



**LTP4242**

**LINE THERMAL PRINTER MECHANISM**

**TECHNICAL REFERENCE**

**39019-2375-04**

**Seiko Instruments Inc.**

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7-1	④	Addition		In addition, design the printer so that the signal GND of the thermal head and the frame GND of the printer mechanism become the same electric potential.

## **LTP4242 TECHNICAL REFERENCE**

### **Document Number 39019-2375-04**

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## **PREFACE**

This reference manual describes the specifications and basic operating procedures for the LTP4242 Line Thermal Printer Mechanism. Read it thoroughly so that you are able to use the LTP4242 properly.

SII has not investigated the intellectual property rights of the sample circuits included in this manual. Fully investigate the intellectual property rights of these circuits before using.



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## CHAPTER 1

### FEATURES

The LTP4242 Line Thermal Printer Mechanism is a compact, high-speed thermal line dot printing mechanism. It can be used with a measuring instrument and analyzer, a POS, a communication device, or a data terminal device.

The LTP4242 has the following features:

- Compact and light  
The mechanism's dimensions are compact: 86.5 mm in width, 52 mm in depth, 22 mm in height, and approximately 150 g in weight.
- High resolution printing  
A high-density print head of 8 dots/mm produces clear and precise printing.
- Long life  
The mechanism is a maintenance-free device with the ability to print about 30 km or 50 million pulses.
- High speed printing <sup>1</sup>  
A maximum print speed of 560 dot lines per second (70 mm per second) is attainable.
- Compatible with thick paper <sup>2</sup>  
There are two possible paper paths; with the straight path, printing on thick paper is possible.
- Low noise  
Thermal line dot printing is used to guarantee low-noise printing.
- Automatic paper load  
A paper detector tells the LTP4242 when to load paper.
- Thermal head cleaning, replacement  
Cleaning and replacement can be easily done by moving the head release lever to the open position.

<sup>1</sup> Print speed differs depending on working conditions.

<sup>2</sup> Paper load path (curl or straight) is preset at the factory. To determine which path is used, contact a Seiko Instruments sales representative.

- Anti-static Electricity Function  
All metal parts can be connected to FG by connecting FG to the secured part of the printer.
  - Paper Winder<sup>3</sup>  
The drive power of the printer can be used for a paper winder.
- <sup>3</sup> Please specify your intent to use a paper winder because the specifications of the printer must be set accordingly at the factory.

**CHAPTER 2**  
**SPECIFICATIONS**

**2.1 GENERAL SPECIFICATIONS**

Table 2-1 General Specifications

Item	Specification
Print method	Thermal dot line printing
Dots per line	448 dots (print area 432 dots)
Resolution	8 dots/mm
Print width	56 mm (print area 54 mm)
Maximum print speed <sup>1</sup>	560 dot lines/sec (70 mm/sec)
Paper feed pitch	0.125 mm
Head temperature detection	Via a thermistor
Head-up detection	Via a mechanical switch
Out-of-paper detection	Via a photo interrupter
Operating voltage range	
V <sub>P</sub> line	24 ± 10% V
V <sub>dd</sub> line	5 ± 10% V

Table 2-1 General Specifications (Continued)

Item	Specification				
Current consumption For driving the head ( $V_P$ ) <sup>2</sup>	Print%	max.		Rated	
		Peak Current	(Average)	Peak Current	(Average)
	100%	7.4A	(2.4A)	5.7A	(2.6A)
	50%	3.7A	(1.2A)	2.9A	(1.3A)
	25%	1.8A	(0.6A)	1.4A	(0.7A)
	12.5%	0.9A	(0.3A)	0.7A	(0.3A)
For driving the motor ( $V_P$ )	0.25 A				
For head logic ( $V_{dd}$ )	Maximum 0.1 A				
Operating temperature range	0° to 50°C				
Storage temperature range	-20° to 60°C				
Life span (at 25° C and rated energy)	50 million pulses or more				
Activation pulse resistance	(print ratio=25%)				
Abrasion resistance	30 km or more				
Paper width	58 <sup>+0</sup> <sub>-1</sub> mm				
Paper feed force	50 g or more				
Paper hold force	100 g or more				
Dimensions (width × depth × height)	86.5 × 52.0 × 22.0 mm				
Weight	Approximately 150 g				
Recommended thermal paper	TF50KS-E2C (Nippon Paper Industries) PD-150R (New Oji Paper) PD-160R-N (New Oji Paper)				

<sup>1</sup> The print speed varies according to the processing speed of the controller.

<sup>2</sup> The current consumption for driving the head ( $V_P$ ) was calculated under the following conditions:

- 1) max: voltage: 26.4 V, head resistance: 850 Ω
- 2) Rated: voltage: 24 V, head resistance: 1000 Ω
- 3) Wire resistance: 40 Ω
- 4) Ambient temperature: 25°C
- 5) Print speed: 70 mm/sec
- 6) Number of dots: 248 dots max. (Fixed 2 division)

## 2.2 HEAT ELEMENT DIMENSIONS

The LTP4242 contains a thermal head with 448 heat elements (dot-size). However, the actual print area is 432 (8 dots on both the left and right are not used) because of the paper width.

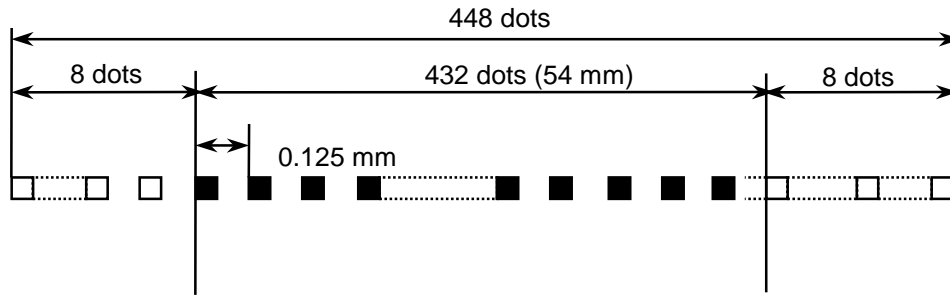


Figure 2-1 Heat Element Dimensions

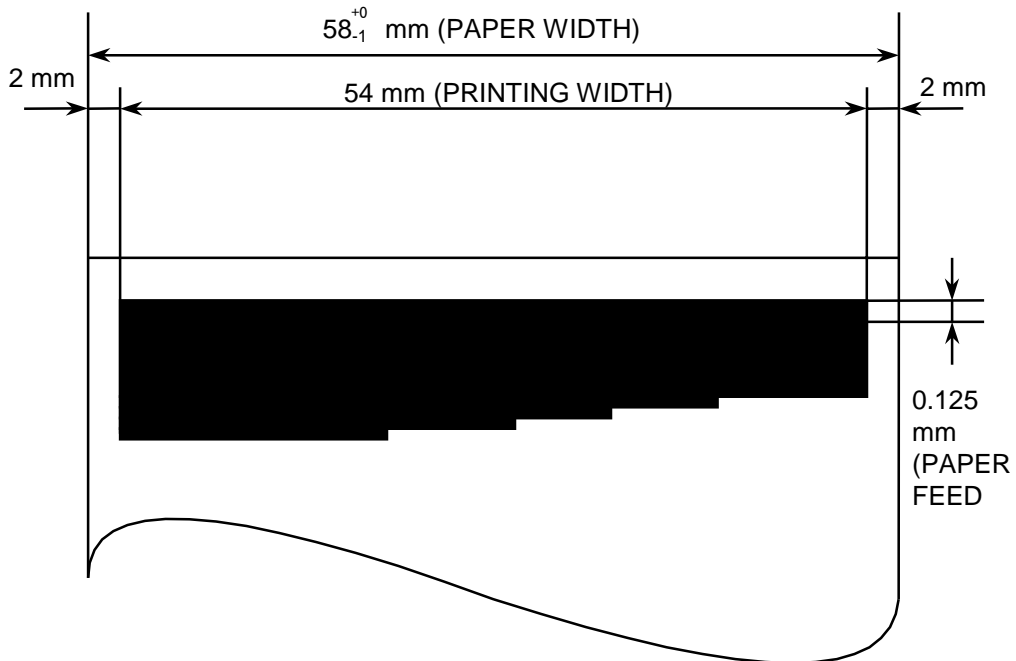


Figure 2-2 Print Area

### 2.3 PAPER FEED CHARACTERISTICS

- The LTP4242 prints with the bi-polar chopper drive method.
- Any type of design for the drive circuit other than the example described in section 2.4.1 may affect the standard functions of the printer.
- Paper is fed in the forward direction when the motor shaft is rotating in the normal direction (clockwise) as seen from the motor gear side.
- The motor is driven by a 2-2 phase excitation and feeds paper by 0.125 mm (equivalent to a single dot pitch) every two steps of the motor drive signal.
- To prevent deterioration in print quality due to backlash of the paper feed system, the motor should be driven 16 steps in the reverse direction then 16 steps in the normal direction during initialization or after backward feeding.
- During paper feed, the motor should be driven at 1120 pps.
- During printing, motor drive frequency should be adjusted so that the head activation pulse width should not exceed the motor step time. (For details, see Chapter 4.)
- Set the drive frequency of the motor (print speed) to the maximum speed so it does not vary up and down. This may result in noise or a loss of paper feed force.
- To automatically load paper, the motor should be driven at 300 pps.
- It is not possible to print while the motor is rotating in the reverse direction.
- Never run the motor under 300 pps because it may result in noise.

## 2.4 STEP MOTOR CHARACTERISTICS

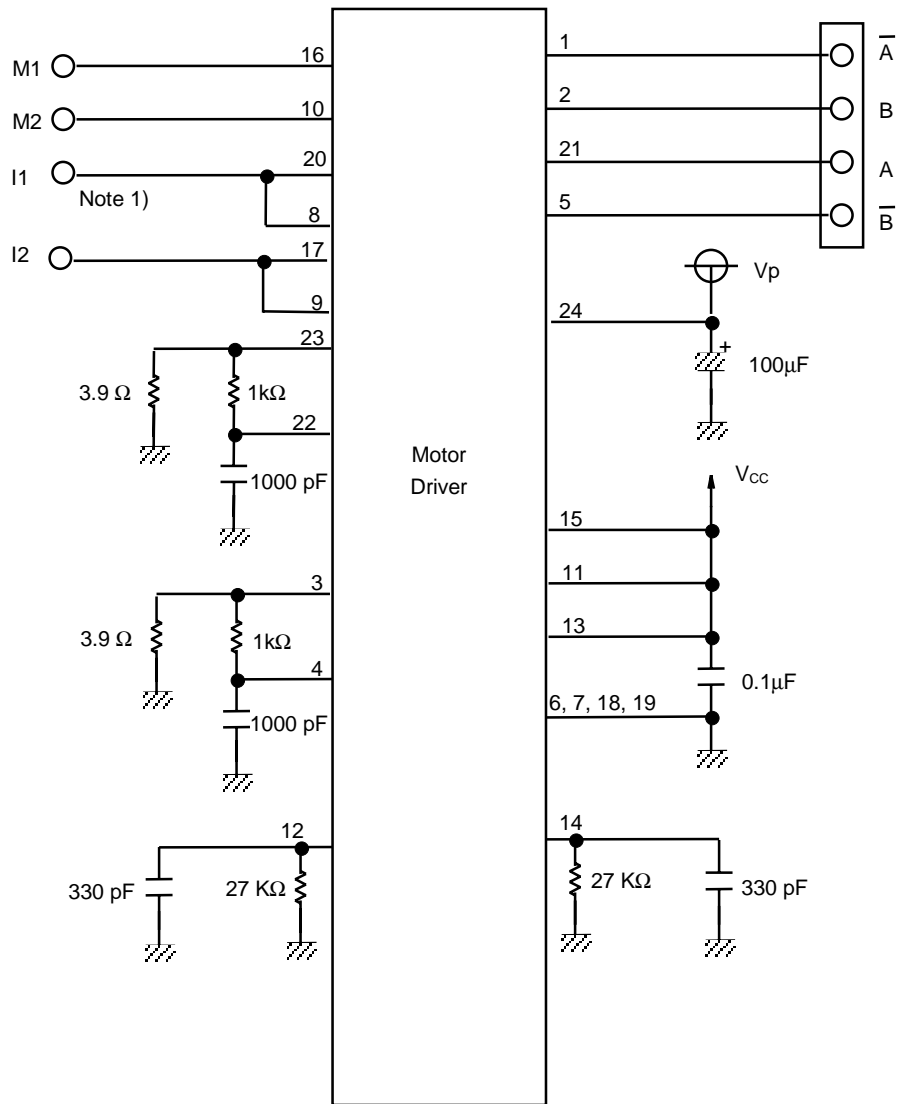
Table 2-2 General Motor Specifications

Item	Specification
Type	PM
Number of phases	4-phase
Drive method	Bi-polar Chopper
Excitation	2-2 phase
Winding resistance per phase	52 $\Omega \pm 7\%$
Rated voltage	24 V $\pm 10\%$
Set current	125 mA/equivalent
Maximum drive frequency	1120 pps max.

