Radio Shack®

Service Manual

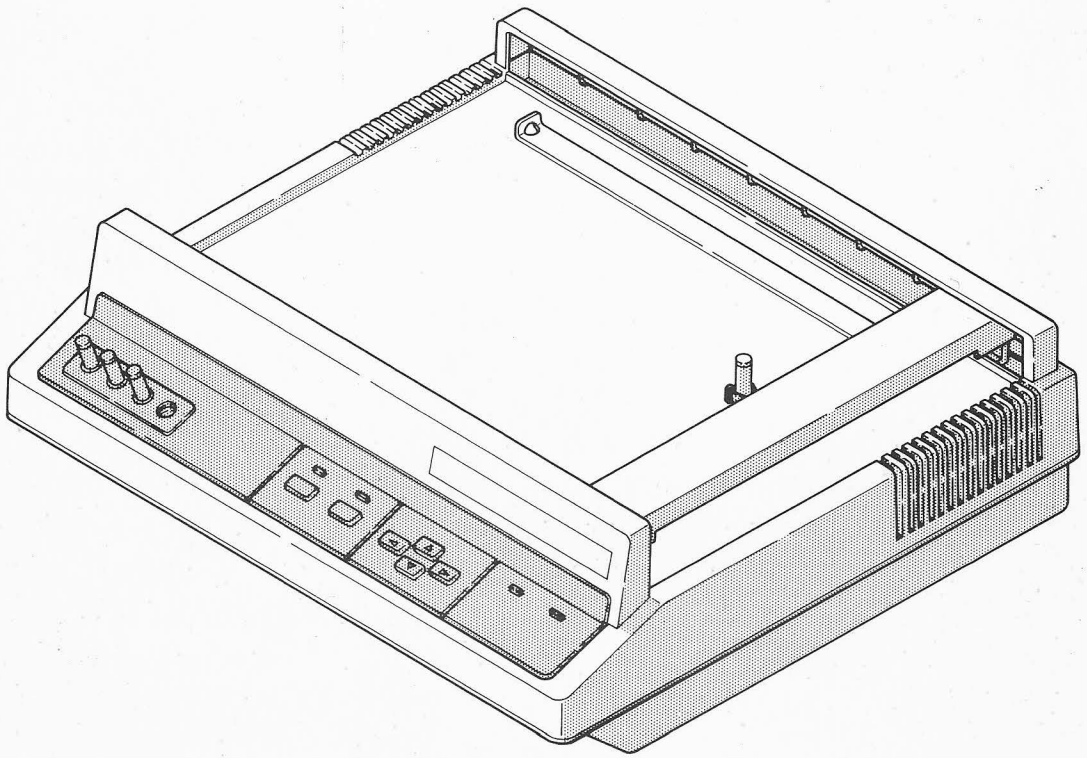
26-1193

TRS-80®

FLAT BED PLOTTER

FP-215

Catalog Number: 26-1193



CUSTOM MANUFACTURED FOR RADIO SHACK , A DIVISION OF TANDY CORPORATION

The Flat Bed Plotter (26-1193) is an intelligent PLOTTER (FP-215) boasting features such as graphic function and printer capability and is easy to interface to any TRS-80 personal computer.

Also, by using a plastic pen recording system, the FP-215 is capable of crisp and impressive printing and drawing. By simplifying the mechanism and incorporating a microprocessor, the plotter has been miniaturized and offers reliable performance.

1) Figures can easily be drawn using command code and parameter.
2) Self-test and print-functions are provided.
3) A parallel interface and a serial interface are furnished to permit easy connection to a computer.
4) High-speed plotting and high graphic quality.
5) Compact, light weight and space-saving design.
6) Low cost, suitable for a personal computer or a micro computer.

TRS-80®
Flat Bed Plotter
Manual

CONTENTS

1. SPECIFICATIONS

- Effective plotting area ..... by Fn command as shown below
  For letter size paper n = 0 (initial condition)
  X axis ..... 270 mm (10.63 inches)
  Y axis ..... 186 mm (7.32 inches)
  For B4 Larger size paper n = 1
  X axis ..... 298 mm (11.73 inches)
  Y axis ..... 216 mm (8.5 inches)
- Plotting speed ..... 100 mm/sec (3.93 inches/second Axially)
- Printing speed ..... 3 cps (character size 2.4×1.6 mm) (0.094×0.063 inches)
- Step size ..... 0.1 mm (internal processing 0.05 mm) (0.00393 inches)
- Accuracy ..... Distance 1% : Repeatability 0.3 mm (0.012 inches)
- Pen ..... Single pen type
  plastic pen
- Color ..... 4 colors black, red, blue, green
- Ink ..... Water based
  Note:As water based ink dries easily, the cap should be placed on the pen when the PLOTTER is not being used.
- Paper size ..... (MAX) B4-size (364 mm × 257 mm) (Approx 14.3" × 10.1")
  or Letter-size (279.4 mm × 216 mm) (11" × 8.5")
  55 Kg quality paper
- Paper setting ..... Magnet plate

Environmental conditions .....
Operation temperature : 5°c - 40°c
Operation humidity : 30 - 80%
Storage temperature : —40° - 70°c
- Storage humidity : 10% - 90%

These figures assume that freezing does not occur.
Power supply ..... AC 105 - 135V 50/60Hz (U.S.A:CANADA)
AC 216 - 264V 50Hz (UK:AUSTRALIA)
AC 198 - 242V 50Hz (BELGIUM)

- Power consumption ..... MAX 90W
- Dimensions ..... 410 mm (W) × 372 mm (D) × 121 mm (H)
  Approx 16.1 (W) × 14.6 (D) × 4.8 (H) inches
- Weight ..... Approx : 11kg (24 Lbs)
- Input signals ..... 7 bits ASCII code
- Input mode ..... Parallel interface
  Serial interface (600/1200 BPS switch Selectable)
- Intelligent capabilities

Modes ..... ON LINE conditions
(1) GRAPHIC mode (when power switch on)
(2) PRINT mode
OFF LINE conditions
(1) SELF-TEST mode
(2) MANUAL mode

Plotting instruction ..... 10 types of vector instructions
4 types of character instructions

- Static discharge ..... 2.0 kv (100pF)
- Acoustic noise generation ..... Less than 65dB at 1m
- Reliability (MTBF) ..... 1000H (50% duty)
- Pen life ..... 300 m (30,000 character by S4 size character)

2. OPERATIONAL DESCRIPTION

2.1 Block Diagram

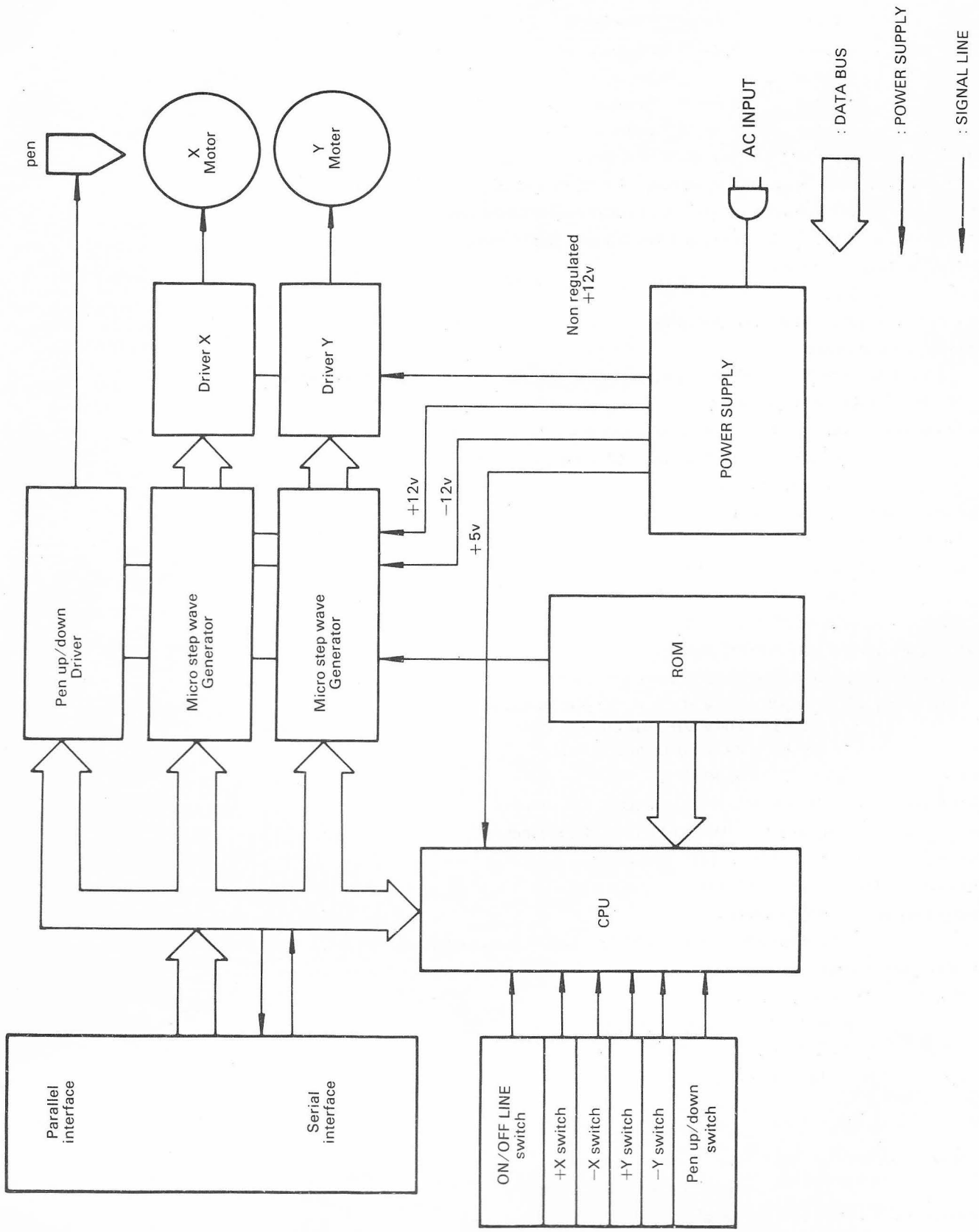


Diagram 1

2.2 Structure and Characteristics of Offline and Online Conditions.

Diagram 2 is a block diagram showing the structure of the individual modes and the switches.

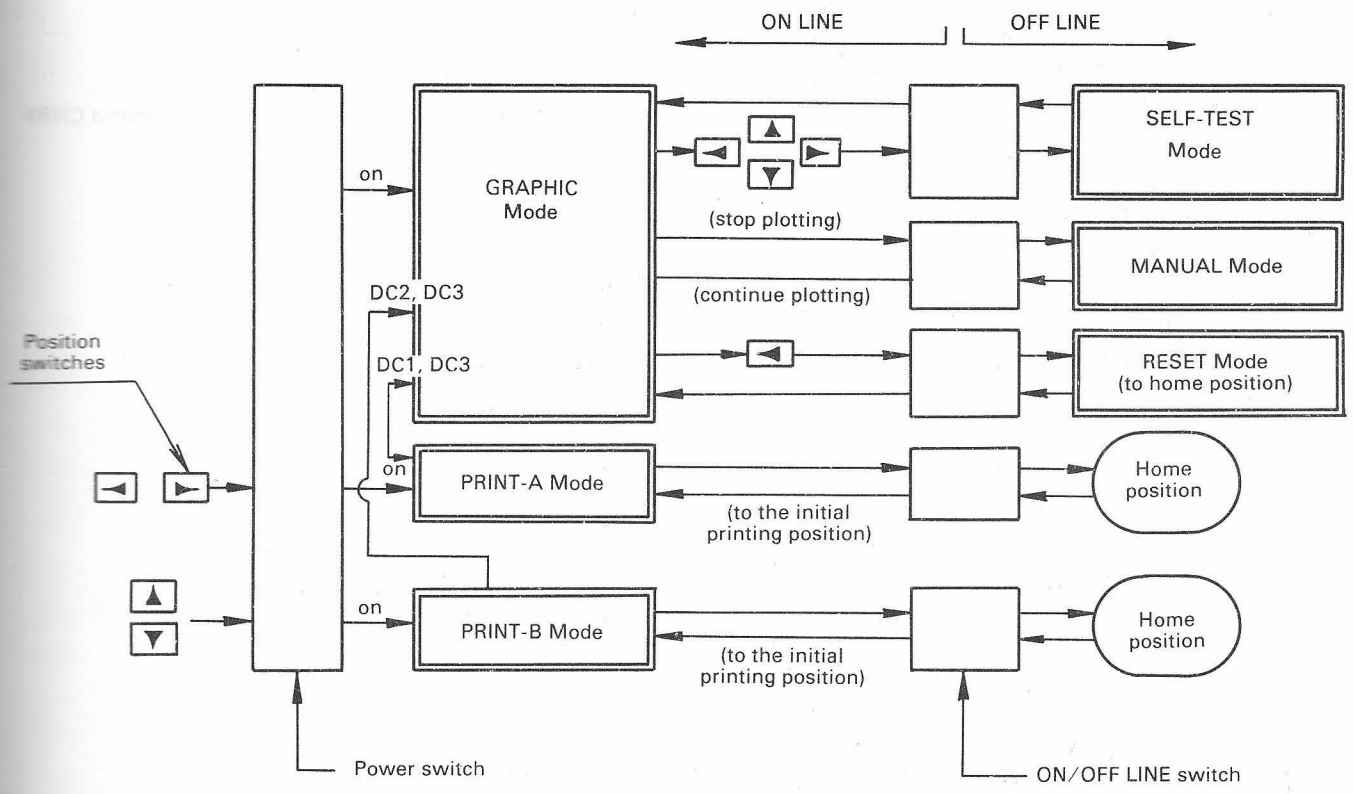


Diagram 2

Device Control Code

DC1 : Decimal Code 17	.....	GRAPHIC Mode	PRINT-A Mode
DC2 : Decimal Code 18	.....	GRAPHIC Mode	PRINT-B Mode
DC3 : Decimal Code 19	.....	PRINT-A/B Mode	GRAPHIC Mode

2.3 Print-A Mode (Horizontal Print Mode)

In the Print mode, you can use your Plotter like an ordinary printer either by hardware or software commands. To enter Print mode via hardware, power-up the Plotter and simultaneously press◄and►for horizontal format printing (PRINT-A Mode). To do so via software, send a CHR$ (17). By turning PRINT-A Mode, the pen will move from starting position to the coordinate position (255,1650) and will print in the PRINT-A Mode according to the input character code.

In the PRINT-A Mode a character size of 2.4mm × 1.6mm, 92 characters per line and 36 lines per page can be printed.

NOTE (1) When the last character of the last line has been printed, the Plotter stops printing. To change the paper, press ON/OFF LINE switch. Pen will move to Home position.
Press ON/OFF LINE again after changed paper, then Plotter will restart printing from beginning of new paper.

(2) When printing is finished, press ON/OFF LINE. The pen will move to Home position. If you wish to print some more, press ON/OFF LINE again. The pen will move from Home position to the first designated position and wait for data.

(3) When the Power Switch is turned off, PRINT-A Mode is cancelled.

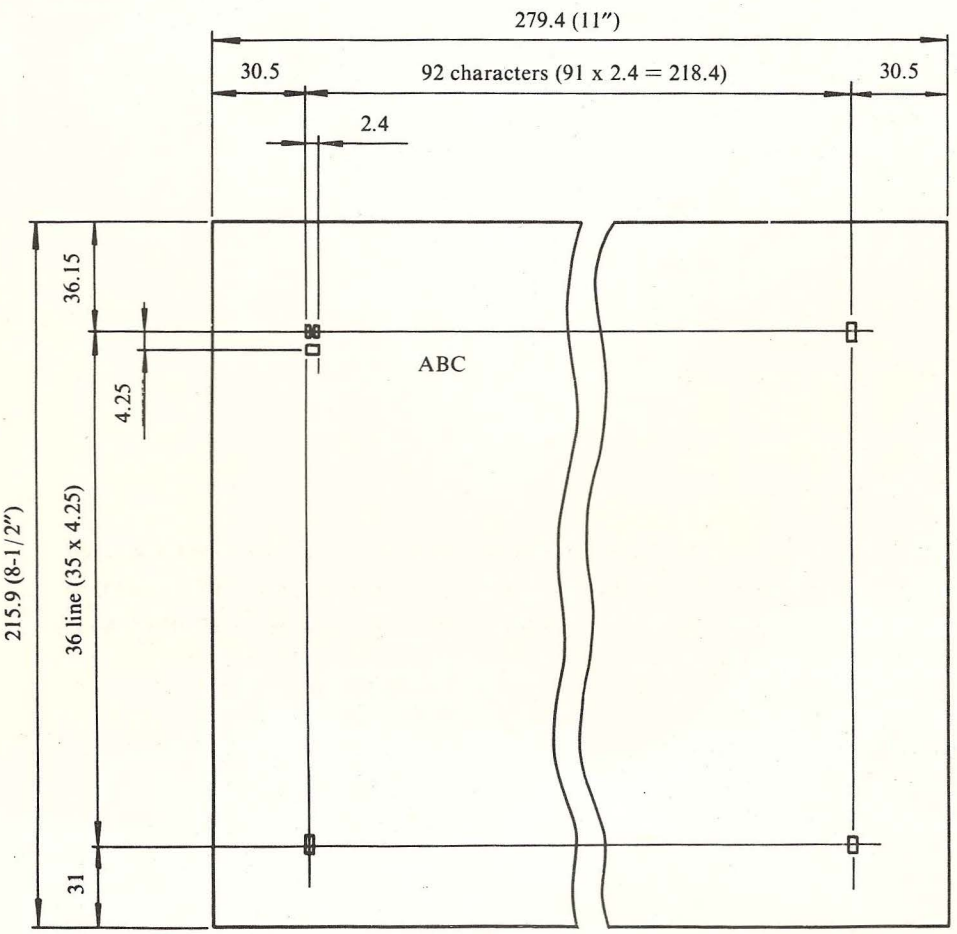
(4) To stop printing, press the ON/OFF LINE after the input signal has stopped.

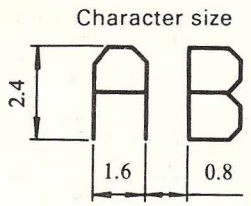
(5) To enter GRAPHIC Mode, send a decimal code 19 to the Plotter. From BASIC, use the command CHR$ (19).

Example of a Print Mode program (below is shows a program for TRS-80 Model I/II/III)

(program)	(print)
(1) LPRINT"APY4101"	APY4101
(2) 10 LPRINT"PLOTTER"	PLOTTER
(3) LLIST	Prints the program list.

Horizontal chart character printing format (letter size)





Note The paper is always assumed to be placed on the plotter with it's longer side parallel to operational panel.

2.4 Print-B Mode (Vertical Print Mode)

In the Print mode, you can use your Plotter like an ordinary printer either by hardware or software commands. To enter Print mode via hardware, power-up the Plotter and simultaneously press ▲ and ▼ for vertical format printing (PRINT-B Mode). To do so via software, send a CHR$ (18). By turning PRINT-B Mode, the pen will move from starting position to the coordinate position (260,250) and will print in the PRINT-B Mode according to the input character code.
In the PRINT-B Mode a character size of 2.4mm × 1.6mm, 64 characters per line and 54 lines per page can be printed.

NOTE (1) When the last charactor of the last line has been printed, the Plotter stops printing. To change the paper, press ON/OFF LINE switch. Pen will move to Home position.
Press ON/OFF LINE again after changing paper, then Plotter will restart printing from begining of new paper.

(2) When printing is finished, press ON/OFF LINE. The pen will move to Home position. If you wish to print some more, press ON/OFF LINE again. The pen will move from Home position to the first designated position and wait for data.

(3) When the Power Switch is turned off, PRINT-B Mode is cancelled.

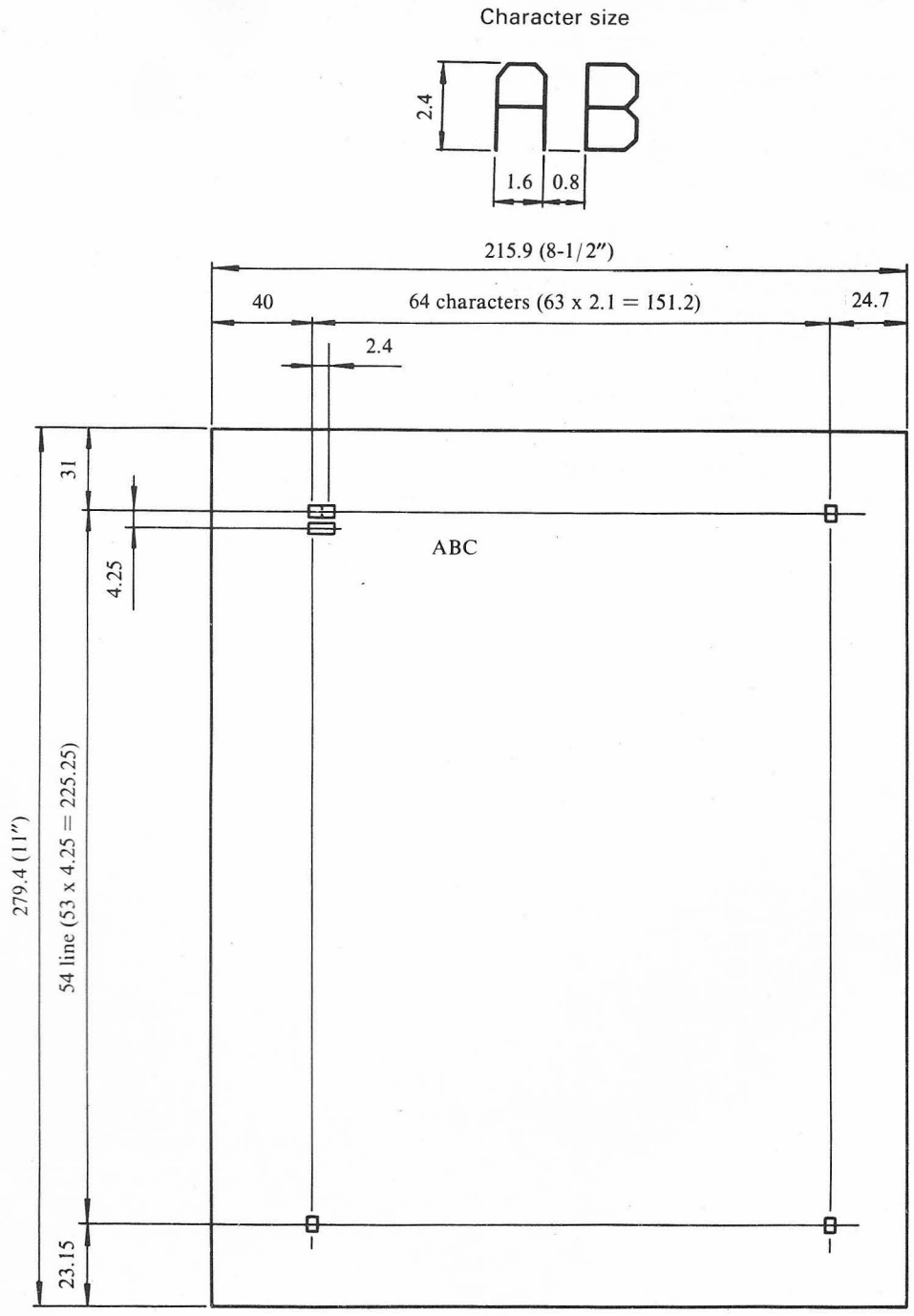
(4) To stop printing, press the ON/OFF LINE after the input signal has stopped.

(5) To enter GRAPHIC Mode, send a decimal code 19 to the Plotter. From BASIC, use the command CHR$ (19).

Example of a Print Mode program (below is shows a program for TRS-80 Model I/II/III)

(program)	(print)
(1) LPRINT"APY4101"	APY4101
(2) 10 LPRINT"PLOTTER"	PLOTTER
(3) LLIST	Prints the program list.

Vertical chart character printing format (letter size)



Note The paper is always assumed to be placed on the plotter with it's longer side parallel to operational panel.

2.5 Self-Test Mode

In GRAPHIC MODE, press ON/OFF LINE while all of the four position switches (◄ ▲ ▼ ►) are being pressed. The plotter will plot a test pattern which checks stored instructions for plotting.

After completing the plotting, the pen returns to its Home position. When the ON/OFF LINE switch is pressed, this mode is cancelled and the Plotter switches to the GRAPHIC Mode.

Do not press the PEN UP/DOWN switch or ON/OFF LINE switch during SELF-TEST mode.

RADIO SHACK FLATBED PLOTTER

26-1193 FP-215

!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMN

OPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~

Self-check pattern

2.6 Graphic Mode

2.6.1 Table of Graphic Commands

Command	Format	Functions
LINE TYPE	Lp p= 0 to 1	Specifies a solid or a dotted line when drawing a straight line. p=0 (solid line) p=1 (dotted line)
LINE SCALE	Bl l = 1 to 127	Specifies a pitch for the dotted line. line and space: 1:1 Initial value (l = 30)
DRAW	$Dx_1, y_1, x_2, y_2, \cdots x_n, y_n$ −9999≦Xi≦9999 −9999≦Yi≦9999	Sequentially draws lines which pass Xi, Yi coordinate position. The Xi, Yi coordinate value is expressed in terms of integral multiples of 0.1mm. No input signal for more than one second after the completion of DRAW command causes the pen to go up.
MOVE	$Mx_1, y_1, x_2, x_2, \cdots x_n, y_n$ −9999≦Xi≦9999 −9999≦Yi≦9999	Moves a pen in the UP position over lines which pass Xi, Yi coordinate position.
RELATIVE DRAW	$J\triangle x_1, \triangle y_1, \triangle x_2, \triangle y_2, \cdots \triangle x_n, \triangle y_n$ −9999≦△Xi≦9999 −9999≦△Yi≦9999 −32767≦Σ△Xi≦32767 −32767≦Σ△Xi≦32767	Plots lines sequentially from X., Y. to (X. + ΣXi), (Y + Σ Yi) △Xi, △Yi represent increments (decrements) in movements. No input signal for more than one second after the completion of RELATIVE DRAW command causes the pen to go up.
RELATIVE MOVE	$R\triangle x_1, \triangle y_1, \triangle x_2, \triangle y_2, \cdots \triangle x_n, \triangle y_n$ −32767≦Σ△Xi≦32767	Moves a pen in the UP position from Xo Yo to (X + ΣXi), (Y + ΣYi)
AXIS	X p.q.r. p = 0 to 1 q = −9999 to 9999 r = 1 to 255	plots coordinate axis, Y axis with P=0 and X axis with p=1, where q represents scale intervals and r does the frequency of repetition.
HOME	H	Moves a pen in the UP mode to a home position. (F command will change the home position.)
ALPHA SCALE	Sn n = 1 to 255	Specifies character and mark size: Initialization mode (n=4)
ALPHA ROTATE	Qn n = 0 to 3	Rotates character angle: n=0:0°, n=1:270°, n=2:180°, n=3:90°
PRINT	$P_{A1, A2, ..Ai..An}$	Plots such characters as specified by Ai.
MARK	Nn n= 0 to 5	Plots a mark specified by n n=0:x, n=1:◇, n=2:□, n=3:△, n=4:⧖, n=5:⊙
INITIALIZE	$I_{X1, Y1}$ −9999≦Xi≦9999 −9999≦Yi≦9999	Assign X1 and Y1 to origin. (at initial condition X1=0, Y1=0) The pen moves to an original point specified by X1, Y1 Depending on the effective plotting area designation, there are 2 initial origins.
PLOTTING AREA	Fn n = 0 to 1	Specify the effective plotting area (at initial condition n=0) n=0:plotting area 270 × 186 mm (for letter size paper) n=1:plotting area 298 × 216 mm (for B4 size paper)

2.6.2 Construction of Graphic Commands

Command format

Command code (One letter)	Parameter (Numeric data up to 4 digits)	Delimiter (comma)	Parameter (Numeric data up to 4 digits)	Delimiter (comma)	---	Parameter (Numeric data up to 4 digits)	Terminator (CR)

A line from a command to CR is executed as an instruction.

Example (1): Set a character angle at Q=1.

ASCII code: Q 1 CR

Hexadecimal notation: 51 31 OD

Example (2): Print XY PLOTTER

P XY PLOTTER CR

Example (3): Plot a line at a point of x=200 and y=0, and then move the pen to a point of X=0 and Y=200.

D 200, 0, 0, 200 CR

2.6.3 Control Codes and Character Codes

Control Codes

Codes			
Decimal	Octal	Hex	Symbol
10	012	OA	LF
13	015	OD	CR
17	21	11	DC1
18	22	12	DC2
19	23	13	DC3

LF:The pen moves to next line.

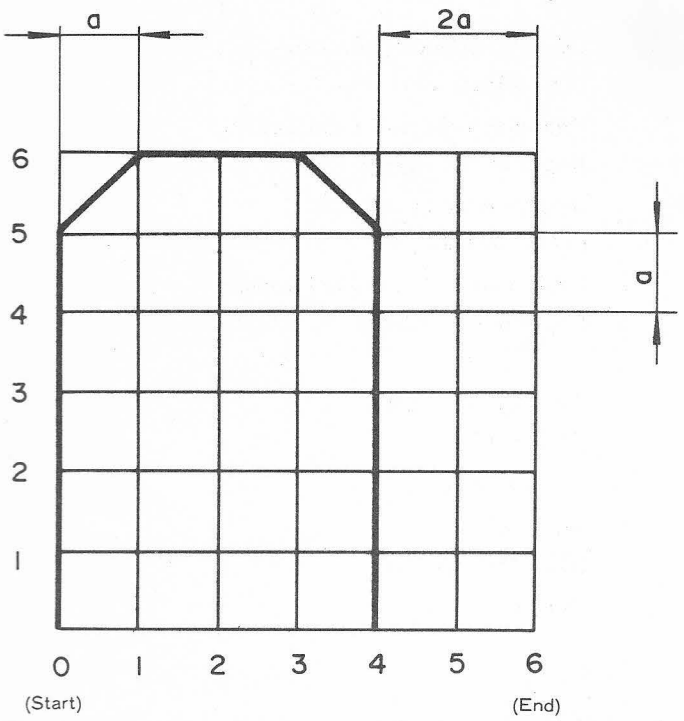
CR:The pen moves to the first printing position of next line.

Character Codes

Code			Char.	Code			Char.	Code			Char.
Dec.	Hex	Oct.		Dec.	Hex	Oct.		Dec.	Hex	Oct.	
32	20	40	(Space)	64	40	100	@	96	60	140	`
33	21	41	!	65	41	101	A	97	61	141	a
34	22	42	"	66	42	102	B	98	62	142	b
35	23	43	#	67	43	103	C	99	63	143	c
36	24	44	$	68	44	104	D	100	64	144	d
37	25	45	%	69	45	105	E	101	65	145	e
38	26	46	&	70	46	106	F	102	66	146	f
39	27	47	'	71	47	107	G	103	67	147	g
40	28	50	(	72	48	110	H	104	68	150	h
41	29	51	)	73	49	111	I	105	69	151	i
42	2A	52	*	74	4A	112	J	106	6A	152	j
43	2B	53	+	75	4B	113	K	107	6B	153	k
44	2C	54	,	76	4C	114	L	108	6C	154	l
45	2D	55	—	77	4D	115	M	109	6D	155	m
46	2E	56	.	78	4E	116	N	110	6E	156	n
47	2F	57	/	79	4F	117	O	111	6F	157	o
48	30	60	0	80	50	120	P	112	70	160	p
49	31	61	1	81	51	121	Q	113	71	161	q
50	32	62	2	82	52	122	R	114	72	162	r
51	33	63	3	83	53	123	S	115	73	163	s
52	34	64	4	84	54	124	T	116	74	164	t
53	35	65	5	85	55	125	U	117	75	165	u
54	36	66	6	86	56	126	V	118	76	166	v
55	37	67	7	87	57	127	W	119	77	167	w
56	38	70	8	88	58	130	X	120	78	170	x
57	39	71	9	89	59	131	Y	121	79	171	y
58	3A	72	:	90	5A	132	Z	122	7A	172	z
59	3B	73	;	91	58	133	[	123	7B	173	{
60	3C	74	<	92	5C	134	\	124	7C	174	|
61	3D	75	=	93	5D	135	]	125	7D	175	}
62	3E	76	>	94	5E	136	^	126	7E	176	~
63	3F	77	?	95	5F	137	—				

Other undefined codes are ignored.

2.6.4 Character Construction



a = 0.1x (n)

(n represents a value specified by Sn)

Note 1) When the P command is executed in the graphic mode, a character is plotted using the current pen position as an origin.

2) When the Q command is executed in the graphic mode, a character is rotated with the starting point in the above diagram as a pivot.

2.7 Alert Lamp On

The ALERT lamp will light when:

- Illegal characters are entered as a command input.
- Parameter limit exceeded (over 5 digits).
- Limits of pen movement exceeded: must be within the range of ±16383 steps with home position as the center.
- If you enter a parameter that has a non-integer value.

To clear, press the ON/OFF Line Switch once to enter the Off-Line mode. Press again to return to On-Line status. The ALERT lamp will go off and printing restores to normal.

2.8 Interface

The Plotter is equipped with a serial interface and a parallel interface. Either can be selected as desired by a built-in selector switch.

NOTE When a serial interface and a parallel interface are connected at the same time, the XY PLOTTER does not move.

Connector and Cable

(1) Connector

1) Parallel

Plotter side: 36-pole connector (female)
(57L-40360-27C)
(Manufactured by Daiichi Denshi Kogyo or equivalent)

Cable side: 36-pole connector (male)
(57-30360-D8)
(Manufactured by Daiichi Denshi Kogyo or equivalent)

2) Serial

Plotter side: 4-pin DIN receptacle
(TCS +440)
(Hoshiden Co., Ltd.)

Cable side: 4-pin DIN plug
(TCP 0546-01-010)
(Hoshiden Co., Ltd.)

(2) Cable

For noise control, twisted pair cables should be used, with a maximam length of 1m.

2.8.1 Parallel Interface Specification

PIN No.	DESCRIPTION	PIN No.	DESCRIPTION
1	$\overline{\text{STROBE}}$	19	TWISTED PAIR GND (Pin1)
2	DATA 1	20	TWISTED PAIR GND (Pin2)
3	DATA 2	21	TWISTED PAIR GND (Pin3)
4	DATA 3	22	TWISTED PAIR GND (Pin4)
5	DATA 4	23	TWISTED PAIR GND (Pin5)
6	DATA 5	24	TWISTED PAIR GND (Pin6)
7	DATA 6	25	TWISTED PAIR GND (Pin7)
8	DATA 7	26	TWISTED PAIR GND (Pin8)
9	DATA 8	27	TWISTED PAIR GND (Pin9)
10	$\overline{\text{ACKNOWLEDGE}}$	28	TWISTED PAIR GND (Pin10)
11	BUSY	29	TWISTED PAIR GND (Pin11)
12	GND	30	TWISTED PAIR GND (Pin12)
13	$\overline{\text{BUSY}}$	31	NC
14	NC	32	$\overline{\text{FAULT}}$
15	NC (Not Connected)	33	NC (Not Connected)
16	NC	34	NC
17	NC	35	NC
18	+5V	36	NC

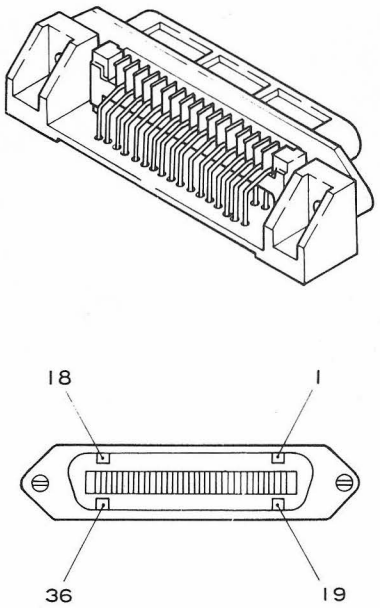


Fig.1 Connector pin number

2.8.2 Serial Interface Specification

PIN No.	DESCRIPTION
1	NC (Not Connected)
2	$\overline{\text{BUSY}}$
3	GND (0V)
4	$\overline{\text{DATA}}$

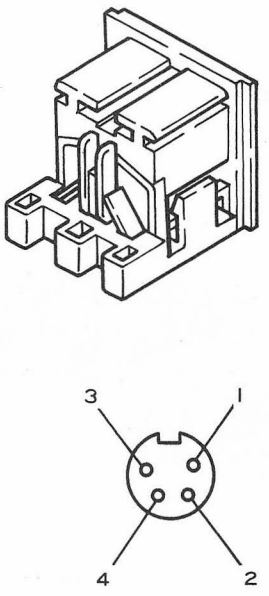


Fig.2 Connector pin number

2.8.3 Interface Level

(1) Parallel

TTL level

Input high level	2.0 - 5.0v
low level	0 - 0.8v
Output high level	2.4 - 5.0v
low level	0 - 0.4v

(2) Serial

$+3v \leqq$ Input high level $\leqq +25v$

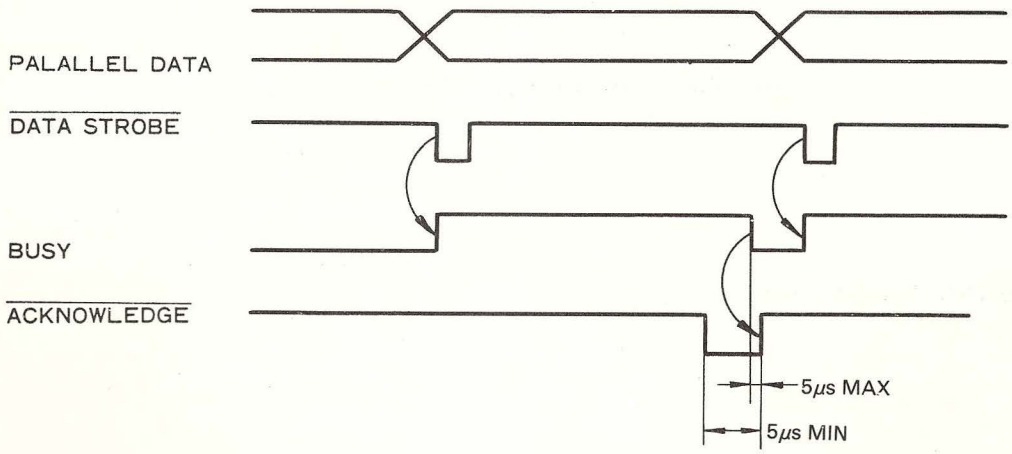
$-3v \geqq$ Input low level $\geqq -25v$

$+5v \leqq$ Output high level $\leqq +25v$

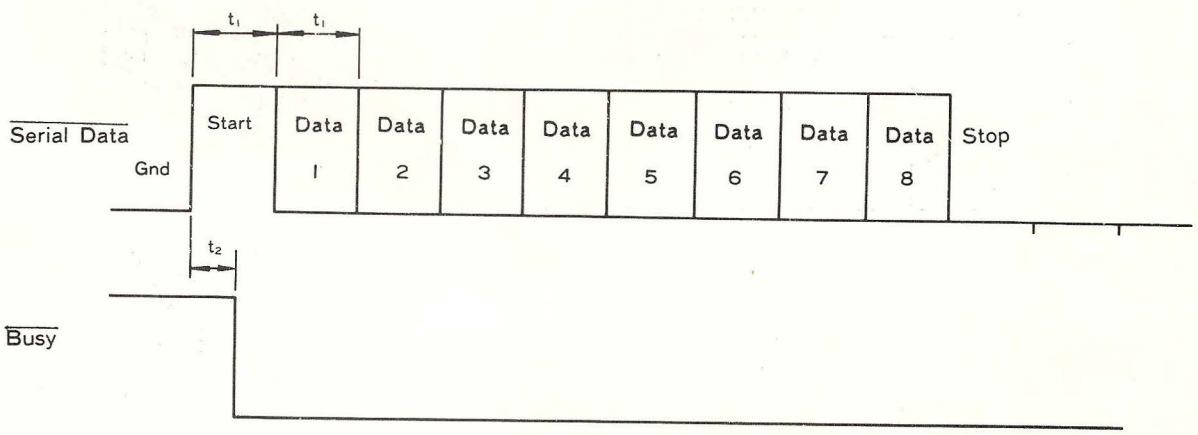
$-3v \geqq$ Output low level $\geqq -25v$

2.8.4 Interface Time Chart

(1) Parallel



(2) Serial



Baud Rate	t1	t2
600 BPS	1.67ms	0.83ms
1200 BPS	0.83ms	0.42ms

2.8.5 Interface Switch

The interface switch is at the back on the left side of the plotter. The switch can be set for parallel or serial interface from the outside of the case by using a pair of tweezers or a small screwdriver. The following diagrams show the switch positions as seen from the rear of the plotter.

