-watt, 10%
R123	6-122-12	1200 Ω
R124	6-122-12	1200 Ω
R125	1-20-1	330 Ω, 1-watt, 10%
R126	6-122-12	1200 Ω
R127	6-122-12	1200 Ω
R128	1-20-1	330 Ω, 1-watt, 10%
R129	6-122-12	1200 Ω
R130	NOT USED	
R131	6-122-12	1200 Ω
R132	1-20-1	330 Ω, 1-watt, 10%
R133	6-122-12	1200 Ω
R134	6-102-12	1200 Ω
R135	1-20-1	330 Ω, 1-watt, 10%
R136	6-122-12	1200 Ω

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
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## Resistors (Cont'd.)

R137	6-681-12	680 Ω
R138	6-222-12	2200 Ω
R139	6-681-12	680 Ω
R140	NOT USED	
R141	6-222-12	2200 Ω
R142	6-681-12	680 Ω
R143	6-222-12	2200 Ω
R144	NOT USED	
R145	NOT USED	
R146	NOT USED	
R147	NOT USED	
R147	NOT USED	
R148	6-391	390 Ω, 1/2-watt
R149	6-391	390 Ω, 1/2-watt
R150	NOT USED	
R151	6-104-12	100 kΩ
R152	6-122-12	1200 Ω
R153	6-122-12	1200 Ω
R154	6-122-12	1200 Ω
R155	6-122-12	1200 Ω
R156	6-122-12	1200 Ω
R157	6-122-12	1200 Ω
R158	6-122-12	1200 Ω
R159	6-122-12	1200 Ω
R160	NOT USED	
R161	6-122-12	1200 Ω
R162	6-122-12	1200 Ω
R163	6-471	470 Ω, 1/2-watt
R164	6-122-12	1200 Ω
R165	6-103-12	10 kΩ
R166	6-183-12	18 kΩ
R167	6-122-12	1200 Ω
R168	6-122-12	1200 Ω
R169	3-2-2	.33 Ω, 2-watt
R170	6-681-12	680 Ω
R171	6-1001-12	1000 Ω, 1%
R172	6-6001-12	6000 Ω, 1%
R173	6-222-12	2200 Ω
R174	6-122-12	1200 Ω

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
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**Resistors (Cont'd.)**

R175	6-272-12	2700 Ω
R176	6-471	470 Ω, 1/2-watt
R177	6-122-12	1200 Ω
R178	6-392-12	3900 Ω
R179	6-392-12	3900 Ω
R180	6-122-12	1200 Ω
R181	6-471	470 Ω, 1/2-watt
R182	6-105-12	1 MΩ
R183	6-105-12	1 MΩ
R184	6-562-12	5600 Ω
R185	6-122-12	1200 Ω
R186	6-472-12	4700 Ω
R187	6-122-12	1200 Ω
R188	6-562-12	5600 Ω
R189	3-26-5	390 Ω, 5-watt
R190	6-101-12	100 Ω
R191	6-1002-12	10 kΩ, 1%
R192	6-2109-12	21 Ω, 1%
R193	6-4709-12	47 Ω, 1%
R194	6-3300-12	330 Ω, 1%
R195	11-90	200 Ω control
R196	6-562-12	5600 Ω
R197	6-101-12	100 Ω
R198	6-122-12	1200 Ω
R199	6-122-12	1200 Ω
R201	6-122-12	1200 Ω
R202	6-122-12	1200 Ω
R203	6-121-12	120 Ω
R204	6-122-12	1200 Ω
R205	6-121-12	120 Ω
R206	6-122-12	1200 Ω
R207	6-473-12	47 kΩ
R208	6-471	470 Ω, 1/2-watt
R209	6-471	470 Ω, 1/2-watt
R210	NOT USED	
R211	6-471	470 Ω, 1/2-watt
R212	6-471	470 Ω, 1/2-watt
R213	6-122-12	1200 Ω
R214	3-26-5	390 Ω, 5-watt
R215	6-122-12	1200 Ω
R216	3-41-10	33 Ω, 10-watt
R217	3-41-10	33 Ω, 10-watt

**CAPACITORS**

C1	21-70	.01 μF ceramic
C2	25-272	6000 μF electrolytic
C3	25-854	5600 μF electrolytic
C4	25-208	1500 μF electrolytic
C5	25-836	17 μF electrolytic
C101	21-722	330 pF ceramic
C102	21-722	330 pF ceramic
C103	21-722	330 pF ceramic

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
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**Capacitors (Cont'd.)**

C104	21-722	330 pF ceramic
C105	21-722	330 pF ceramic
C106	21-722	330 μF ceramic
C107	21-722	330 pF ceramic
C108	21-6	27 pF ceramic
C109	21-143	.05 μF ceramic
C110	21-36	.002 μF ceramic
C111	21-143	.05 μF ceramic
C112	21-143	.05 μF ceramic
C113	25-901	220 μF electrolytic
C114	21-199	.1 μF ceramic
C115	25-220	10 μF electrolytic
C116	21-199	.1 μF ceramic
C117	21-199	.1 μF ceramic
C118	21-199	.1 μF ceramic
C120	NOT USED	
C121	21-199	.1 μF ceramic
C122	21-199	.1 μF ceramic
C123	21-199	.1 μF ceramic
C124	21-199	.1 μF ceramic
C125	25-824	500 μF electrolytic
C126	25-262	250 μF electrolytic
C127	25-281	39 μF tantalum
C201	21-46	.005 μF ceramic
C202	21-46	.005 μF ceramic
C203	21-199	.1 μF ceramic
C204	27-62	.68 μF Mylar

