SII

LTPD247A/B, LTPD347A/B
THERMAL PRINTER MECHANISM
TECHNICAL REFERENCE

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Seiko Instruments Inc.

LTPD247A/B, LTPD347A/B THERMAL PRINTER MECHANISM TECHNICAL REFERENCE

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PREFACE

This technical reference describes the specifications and basic operating procedures for the LTPD247A/B and LTPD347A/B thermal printer mechanism (hereinafter referred to as “printer”).

The LTPD247A/B and LTPD347A/B have the following model.

- LTPD247A-432-E
- LTPD247B-432-E
- LTPD347A-576-E
- LTPD347B-576-E

This technical reference usually describes information common to any printer unless otherwise specified. If the information is different depending on models, specific model names are mentioned clearly.

Chapter 1 “Precautions” describes safety, design, and handling precautions. Read it thoroughly before designing so that you are able to use the product properly.

SII has not investigated the intellectual property rights of the sample circuits included in this technical reference. Fully investigate the intellectual property rights of these circuits before using. In particular, SII reserves the industrial property rights for the heat storage simulation described in Chapter 3. Using it for the other printers is infringement on the industrial property rights.

The printer complies with EU RoHS Directive (2002/95/EC)

The printer contains “Pb”, the details are described below.

- Printer mechanism : a particular free-cutting steel parts, a particular component in glass of the electronic parts

＊Lead-containing items listed above are exempt from RoHS (2002/95/EC).

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CHAPTER 1
PRECAUTIONS

Read through this technical reference to design a product and to operate the printer properly. Pay special attention to the precautions noted in each section for details. Information contained in this technical reference is subject to change without notice.
For the latest information, contact our sales representative.

Sufficient evaluation and confirmation should be performed with the designed outer case mounted, to ensure proper use of the printer.

SII shall not be liable for any damages and/or loss that are caused by improper handling of the printer, any use not contained in this technical reference or that result from the outer case, unless such damages and/or loss originate from the printer itself.

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

The printer is designed and manufactured to be mounted onto general electronic equipment. If high reliability is required of the printer in respect to hazardous influences on the body or life and loss to property, redundant design of the entire system should be carried out and verify the performance with your actual device before commercialization. And our sales representative should be informed as such in advance.

Follow the precautions listed below when designing a product using the printer. Include any necessary precautions into your operation manual to ensure safe operation of your product by users.

1.1 SAFETY PRECAUTIONS

Follow the precautions listed below when designing a product using the printer. Include any necessary precautions into your operation manual and attach warning labels to your products to ensure safe operation.

- **Precautions to prevent the thermal head from overheating**

  When the thermal head heat elements are continuously activated by a CPU or other malfunction, the thermal head may overheat and may cause smoke and fire. Follow the method described in Chapter 3 “Detecting Abnormal Temperatures by Hardware” to monitor the temperature of the thermal head to prevent overheating. Turn the printer off immediately if any abnormal conditions occur.

- **Precautions for rising temperatures of the thermal head**

  Temperature of the thermal head and its peripherals rises very high during and immediately after printing. Be sure to design the outer case to prevent users from burn injuries by touching them. Place warning labels to warn users to ensure safe operation. As for thermal head cleaning, warn users to allow the thermal head to cool before cleaning. In order to allow cooling, secure clearance between the thermal head and the outer case when designing the outer case.

- **Precautions for rising temperatures of the motor**

  Temperature of the motor and its peripherals rises very high during and immediately after printing. Be sure to design the outer case to prevent users from burn injuries by touching them. Place warning labels to warn users to ensure safe operation. In order to allow cooling, secure clearance between the motor and the outer case when designing the outer case.

- **Precautions for sharp edges of the printer**

  The printer may have some sharp edges and cutting surfaces of the metal parts. Be sure to design the outer case to prevent the users from injuring himself/herself by touching the sharp edges and place warning labels to warn users to ensure safe operation.

- **Precautions for motor drive**

  The hair may get caught in the exposed platen and the gears. Control the motor not to drive when the outer case and the platen block are in open state. Also, make sure to design the outer case so as not to touch the platen and the gears and also prevent any objects from getting caught. Place warning labels to warn users to ensure safe operation.

1.2 DESIGN AND HANDLING PRECAUTIONS

To maintain the primary performance of the printer and to prevent future problems from occurring, follow the precautions below.

1.2.1 Design Precautions

- Apply power in the following manner:
  At power on : 1) V_{dd} → 2) V_P
  At shut down : 1) V_P → 2) V_{dd}
- A surge voltage between V_P and GND should not exceed 10V.
- For noise countermeasure, connect a 0.1μF capacitor between V_{dd} and GND pins near the connector.
- Make the wire resistance between the power supply (V_P and GND) and the printer (connecting terminals) as small as possible (below 50mΩ). Keep distance from signal lines to reduce electrical interference.
- Keep the V_P power off while not printing in order to prevent the thermal head from electrolytic corrosion. In addition, design the product so that the Signal Ground (SG) of the thermal head and the Frame Ground (FG) of the printer become the same electric potential.
- Use C-MOS IC chips for CLK, $\overline{\text{LAT}}$, DI and $\overline{\text{DST}}$ signals of the thermal head.
- When turning the power on or off, or during not printing, always disable the $\overline{\text{DST}}$ terminals.
- To prevent the thermal head from being damaged by static electricity, the printer main body and the platen block are connected to Frame Ground (FG) of the outer case. See Chapter 6 “OUTER CASE DESIGN GUIDE” for the connecting method. Verify the performance with your actual device.
- Always detect the outputs of the platen position sensor and out-of-paper sensor. Never activate the thermal head when the platen block is in open state and when there is no thermal paper. Incorrect activation of the thermal head may reduce the life of the thermal head and the platen and may damage them.
- A pause time between thermal head activations of the same heat element shall be secured more than 0.5ms. Pay attention to when using one division printing or when a thermal head activation time becomes longer. If activating for a long time without the pause time, the thermal head may become damaged.
- If too much energy is applied to the thermal head, it may overheat and become damaged. Always use the printer with the specified amount of energy shown in Chapter 3 “CONTROLLING THE ACTIVATION PULSE WIDTH FOR THERMAL HEAD”.
- Noise and vibration during printing vary depending on the motor pulse rate. Verify the performance with your actual device.
- Paper feed force can be decreased depending on the motor pulse rate. Verify the performance with your actual device.
- Do not perform continuous printing to prevent the motor from overheating. Refer to Chapter 3 “Motor Drive Method” to set a pause time.
- Paper feeding may be confused with several dot lines when printing is started from waiting status. When printing and paper feeding are interrupted and then started printing, as this may cause the paper feeding be confused. It especially affects printing of bit images. Always feed the thermal paper for more than 48 steps at start up or do not interrupt printing.
- To prevent degradation in the print quality due to the backlash of the paper drive system, feed the thermal paper for 48 steps or more at the initialization, at a time after setting/releasing the platen block, and a time after cutting with a tea bar.

- Do not feed the thermal paper backwards more than 9mm. Surface of thermal paper may get scratched by backward feed. The backward feed may cause paper skew and jams depending on paper roll layout and designing of paper holder. Be sure to confirm performance with your product before using the backward feed.

- If printing at a high print ratio for longer length, non-printing area may be colored due to an accumulation of heat. Verify the performance with your actual device.

- Do not print without the thermal paper. It may cause damage the platen block and the thermal head.

- The rotation system of the door on the outer case that holds the platen block must be set by pushing the center of the platen block. If only one end of the platen block is set, a print defect, and/or a paper jam will occur. Verify the performance with your actual device. In order to be pushed the center of the platen block to set it, put an indication to do so.

- If the printer main body and the platen block are not placed in proper position, the print defect and the paper jam may occur. Therefore, pay special attention to it when designing the outer case. For the position relation between the printer main body and the platen block, see Chapter 6 “OUTER CASE DESIGN GUIDE”.

- Design the outer case to ensure enough space to allow the users to handle surrounding the operation portion (the platen release lever) easily with fingers. Otherwise the printer unit will be inoperable.

- If designing the outer case with a structure to bring the platen block up automatically using a spring property after released, make sure not to apply more than enough force to bring the platen block up. If designing a structure that the only one side of the outer case is brought up, the position relation between the printer main body with the movable blade unit and the platen block with the fixed blade will be improperly and will result in the print defect or the cut failure. Verify the performance with your actual device.

- Design the thermal paper supply system in accordance with Chapter 6 “OUTER CASE DESIGN GUIDE”. When the paper supply position is improper, print difficulty or paper detection difficulty will be caused and the surface of thermal paper may get scratched. Verify the performance with your actual device.

- Do not use labeling paper, 2-ply thermal paper, and thermal paper with thickness of 86μm or thicker.

- Design the product so that a tension force is not applied to the FPC. The FPC could be moved by setting/releasing the platen block, so design the product so that the FPC has enough play after connected it. The tension force may cause some print problems and may damage the FPC.

- Metal parts may become discolored and rusted due to the operational environment. Consider these factors regarding appearance.

1.2.2 Handling Precautions

Incorrect handling may reduce the efficiency of the printer and cause damage. Handle the printer with the following precautions.
Also, include any necessary precautions so that users handle the printer with care.

- Using anything other than the specified thermal paper does not guarantee print quality and life of the thermal head.
  The followings are examples of trouble:
  (1) Poor printing quality due to low thermal sensitivity.
  (2) Abrasion of the thermal head due to paper surface roughness.
  (3) Printing stuck and unusual noise due to sticking the thermal layer of the thermal paper to the thermal head.
  (4) Printing fade due to low preservability of the thermal paper.
  (5) Electrolytic corrosion of the thermal head due to inferior paper.

- After the printer has been left not in use for long period of time, the platen could be deformed and resulted in print quality deteriorated. In this case, feed thermal paper for a while to recover deformation of the platen. If the thermal head is remained in contact with the platen without thermal paper for a long time, the platen and the thermal head may be stuck together and cause paper feed difficulty. If facing this problem, release the platen block and set it back again before starting printing.

- Never loosen the screws that fasten respective parts of the printer. Loosened screws may reduce the efficiency of the performance of the printer mechanism.

- Do not release the platen block during printing; otherwise this may reduce the efficiency of the printer.

- Do not apply stress to the platen block during printing. The print defect may occur.

- When setting the platen block, the reduction gear may interfere with the platen gear and may cause the platen block to not be set. In such a case, release the platen block and set it again.

- Never pull out the thermal paper while the platen block is set. The printer may become damaged.

- When handling the printer, make sure to use antistatic clothing and to ground yourself to prevent the thermal head from damaged by static electricity. Especially take care of the thermal head heat element and the connecting terminal.

- Do not hit or scratch the surface of the thermal head with any sharp or hard object. This could damage the thermal head.

- When printing at a high print ratio in a low temperature or high humidity environment, the vapor from the thermal paper during printing may cause condensation to form on the printer and soil the thermal paper itself. Prevent the thermal head from a drop of water. It may cause electrolytic corrosion of the thermal head. If condensed, do not activate electricity until dried.

- Connect or disconnect the connecting terminal after turn off the power of the printer.

- Do not apply stress to the FPC while connecting and disconnecting the connecting terminal. Otherwise the FPC may become damaged.

- Warn the users not to pull the thermal paper and to change an angle of the thermal paper discharge during printing. Otherwise, the paper jam or the cut failure may occur.

- In order to prevent the thermal head from damage and to avoid the print defect, warn the users not to touch the thermal head and the sensor directly when handling the printer like replacing thermal paper.

- Do not use a paper roll with glued end or folded end. In case of using such roll papers, replace to a new one before the end of the paper roll is shown up.

- The printer is not waterproof and drip proof. Prevent contact with water and do not operate with wet hands as it may damage the printer or may cause a short circuit or fire.
- The printer is not dust proof. If use the printer in a dusty place, it may damage the thermal head or paper drive system.
- Do not use the printer in corrosive gas and siloxane atmosphere as it may cause the contact failure.

1.2.3 Precautions on Discarding

When discarding used printers, discard them according to the disposal regulations and rules of each respective district.

CHAPTER 2
FEATURES

The printer is a compact printer that adopts a thermal line dot printing method. It can be used with measuring instruments and analyzer, a POS, a communication terminal device, or a data terminal device.

The printer has the following features:

- **High resolution Printing**

  A high-density print head of 8 dots/mm produces clear and precise printing.

- **Compact**

  LTPD247A:
  Dimensions : W71.0mm x D30.0mm x H15.0mm
  LTPD247B:
  Dimensions : W71.0mm x D15.0mm x H30.0mm
  LTPD247A/B:
  Mass : approx. 56 g

  LTPD347A:
  Dimensions : W91.0mm x D30.0mm x H15.0mm
  LTPD347B:
  Dimensions : W91.0mm x D15.0mm x H30.0mm
  LTPD347A/B:
  Mass : approx. 64 g

- **High print speed** *

  LTPD247A/B:
  Maximum 200mm/s print is available.

  LTPD347A/B:
  Maximum 150mm/s print is available.

- **Easy operation**

  Platen block open mechanism provides easy paper installation.

- **Maintenance Free**

  No cleaning and no maintenance required.

- **Low noise**

  Thermal printing technology realizes low-noise print.

*: Print speed differs depending on working conditions.

CHAPTER 3
SPECIFICATIONS

3.1 GENERAL SPECIFICATIONS

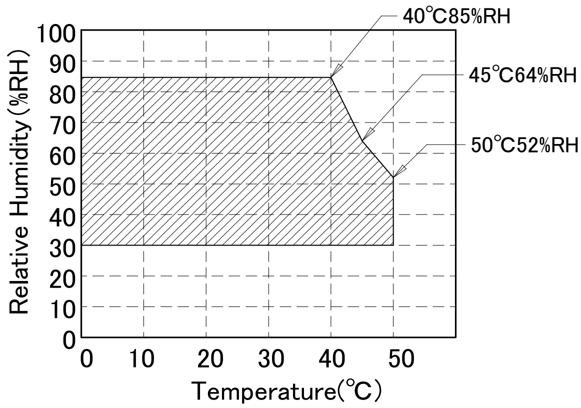
Table 3-1 lists the general specifications of the printer.

Table 3-1 General Specifications

(1/2)

Items	**Specifications**			
	LTPD247A	LTPD247B	LTPD347A	LTPD347B
Printing method	Thermal dot line printing			
Total dots per line	432 dots		576 dots	
Printable dots per line	432 dots		576 dots	
Simultaneously activated dots	288 dots			
Resolution	W8 dots/mm x H8 dots/mm			
Paper feed pitch	0.0625mm			
Maximum print speed	200mm/s [*1]		150mm/s [*1]	
Print width	54mm		72mm	
Paper width	58^{0}_{-1}mm		80^{0}_{-1}mm	
Thermal head temperature detection	Thermistor			
Platen position detection	Mechanical switch			
Out-of-paper detection	Reflection type photo interrupter			
Operating voltage range V_P line V_{dd} line	 21.6to 26.4V 2.7 to 3.6V, 4.75 to 5.25V			
Current consumption V_P line Thermal head drive	5.23A max. (at 26.4V) [*2]			
Motor drive	0.44A max.		0.40A max.	
V_{dd} line Thermal head Logic	0.10A max.			