## 2.4.1 Motor Drive Circuit

### (1) Sample Drive Circuit

A sample drive circuit for the motor is shown in Figure 2-3.



\* Selected motor driver

Note) V<sub>p</sub>=24V

L6219 (SGS THOMSON)

Note) V<sub>CC</sub>=5V

UDN2916B-V (SANKEN)

Note 1) Connect I1 to GND when using the LTP4242B-C432 with Winder Unit WU280.

Figure 2-3 Sample Drive Circuit (Motor)

(2) Excitation Sequence

As shown in Table 2-3, the LTP4242 feeds the paper in the normal direction when the motor is excited in the order of step 1, step 2, step 3, step 4, step 1, step 2, . . . . On the other hand, to rotate the motor in the reverse direction, drive the motor in the reverse order: step 4, step 3, step 2, step 1, step 4, step 3, . . . .

Sequence	Signal Name			
	$\bar{A}$	B	A	$\bar{B}$
Step 1	OFF	ON	ON	OFF
Step 2	ON	ON	OFF	OFF
Step 3	ON	OFF	OFF	ON
Step 4	OFF	OFF	ON	ON

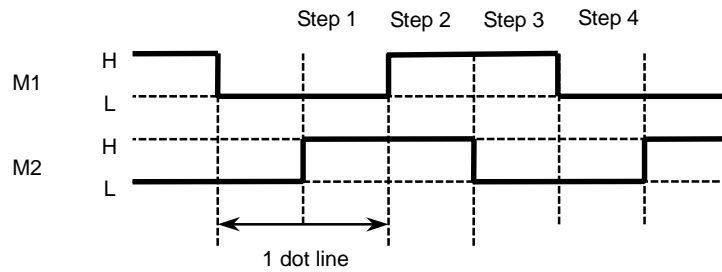


Figure 2-4 Input Voltage Signals for the Sample Drive Circuit (Motor)

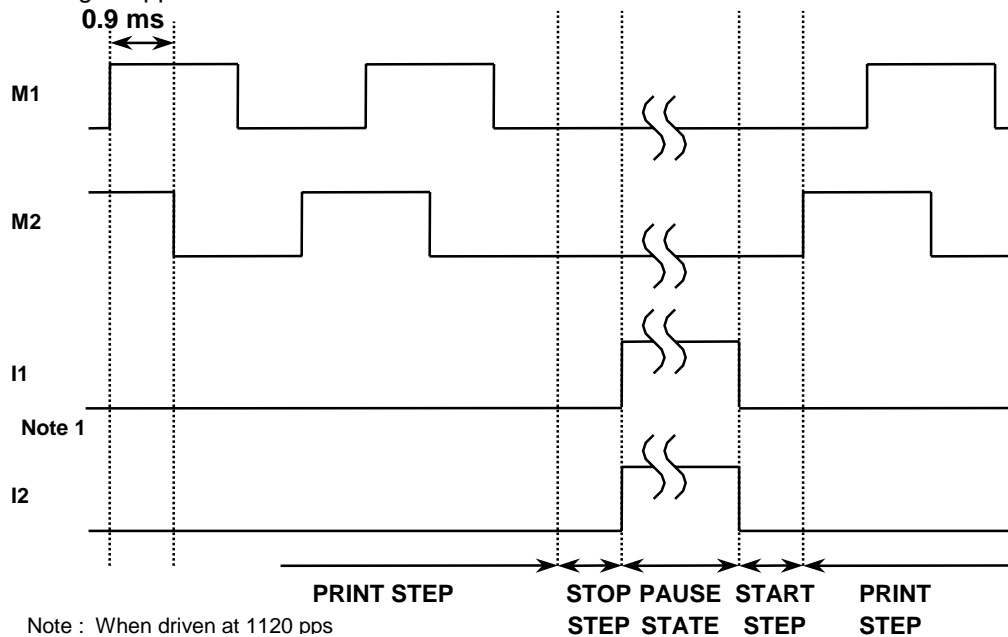
## 2.4.2 Motor Timing

Refer to the time chart in Figure 2-5 when designing the control circuit or software for starting and stopping the motor. Also note the following precautions:

### Precautions for Designing the Motor Control Circuit and Software

- (1) Stop step
  - To stop the motor, excite for 50 msec with the same phase as the last one in the printing step.
- (2) Pause state
  - <When using the LTP4242 only>
    - In the pause state, set I1 and I2 to high. Even when the step motor is not excited, it keeps holding torque to prevent paper from sliding.
  - <When using the LTP4242B-C432 with Winder Unit WU280>
    - I1 is Low (GND). 1/3 of the specified current flows to the motor and the motor is in half excitation state.
- (3) Start step
  - To restart the motor from the stop step, immediately shift the motor into the print sequence.
  - To restart the motor from the pause (no excitation) state, shift the motor into the print sequence after outputting the same phase as that of the stop step for a single step of the first acceleration step (3323  $\mu$ sec).

The voltages applied to the motor coils are shown below.



Note : When driven at 1120 pps

Note 1: I1 is always Low (GND) when using the LTP4242 with Winder Unit WU280.

Figure 2-5 Motor Start/Stop Timing (When using the LTP4242 only)

### 2.4.3 Precautions for Driving the Motor

#### Acceleration Control

When driving the motor, acceleration must be controlled at start up in order to maintain the paper feed force.

Accelerate the motor up to the maximum speed by following the acceleration steps shown in Table 2-4.

The method for accelerating the motor is as follows:

1. Output the start step for 3323 ( $\mu\text{sec}$ )
2. Output the first step for the first acceleration step time
3. Output the second step for the second acceleration step time
4. Output the nth step for the nth step acceleration time
5. After accelerating to the maximum driving speed the motor is driven at constant speed.

Printing can be executed during acceleration.

Table 2-4 Acceleration Steps

STEP No.	SPEED PPS	STEP TIME $\mu\text{SEC}$
Start	—	3323
1	301	3323
2	487	2054
3	631	1586
4	751	1331
5	857	1167
6	952	1050
7	1039	962
8	1120	892

## 2.5 THERMAL HEAD

### 2.5.1 Structure of the Thermal Head

As shown in Figure 2-6, the thermal head consists of heat elements and a head driver which drives and controls the heat element.

Serial print data input from DATA IN (DI) is transferred to the shift register synchronously with the CLOCK (CP), then stored in the latch register at the timing of the LATCH (LA) signal.

The heat elements which correspond to the latched print data are activated when the head activation signal (print commands DST1 to DST7) turns on the gate. The LTP4242 has seven head activation terminals (DSTs), thus making it so that the print operation is divided into a maximum of nine blocks to be executed. Table 2-5 shows the relation between the DSTs and the heat elements.

Table 2-5 DST Terminals and Activated Heat Elements

DST Number	Heat Element Number	Dots/DST
1	1 - 64	64
2	65 - 128	64
3	129 - 192	64
4	193 - 256	64
5	257 - 320	64
6	321 - 384	64
7	385 - 448	64

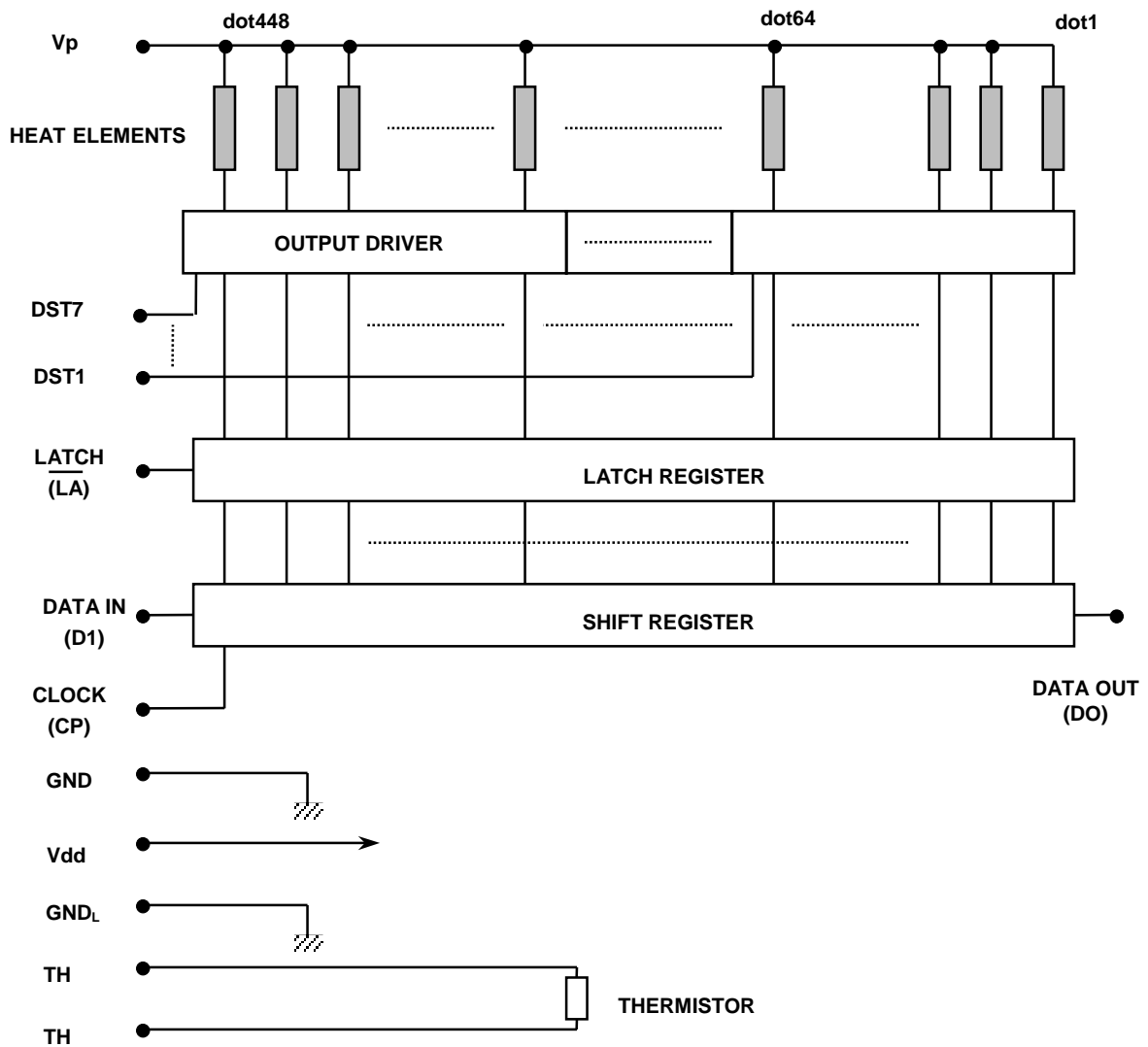
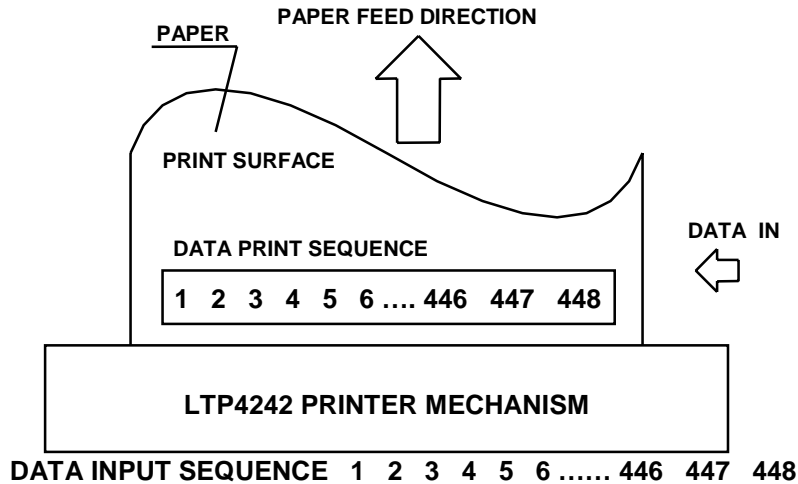


Figure 2-6 Thermal Head Block Diagram

### 2.5.2 Printed Position of the Data

Data dots from 1 to 448 which are transferred through DATA IN (DI) are printed as shown in Figure 2-7.