For parallel interface set all the switch positions down.

For serial interface.

a) For 600 baud, set all the switch positions up.

b) For 1200 baud, set the 1, 3, 4 switch positions up and only the 2 position down.

NOTE: The switches only operate in the manner shown above.

3. PLOTTER ASSEMBLIES

Ref. No.	Description
1	Beam Assembly
2	Beam Parts Assembly
3	Base Frame Assembly
4	Base Frame Parts Assembly
5	Mechanical Parts Assembly
6	Front PCB Assembly
7	Power Supply Assembly
8	Main PCB Assembly
9	Lower Cover Assembly
10	Lower Cover Parts Assembly
11	Upper Cover Unit
12	Upper Cover Parts Assembly
13	Power Supply Unit

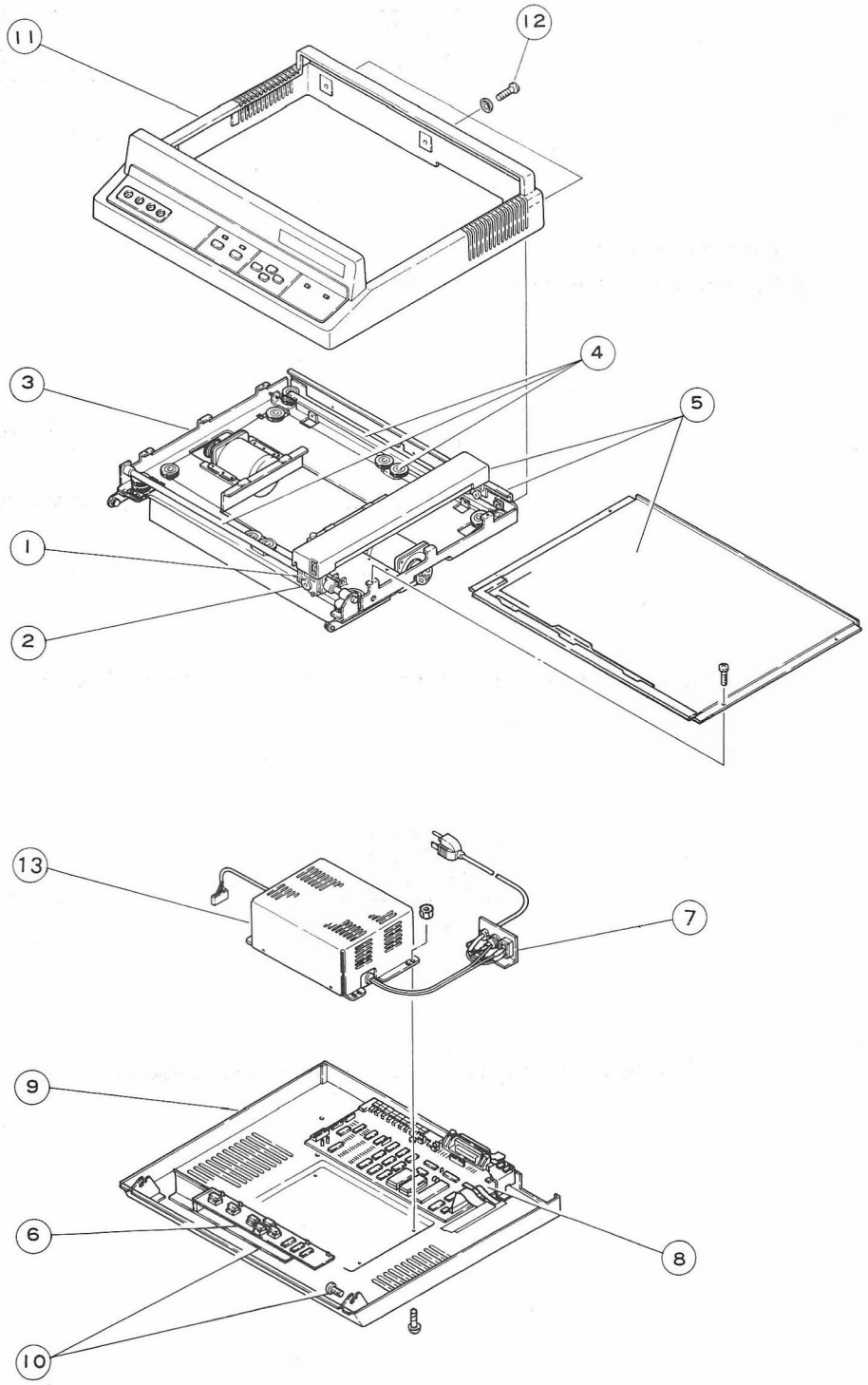


Fig. 3 Plotter Assemblies

3.1 Beam Assembly

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
A-1	Front Beam Assy		A19004B
A-1A	Beam Front		A19005A
A-1B	Stud F		A16010
A-1C	Unit,Pulley (D14)		A17008A
A-1D	E Ring E-3		A34E30Z
A-1E	Pulley Post (Front)		A16009
A-1F	Unit,Pulley (D14)		A17008A
A-2	Rear Beam Assy		A19006B
A-2A	Beam Rear		A19003
A-2B	Stud E		A16007
A-2C	Unit,Pulley (D14)		A17008A
A-2D	E Ring E-3		A34E30Z
A-2E	Stud G		A16011
A-2F	Roller		A17003
A-2G	E Ring E-2.5		A34E25Z
A-2H	E Ring E-3		A34E30Z
A-2I	Pulley Post (Rear)		A16009
A-2J	Unit,Pulley (D14)		A17008 A
A-2K	Plate,Roller Tension		A14015
A-3	Carriage Frame Assy		A19007B
A-3A	Frame Carriage		A19001
A-3B	Unit,Bobbin		A93002A
A-3C	Holder A		A13005
A-3D	Screw M2.5 × L4 + Spring Washer		A30A2504Z1
A-3F	Cable Pen		A75007
A-3G	Unit,Yoke		A14027A
A-3H	Screw M2.5 × L8		A30A2508Z0
A-3I	Spring		A22001
A-3J	Pin		A15003
A-4	Cover Side		A13006
A-5	Shaft Slide		A15002
A-7	Screw (IMO) M3 × L4		A30001
A-8	Rail Slide		A13007
A-9	Screw (IMO) M3 × L4		A30001
A-10	Screw M2.5 × L5		A30A2505Z0
A-11	Cushion Rubber A		A45002

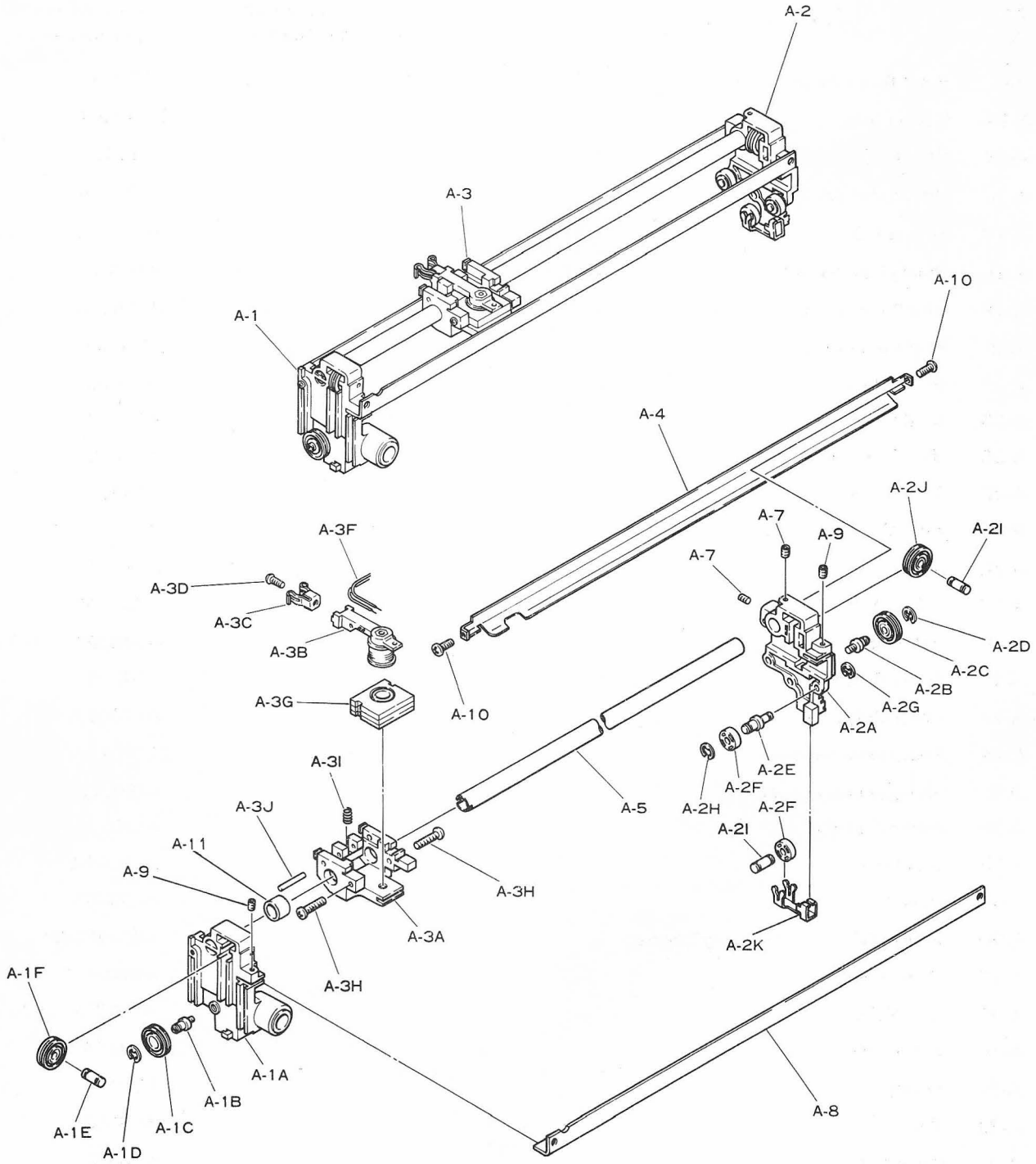


Fig. 4 Beam Assembly

Function

The beam assembly has a carriage frame assy (A-3) to mount a pen and a sliding mechanism to slide in X and Y directions.

The carriage frame assy (A-3) is mounted on a guide mechanism to slide in Y direction and moves the pen up and down. Both ends of the guide mechanism are mounted on the front beam assy (A-1), a sliding mechanism in X direction, and on the rear beam assy (A-2).

Removing/Replacing

Tools Required: Phillips screwdriver, flat-end screwdriver, pliers, and wrench

1. Remove 2 hexagon socket set screws (A9) and slide rail.
2. Remove 2 screws (A-10) and the side cover.
3. Remove 2 hexagon socket set screws (A-7) and the slide shaft (A-5), then disassemble into the front beam assy, rear beam assy, and carriage frame assy.
4. When disassembling the front beam assy, pull out the E-ring (A-1D) with a screwdriver.
5. When disassembling the rear beam assy, pull out the E-ring (A-2D), remove the pulley, and remove the stud (A-2B) with a screwdriver. When disassembling the roller section, pull out the E-ring (A-2H), remove the roller, pull out the E-ring (A-2G), then dismount the stud (A-2E).
6. The carriage frame assy can be disassembled by pulling out the pin (A-3J) and 2 screws (A-3H). Remove the holder A (A-3C) by unfastening the screw (A-3D).

Adjustment (Precautions)

1. Untighten the screw (A-3D) and adjust the holder A (A-3C) by moving it up and down to adjust the height of the pen. (Adjust the height of the pen so that the space between the panel plate and the tip of the pen is $1^{+0.5}_{-0}$mm.)

Notes:

1. The bobbin unit (A-3B) must operate lightly after mounting the carriage frame (A-3A) on it.
2. The carriage must slide lightly after mounting the carriage frame assy (slide load below 30 g).
3. Set the pulley by facing the projecting side towards the stud.
4. (1) The tightening torque for M3 screws is 1.5 ~ 2 kg cm.
   (2) The tightening torque for the stud (A-1B, A-2B) is 1.3 ~ 2 kg cm.
   (3) The tightening torque for M2.5 screws are 1.5 ~ 2 kg cm.

3.2 Beam Parts Assembly

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
B-1	Unit,Harness		A 75009 B
B-1A	Unit,Reed Switch P.C.B.		A 60006 A
B-2	Screw M2 × L5 + Spring Washer + Flat Washer		A30A2005Z4
B-3	Harness Clamp		A 14014
B-4	Flat Print Circuit Clamp		A 14013
B-5	Double Face		A 47003
B-6	Screw M2 × L5		A30A2005Z0
B-7	Screw M2 × L6		A30A2006Z0

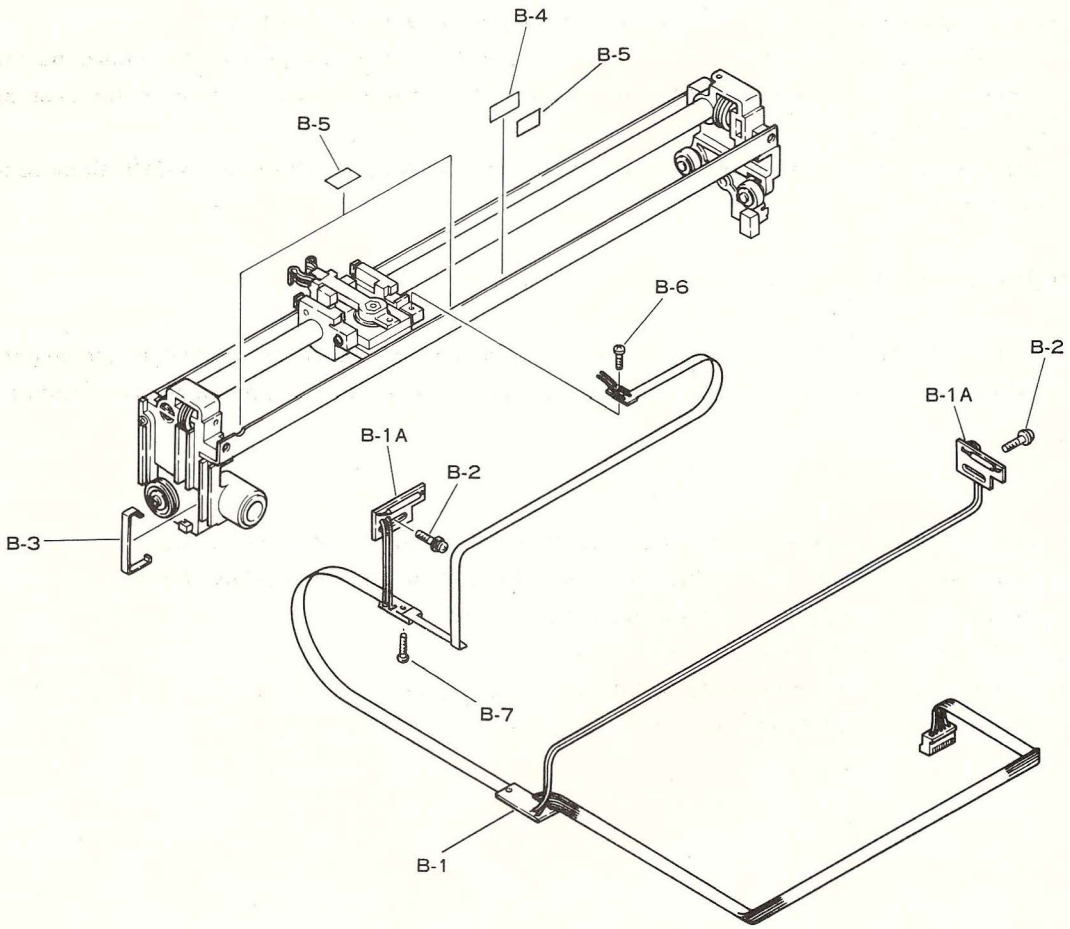


Fig.5 Beam Parts Assembly

Function

The read switch PCB mounted on the beam assy and base frame assy change the positions of the read switches magnetically. They are switched on by changing their mounting positions right and left-hand. They set origins on X and Y axes.

Removing/Replacing

Tools Required: Phillips screwdriver, pliers, soldering iron

1. Disconnect the lead wire connecting the PCB with the bobbin unit with a soldering iron.
2. Unfasten screws (B—6) and remove the PCB.
3. Remove the harness unit (B-1) mounted on the guide rail at 3 double faces (B-5), flat print circuit clamp (B-4), and harness clamp (B-3).
4. Unfasten the screws (B-2) and remove the reed switch PCB unit (B-1A). (2 locations)
5. Unfasten the screws (J-4) and remove the harness unit (B-1) beginning with the front beam.
6. Disconnect the 5P connector mounted on the main PCB.

Adjustment

1. If the starting point of the plotter pen movement is not on the original position as printed (silk print) on the panel plate, it can be returned to the exact position by adjusting the attachment location of the reed switch PCB unit mounted on the beam assy and base frame assy in X and Y directions, using the holes on the base plate.
   a. Fine adjustment in Y direction

      Unfasten the screw (B-2) that holds the reed SW PCB unit (B-1A) attached to the beam assembly. Then move it in direction (1) along the holes of the base plate. The pen also moves in direction (1). Similarly, if you move the reed SW PCB unit along the holes of the base plate in direction (2), the pen also moves in direction (2).
      After the adjustment of the Y direction is completed, untighten the screw and secure the base plate.
   b. Fine adjustment in X direction

      Unfasten the screw (B-2) that holds the reed SW PCB unit (B-1A) attached to the base frame assembly. Then, move it in direction (3) along the holes of the plate, the pen also moves in direction (3). Similarly, if you move the reed SW PCB unit along the holes of the base plate of direction (4), the pen also moves in direction (4).
      After the adjustment of the X direction is completed, unfasten the screw and secure the base plate.

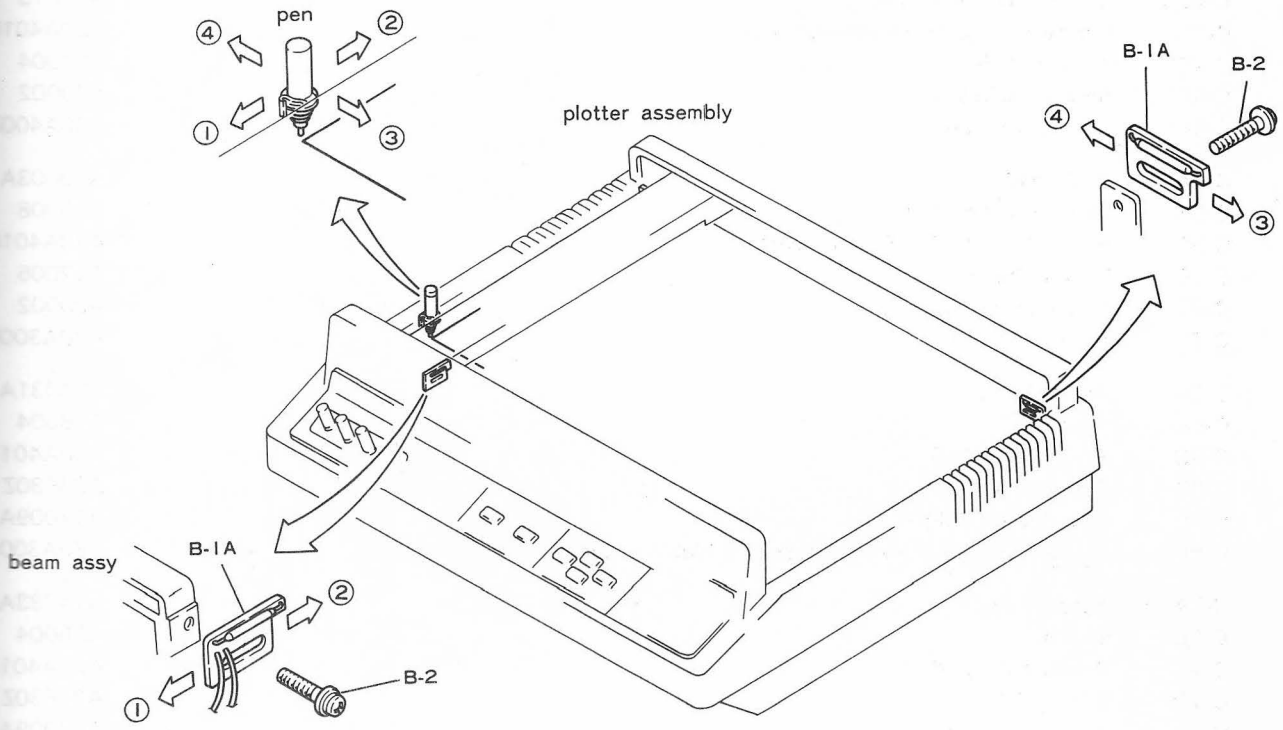


Fig.6 Original Position Adjustment

Notes:

1. Be careful about the reed switch bending direction.
2. Do not move the pen up and down when coating with silicone.
3. Do not project the double face tape from flexible printed cuircuit
4. Be careful not to cause a short circuit from excessive solder.

3.3 Base Frame Assembly

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
C-1A	Base Frame		A12001
C-1B	Cushion Rubber Plate		A45001
C-1C	Spacer		A16004
C-1D	Unit,Pulley (D22)		A17009A
C-1E	E Ring E-3		A34E30Z
C-1F	Unit,Pulley (D22)		A17009A
C-1G	E Ring E-3		A34E30Z
C-1H	Unit,Pulley (D22)		A17009A
C-1I	E-Ring E-3		A34E30Z
C-1J	Bar Set Plate		A14022
C-1K	Support Bar		A16002
C-1L	E Ring E-3		A34E30Z
C-1M	Adjust Plate C		A14010
C-1N	Screw M3 × L22		A30A3022Z0
C-1O	Screw M3 × L8 + Spring Washer + Flat Washer		A30A3008Z4
C-2	Unit,Support Plate (Right)		A14028A
C-2A	Screw M3 × L6 + Spring Washer		A30A3006Z1
C-3	Unit,Support Plate (Left)		A14029A
C-3A	Screw M3 × L6 + Spring Washer		A30A3006Z1
C-4A	X—Axis Motor		A90002A
C-4B	Motor Bracket (X—Axis)		A13013
C-4C	Screw M4 × L10 +SpringWasher		A30A4010Z1
C-4D	X—Axis Pulley		A17004
C-4E	Screw (IMO) M3 ×L8		A30002
C-4F	Screw M4 × L8		A30A4008Z1
C-5A	Y—Axis Motor		A90003A
C-5B	Motor Bracket (Y-Axis)		A13008
C-5C	Screw M4 × L10 + Spring Washer		A30A4010Z1
C-5D	Y—Axis Pulley		A17005
C-5E	Screw (IMO) M3 × L8		A30002
C-5F	Screw M3 × L8		A30A3008Z1
C-6A	Adjust Plate A		A14031A
C-6B	Spacer		A16004
C-6C	Screw M4 × L16		A30A4016Z0
C-6D	E Ring E-3		A34E30Z
C-6E	Unit,Pulley (D22)		A17009A
C-6F	Screw M3 × L8 + Spring Washer + Flat Washer		A30A3008Z4
C-7A	Adjust Plate B		A14033A
C-7B	Spacer		A16004
C-7C	Screw M4 × L16		A30A4016Z01
C-7D	E-Ring E-3		A34E30Z
C-7E	Unit,Pulley (D22)		A17009A
C-7F	Screw M3 × L8+ Spring Washer + Flat Washer		A30A3008Z4
C-8	Wire Cramp A K-104G		A59001
C-9	Wire Cramp B K-105G		A59008

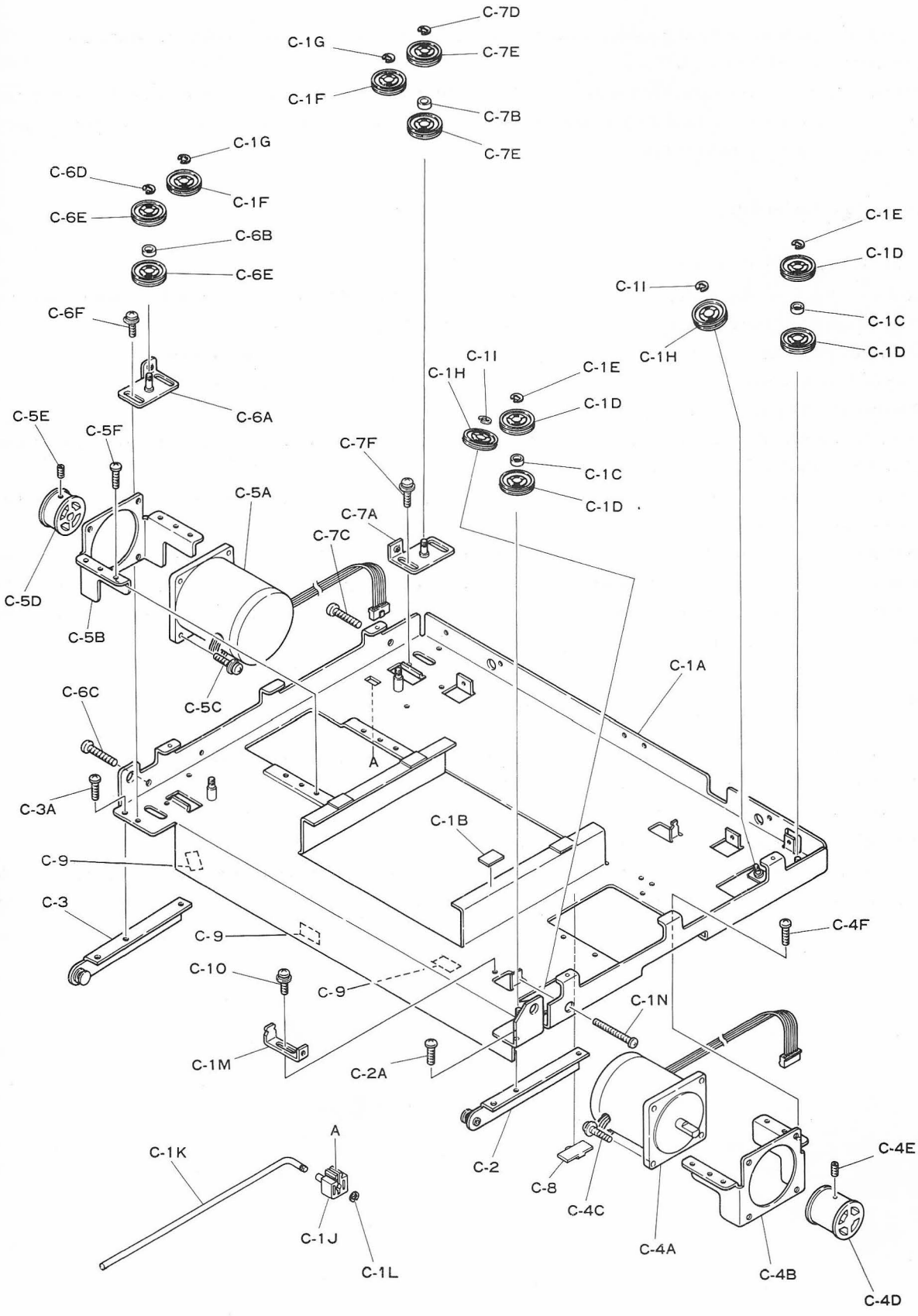


Fig. 7 Base Frame Assembly

Function

This assembly is made up of motors to drive in X and Y axis directions, brackets to support them, and a frame that serves as the body.

Of the two motors, the right-hand motor is for driving the X-axis, and the one on the left side, for driving the Y-axis. The motors are mounted on the base frame through the brackets. The base frame mounts pulleys to change motor drive to move in X and Y directions.

Removing/Replacing

Tools Required: Phillips screwdriver, pliers, and wrench

1. Unfasten the 2 screws (C-6C, C-6F), remove the adjust plate A (C-6A) and E ring (C-6D), then dismount the two pulley (D22) units (C-6E) and spacer (C-6B). Also remove (C-7) in the same manner.
2. Remove the E ring (C-1G) and dismount the pulley (D22) unit (C-1F) from the base frame.
3. Remove the E ring (C-1E) and dismount two pulley (D22) units (C-1D) and spacers (C-1C).
4. Remove the E ring (C-1I) and dismount the pulley (D22) unit (C-1H).
5. Remove the E ring (C-1L), pull out the support bar (C-1K) from the bar set plate (C-1J), then remove the bar set plate (C-1J) from the base frame (C-1A). (Section A)
6. Unfasten the 3 screws (C-2A) and remove the support plate (right) unit (C-2). (Remove the support plate (left) unit (C-3) in the same method.)
7. Unfasten the 4 screws (C-4F) and remove the motor bracket (X-axis) (C-4B) from the base frame (C-1A). Unfasten the 4 screws (C-4C), dismount the X-axis motor (C-4A) from the motor bracket, then remove the X-axis pulley (C-4A) mounted on the motor shaft section by unfastening 2 hexagon socket set screws (C-4E). (Remove the C-5 Y-axis motor in the same method.)

Notes:

1. The tightening torque for M3 screws is 7 ~ 9 kg cm. Screw (C-4E, C-5E) is 2~3 kgcm.
2. The tightening torque for M4 screws is 16 ~ 18 kg cm.
3. Set the pulley with lock pawls facing downward.
4. After setting, the pulleys should rotate smoothly.
5. Set the X-axis motor so that the harness comes out from the left side of the bracket when mounted on the motor bracket, and the Y-axis motor, from the right side of the bracket.

3.4 Base Frame Parts Assembly.

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
D-1A	Unit,Pulley (D22)		A17009A
D-1B	Idle Plate		A14023
D-1C	Stud E		A16007
D-1D	E Ring E-3		A34E30Z
D-2	Guide Shaft		A15001
D-3	E Ring E-6		A34E60Z
D-4	Wave Washer		A32U80R
D-5	Cushion Rubber B		A45004
D-6	Guide Rail		A13003
D-7	Screw M3 × L4		A30A3004Z0
D-8	Unit,X-axis Wire		A24007A
D-9	Unit,Y-axis Wire		A24008A
D-10	Unit,Idle Wire A		A24009A
D-11	Unit,Idle Wire B		A24010A
D-12	Unit,Wire Cramp		A14035A
D-13	Screw M3 × L5 + Spring Washer		A30A3005Z1

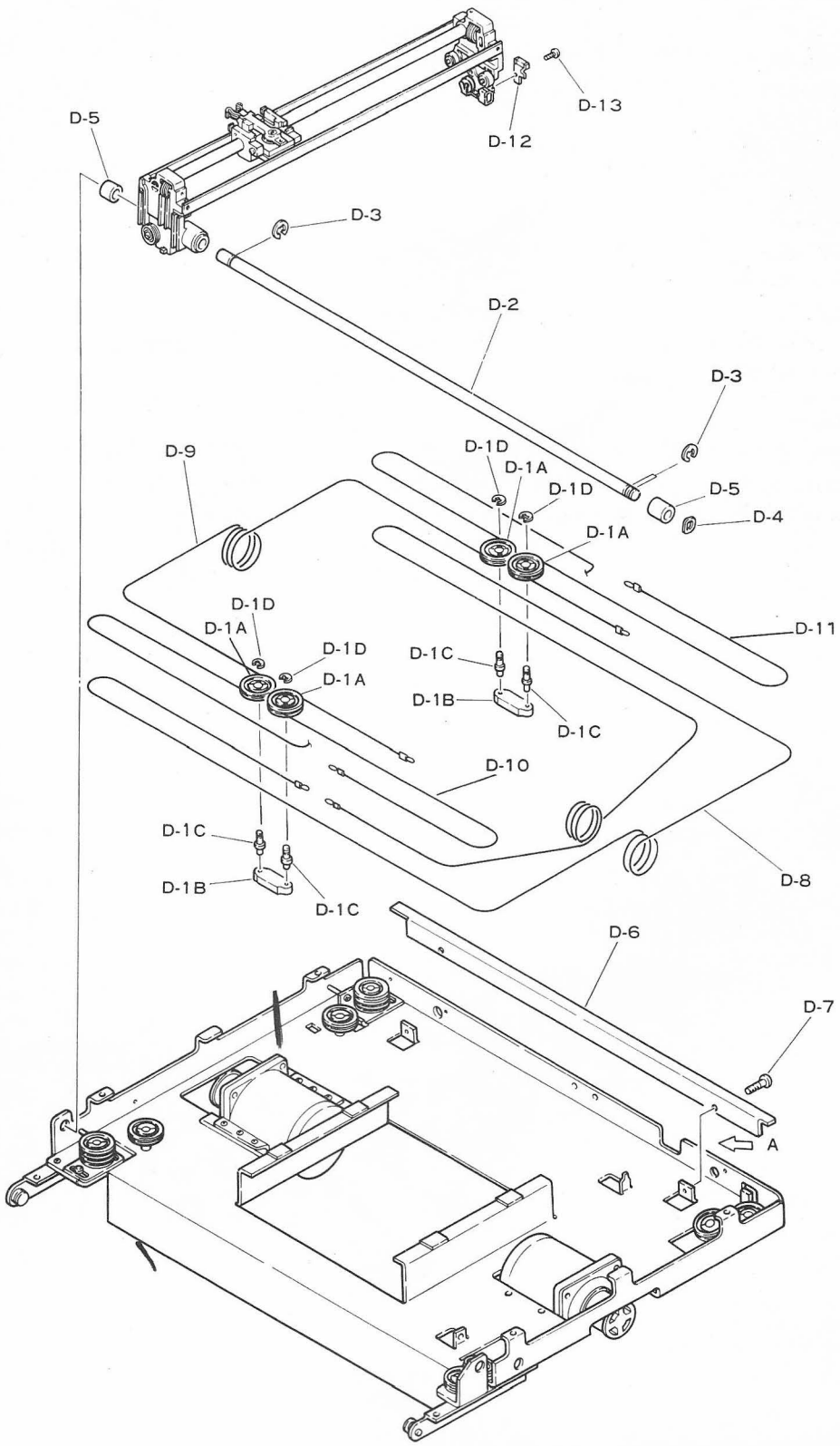


Fig. 8 Base Frame Parts Assembly

Function

This assembly consists of wires to slide the beam assy in the X and Y directions using a group of pulleys.The motor drive allows the beam assy to slide in X and Y directions by wires through the pulleys that freely move.
The beam assy is mounted on the base frame through the guide rail which guides movement in an X direction, through the guide shaft, and through other parts.

Removing/Replacing

Tools Required: Phillips screwdriver, flat end screwdriver, and pliers.

1. Move the beam assy parallel with the X direction up to the slit section Ⓐ of the base frame, unfasten screws (D-13), then remove the unit wire cramp (D-12).
2. Loosen the wire tension adjust screws (C-1N, C-10), and dismount the unit Y-axis wire (D-9) from the body.
3. Loosen the wire tension adjust screws (C-6C, C-6F), and dismount the unit idle wire (D-10) from the body. (Dismount the unit idle wire A (D-11) in the same method)
4. Remove the X-axis wire unit (D-8).
5. Dismount the E ring (D-1D) and pulley (D22) unit (D-1A). Loosen the stud (D-1C) screw and remove the 2 studs from the idle plate (D-1B).
6. Unfasten 2 screws (D-7) and remove the guide rail (D-6).
7. Dismount 3 E rings (D-3) and remove 2 cushion rubbers (D-5) and wave washer (D-4). Pull out the guide shaft (D-2) from the base frame and beam assy.

Wire Stringing

1. X-axis wire stringing (Figure. 9)
   a. Hook the X-axis wire ① on the front beam hook of the beam assy and rotate 1 turn along the groove.
   b. Wind on the pulley Ⓑ, insert below the base frame, then wind on the X-axis motor pulley assy ② 5 times.
   c. Pull out on the upper face of the base frame, wind on the pulley Ⓓ, and string the wire ① between the lower pulleys Ⓔ and Ⓕ.
   d. Wind the wire to the X-axis motor pulley ② 5 times, insert through the lower pulleys Ⓗ and Ⓘ, and set on the front slider ③ hook.

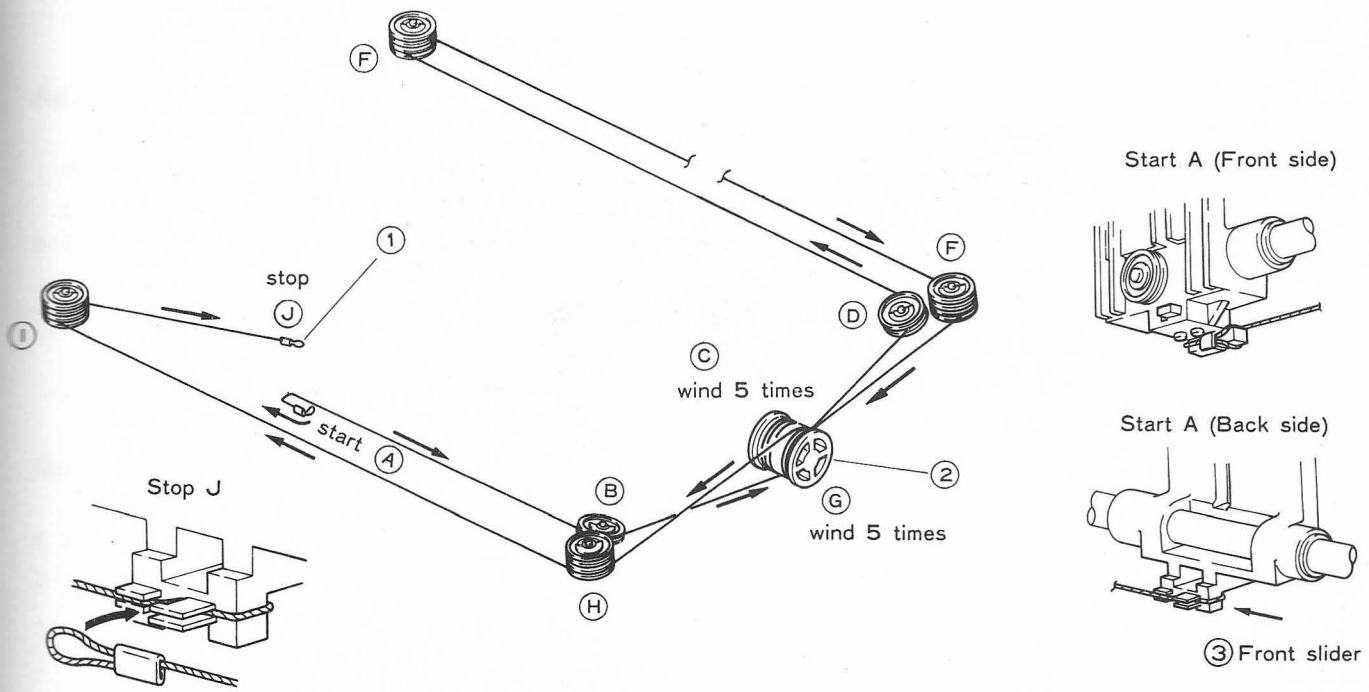


Fig. 9 X-Axis Wire Stringing

2. Idle Wire Stringing (Figure 10)
   a. Anchor the idle plate assy ③, set the idle wire ① on the front beam assy ② hook, insert it through the upper section of the pulley on the right side and idle plate assy ③, then mount the wire on the adjust plate c ④.
   b. Set the idle wire assy ⑤ through the hook of the rear beam assy ⑥, insert it through the upper section of the pulley on the left side and idle plate assy ③ through their grooves and mount it on the wire hook of the base frame assy ⑦.