(2/2)

<table>
<tr><th colspan="2" rowspan="2">Items</th><th colspan="4">Specifications</th></tr>
<tr><th>LTPD247A</th><th>LTPD247B</th><th>LTPD347A</th><th>LTPD347B</th></tr>
<tr><td colspan="2">Operating temperature and humidity range</td><td colspan="4">-10 to 50°C (Non condensing)

</td></tr>
<tr><td colspan="2">Storage temperature range</td><td colspan="4">-35 to75°C (Non condensing)</td></tr>
<tr><td rowspan="2">Life span (at 25°C and rated energy)</td><td>Activation pulse resistance</td><td colspan="4">100 million pulses or more *3</td></tr>
<tr><td>Abrasion resistance</td><td colspan="4">100km or more
(excluding damage caused by dust and foreign materials)</td></tr>
<tr><td colspan="2">Paper feed force</td><td colspan="4">0.98N (100gf) or more</td></tr>
<tr><td colspan="2">Paper hold force</td><td colspan="4">0.98N (100gf) or more</td></tr>
<tr><td colspan="2">Dimensions
(excluding convex part)</td><td>W71.0mm × D30.0mm × H15.0mm</td><td>W71.0mm × D15.0mm × H30.0mm</td><td>W91.0mm × D30.0mm × H15.0mm</td><td>W91.0mm × D15.0mm × H30.0mm</td></tr>
<tr><td colspan="2">Mass</td><td colspan="2">approx. 56g</td><td colspan="2">approx. 64g</td></tr>
<tr><td colspan="2">Specified thermal paper</td><td colspan="2">Nippon Paper

Oji Paper

Mitsubishi Paper mills limited
Jujo Thermal

Mitsubishi Hi-Tech Paper

Papierfabrik August Koehler AG
KSP

KANZAN</td><td colspan="2">TF50KS-E2D
TP50KJ-R
TL69KS-LH
PD160R-63
PD160R-N
P220VBB-1
AP50KS-D
AF50KS-E
F5041
P5045
KT55F20
P300
P350
P350-2.0
KIP370
KIP470
KF50
KPR440</td></tr>
</table>

*1: Print speed changes according to the processing speed of the controller and print pulse width.
*2: When the number of simultaneously activated dots is specified as 288.
*3: Excluded when the same dots are printed continuously.

3.2 HEAT ELEMENT DIMENSIONS

Figure 3-1 shows heat element dimensions.   Figure 3-2 shows print area.

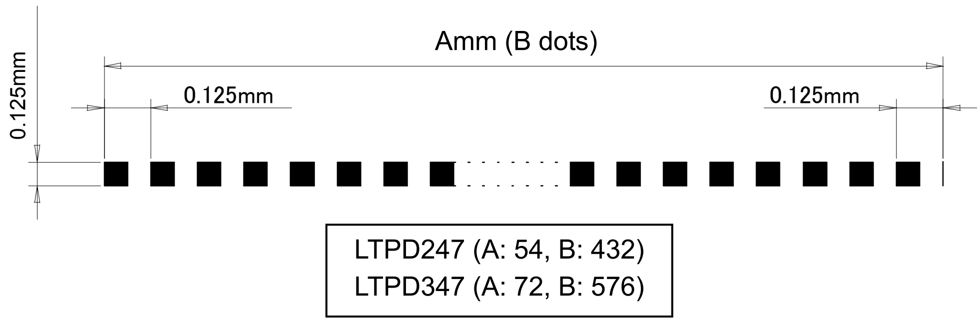


Figure 3-1   Heat Element Dimensions

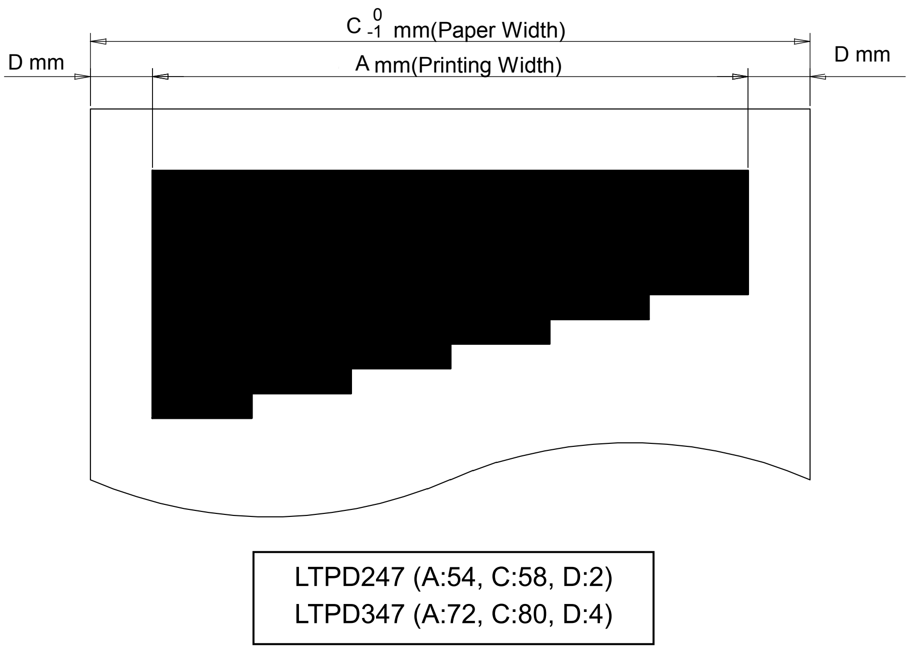


Figure 3-2   Print Area

3.3 STEP MOTOR

3.3.1 General Specifications

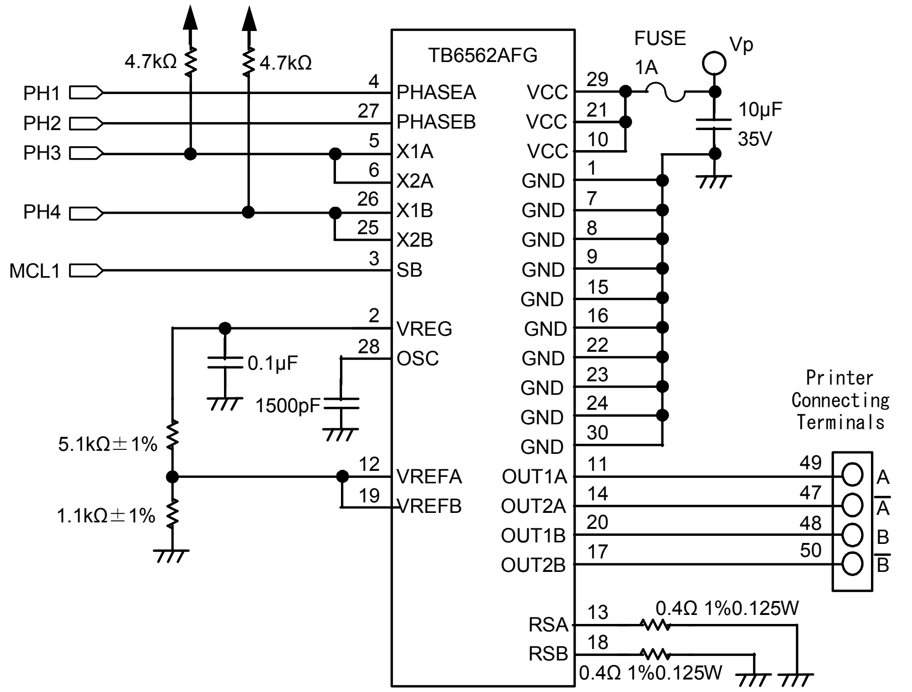
Table 3-2 shows general specifications of the step motor.

Table 3-2 General Specifications of the Step Motor

Item	Specifications	
	LTPD247	LTPD347
Type	PM type step motor	
Drive method	Bi-polar chopper	
Excitation	2-2 phase	
Winding resistance per phase	26Ω/phase ±10%	
Motor drive voltage	V_P : 21.6 to 26.4V	
Motor controlled current	220 mA/phase	200 mA/phase
Drive pulse rate	3200pps max.	2400pps max.

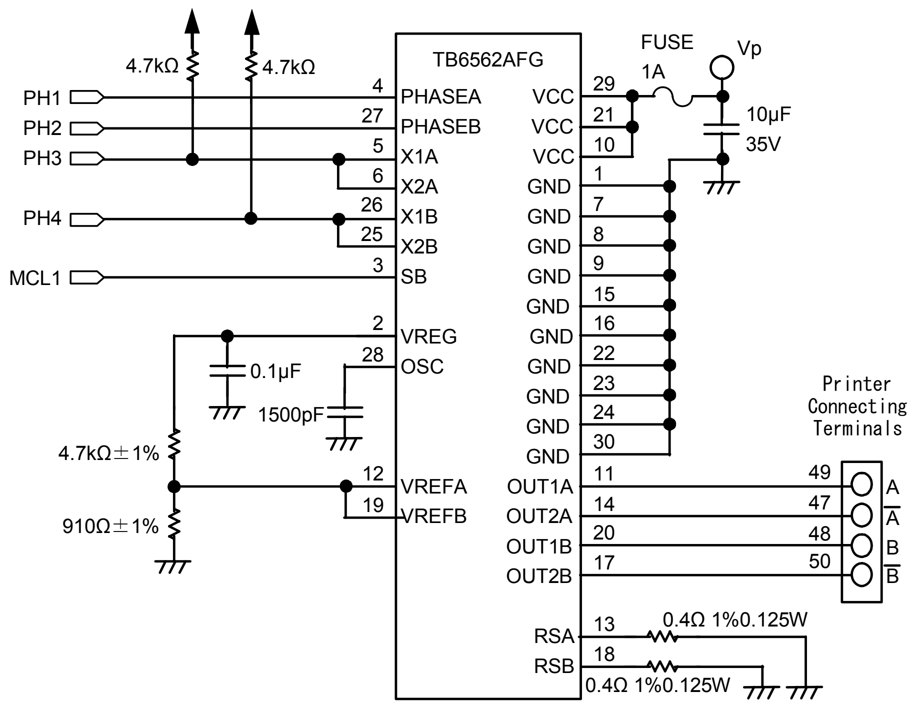
3.3.2 Sample Drive Circuit

Figure 3-3 shows a sample drive circuit for LTPD247 and Figure 3-4 shows a sample drive circuit for LTPD347.



* Recommended motor driver : TB6562AFG(Toshiba)

Figure 3-3 Sample Drive Circuit (LTPD247)

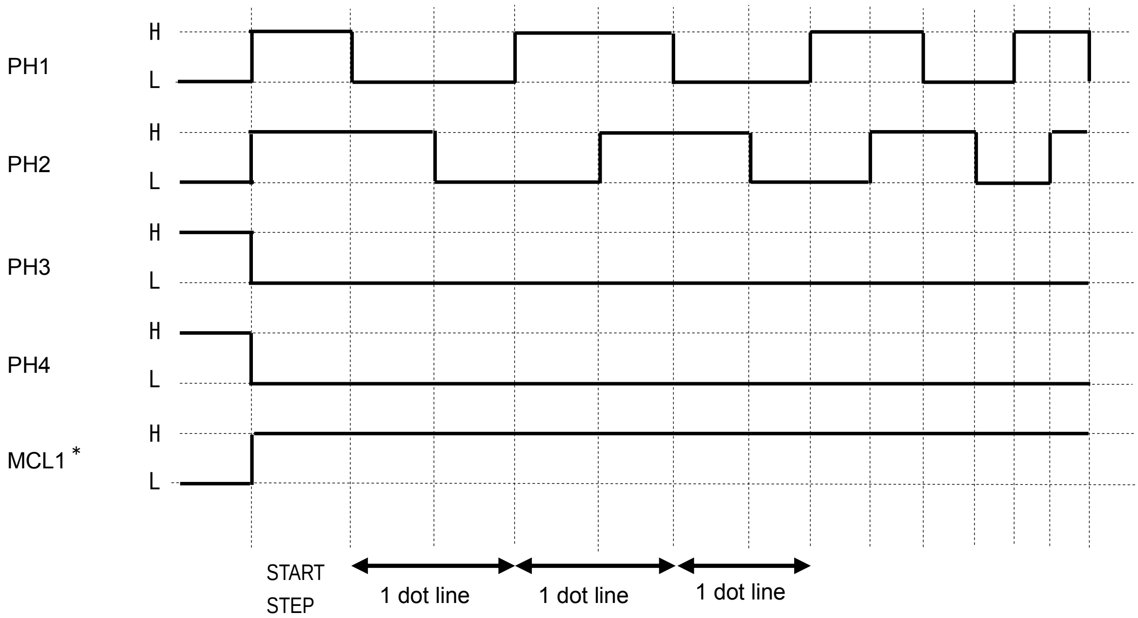


* Recommended motor driver : TB6562AFG(Toshiba)

Figure 3-4 Sample Drive Circuit (LTPD347)

3.3.3 Excitation Sequence

Drive the motor with 2-2 phase excitation. One step of the motor drive signal feeds the paper 0.0625 mm. One dot line is consisted of 2 steps. When the voltage signal shown in Figure 3-5 is input to the motor drive circuit shown in Figure 3-3, the printer feeds the paper in the normal direction when the motor is excited in order of step 1, step 2, step 3, step 4, step 5, step 6, step7, step 8, step 1, step 2, ... , as shown in Table 3-3.



*: Set MCL1 to "High" while the motor is driven.

Figure 3-5 Input Voltage Waveforms for the Sample Drive Circuit

Table 3-3 Excitation Sequence

	Input signal				Output signal			
	PH1	**PH2**	**PH3**	**PH4**	**A**	**B**	$\overline{A}$	$\overline{B}$
Step 1	L	H	L	L	L	H	H	L
Step 2	L	L	L	L	L	L	H	H
Step 3	H	L	L	L	H	L	L	H
Step 4	H	H	L	L	H	H	L	L
Step 5	L	H	L	L	L	H	H	L
Step 6	L	L	L	L	L	L	H	H
Step 7	H	L	L	L	H	L	L	H
Step 8	H	H	L	L	H	H	L	L

3.3.4 Motor Start/Stop Method

Refer to the timing chart in Figure 3-6 when designing the control circuit or software for starting and stopping the motor. Also note the following precautions:

(1) Start step

To start the motor from the pause (no excitation) state, shift the motor to the sequence of print step after exciting the same phase as that of the stop step for the first acceleration step time of the acceleration step.

To restart the motor from the stop step, immediately shift the motor to the sequence of print step.

(2) Stop step

To stop the motor, excite the same phase as the last one in the printing step for 20ms.

(3) Pause state

In the pause state, do not excite the motor to prevent to the motor from overheating. Even when the motor is not excited, holding torque of the motor prevents the paper from moving.

Input signals for a sample drive circuit are shown in Figure 3-6.

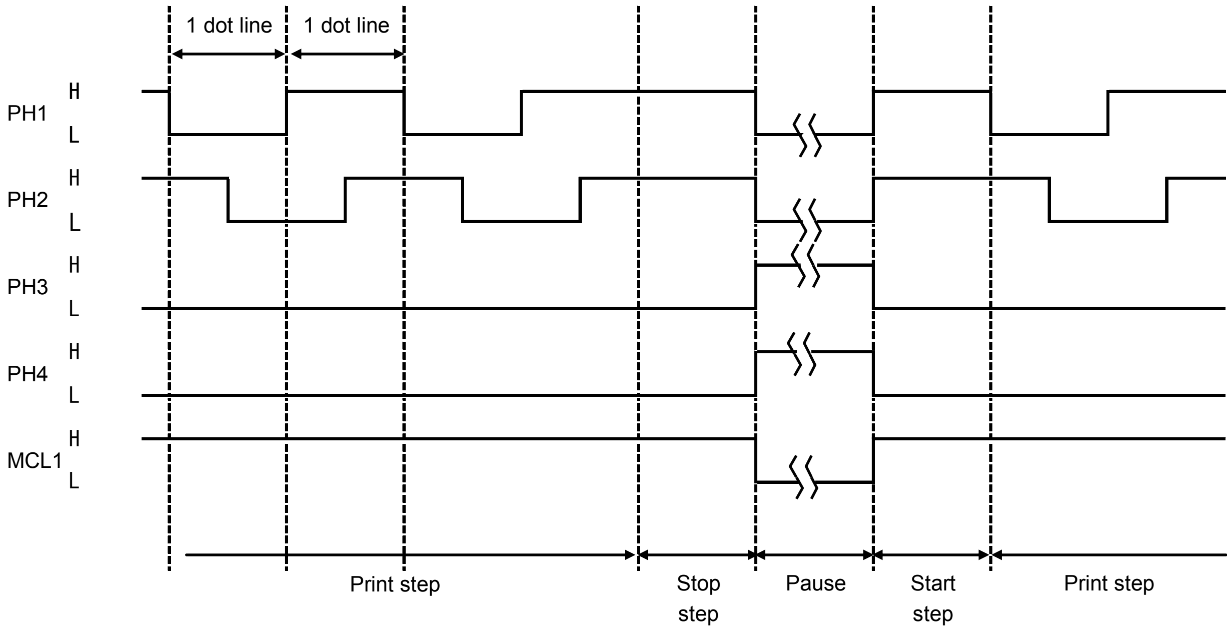


Figure 3-6 Motor Start/Stop Timing Chart

3.3.5 Motor Drive Method

Drive the motor by the following methods.