NOTE: The first eight dots on the left and the last eight dots on the right are outside the print area.

Figure 2-7 Printed Position of the Data

### 2.5.3 Head Resistance

The LTP4242 head resistance is classified into three ranks as shown in Table 2-6. Head resistance ranks are also indicated on the label on the front of the LTP4242.

Table 2-6 Head Resistance Ranks

Rank	Head Resistance
A	1050 to 1150 $\Omega$
B	950 to 1050 $\Omega$
C	850 to 950 $\Omega$

\* The rank is written on the label on the left side panel of the printer.

**Sample Label showing the Head Resistance Rank**

In this example, the head resistance rank is A.

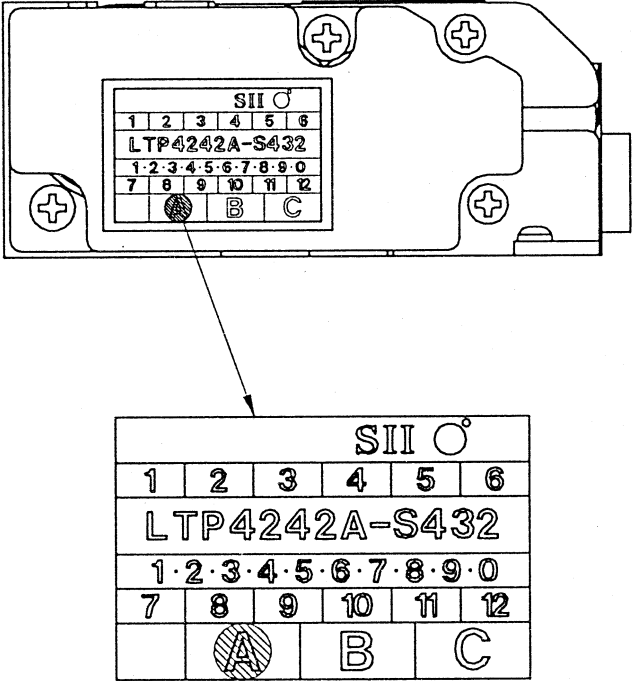


Figure 2-8 Sample Label showing the Head Resistance Rank

**2.5.4 Head Voltage**

The LTP4242 has a built-in head driver IC. Table 2-7 shows the head voltage.

Table 2-7 Head Voltage

Item		Voltage Range
Head drive voltage	$V_p$	21.6 to 26.4 V
Head logic voltage	$V_{dd}$	4.5 to 5.5 V

### 2.5.5 Peak Current

Since the peak current (maximum current) may reach the values calculated using equation (1) when the thermal head is driven, make sure that the allowable current for the cable material and the voltage drop on the cables are well within the specified range.

Equation 1:

$$I_P = \frac{N \times V_P}{RH}$$

$I_P$ : Peak current (A)

$N$ : Number of dots that are driven at the same time

$V_P$ : Head drive voltage (V)

$RH$ : Head resistance ( $\Omega$ )

## 2.5.6 Thermal Head Electrical Characteristics

Table 2-8 Thermal Head Electrical Characteristics (at V<sub>dd</sub>=5V, 25°C)

Item	Symbol	Conditions	Min.	Typ.	Max.
Head resistance	RH	—	850 Ω	1000 Ω	1150 Ω
Head drive voltage	V <sub>p</sub>	standard print conditions	21.6V	24.0 V	26.4V
Logic block voltage	V <sub>dd</sub>	—	4.5 V	5.0 V	5.5 V
Logic block current	I <sub>dd</sub>	waiting	-	-	0.5 mA
		f <sub>cp</sub> =2 MHz DI fixed	-	-	6 mA
		f <sub>cp</sub> =4 MHz, DI=1/2f <sub>cp</sub>	-	-	10 mA
“High” input voltage	V <sub>ih</sub>	DST, DI, $\overline{\text{LA}}$ , CP	0.8 V <sub>dd</sub>	-	V <sub>dd</sub>
“Low” input voltage	V <sub>il</sub>	DST, DI, $\overline{\text{LA}}$ , CP	0 V <sub>dd</sub>	-	0.2 V <sub>dd</sub>
“High” input current	I <sub>ih</sub>	DI	-	-	0.5 μA
		DST1 to DST7 (all)	-	-	35 μA
		$\overline{\text{LA}}$ , CP	-	-	4.5 μA
“Low” input current	I <sub>il</sub>	DI	-	-	-0.5 μA
		DST1 to DST7 (all)	-	-	-0.5 μA
		$\overline{\text{LA}}$ , CP	-	-	-4.5 μA
“High” output voltage	V <sub>oh</sub>	DO, at no load	4.45 V	-	-
“Low” output voltage	V <sub>ol</sub>	DO, at no load	-	-	0.05 V
“High” output current	I <sub>oh</sub>	DO, at V <sub>oh</sub> =V <sub>dd</sub> -0.4 V	-0.5 mA	-	-
“Low” output current	I <sub>ol</sub>	DO, at V <sub>ol</sub> =0.4 V	0.5 mA	-	-

Table 2-8 Thermal Head Electrical Characteristics (at V<sub>dd</sub>=5V, 25°C) (Continued)

Item	Symbol	Conditions	Min.	Typ.	Max.
Maximum clock frequency	f <sub>cp</sub>	—	-	-	4 MHz
Data setup time	t <sub>1</sub>	See Figure 2-9.	50 ns	-	-
Data hold time	t <sub>2</sub>	See Figure 2-9.	20 ns	-	-
Clock pulse width	t <sub>3</sub>	See Figure 2-9.	100 ns	-	-
Data output delay time	t <sub>4</sub>	See Figure 2-9.	-	-	200 ns
Latch setup time	t <sub>5</sub>	See Figure 2-9.	200 ns	-	-
Latch pulse width	t <sub>6</sub>	See Figure 2-9.	200 ns	-	-
DST setup time	t <sub>7</sub>	See Figure 2-9.	300 ns	-	-

### 2.5.7 Timing Chart

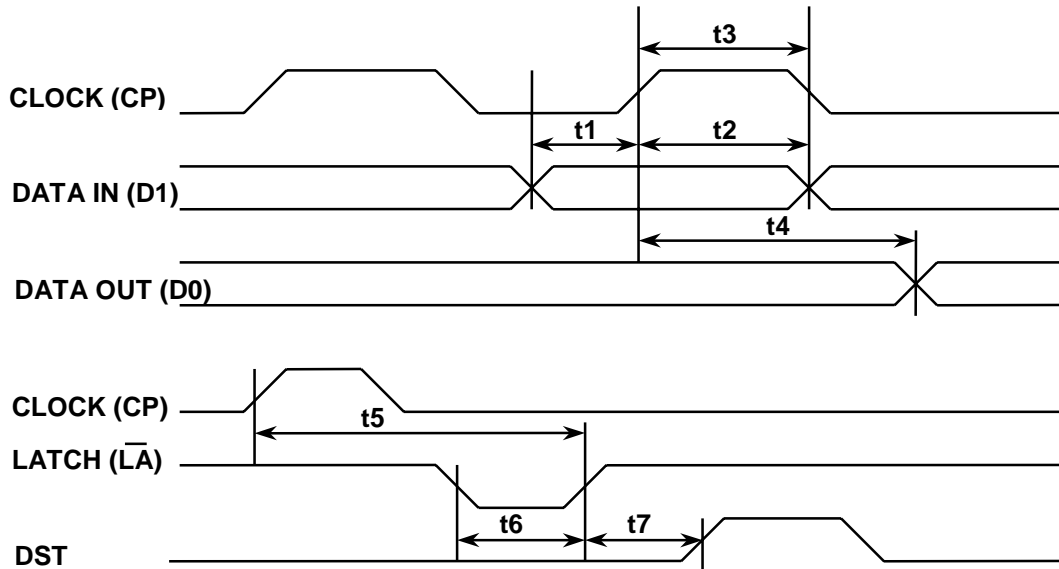


Figure 2-9 Timing Chart

## 2.6 CONTROLLING THE HEAD ACTIVATION (DST) PULSE WIDTH

### 2.6.1 Calculation of the Head Activation Pulse Width

To execute high quality printing using the LTP4242, the value that is calculated using the following equation (2) must be adjusted according to the printer installation environment. Calculate the values used in equation (2) according to the steps in Sections 2.6.2 to 2.6.4.

Printing using too high of voltage or too long of pulse width may shorten the life of the thermal head.

Equation 2:

$$t = \frac{E \times R}{V^2} \times C$$

t	: Head activation pulse width (ms)	
V	: Head activation voltage (V)	
E	: Applied energy (mJ)	Refer to Section 2.6.2.
R	: Head resistance ( $\Omega$ )	Refer to Section 2.6.3.
C	: Head activation pulse term coefficient	Refer to Section 2.6.4.

### 2.6.2 Calculation of the Applied Energy

The applied energy should be according to the temperature of the thermal head and the printer installation environment. Detect temperature according to the resistance value of the thermistor installed in the thermal head. Calculate the printing energy using equation (3) and the paper coefficient and temperature coefficient.

Equation 3:

$$E = (E_0 - T_C (T_x - 25)) \times P$$

E	: Applied energy (mJ)
E <sub>0</sub>	: Standard applied energy 0.3691 (mJ)
T <sub>x</sub>	: Detected temperature using the thermistor ( $^{\circ}\text{C}$ ) <sup>1</sup>
P	: Thermal paper coefficient

TF50KS-E2C (Nippon Paper Industries)	} 1.0
PD-150R (New Oji Paper)	
PD-160R-N (New Oji Paper)	

T <sub>C</sub>	: Temperature coefficient	0.004430
----------------	---------------------------	----------

<sup>1</sup> The thermistor resistance value at T<sub>x</sub> ( $^{\circ}\text{C}$ ). Refer to Section 2.6.5.

### 2.6.3 Adjustment of the Head Resistance

Adjustment of the head resistance is according to equation (4). Due to wiring resistance there is a drop in voltage.

Equation 4:

$$R = \frac{(RH + 25 + (R_C + rc) \times N)^2}{RH}$$

RH: Head resistance

rank A 1100 ( $\Omega$ )

rank B 1000 ( $\Omega$ )

rank C 900 ( $\Omega$ )

25: Wiring resistance in the thermal head ( $\Omega$ )

$R_C$ : Common terminal wiring resistance in the thermal head 0.16 ( $\Omega$ )

rc: Wiring resistance between  $V_P$  and GND ( $\Omega$ )<sup>1</sup>

N: Number of dots driven at the same time

<sup>1</sup> This resistance is the resistance of the wire used between the FPC terminal of thermal head, the power supply, the resistance of switching circuit of relay, etc.

### 2.6.4 Head Activation Pulse Term Coefficient

The head activation pulse term coefficient (equal motor drive frequency) is according to equation (5) because the printing density changes by printing speed.

Equation 5:

$$C = 1 - \frac{2.1}{(3.6 + W)}$$

W: Head activation pulse term for 1 dot line (ms)

$W = 2000 / \text{motor drive frequency (pps)}$

### 2.6.5 Thermistor Resistance

The resistance of the thermistor at the operating temperature  $T_x$  ( $^{\circ}\text{C}$ ) is determined using the following equation (6).