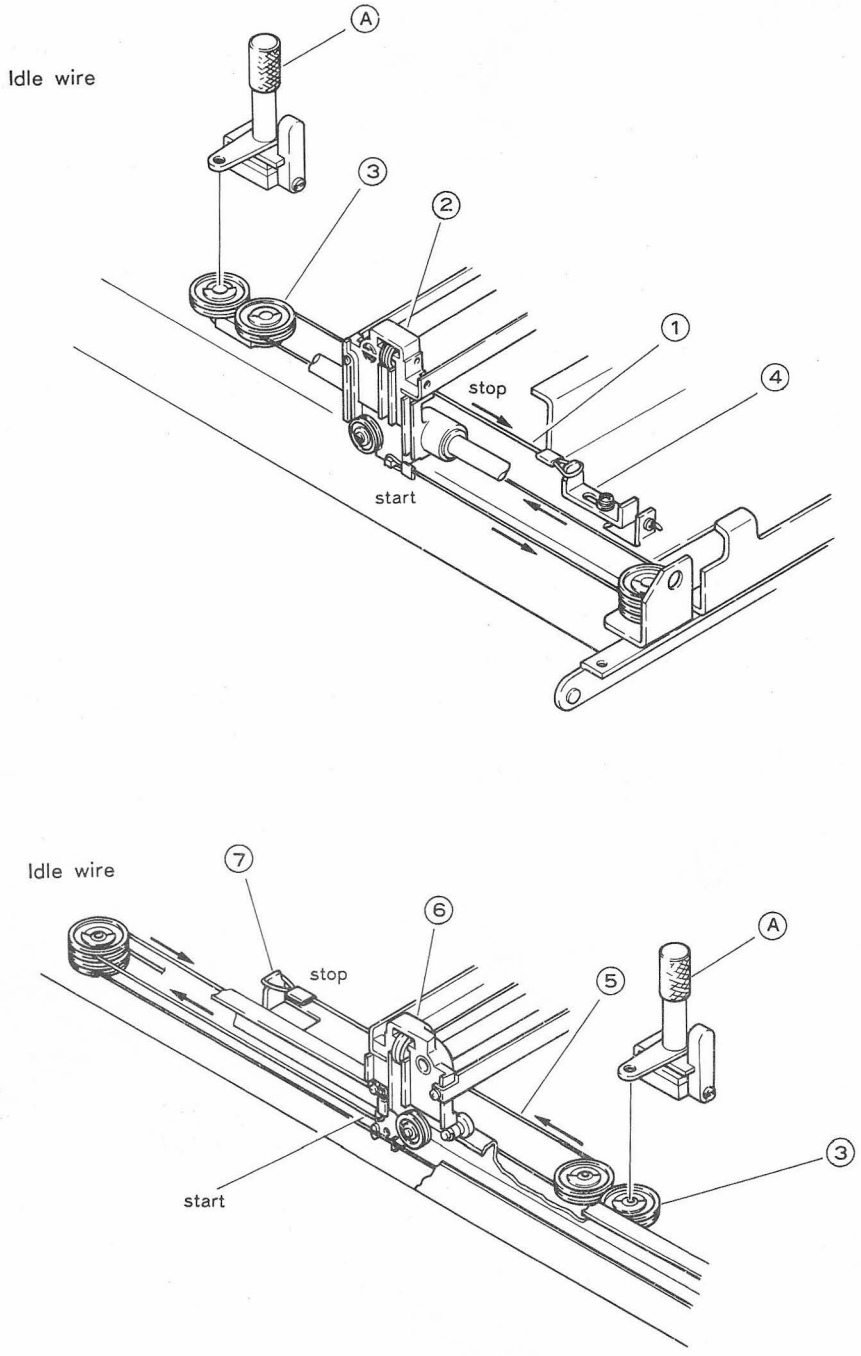


Fig. 10 Idle Wire Stringing

3. Y-Axis Wire Stringing (Figure 11)
   a. Also set the Y wire assy ③ on the wire hook Ⓐ of the carriage frame assy and insert it through the pulleys Ⓑ, Ⓒ, Ⓓ, Ⓔ, and Ⓕ.
   b. Wind the wire on the Y-axis motor pulley assy ④ 5 times.
   c. Set the wire on the wire hook section Ⓜ of the carriage frame assy through the pulleys Ⓗ, Ⓘ, Ⓙ, Ⓚ, and Ⓛ.

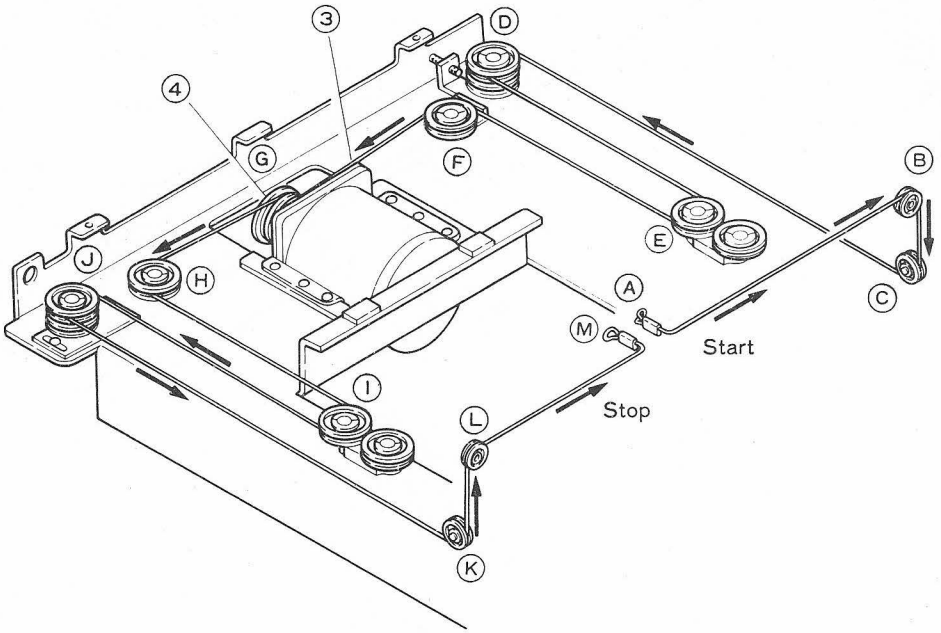


Fig. 11 Y-Axis Wire Stringing

Adjustment (See Figure 12)

1. Push the beam assy towards the left side of the body, then adjust with the wire tension adjust screws (C-1N, C-10) so that the tension becomes 50 ~ 70 g when point ① is pulled 5 mm.
2. Push the beam assy towards the left side of the body, then adjust with the wire tension adjust screws (C-6C, C-6F) so that the tension becomes 70 ~ 90 g when point ② is pulled 5 mm. Similarly adjust the wire tension adjust screws (C-7C, C-7F) so that the tension becomes 70 ~ 90 g when point ③ is pulled 5 mm.

   Caution: When pulling the wire to measure, pull the wire at the center of the body.

Notes:

1. Wind the wire on the X- and Y-axis pulleys 5 times and reassemble so as not to cause a gap.
2. The pulleys should rotate smoothly after being set.

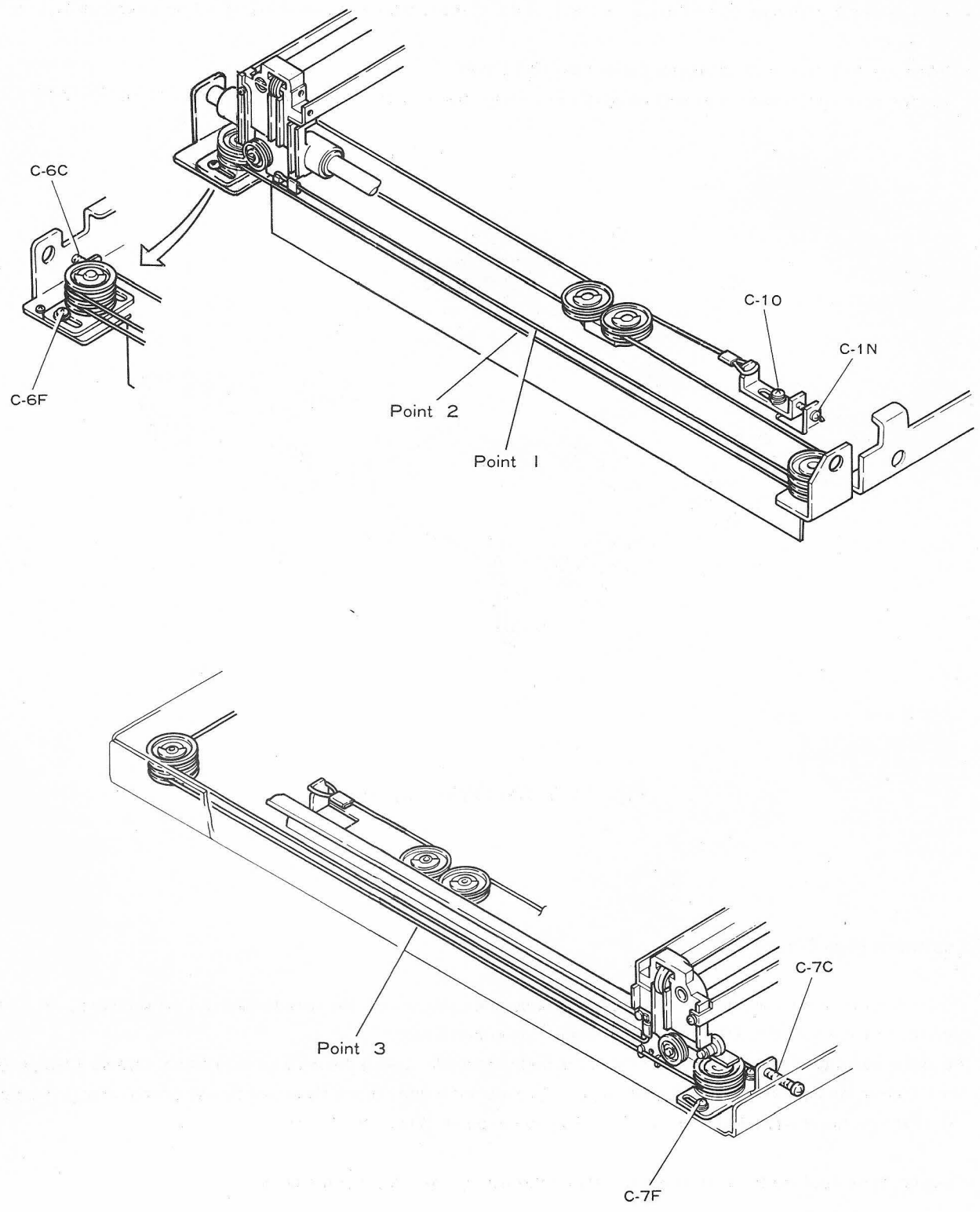


Fig. 12 Wire Tension Adjustment

3.6 Front P.C.B. Assembly

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
IC127	Flip-Flop	SN74LS74A or Equivalent			A61LS74**I
IC128	Quad Nand	SN74LS00 or Equivalent			A61LS00**I
TR116	Transistor	2SD636R			A62T2D636*
D14	Light Emitting Diode	SLP-255B			A83001
D15	Light Emitting Diode	SLP-155B			A83002
D16	Light Emitting Diode	SLP-255B			A83001
D17	Light Emitting Diode	SLP-255B			A83001
C145	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
C146	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
C147	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
C148	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
CN8	Front Panel Connector	IL-G-12p-S3T2-E			A70011
R185	Carbon Resistor	1/4W 150Ω	J		A63C04151J
R186	Carbon Resistor	1/4W 2.2KΩ	J		A63C04222J
R187	Carbon Resistor	1/4W 4.7KΩ	J		A63C04472J
R188	Carbon Resistor	1/4W 150Ω	J		A63C04151J
R189	Carbon Resistor	1/4W 150Ω	J		A63C04151J
R190	Carbon Resistor	1/4W 150Ω	J		A63C04151J
R191	Carbon Resistor	1/4W 150Ω	J		A63C04151J
R192	Carbon Resistor	1/4W 150Ω	J		A63C04151J
R193	Carbon Resistor	1/4W 150Ω	J		A63C04151J
R194	Carbon Resistor	1/4W 150Ω	J		A63C04151J
SW12	Tact Switch	KHE10901			A87002
SW13	Tact Switch	KHE10901			A87002
SW14	Tact Switch	KHE10901			A87002
SW15	Tact Switch	KHE10901			A87002
SW16	Tact Switch	KHE10901			A87002
SW17	Tact Switch	KHE10901			A87002
SW12-1	Key Top C				A27003
SW13-1	Key Top C				A27003
SW14-1	Key Top B				A27002
SW15-1	Key Top B				A27002
SW16-1	Key Top A				A27001
SW17-1	Key Top A				A27001
F-1	Unit Front P.C.B				A60002-01A
F-2	Unit Flat Cable				A750011A

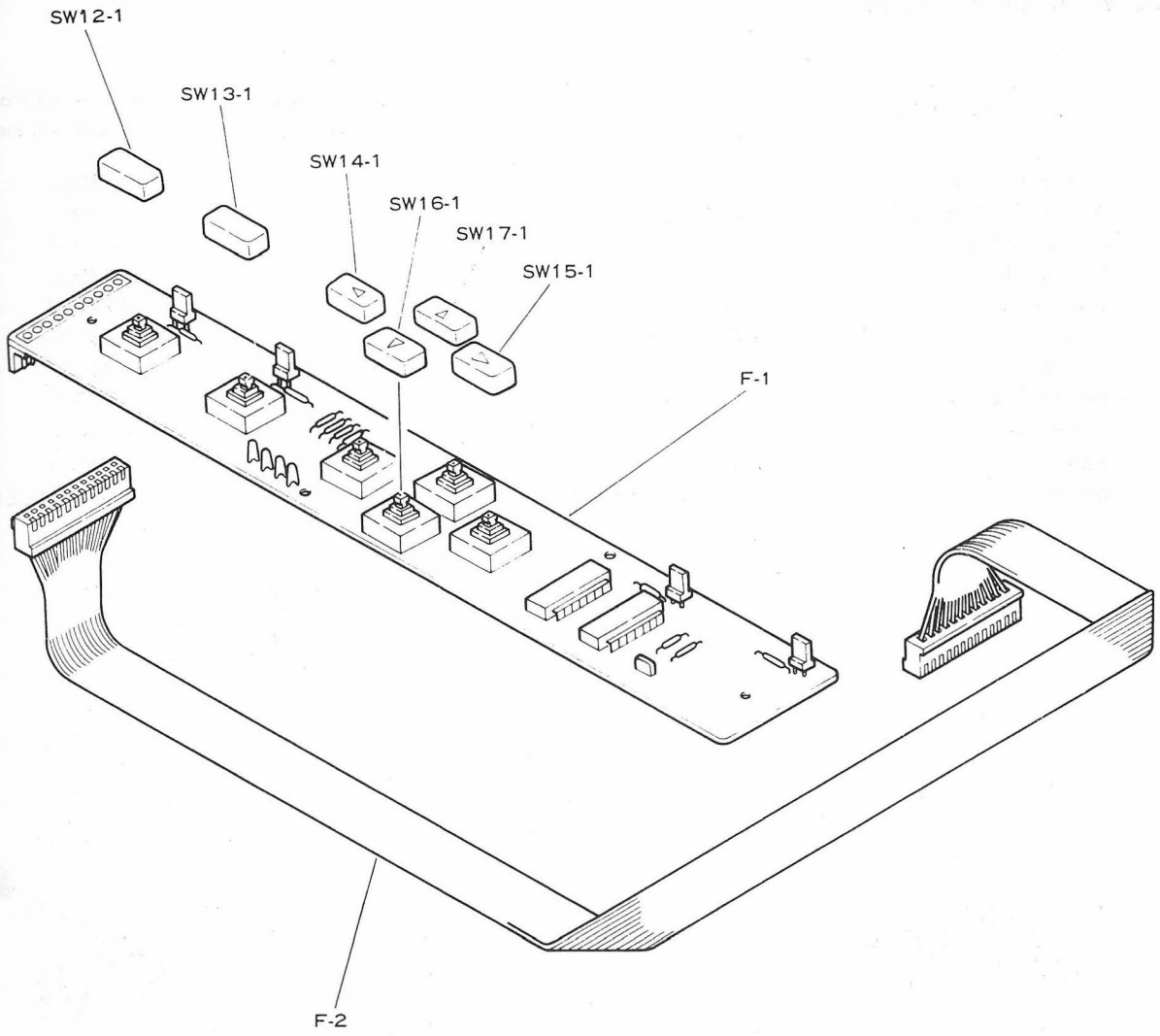


Fig.14 Front P.C.B. Assembly

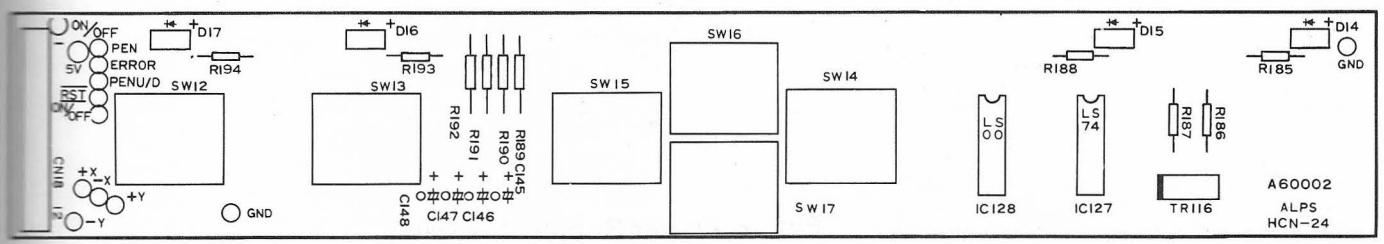


Fig.15 Panel P.C. Board

Removing/Replacing

1. Disconnect both 12-pin connectors of the flat cable unit (F-2) connecting the main PCB unit (H-1) and front PCB unit (F-1), then remove the cable from the clamp mounted on the lower cover.
2. Remove the key top (SW12-1) from the switch in front of the front PCB unit. (The same for SW13-1 through SW17-1)

Note

1. Check for broken wires of the front cable unit after connecting to the connector.

3.7 Power Supply Assembly

Ref. No.	Description		Radio Shack Part Number	Manufacturer Part Number
G-1A	Switch Bracket			A13002
G-1B	A.C Cord with Plug	SVT3×18 AWG		A75005
G-1C	Power Switch	SDJ1S		A87001
G-1D	Cord Bushing	KR-51		A59003
G-1E	Terminal	320553		A72003
G-1F	Fuse	MGC UL2A		A73001
G-1G	Fuse Holder	FH002		A71002
G-1H	Shrink Tube	F2 L=20mm		A76001
G-1I	Power Cable	18AWG(Black) L=65mm		A75008
G-1J	Band Stopper	CV-70		A59004
G-1K	Screw	M3 x L5 + Spring Washer		A30A3005Z1

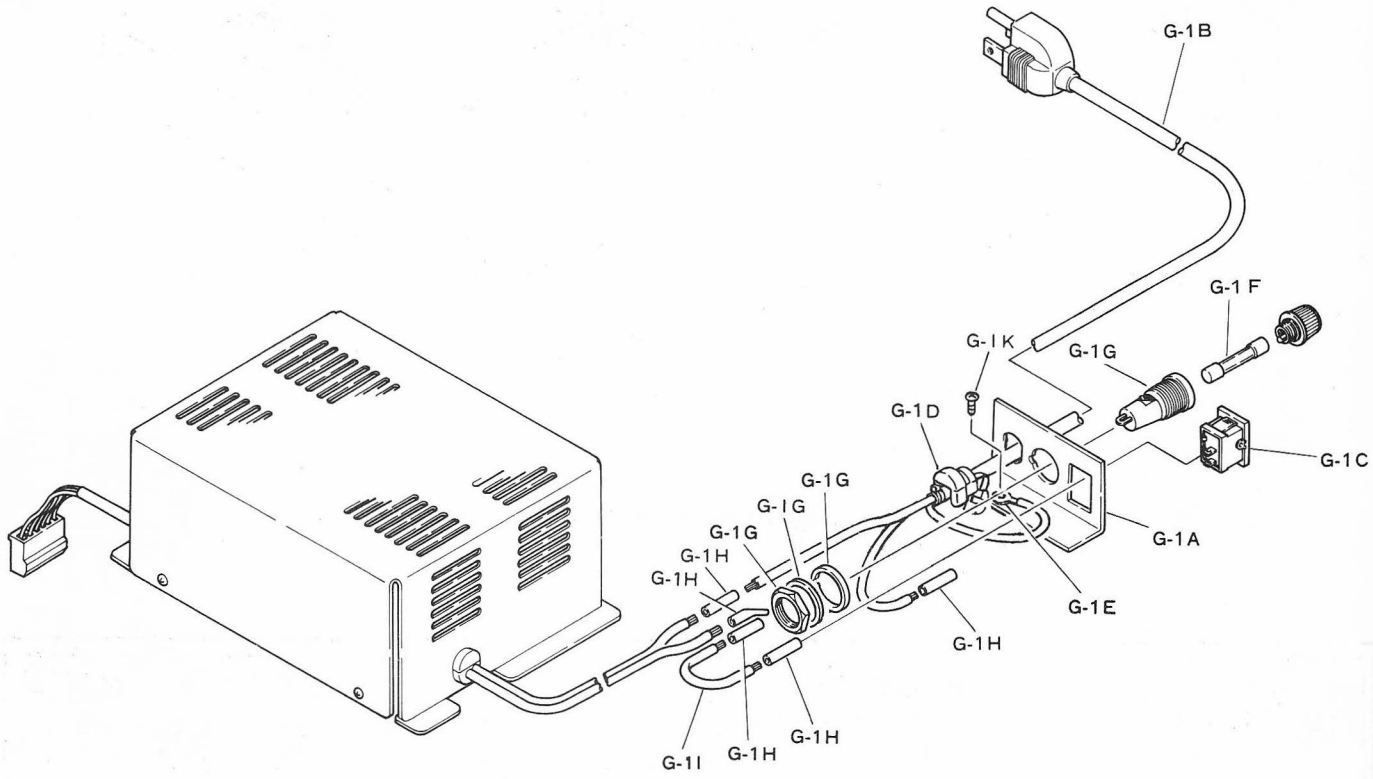


Fig.16 Power Supply Assembly

Removing/Replacing

Tools Required : pliers and soldering iron

1. Remove the parts mounted on the switch bracket (G-1A) and connection from the power supply with a soldering iron.
2. Disconnect the AC cord with plug (G-1B) and remove the power switch (G-1C) and fuse holder (G-1G) from the switch bracket (G-1A).
3. Loosen the fuseholder cover and take out the fuse (G-1F).

3.8 Main P.C.B Assembly

Ref. No.	Description		Radio Shack Part Number	Manufacturer Part Number
IC1	RS-232 Driver	SN75150 or Equivalent		A61XX001I
IC2	Data Selectors	SN74LS157 or Equivalent		A61LS157*I
IC3	Data Selectors	SN74LS157 or Equivalent		A61LS157*I
IC4	Flip-Flops	SN74LS74A or Equivalent		A61LS74**I
IC5	Timer	NE555 or Equivalent		A610P555*I
IC6	Quad And	SN74LS08 or Equivalent		A61LS08**I
IC7	Hex Buffers	SN7407 or Equivalent		A610007**I
IC8	Micro Processor	TMP8039P, 11MHZ		A61CP8039T
IC9	Octal Buffers	SN74LS244 or Equivalent		A61LS244*I
IC10	Dual Single Shot	SN74LS123 or Equivalent		A61LS123*I
IC11	EP Rom (1)	TMM2732D or Equivalent		A001D
IC12	EP Rom (2)	TMM2732D or Equivalent		A002D
IC13	Hex Inverters	SN7404 or Equivalent		A610004**I
IC14	Latches	SN74LS75 or Equivalent		A61LS75**I
IC15	Latches	SN74LS75 or Equivalent		A61LS75**I
IC16	Hex Buffers	SN7407 or Equivalent		A610007**I
IC17	Flip-Flops	SN74LS175 or Equivalent		A61LS175*I
IC18	Flip-Flops	SN74LS175 or Equivalent		A61LS175*I
IC19	Hex Invertors	SN7406 or Equivalent		A610006**I
IC20	Decoder	TC4028BP or Equivalent		A61CM4028T
IC21	Decoder	TC4028BP or Equivalent		A61CM4028T
IC22	Bilateral Switch	TC4066BP or Equivalent		A61CM4066T
IC23	Bilateral Switch	TC4066BP or Equivalent		A61CM4066T
IC24	Operational Amplifier	LM324 or Equivalent		A61OP324*I
IC25	Operational Amplifier	LM348 or Equivalent		A61OP348*T
IC26	Bilateral Switch	TC4066BP or Equivalent		A61CM4066T
TR1	Transistor	2SD636-R		A62T2D636*
TR2	Transistor	2SD636-R		A62T2D636*
TR3	Transistor	2SB937Q		A62T2B937*
TR4	Transistor	2SD1260Q		A62T2D1260
TR5	Transistor	2SB937Q		A62T2B937*
TR6	Transistor	2SD1260Q		A62T2D1260
TR7	Transistor	2SD1275Q		A62T2D1275
TR8	Transistor	2SD1276Q		A62T2D1276
TR9	Transistor	2SD1276Q		A62T2D1276
TR10	Transistor	2SD1276Q		A62T2D1276
TR11	Transistor	2SD1276Q		A62T2D1276
TR12	Transistor	2SD1276Q		A62T2D1276
TR13	Transistor	2SD1276Q		A62T2D1276
TR14	Transistor	2SD1276Q		A62T2D1276
TR15	Transistor	2SD1276Q		A62T2D1276
D1	Diode Silicon	1SS53		A62X001
D2	Diode Silicon	1SS53		A62X001
D3	Diode Silicon	1SS53		A62X001
C1	Ceramic Capacitor	50V 0.01μF		A66C5103KT
C2	Ceramic Capacitor	50V 0.01μF		A66C5103KT
C3	Ceramic Capacitor	50V 0.01μF		A66C5103KT
C4	Ceramic Capacitor	50V 0.01μF		A66C5103KT
C5	Tantalum Electrolytic Capa.	25V 1μF		A65T21R0KN
C6	Ceramic Capacitor	50V 0.01μF		A66C5103KT
C7	Ceramic Capacitor	50V 0.01μF		A66C5103KT
C8	Ceramic Capacitor	50V 0.01μF		A66C5103KT
C9	Ceramic Capacitor	50V 0.01μF		A66C5103KT
C10	Ceramic Capacitor	50V 0.01μF		A66C5103KT

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
C11	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C12	Ceramic Capacitor	50V 0.001μF			A66C5102KT
C13	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C14	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C15	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
C16	Ceramic Capacitor	50V 0.001μF			A66C5102KT
C17	Ceramic Capacitor	50V 0.001μF			A66C5102KT
C18	Ceramic Capacitor	50V 0.001μF			A66C5102KT
C19	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C20	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C21	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
C22	Ceramic Capacitor	50V 0.01μF			A66C5102KT
C23	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
C24	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
C25	Tantalum Electrolytic Cap	25V 1μF			A65T21ROKN
C26	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C27	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C28	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C29	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C30	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C31	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C32	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C33	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C34	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C35	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C36	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C37	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C38	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C39	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C40	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C41	Ceramic Capacitor	50V 0.01μF			A66C5103KT
C42	Electrolytic Capacitor	25V 33μF			A65A2330MA
C43	Electrolytic Capacitor	25V 10μF			A65A2100MA
C44	Electrolytic Capacitor	25V 10μF			A65A2100MA
C45	Electrolytic Capacitor	25V 33μF			A65A2330MA
CSA	Ceramic Ocillator	CSA11.0MT			A67021
CSC	Ceramic Capacitor	CSC300			A67022
VR	Variable Resistor	1/2W 6.8KΩ-B			A64001
RA1	Resistor Array	1/8W 10KΩ	9AJ		A63X001
RA2	Resistor Array	1/8W 10KΩ	9AJ		A63X001
RA3	Resistor Array	1/8W 10KΩ	9AJ		A63X001
R1	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R2	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R3	Carbon Resistor	1/4W 4.7KΩ	J		A63C04472J
R4	Carbon Resistor	1/4W 2.2KΩ	J		A63C04222J
R5	Carbon Resistor	1/4W 560KΩ	J		A63C04564J
R6	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R7	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R8	Carbon Resistor	1/4W 2.2KΩ	J		A63C04222J
R9	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R10	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R11	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R12	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R13	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R14	Carbon Resistor	1/4W 470Ω	J		A63C04471J
R15	Carbon Resistor	1/4W 10KΩ	J		A63C04103J

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
R16	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R17	Carbon Resistor	1/4W 220Ω	J		A63C04221J
R20	Carbon Resistor	1/4W 220Ω	J		A63C04221J
R21	Carbon Resistor	1/4W 220Ω	J		A63C04221J
R22	Carbon Resistor	1/4W 270Ω	J		A63C04271J
R23	Carbon Resistor	1/4W 270Ω	J		A63C04271J
R24	Carbon Resistor	1/4W 510KΩ	J		A63C04514J
R25	Carbon Resistor	1/4W 510KΩ	J		A63C04514J
R26	Carbon Resistor	1/4W 160Ω	J		A63C04161J
R27	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R28	Carbon Resistor	1/4W 11KΩ	J		A63C04113J
R29	Carbon Resistor	1/4W 12KΩ	J		A63C04123J
R30	Carbon Resistor	1/4W 13KΩ	J		A63C04133J
R31	Carbon Resistor	1/4W 15KΩ	J		A63C04153J
R32	Carbon Resistor	1/4W 18KΩ	J		A63C04183J
R33	Carbon Resistor	1/4W 24KΩ	J		A63C04243J
R34	Carbon Resistor	1/4W 39KΩ	J		A63C04393J
R35	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R36	Carbon Resistor	1/4W 11KΩ	J		A63C04113J
R37	Carbon Resistor	1/4W 12KΩ	J		A63C04123J
R38	Carbon Resistor	1/4W 13KΩ	J		A63C04133J
R39	Carbon Resistor	1/4W 15KΩ	J		A63C04153J
R40	Carbon Resistor	1/4W 18KΩ	J		A63C04183J
R41	Carbon Resistor	1/4W 24KΩ	J		A63C04243J
R42	Carbon Resistor	1/4W 39KΩ	J		A63C04393J
R43	Carbon Resistor	1/4W 39KΩ	J		A63C04393J
R44	Carbon Resistor	1/4W 24KΩ	J		A63C04243J
R45	Carbon Resistor	1/4W 18KΩ	J		A63C04183J
R46	Carbon Resistor	1/4W 15KΩ	J		A63C04153J
R47	Carbon Resistor	1/4W 13KΩ	J		A63C04133J
R48	Carbon Resistor	1/4W 12KΩ	J		A63C04123J
R49	Carbon Resistor	1/4W 11KΩ	J		A63C04113J
R50	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R51	Carbon Resistor	1/4W 39KΩ	J		A63C04393J
R52	Carbon Resistor	1/4W 24KΩ	J		A63C04243J
R53	Carbon Resistor	1/4W 18KΩ	J		A63C04183J
R54	Carbon Resistor	1/4W 15KΩ	J		A63C04153J
R55	Carbon Resistor	1/4W 13KΩ	J		A63C04133J
R56	Carbon Resistor	1/4W 12KΩ	J		A63C04123J
R57	Carbon Resistor	1/4W 11KΩ	J		A63C04113J
R58	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R59	Carbon Resistor	1/4W 2.2KΩ	J		A63C04222J
R60	Carbon Resistor	1/4W 2.2KΩ	J		A63C04222J
R61	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R62	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R63	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R64	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
R65	Carbon Resistor	1/4W 2.2KΩ	J		A63C04222J
R66	Carbon Resistor	1/4W 2.2KΩ	J		A63C04222J
R67	Carbon Resistor	1/4W 6.2KΩ	J		A63C04622J
R68	Carbon Resistor	1/4W 9.1KΩ	J		A63C04912J
R69	Carbon Resistor	1/4W 6.2KΩ	J		A63C04622J
R70	Carbon Resistor	1/4W 9.1KΩ	J		A63C04912J
R71	Carbon Resistor	1/4W 9.1KΩ	J		A63C04912J

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
R72	Carbon Resistor	1/4W 6.2KΩ	J		A63C04622J
R73	Carbon Resistor	1/4W 9.1KΩ	J		A63C04912J
R74	Carbon Resistor	1/4W 6.2KΩ	J		A63C04622J
R75	Carbon Resistor	1/4W 10KΩ	J		A63C04703J
R76	Carbon Resistor	1/4W 22KΩ	J		A63C04223J
R77	Carbon Resistor	1/4W 22KΩ	J		A63C04223J
R78	Carbon Resistor	1/4W 22KΩ	J		A63C04223J
R79	Carbon Resistor	1/4W 22KΩ	J		A63C04223J
R80	Carbon Resistor	1/4W 10KΩ	J		A63C04103J
SW1	Dip Switch 4-Circuit	DYS-4			A87003
CN1	Serial Interface Connector	TCS4440-01-1011			A70002
CN2	Reed Switch, Pen Coil Connector	IL-G-5P-S3T2-E			A70006
CN3	Front Panel Connector	IL-G-12P-S3T2-E			A70011
CN4	Parallel Interface Connector	ADS-36BLFDR1			A70001
CN5	#X Motor Connector	IL-G-6P-S3T2-E			A70007
CN6	#Y Motor Connector	IL-G-7P-S3T2-E			A70008
CN7	Power Source Connector	5277-06A			A70009
IC11-1	IC Sockets 24 Pin	DILB24P-8J			A71004
IC12-1	IC Sockets 24 Pin	DILB24P-8J			A71004
H-1	Main P.C.B Unit				A60001A
H-1A	Screw	M3 x L6 + Spring Washer			A30A3006Z1
H-1B	Screw	M3 x L6			A30A30006Z0
H-1C	TR Set Plate				A14017
H-2	Main P.C.B Fix Plate A				A14018
H-3	Main P.C.B Fix Plate B				A14020
H-4	Screw	M2.5×L8			A30A2508Z0

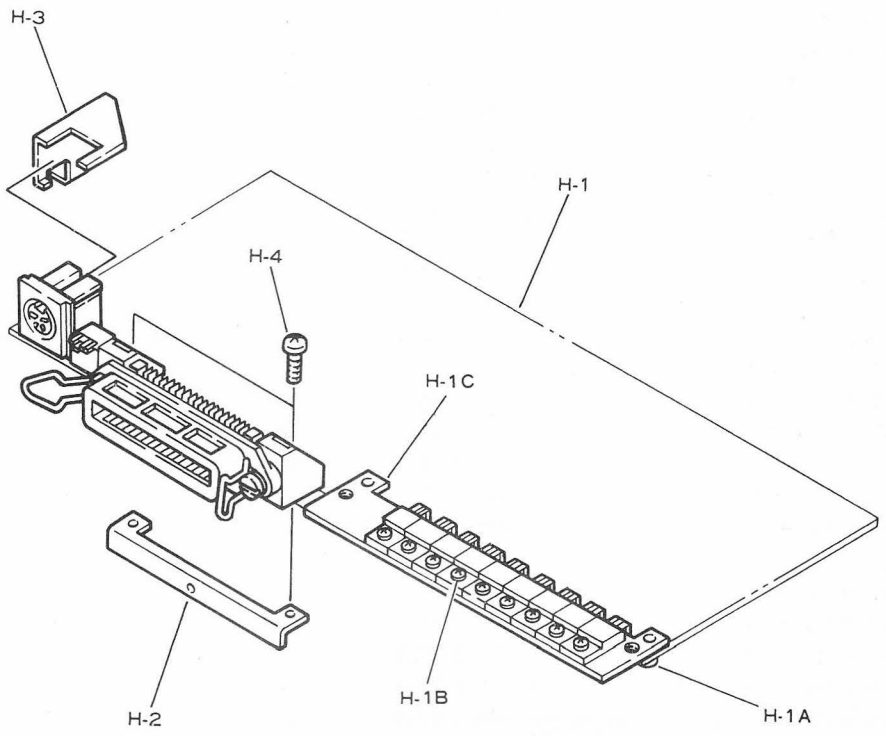
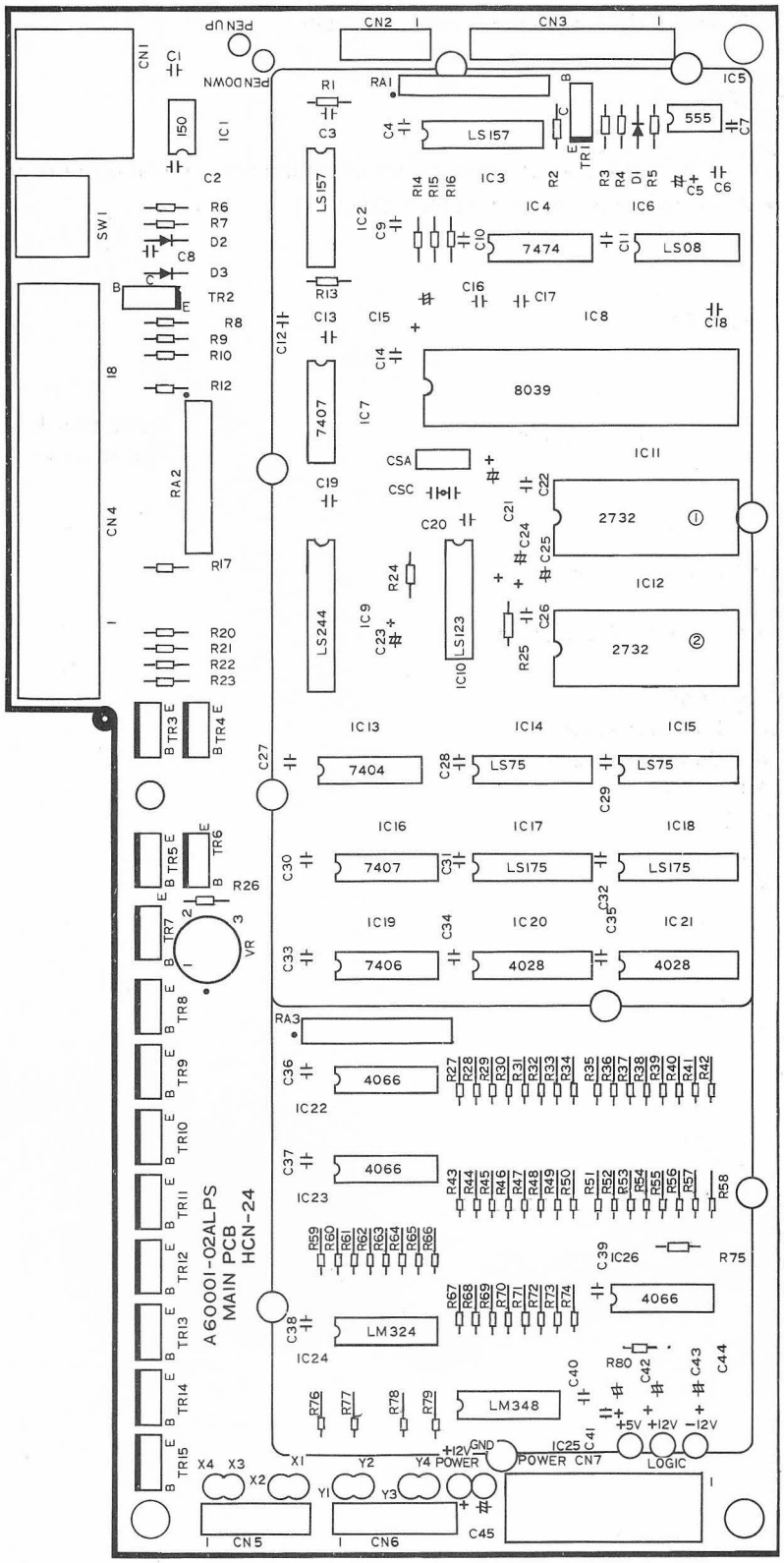


Fig.17 Main P.C.B. Assembly


A60001-02ALPS
MAIN PCB
HCN-24
CN1
CN2
CN3
CN4
CN5
CN6
CN7
PEN UP
PEN DOWN
SW1
IC1
150
LS157
555
7474
LS08
8039
7407
LS244
LS123
2732
7404
LS75
LS175
4028
4066
LM324
LM348
VR
TR1
TR2
TR3
TR4
TR5
TR6
TR7
TR8
TR9
TR10
TR11
TR12
TR13
TR14
TR15
D1
D2
D3
RA1
RA2
RA3
X1
X2
X3
X4
Y1
Y2
Y3
Y4
+12V
GND
+5V
-12V
POWER
LOGIC

Removing/Replacing

Tools Required: phillips screw driver

1. Remove the screw (H-4) and main PCB fix plate A (H-2).
2. Remove the main PCB fix plate B (H-3) from the connector section.