**DIODES — TRANSISTORS — INTEGRATED CIRCUITS**

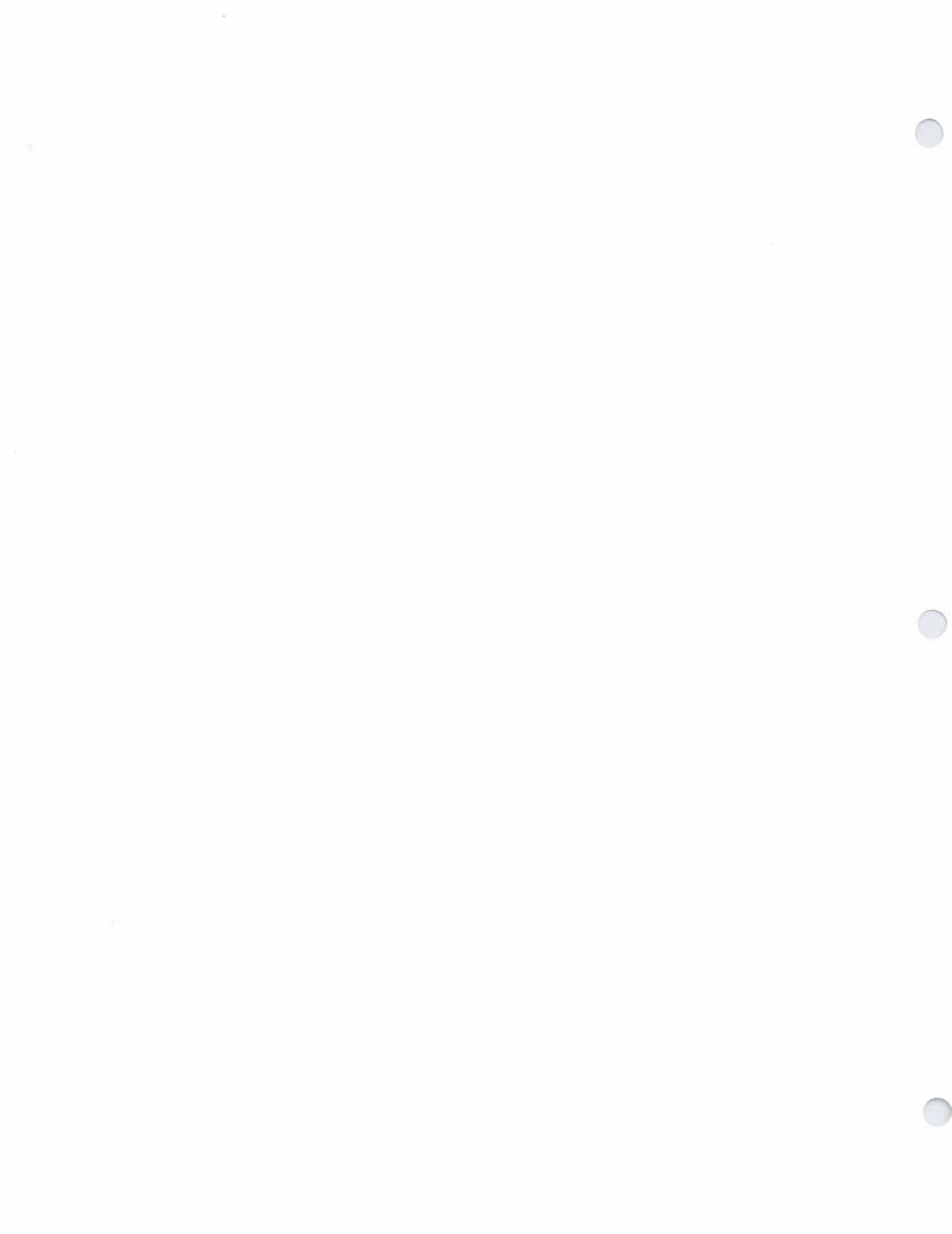
See "Semiconductor Identification Charts."

**GENERAL**

T1	54-962	Power transformer
SW1, SW4-	64-860	6-section switch
SW8		
SW2	60-54	120/240 switch
SW3	60-608	NOR/LOW switch
	266-996	Print head
	266-1007	Ribbon
	253-710	Cork ribbon tension washer
	253-167	Teflon clutch washer
	258-728	Clutch spring
	420-94	Head motor
	420-602	Paper drive motor
	420-603	Ribbon motor
F1	421-20	1/2-ampere, slow-blow fuse
F1	421-23	1-ampere, slow-blow fuse
F101	421-63	6/10-ampere, slow-blow fuse
	349-1	Head drive cable (3.5 feet)







# CUSTOMER SERVICE

## REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

## ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company  
Benton Harbor  
MI 49022  
Attn: Parts Replacement

**Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.**

## OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

## TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

**Please do not send parts for testing**, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

## REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

**If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.**

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least **THREE INCHES** of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company  
Service Department  
Benton Harbor, Michigan 49022



HEATH COMPANY • BENTON HARBOR, MICHIGAN  
***THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM***

LITHO IN U.S.A.