Equation 6:

$$R_x = R_{25} \times \text{EXP} \left\{ B \times \left( \frac{1}{273 + T_x} - \frac{1}{298} \right) \right\}$$

- $R_x$ : Resistance at operating temperature  $T_x$  ( $^{\circ}\text{C}$ )
- $R_{25}$ :  $15 \text{ k}\Omega \pm 10\%$  ( $25^{\circ}\text{C}$ )
- $B$ :  $3750 \text{ K} \pm 200 \text{ K}$
- $T_x$ : Operating temperature ( $^{\circ}\text{C}$ )
- EXP (A): The Ath power of natural logarithm e (2.71828)

[Rating]

Operating temperature range:  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

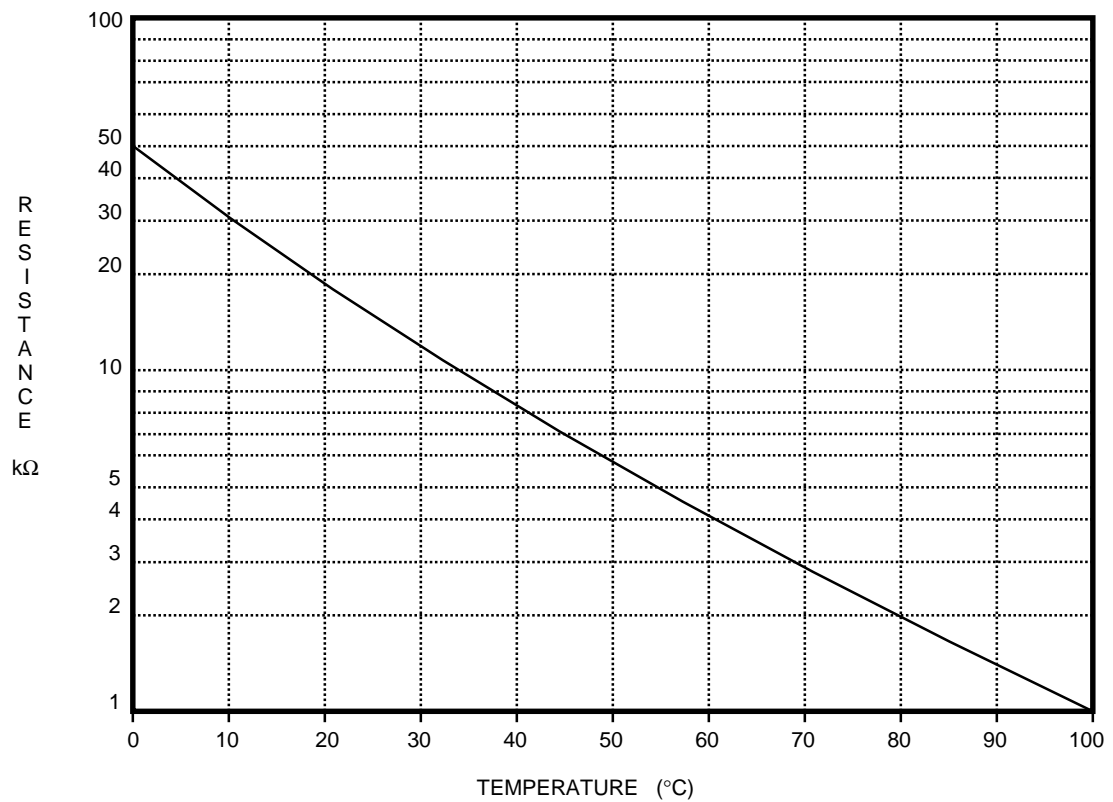


Figure 2-10 Thermistor Resistance vs. Temperature

Table 2-9 Temperature and Corresponding Thermistor Resistance

Temperature (°C)	Thermistor Resistance (kΩ)
0	47.49
5	37.09
10	29.23
15	23.22
20	18.59
25	15.00
30	12.19
35	9.97
40	8.21
45	6.80
50	5.66
55	4.74
60	4.00
65	3.38
70	2.88
75	2.46
80	2.11
85	1.82
90	1.58
95	1.37
100	1.19

## 2.6.6 Detecting Abnormal Temperatures of the Thermal Head

To protect the thermal head and to ensure personal safety, abnormal thermal head temperatures must be detected by both hardware and software as follows:

- Detecting abnormal temperatures by software

Design software that will deactivate the heat elements if the thermal head thermistor (TH) detects a temperature higher than 80°C (thermistor resistance  $R_{TH} \leq 2.11 \text{ k}\Omega$ ), and reactivate the heat elements when a temperature lower than 60°C ( $R_{TH} \geq 4.00 \text{ k}\Omega$ ) is detected. If the thermal head continues to be activated at a higher temperature than 80°C, the life of the thermal head may be shortened significantly.

- Detecting abnormal temperatures by hardware

If the control unit (CPU) malfunctions, the software for detecting abnormal temperatures may not function properly, resulting in overheating of the thermal head. The overheating of the thermal head may cause damage to the thermal head or cause skin burns.

Always use hardware in conjunction with software for detecting abnormal temperatures to ensure personal safety (this may not prevent damage to the thermal head).

Using a window comparator circuit or similar detector, design hardware that detects the following abnormal conditions:

- (a) Overheating of the thermal head (approximately 100°C or higher ( $R_{TH} \leq 1.19 \text{ k}\Omega$ ))
- (b) Faulty thermistor connection (the thermistor may be open or short-circuited).

If (a) and (b) detected, immediately deactivate the heat elements. Reactivate the heat elements after they have returned to normal.

## 2.7 HEAD-UP DETECTOR

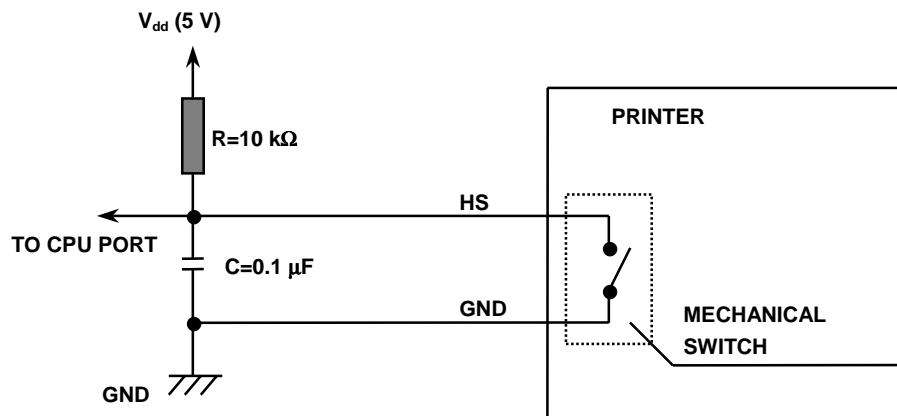
LTP4242 has a built-in head-up detector to detect whether the head is up or down. This detector is a mechanical switch which is designed to close when the head is in the down position (printing state) and to open when in the up position.

The external circuit should be designed so that it detects the output from the head-up detector and does not activate the thermal head when the head is in the up position. Otherwise, the thermal head may be damaged or the life of the head may be shortened significantly.

### 2.7.1 General Specifications

Maximum rating: 7 V DC, 1 mA  
Contact resistance: 70 m $\Omega$  maximum

### 2.7.2 Sample External Circuit



The mechanical switch is closed when the head is in the down position.

Figure 2-11 Sample External Circuit for the Head-Up Detector

Note that there is a time lag between the time when the thermal head stays completely up or down and when the head-up detector starts to operate.

Always use the capacitor shown in Figure 2-11 to prevent the switch from malfunctioning as a result of chattering.

## 2.8 PAPER DETECTOR

The LTP4242 has a built-in paper detector (reflection type photo-interrupter) to check for the presence or absence of paper.

The external circuit should be designed so that it detects the output from the paper detector and does not activate the thermal head when paper runs out. Otherwise, the thermal head or platen roller may be damaged or the life of the thermal head may be significantly shortened.

### 2.8.1 General Specifications

Table 2-10 Absolute Maximum Ratings of the Paper Detector (at 25°C)

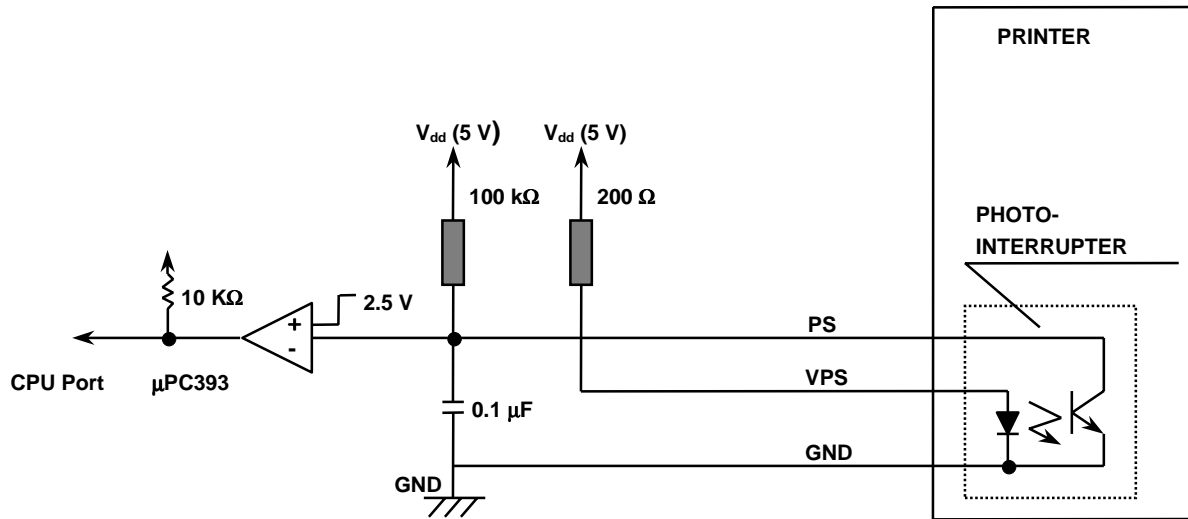
Item		Symbol	Rating
LED (input)	Forward current	$I_F$	50 mA
	Peak forward current	$I_{FM}$	1A
	Reverse voltage	$V_R$	6 V
	Allowable current	$P$	75 mW
Phototransistor (output)	Collector-to-emitter voltage	$V_{CEO}$	35 V
	Emitter-to-collector voltage	$V_{ECO}$	6 V
	Collector current	$I_C$	20 mA
	Collector loss	$P_C$	75 mW
Total allowable loss		$P_{tot}$	100 mW
Operating temperature		$T_{opr}$	-25° to +85°C
Storage temperature		$T_{stg}$	-40° to +100°C

Table 2-11 Paper Detector Input/Output Conditions

Item		Symbol	Conditions	Std.	Max.
LED (input)	Forward voltage	$V_F$	$I_F=20\text{ mA}$	1.2 V	1.4 V
	Peak forward voltage	$V_{FM}$	$I_{FM}=0.5\text{ A}$	3.0 V	4.0 V
	Reverse current	$I_R$	$V_R=6\text{ V}$	—	10 $\mu\text{A}$
	Capacity between terminals	$C_t$	$V_R=0\text{ V}$ , $f=1\text{ kHz}$	50 pF	100 pF
Phototransistor (output)	Dark current	$I_{CEO}$	$V_{CE}=20\text{ V}$	$10^{-9}\text{ A}$	$10^{-7}\text{ A}$
Transfer char.	Photoelectric current	$I_C$	$I_F=4\text{ mA}$ , $V_{CE}=2\text{ V}$	45 $\mu\text{A}$	120 $\mu\text{A}$
	Response time (at rise)	$t_r$	$I_C=100\text{ }\mu\text{A}$ , $V_{CE}=2\text{ V}$ $R_L=1\text{ k}\Omega$ , $d=1\text{ mm}^1$	20 $\mu\text{s}$	100 $\mu\text{s}$
	Response time (at fall)	$t_f$		20 $\mu\text{s}$	100 $\mu\text{s}$
	Leak current	$I_{LEAK}$	$I_F=4\text{ mA}$ , $V_{CE}=2\text{ V}$	—	0.1 $\mu\text{A}$

<sup>1</sup> d=Sensing distance

## 2.8.2 Sample External Circuit



The PS signal is high when paper is exhausted.