(1) Motor drive pulse rate

During paper feeding, the motor should be driven equal or lower the following maximum motor drive pulse rate.

LTPD247 Maximum motor drive pulse rate (P_M) : 3200 pps
LTPD347 Maximum motor drive pulse rate (P_M) : 2400 pps

(2) Acceleration control

When driving the motor, the acceleration control is required to maintain the paper feed force of start up. If acceleration of the motor does not perform correctly, the motor may step out if it has a heavy workload. Accelerate the speed sequentially up to the maximum motor drive pulse rate P_M according to the Table 3-4 or Table 3-5 Acceleration Steps.

Acceleration should be performed by the acceleration step time below, that is output the phase.

1. Drive the start step as same as acceleration step time at Start acceleration step.
2. Drive the first step as same as acceleration step time at 1st acceleration step.
3. Drive the second step as same as acceleration step time at 2nd acceleration step.
4. Hereinafter, drive the "n"th step as same as acceleration step time at "n"th acceleration step.
5. After accelerating up to the maximum motor drive pulse rate P_M, drive the motor at a constant speed.

Available to print during acceleration.

(3) Deceleration control

The activation time of the thermal head may be longer than the motor step time depending on the type of the thermal paper, content of the printing and use conditions. In that case, decelerate the motor speed by extending the acceleration step time until the thermal head activation has been completed.

In the case of reducing the motor speed, the deceleration control based on the estimated motor speed is required for preventing paper feed failure caused by the steep change of the motor speed. Decelerate the speed properly, otherwise the motor may not rotate properly due to the steep change of the motor speed.

To prevent the steep change of the motor speed, follow the deceleration method as shown below.
Every dot line, predict the dot line that needs to decelerate after the next step.
The predicted range is 20 dot lines (40 steps) ahead from the next step.
If there is/are the dot line(s) that need(s) to decelerate, find the number of row (=an) for decelerating at the next step from the current acceleration step number.
Determine the next acceleration step time (= acceleration step number) based on the maximum value of calculated "an" (a1 to a40).

Find each "an" from the next step to the 40th step by following the procedure.

1. Find the thermal head activation time based on the equation of "3.5.1 Calculation of Activation Pulse Width".Calculate the Printing energy(E) and Adjusted voltage (V) using the temperature detected by thermistor and the thermal head drive voltage at that time.
   Calculate the Activation cycle(W)(the time from the start of the preceding activation to the start of the current activation) using "an" which is found at the previous step.
   If an≤0 such as during acceleration or driving constantly at maximum speed, use an=0.

2. Find the current acceleration step on Table 3-4 or Table 3-5, and then find the nearest acceleration step number which is longer than a half of the calculated thermal head activation time and smallest.

3. Find the number of row (an) to decelerate from current acceleration step number to next step by substituting the calculated acceleration step number into the following equation.
"an" should be rounded off to an integer.

$$an = \frac{(Y - Yn)}{n}$$

an:	Number of row to decelerate from current acceleration step number to next step
Y:	Current acceleration step number (=Current acceleration step time)
Yn:	Acceleration step number at "n"th step ahead (=Acceleration step time at "n"th step ahead
n:	Step to decelerate (n=1,2,3…,40)

(For example : LTPD247)
For example: If there is a dot line which holds the maximum value of "an" at 20th step ahead from the current step.

1 The calculated pulse width is assumed as t=0.888msec.

2 Find the acceleration step number from Table3-4.
Current acceleration step time of motor：313 μ s -> Acceleration step number=120
Calculated acceleration step time of motor：445 μ s -> Acceleration step number=60
(Necessary acceleration step time based on the calculated activation pulse width is 0.888/2×1000＝444 μ s
The nearest acceleration step time which is longer than 444μs and smallest is 445μs.)

3 Find the number of row of acceleration step to decelerate from current acceleration step number to next step (an) using the following equation.

$$a20 = \frac{(120 - 60)}{20} = 3$$

According to the maximum value a20=3 by calculated value of "an" (a1 to a40), next acceleration step time of the next step should be 317μs at the 117th acceleration step which reduced the row by three rows from the current 120th acceleration step.

If the actual thermal head activation time exceeds the estimated acceleration step time, drive the printer drive motor so that the motor driving composition of 1st step at 1st dot line and 2nd step at 1st dot line divides the thermal head activation time equally.

(4) Reacceleration control

Follow the procedure below if :
Unable to accelerate the speed due to deceleration control.
The speed has been reduced at a certain speed and then accelerates the speed again.

The next step time after reducing the speed is the nearest acceleration step time, which should be shorter than the previous acceleration step time and longest.

(For example : LTPD247)
According to Table 3-4, if the motor acceleration step time of the previous step is 900μs, the next step should be the 16th acceleration step (885μs).

Hereinafter, accelerate the speed sequentially up to the maximum motor drive pulse rate P_M according to Table 3-4 or Table 3-5.

Table 3-4 Acceleration Steps（LTPD247）

(1/2)

Number of Steps	Speed (pps)	Step Time (μs)	Number of Steps	Speed (pps)	Step Time (μs)
Start	—	5000	31	1600	625
1	208	4805	32	1627	615
2	337	2970	33	1653	605
3	436	2293	34	1679	596
4	519	1925	35	1704	587
5	593	1688	36	1729	578
6	658	1519	37	1754	570
7	719	1392	38	1778	562
8	774	1291	39	1802	555
9	827	1209	40	1826	548
10	876	1141	41	1850	541
11	923	1083	42	1873	534
12	968	1033	43	1896	528
13	1011	989	44	1918	521
14	1052	951	45	1940	515
15	1092	916	46	1963	510
16	1130	885	47	1984	504
17	1167	857	48	2006	499
18	1203	831	49	2027	493
19	1238	808	50	2048	488
20	1272	786	51	2069	483
21	1305	766	52	2090	478
22	1338	748	53	2111	474
23	1369	730	54	2131	469
24	1400	714	55	2151	465
25	1430	699	56	2171	461
26	1460	685	57	2191	456
27	1489	671	58	2210	452
28	1518	659	59	2230	448
29	1546	647	60	2249	445
30	1573	636	—	—	—

Number of Steps	Speed (pps)	Step Time (μs)	Number of Steps	Speed (pps)	Step Time (μs)
61	2268	441	91	2781	360
62	2287	437	92	2797	358
63	2306	434	93	2812	356
64	2325	430	94	2827	354
65	2343	427	95	2842	352
66	2361	423	96	2858	350
67	2380	420	97	2873	348
68	2398	417	98	2888	346
69	2416	414	99	2903	345
70	2433	411	100	2917	343
71	2451	408	101	2932	341
72	2469	405	102	2947	339
73	2486	402	103	2962	338
74	2503	399	104	2976	336
75	2520	397	105	2991	334
76	2538	394	106	3005	333
77	2554	391	107	3019	331
78	2571	389	108	3034	330
79	2588	386	109	3048	328
80	2605	384	110	3062	327
81	2621	382	111	3076	325
82	2638	379	112	3090	324
83	2654	377	113	3104	322
84	2670	375	114	3118	321
85	2686	372	115	3132	319
86	2702	370	116	3146	318
87	2718	368	117	3159	317
88	2734	366	118	3173	315
89	2750	364	119	3186	314
90	2765	362	120	3200	313

Table 3-5 Acceleration Steps（LTPD347）

(1/2)

Number of Steps	Number of Steps	Step Time (μs)	Number of Steps	Speed (pps)	Step Time (μs)
Start	-	6407	31	1200	833
1	156	6407	32	1220	820
2	253	3960	33	1240	807
3	327	3058	34	1259	794
4	390	2567	35	1278	782
5	444	2250	36	1297	771
6	494	2025	37	1316	760
7	539	1856	38	1334	750
8	581	1722	39	1352	740
9	620	1613	40	1370	730
10	657	1522	41	1387	721
11	692	1444	42	1405	712
12	726	1378	43	1422	703
13	758	1319	44	1439	695
14	789	1267	45	1455	687
15	819	1221	46	1472	679
16	847	1180	47	1488	672
17	875	1142	48	1504	665
18	902	1108	49	1520	658
19	929	1077	50	1536	651
20	954	1048	51	1552	644
21	979	1022	52	1568	638
22	1003	997	53	1583	632
23	1027	974	54	1598	626
24	1050	952	55	1613	620
25	1073	932	56	1628	614
26	1095	913	57	1643	609
27	1117	895	58	1658	603
28	1138	878	59	1672	598
29	1159	863	60	1687	593
30	1180	847	-	-	-

Number of Steps	Number of Steps	Step Time (μs)	Number of Steps	Speed (pps)	Step Time (μs)
61	1701	588	91	2086	479
62	1715	583	92	2097	477
63	1729	578	93	2109	474
64	1743	574	94	2120	472
65	1757	569	95	2132	469
66	1771	565	96	2143	467
67	1785	560	97	2155	464
68	1798	556	98	2166	462
69	1812	552	99	2177	459
70	1825	548	100	2188	457
71	1838	544	101	2199	455
72	1851	540	102	2210	452
73	1864	536	103	2221	450
74	1877	533	104	2232	448
75	1890	529	105	2243	446
76	1903	525	106	2254	444
77	1916	522	107	2265	442
78	1928	519	108	2275	440
79	1941	515	109	2286	437
80	1953	512	110	2296	435
81	1966	509	111	2307	433
82	1978	506	112	2318	431
83	1990	502	113	2328	430
84	2003	499	114	2338	428
85	2015	496	115	2349	426
86	2027	493	116	2359	424
87	2039	491	117	2369	422
88	2051	488	118	2380	420
89	2062	485	119	2390	418
90	2074	482	120	2400	417

(5) Preventing Overheat

To prevent the motor from overheating, the drive time and drive ratio are limited.
Follow the Table 3-6 shown below to set a drive time and a pause time of the motor.

Table 3-6 Maximum Drive Time and Drive Ratio

Drive pulse rate (pps)			Maximum continuous drive time (s)	Motor drive voltage Vp (V)
				Drive ratio
400	to	800	40.0	52%
800	to	1200	20.0	55%
1200	to	1600	14.0	56%
1600	to	2000	13.0	50%
2000	to	2400	8.0	50%
2400	to	2800	7.0	53%
2800	to	3200	6.0	54%
3200			5.0	50%

$$\text{Drive Ratio}(\%) = \frac{\text{Drive Time}}{\text{Drive Time} + \text{Pause Time}} \times 100\,(\%)$$

3.3.6 Motor Drive Precautions

- Using the motor drive circuit other than the circuit shown in "Section 3.3.2 Sample Drive Circuit" may not ensure the specified efficiency.
- To prevent degradation in the print quality due to the backlash of the paper drive system, feed the paper for 24 steps or more at the initialization, at a time after setting/releasing the platen block, and a time after cutting with a paper cutter. During this time, drive the motor with constant speed at the 1st acceleration step.
- When printing, change the motor drive pulse rate depending on the operational conditions such as voltage, temperature, and the number of activated dots. (See Chapter 5 “PRINT DRIVE METHOD” for details)
- When printing, change the motor drive pulse rate so that the activation pulse width of the thermal head does not exceed the sum of the two-step times of the motor. (See Chapter 5 “PRINT DRIVE METHOD” for details).
- Do not feed the thermal paper backwards no more than 9mm. Surface of thermal paper may get scratched by backward feed. The backward feed may cause paper skew and jams depending on paper roll layout and designing of paper holder. Be sure to confirm performance with your product before using the backward feed.
- Do not print intermittently (Do not repeat printing and stopping in a short interval.)
  If doing so, print quality may be decreased due to unevenness of the paper feed pitch.
- Always perform the start and the stop steps for both character print and bit image print.
- For the motor stop, a minimum one dot line of motor feed is required from the step that thermal head was activated. If the motor is stopped at the step that the thermal head has been activated, paper feed difficulty may be caused due to sticking of the thermal paper to the thermal head.
- Sound and vibration during printing vary depending on the motor drive pulse rate. Verify the performance with your actual device.

3.4 THERMAL HEAD

The thermal head consists of heat elements and a thermal head driver that drives and controls the heat elements. The printing data input the DI terminal is “High” at printing and “Low” at non printing.
The data from the DI terminal is transferred to the shift register at the rising edge of the CLK signal.
The data is stored into the latch register by making $\overline{LAT}$ signal "Low" after one line data is transferred. The heat elements are activated by making $\overline{DST}$ signal "Low" in accordance with the stored print data.

In the LTPD247, a division printing by 3 blocks is available. Each block has 144 dots heat elements.
In the LTPD347 a division printing by 144 dots in 4 block each are available. The divided printing is effective for a high print ratio printing because the peak current can be cut down with the reduction of the average print speed.

3.4.1 Structure of the Thermal Head

Figure 3-7 shows the thermal head block diagram when driving the LTPD247.

Table 3-7 and Table 3-8 show the relationship between $\overline{DST}$ blocks and activated heating elements.

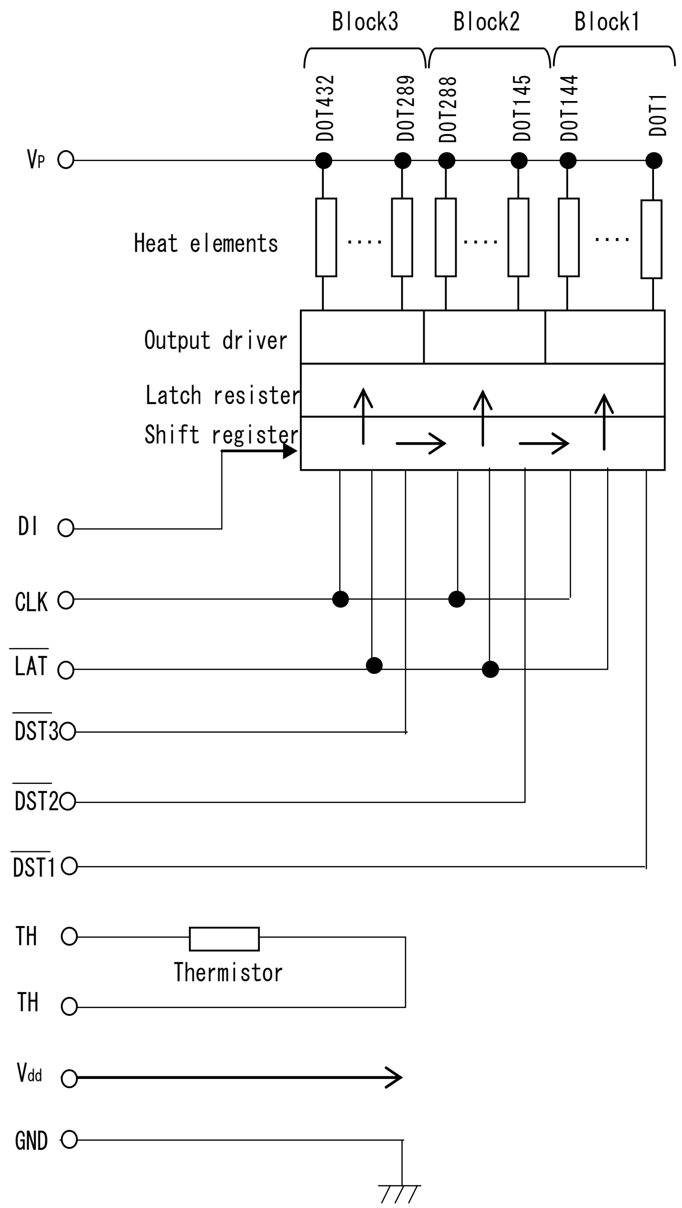


Figure 3-7 Thermal Head Block Diagram(LTPD247)

Table 3-7 $\overline{\text{DST}}$ Blocks and Activated Heating Elements(LTPD247)

Block	$\overline{\text{DST}}$ Number	Heating Element Number	Dots/$\overline{\text{DST}}$
1	$\overline{\text{DST1}}$	1 to 144	144
2	$\overline{\text{DST2}}$	145 to 288	144
3	$\overline{\text{DST3}}$	289 to 432	144

Table 3-8 $\overline{\text{DST}}$ Blocks and Activated Heating Elements(LTPD347)

Block	$\overline{\text{DST}}$ Number	Heating Element Number	Dots/$\overline{\text{DST}}$
1	$\overline{\text{DST1}}$	1 to 144	144
2	$\overline{\text{DST2}}$	145 to 288	144
3	$\overline{\text{DST3}}$	289 to 432	144
4	$\overline{\text{DST4}}$	433 to 576	144

3.4.2 Print Position of the Data

432-bit data (#1 to #432) transferred through DI terminals are printed when driving the LTPD247 as shown in Figure 3-8.