Adjustment (Precautions)

1. Turn the VR of the main P.C.B., the degree of contact pressure of the pen when it is in the down position can be adjusted. (The degree of contact pressure is set at 23 ~ 30 g)

3.9 Lower Cover Assembly

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
I-1	Unit, Lower Cover		A10005A
I-2	Heat Sink A		A25001
I-3	Screw M3 × L6 + Spring Washer		A30A3006Z1
I-4	Rubber Foot		A45003
I-5	Screw M3 × L12 + Flat Washer (Large)		A30A3012Z3
I-6	FCC Label		A28003
I-7	Wire Cramp A K-104G		A59001
I-8	Screw M3 × L8 + Spring Washer		A30A3008Z1
I-9	Screw M3 × L6 + Spring Washer		A30A3006Z1
I-10	Screw M3 × L12		A30A3012Z0
I-11	Plate (Main P.C.B Set)		A14019
I-12	Screw M2.5 × L5		A30A2505Z0
I-13	Screw M3 × L4		A30A3004Z0
I-14	Fastener		A59002
I-15	UL Mark Label		A28005
I-16	Caution Label		A28007
I-17	Wire Cramp B K-105G		A59008
I-18	Data Code Lavel		A28020
I-19	Nut M3		A31S30Z1

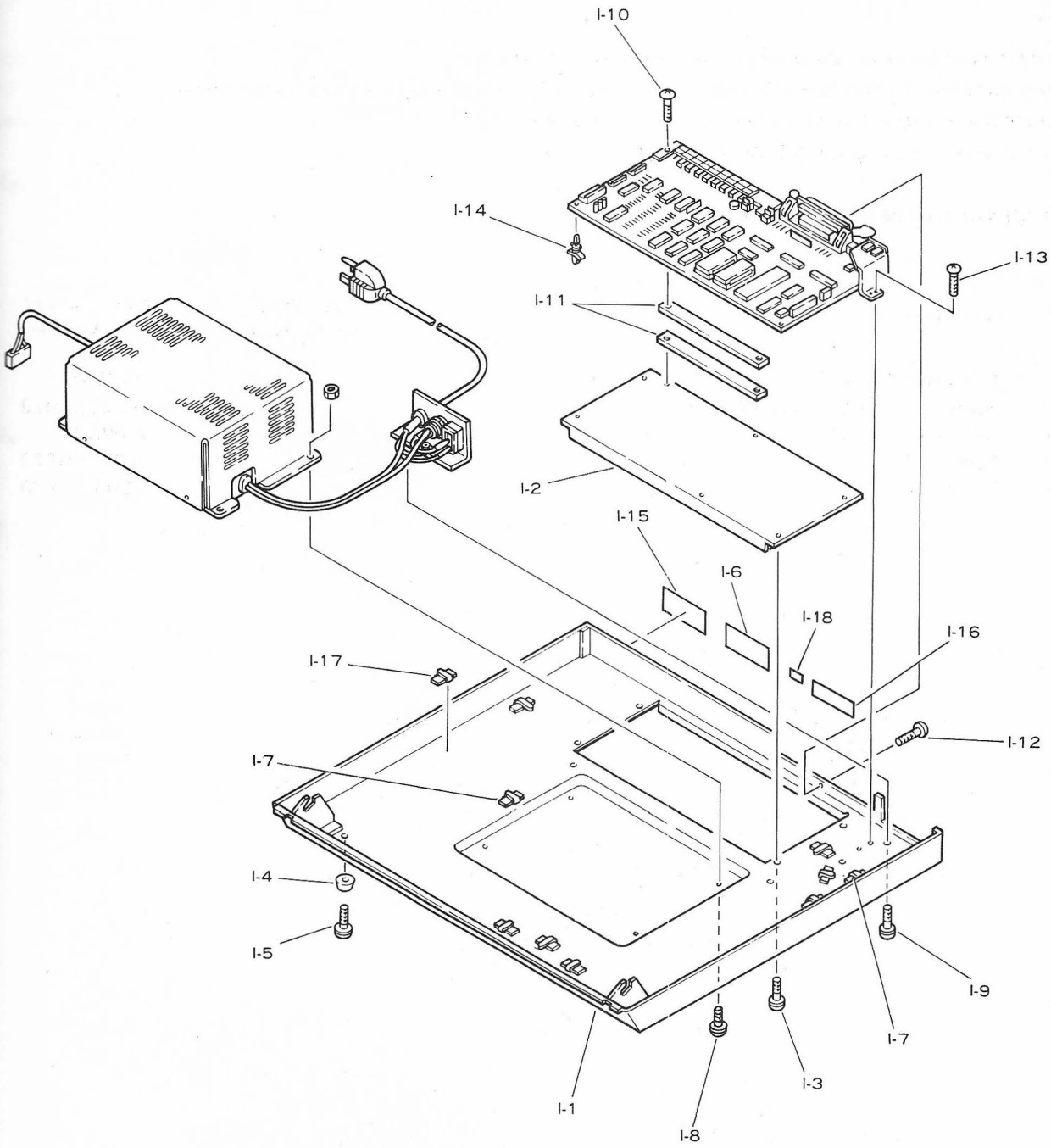


Fig.18 Lower Cover Assembly

Removing/Replacing

Tools Required: Phillips screw driver

1. Unscrew the 4 screws (I-8) and 2 screws (I-9) to remove the power supply assy.
2. Unscrew the 2 screws (I-10), 2 screws (I-13), and screw (I-12), disconnect the fastener (I-14) hook, then remove the main PCB assy.
3. Remove the 2 plates (I-11).
4. Remove the 2 fasteners (I-14) from the lower cover unit (I-1).
5. Unscrew the 4 screws (I-3) and remove the heatsink (I-2).
6. Unscrew the 4 screws (I-5) and remove the rubber foot (I-4).
7. Remove the11wire clamps (I-7) (I-17) after peeling off the adhesive.

Note:

1. Apply silicone grease on the plate (I-11) except to side of the plate.
2. When attaching the heat sink (I-2), make sure the side with the plate set hole is turned to the rear.
3. Tighten the screw so that the rubber foot will not move around.
4. The tightening torque of the M3 screw is set at 7-9 kg/cm.

3.10 Lower Cover Parts Assembly

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
J-1	X-Axis F.P.C Guide		A13001
J-2	Screw M2.5 × L4 + Flat Washer		A30A2504Z3
J-3	Set Plate (X-Axis F.P.C)		A14021
J-4	Screw M2 × L10		A30A2010Z0
J-5	Screw M3 × L4		A30A3004Z0

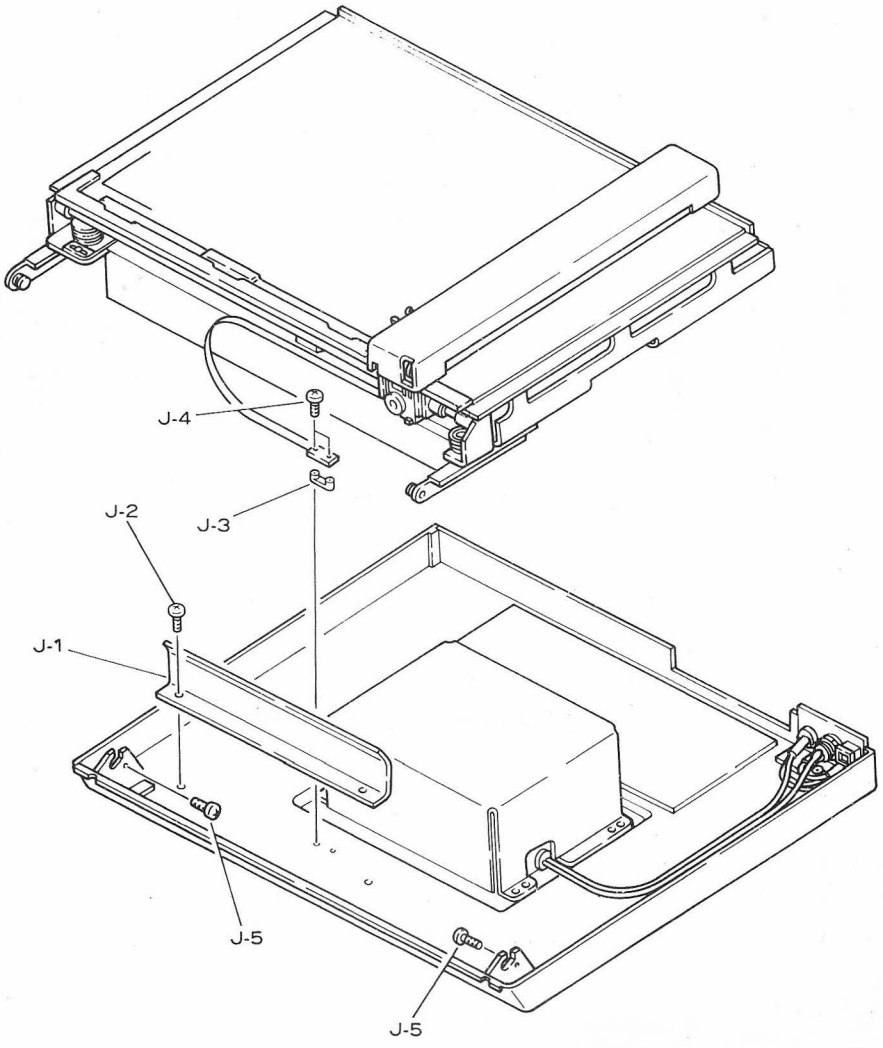


Fig.19 Lower Cover Parts Assembly

Function

This is composed of the parts that are attached to the lower cover. The F.P.C. Guide (J-1) is the guide which prevents the F.P.C. from popping out to the front side. The set-plate (J-3) fixes the F.P.C. The base frameand lower cover are fastened with the screw (J-5) and it is possible to open them.

Removing/Replacing

Tool Required: Phillips screwdriver

1. Open the base frame assy and lower cover assy.
2. Unfasten the screw (J-4) at two positions and remove the harness and set-plate.
3. Unfasten the screw (J-2) at two positions and remove the X-axis F.P.C Guide (J-2).
4. Unfasten the screw (J-5) at two positions and remove the lower cover assy from the base frame assy.

Note: Move the beam to the right and left after assemblying to confirm that the F.P.C does not pop out of the guide shaft.

3.11 Upper Cover Unit

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
K-1	Upper Cover A		A10002
K-2	Number Label		A28001
K-3	Upper Cover B		A10003
K-4	RS Logo		A28002
K-5	Screw M3 × L8(FT)		A30003
K-6	Plate (Front)		A13010
K-7	Screw M3 × L5		A30B3005Z0
K-8	Nut M3		A31S30Z1
K-9	Fuse Label		A28006
K-10	Plate Guide		A14036
K-11	Screw M3 × L6(FT)		A30005

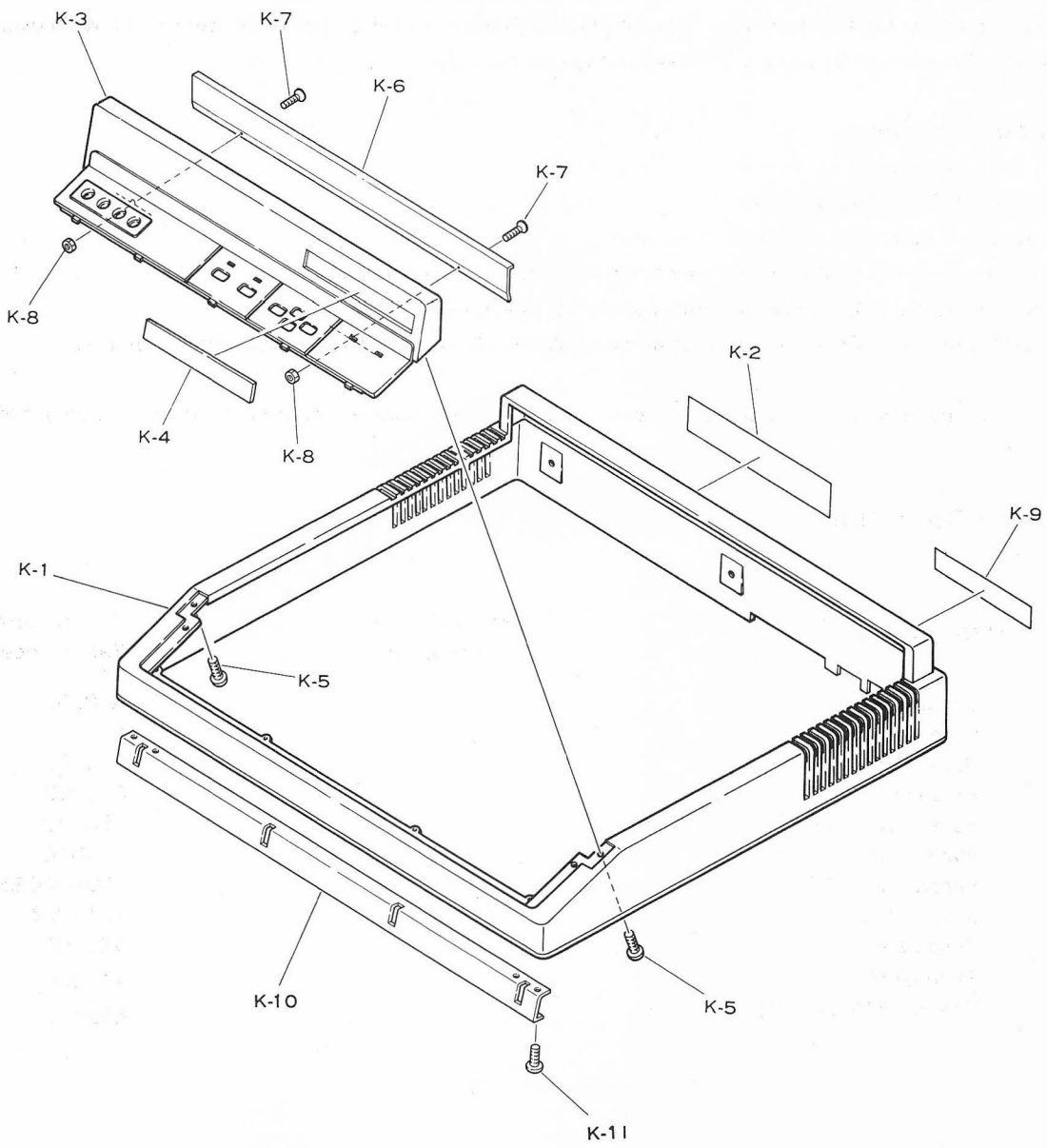


Fig.20 Upper Cover Unit

Function

This is the exterior part that is attached to the front face of the body.

Removing/Replacing

Tools Required: Phillips screwdriver

1. Unfasten the screw (K-5) at two positions and remove the uppr cover B (K-3) from the upper cover A (K-1).
2. Unscrew the screw (K-7) at two positions and remove from the nut (K-8). Then remove the plate (K-6) from the upper cover B.
3. Remove the number label (K-2) from the upper cover A(K-1) and remove the RS Logo (K-4) from the upper cover B (K-3).

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
L-1	Screw M3 × L6		A30A3006Z0
L-2	Rozet Screw M3 × L6		A30004
L-3	Rozet Washer		A32R30C
L-4	Screw M3 × L6(FT)		A30005
L-5	Screw M4 × L6		A30A4006Z0
L-6	Steel Plate		A14026

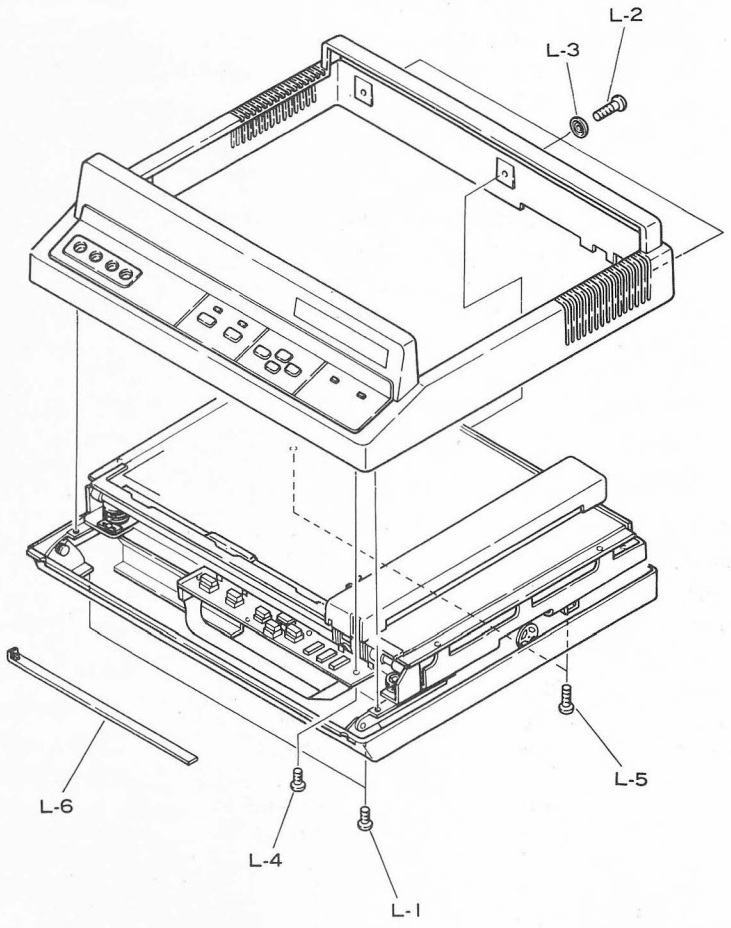


Fig.21 Upper Cover Parts Assembly

Function

This is the part to attach the upper cover unit to the main body.

Removing/Replacing

Tool Required: Phillips screwdriver

1. Unscrew the screw (L-5) at two positions to make it possible to open and close.
2. Unscrew the rozet screw (L-2) and rozet washer (L-3) at three positions.
3. Unscrew the screw (L-1) at two positions and remove the upper cover unit. When removing the upper cover unit, try not to press the front P.C.B.
4. Unscrew the screw (L-4) at four positions and remove the front P.C.B. from the upper cover assy.

3.13 Power Supply Unit

Ref. No.	Description				Radio Shack Part Number	Manufacturer Part Number
N	**Power Supply Unit**					A80001
N-1	Printed Circuit Board (Main) Assembly					A60008A
IC1	Switch Regurator	MB3759				A61XX0002F
IC2	Voltage Regulator	μPC78M12 or Equivalent				A61XX0003N
IC3	Voltage Regulator	LM79L12 or Equivalent				A61XX0004S
IC4	Voltage Regulator	μPC7805H or Equivalent				A61XX0005N
Q1	Transistor	2SA1010L				A62T2A1010
Q2	Transistor	2SA684P				A62T2A684*
Q3	Transistor	2SC945P				A62T2C945*
Q4	Transistor	2SA733P				A62T2A733*
Q5	Transistor	2SA733P				A62T2A733*
Q6	Transistor	2SC945P				A62T2C945*
D1	Diode	S10VB10	400V	10A		A62X002
D2	Diode	S12KC20	200V	12A		A62X003
D3	Diode	S3VC10	100V	2.5A		A62X004
D4	Diode	S1VB10	100V	0.6A		A62X005
C4	Electrolytic Capacitor	50V	4700μF			A65A5472MX
C5	Film Capacitor	100V	4700pF			A66F7472KX
C6	Film Capacitor	100V	0.01μF			A66F7103KX
C7	Film Capacitor	100V	0.01μF			A66F7103KX
C8	Film Capacitor	100V	3300pF			A66F7332KX
C9	Electrolytic Capacitor	25V	1000μF			A65A2102MC
C10	Electrolytic Capacitor	25V	1000μF			A65A2102MC
C11	Electrolytic Capacitor	25V	1000μF			A65A2102MC
C12	Electrolytic Capacitor	25V	220μF			A65A2221MX
C13	Electrolytic Capacitor	16V	3300μF			A65A1322MX
C14	Electrolytic Capacitor	25V	47μF			A65A2470MX
C15	Electrolytic Capacitor	25V	47μF			A65A2470MX
C16	Electrolytic Capacitor	10V	100μF			A65A1101MX
C18	Film Capacitor	100V	3300pF			A66F7332KX
C19	Film Capacitor	100V	0.01μF			A66F7103KX
RV1	Variable Resistor	1KΩ	B			A64002
RV2	Variable Resistor	1KΩ	B			A64002
R1	Carbon Resistor	1/4W	270Ω			A63C04271J
R2	Carbon Resistor	1/4W	1KΩ			A63C04102J
R3	Metal- Oxide Resistor	1W	6.2KΩ			A63M10622J
R4	Carbon Resistor	1/4W	13KΩ			A63C04133J
R5	Carbon Resistor	1/4W	1KΩ			A63C04102J
R6	Carbon Resistor	1/4W	100KΩ			A63C04124J
R7	Carbon Resistor	1/4W	15KΩ			A63C04153J
R8	Carbon Resistor	1/4W	1KΩ			A63C04102J
R9	Carbon Resistor	1/4W	470Ω			A63C04471J
R10	Carbon Resistor	1/4W	20KΩ			A63C04203J
R11	Carbon Resistor	1/4W	1.5KΩ			A63C04152J
R12	Carbon Resistor	1/4W	20KΩ			A63C04203J
R13	Manganium Wire(φ1.6)					A63X003
R14	Carbon Resistor	1/4W	2.4KΩ			A63C04242J
R15	Carbon Resistor	1/4W	1.5KΩ			A63C04152J
R16	Metal- Oxide Resistor	3W	200Ω			A63M30201J

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
R17	Carbon Resistor	1/4W	10KΩ		A63C04103J
R18	Carbon Resistor	1/4W	10KΩ		A63C04103J
R19	Carbon Resistor	1/4W	10KΩ		A63C04103J
R20	Carbon Resistor	1/4W	33KΩ		A63C04333J
R21	Carbon Resistor	1/4W	10KΩ		A63C04103J
R22	Carbon Resistor	1/4W	10KΩ		A63C04103J
R23	Carbon Resistor	1/4W	10KΩ		A63C04103J
R24	Carbon Resistor	1/4W	1KΩ		A63C04102J
L3	Inductor	4A	300μH		A68003
J1	Jumper Wire (A)				A75015
J2	Jumper Wire (B)				A75015
N-2	Printed Circuit Board (Noise Filter)Assembly				A60009A
C1	Ceramic Capacitor	AC125V	2200pF		A66C001
C2	Ceramic Capacitor	AC125V	2200pF		A66C001
C3	Metallized Capacitor	AC125V	0.1μF		A66X002
C17	Metallized Capacitor	AC125V	0.1μF		A66X002
L-1	Inductor	2A	130μH		A68001
L-2	Inductor	2A	125μH		A68002
L-4	Inductor	2A	1mH		A68004
N-3	Chassis	3-301-056-03			A10006
N-4	Cover	3-201-026-03			A10007
N-5	Heat Sink	3-401-086-03			A25002
N-6	Cord Strain Relief Bushing		5N4		A59005
N-7	Cord Strain Relief Bushing		4N4		A59006
N-8	4-Core Cord	2464	VW-1		A75012
N-9	AC Cord SPT-2	VW-1	2×18AWG		A75013
N-10	Terminal		2-3		A72004
N-11	Ground Wire 1007	18AWG	VW-1		A75014
N-12	Phillips Pan Head Screw		M3 × L6		A30A3006Z0
N-13	Phillips Pan Head Screw		M3 × L12		A30A3012Z2
N-14	Flat Screw		M3 × L10		A30B3010Z0
N-15	Flat Screw		M3 × L8		A30B3008Z0
N-16	Flat Screw		M4 × L12		A30B4012Z0
N-17	Nut		M4		A31S40Z1
N-18	Washer		φ3		A32H30Z
N-19	Spring Washer		φ3		A32S30Z
N-20	Washer		φ4		A32M40Z
N-21	Spring Washer		φ4		A32S40Z
N-22	Nut		M3		A31S30Z1
N-23	Heat Sink (B)				A25003
N-24	Transistor Bracket (A)				A13015
N-25	Transistor Bracket (B)				A13016
N-26	Shrinking Tube (A)		φ15 × L23		A76002
N-27	Shrinking Tube (B)		φ18 × L30		A76003
N-28	Heat Sink Seat (A)		TC-30AG		A25004
N-29	Heat Sink Seat (B)		TC-30AG		A25005
N-30	Tube D-3.3		φ3.3 × L110		A76004
N-31	Tube D-5.2		φ5.2 × L80		A76005
N-32	Tube D-5.2		φ5.2 × L110		A76005
N-33	Binder		T18R		A59007
N-34	Connector		5196-06		A70012
T(N-35)	Transformer				A80002

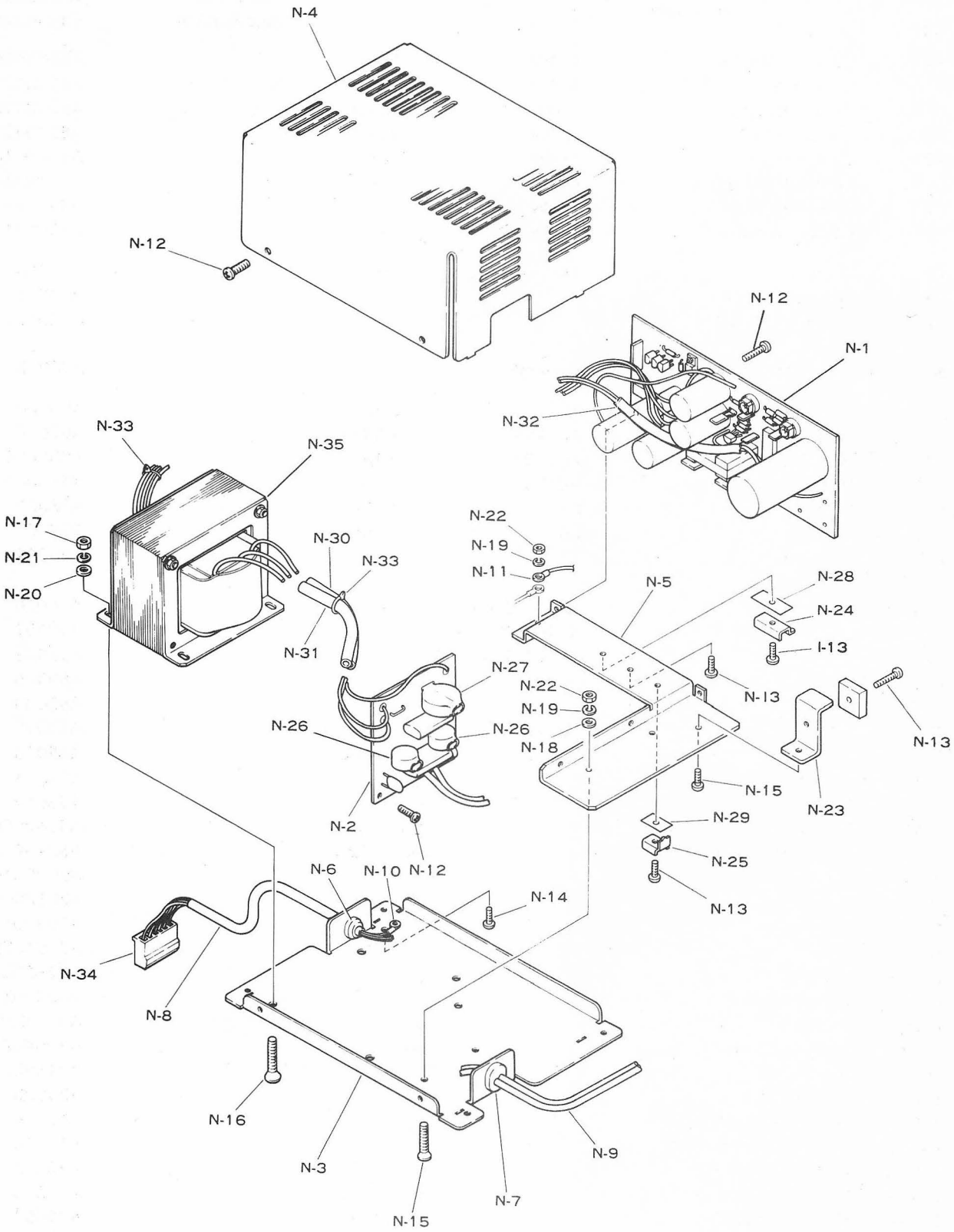


Fig.22 Power Supply Unit

4. MAINTENANCE

Care should be exercised for the following matters in the installation and use of the plotter:

- The plotter should be placed and operated in a horizontal position.
  Using an inclined position may impair the plotter performance.
- Keep the plotter away from direct sunlight or direct heat or cold. For example, direct sunlight on the top cover may heat the plotter above the maximum operating temperature of +40°C.
- Keep the plotter away from dust and moisture.
  Dust or moisture may damage the plotter mechanism which will degrade the plotter performance.
- Do not block the ventilation opening on the cover. Blocking the ventilation opening will cause the plotter temperature to rise which leads to mid-operation plotter failure.
- Never use the plotter in environments that contain much iron dust or debris since the recording panel uses a magnet sheet. Because of the magnetic field of the magnetic sheet, programs may be erased if a magnetic tape cassette or floppy diskette is put on the recording panel.
- Do not attempt to use a power supply other than the one specified.

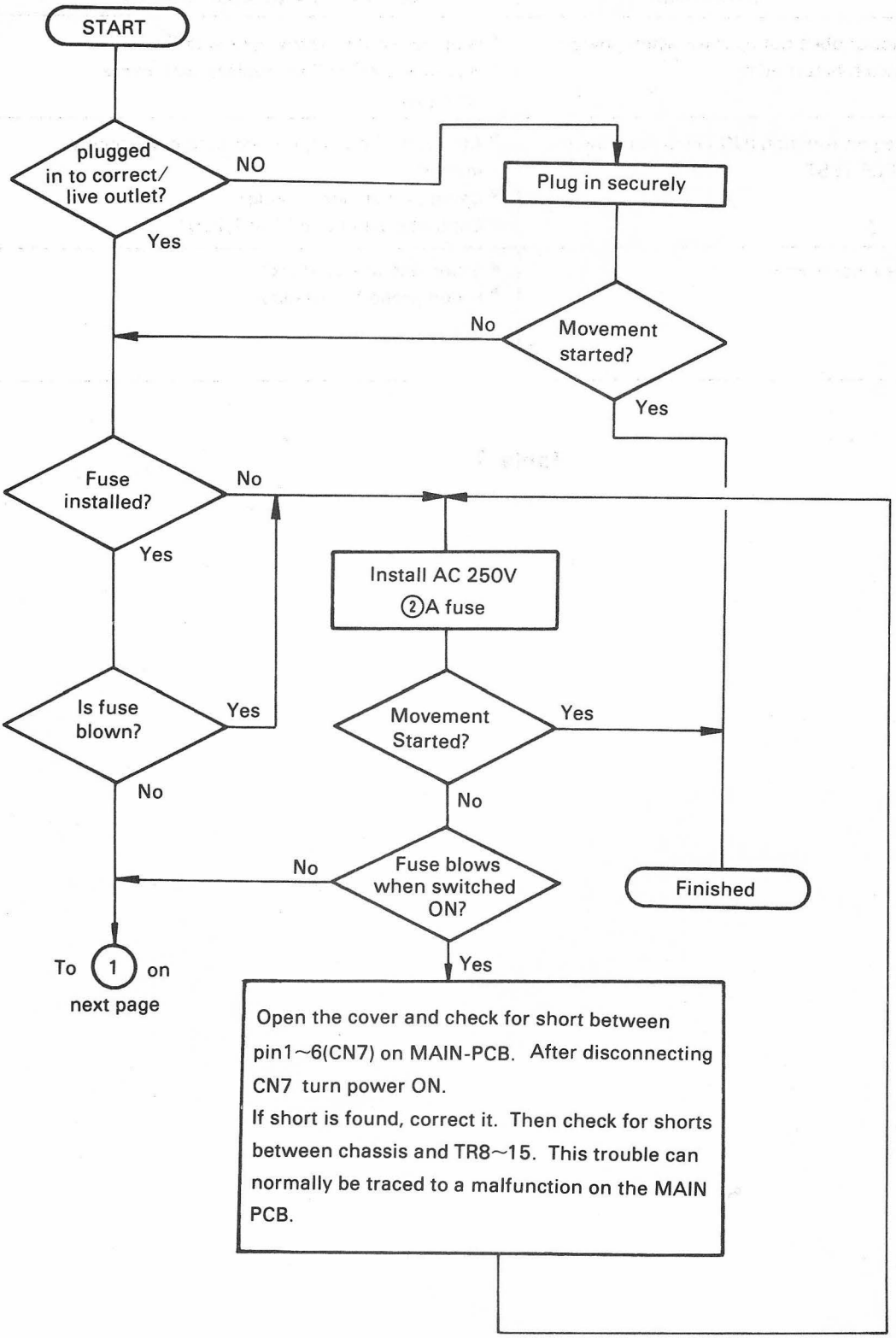
- Do not touch by hand or put any heavy materials on the recording panel.
  This will deform the plotter structure or cause mis-alignment between the recording pen and panel which will make the plotter unworkable.
- A location with mechanical vibration or electrical noise should be avoided.
- When the plotter is not in use, cover with a vinyl sheet or cloth to protect from dirt and dust.
  Paper placed on the plotter is effective to prevent dust and dirt. If the plotter becomes dusty, wipe off carefully with a clean soft cloth. (If necessary, alcohol or water can be used but never use thinner.)
- When the XY plotter is not being used, remove and cap the pen, and place in storage.

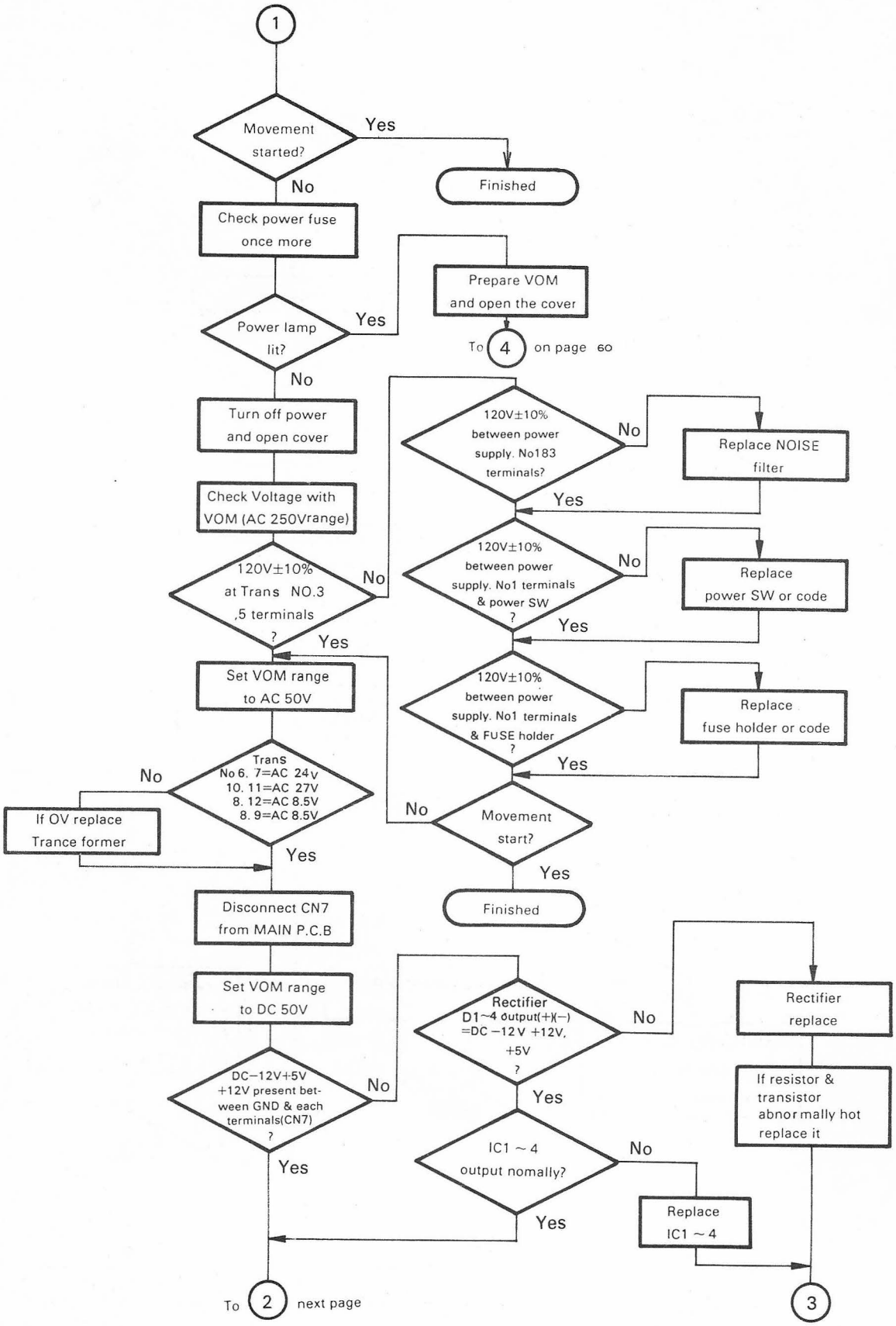
5. TROUBLESHOOTING

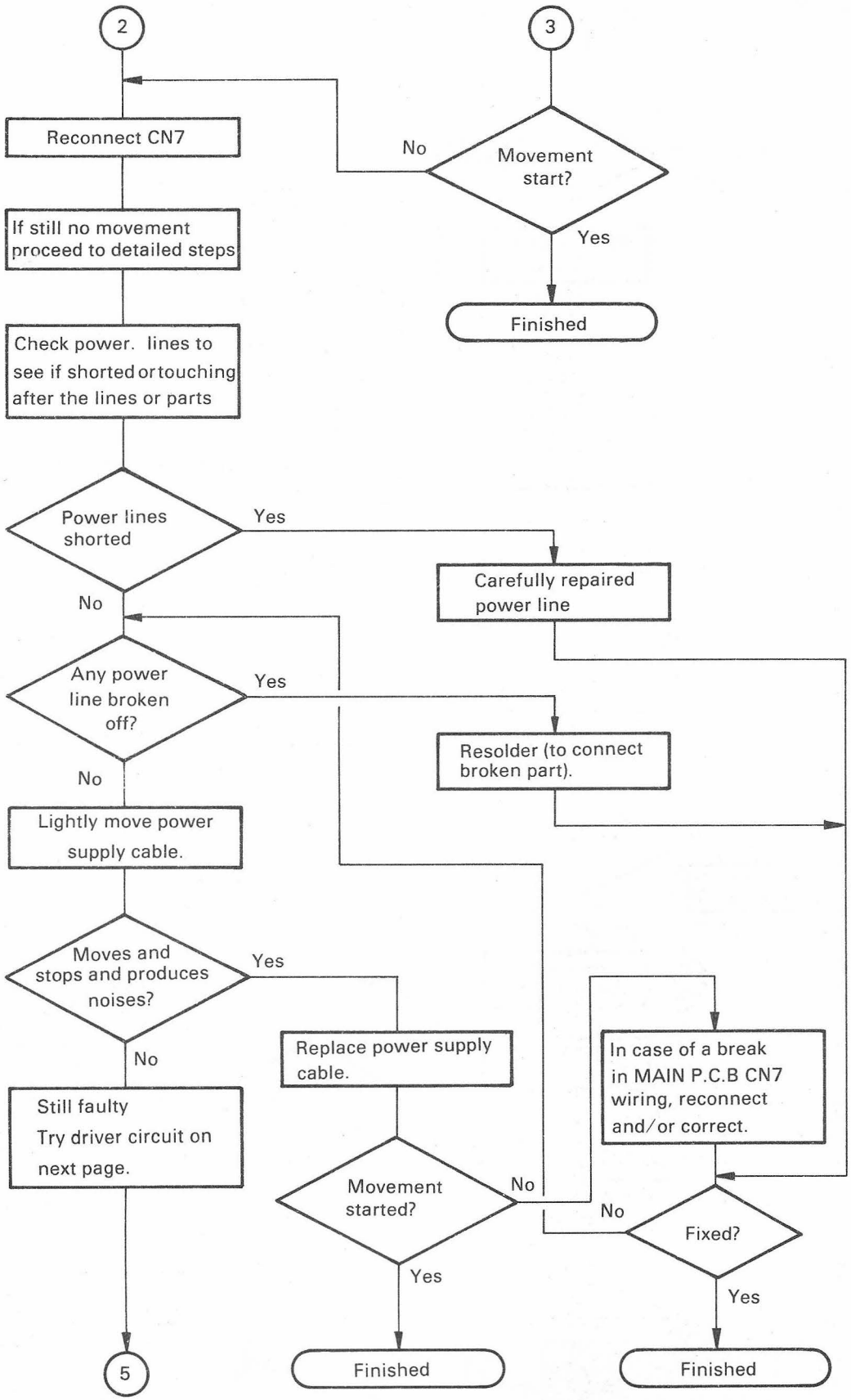
SYMPTOM	INSPECTION AND ADJUSTMENT
Plotter does not operate when power switch is turned on.	• Is power cord properly connected? • Has fuse blown? If so, replace with same rating type.
No plot function (ON LINE) but runs in SELF-TEST.	• Are plotter-to-computer connectors properly mated? • Using proper signal cable? Computer baud at 600 or 1,200?
Pen won't write.	• Is pen bad or out of ink? • Is pen properly installed?