Figure 2-12 Sample External Circuit of the Paper Detector

### 2.8.3 Automatic Paper Load

Paper can be automatically loaded when used in conjunction with the paper detector. To prevent paper from skewing, cut the edges at right angles with respect to the paper feed direction before loading it.

If skewed, feed the paper until it is straight, or place the head in the up position and adjust the paper so that it is fed straight.

Figure 2-13 shows a flowchart for automatically loading paper.

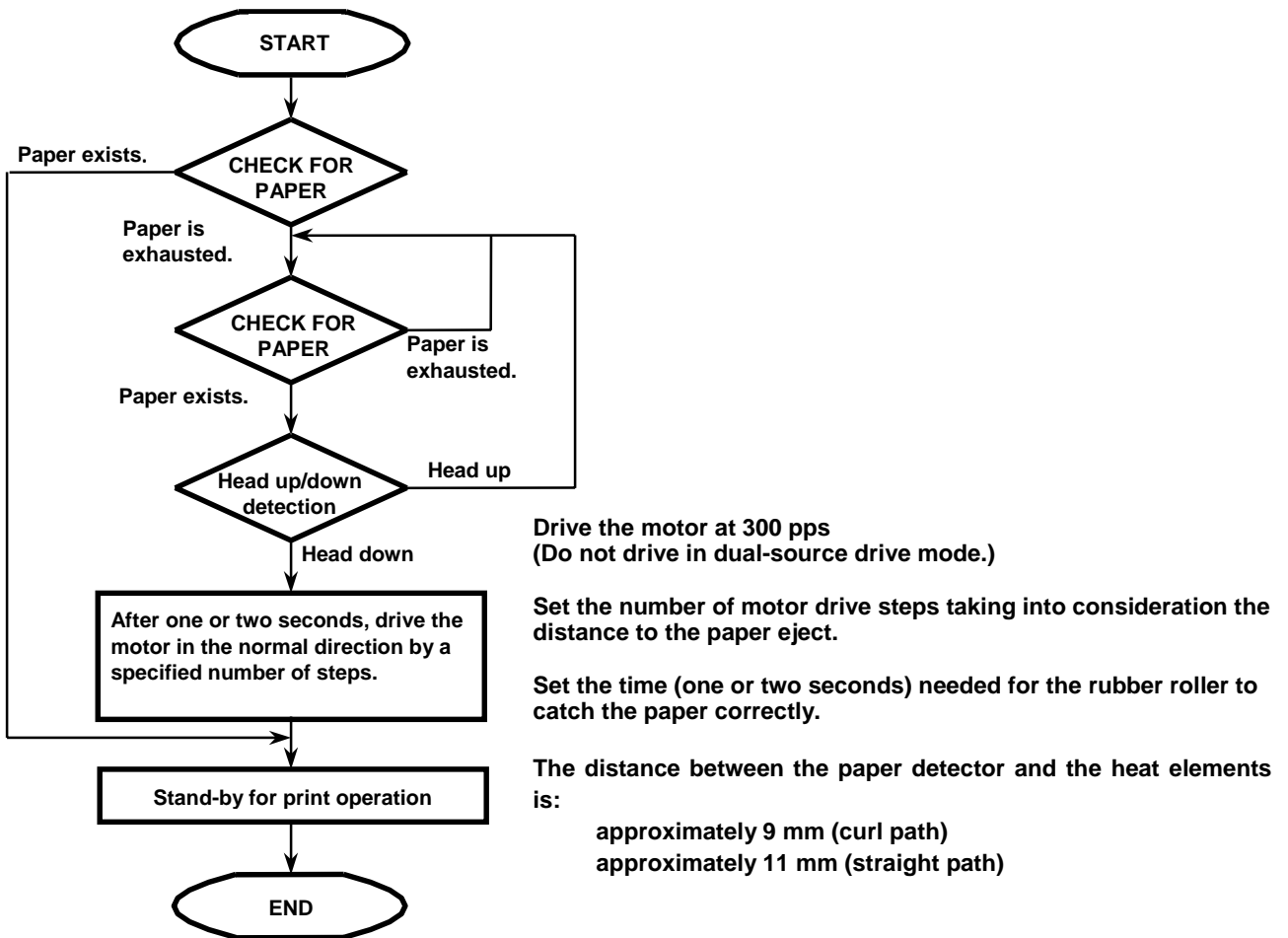


Figure 2-13 Flowchart for Automatic Paper Load

## CHAPTER 3

### CONNECTING EXTERNAL CIRCUITS

Use the recommended connectors for connecting the external circuits of the LTP4242 as shown in Table 3-1.

Table 3-1 Recommended Connectors

<b>No.</b>	<b>Functions</b>	<b>Number of Pins</b>	<b>Recommended Connectors (External Circuit)</b>
1	Thermal Head Control Terminals (Molex-Japan Co., Ltd. 53313-2615)	26	Molex-Japan Co., Ltd. 51089-2605 52478-2615
2	Motor and/or Sensor Terminals (Molex-Japan Co., Ltd. 51021-0900)	9	Molex-Japan Co., Ltd. 53047-0910 (vertical type) 53048-0910 (horizontal type) 51047-0900 (intermediate)

### 3.1 THERMAL HEAD CONTROL CONNECTOR

Figure 3-1 shows the terminal configuration of the thermal head control.

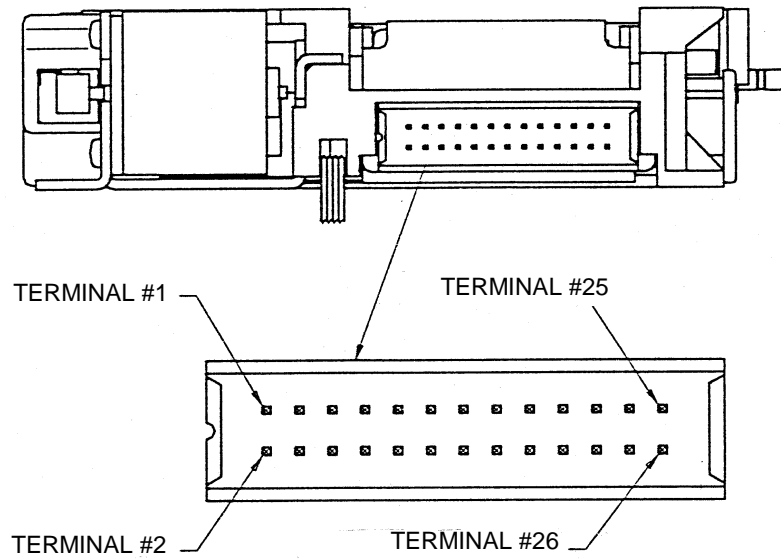


Figure 3-1 Thermal Head Control Terminals

Table 3-2 Thermal Head Control Terminal Assignments

No.	SIGNAL	FUNCTION	No.	SIGNAL	FUNCTION
1	V <sub>P</sub>	Head drive power	2	GND	GND
3	V <sub>P</sub>	Head drive power	4	GND	GND
5	V <sub>P</sub>	Head drive power	6	GND	GND
7	TH	Thermistor	8	TH	Thermistor
9	DST 1	Block 1 print command	10	DATA OUT	Print data output (serial output)
11	DST 2	Block 2 print command	12	GND <sub>L</sub>	Head logic GND
13	DST 3	Block 3 print command	14	LATCH	Transferred data latch (memory)
15	DST 4	Block 4 print command	16	CLOCK	Data transfer synchronize signal
17	DST 5	Block 5 print command	18	DATA IN	Print data input (serial input)
19	DST 6	Block 6 print command	20	V <sub>dd</sub>	Head logic power
21	DST 7	Block 7 print command	22	GND	GND
23	V <sub>P</sub>	Head drive power	24	GND	GND
25	V <sub>P</sub>	Head drive power	26	GND	GND

### 3.2 MOTOR/DETECTOR CONNECTOR

Figure 3-2 shows the motor control terminals, paper detector terminals, and head-up detector terminals on the motor/detector connector.

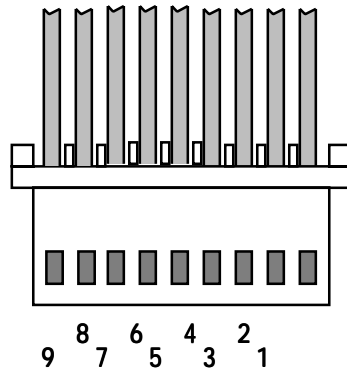


Figure 3-2 Terminals on the Motor/Detector Connector

Table 3-3 Terminal Assignments of the Motor/Detector Connector

Terminal Number	Signal Name	Function
1	$\bar{A}$	Motor drive signal
2	B	Motor drive signal
3	A	Motor drive signal
4	$\bar{B}$	Motor drive signal
5	$V_{PS}$	LED anode (power supply side)
6	PS	Phototransistor collector (output side)
7	GND	Paper detector output ground
8	GND	Head-up detector output ground
9	HS	Head-up detector output

Terminal numbers 8 and 9 can be reversed because the head up detector is a mechanical switch.

## CHAPTER 4

### DRIVE METHOD

Drive the motor and the thermal head at the same time for printing. Figure 4-1 is a timing chart for driving using two divisions. Figure 4-1 is an example of acceleration control of the motor, data transfer to the head and two-divisions of the head.

The motor maximum driving frequency is 1120 pps. The inverse of this frequency (time for one step) is defined as  $T_m$ .

A: Pause  
state

Transfer the data of the first dot line to the SHIFT REGISTER of the thermal head.

B: Start step output

Output the same phase to the motor as that having been output just before the motor stopped. The step time is  $T_m$ .

C: First step

Drive the motor 1 step. The time of the step is the time of the first acceleration step. Output a LATCH signal and store the data transferred in step A in the LATCH REGISTER.

Start printing from DST1. The applied energy is the pulse width asked for in section 2.6. Transfer the data of the second dot line to the SHIFT REGISTER of the thermal head.

D: Second step

Drive the motor one step. The step time is a longer time which is the second acceleration step, or  $T_m$ . Start printing from DST2.

Repeat the steps in the same way. While applying energy to the head, transfer the next dot line to the SHIFT REGISTER of the thermal head.

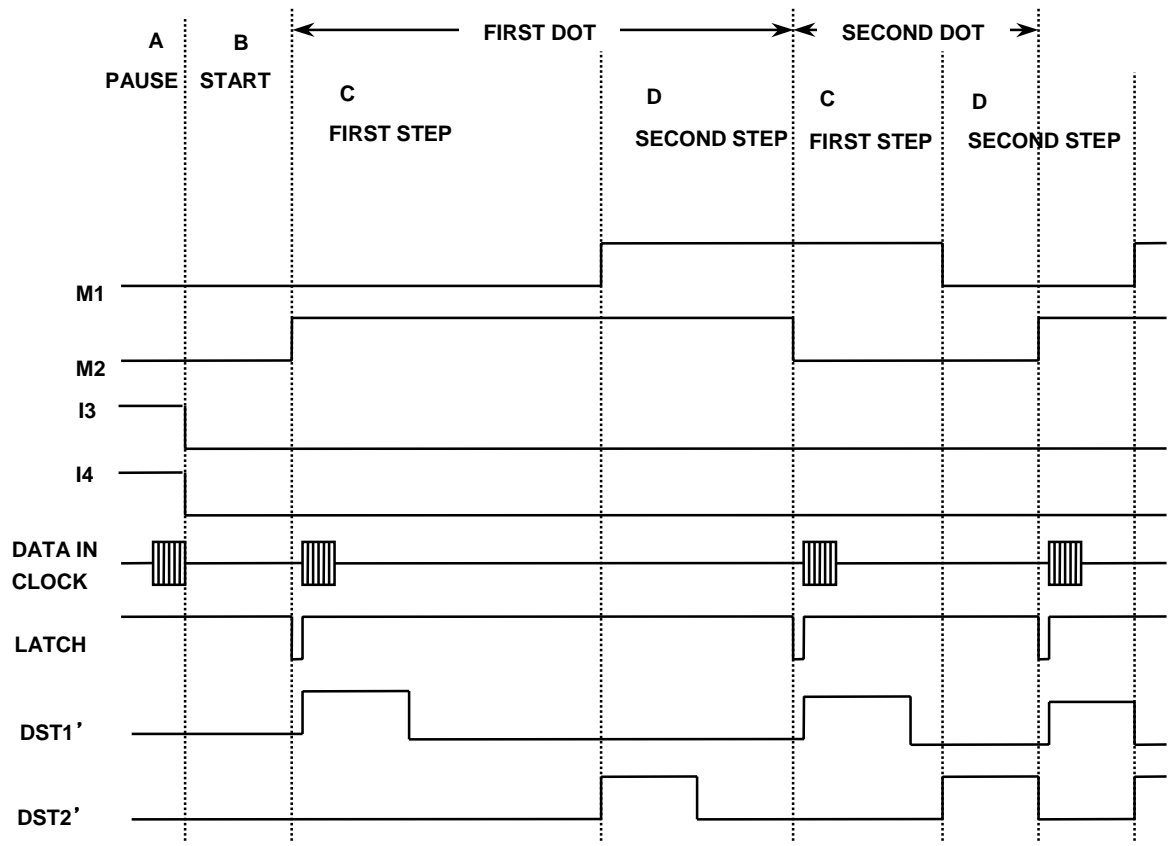


Figure 4-1 Timing Chart for Driving Using Two Divisions



## **Recommended Screws and Washers**

Recommended mounting screws and washers are as follows:

- ① JIS B1111 M3 pan head Phillips screw
- ② Small P Tight 3 screw for plastic

### **5.1.2 Precautions for Securing the Printer**

Make sure that no excessive force, deformation, nor torsion acts on the printer while securing it. Otherwise, abnormalities such as deterioration of print quality, paper skew, paper jam and/or excessive noise may occur.