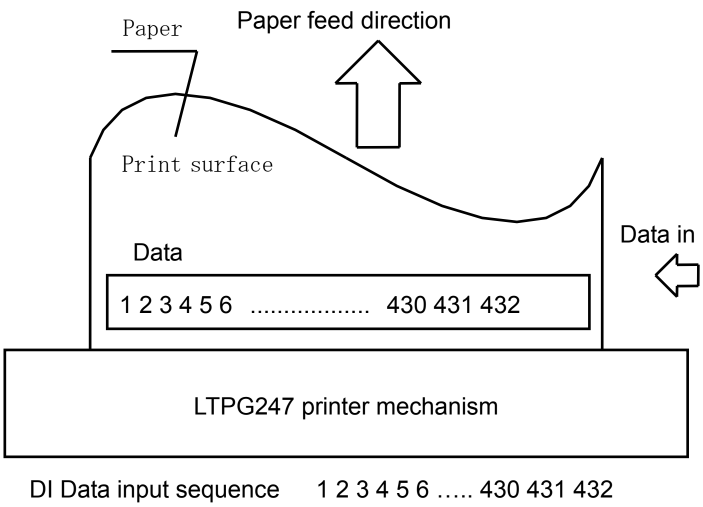


Figure 3-8 Print Position of the Data(LTPD247)

3.4.3 Electrical Characteristics of Thermal Head

Table 3-9 and Table 3-10 show electrical characteristics of thermal head.

Table 3-9 Electrical Characteristics of Thermal Head(LTPD247)

(at 25 °C)

Item		Symbol	Conditions		Rated value MIN	TYP	MAX	Unit
Thermal head heat element resistance		R_H			1455	1500	1545	Ω
Thermal Head drive voltage		V_P			21.6	24.0	26.4	V
Thermal Head drive current		I_P	at the number of simultaneously activated dots = 288		-	-	5.23	A
Logic voltage		V_{dd}			2.7	3.3	3.6	V
					4.75	5	5.25	V
Logic current		I_{dd}	f_{DI}=1/2f_{CLK}		-	-	36	mA
Input voltage	High	V_{IH}	CLK, DI, $\overline{LAT}$, DST		0.8V_{dd}	-	V_{dd}	V
	Low	V_{IL}	CLK, DI, $\overline{LAT}$, DST		0	-	0.2 V_{dd}	V
DI input current	High	I_{IH} DI	V_{IH} = V_{dd}		-	-	0.5	μA
	Low	I_{IL} DI	V_{IL} = 0V		-	-	-0.5	μA
$\overline{DST}$ input current (High active)	High	I_{IH} DST	Vdd=5V, V_{IH}=Vdd		-	-	0.5	μA
	Low	I_{IL} DST	V_{IL} = 0V	2.7V≤V_{dd}≤3.6V	-	-	-16	μA
				4.75≤V_{dd}≤5.25V	-	-	-24.5	μA
CLK input current	High	I_{IH} CLK	V_{IH} = V_{dd}		-	-	1.5	μA
	Low	I_{IL} CLK	V_{IL} = 0V		-	-	-1.5	μA
$\overline{LAT}$ input current	High	I_{IH} $\overline{LAT}$	V_{IH} = V_{dd}		-	-	1.5	μA
	Low	I_{IL} $\overline{LAT}$	V_{IL} = 0V		-	-	-1.5	μA
CLK frequency		f_{CLK}	2.7V≤Vdd≤3.6V		-	-	8	MHz
			4.75≤Vdd≤5.25V		-	-	16	MHz
CLK pulse width		t1	See the Timing Chart.	2.7V≤Vdd≤3.6V	56	-	-	ns
				4.75≤Vdd≤5.25V	28	-	-	ns
DI setup time		t2	See the Timing Chart.	2.7V≤Vdd≤3.6V	30	-	-	ns
				4.75≤Vdd≤5.25V	15	-	-	ns
DI hold time		t3	See the Timing Chart.	2.7V≤Vdd≤3.6V	10	-	-	ns
				4.75≤Vdd≤5.25V	10	-	-	ns
$\overline{LAT}$ setup time		t4	See the Timing Chart.		100	-	-	ns
$\overline{LAT}$ pulse width		t5	See the Timing Chart.		100	-	-	ns
$\overline{LAT}$ hold time		t6	See the Timing Chart.		50	-	-	ns
DST setup time		t7	See the Timing Chart.		300	-	-	ns
$\overline{LAT}$ wait time		t8*	See the Timing Chart.	2.7V≤Vdd≤3.6V	30	-	-	μs
				4.75≤Vdd≤5.25V	15	-	-	μs

*: If MIN at "$\overline{LAT}$ wait time" in the table cannot be secured, it may cause Vp voltage fluctuations.

Table 3-10 Electrical Characteristics of Thermal Head(LTPD347)

(at 25 °C)

Item		Symbol	Conditions		MIN	TYP	MAX	Unit
					Rated value			
Thermal head heat element resistance		R_H			1455	1500	1545	Ω
Thermal Head drive voltage		V_P			21.6	24.0	26.4	V
Thermal Head drive current		I_P	at the number of simultaneously activated dots = 288		-	-	5.23	A
Logic voltage		V_{dd}			2.7	3.3	3.6	V
					4.75	5	5.25	V
Logic current		I_{dd}	$f_{DI}=1/2f_{CLK}$		-	-	48	mA
Input voltage	High	V_{IH}	CLK, DI, $\overline{LAT}$, DST		$0.8V_{dd}$	-	V_{dd}	V
	Low	V_{IL}	CLK, DI, $\overline{LAT}$, DST		0	-	$0.2\ V_{dd}$	V
DI input current	High	I_{IH} DI	$V_{IH} = V_{dd}$		-	-	0.5	μA
	Low	I_{IL} DI	V_{IL} = 0V		-	-	-0.5	μA
DST input current (High active)	High	I_{IH} DST	V_{dd}		-	-	0.5	μA
	Low	I_{IL} DST	V_{IL} = 0V	$2.7V \le V_{dd} \le 3.6V$	-	-	-16	μA
				$4.75V \le V_{dd} \le 5.25V$	-	-	-24.5	μA
CLK input current	High	I_{IH} CLK	$V_{IH} = V_{dd}$		-	-	2.0	μA
	Low	I_{IL} CLK	V_{IL} = 0V		-	-	-2.0	μA
$\overline{LAT}$ input current	High	I_{IH} $\overline{LAT}$	$V_{IH} = V_{dd}$		-	-	2.0	μA
	Low	I_{IL} $\overline{LAT}$	V_{IL} = 0V		-	-	-2.0	μA
CLK frequency		f_{CLK}	$2.7V \le V_{dd} \le 3.6V$		-	-	8	MHz
			4.75≤Vdd≤5.25V		-	-	16	MHz
CLK pulse width		t1	See the Timing Chart.	$2.7V \le V_{dd} \le 3.6V$	56	-	-	ns
				$4.75V \le V_{dd} \le 5.25V$	28	-	-	ns
DI setup time		t2	See the Timing Chart.	$2.7V \le V_{dd} \le 3.6V$	30	-	-	ns
				$4.75V \le V_{dd} \le 5.25V$	15	-	-	ns
DI hold time		t3	See the Timing Chart.	$2.7V \le V_{dd} \le 3.6V$	10	-	-	ns
				$4.75V \le V_{dd} \le 5.25V$	10	-	-	ns
$\overline{LAT}$ setup time		t4	See the Timing Chart.		100	-	-	ns
$\overline{LAT}$ pulse width		t5	See the Timing Chart.		100	-	-	ns
$\overline{LAT}$ hold time		t6	See the Timing Chart.		50	-	-	ns
DST setup time		t7	See the Timing Chart.		300	-	-	ns
$\overline{LAT}$ wait time		t8*	See the Timing Chart.	$2.7V \le V_{dd} \le 3.6V$	30	-	-	μs
				$4.75V \le V_{dd} \le 5.25V$	15	-	-	μs

*: If MIN at "$\overline{LAT}$ wait time" in the table cannot be secured, it may cause Vp voltage fluctuations.

3.4.4 Timing Chart

Figure 3-9 shows a thermal head drive timing chart.

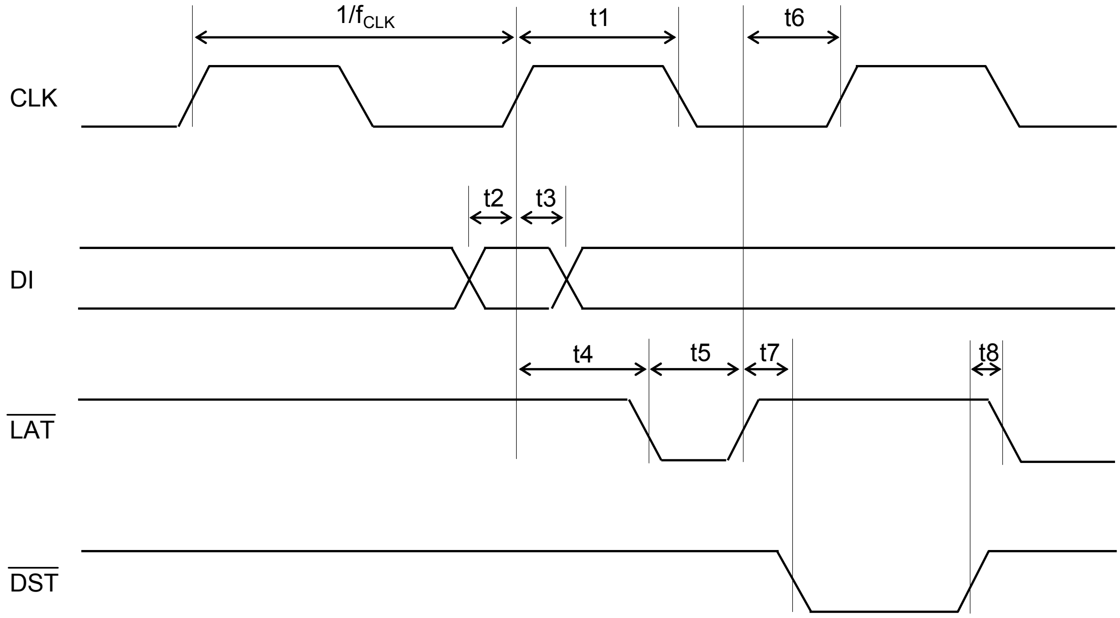


Figure 3-9 Thermal Head Drive Timing Chart

3.4.5 Thermal Head Resistance

Table 3-11 shows resistance of the thermal head of the printer.

Table 3-11 Thermal Head Resistance

Thermal Head Resistance
1455 to 1545Ω

3.4.6 Maximum Current Consumption

Since the maximum current consumption may reach the values calculated using equation (1) when the thermal head is driven, the number of simultaneously activated dots should be determined not to exceed power supply capacity. Also, allowable current for the cable material and the voltage drop on the cable should be cared well.

Equation (1):

$$I_P = \frac{N_{SA} \times V_P}{R_{H\,min}}$$

I_P	:	Maximum current consumption (A)	
N_{SA}	:	Number of simultaneously activated dots	
V_P	:	Thermal head drive voltage (V)	
$R_{H\,min}$	:	Minimum thermal head heat element resistance	1455(Ω)

3.5 CONTROLLING THE ACTIVATION PULSE WIDTH FOR THERMAL HEAD

To execute high quality printing using the printer, the activation pulse width according to printer use condition must be used. Control printing with the activation pulse width calculated by the following sequence. Printing at too high voltage or too long activation pulse width may shorten the life of the thermal head.

3.5.1 Calculation of Activation Pulse Width

Each value can be calculated according to the steps in Section 3.5.2 to 3.5.6 and the activation pulse width “t” can be calculated by substituting each value into the equation (2).

Equation (2):

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

t	:	Thermal head pulse width (ms)	
E	:	Printing energy (mJ)	See section 3.5.2
R	:	Adjusted resistance (Ω)	See section 3.5.3
V	:	Adjusted voltage (V)	See section 3.5.4
C	:	Thermal head activation pulse cycle coefficient	See section 3.5.6

3.5.2 Calculation of Printing Energy

The printing energy "E" can be calculated using equation (3) as the appropriate printing energy is different depending on each specified thermal paper and the temperature of the thermal head.

Equation (3):

$$E = E_{25} - T_C \times (T_X - 25)$$

E_{25}	:	Standard printing energy	See Table 3-12 or Table 3-13
T_C	:	Temperature coefficient	See Table 3-12 or Table 3-13
T_X	:	temperature detected by thermistor (°C) *	

*[1]Measure the temperature using the resistance of the built-in thermistor on the thermal head.
For the thermistor resistance value at T_X (°C), see Section 3.5.8.

Table 3-12 Standard printing energy and Temperature coefficient (LTPD247)

Thermal paper		Standard printing energy (mJ)	Temperature coefficient	
			Less than 25°C	25°C or higher
Nippon Paper	TF50KS-E2D	0.2998	0.002651	0.004241
	TP50KJ-R	0.3341	0.002057	0.004333
	TL69KS-LH	0.3838	0.001087	0.003272
Oji Paper	PD160R-63	0.2865	0.001427	0.003096
	PD160R-N	0.2943	0.000689	0.002767
Mitsubishi Paper mills limited	P220VBB-1	0.3134	0.003714	0.003390
Jujo Thermal	AP50KS-D	0.3439	0.001930	0.005206
	AF50KS-E	0.3074	0.001837	0.004158
Mitsubishi Hi-Tech Paper	F5041	0.3546	0.002110	0.004137
	P5045	0.3803	0.005593	0.004545
Papierfabrik August Koehler AG	KT55F20	0.3387	0.001991	0.004303
KSP	P300	0.3626	0.001974	0.004487
	P350	0.2951	0.003060	0.003674
	P350-2.0	0.2942	0.003608	0.004185
	KIP370	0.4213	0.002091	0.004485
	KIP470	0.3553	0.003153	0.003915
KANZAN	KF50	0.3360	0.000847	0.004443
	KPR440	0.3388	0.001570	0.004499

Table 3-13 Standard printing energy and Temperature coefficient (LTPD347)

Thermal paper		Standard printing energy (mJ)	Temperature coefficient	
			Less than 25°C	25°C or higher
Nippon Paper	TF50KS-E2D	0.2998	0.003666	0.003666
	TP50KJ-R	0.4009	0.005592	0.005199
	TL69KS-LH	0.4848	0.002960	0.004133
Oji Paper	PD160R-63	0.3821	0.002577	0.004581
	PD160R-N	0.3270	0.001291	0.003487
Mitsubishi Paper mills limited	P220VBB-1	0.3134	0.003714	0.003390
Jujo Thermal	AP50KS-D	0.3126	0.000957	0.003835
	AF50KS-E	0.3074	0.001384	0.003838
Mitsubishi Hi-Tech Paper	F5041	0.3901	0.002321	0.004551
	P5045	0.3458	0.005085	0.004132
Papierfabrik August Koehler AG	KT55F20	0.3725	0.002190	0.004733
KSP	P300	0.3972	0.002115	0.004878
	P350	0.3689	0.004347	0.004900
	P350-2.0	0.3678	0.005231	0.005231
	KIP370	0.5687	0.002823	0.006054
	KIP470	0.4087	0.004228	0.004899
KANZAN	KF50	0.3696	0.000932	0.004887
	KPR440	0.4235	0.001842	0.005624

3.5.3 Adjustment of Thermal Head Resistance

The adjusted resistance “R” can be calculated using equation (4) to adjust the thermal head resistance as a voltage drop is caused by wiring resistance.