Table 1

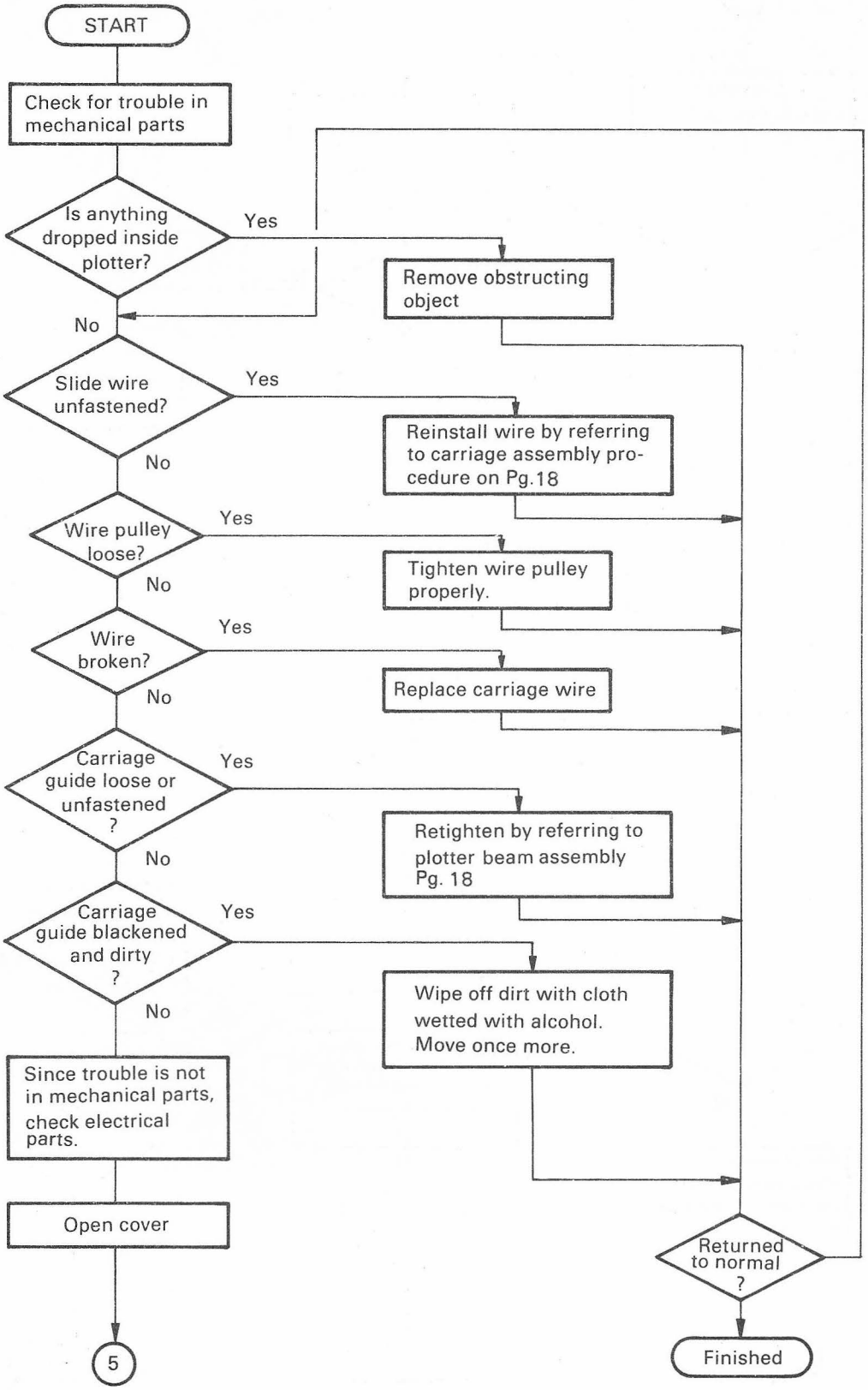
No Movement at All

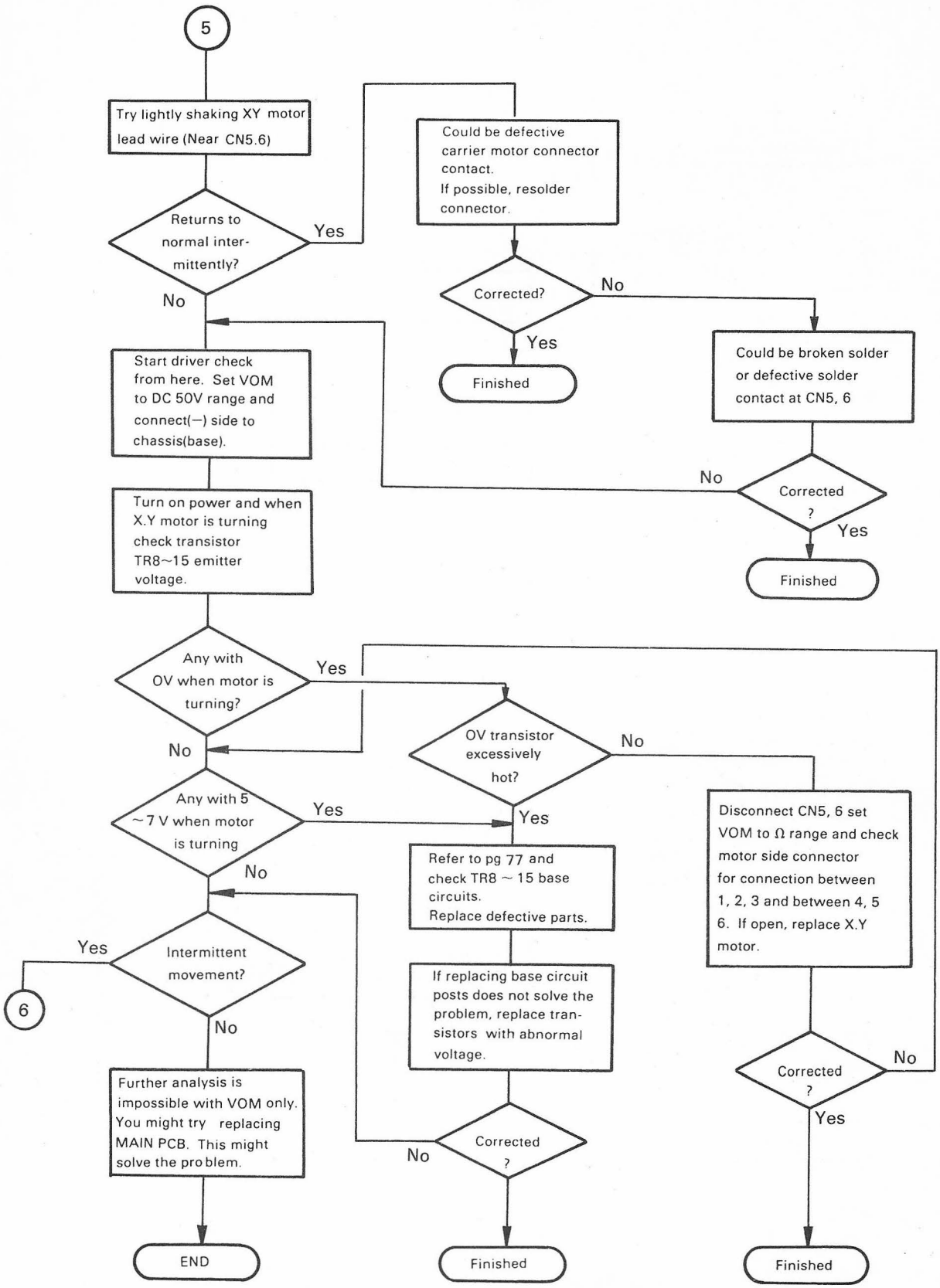


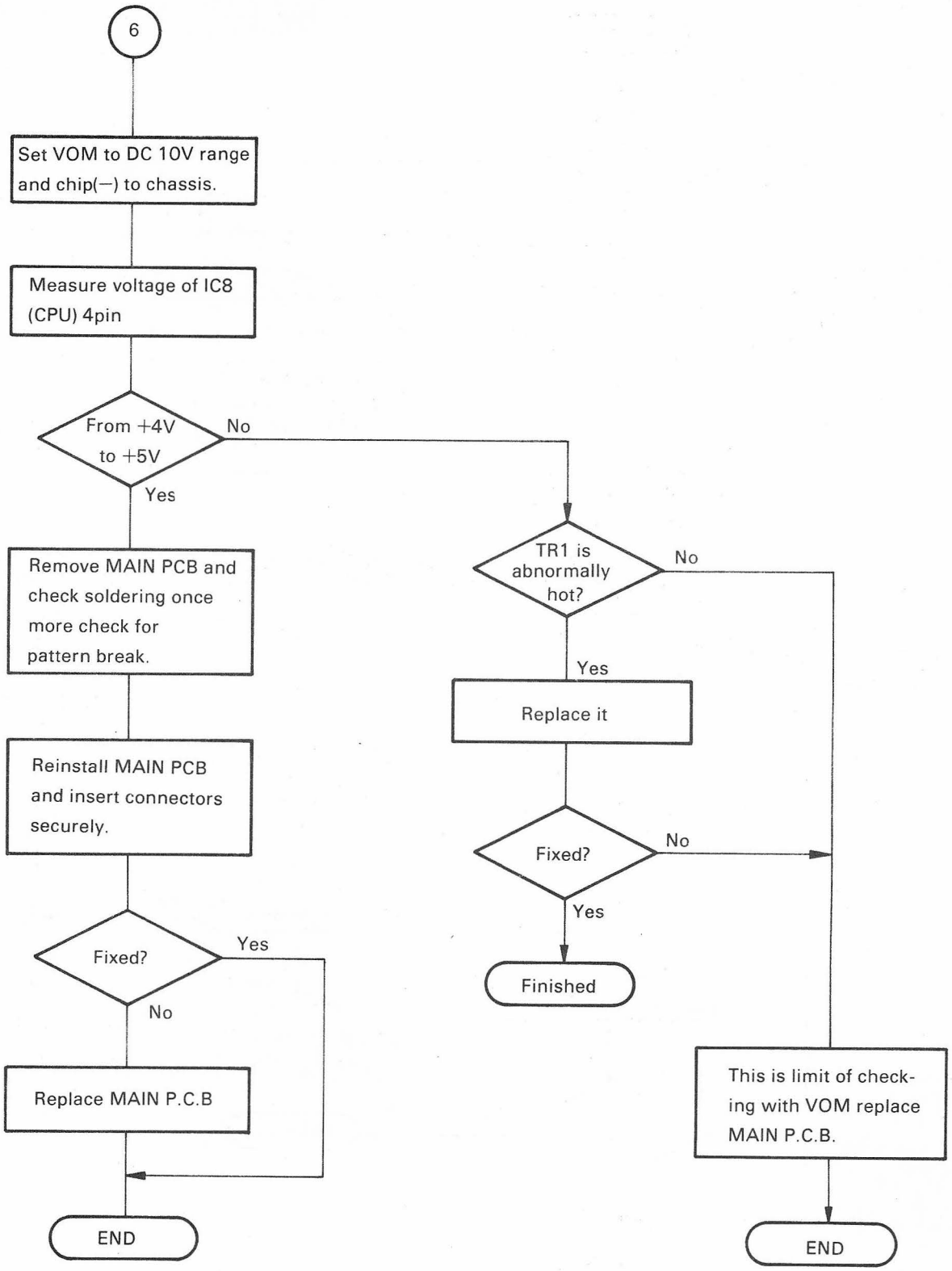

1
Movement started?
Yes
Finished
No
Check power fuse once more
Power lamp lit?
Yes
Prepare VOM and open the cover
To 4 on page 60
No
Turn off power and open cover
Check Voltage with VOM (AC 250Vrange)
120V±10% at Trans NO.3 ,5 terminals ?
No
Yes
Set VOM range to AC 50V
Trans No 6. 7=AC 24V 10. 11=AC 27V 8. 12=AC 8.5V 8. 9=AC 8.5V
No
If OV replace Trance former
Yes
Disconnect CN7 from MAIN P.C.B
Set VOM range to DC 50V
DC−12V+5V +12V present between GND & each terminals(CN7) ?
No
Yes
To 2 next page
120V±10% between power supply. No183 terminals?
No
Replace NOISE filter
Yes
120V±10% between power supply. No1 terminals & power SW ?
No
Replace power SW or code
Yes
120V±10% between power supply. No1 terminals & FUSE holder ?
Replace fuse holder or code
Yes
No
Movement start?
Yes
Finished
Rectifier D1~4 output(+)(−) =DC −12V +12V, +5V ?
No
Rectifier replace
Yes
IC1 ~ 4 output nomally?
No
Replace IC1 ~ 4
Yes
If resistor & transistor abnormally hot replace it
3


2
3
Reconnect CN7
No
Movement start?
Yes
If still no movement proceed to detailed steps
Finished
Check power. lines to see if shorted or touching after the lines or parts
Power lines shorted
Yes
Carefully repaired power line
No
Any power line broken off?
Yes
Resolder (to connect broken part).
No
Lightly move power supply cable.
Moves and stops and produces noises?
Yes
Replace power supply cable.
In case of a break in MAIN P.C.B CN7 wiring, reconnect and/or correct.
No
Still faulty
Try driver circuit on next page.
Movement started?
No
Fixed?
No
Yes
Yes
5
Finished
Finished

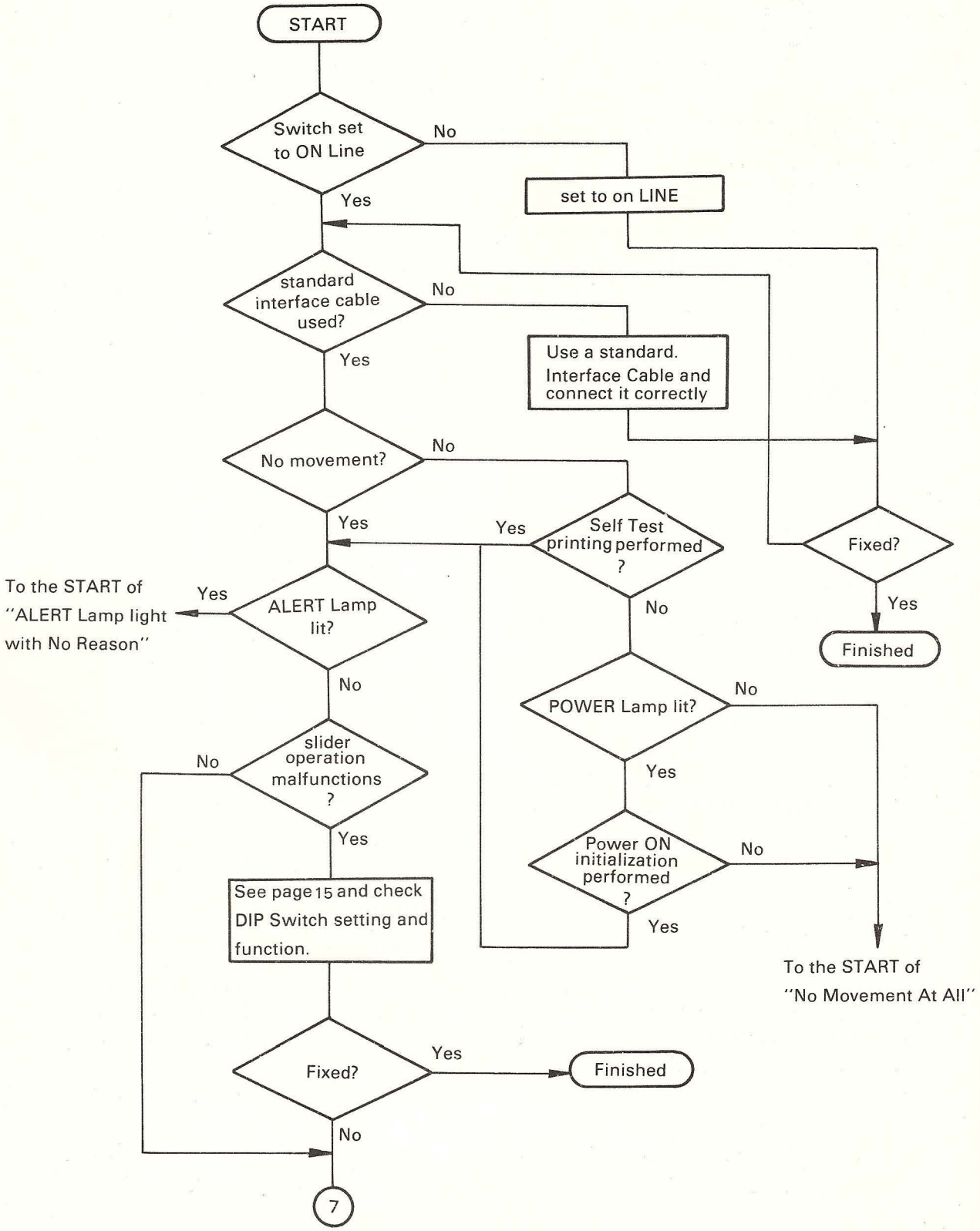
Noise When Power is Switched ON

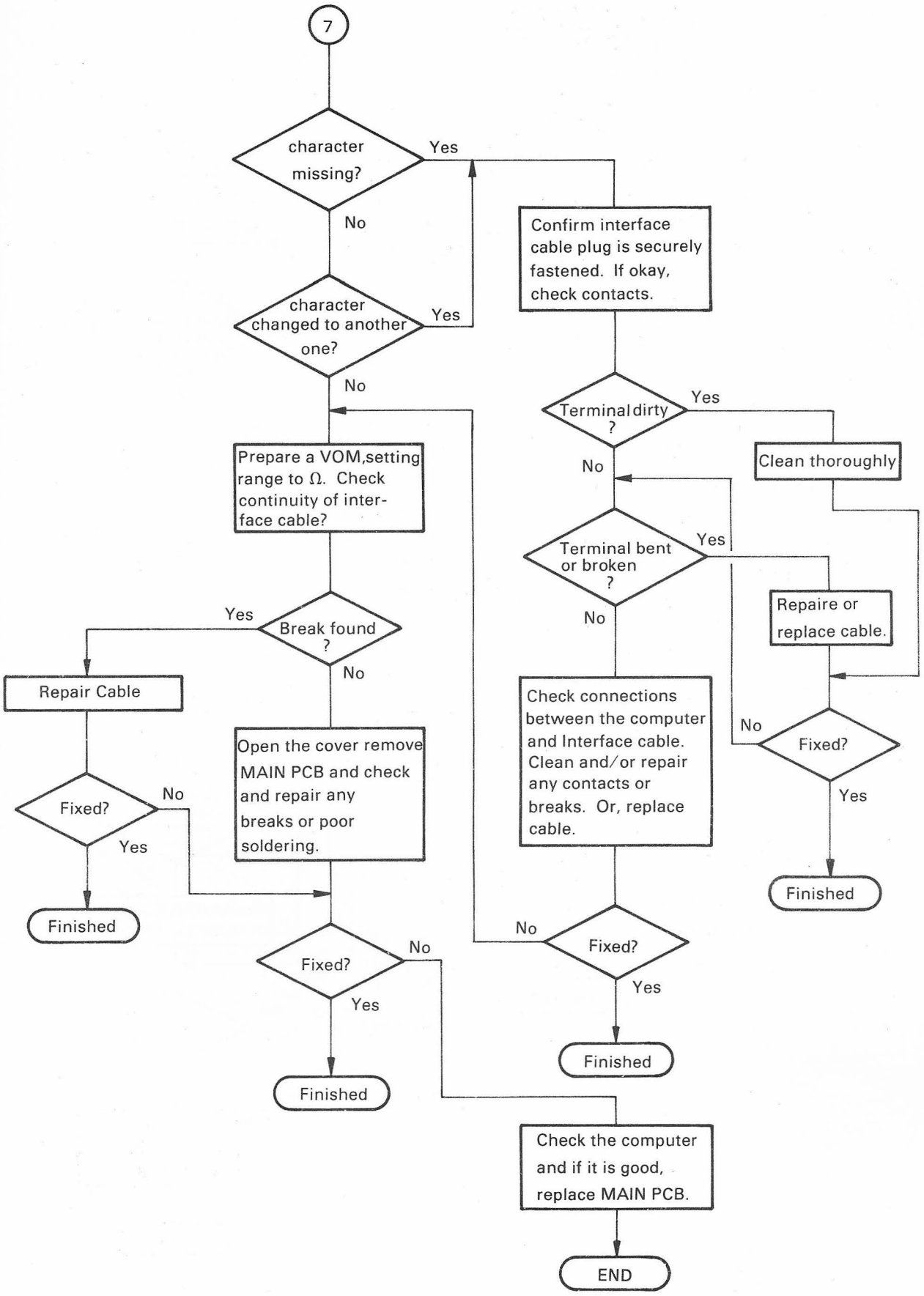



5
Try lightly shaking XY motor lead wire (Near CN5.6)
Returns to normal inter-mittently?
Yes
Could be defective carrier motor connector contact.
If possible, resolder connector.
Corrected?
No
Yes
Finished
No
Could be broken solder or defective solder contact at CN5, 6
Corrected ?
No
Yes
Finished
Start driver check from here. Set VOM to DC 50V range and connect(−) side to chassis(base).
Turn on power and when X.Y motor is turning check transistor TR8~15 emitter voltage.
Any with OV when motor is turning?
Yes
No
OV transistor excessively hot?
No
Yes
Disconnect CN5, 6 set VOM to Ω range and check motor side connector for connection between 1, 2, 3 and between 4, 5 6. If open, replace X.Y motor.
Any with 5 ~7 V when motor is turning
Yes
No
Yes
Refer to pg 77 and check TR8 ~ 15 base circuits.
Replace defective parts.
If replacing base circuit posts does not solve the problem, replace transistors with abnormal voltage.
Corrected ?
No
Yes
Finished
Corrected ?
No
Yes
Finished
Yes
Intermittent movement?
6
No
Further analysis is impossible with VOM only. You might try replacing MAIN PCB. This might solve the problem.
END

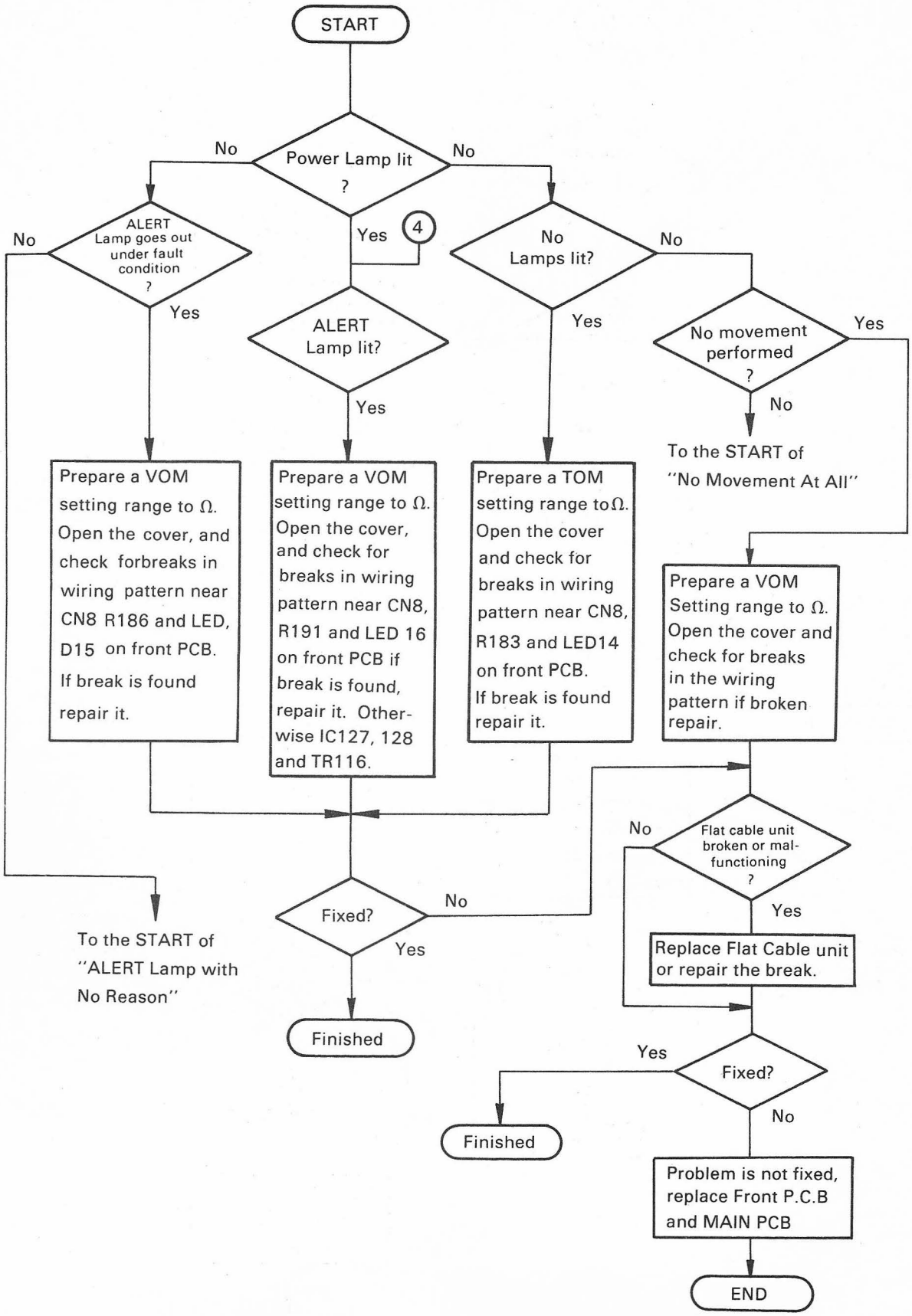

6
Set VOM to DC 10V range and chip(−) to chassis.
Measure voltage of IC8 (CPU) 4pin
From +4V to +5V
No
Yes
Remove MAIN PCB and check soldering once more check for pattern break.
Reinstall MAIN PCB and insert connectors securely.
Fixed?
Yes
No
Replace MAIN P.C.B
END
TR1 is abnormally hot?
No
Yes
Replace it
Fixed?
No
Yes
Finished
This is limit of checking with VOM replace MAIN P.C.B.
END

ON LINE Plotting is Bad

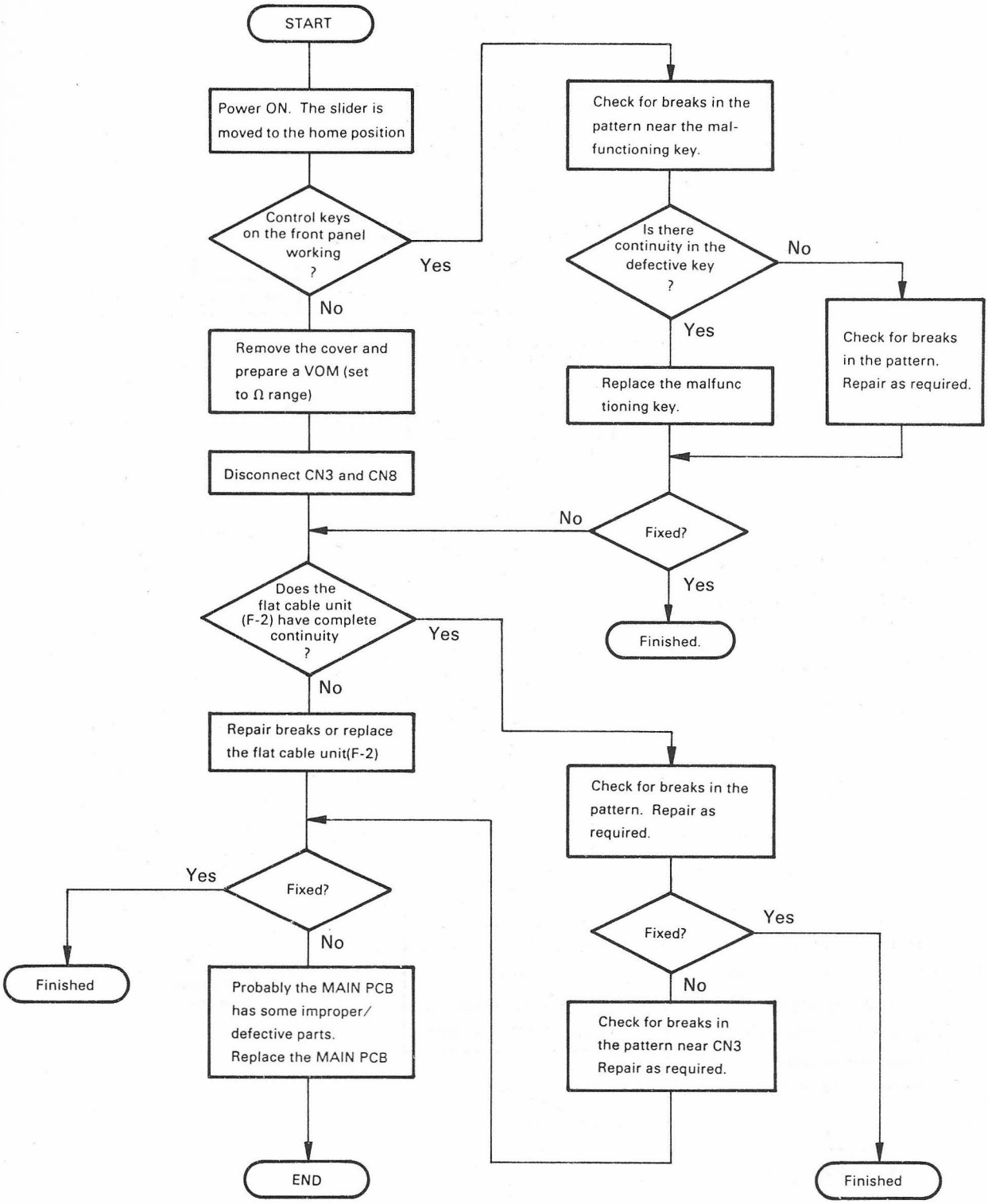



7
character missing?
Yes
No
character changed to another one?
Yes
No
Prepare a VOM,setting range to Ω. Check continuity of interface cable?
Yes
Break found ?
No
Repair Cable
Fixed?
No
Yes
Finished
Open the cover remove MAIN PCB and check and repair any breaks or poor soldering.
Fixed?
No
Yes
Finished
Confirm interface cable plug is securely fastened. If okay, check contacts.
Terminal dirty ?
Yes
No
Clean thoroughly
Terminal bent or broken ?
Yes
No
Repaire or replace cable.
Check connections between the computer and Interface cable. Clean and/or repair any contacts or breaks. Or, replace cable.
No
Fixed?
Yes
Finished
Fixed?
No
Yes
Finished
Check the computer and if it is good, replace MAIN PCB.
END

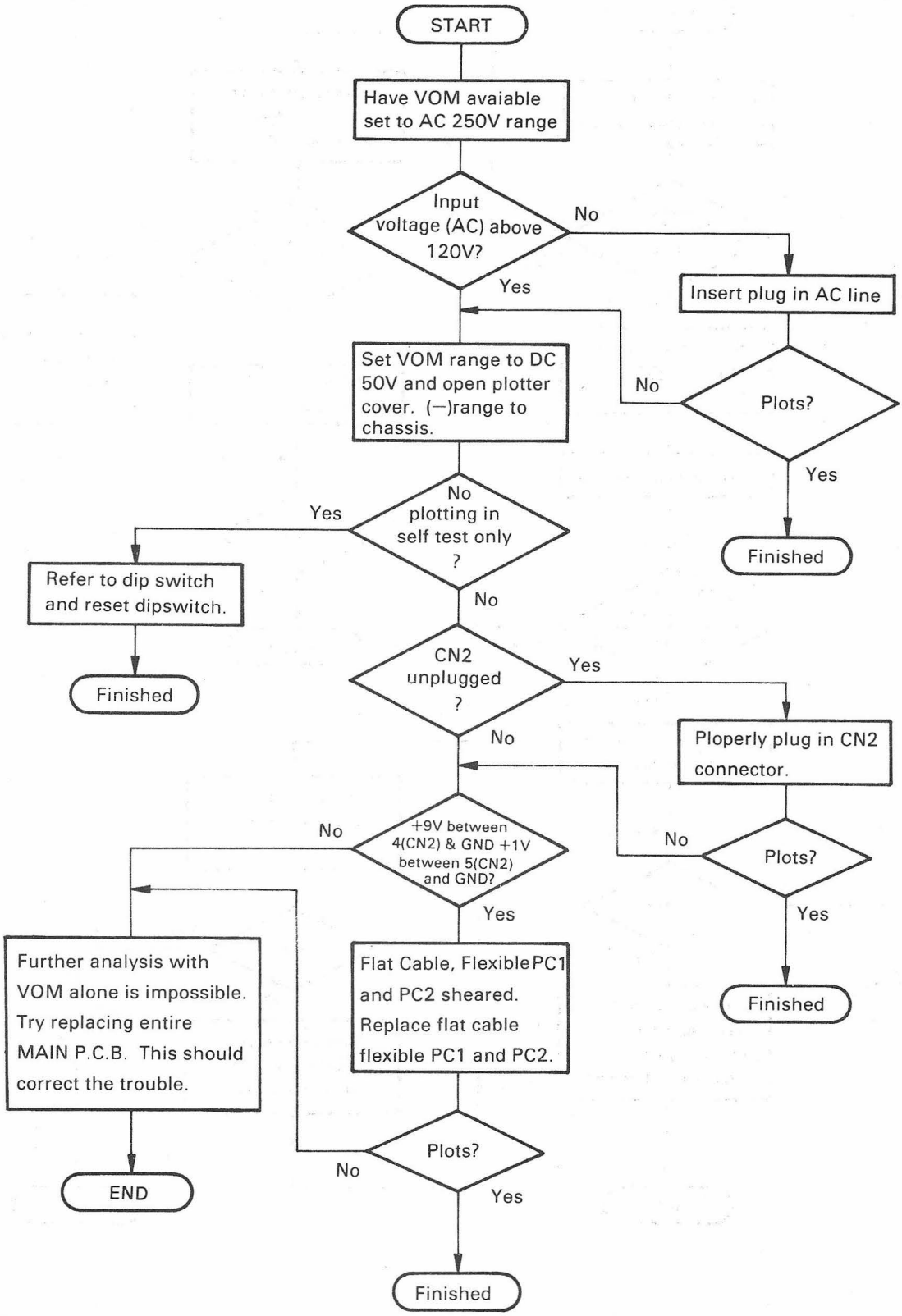
Lamp Do Not Light



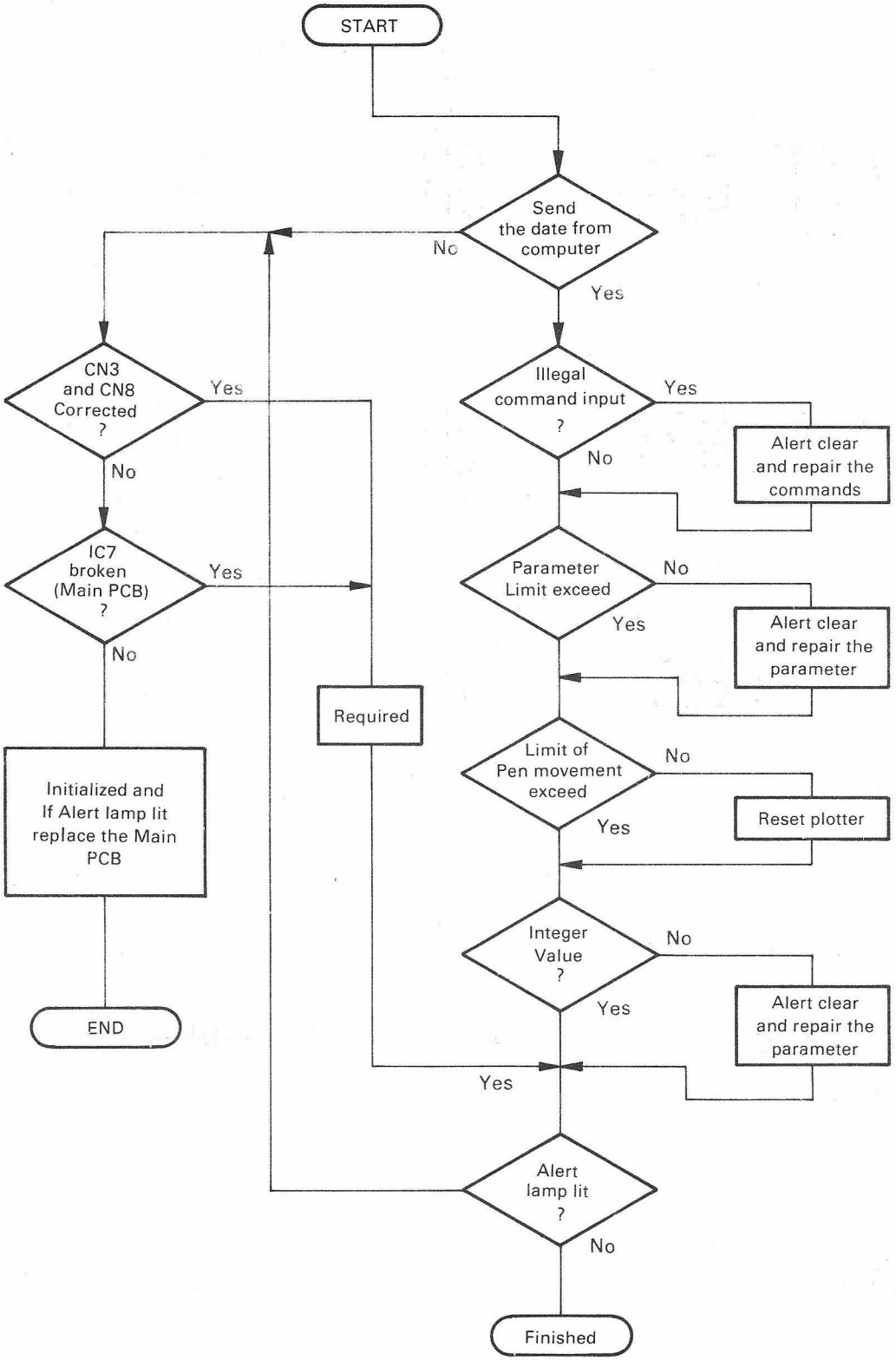
Control Keys Fail To Work



When Not Plotting



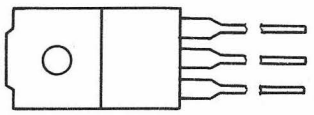
Alert Lamp Lights With No Reason



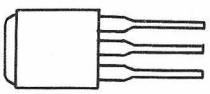
6. ELECTRONIC CIRCUIT AND CIRCUIT PARTS

6.1 Semiconductor Lead Identification

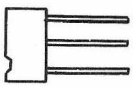
A) 2SD1275, 2SD1276
B) 2SB937, 2SD1260
C) 2SD636-R