## **5.2 LAYOUT OF PRINTER AND PAPER**

The LTP4242 can be laid out as shown in Figure 5-2 or 5-3 according to the loading direction of the paper. When ordering, make your selection between the two models based on the desired use.

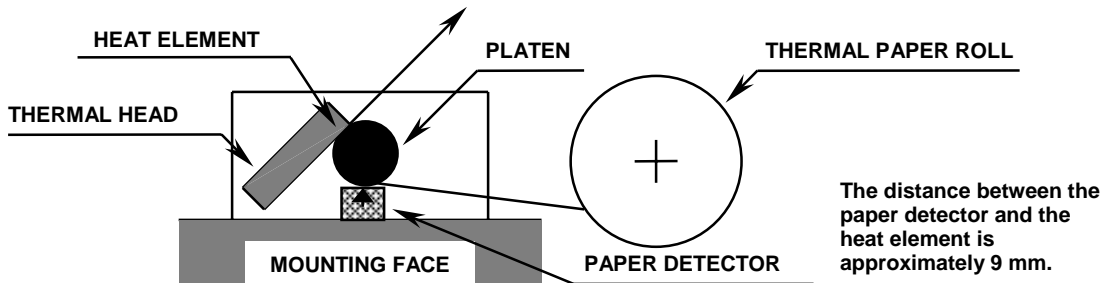


Figure 5-2 Curled Path

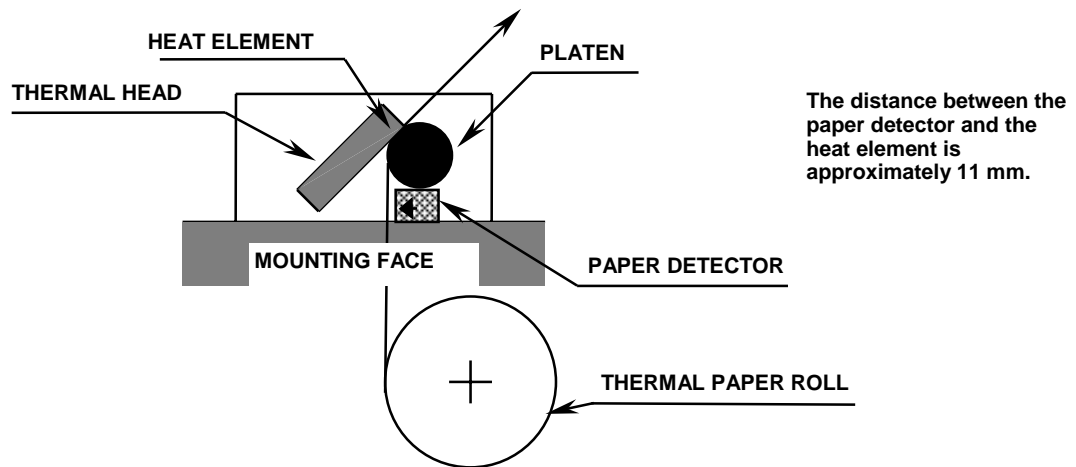


Figure 5-3 Straight Path

### 5.3 WHERE TO MOUNT THE PAPER HOLDER

When determining the layout of paper holder, note the following:

- When you use a paper roll, set the holder so that the paper is in alignment with the paper intake with no horizontal offset, and that the center axis of the paper roll is parallel with the printer.
- Keep the paper feed force 50 g or less.

### 5.4 WHERE TO MOUNT THE PAPER CUTTER

Install the paper cutter so that it does not interfere with the paper feed. The angles and positions for feeding paper are shown in Figure 6-1.

- If the distance between the edge of the thermal head and the edge of the fed paper is too small, the paper may be caught by the platen. Please take this into account when designing.
- Use a cutter with a sharp edge so that paper is cut with the paper hold force or less.



**CHAPTER 6**  
**APPEARANCE AND DIMENSIONS**

Figure 6-1 shows the appearance and external dimensions of the LTP4242.



## CHAPTER 7

### DESIGNING AND HANDLING PRECAUTIONS

To maintain the initial level of performance of the LTP4242 and to prevent future problems from occurring, observe the following precautions.

#### 7.1 DESIGN PRECAUTIONS

- ① Do not apply an energy source that is too high.

If too much energy is applied to the thermal head, it may overheat and become damaged. Always use the printer with the specified energy.

- ② When turning the power on or off, always disable (put in low state) the DST terminals.

- ③ To prevent the thermal head from being damaged by static electricity:

- Fix the printer to the FG through the hole d (see Figure 5-1).
- Connect the GND terminal of the thermal head control FPC to FG through an approximately 1 M $\Omega$  resistor.

- ④ Keep the  $V_P$  power off while not printing in order to prevent the thermal head from being electrolytically corroded.

In addition, design the printer so that the signal GND of the thermal head and the frame GND of the printer mechanism become the same electric potential.

- ⑤ Make the wire resistance between the power supply and the  $V_P$  and/or GND terminals on the thermal head controller as small as possible (below 50 m $\Omega$ ).

- ⑥ For noise detection, connect a capacitor near the FPC connector.

$V_P$ -GND      approximately 10  $\mu$ F capacitor

$V_{dd}$ -GND     approximately 1  $\mu$ F capacitor

- ⑦ Apply power in the following manner:

At power ON:    1)  $V_{dd}$  (5 V)  $\rightarrow$  2)  $V_P$  (24 V)

At shut down:   1)  $V_P$  (24 V)  $\rightarrow$  2)  $V_{dd}$  (5 V)

- ⑧ When printing at a high print rate (black or zig zag pattern) in a low temperature or high humidity environment, the vapor from the paper during printing may cause condensation to form on the printer or may soil the paper itself.

- ⑨ Set the maximum print speed so that there is no variation in the motor drive frequency. Variation in the drive frequency may lead to noise or a loss of paper feed force.

## 7.2 HANDLING PRECAUTIONS

- ① If any paper other than that specified is used, high print quality and long life of the thermal head cannot be guaranteed.

Possible problems that may occur:

- Poor print quality due to low-sensitivity paper
  - Abrasion of the thermal head due to paper surface which is too rough
  - Sticking between the thermal layer of the paper and the thermal head resulting in excessive noise during printing
  - Print fading due to low print preservation
  - Corroded thermal head
- ② Do not print without paper; otherwise, the platen or thermal head may become damaged.
  - ③ Do not hit or scratch the surface of the thermal head with any sharp or hard object.
  - ④ When the printer is not in use, place the thermal head in the up position. If the thermal head is left in contact with the platen, the platen may become deformed.
  - ⑤ To prevent the heat elements, ICs, etc. from being damaged due to static electricity, take both antistatic and grounding measures before handling the printer.
  - ⑥ Do not apply any stress to the thermal head control terminal.

## 7.3 SAFETY PRECAUTIONS

- ① If the heat elements are activated continuously for an abnormally long time due to CPU malfunction, the thermal head may be overheated, resulting in damage to the thermal head or possibility of skin burns. To prevent personal injury, be sure to use hardware in conjunction with software for detecting abnormal head temperatures as described in Section 2.6.7.
- ② Do not touch the thermal head or motor directly. The temperature of each may be high enough to cause skin burns during and immediately after printing.

## 7.4 LOADING/UNLOADING PAPER PRECAUTIONS

### ① Loading paper

- Load paper with the thermal head in the up position.
- Insert the paper straight into the paper inlet.
- When the edge of the paper comes up from between the thermal head and the platen, pull the edge of the paper, check whether the paper is aligned correctly, and place the thermal head into the down position.

### ② Unloading paper

- Unload paper with the thermal head in the up position.
- Pull the paper straight up by hand in the direction in which the paper is normally fed.
- If the paper is bonded on the core of the paper roll, separate the paper from the core and then pull the paper out.

### ③ Automatically loading paper

- Load paper with the thermal head in the down position.
- Cut the edge of paper in the manner shown in Figure 7-1.

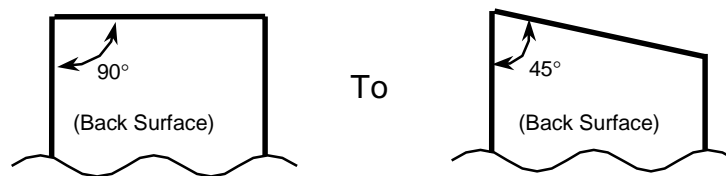
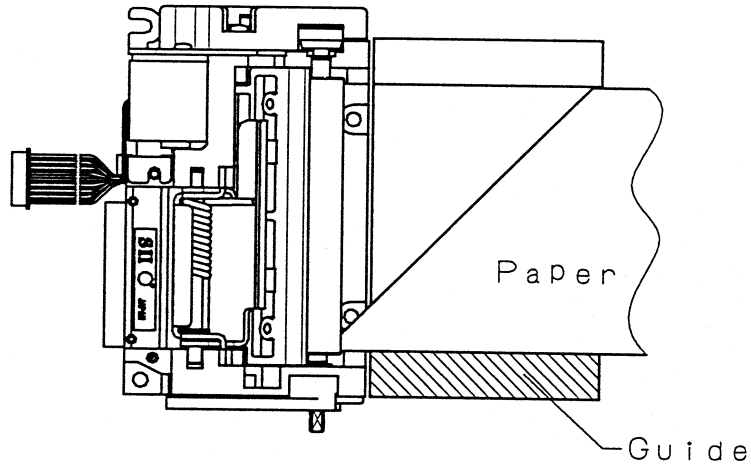


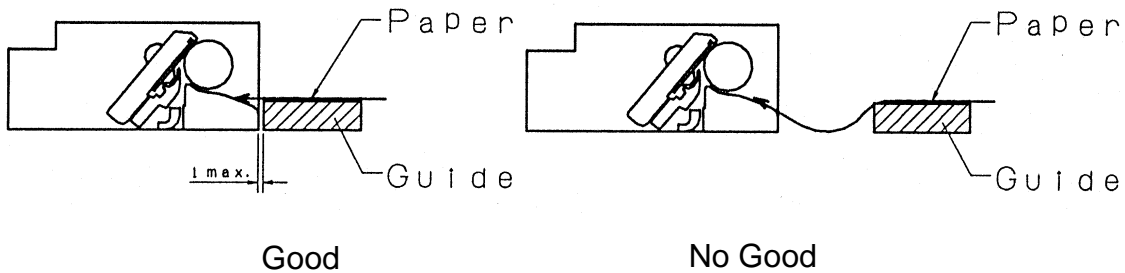
Figure 7-1 Paper Edge

NOTE: The paper sensor is located on the same side as the head-up lever. If the paper is cut in a direction opposite to that shown in Figure 7-1, then it will not detect the paper.