Equation (4):

$$R = \frac{(R_H + R_i + (R_C + r_c) \times N_{SA})^2}{R_H}$$

R_H	:	Thermal head heat element resistance	1500 (Ω)
Ri	:	Wiring resistance in the thermal head	40 (Ω) *1
RC	:	Common terminal wiring resistance in the thermal head	0.32 (Ω)
rC	:	Wiring resistance between Vp and GND (Ω) *2	

*1 V_{dd} is 5.0V. Ri is 55(Ω) if Vdd is 3.0 or 3.3V

*2 The resistance is a serial resistance of the wire and switching circuit of relay between control terminal and power supply.

3.5.4 Adjustment of Thermal Head drive Voltage

The adjusted voltage “V” can be calculated using equation (5) as the printing density changes by the difference of the thermal head drive voltage.

Equation (5):

$$V = 0.968 \times V_P - 0.598$$

V_P : Thermal head drive voltage (V)

3.5.5 Setting of Activation Pause Time

In order to protect the thermal head heat elements, when the same heat element dots are activated continuously on the successive dot line, determine the activation pulse cycle (the time from the start of the preceding activation to the start of the current activation) which meets equation (6) to secure the pause time.

Equation (6):

$$W > t + 100\ (\mu s)$$

W : Activation cycle (μs)

*: W (Activation cycle) is the drive time for 2 step (1 dot line) drive cycle.

3.5.6 Adjustment by Thermal Head Activation Pulse Cycle

The thermal head activation pulse cycle coefficient "C" can be calculated using equations (7) as the printing density varies by the thermal head activation pulse cycle (equivalent for motor drive pulse rate).

Equation (7): when 2 step driving cycle is lower than 2640(μs):

$$C = \frac{132.151 \times W}{10^6} + 0.360$$

when 2 step driving cycle is 2640(μs) and higher:

$$C = \frac{80.812 \times W}{10^6} + 0.496$$

3.5.7 Calculation Sample for the Activation Pulse Width

Table 3-14 lists the calculation samples of the activation pulse width calculated using equation (2) and the values obtained using equations (3) to (5) and (7).

Table 3-14 Activation Pulse Width

Unit:ms

V_P [V]	T_X [℃]	Motor drive pulse rate [pps]														
		400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
21.6	−10	1.521	1.294	1.167	1.055	0.981	0.928	0.888	0.857	0.832	0.811	0.795	0.780	0.768	0.757	0.748
	0	1.418	1.206	1.088	0.984	0.914	0.865	0.828	0.799	0.776	0.757	0.741	0.728	0.716	0.706	0.698
	10	1.316	1.119	1.009	0.913	0.848	0.802	0.768	0.741	0.719	0.702	0.687	0.675	0.664	0.655	0.647
	20	1.213	1.032	0.930	0.841	0.782	0.740	0.708	0.683	0.663	0.647	0.634	0.622	0.612	0.604	0.596
	30	1.080	0.918	0.828	0.749	0.696	0.658	0.630	0.608	0.590	0.576	0.564	0.554	0.545	0.537	0.531
	40	0.915	0.778	0.702	0.635	0.590	0.558	0.534	0.515	0.500	0.488	0.478	0.469	0.462	0.456	0.450
	50	0.751	0.638	0.576	0.521	0.484	0.458	0.438	0.423	0.411	0.401	0.392	0.385	0.379	0.374	0.369
	60	0.587	0.499	0.450	0.407	0.378	0.358	0.342	0.330	0.321	0.313	0.306	0.301	0.296	0.292	0.288
	70	0.422	0.359	0.324	0.293	0.272	0.257	0.246	0.238	0.231	0.225	0.221	0.217	0.213	0.210	0.208
	80	0.258	0.219	0.198	0.179	0.166	0.157	0.150	0.145	0.141	0.138	0.135	0.132	0.130	0.128	0.127
24.0	-10	1.225	1.042	0.940	0.850	0.790	0.747	0.715	0.690	0.670	0.653	0.640	0.628	0.618	0.610	0.602
	0	1.142	0.971	0.876	0.792	0.736	0.696	0.666	0.643	0.625	0.609	0.597	0.586	0.577	0.569	0.562
	10	1.060	0.901	0.813	0.735	0.683	0.646	0.618	0.597	0.579	0.565	0.553	0.543	0.535	0.527	0.521
	20	0.977	0.831	0.749	0.678	0.630	0.596	0.570	0.550	0.534	0.521	0.510	0.501	0.493	0.486	0.480
	30	0.869	0.739	0.667	0.603	0.560	0.530	0.507	0.489	0.475	0.464	0.454	0.446	0.439	0.433	0.427
	40	0.737	0.627	0.565	0.511	0.475	0.449	0.430	0.415	0.403	0.393	0.385	0.378	0.372	0.367	0.362
	50	0.605	0.514	0.464	0.419	0.390	0.369	0.353	0.340	0.331	0.323	0.316	0.310	0.305	0.301	0.297
	60	0.472	0.402	0.362	0.328	0.304	0.288	0.276	0.266	0.258	0.252	0.247	0.242	0.238	0.235	0.232
	70	0.340	0.289	0.261	0.236	0.219	0.207	0.198	0.191	0.186	0.181	0.178	0.174	0.172	0.169	0.167
	80	0.208	0.177	0.159	0.144	0.134	0.127	0.121	0.117	0.114	0.111	0.108	0.106	0.105	0.103	0.102
26.4	-10	1.008	0.857	0.773	0.699	0.650	0.614	0.588	0.567	0.551	0.537	0.526	0.517	0.509	0.502	0.495
	0	0.939	0.799	0.721	0.652	0.606	0.573	0.548	0.529	0.514	0.501	0.491	0.482	0.474	0.468	0.462
	10	0.871	0.741	0.668	0.604	0.562	0.531	0.508	0.491	0.477	0.465	0.455	0.447	0.440	0.434	0.429
	20	0.803	0.683	0.616	0.557	0.518	0.490	0.469	0.452	0.439	0.429	0.420	0.412	0.406	0.400	0.395
	30	0.715	0.608	0.548	0.496	0.461	0.436	0.417	0.403	0.391	0.381	0.373	0.367	0.361	0.356	0.352
	40	0.606	0.515	0.465	0.420	0.391	0.370	0.354	0.341	0.331	0.323	0.317	0.311	0.306	0.302	0.298
	50	0.497	0.423	0.381	0.345	0.321	0.303	0.290	0.280	0.272	0.265	0.260	0.255	0.251	0.248	0.245
	60	0.388	0.330	0.298	0.269	0.250	0.237	0.227	0.219	0.212	0.207	0.203	0.199	0.196	0.193	0.191
	70	0.280	0.238	0.214	0.194	0.180	0.170	0.163	0.157	0.153	0.149	0.146	0.143	0.141	0.139	0.137
	80	0.171	0.145	0.131	0.118	0.110	0.104	0.100	0.096	0.093	0.091	0.089	0.088	0.086	0.085	0.084

Note) The table above is for LTPD247 and applicable under the following condition:

- Use of thermal paper “TF50KS-E2D”
- Vp and GND wiring resistance : rc = 0
- The number of simultaneously activated dots : N = 288

3.5.8 Temperature Characteristics of Thermistor

Calculate the resistance of the thermistor (R_X) at the operating temperature T_X (°C) using the following equation (8). Variation of resistance by temperature is shown in Figure 3-10 and Table 3-15.

Equation (8):

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

R_X	:	Resistance at T_X °C (Ω)	
R_{25}	:	Resistance at 25 °C	30 ±5% (kΩ)
B	:	B value	3950 ± 2% (K)
T_X	:	Temperature detected by thermistor (°C)	
EXP (A)	:	The "A" th power of natural logarithm e (2.71828)	

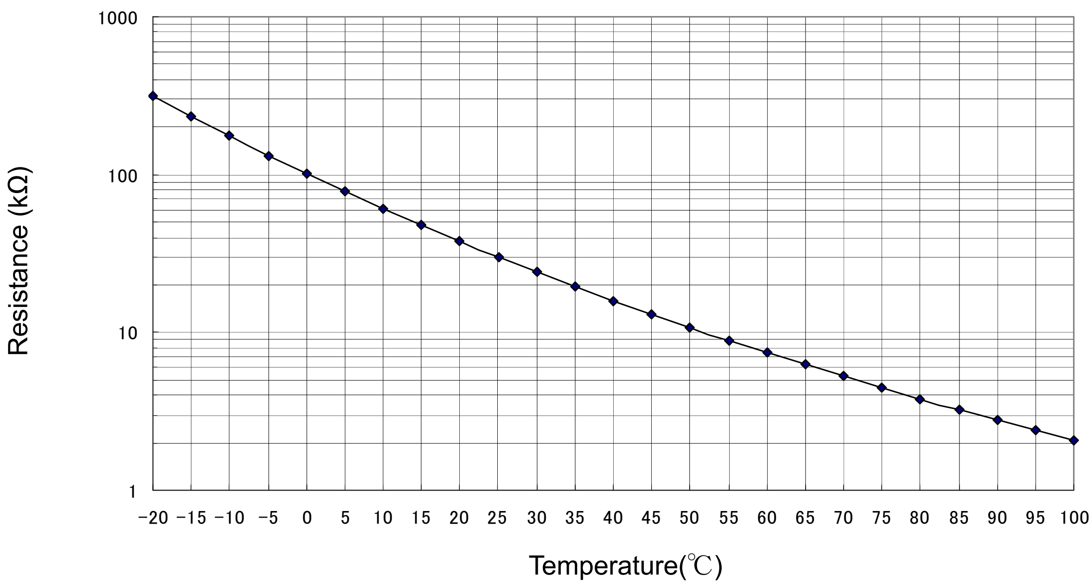


Figure 3-10 Thermistor Resistance vs. Temperature

Table 3-15 Temperature Characteristics

Temperature (°C)	Thermistor Resistance (kΩ)
-20	316.97
-15	234.22
-10	175.07
-5	132.29
0	100.99
5	77.85
10	60.57
15	47.53
20	37.61
25	30.00
30	24.11
35	19.51
40	15.89
45	13.03
50	10.75
55	8.92
60	7.45
65	6.25
70	5.27
75	4.47
80	3.80
85	3.25
90	2.79
95	2.41
100	2.09

3.5.9 Detecting Abnormal Temperature of the Thermal Head

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

(1) 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 $R_{TH} \leqq 3.80$ kΩ), and reactivate the heat elements when a temperature lower than 60°C ($R_{TH} \geqq 7.45$ kΩ) is detected. If the thermal head continues to be activated at a temperature higher than 80°C, the life of the thermal head may be shortened significantly.

(2) Detecting abnormal temperatures by hardware

If the thermal head continues to be activated by malfunction of the control unit (CPU), the software for detecting abnormal temperatures may not function properly, resulting in overheating of the thermal head. Overheating of the thermal head not only may damage the thermal head but also may cause smoke, fire and burn injuries. Always use hardware together with software for detecting abnormal temperatures to ensure personal safety. (If the control unit malfunctions, it may be impossible to prevent damage on the thermal head even if an abnormal temperature is detected by hardware.).

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

(a) Overheating of the thermal head
(approximately 100°C or higher ($R_{TH} \leqq 2.09$ kΩ))

(b) Faulty thermistor connection (the thermistor may be open or short-circuited).

If (a) or (b) is detected, immediately turn off the power supply. Reactivate the heat elements after they have returned to normal.

3.6 OUT-OF-PAPER SENSOR

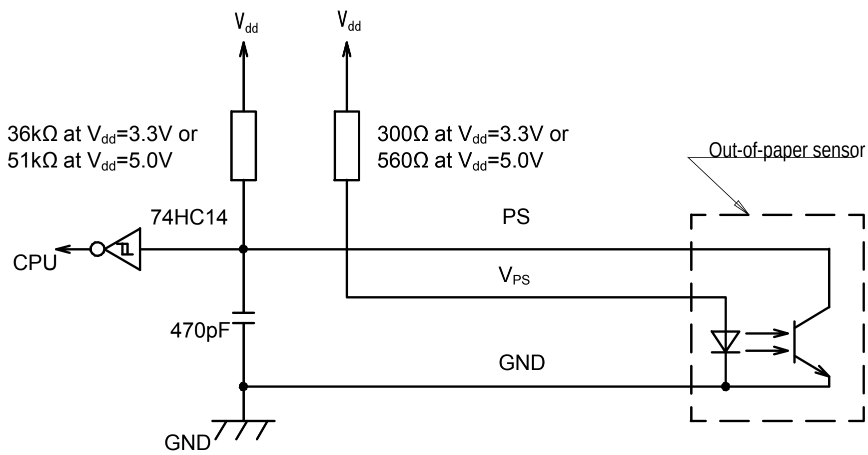
The printer has a built-in out-of-paper sensor (reflection type photo interrupter) to detect whether paper is present or not. An external control circuit should be designed so that it detects output from the out-of-paper sensor and does not activate the thermal head and motor when there is no paper. Doing not so may cause damage to the thermal head or platen roller or shorten the life of the thermal head significantly. If the motor is driven when there is no paper, a load is put on the paper drive system and the life of the printer may be shortened significantly.

Table 3-16 shows about the out-of-paper sensor used for this printer.

Table 3-16 Out-of-paper Sensor

Item	Specification
Type	NJL5902R (Rank B)
Manufacturer	New Japan Radio Co.,Ltd.

Figure 3-11 shows sample external control circuit of the out-of-paper sensor.



* The PS signal is “High” when there is no paper.

Figure 3-11 Sample External Circuit of the Out-of-paper Sensor

3.7 PLATEN POSITION SENSOR

The printer has a built-in platen position sensor for detecting whether the platen block is set or released. This sensor is a mechanical switch which is designed to be on when the platen block is set and to be off when it is released.

The external control circuit should be designed to detect output from the platen position sensor and output from the out-of-paper sensor described in 3.6. If the platen open and the no paper are detected, the external control circuit should not activate the thermal head. Otherwise, the thermal head may become damaged or its life may be shortened significantly.

Activate the thermal head when the platen block is closed by detecting the output from the platen position detection, and in the paper presence state by detecting the output from the paper sensor.

The hair may get caught in the exposed platen and the gear if the motor is driven when the platen block is in open state.