A) 1; Emitter
2; Collector
3; Base



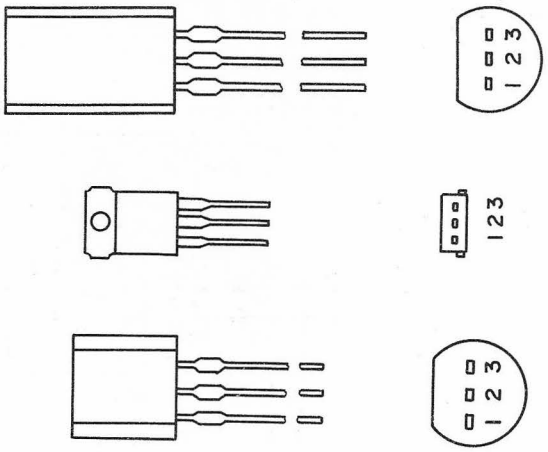
B) 1; Emitter
2; Collector
3; Base



C) 1; Base
2; Collector
3; Emitter

D) 1SS53

E) 2SA684P
F) 2SA1010L
G) 2SC945P, 2SA733P

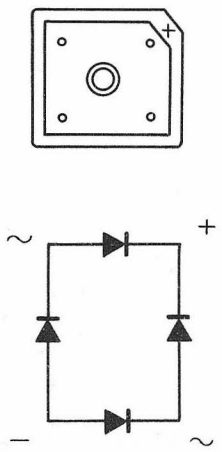


E) 1; Emitter
2; Collector
3; Base

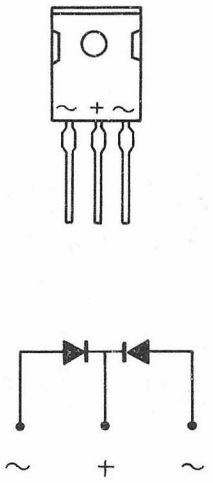
F) 1; Base
2; Collector
3; Emitter

G) 1; Emitter
2; Collector
3; Base

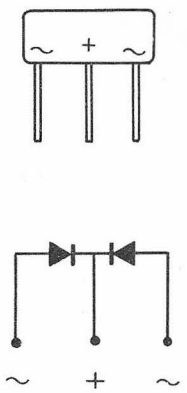
H) S10VB10



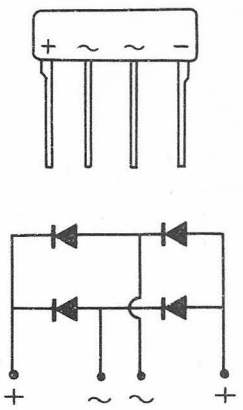
I) S12KC20



J) S3VC10

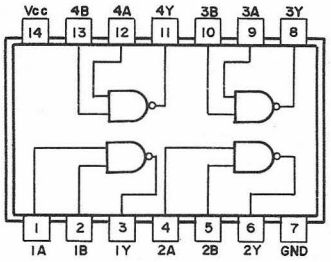


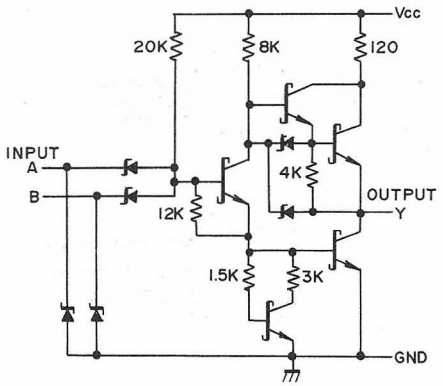
K) S1VB10



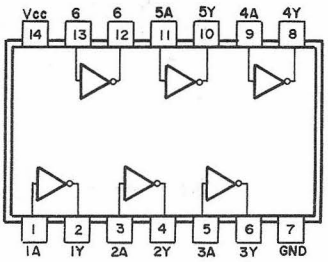
6.2 Integrated Circuit Lead Identification

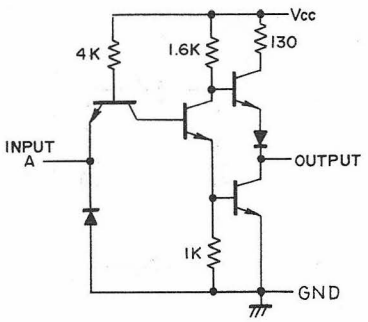
74LS00 Quad 2 Input NAND



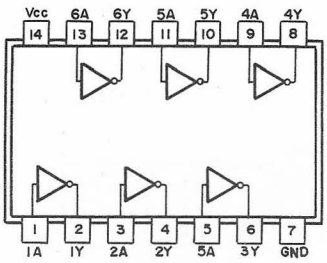


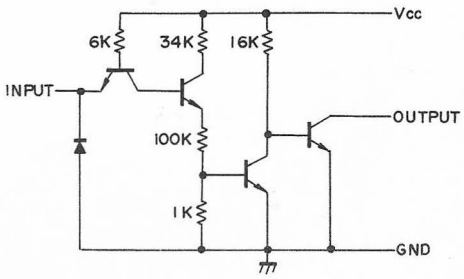
7404 Hex-Inverters



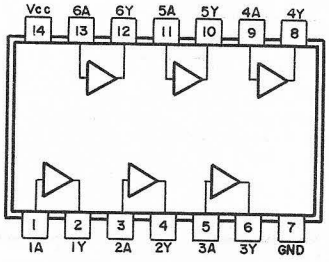


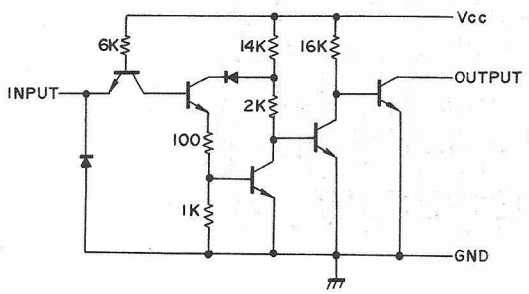
7406 Hex O.C. Inverters



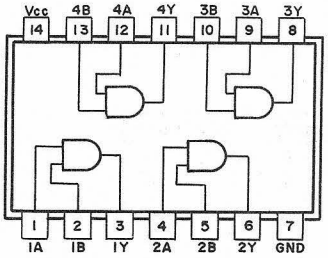


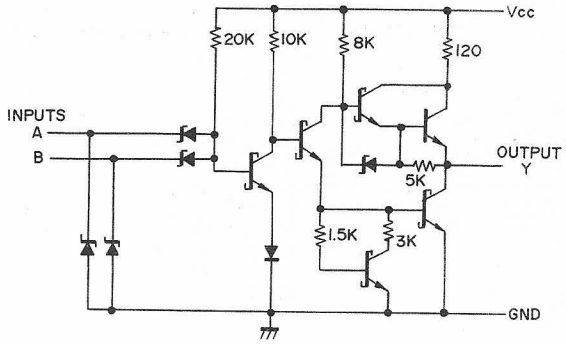
7407 Hex O.C. Buffers



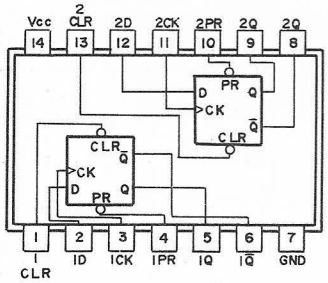


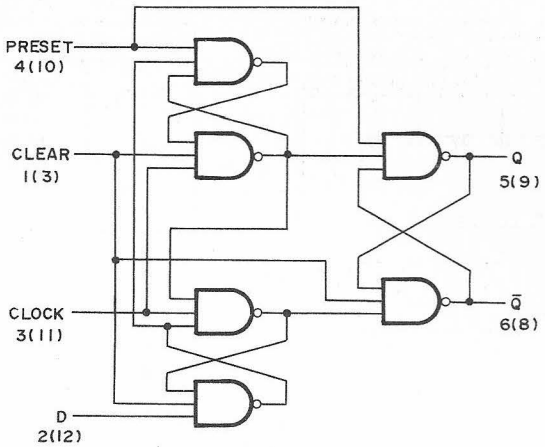
74LS08 Quad 2Input AND



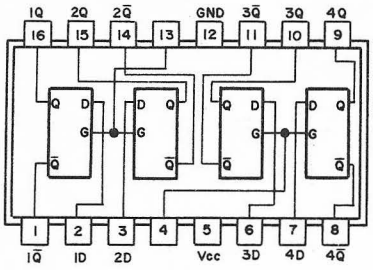


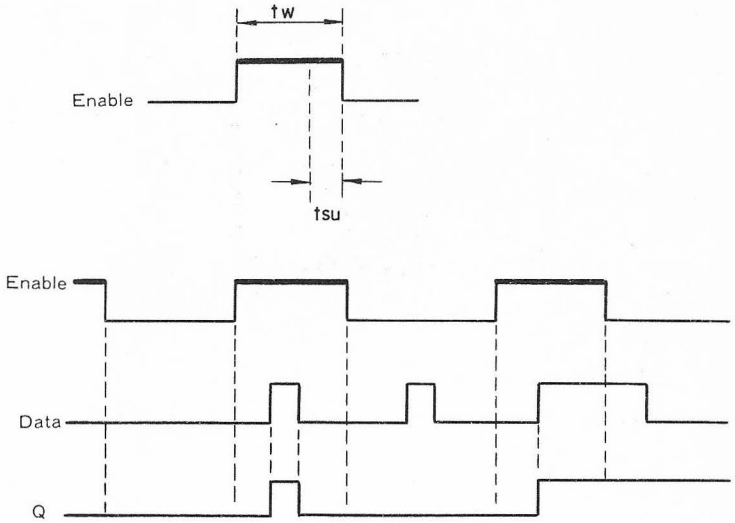
74LS74A Dual D-FFS with preset and clear



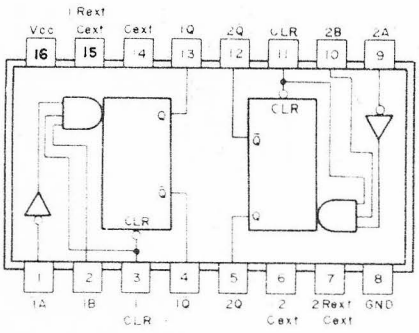


74LS75 4 Bit Latches



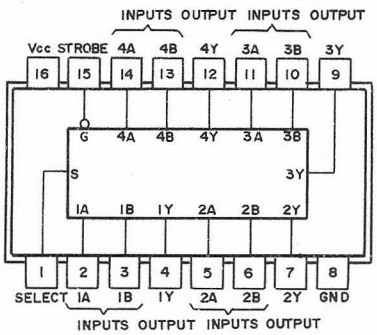


74LS123 Dual Retriggerable Single Shot



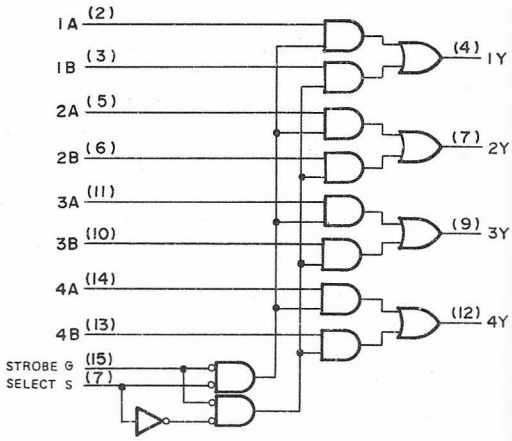
INPUTS			OUTPUTS	
CLEAR	A	B	Q	Q̄
L	X	X	L	H
X	H	X	L	H
X	X	L	L	H
H	L	↑	⎍	⎎
H	↓	H	⎍	⎎
↑	L	H	⎍	⎎

74LS157 2 to 1 Dats Selectors

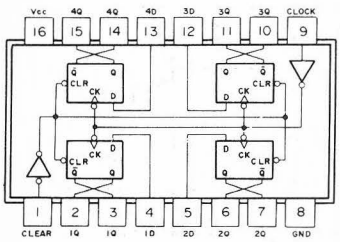


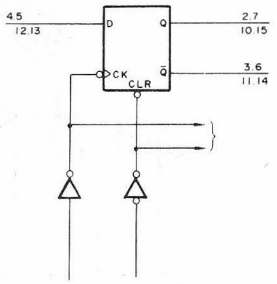
FUNCTION TABLE

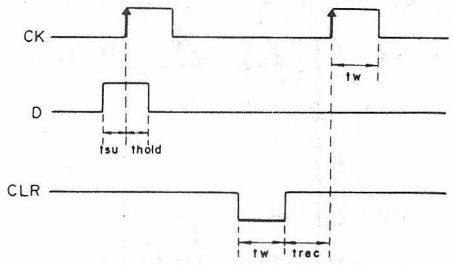
INPUTS		OUTPUT
Select	Strobe G	Y
X	H	L
L	L	A
H	L	B



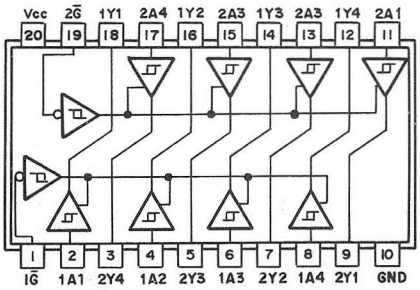
74LS175 Quad D-FFS

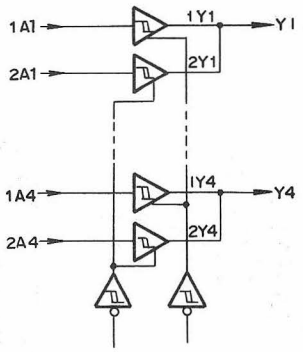




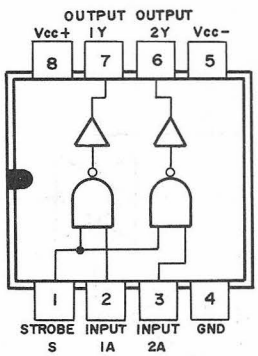


74LS244 Octal 3 State Bus Buffers

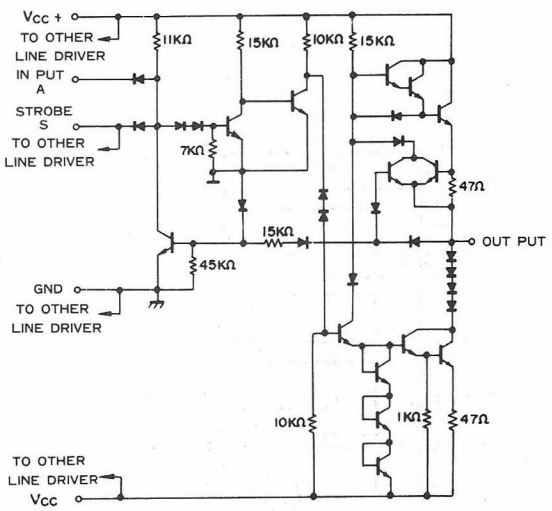




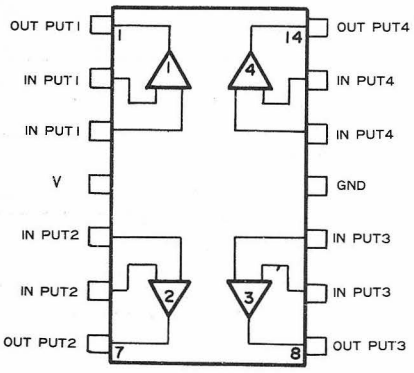
SN75150

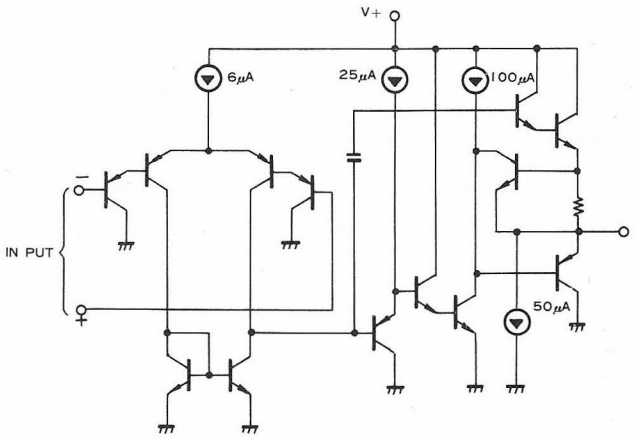


RS-232 Driver

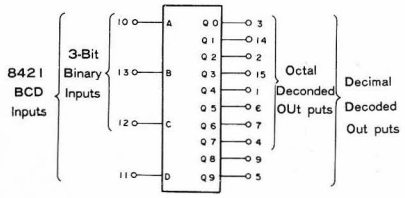


LM324

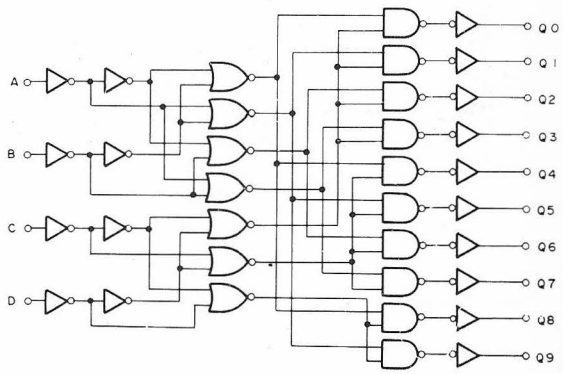




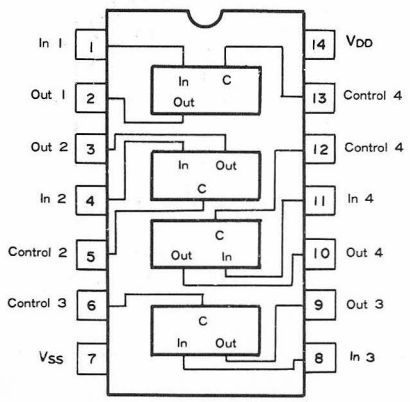
4028B BCD-to-Decimal Decoder

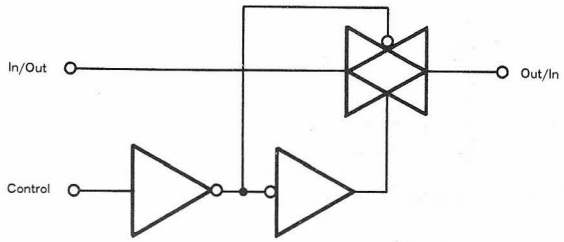


INPUT				OUTPUT									
D	C	B	A	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0
0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	0	0	0	0	1	0
0	0	1	0	0	0	0	0	0	0	0	1	0	0
0	0	1	1	0	0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0	1	0	0	0	0
0	1	0	1	0	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	0	1	0	0	0	0	0	0
0	1	1	1	0	0	1	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0	0	0	0	0	0
1	0	0	1	1	0	0	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0	0	0	0	0	0



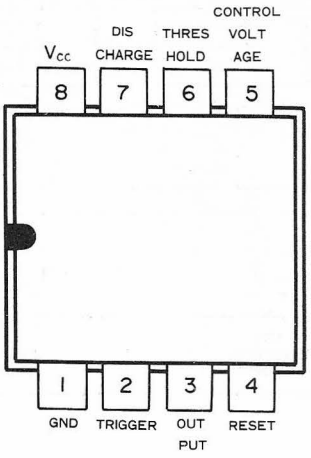
4066B Quadruple Analog Switch

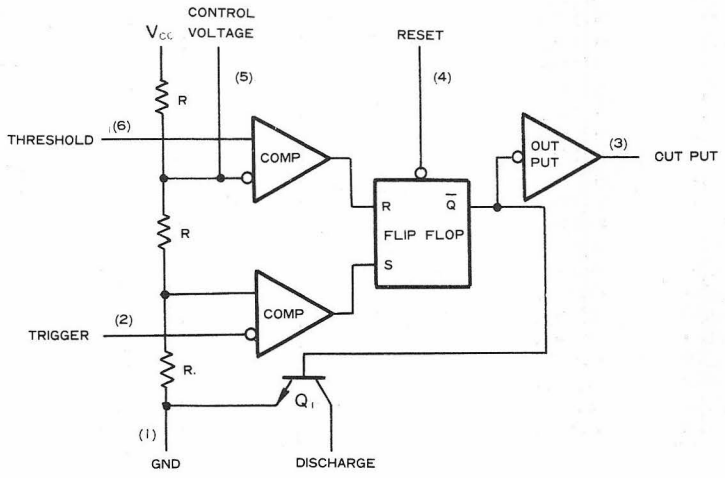




NE555

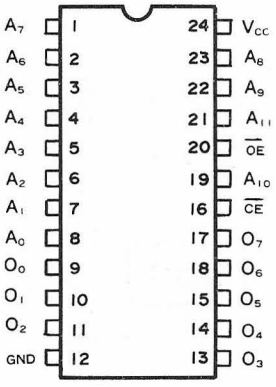
PRECISION TIMERS

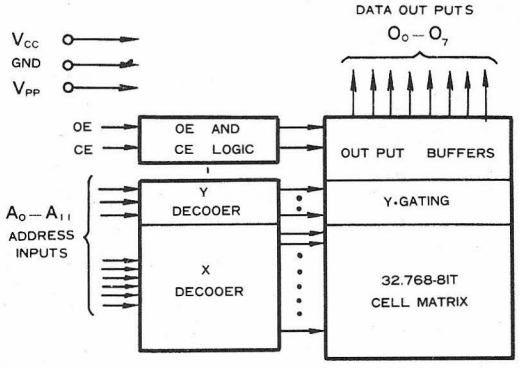




2732

32K(4K×8) UV Erasable P ROM

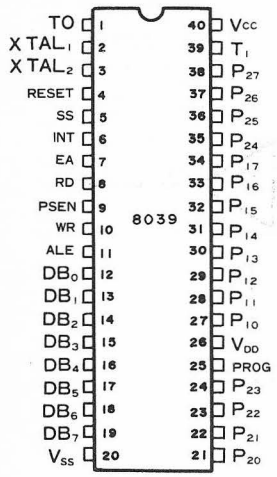


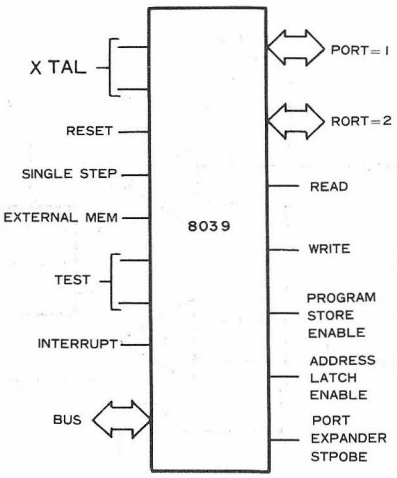


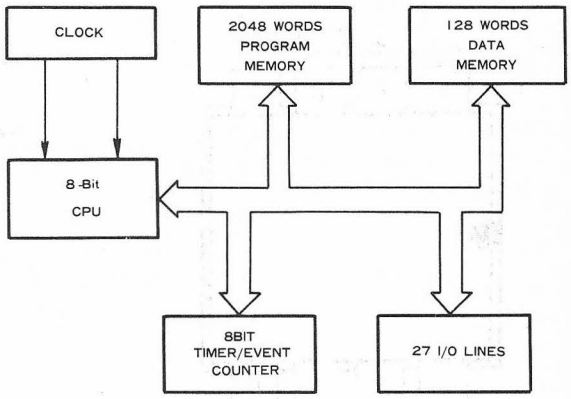
PIN NAMES

$A_0 - A_{10}$	ADDRESS
CE	CHIP ENABLE
CE	OUT PUT ENABLE
$O_0 - O_7$	OUT PUTS

8039 8-Bit Microcomputer

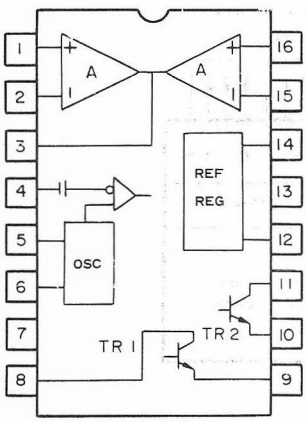


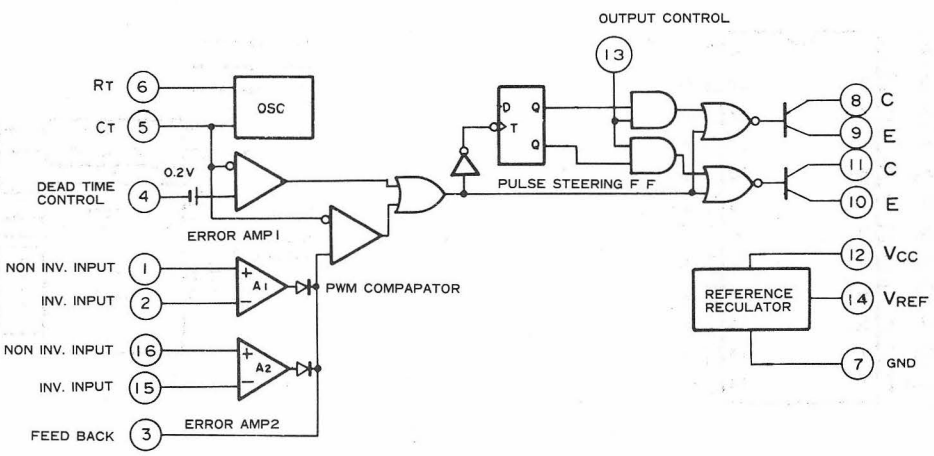




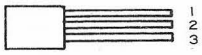
MB3759 Switching Regurator

MB3759

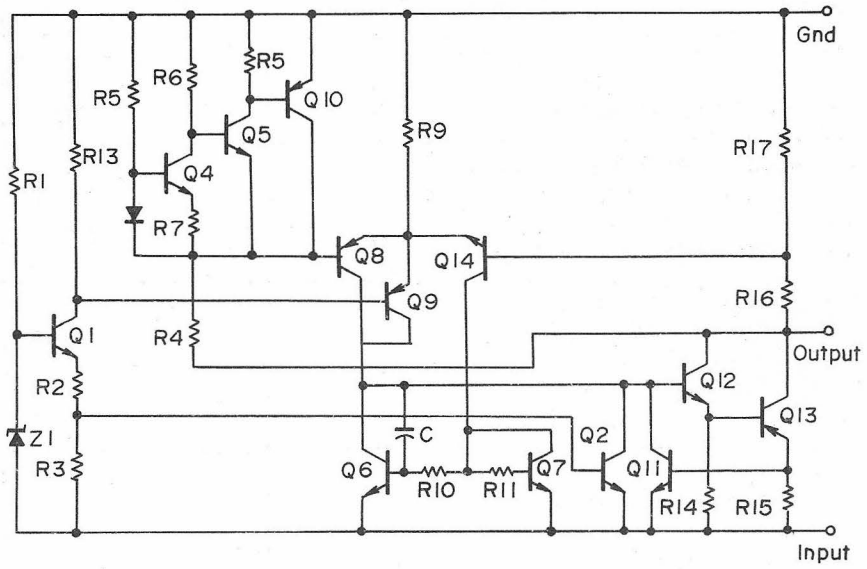




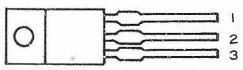
LM79L12



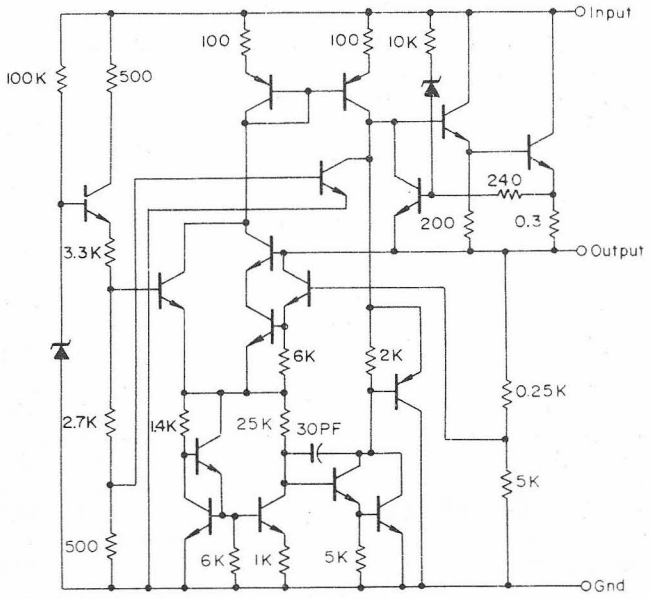
Pin 1. Ground
2. Input
3. Output



μPC78M12, μPC7805H



Pin 1. Input
2. Ground
3. Output



6.3 I.C.Electrical Characteristics

D.C. AND OPERATING CHARACTERISTICS $T_A = 0°C$ to $70°C$, $V_{CC} = V_{DD} = +5V \pm 10\%$, $V_{SS} = 0V$

Symbol	Parameter	Limits			Unit	Test Conditions
		Min.	Typ.	Max.		
V_{IL}	Input Low Votage (All Except XTAL1, XTAL2)	−0.5		0.8	V	
V_{IH}	Input High Voltage (All Except XTAL1, XTAL2, $\overline{RESET}$)	2.0		V_{CC}	V	
V_{IH1}	Input High Voltage ($\overline{RESET}$,XTAL1)	3.0		V_{CC}	V	
V_{OL}	Output Low Voltage (BUS, $\overline{RD}$, $\overline{WR}$, $\overline{PSEN}$, ALE)			0.45	V	$I_{OL} = 2.0mA$
V_{OL1}	Output Low Voltage (All Other Outputs Except PROG)			0.45	V	$I_{OL} = 1.6mA$
V_{OH}	Output High Voltage (BUS, $\overline{RD}$, $\overline{WR}$, $\overline{PSEN}$, ALE)	2.4			V	$I_{OH} = 100\mu A$
V_{OH1}	Output High Voltage (All Other Outputs)	2.4			V	$I_{OH} = 50\mu A$
I_{IL}	Input Leakage Current (T1, EA, $\overline{INT}$)			±10	μA	$V_{SS} < V_{IN} < V_{CC}$
I_{OL}	Output Leakage Current (Bus, To) (High Impedance State)			−10	μA	$V_{CC} > V_{IN} > V_{SS} + 0.45$
I_{DD}	Power Down Supply Current		20	50	mA	$T_A = 25°C$
$I_{DD}+I_{CC}$	Total Supply Current		75	140	mA	$T_A = 25°C$

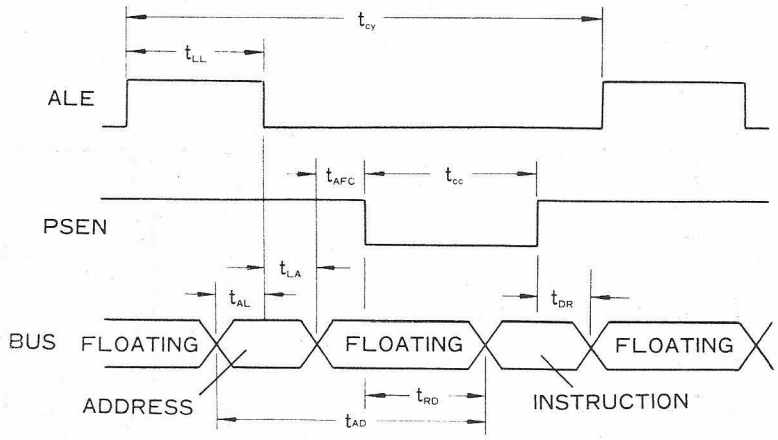
A.C. CHARACTERISTICS $T_A = 0°C$ to $70°C$, $V_{CC} = V_{DD} = +5V \pm 10\%$, $V_{SS} = 0V$

Symbol	Parameter	8039		Unit	Conditions
		Min.	Max.		
t_{LL}	ALE Pulse Width	400		ns	
t_{AL}	Address Setup to ALE	150		ns	
t_{LA}	Address Hold from ALE	80		ns	
t_{CC}	Control Pulse Width ($\overline{PSEN}$, $\overline{RD}$, $\overline{WR}$)	900		ns	
t_{OW}	Data Set-Up Before $\overline{WR}$	500		ns	
t_{WD}	Data Hold After $\overline{WR}$	120		ns	$C_L = 20$ pF
t_{CY}	Cycle Time	2.5	15.0	μs	6MHz XTAL
t_{DR}	Data Hold	0	200	ns	
t_{RD}	$\overline{PSEN}$, $\overline{RD}$ to Data In		500	ns	
t_{AW}	Address Setup to $\overline{WR}$	230		ns	
t_{AD}	Address Setup to Data In		950	ns	
t_{AFC}	Address Float to $\overline{RD}$, $\overline{PSEN}$	0		ns	

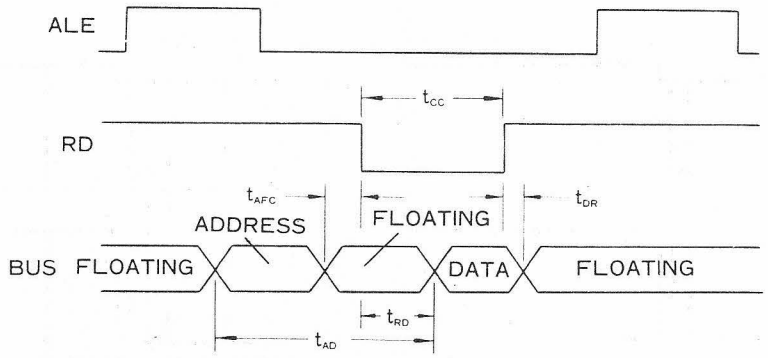
A.C. TEST CONDITIONS Control Outputs: $C_L = 80pF$ BUS Outputs: $C_L = 150$ pF $t_{CY} = 2.5$

WAVEFORMS

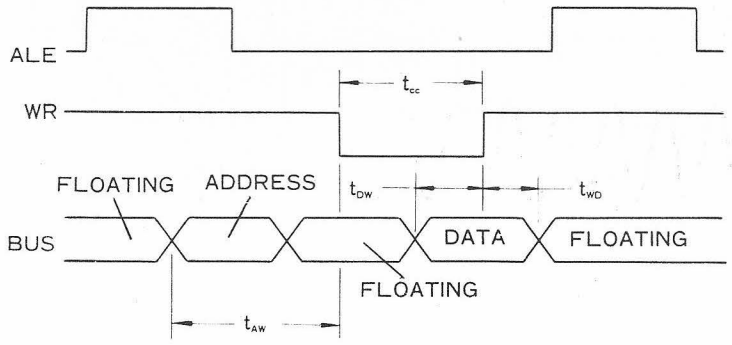
Instruction Fetch From External Program Memory