- Insert the paper straight into the printer until it stops. Design and attach a guide to the printer before the insert opening to prevent the paper from slanting.



Design a paper insert guide so the paper does not slant when inserted.



- When the paper slants after being inserted, either feed paper until it straightens out or pull up the head and reset the paper.
- In a high temperature, high humidity environment, the paper may lose its stiffness resulting in a loss of efficiency of the automatic paper insert or a paper jam. Confirm the printer works well under the conditions it is intended to be used.
- There may be a loss of efficiency of the automatic paper insert when the diameter of the paper roll is small and the paper is wound tightly.

## 7.5 HEAD CLEANING PROCEDURE AND PRECAUTIONS

### 7.5.1 Head Cleaning Procedure

- ① Pull head block holder forward ①, and then pull up on it to remove it ②.

Note 1: The head block holder cannot be removed when the head is up.

Note 2: The head block holder is hot directly after printing, so let it cool before removing it.

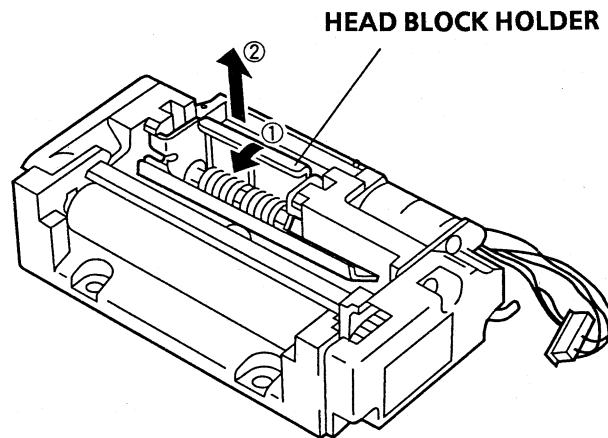


Figure 7-2 Head Cleaning Procedure (1)

- ② Pull up the thermal head and clean the heat elements with alcohol and a cotton swab.

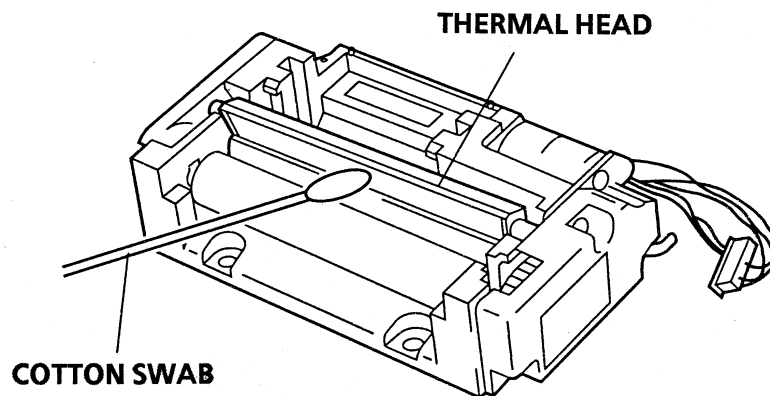


Figure 7-3 Head Cleaning Procedure (2)

③ After the alcohol has completely dried, replace the head block holder.

③-1 Insert the axis of the head block holder into the notch in the frame.

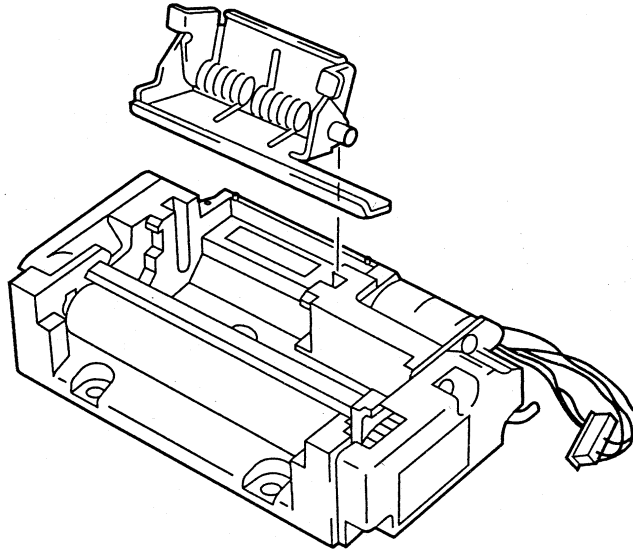


Figure 7-4 Head Cleaning Procedure (3)

③-2 While pulling forward on the head block holder, push it down.  
Note 1: The head block holder cannot be replaced when the head is up.

③-3 Check to see the head block holder is completely locked in the printer.

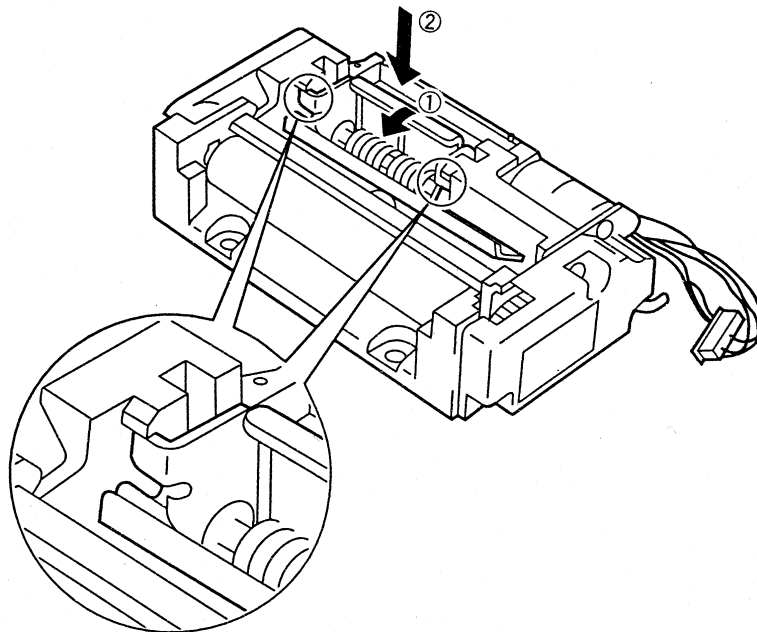


Figure 7-5 Head Cleaning Procedure (4)

### **7.5.2 Head Cleaning Precautions**

- ① Cleaning fluid :  
ethyl alcohol, isopropyl alcohol.
- ② Do not use sandpaper, cutter, etc. when cleaning. They will damage the heat elements.

### **7.6 CLEARING A PAPER JAM**

- ① Put the head up lever in the head up position and slowly pull the paper toward the paper outlet.
- ② If step ① does not clear the paper jam, clear it by removing the head block holder. (Refer to section 7.5.1 for instructions on how to remove the head block holder.)



## CHAPTER 8

### PERIPHERALS

#### 8.1 PAPER CUTTER

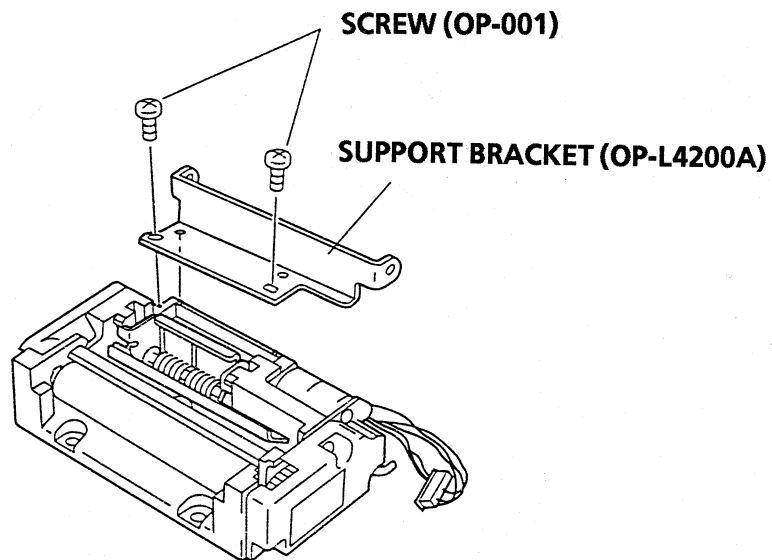
The ACU1224A-A or ACU1224D-A paper cutter unit can be installed on the LTP4242.

The ACU1224A-A and ACU1224D-A paper cutter units are guillotine type of cutters that can be selective the paper cutting types through the selection of the motor direction (clockwise or counter-clockwise). Please refer to the "ACU1000 Paper Cutter Technical Reference" for the specifications and drive method of the ACU1224A-A and ACU1224D-A.

##### 8.1.1 Installation Method

(1) When using the support bracket made for the ACU1224A-A and ACU1224D-A:

- ① Secure the support bracket (OP-L4200A) with two tap tight P tight screws 2 X 8 (OP-001).
- ② Attach the ACU1224A-A paper cutter unit.



Note: The numbers inside the brackets show the company part numbers.

Figure 8-1 Installing the Support Bracket

(2) When designing a support bracket:

Design a support bracket so the rotation support points are located as shown in Figure 8-2.

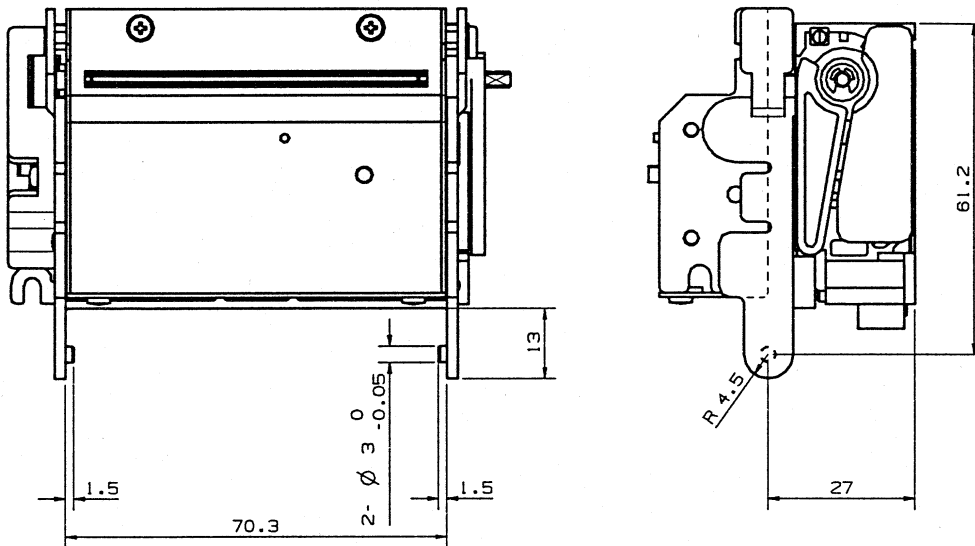


Figure 8-2 Support Bracket Design

### 8.1.2 Paper Insertion

(1) Inserting the paper manually:

- ① Put the printer head up.
- ② Cut the edge of the paper as shown in Figure 8-3.

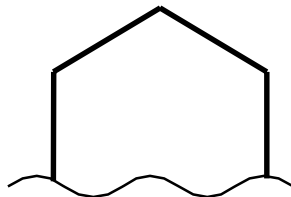


Figure 8-3 Paper Edge (Manual Load)

- ③ Insert the edge of the paper straight into the insertion slot and feed the paper until it emerges from the paper cutter.
- ④ Pull on the edge of the paper and check to make sure it is properly set, then put the head down.

(2) Loading the paper automatically:

- ① Load paper with the thermal head in the down position.
- ② Cut the edge of paper in the manner shown in Figure 8-4.

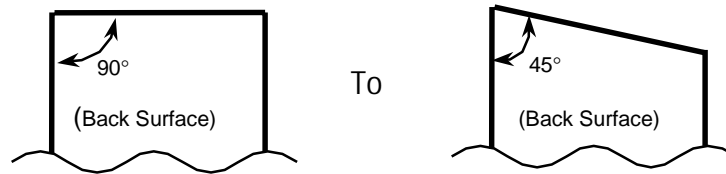


Figure 8-4 Paper Edge (Automatic Load)

NOTE: The paper sensor is located on the same side as the head-up lever. If the paper is cut in a direction opposite to that shown in Figure 8-4, then it will not detect the paper.