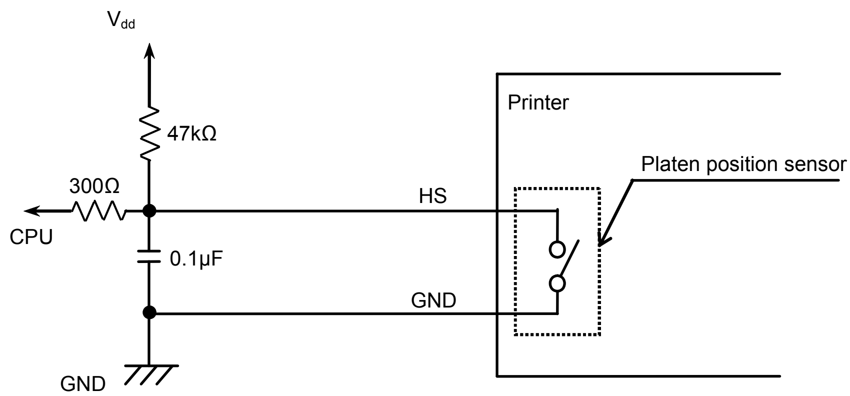
3.7.1 General Specifications

Table 3-17 shows about the general specification

Table 3-17 General Specifications of Platen Position Sensor

Item	Specification
Rated voltage	DC5.0V
Rated current	1mA
Contact resistance	3Ω max.

Figure 3-12 shows sample external control circuit of the platen position sensor.



* The HS signal is “High” when the platen is in an OPENED state.

Figure 3-12 Sample External Circuit of the Platen Position Sensor

3.7.2 Platen Position Sensor Precautions

- Be sure that there is a time lag between the time when the thermal head is set and the time when the platen position sensor actually starts detecting.
- Always use the capacitor shown in Figure 3-12 to prevent the switch from malfunctioning due to chattering.

CHAPTER 4
CONNECTING TERMINALS

4.1 RECOMMENDED CONNECTOR FOR EXTERNAL CIRCUITS

Use the recommended connectors listed in Table 4-1 to connect the printer connecting terminals firmly to the external circuits.

Table 4-1 Recommended Connectors

Number of Terminals	Recommended Connectors
50	MOLEX INC: 0541045031 (right angle type, top contact, gold plated)

4.2 CONNECTING TERMINALS

Figure 4-1 shows the terminal configuration of the connecting terminals and Table 4-2 and Table 4-3 show terminal assignments of the connecting terminals.

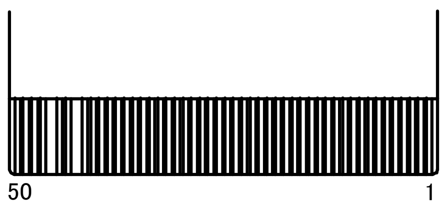


Figure 4-1 Connecting Terminals

Table 4-2 Terminal Assignments of the Connecting Terminal（LTPD247）

（1/2）

Terminal Number	Signal Name	Description
1	V_P	Thermal head drive power supply
2	V_P	Thermal head drive power supply
3	V_P	Thermal head drive power supply
4	V_P	Thermal head drive power supply
5	V_P	Thermal head drive power supply
6	V_P	Thermal head drive power supply
7	DI	Print data input (serial input)
8	CLK	Synchronizing signal for print data transfer
9	GND	GND
10	GND	GND
11	GND	GND
12	GND	GND
13	GND	GND
14	GND	GND
15	NC	No connection
16	NC	No connection
17	$\overline{DST3}$	Thermal head print activation instruction signal (#3 block)
18	V_{dd}	Logic power supply
19	TH2	Thermistor (the one is used for GND)
20	TH2	Thermistor (the one is used for GND)
21	TH1	Thermistor
22	NC	No connection
23	$\overline{DST2}$	Thermal head print activation instruction signal (#2 block)
24	$\overline{DST1}$	Thermal head print activation instruction signal (#1 block)
25	GND	GND
26	GND	GND
27	GND	GND
28	GND	GND
29	GND	GND
30	GND	GND

Terminal Number	Signal Name	Description
31	$\overline{LAT}$	Print data latch (memory storage) signal
32	V_P	Thermal head drive power supply
33	V_P	Thermal head drive power supply
34	V_P	Thermal head drive power supply
35	V_P	Thermal head drive power supply
36	V_P	Thermal head drive power supply
37	V_P	Thermal head drive power supply
38	N.C.	No connection
39	PS	Output signal of the paper sensor (Photo-transistor collector)
40	V_{PS}	Power supply of the paper sensor (LED anode)
41	GND	GND of the paper sensor (LED cathode, photo-transistor emitter) Platen position sensor GND
42	HS	Platen position sensor output
43	N.C.	No connection
44	FG	FG
45	FG	FG
46	N.C.	No connection
47	$\overline{A}$	Motor drive signal
48	B	Motor drive signal
49	A	Motor drive signal
50	$\overline{B}$	Motor drive signal

Table 4-3 Terminal Assignments of the Connecting Terminal（LTPD347）

（1/2）

Terminal Number	Signal Name	Description
1	V_P	Thermal head drive power supply
2	V_P	Thermal head drive power supply
3	V_P	Thermal head drive power supply
4	V_P	Thermal head drive power supply
5	V_P	Thermal head drive power supply
6	V_P	Thermal head drive power supply
7	DI	Print data input (serial input)
8	CLK	Synchronizing signal for print data transfer
9	GND	GND
10	GND	GND
11	GND	GND
12	GND	GND
13	GND	GND
14	GND	GND
15	N.C.	No connection
16	$\overline{DST4}$	Thermal head print activation instruction signal (#4 block)
17	$\overline{DST3}$	Thermal head print activation instruction signal (#3 block)
18	V_{dd}	Logic power supply
19	TH2	Thermistor (the one is used for GND)
20	TH2	Thermistor (the one is used for GND)
21	TH1	Thermistor
22	NC	No connection
23	$\overline{DST2}$	Thermal head print activation instruction signal (#2 block)
24	$\overline{DST1}$	Thermal head print activation instruction signal (#1 block)
25	GND	GND
26	GND	GND
27	GND	GND
28	GND	GND
29	GND	GND
30	GND	GND

(2/2)

Terminal Number	Signal Name	Description
31	$\overline{LAT}$	Print data latch (memory storage) signal
32	V_P	Thermal head drive power supply
33	V_P	Thermal head drive power supply
34	V_P	Thermal head drive power supply
35	V_P	Thermal head drive power supply
36	V_P	Thermal head drive power supply
37	V_P	Thermal head drive power supply
38	N.C.	No connection
39	PS	Output signal of the paper sensor (Photo-transistor collector)
40	V_{PS}	Power supply of the paper sensor (LED anode)
41	GND	GND of the paper sensor (LED cathode, photo-transistor emitter) Platen position sensor GND
42	HS	Platen position sensor output
43	N.C.	No connection
44	FG	FG
45	FG	FG
46	N.C.	No connection
47	$\overline{A}$	Motor drive signal
48	B	Motor drive signal
49	A	Motor drive signal
50	$\overline{B}$	Motor drive signal

CHAPTER 5
PRINT DRIVE METHOD

5.1 MOTOR AND THERMAL HEAD DRIVE METHOD

The motor and the thermal head must be driven at the same time for printing.

The example of the LTPD247 driving is shown below.
Figure 5-1 shows a timing chart for driving using fixed two division printing.
Figure 5-2 shows a timing chart for driving using one division printing.

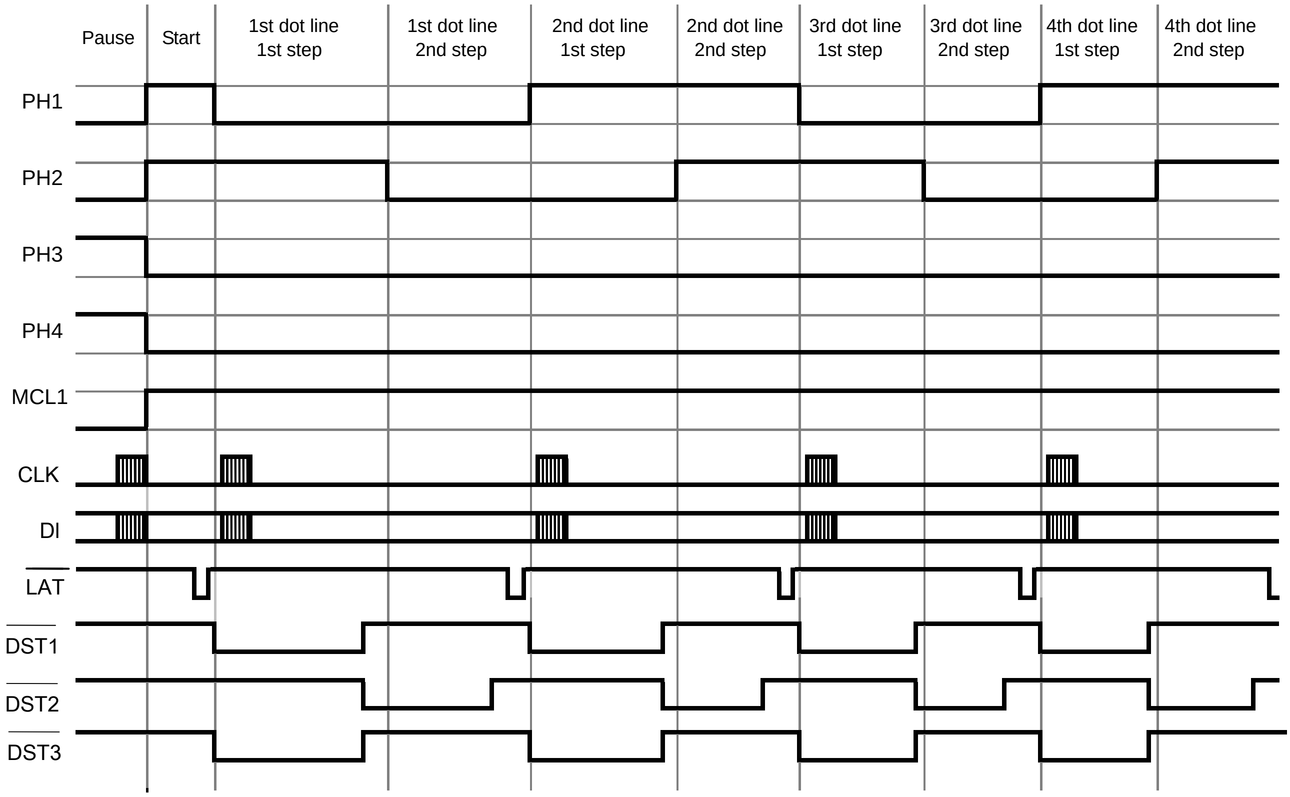


Figure 5-1 Timing Chart for Driving Using Two Divisions (LTPD247)

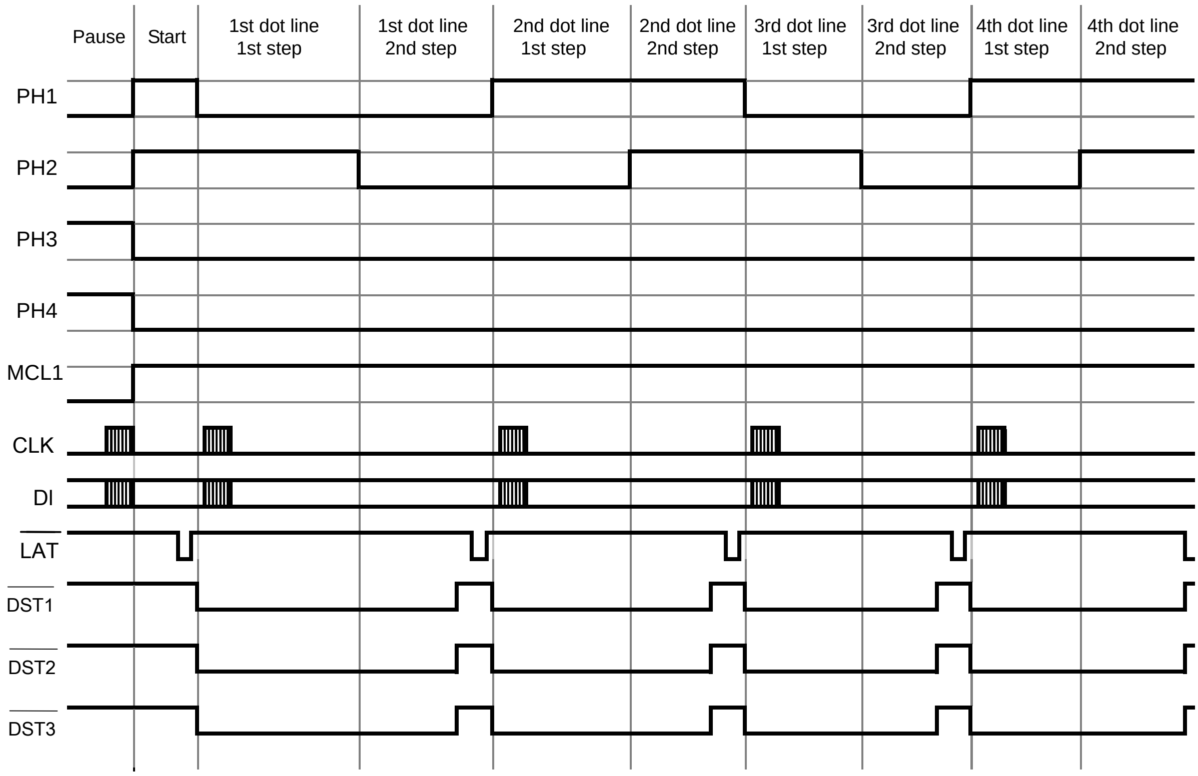


Figure 5-2 Timing Chart for Driving Using One Division (LTPD247)

The drive method using fixed two divisions is explained below (See Figure 5-1):

(1) Pause state

Inactivate the motor and always make $\overline{\text{DST}}$ signal of the thermal head "High".

(2) Start step

Excite the motor by the same phase which is output just before the motor stops.

(3) 1st dot line

Configure the 1 dot line by 2 steps of the motor drive signal.

At the 1st step of the motor drive signal, start activation of the thermal head by synchronized $\overline{\text{DST1}}$ and $\overline{\text{DST3}}$, printing 1st dot line by $\overline{\text{DST1}}$ to $\overline{\text{DST3}}$.

After 1 step of the motor drive signal is completed, input the 2nd step of the motor drive signal. (It is not necessary to synchronize the activation of the thermal head.)

Input the $\overline{\text{DST}}$ signal previously, transfer the data which is printed into the “SHIFT REGISTER” in the thermal head. And latch to “LATCH REGISTER” of the thermal head by inputting the $\overline{\text{LAT}}$ signal.

(4) Procedures that follows the 2nd dot line

Drive the motor in the same way as the 1st dot line. Repeat the motor driving and thermal head activation.

5.2 THERMAL HEAD DIVISION DRIVE METHOD

In the thermal head of the printer, there are 3 blocks (every 144 dots) in 1 dot line for LTPD247. There are 4 blocks (4 blocks are divided every 144 dots) in 1 dot line for LTPD347. These blocks are called physical blocks. $\overline{\text{DST}}$ signal is allocated to each physical block to activate it. To drive the thermal head, physical blocks are activated in groups. The group of physical blocks is called a logical block.

The following two methods are available as thermal head division drive methods. Select one you desire.

(1) Fixed division method

Logical blocks (physical blocks to be driven at the same time) are predetermined for the fixed division method.

In this method, high quality printing is available because the physical blocks are always driven in the same order.

(2) Dynamic division method

Logical blocks are predetermined so that number of dots of the physical block does not exceed the specified maximum number of the activating dots for every 1 dot line printing. Logical blocks are predetermined for every 1 dot line printing.
The maximum current consumption can be controlled within a constant value.

Since the order of the printing block and print speed are changed in each dot line according to the content of the print data, print quality in this method may be lower than that in fixed division method. If print quality is regarded as important, printing in fixed division method is recommended.

5.3 PRECAUTIONS FOR PRINT DRIVE

- When using one division printing, a pause time between thermal head activations of the same heat element shall be secured more than 0.1ms.

- The number of the maximum thermal head division in one dot line should be 6 or lower for LTPD247 and 8 or lower for LTPD347 to maintain print quality. The number of the simultaneously activated dots should be 288 dots or less.