Read From External Data Memory

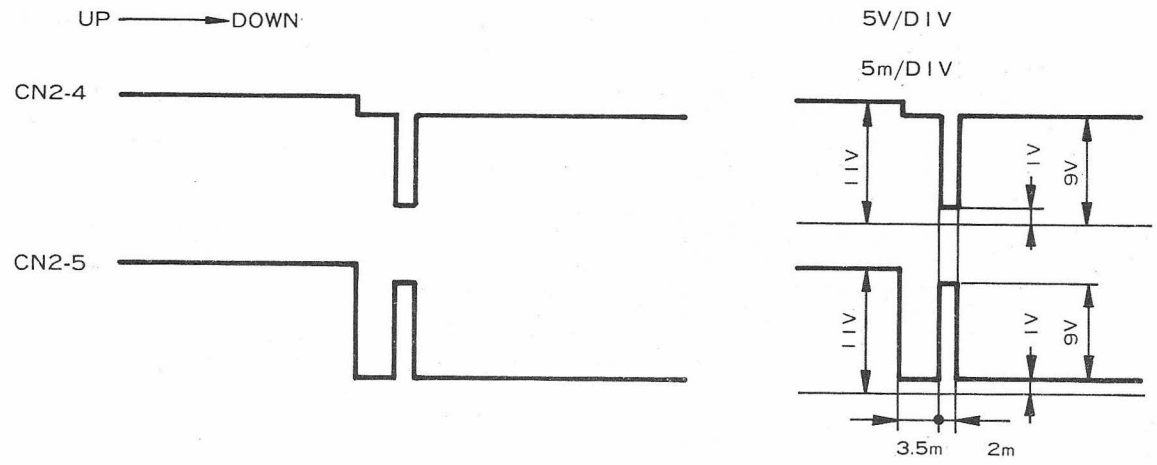


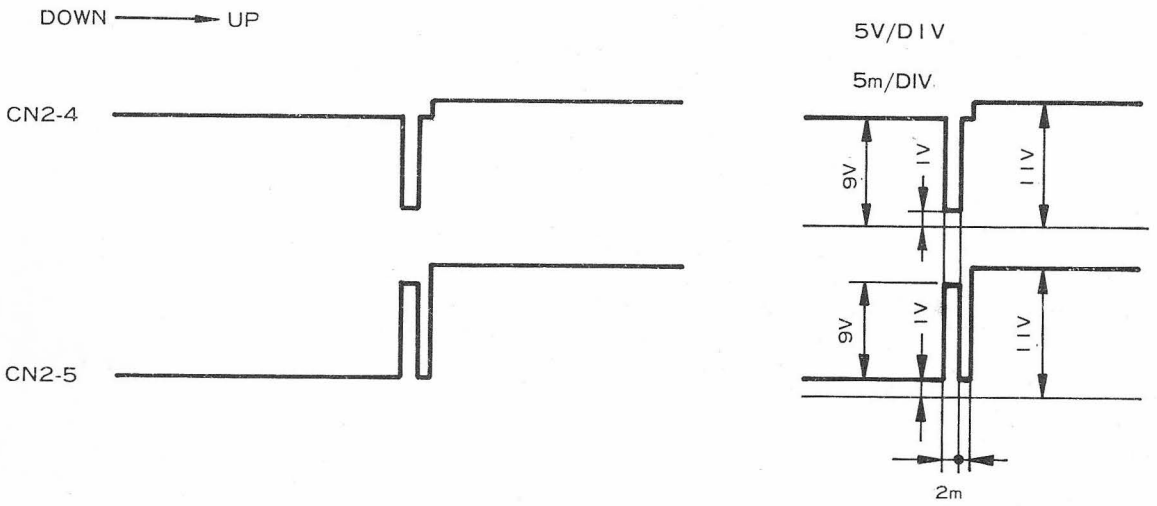
Write To External Data Memory

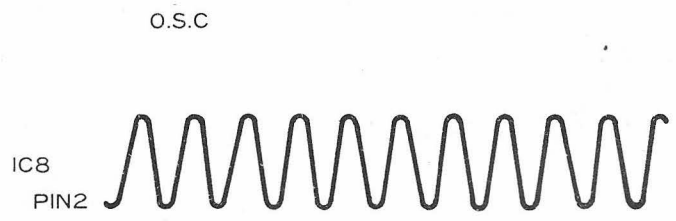


6.4 Wave Forms of Electronic Circuits

PEN UP/DOWN

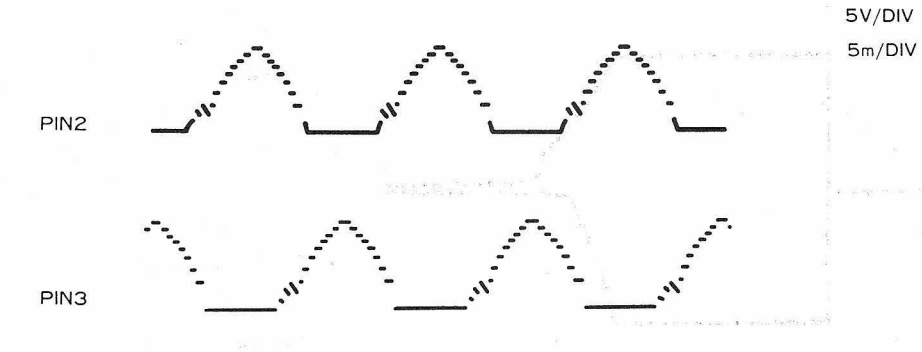


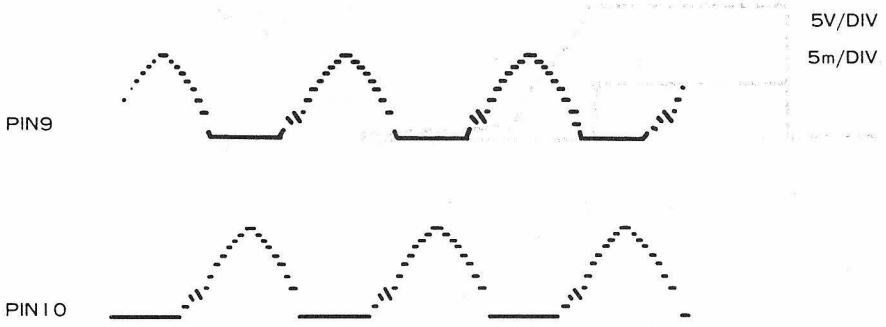


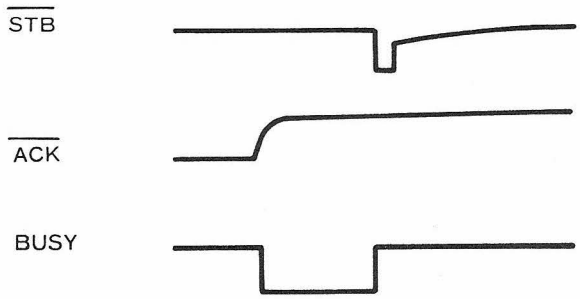


MOTOR DRIVING TIMING

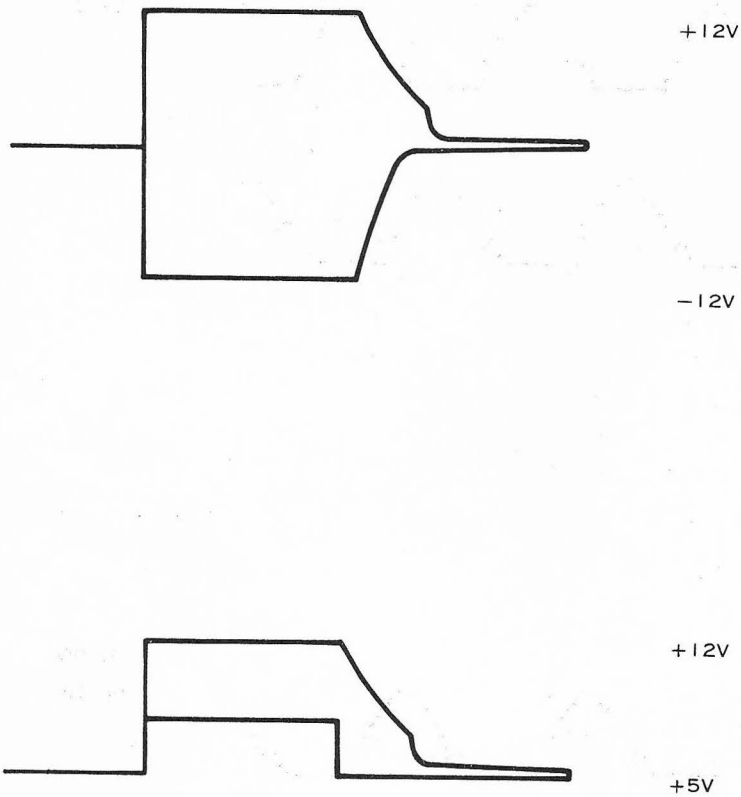
IC23







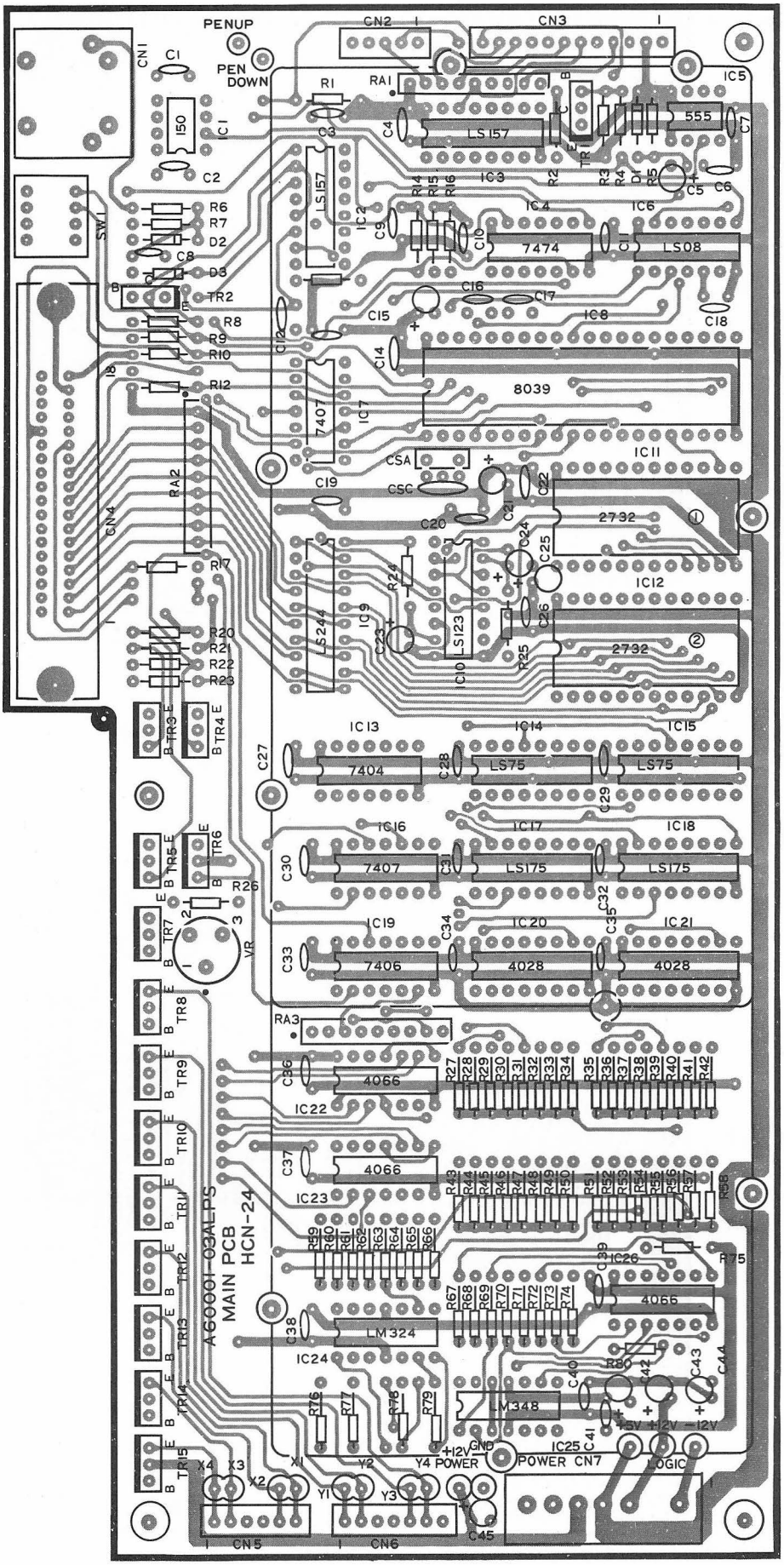
POWER SUPPLY VOLTAGE WAVE FORM



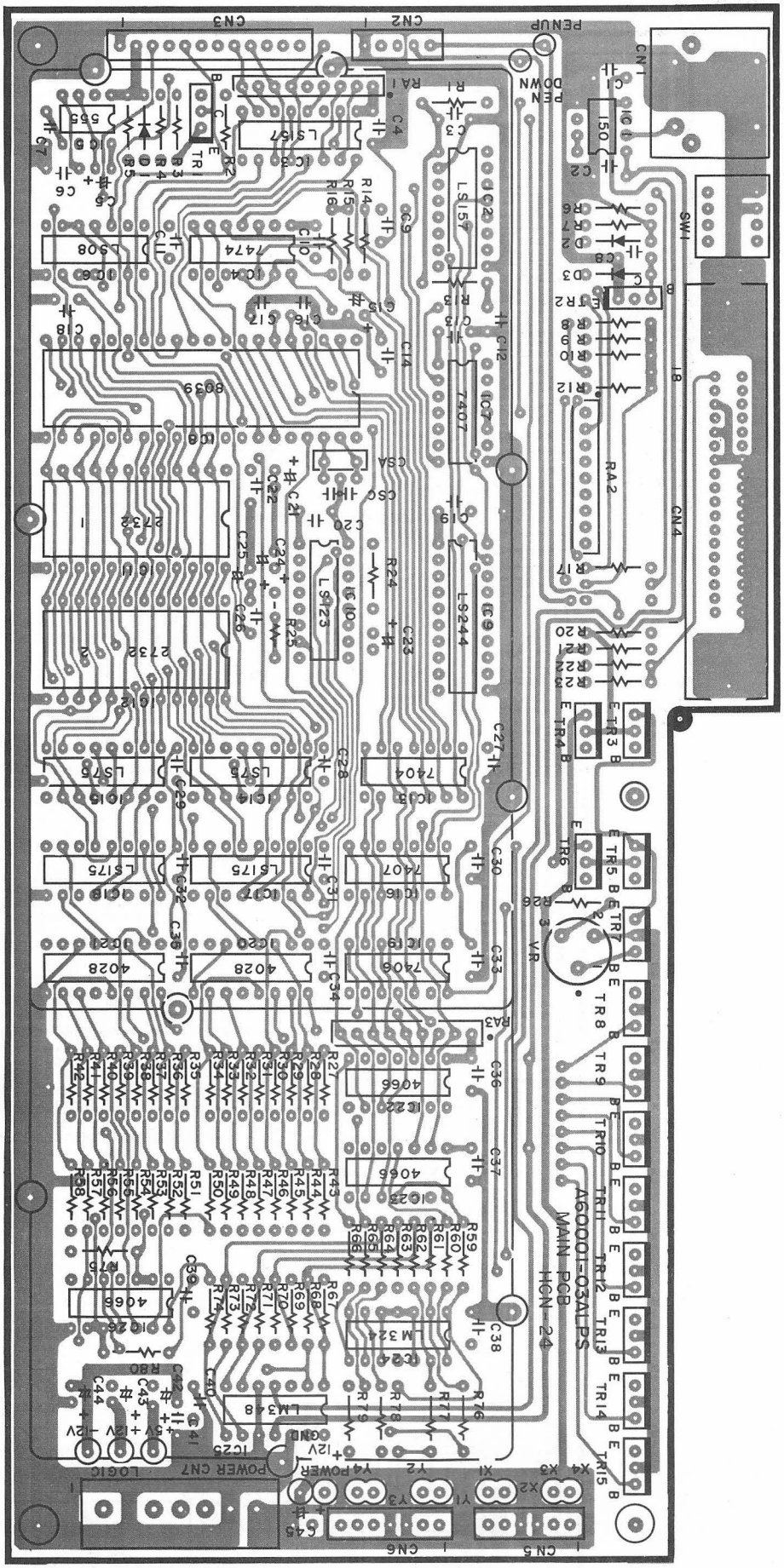
7. PRINT CIRCUIT BOARD ART

7.1 Main Print Circuit Board

(TOP VIEW)

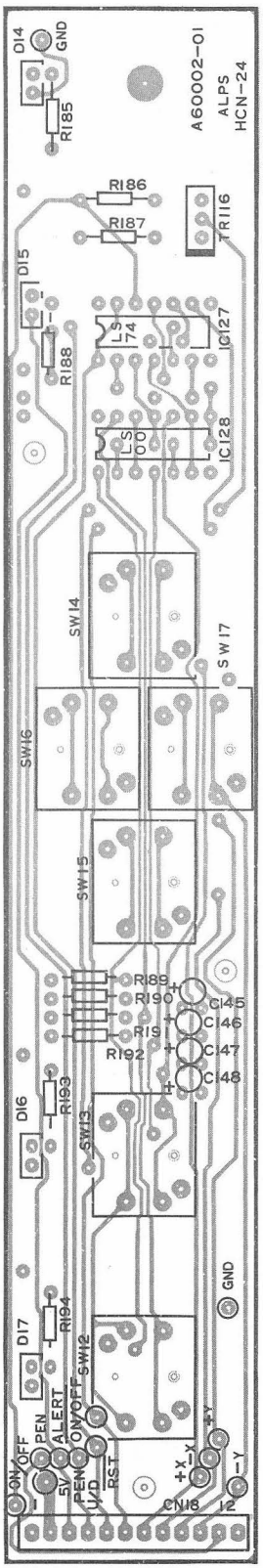


(BOTTOM VIEW)

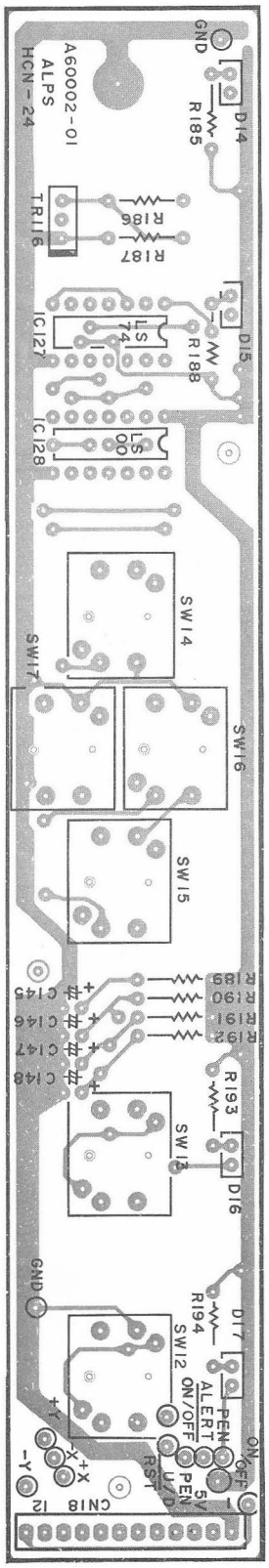


7.2 Front Print Circuit Board

(TOP VIEW)

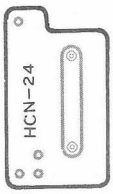


(BOTTOM VIEW)

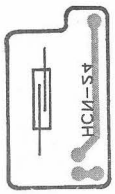


7.3 Lead Switch Print Circuit Board

(TOP VIEW)



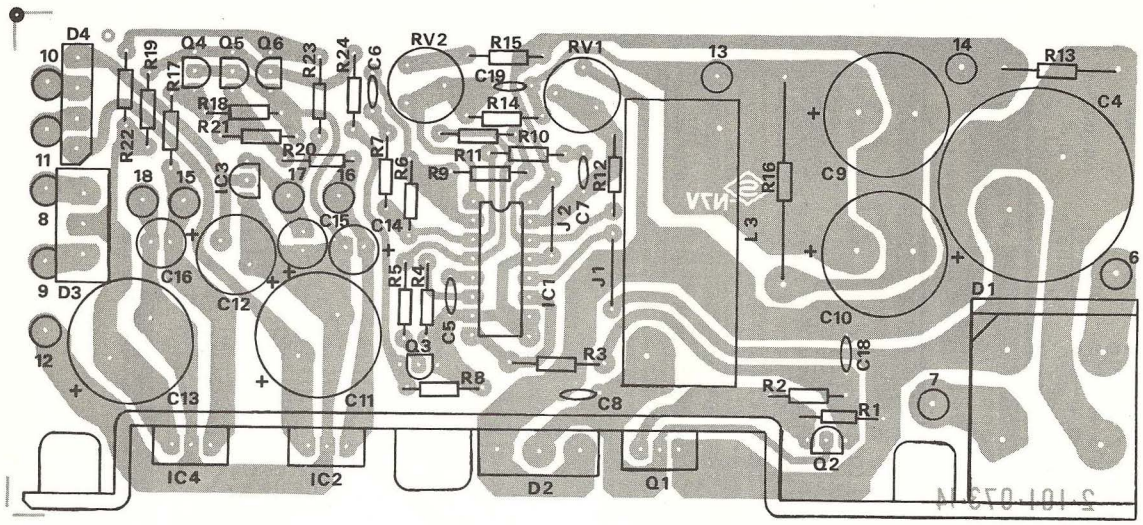
(BOTTOM VIEW)



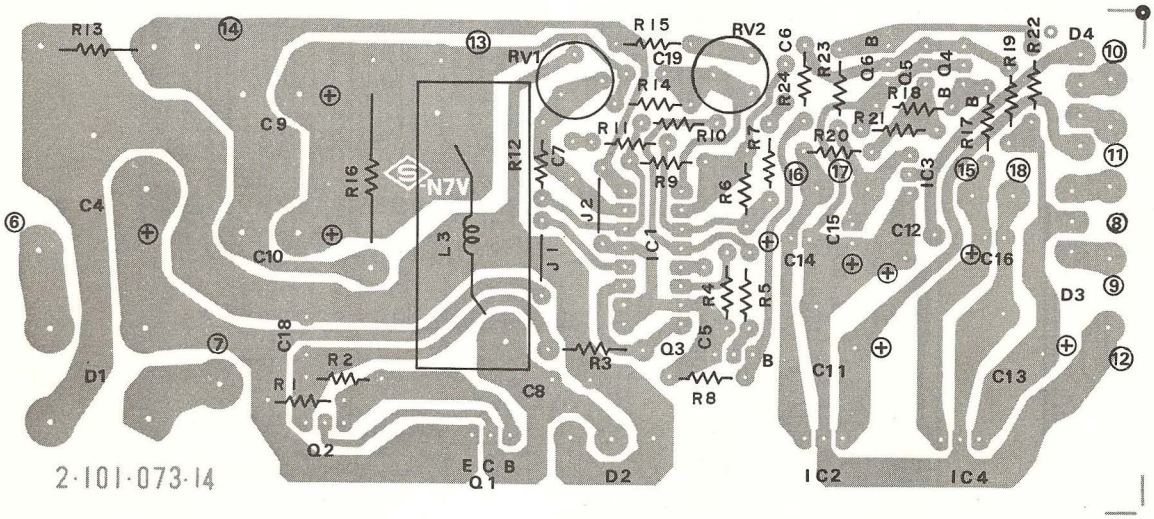
7.4 Power Supply Circuit Board

Printed Circuit Board (Main)

(Top View)

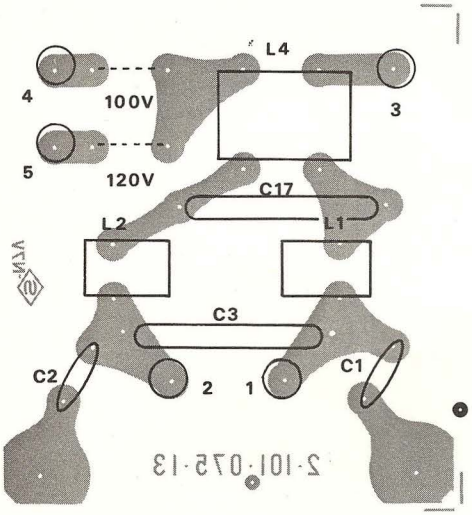


(Bottom View)

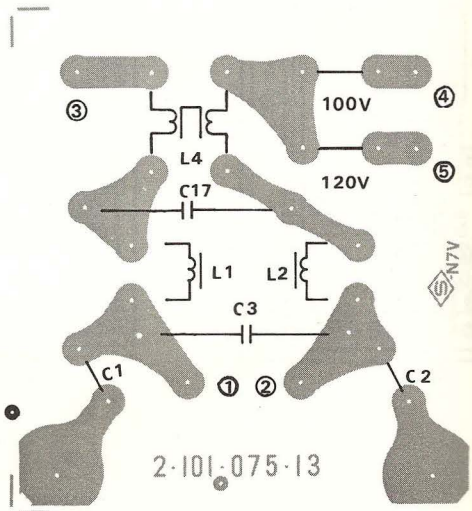


Printed Circuit Board (Noise Filter)

(Top View)



(Bottom View)



8. PARTS LIST

8.1 Electrical Parts List

8.1.1 Front P.C.B Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
	Capacitors		
C145	1μF 25V Tantalum Electrolytic		A65T21ROKN
C146	1μF 25V Tantalum Electrolytic		A65T21ROKN
C147	1μF 25V Tantalum Electrolytic		A65T21ROKN
C148	1μF 25V Tantalum Electrolytic		A65T21ROKN
	Connector		
CN8	Front Panel IL-G-12P-S3T2-E		A70011
	Light Emitting Diode		
D14	SLP-255B		A83001
D15	SLP-155B		A83002
D16	SLP-255B		A83001
D17	SLP-255B		A83001
	Integrated Circuits		
IC127	Flip-Flop SN74LS74A or Equivalent		A61LS74**I
IC128	Quad Nand SN74LS00 or Equivalent		A61LS00**I
	Resistors		
R185	150Ω 1/4W J Carbon		A63C04151J
R186	2.2KΩ 1/4W J Carbon		A63C04222J
R187	4.7KΩ 1/4W J Carbon		A63C04472J
R188	150Ω 1/4W J Carbon		A63C04151J
R189	150Ω 1/4W J Carbon		A63C04151J
R190	150Ω 1/4W J Carbon		A63C04151J
R191	150Ω 1/4W J Carbon		A63C04151J
R192	150Ω 1/4W J Carbon		A63C04151J
R193	150Ω 1/4W J Carbon		A63C04151J
R194	150Ω 1/4W J Carbon		A63C04151J
	Switches		
SW12	Tact KHE10901		A87002
SW13	Tact KHE10901		A87002
SW14	Tact KHE10901		A87002
SW15	Tact KHE10901		A87002
SW16	Tact KHE10901		A87002
SW17	Tact KHE10901		A87002
SW12-1	Key Top		A27003
SW13-1	Key Top		A27003
SW14-1	Key Top		A27002
SW15-1	Key Top		A27002
SW16-1	Key Top		A27001
SW17-1	Key Top		A27001
TR116	Transister 2SD636R		A62T2D636*
F-1	Unit, Front P.C.B		A60002-01A
F-2	Unit, Flat Cable		A75011A

8.1.2 Main P.C.B Assy Parts List

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
	Capacitors				
C1	0.01μF	50V	Ceramic		A66C5103KT
C2	0.01μF	50V	Ceramic		A66C5103KT
C3	0.01μF	50V	Ceramic		A66C5103KT
C4	0.01μF	50V	Ceramic		A66C5103KT
C5	1μF	25V	Tantalum Electrolytic		A65T21R0KN
C6	0.01μF	50V	Ceramic		A66C5103KT
C7	0.01μF	50V	Ceramic		A66C5103KT
C8	0.01μF	50V	Ceramic		A66C5103KT
C9	0.01μF	50V	Ceramic		A66C5103KT
C10	0.01μF	50V	Ceramic		A66C5103KT
C11	0.01μF	50V	Ceramic		A66C5103KT
C12	0.001μF	50V	Ceramic		A66C5102KT
C13	0.01μF	50V	Ceramic		A66C5103KT
C14	0.01μF	50V	Ceramic		A66C5103KT
C15	1μF	25V	Tantalum Electrolytic		A65T21R0KN
C16	0.001μF	50V	Ceramic		A66C5102KT
C17	0.001μF	50V	Ceramic		A66C5102KT
C18	0.001μF	50V	Ceramic		A66C5102KT
C19	0.01μF	50V	Ceramic		A66C5103KT
C20	0.01μF	50V	Ceramic		A66C5103KT
C21	1μF	25V	Tantalum Electrolytic		A65T21R0KN
C22	0.01μF	50V	Ceramic		A66C5102KT
C23	1μF	25V	Tantalum Electrolytic		A65T21R0KN
C24	1μF	25V	Tantalum Electrolytic		A65T21R0KN
C25	1μF	25V	Tantalum Electrolytic		A65T21R0KN
C26	0.01μF	50V	Ceramic		A66C5103KT
C27	0.01μF	50V	Ceramic		A66C5103KT
C28	0.01μF	50V	Ceramic		A66C5103KT
C29	0.01μF	50V	Ceramic		A66C5103KT
C30	0.01μF	50V	Ceramic		A66C5103KT
C31	0.01μF	50V	Ceramic		A66C5103KT
C32	0.01μF	50V	Ceramic		A66C5103KT
C33	0.01μF	50V	Ceramic		A66C5103KT
C34	0.01μF	50V	Ceramic		A66C5103KT
C35	0.01μF	50V	Ceramic		A66C5103KT
C36	0.01μF	50V	Ceramic		A66C5103KT
C37	0.01μF	50V	Ceramic		A66C5103KT
C38	0.01μF	50V	Ceramic		A66C5103KT
C39	0.01μF	50V	Ceramic		A66C5103KT
C40	0.01μF	50V	Ceramic		A66C5103KT
C41	0.01μF	50V	Ceramic		A66C5103KT
C42	33μF	25V	Electrolytic		A65A2330MA
C43	10μF	25V	Electrolytic		A65A2100MA
C44	10μF	25V	Electrolytic		A65A2100MA
C45	33μF	25V	Electrolytic		A65A2330MA
	Connector				
CN1	Serial Interface		TCS4440-01-1011		A70002
CN2	Reed Switch, Pen Coil		IL-G-5P-S3T2-E		A70006
CN3	Front Panel		IL-G-12P-S3T2-E		A70011
CN4	Parallel Interface		ADS-36BLFDR1		A70001
CN5	#X Motor		IL-G-6P-S3T2-E		A70007

Ref. No.	Description				Radio Shack Part Number	Manufacturer Part Number
CN6	#Y Motor		IL-G-7P-S3T2-E			A70008
CN7	Power Source		5277-06A			A70009
CSA	Ceramic Ocillator		CSA11. OMT			A67021
CSC	Ceramic Capacitor		CSC300			A67022
			Diodes			
D1	Silicon	1SS53				A62X001
D2	Silicon	1SS53				A62X001
D3	Silicon	1SS53				A62X001
IC1	RS-232 Driver		SN75150 or Equivalent			A61XX001I
IC2	Data Selectors		SN74LS157 or Equivalent			A61LS157*I
IC3	Data Selectors		SN74LS157 or Equivalent			A61LS157*I
IC4	Frip-Flops		SN74LS74A or Equivalent			A61LS74**I
IC5	Timer		NE555 or Equivalent			A61OP555*I
IC6	Quad And		SN74LS08 or Equivalent			A61LS08**I
IC7	Hex Buffers		SN7407 or Equivalent			A610007**I
IC8	Micro Processor		TMP8039P, 11MHZ			A61CP8039T
IC9	Octal Buffers		SN74LS244 or Equivalent			A61LS244*I
IC10	Dual Single Shot		SN74LS123 or Equivalent			A61LS123*I
IC11	EP Rom (1)		TMM2732D or Equivalent			A001D
IC11-1	IC Sockets 24Pin		DILB24P-8J			A71004
IC12	EP Rom (2)		TMM2732D or Equivalent			A002D
IC12-1	IC Sockets 24Pin		DILB24P-8J			A71004
IC13	Hex Inverters		SN7404 or Equivalent			A610004**I
IC14	Latches		SN74LS75 or Equivalent			A61LS75**I
IC15	Latches		SN74LS75 or Equivalent			A61LS75**I
IC16	Hex Buffers		SN7407 or Equivalent			A610007**I
IC17	Flip-Flops		SN74LS175 or Equivalent			A61LS175*I
IC18	Flip-Flops		SN74LS175 or Equivalent			A61LS175*I
IC19	Hex Inverters		SN7406 or Equivalent			A610006**I
IC20	Decoder		TC4028BP or Equivalent			A61CM4028T
IC21	Decoder		TC4028BP or Equivalent			A61CM4028T
IC22	Bilateral Switch		TC4066BP or Equivalent			A61CM4066T
IC23	Bilateral Switch		TC4066BP or Equivalent			A61CM4066T
IC24	Operational Amplifier		LM324 or Equivalent			A610P324*I
IC25	Operational Amplifier		LM348 or Equivalent			A610P348*I
IC26	Bilateral Switch		TC4066BP or Equivalent			A61CM4066T
			Resistor Arreys			
RA1	10KΩ	1/8W	9AJ			A63X001
RA2	10KΩ	1/8W	9AJ			A63X001
RA3	10KΩ	1/8W	9AJ			A63X001
			Resistors			
R1	10KΩ	1/4W	J	Carbon		A63C04103J
R2	10KΩ	1/4W	J	Carbon		A63C04103J
R3	4.7KΩ	1/4W	J	Carbon		A63C04472J
R4	2.2KΩ	1/4W	J	Carbon		A63C04222J
R5	560KΩ	1/4W	J	Carbon		A63C04564J
R6	10KΩ	1/4W	J	Carbon		A63C04103J
R7	10KΩ	1/4W	J	Carbon		A63C04103J
R8	2.2KΩ	1/4W	J	Carbon		A63C04222J
R9	10KΩ	1/4W	J	Carbon		A63C04103J
R10	10KΩ	1/4W	J	Carbon		A63C04103J

Ref. No.	Description				Radio Shack Part Number	Manufacturer Part Number
R11	10KΩ	1/4W	J	Carbon		A63C04103J
R12	10KΩ	1/4W	J	Carbon		A63C04103J
R13	10KΩ	1/4W	J	Carbon		A63C04103J
R14	470Ω	1/4W	J	Carbon		A63C04471J
R15	10KΩ	1/4W	J	Carbon		A63C04103J
R16	10KΩ	1/4W	J	Carbon		A63C04103J
R17	220Ω	1/4W	J	Carbon		A63C04221J
R20	220Ω	1/4W	J	Carbon		A63C04221J
R21	220Ω	1/4W	J	Carbon		A63C04221J
R22	270Ω	1/4W	J	Carbon		A63C04271J
R23	270Ω	1/4W	J	Carbon		A63C04271J
R24	510KΩ	1/4W	J	Carbon		A63C04514J
R25	510KΩ	1/4W	J	Carbon		A63C04514J
R26	160Ω	1/4W	J	Carbon		A63C04161J
R27	10KΩ	1/4W	J	Carbon		A63C04103J
R28	11KΩ	1/4W	J	Carbon		A63C04113J
R29	12KΩ	1/4W	J	Carbon		A63C04123J
R30	13KΩ	1/4W	J	Carbon		A63C04133J
R31	15KΩ	1/4W	J	Carbon		A63C04153J
R32	18KΩ	1/4W	J	Carbon		A63C04183J
R33	24KΩ	1/4W	J	Carbon		A63C04243J
R34	39KΩ	1/4W	J	Carbon		A63C04393J
R35	10KΩ	1/4W	J	Carbon		A63C04103J
R36	11KΩ	1/4W	J	Carbon		A63C04113J
R37	12KΩ	1/4W	J	Carbon		A63C04123J
R38	13KΩ	1/4W	J	Carbon		A63C04133J
R39	15KΩ	1/4W	J	Carbon		A63C04153J
R40	18KΩ	1/4W	J	Carbon		A63C04183J
R41	24KΩ	1/4W	J	Carbon		A63C04243J
R42	39KΩ	1/4W	J	Carbon		A63C04393J
R43	39KΩ	1/4W	J	Carbon		A63C04393J
R44	24KΩ	1/4W	J	Carbon		A63C04243J
R45	18KΩ	1/4W	J	Carbon		A63C04183J
R46	15KΩ	1/4W	J	Carbon		A63C04153J
R47	13KΩ	1/4W	J	Carbon		A63C04133J
R48	12KΩ	1/4W	J	Carbon		A63C04123J
R49	11KΩ	1/4W	J	Carbon		A63C04113J
R50	10KΩ	1/4W	J	Carbon		A63C04103J
R51	39KΩ	1/4W	J	Carbon		A63C04393J
R52	24KΩ	1/4W	J	Carbon		A63C04243J
R53	18KΩ	1/4W	J	Carbon		A63C04183J
R54	15KΩ	1/4W	J	Carbon		A63C04153J
R55	13KΩ	1/4W	J	Carbon		A63C04133J
R56	12KΩ	1/4W	J	Carbon		A63C04123J
R57	11KΩ	1/4W	J	Carbon		A63C04113J
R58	10KΩ	1/4W	J	Carbon		A63C04103J
R59	2.2KΩ	1/4W	J	Carbon		A63C04222J
R60	2.2KΩ	1/4W	J	Carbon		A63C04222J
R61	10KΩ	1/4W	J	Carbon		A63C04103J
R62	10KΩ	1/4W	J	Carbon		A63C04103J
R63	10KΩ	1/4W	J	Carbon		A63C04103J
R64	10KΩ	1/4W	J	Carbon		A63C04103J
R65	2.2KΩ	1/4W	J	Carbon		A63C04222J
R66	2.2KΩ	1/4W	J	Carbon		A63C04222J
R67	6.2KΩ	1/4W	J	Carbon		A63C04622J
R68	9.1KΩ	1/4W	J	Carbon		A63C04912J

Ref. No.	Description				Radio Shack Part Number	Manufacturer Part Number
R69	3.3KΩ	1/4W	J	Carbon		A63C04332J
R70	9.1KΩ	1/4W	J	Carbon		A63C04912J
R71	9.1KΩ	1/4W	J	Carbon		A63C04912J
R72	6.2KΩ	1/4W	J	Carbon		A63C04622J
R73	9.1KΩ	1/4W	J	Carbon		A63C04912J
R74	6.2KΩ	1/4W	J	Carbon		A63C04622J
R75	10KΩ	1/4W	J	Carbon		A63C04103J
R76	22KΩ	1/4W	J	Carbon		A63C04223J
R77	22KΩ	1/4W	J	Carbon		A63C04223J
R78	22KΩ	1/4W	J	Carbon		A63C04223J
R79	22KΩ	1/4W	J	Carbon		A63C04223J
R80	10KΩ	1/4W	J	Carbon		A63C04103J
SW1	Dip Switch 4-Circuit		DYS-4			A87003
			Transistors			
TR1	2SD636-R					A62T2D636*
TR2	2SD636-R					A62T2D636*
TR3	2SB937Q					A62T2B937*
TR4	2SD1260Q					A62T2D1260
TR5	2SB937QR					A62T2B937*
TR6	2SD1260Q					A62T2D1260
TR7	2SD1275Q					A62T2D1275
TR8	2SD1276Q					A62T2D1276
TR9	2SD1276Q					A62T2D1276
TR10	2SD1276Q					A62T2D1276
TR11	2SD1276Q					A62T2D1276
TR12	2SD1276Q					A62T2D1276
TR13	2SD1276Q					A62T2D1276
TR14	2SD1276Q					A62T2D1276
TR15	2SD1276Q					A62T2D1276
VR	Variable Resistor		1/2W	6.8KΩ-B		A64001
H-1	Unit, Main P.C.B					A60001A
H-1	Unit, Main P.C.B					A60001A
H 1A	Screw		M3 x L6 + Spring Washer			A30A3006Z1
H 1B	Screw		M3 x L6			A30A3006Z0
H 1C	TR Set Plate					A14017
H-2	Main P.C.B Fix Plate A					A14018
H-3	Main P.C.B Fix Plate B					A14020
H-4	Screw		M2.5 × L8			A30A2508Z0

8.2 Mechanical Parts List

8.2.1 Beam Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
A-1	Front Beam Assy		A19004B
A-1A	Beam Front		A19005A
A-1B	Stud F		A16010
A-1C	Unit, Pulley (D14)		A17008A
A-1D	E Ring E-3		A34E30Z
A-1E	Pulley Post (Front)		A16009
A-1F	Unit, Pulley (D14)		A17008A
A-2	Rear Beam Assy		A19006B
A-2A	Beam Rear		A19003
A-2B	Stud E		A16007
A-2C	Unit, Pulley (D14)		A17008A
A-2D	E Ring E-3		A34E30Z
A-2E	Stud G		A16011
A-2F	Roller		A17003
A-2G	E Ring E-2.5		A34E25Z
A-2H	E Ring E-3		A34E30Z
A-2I	Pulley Post (Rear)		A16009
A-2J	Unit, Pulley (D14)		A17008A
A-2K	Plate, Roller Tension		A14015
A-3	Carriage Frame Assy		A19007B
A-3A	Frame Carriage		A19001
A-3B	Unit, Bobbin		A93002A
A-3C	Holder A		A13005
A-3D	Screw M2.5 × L4 + Spring Washer		A30A2504Z1
A-3F	Cable Pen		A75007
A-3G	Unit York		A14027A
A-3H	Screw M2.5 × L8		A30A2508Z0
A-3I	Spring		A22001
A-3J	Pin		A15003
A-4	Cover Side		A13006
A-5	Shaft Slide		A15002
A-7	Screw (IMO) M3 × L4		A30001
A-8	Rail Slide		A13007
A-9	Screw (IMO) M3 × L4		A30001
A-10	Screw M2.5 × L5		A30A2505Z0
A-11	Cushion Rubber A		A45002

8.2.2 Beam Parts Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
B-1	Unit, Harness		A75009B
B-1A	Unit, Lead Switch P.C.B		A60006A
B-2	Screw M2 × L5+Spring Washer Flat + Washer		A30A2005Z4
B-3	Harness Clamp		A14014
B-4	Frat Print Circuit Clamp		A14013
B-5	Double Face		A47003
B-6	Screw M2 × L5		A30A2005Z0
B-7	Screw M2 × L6		A30A2006Z0

8.2.3 Base Frame Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
C-1A	Base Frame		A12001
C-1B	Cushion Rubber Plate		A45001
C-1C	Spacer		A16004
C-1D	Unit, Pulley (D22)		A17009A
C-1E	E Ring E-3		A34E30Z
C-1F	Unit, Pulley (D22)		A17009A
C-1G	E Ring E-3		A34E30Z
C-1H	Unit, Pulley (D22)		A17009A
C-1I	E ring E-3		A34E30Z
C-1J	Bar Set Plate		A14022
C-1K	Support Bar		A16002
C-1L	E Ring E-3		A34E30Z
C-1M	Adjust Plate C		A14010
C-1N	Screw M3 × L22		A30A3022Z0
C-10	Screw M3 × L8+Spring Washer+Flat Washer		A30A3008Z4
C-2	Unit, Support Plate (Right)		A14028A
C-2A	Screw M3 × L6 + Spring Washer		A30A3006Z1
C-3	Unit, Support Plate (Left)		A14029A
C-3A	Screw M3 × L6 + Spring Washer		A30A3006Z1
C-4A	X-axis Motor		A90002A
C-4B	Motor Bracket (X-axis)		A13013
C-4C	Screw M4 × L10 + Spring Washer		A30A4010Z1
C-4D	X-axis Pulley		A17004
C-4E	Screw (IMO) M3 × L8		A30002
C-4F	Screw M4 × L8		A30A4008Z1
C-5A	Y-axis Motor		A90003A
C-5B	Motor Bracket (Y-axis)		A13008
C-5C	Screw M4 × L10 + Spring Washer		A30A4010Z1
C-5D	Y-axis Pulley		A17005
C-5E	Screw (IMO) M4 × L8		A30002
C-5F	Screw M3 × L8		A30A3008Z1
C-6A	Adjust Plate A		A14031A
C-6B	Spacer		A16004
C-6C	Screw M4 × L16		A30A4016Z0
C-6D	E Ring E-3		A34E30Z
C-6E	Unit, Pulley (D22)		A17009A
C-6F	Screw M3 × L8 + Spring Washer+Flat Washer		A30A3008Z4
C-7A	Adjust Plate B		A14033
C-7B	Spacer		A16004
C-7C	Screw M4 × L16		A30A4016Z0
C-7D	E Ring E-3		A34E30Z
C-7E	Unit, Pulley (D22)		A17009A
C-7F	Screw M3 × L8 + Spring Washer + Flat Washer		A30A3008Z4
C-8	Wire Cramp A K-104G		A59001
C-9	Wire Cramp B K-105G		A59008

8.2.4 Base Frame Parts Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
D-1A	Unit, Pulley (D22)		A17009A
D-1B	Idle Plate		A14023
D-1C	Stud E		A16007
D-1D	E Ring E-3		A34E30Z
D-2	Guide Shaft		A15001
D-3	E Ring E-6		A34E60Z
D-4	Wave Washer		A32U80R
D-5	Cushion Rubber B		A45004
D-6	Guide Rail		A13003
D-7	Screw M3 × L4		A30A3004Z0
D-8	Unit, X-axis Wire		A24007A
D-9	Unit, Y-axis Wire		A24008A
D-10	Unit, Idle Wire A		A24009A
D-11	Unit, Idle Wire B		A24010A
D-12	Unit, Wire Cramp		A14035A
D-13	Screw M3 × L5 + Spring Washer		A30A3005Z1

8.2.5 Mechanical Parts Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
E-1	Beam Cover		A10004
E-2	Rear Plate		A13004
E-3	Screw M2 × L4		A30A2004Z0
E-4	Unit, Panel Plate		A12004B
E-5	Screw M3 × L6 + Spring Washer		A30A3006Z1

8.2.6 Power Supply Assy Parts List

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
G-1A	Switch Bracket				A13002
G-1B	A.C Cord With Plug	SVT3 × 18AWD			A75005
G-1C	Power Switch	SDJ1S			A87001
G-1D	Cord Bush	KR-51			A59003
G-1E	Terminal	320553			A72003
G-1F	Fuse	MGC UL2A			A73001
G-1G	Fuse Holder	FH002			A71002
G-1H	Shrink Tube	F2	L=20mm		A76001
G-1I	Power Cable	18AWG(Black)	L=65mm		A75008
G-1J	Band Stopper	CV-70			A59004
G-1K	Screw	M3 x L5 + Spring Washer			A30A3005Z1