- ③ Insert the edge of the paper straight into the insertion slot.
- ④ Feed the paper with the paper feed operation of the printer.  
If the paper is slanted, put the head up and straighten out the paper.

Note: 1) There may be a loss of efficiency of the automatic paper insert when the diameter of the paper roll is small and the paper is wound tightly.  
2) In a high temperature, high humidity environment, the paper may lose its stiffness resulting in a loss of efficiency of the automatic paper insert or a paper jam. Confirm the printer works well under the conditions it is intended to be used.

### 8.1.3 Clearing a Paper Jam in the Paper Cutter

Follow these steps to clear a paper jam in the paper cutter.

- ① Stop the power to the paper cutter.
- ② When the blade of the paper cutter is locked and is blocking the outlet of the paper, insert a phillips screwdriver through the slot shown in Figure 8-5 and into the screw in the worm gear of the motor axis. Then, turn the screw until blade retreats.

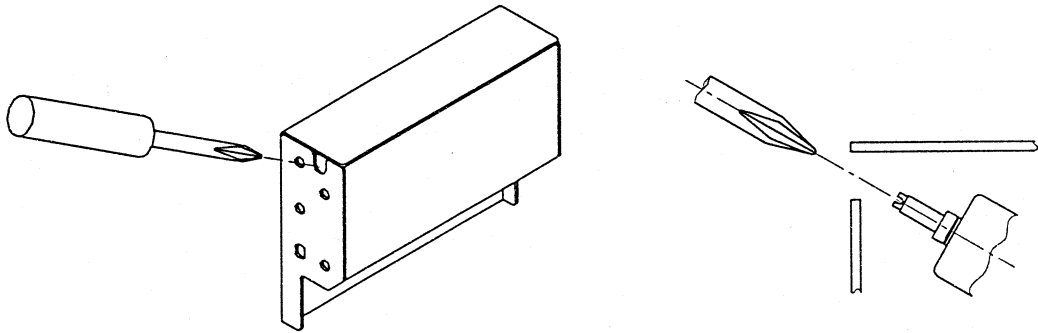


Figure 8-5 Cleaning a Paper Jam (1)

- ③ Open the paper cutter by holding and pushing on the parts shown in Figure 8-6. Then clear the paper jam.

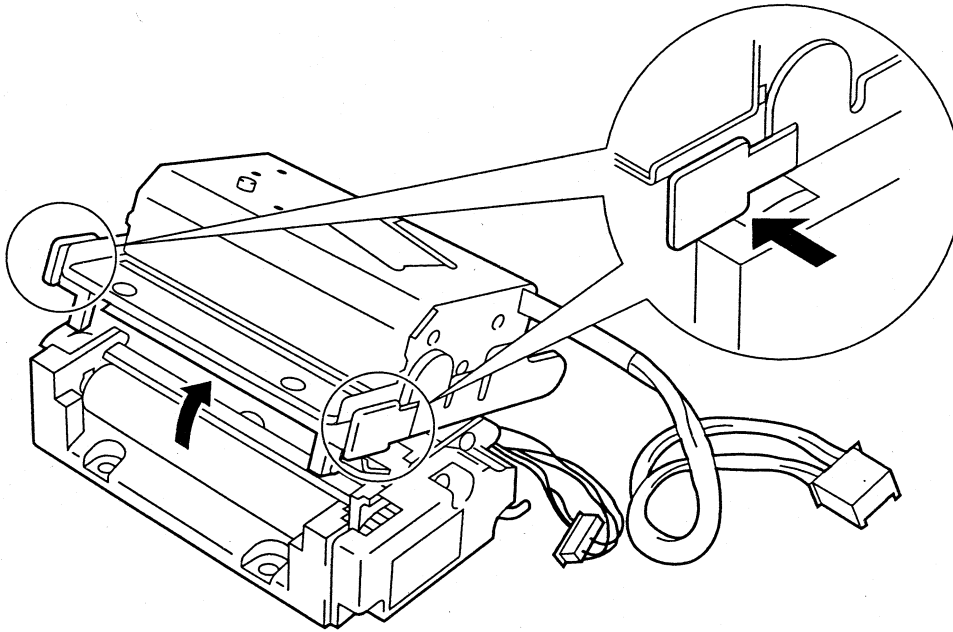
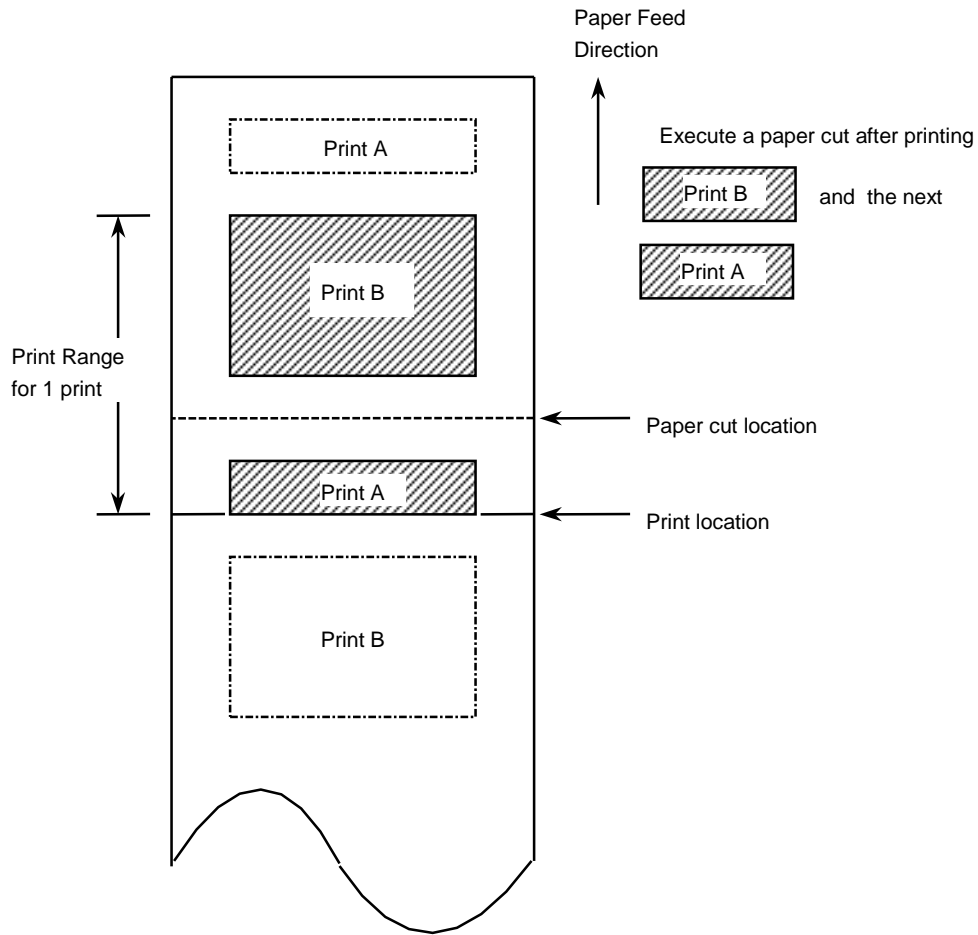


Figure 8-6 Clearing a Paper Jam (2)

- ④ Refer to section 7.6 for instructions on clearing a paper jam inside the printer.

### 8.1.4 Points to Remember when Using the Paper Cutter

- (1) Never execute a back feed after the paper is cut by the autocutter because it may cause a paper jam.
- (2) In order to prevent paper jams, always execute a paper feed of about 3 mm or print feed.
- (3) As shown in Figure 8-7, it is possible to use the margins from the print area to the cut area more effectively by cutting the paper after printing print A following the printing of print B.



- \* The distance between the print location and cut location on the ACU1224A-A or ACU1224D-A Paper Cutter is 12 mm.
- \* Do not print so that A spans B.

Figure 8-7 Using the Paper Effectively When Cutting

### 8.1.5 Appearance of the Printer with the Paper Cutter Installed

Figure 8-8 shows the appearance of the LTP4242 with the paper cutter installed.

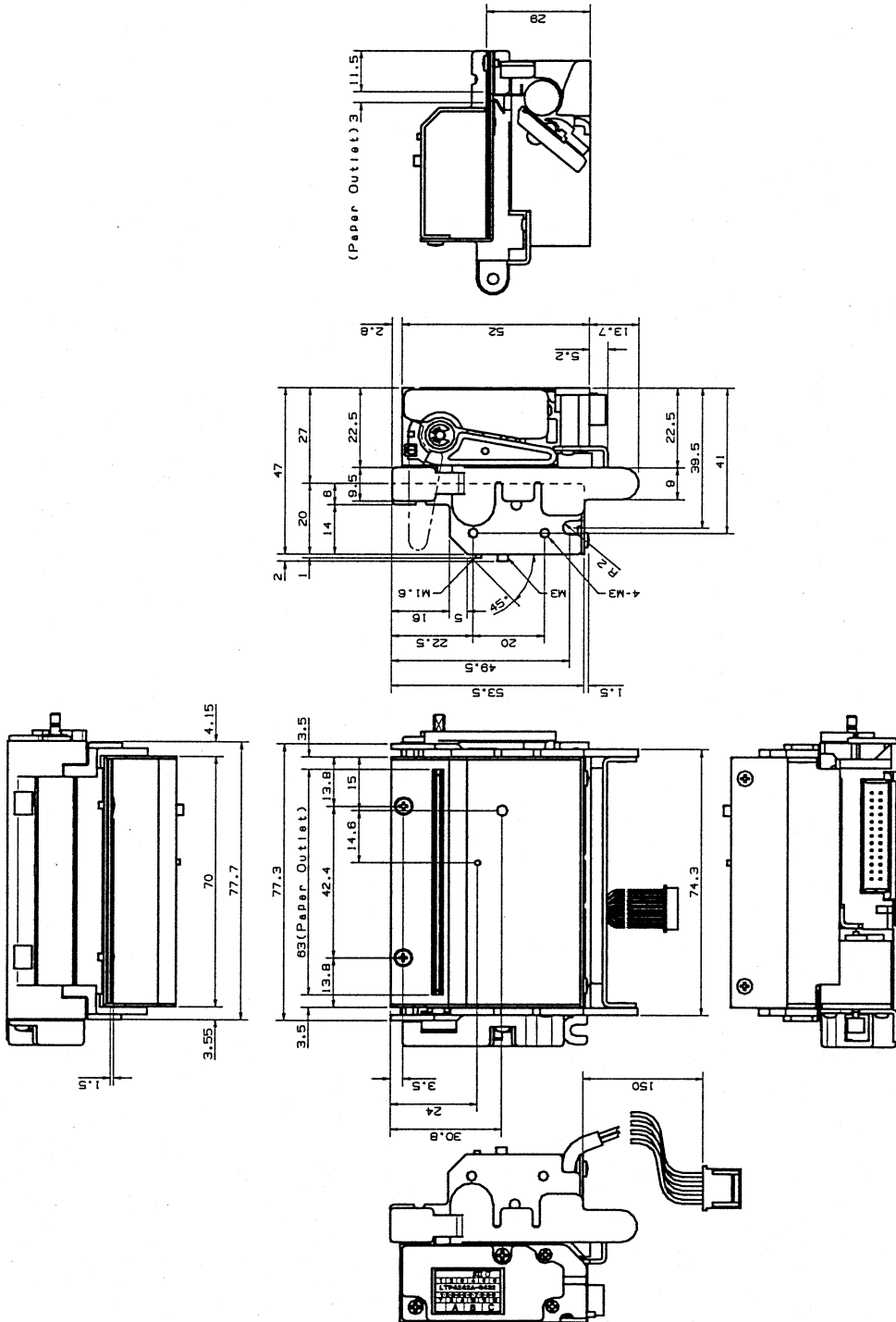


Figure 8-8 Appearance of Printer with Paper Cutter Installed