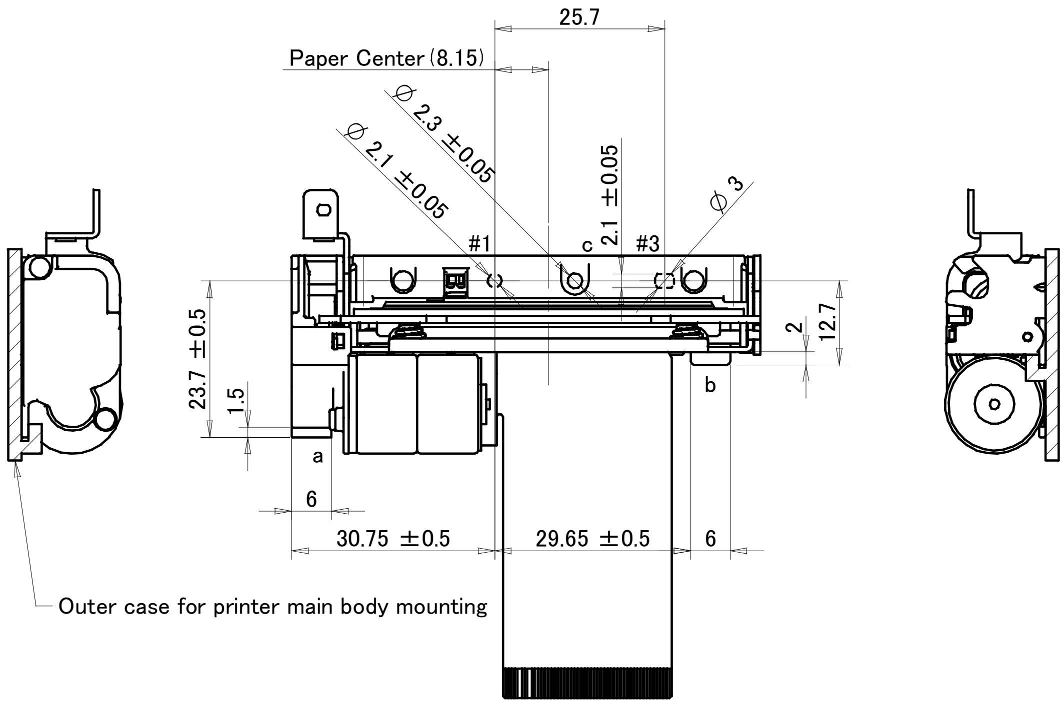
CHAPTER 6
OUTER CASE DESIGN GUIDE

6.1 SECURING THE PRINTER MAIN BODY

6.1.1 How to Mount the Printer Main Body

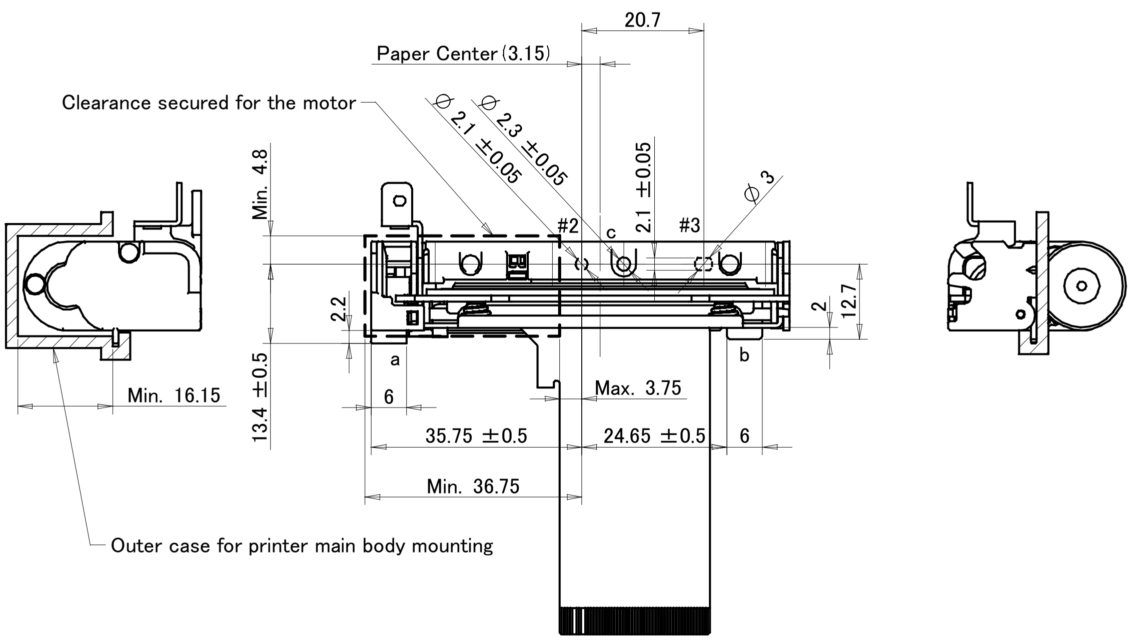
Figure 6-1, Figure 6-2, Figure 6-3 and Figure 6-4 show dimensions for positioning and securing the printer main body.

- Holes #1 to #3 must be used for positioning the printer main body. Design bosses on the outer case to position the printer main body for the positioning holes #1 and #2 (LTPD247A / LTPD347A) or #2 and #3 (LTPD247B / LTPD347B). The height of the bosses on the outer case must be 1.5mm (Max.)
- Secure by screw at the U shaped screwing position c.
- Design the fixing hook to the part of a and b.
- The motors of the LTPD247B and the LTPD347B locate at the bottom of the each printer.
  In order to avoid interfering with the motor, the FPC and the outer case, secure enough clearance around the motor shown in Figure 6-2 and Figure 6-4.



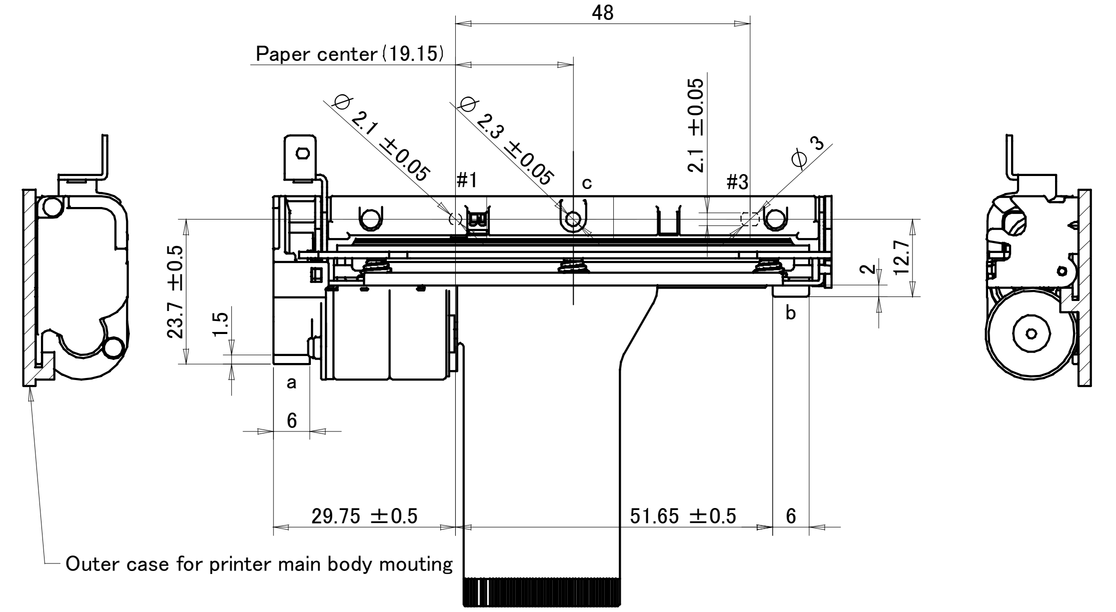
Unit : mm
General tolerance : ±0.1

Figure 6-1 Dimensions for Positioning and Securing the Printer Main Body (LTPD247A)



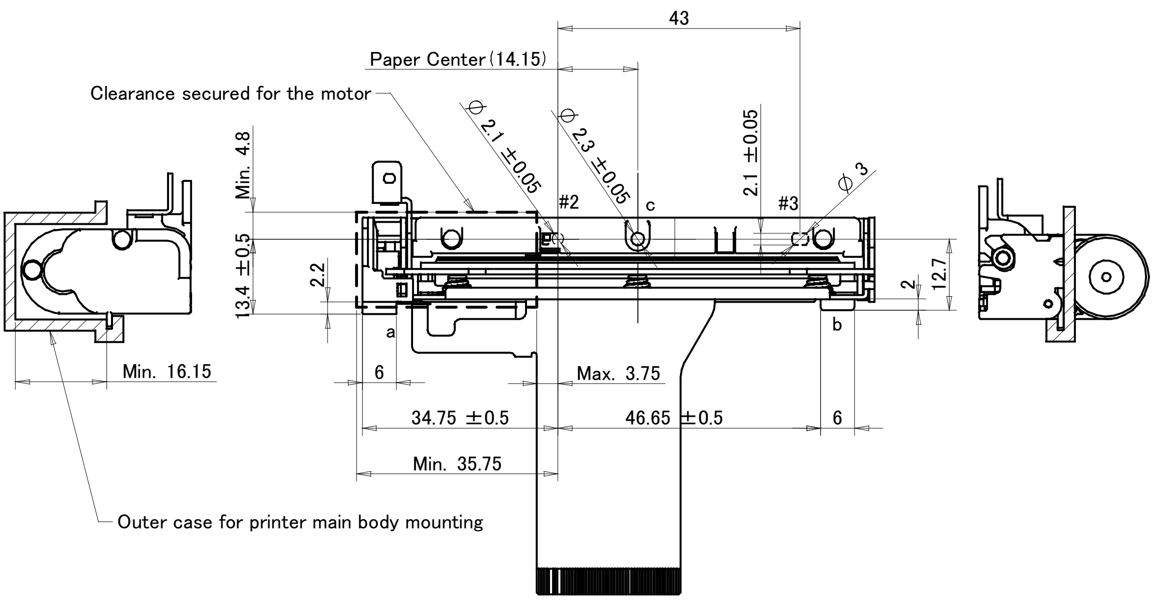
Unit : mm
General tolerance : ±0.1

Figure 6-2 Dimensions for Positioning and Securing the Printer Main Body (LTPD247B)



Unit : mm
General tolerance : ±0.1

Figure 6-3 Dimensions for Positioning and Securing the Printer Main Body (LTPD347A)



Unit : mm
General tolerance : ±0.1

Figure 6-4 Dimensions for Positioning and Securing the Printer Main Body (LTPD347B)

6.1.2 Recommended Screws

M2 cross-recessed pan head screw

6.1.3 Precautions for Securing the Printer Main Body

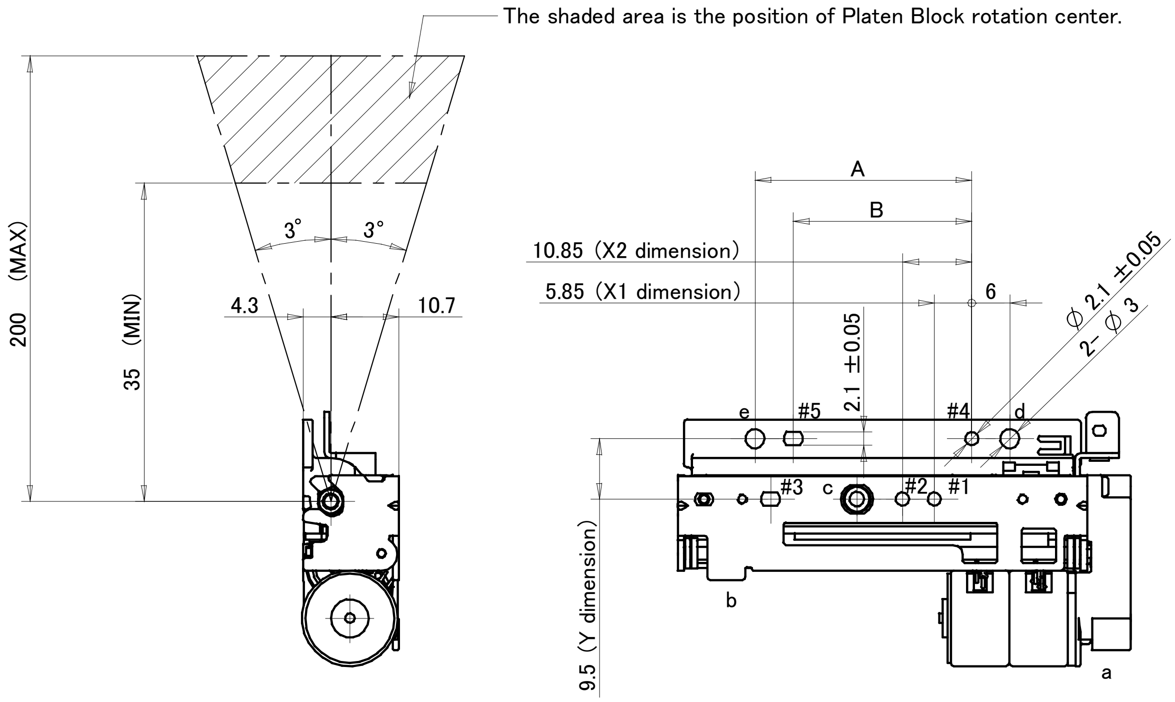
- Prevent from excessive stress, deformation, and torsion for securing the printer, otherwise poor printing quality, paper skewing, paper jamming, and noise during printing may be caused.
- The printer main body to be mounted on a flat surface and prevent from vibration.
- Pay attention not to damage on the FPC when securing the printer main body.

6.2 SECURING THE PLATEN BLOCK

6.2.1 How to Mount the Platen Block

Figure 6-5 shows the dimensions of an engagement position of the printer main body and platen block when setting or releasing the platen block mounted on the door.

- The hole #4 and #5 must be used for positioning the platen block. Design the bosses on the door to position the platen block for the positioning holes #4 and #5. The height of the bosses on the door must be 1.0mm (Max.)
- Secure the platen block using the screw holes d and e.



LTPD247 (A:34, B:28)

LTPD347 (A:56, B:50)

Unit : mm
General tolerance : ±0.1

Figure 6-5 Dimensions for Positioning and Securing the Platen Block

Table 6-1 Allowable Dimensions

Allowable X1 dimension	Allowable X2 dimension	Allowable Y dimension
5.65 to 6.05	10.65 to 11.05	9.3 to 9.7

6.2.2 Recommended Screw

M2.5 cross-recessed pan head screw

6.2.3 Precautions for Securing the Platen Block

- Design the door on which the platen block is mounted, rotation system of the door and mounting position of the platen block on the door so that X1, X2 and Y dimensions as shown in Figure 6-5 are within the allowable dimensions as shown in Table 6-1.
- It is recommended that the door and the outer case on which the printer main body is mounted are designed so that the door is guided by part of the outer case when the platen block is set into the printer main body.
- Design the rotation system of the door so that the center of the rotation is in the shaded area as shown in Figure 6-5
- Design the outer case and the door so that the platen block mounting surface to be parallel (tolerance : ±2°) to the printer main body mounting surface.
- Design the outer case so that the parallelism of #1-#3 and #4-#5 as well as the parallelism of #2-#3 and #4-#5 are 0.2 or less.
- Design the outer case so that the parallelism of the rotation center on the door to the printer main body mounting surface is 0.2 or less.
- Prevent from excessive stress, deformation, and torsion for securing the platen block.
- Design the door and the outer case strong enough to keep the allowable dimensions because stress is applied to them when setting and releasing the platen block. The rotation center of the door should be designed to fit the rotational shaft into the shaft hole so that the platen block should be stable when it is in the close state.
- If the printer main body and the platen block are not placed in proper position, the print defect and the paper jam may occur.
- A door on the outer case that holds the platen block must be set by pushing the center of the platen block. If only one end of the platen block is set, a print defect, and/or a paper jam will occur. Verify the performance with your actual device. In order to be pushed the center of the platen block to set it, put an indication to do so.
- If designing the outer case with a structure to bring the platen block up automatically using a spring property after released, make sure not to apply more than enough force to bring the platen block up. If designing a structure that the only one side of the outer case is brought up, the position relation between the printer main body with the movable blade unit and the platen block with the fixed blade unit will be improperly and will result in the print defect or the cut failure. Verify the performance with your actual device.