8.2.7 Lower Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
I-1	Unit, Lower Cover		A10005A
I-2	Heat Sink A		A25001
I-3	Screw M3×L6+Spring Washer		A30A3006Z1
I-4	Rubber Foot		A45003
I-5	Screw M3 × L12 + Flat Washer (Large)		A30A3012Z3
I-6	FCC Label (U.S.A Only)		A28003
I-7	Wire Cramp A K-104G		A59001
I-8	Screw M3 × L8 + Spring Washer		A30A3008Z1
I-9	Screw M3 × L6 + Spring Washer		A30A3006Z1
I-10	Screw M3 × L12		A30A3012Z0
I-11	Plate (Main P.C.B Set)		A14019
I-12	Screw M2.5×L5		A30A2505Z0
I-13	Screw M3×L4		A30A3004Z0
I-14	Fastener		A59002
I-15	UL Mark Label		A28005
I-16	Caution Label		A28007
I-17	Wire Cramp B K-105G		A59008
I-18	Label Date Code		A28020
I-19	Nut M3		A31S30Z1

8.2.8 Lower Cover Parts Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
J-1	X-axis F.P.C Guide		A13001
J-2	Screw M2.5 × L4 + Flat Washer		A30A2504Z3
J-3	Set Plate (X-axis F.P.C)		A14021
J-4	Screw M2 × L10		A30A2010Z0
J-5	Screw M3 × L4		A30A3004Z0

8.2.9 Upper Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
K-1	Upper Cover A		A10002
K-2	Number Label		A28001
K-3	Upper Cover B		A10003
K-4	RS Logo		A28002
K-5	Screw M3 × L8 (FT)		A30003
K-6	Plate (Front)		A13010
K-7	Screw M3 × L5		A30B3005Z0
K-8	Nut M3		A31S30Z1
K-9	Fuse Label		A28006
K-10	Plate Guide		A14036
K-11	Screw M3 × L6(FT)		A30005

8.2.10 Upper Cover Parts Assy Parts List

Ref. No.	Description		Radio Shack Part Number	Manufacturer Part Number
L-1	Screw	M3 × L6		A30A3006Z0
L-2	Rozet Screw	M3 × L6		A30004
L-3	Rozet Washer			A32R30C
L-4	Screw	M3 × L6 (FT)		A30005
L-5	Screw	M4 × L6		A30A4006Z0
L-6	Steel Plate			A14026

8.2.11 Packing Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
M-1	Unit, Carton		A48007A
M-1B	Cushion (Right)		A48002
M-1C	Cushion (Left)		A48003
M-2	Fuse		A73001
M-3	Owner's Manual		A01001
M-4	Unit, Pen		A41022A

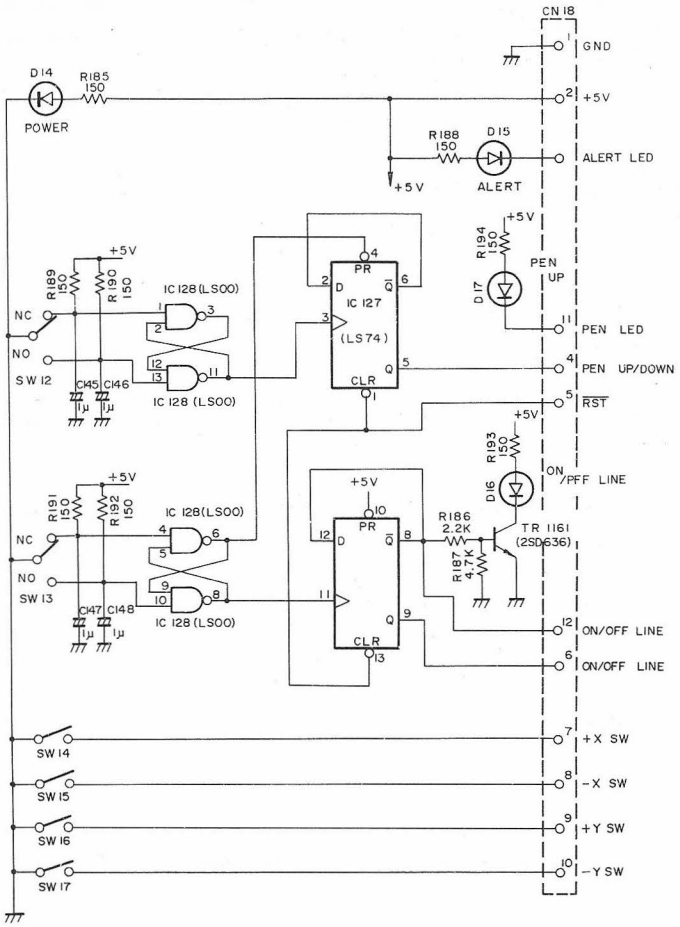
8.3 Power Supply Unit Parts List

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
N	Power Supply Unit				A80001
N-1	Printed Circuit Board (Main) Assembly				A60008A
	Capacitor				
C4	4700μF	50V	Electrolytic		A65A5472MX
C5	4700pF	100V	Film		A66F7472KX
C6	0.01μF	100V	Film		A66F7103KX
C7	0.01μF	100V	Film		A66F7103KX
C8	3300pF	100V	Film		A66F7332KX
C9	1000μF	25V	Electrolytic		A65A2102MC
C10	1000μF	25V	Electrolytic		A65A2102MC
C11	1000μF	25V	Electrolytic		A65A2102MC
C12	220μF	25V	Electrolytic		A65A2221MX
C13	3300μF	16V	Electrolytic		A65A1332MX
C14	47μF	25V	Electrolytic		A65A2470MX
C15	47μF	25V	Electrolytic		A65A2470MX
C16	100μF	10V	Electrolytic		A65A1101MX
C18	3300pF	100V	Film		A66F7332KX
C19	0.01μF	100V	Film		A66F7103KX

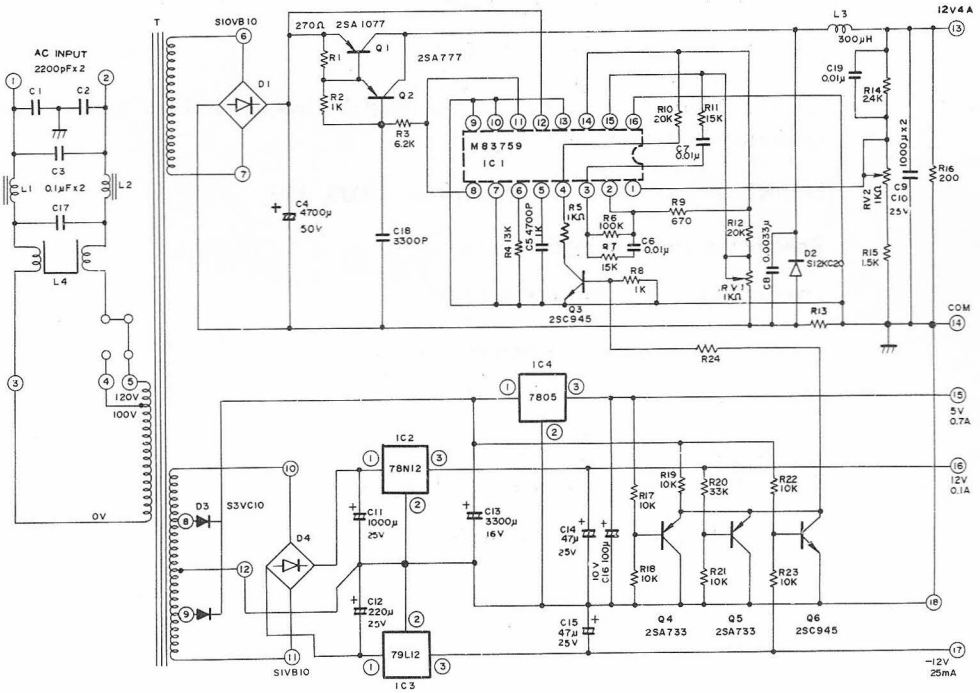
Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
	Diode				
D1	10A	400V	S10VB10		A62X002
D2	12A	200V	S12KC20		A62X003
D3	2.5A	100V	S3VC10		A62X004
D4	0.6A	100V	S1VB10		A62X005
	Regurator				
IC1	MB3759		Switching		A61XX0002F
IC2	μPC78M12 or Equivalent		Voltage		A61XX0003N
IC3	LM79L12 or Equivalent		Voltage		A61XX0004S
IC4	μPC7805H or Equivalent		Voltage		A61XX0005N
J1	Jumper Wire (A)				A75015
J2	Jumper Wire (B)				A75015
L3	4A	300μH	Inductor		A68003
	Transistor				
Q1	2SA1010L or Equivalent				A62T2A1010
Q2	2SA684P or Equivalent				A62T2A684*
Q3	2SC945P or Equivalent				A62T2C945*
Q4	2SA733P or Equivalent				A62T2A733*
Q5	2SA733P or Equivalent				A62T2A733*
Q6	2SC945P or Equivalent				A62T2C945*
	Resistor				
R1	270Ω	1/4W	Carbon		A63C04271J
R2	1KΩ	1/4W	Carbon		A63C04102J
R3	6.2KΩ	1W	Metal-Oxide		A63M10622J
R4	13KΩ	1/4W	Carbon		A63C04133J
R5	1KΩ	1/4W	Carbon		A63C04102J
R6	100KΩ	1/4W	Carbon		A63C04124J
R7	15KΩ	1/4W	Carbon		A63C04153J
R8	1KΩ	1/4W	Carbon		A63C04102J
R9	470Ω	1/4W	Carbon		A63C04471J
R10	20KΩ	1/4W	Carbon		A63C04203J
R11	1.5KΩ	1/4W	Carbon		A63C04152J
R12	20KΩ	1/4W	Carbon		A63C04203J
R13			Manganium Wire (ϕ1.6)		A63X003
R14	2.4KΩ	1/4W	Carbon		A63C04242J
R15	1.5KΩ	1/4W	Carbon		A63C04152J
R16	200Ω	3W	Metal-Oxide		A63M30201J
R17	10KΩ	1/4W	Carbon		A63C04103J
R18	10KΩ	1/4W	Carbon		A63C04103J
R19	10KΩ	1/4W	Carbon		A63C04103J
R20	33KΩ	1/4W	Carbon		A63C04333J
R21	10KΩ	1/4W	Carbon		A63C04103J
R22	10KΩ	1/4W	Carbon		A63C04103J
R23	10KΩ	1/4W	Carbon		A63C04103J
R24	1KΩ	1/4W	Carbon		A63C04102J
RV1	1KΩ	B	Variable Resistor		A64002
RV2	1KΩ	B	Variable Resistor		A64002

Ref. No.	Description				Radio Shack Part Number	Manufacturer Part Number
N-2	Printed Circuit Board (Noise Filter) Assembly					A60009A
	Capacitor					
C-1	2200pF	AC125V	Ceramic			A66C001
C-2	2200pF	AC125V	Ceramic			A66C001
C-3	0.1μF	AC125V	Metallized			A66X002
C-17	0.1μF	AC125V	Metallized			A66X002
	Inductor					
L-1	130μF	2A				A68001
L-2	125μH	2A				A68002
L-4	1mH	2A				A68004
N-3	Chassis			3-301-056-03		A10006
N-4	Cover			3-201-026-03		A10007
N-5	Heat Sink			3-401-086-03		A25002
N-6	Cord Strain Relief Bushing			5N4		A59005
N-7	Cord Strain Relief Bushing			4N4		A59006
N-8	4-Core Cord	2464	VW-1			A75012
N-9	AC Cord	SPT-2	VW-1	2×18AWG		A75013
N-10	Terminal			2-3		A72004
N-11	Ground Wire	1007	18AWG	VW-1		A75014
N-12	Phillips Pan Head Screw		M3 × L6			A30A3006Z0
N-13	Phillips Pan Head Screw		M3 × L12			A30A3006Z2
N-14	Flat Screw		M3 × L10			A30B3010Z0
N-15	Flat Screw		M3 × L8			A30B3008Z0
N-16	Flat Screw		M4 × L12			A30B4012Z0
N-17	Nut		M4			A31S40Z1
N-18	Washer		φ3			A32H30Z
N-19	Spring Washer		φ3			A32S30Z
N-20	Washer		φ4			A32M40Z
N-21	Spring Washer		φ4			A32S40Z
N-22	Nut		M3			A31S30Z1
N-23	Heat Sink (B)					A25003
N-24	Transister Bracket (A)					A13015
N-25	Transister Bracket (B)					A13016
N-26	Shrinking Tube (A)		φ15 × L23			A76002
N-27	Shrinking Tube (B)		φ18 × L30			A76003
N-28	Heat Sink Seat (A)		TC-30AG			A25004
N-29	Heat Sink Seat (B)		TC-30AG			A25005
N-30	Tube D-3.3		φ3 3 × L110			A76004
N-31	Tube D-5.2		φ5.2×L80			A76005
N-32	Tube D-5.2		φ5.2×L110			A76005
N-33	Binder		T18R			A59007
N-34	Connector		5196-06			A70012
N-35	Transformer					A80002

Front Panel Circuit Diagram



Power Supply Circuit Diagram (120V AC Model)



APPENDIX A/USING THE FLAT BED PLOTTER

with the TRS-80 Model II/16

If the Flat Bed Plotter is connected to a Model II or Model 16 and stays BUSY for longer than a few seconds, the Computer will generate an I/O error message and halt a BASIC program. This may happen when the Plotter is executing a long series of graphics instructions.

To avoid this situation, the following error routine may be useful:

1. At the beginning of the program, insert the line:
   10 ON ERROR GOTO 2COO
   Any error will then send program execution to line 2000.
2. Then, starting at line 2000, type:
   2000 IF ERR=56 THEN RESUME
   2010 ON ERROR GOTO 0

The instruction at line 2000 simply says "if the error is PRINTER BUSY FOR TOO LONG" then keep waiting. If there is any other error the program will continue with line 2010

Line 2010 says "Turn off the error rountine and display the error message". This restores the normal error checking routine.

Of course, you may use any line numbers you like instead of 2000.
See your Computer owner's manual for more details.

APPENDIX B/FLAT BED PLOTTER

Command Summary

Each command must be sent with either LPRINT for all TRS-80 Computers except Color Computer or PRINT #-2, for Color Computer.

10 LPRINT "PJON" PRINT#-2, "M100, 100"

B scale	Specifies a pitch for the dotted line. LPRINT "B3' PRINT#-2, "B20"
D destination	Draw from current coordinate to specified destination. If there is more than one point the line continues to the second point, etc. LPRINT "D"; X;", ";Y PRINT#-2, "D500, 350"
F number	Specify the effective plotting area. LPRINT "F1" PRINT#-2, "FO"
H	Moves to home position without drawing line. LPRINT "H" PRINT#-2, "H"
I x, y	Assign × and y to origin. Pen moves to an orginal point specified by x, y. LPRINT "I259, 470" PRINT#-2, "I800, I500"

J destination — Draws a line from current Pen location × steps to the right and Y steps up.

LPRINT "J100, 200, 300, −200, −400, −100"

L type — Change Line type a solid or a dotted line.

LPRINT"L1" PRINT#-2, "LO"

M x, y — Move (Absolute) without drawing to location × steps right (left) and y steps up (down) of present origin.

LPRINT"M1900, 1400" PRINT#-2, "M530, 470"

N number — Draw special markers by specified number.

LPRINT "NO" PRINT#-2, "N5"

P characters — Print characters in Graphic Mode.

LPRINT "PSample-1" PRINT#-2, "P12/16/1982"

Q direction — Change print direction. Direction is 0-3. 0, normal, left-to-right:1, top-to-bottom:2, upside down:3, bottom-to-top.

LPRINT "Q3" PRINT#-2, "Q1"

R x, y — Move (Relative) without drawing from present location to location × steps to the right (left) and y steps up (down).

LPRINT "R-100, -300" PRINT#-2, "R400, 500"

S size — Specify the size of the charector drawn with the P command. H size, o.6X size (mm): W size, 0.4X size (mm).

LPRINT "S4" PRINT#-2, "S100"

S axis, step, intervals — Draw a coordinate axis from present location in direction specified by axis using increments of step and marking intervals of them.

LPRINT "X0, 100, 10" PRINT#-2, "X1, −50, 20"

APPENDIX C/ASCII CHARACTER SET

The following table lists each character the Flat Bed Plotter will print and the ASCII code that will print it.

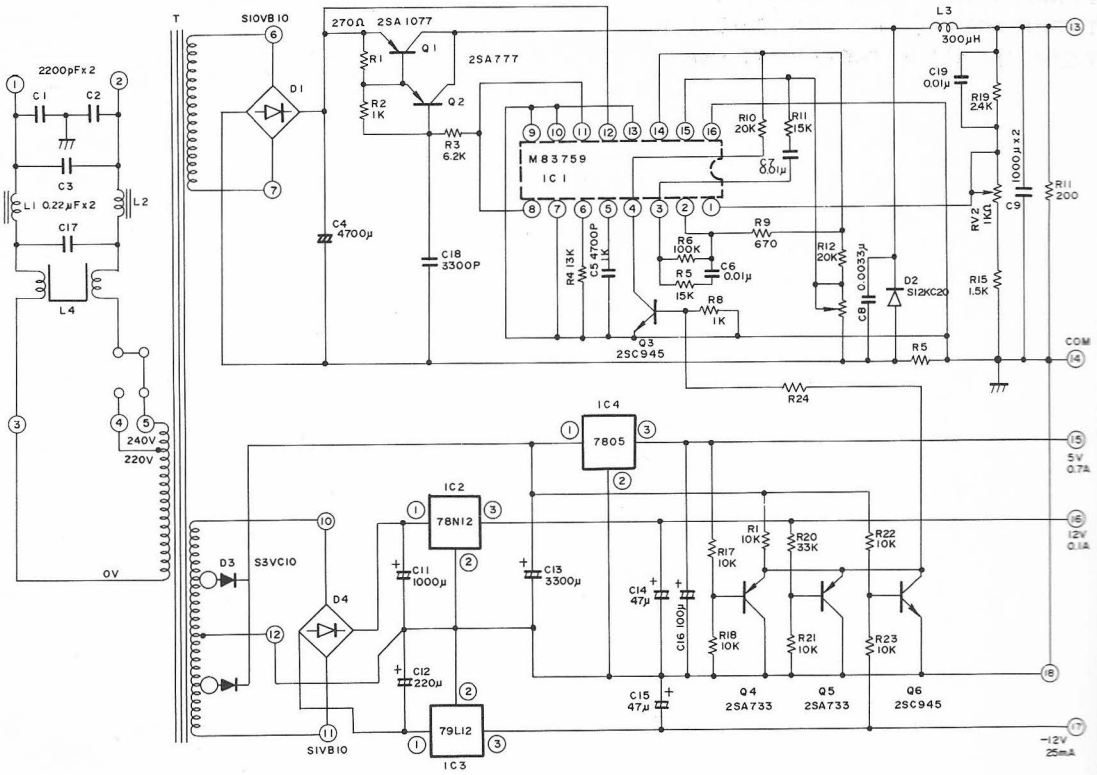
ASCII Code	Character	ASCII Code	Character
33	!	80	P
34	"	81	Q
35	#	82	R
36	$	83	S
37	%	84	T
38	&	85	U
39	'	86	V
40	(	87	W
41	)	88	X
42	*	89	Y
43	+	90	Z
44	,	91	[
45	-	92	\
46	.	93	]
47	/	94	^
48	0	95	_
49	1	96	`
50	2	97	a
51	3	98	b
52	4	99	c
53	5	100	d
54	6	101	e
55	7	102	f
56	8	103	g
57	9	104	h
58	:	105	i
59	;	106	j
60	<	107	k
61	=	108	l
62	>	109	m
63	?	110	n
64	@	111	o
65	*A*	112	p
66	*B*	113	q
67	*C*	114	r
68	*D*	115	s
69	E	116	t
70	F	117	u
71	G	118	v
72	H	119	w
73	I	120	x
74	J	121	y
75	K	122	z
76	L	123	{
77	M	124	|
78	N	125	}
79	O	126	~
		127	

Control Codes and the ASCII Code Required

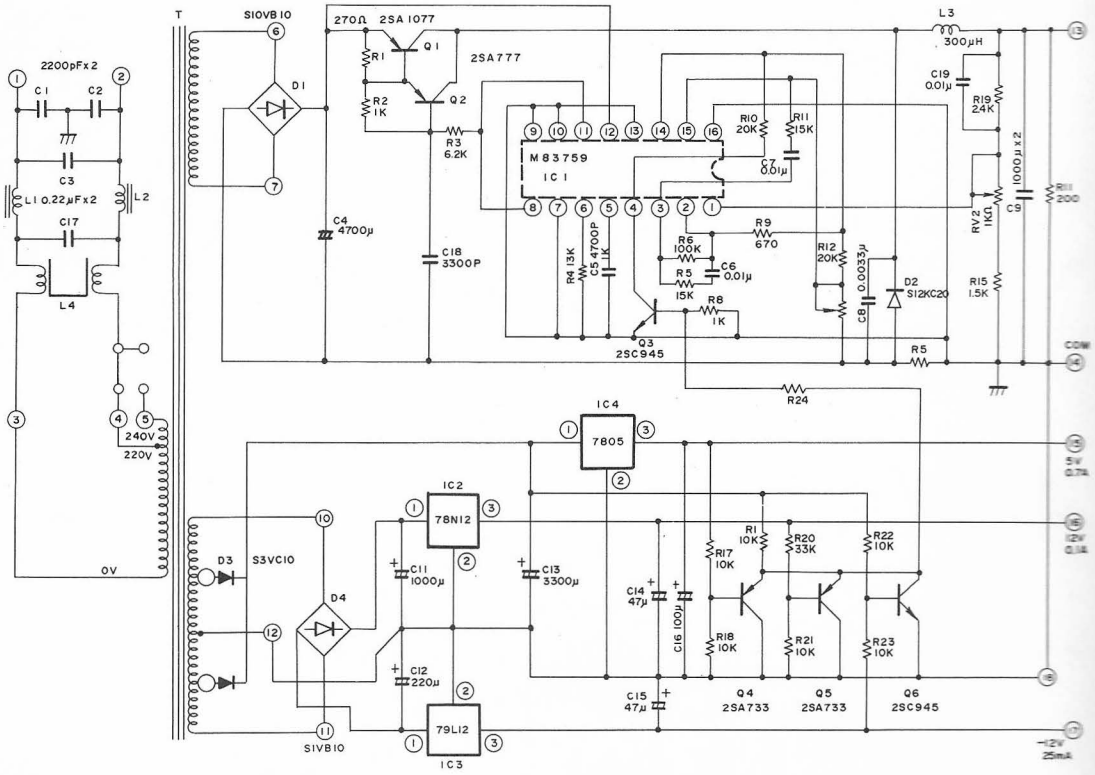
10	LINEFEED
13	CARRIAGE RETURN
17	SET PRINT MODE A (FROM GRAPHIC MODE)
18	SET PRINT MODE B (FROM GRAPHIC MODE)
19	SET GRAPHIC MODE (FROM PRINT MODE)

APPENDIX D/ADDITIONAL INFORMATION FOR CANADIAN/EUROPEAN/AUSTRALIAN MODELS

Power Supply Circuit Diagram (240V AC Model)

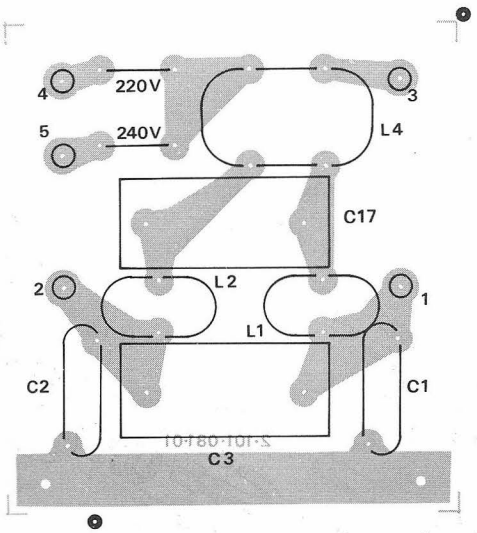


Power Supply Circuit Diagram (220V AC Model)

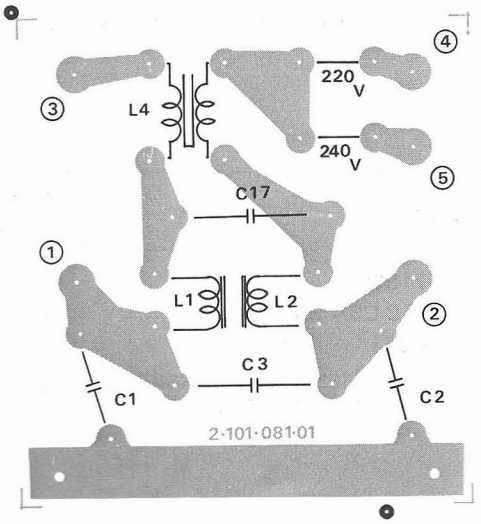


Printed Circuit Board (Noise Filter)
(European Models)

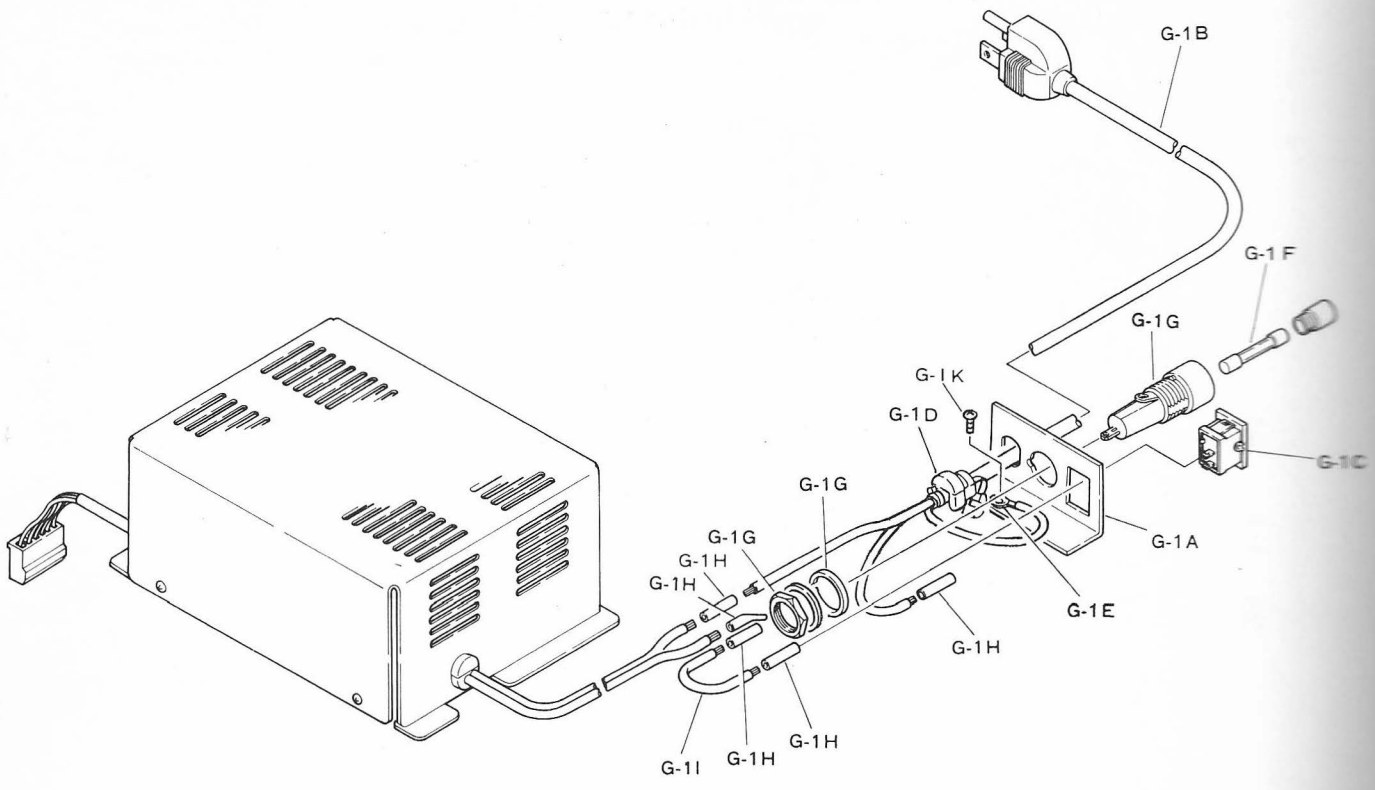
(Top View)



(Bottom View)



Canadian Model



Power Supply Assembly

Power Supply Assy Parts List

Ref. No.	Description		Radio Shack Part Number	Manufacturer Part Number
G-1E	Terminal	171509-2		A72007
G-1F	Fuse	MGC CSA 2A		A73002
G-1G	Fuse Holder	FH031		A71003
G-1K	Screw	M4 x L5		A30A4005Z0

Lower Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
I-6	No Used		—

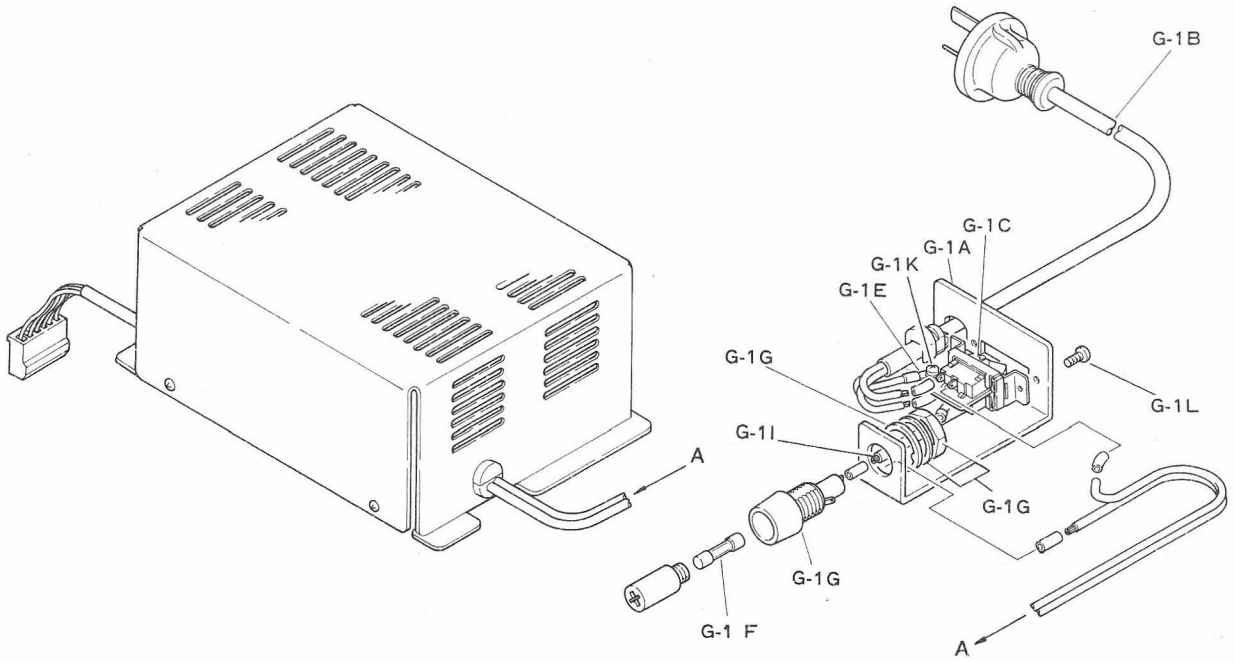
Upper Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
K-2	Number Label		A28010
K-9	Fuse Label		A28015

Packing Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
M-2	Fuse		A73002
M-3	Owner's Manual		A01002

Australia Model



Power Supply Assembly

Power Supply Assy Parts List

Ref. No.	Description		Radio Shack Part Number	Manufacturer Part Number
G-1A	Switch Bracket			A13018
G-1B	A.C.Cord With Plug	VM0418		A75022
G-1C	Power Switch	SDE3S-E		A87004
G-1E	Terminal	171509-2		A72007
G-1F	Fuse	WK 1A		A73003
G-1G	Fuse Holder	FH033		A71004
G-1I	Power Cable	18AWG (Black) L = 50mm		A75025
G-1K	Screw	M4 x L5		A30A4005Z0
G-1L	Screw	M3 x L5		A30A3005Z0

Lower Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
I-1	Unit, Lower Cover		A10005A01
I-6	No Used		—

Upper Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
K-2	Number Label		A28012
K-9	Fuse Label		A28016

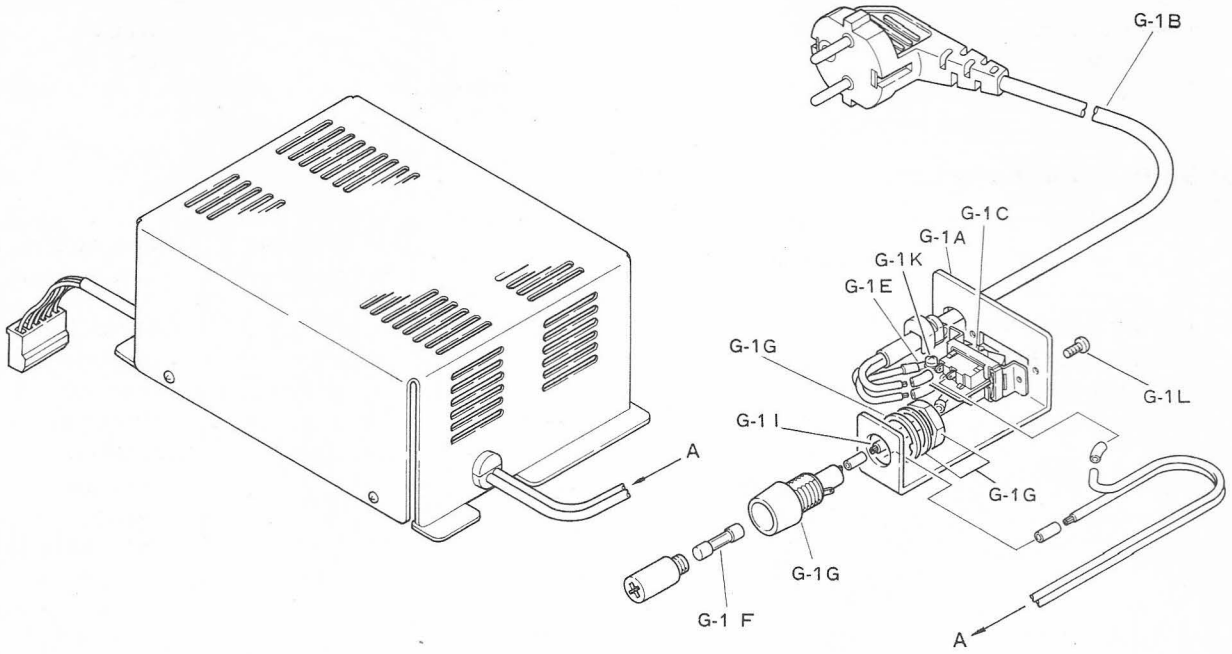
Power Supply Unit Parts List

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
N	Power Supply Unit				A80001B03
N-2	Print Circuit Board (Noise Filter) Assembly				A60009A03
C1	Ceramic Capacitor	AC400V	2200pF		A66C003
C2	Ceramic Capacitor	AC400V	2200pF		A66C003
C3	Ceramic Capatitor	AC250V	0.22μF		A66X004
C17	Ceramic Capacitor	AC250V	0.22μF		A66X004
N-35	Transformer				A80004

Packing Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
M-2	Fuse		A73003

Belgium Model



Power Supply Assembly

Power Supply Assy Parts List

Ref. No.	Description		Radio Shack Part Number	Manufacturer Part Number
G-1A	Switch Bracket			A13018
G-1B	A.C.Cord With Plug	VM0099		A75021
G-1C	Power Switch	SDE3S-E		A87004
G-1E	Terminal	171509-2		A72007
G-1F	Fuse	WK1A		A73003
G-1G	Fuse Holder	FH033		A71004
G-1I	Power Cable	118AWG(Black) L = 50mm		A75025
G-1K	Screw	M4 x L5		A30A4005Z0
G-1L	Screw	M3 x L5		A30A3005Z0

Lower Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
I-1	Unit, Lower Cover		A10005A0
I-6	No Used		—

Upper Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
K-2	Number Label		A28014
K-9	Fuse Label		A28018

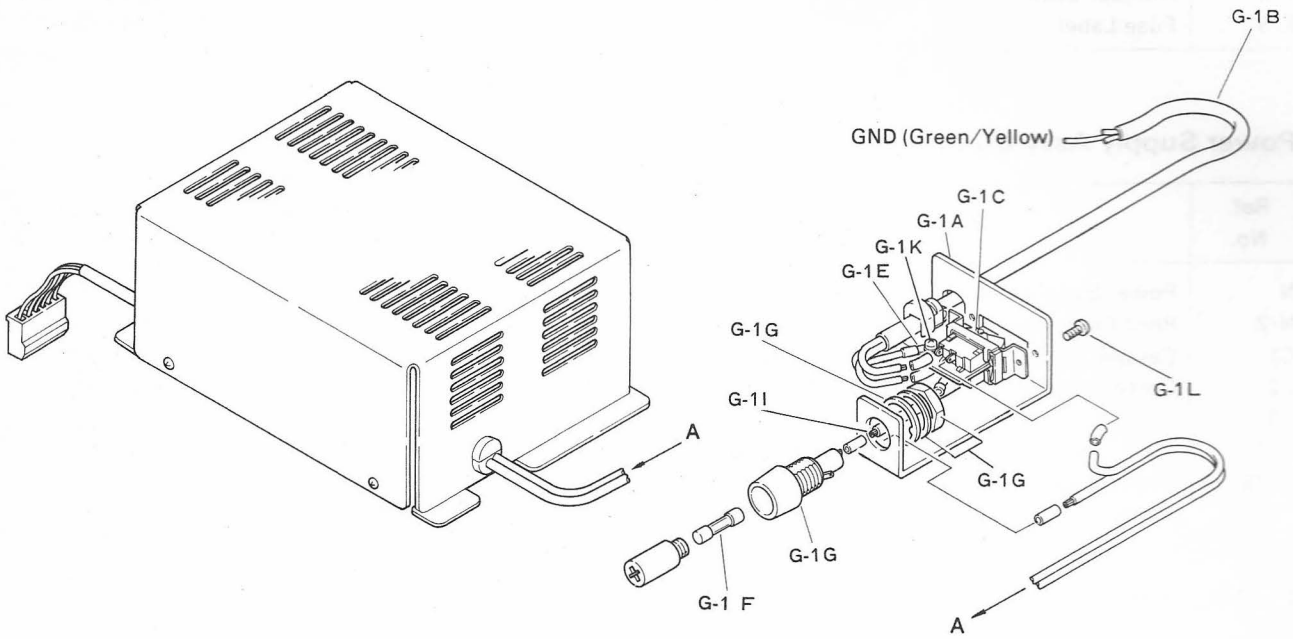
Power Supply Unit Parts List

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
N	Power Supply Unit				A80001B01
N-2	Print Circuit Board (Noise Filter) Assembly				A60009A01
C1	Ceramic Capacitor	AC400V	2200pF		A66C003
C2	Ceramic Capacitor	AC400V	2200pF		A66C003
C3		AC250V	0.22μF		A66X004
C17		AC250V	0.22μF		A66X004
N-35	Transformer				A80004

Packing Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
M-2	Fuse		A73003

UK Model



Power Supply Assembly

Power Supply Assy Parts List

Ref. No.	Description		Radio Shack Part Number	Manufacturer Part Number
G-1A	Switch Bracket			A13018
G-1B	A.C.Cord With Plug	VM0081		A75023
G-1C	Power Switch	SDE3S-E		A87004
G-1E	Terminal	171509-2		A72007
G-1F	Fuse	WK 1A		A73003
G-1G	Fuse Holder	FH033		A71004
G-1I	Power Cable	18AWG (Black) L = 50mm		A75025
G-1K	Screw	M4 x L5		A30A4005Z0
G-1L	Screw	M3 x L5		A30A3005Z0

Lower Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
I-1	Unit, Lower Cover		A10005A01
I-6	No Used		—

Upper Cover Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
K-2	Number Label		A28012
K-9	Fuse Label		A28016

Power Supply Assy Unit Parts List

Ref. No.	Description			Radio Shack Part Number	Manufacturer Part Number
N	Power Supply Unit				A80001B03
N-2	Print Circuit Board (Noise Filter) Assembly				A60009A03
C1	Ceramic Capacitor	AC400V	2200pF		A66C003
C2	Ceramic Capacitor	AC400V	2200pF		A66C003
C3		AC250V	0.22μF		A66X004
C17		AC250V	0.22μF		A66X004
N-35	Transformer				A80004

Packing Assy Parts List

Ref. No.	Description	Radio Shack Part Number	Manufacturer Part Number
M-2	Fuse		A73003

RADIO SHACK, A DIVISION OF TANDY CORPORATION

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