6.3 CONNECT THE PRINTER TO FRAME GROUND (FG)

To prevent the thermal head from being damaged by static electricity, it is recommended that the printer mechanism is connected to frame ground (FG). Verify the performance with your actual device.

6.3.1 How to Connect the Printer to Frame Ground (FG)

- Connect the printer main body to the Frame Ground (FG) of the outer case with the printer connecting terminals No.44 and 45 shown in Chapter 4, through the Frame Ground (FG) of the circuit board.
  When the printer main body is connected, make the shortest possible position of the printer connecting terminals and the Frame Ground (FG) of the outer case. And those are not effect to the control signal.

- If using a sheet metal material for the door, the door should also be connected to the frame ground (FG) of the interface board.

- All Frame Ground (FG) must be same electrical potentials.

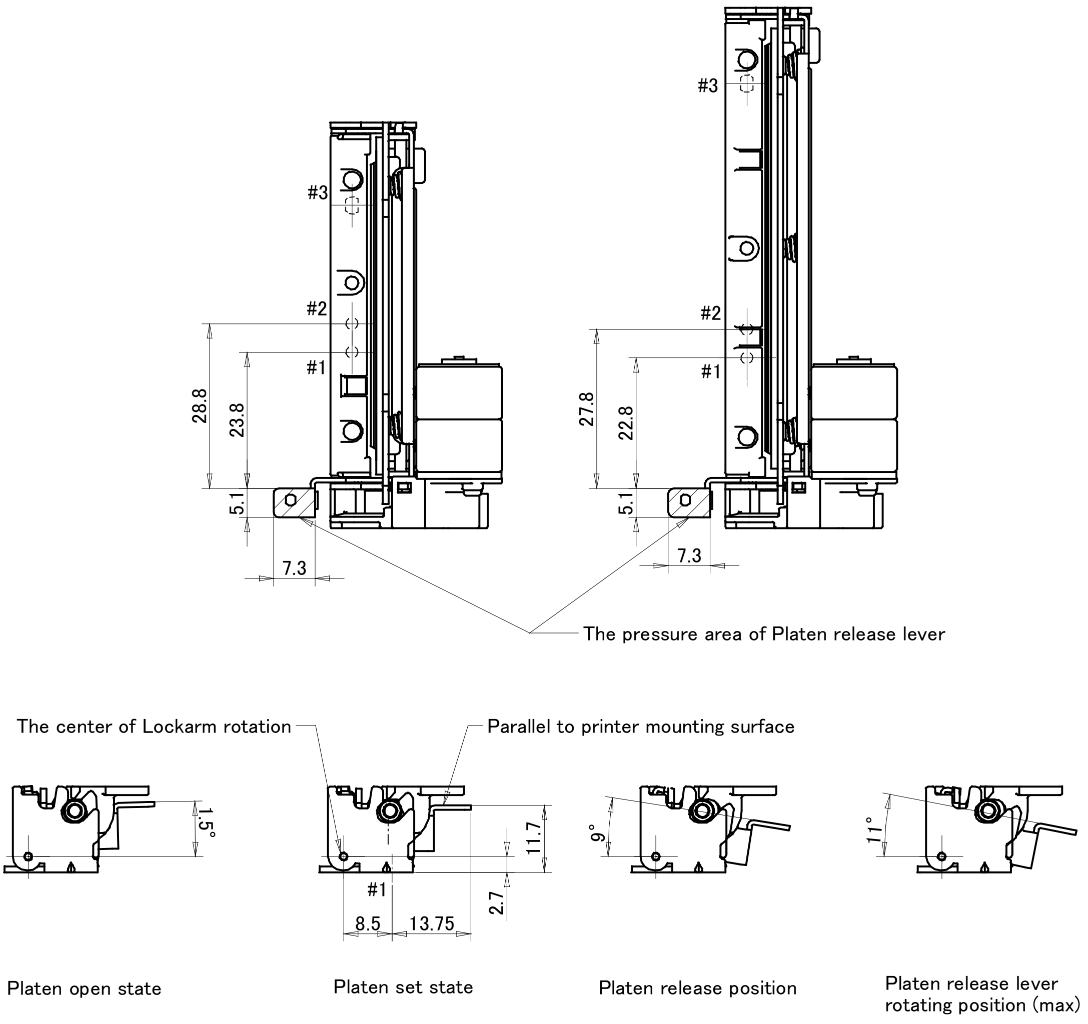
- Connect the signal ground (SG) to the frame ground (FG) using a 1MΩ resistor so that the electric potential of the signal ground (SG) of the thermal head and that of the frame ground (FG) of the printer are equal.

6.4 DESIGN THE PLATEN RELEASE LEVER

Figure 6-6 shows dimensions of the release lever and its movement when the platen release lever is released.

When designing the button or the lever that will operate simultaneously with the platen release lever, follow the precautions below.

- Design a stopper in the outer case to prevent to exceed 11 degree range of the platen release lever’s motion and to be applied excessive force (29.4N (3kg)).
- Design the button or the lever and its motion so that the platen release lever is pushed to an angle of 9 degrees of the released position. Design the stopper in the outer case to prevent the lever from being damaged when the extraordinary force is applied to the platen release lever.
- Design the button or the lever so that no load is constantly applied to it while the platen block is set.



Unit : mm
General tolerance : ±0.5

Figure 6-6 External Dimensions and Motion of the Platen Release Lever

6.5 LAYOUT OF THE PRINTER AND PAPER

The printer mechanism can be laid out as shown in Figure 6-7 according to the loading direction of the thermal paper.

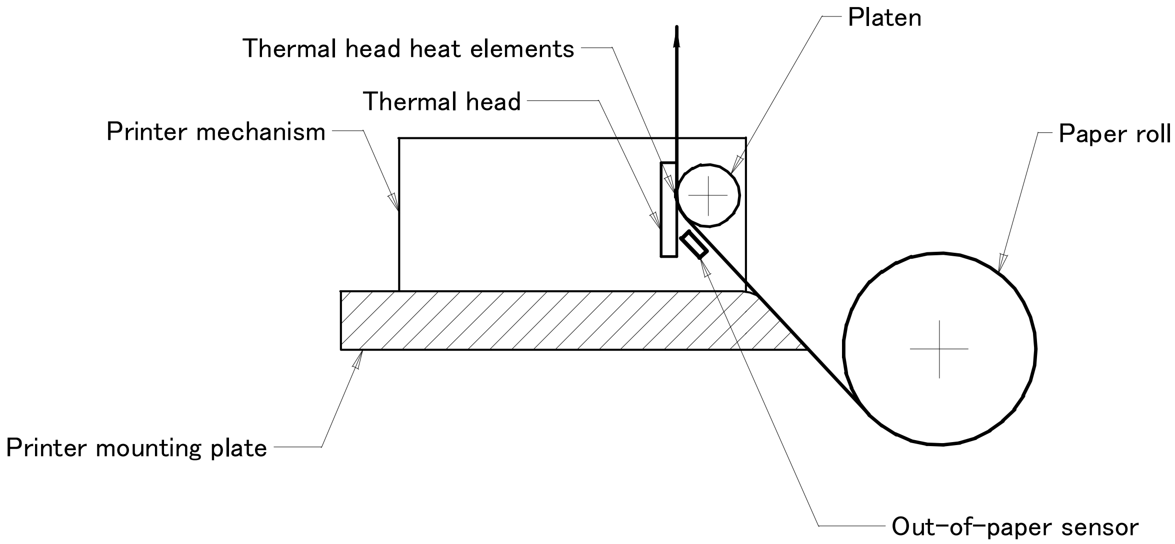


Figure 6-7 Recommended Layout between the Printer and the Paper

* The thermal paper feeding distance between the out-of-paper sensor and the heat element is approximately 8.3mm

6.6 WHERE TO MOUNT THE PAPER HOLDER

When designing the layout of the paper holder, note the followings. The recommended configuration of the paper holder is shown in Figure 6-8.

- Design the paper holder and the paper guide so that the thermal paper will be straight to the paper inlet port without any horizontal shifting and so that the center axis of the paper roll will be parallel to the printer when using paper roll.
- Design the paper holder so that the paper feed load should be 0.98N (100gf) or less. Be aware that the printing problem and paper feed problem may occur in the following case even if it is below 0.98N. Design the paper holder so as not to make these conditions and verify the performance with your actual device.

  ex)
  In case that the paper roll wobbles in the paper holder.
  In case that tension of the thermal paper between the paper roll and the printer changes rapidly.

  In addition, do not use following types of thermal paper:

  Expanded paper roll
  Deformed paper roll
  Roll core is sticking out.
  Width of the paper roll is out of spec

  When the thermal paper feeds backwards, design the space for the thermal paper returns to the paper holder side smoothly. Otherwise the backward feed may cause paper skew and jam.
  Do not feed the thermal paper backwards more than 9mm. If the thermal paper is out of the holding status with the thermal head and the platen, the printer mechanism cannot feed.

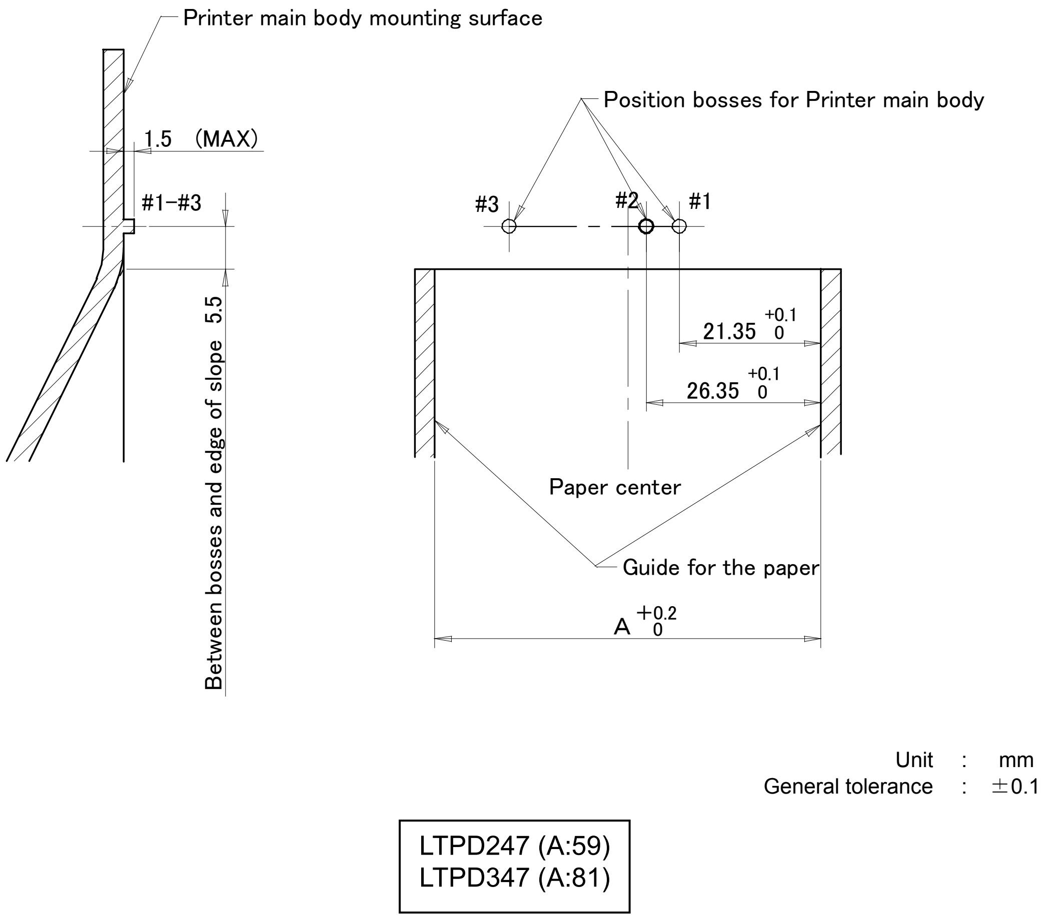


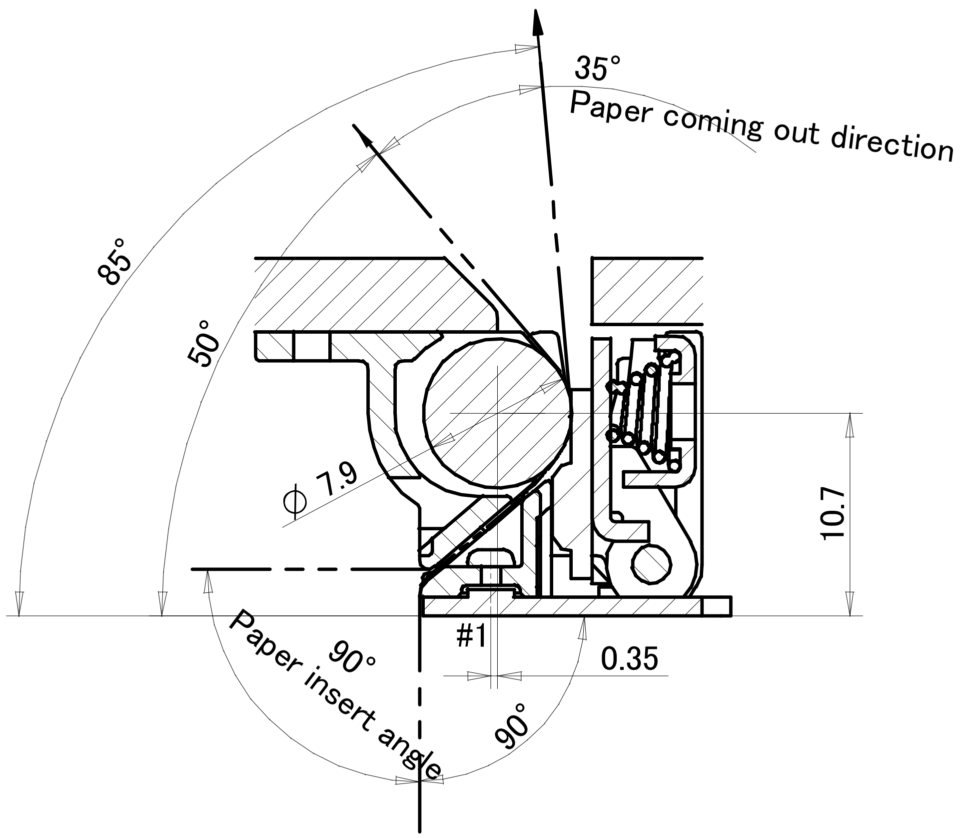
Figure 6-8 Recommended Paper Holder Dimensions

6.7 DESIGN PAPER EXIT

6.7.1 Design the Shape of the Paper Exit

When designing the shape of the paper exit, note the followings.

- Design the shape of the paper exit so that stress is not applied to the thermal paper that comes out.
- Design the paper exit of the outer case and the door so that the thermal paper coming out angle must be within of 50° to 85° as shown inFigure 6-9. The paper exit design should not interfere with the thermal paper coming out. Design the paper exit not to change thermal paper coming out direction and not interfere with paper feeding.



Unit : mm
General tolerance : ±0.1

Figure 6-9 Paper Path

6.7.2 Design the Paper Cutter

- Design paper cutter mounting position so the edge of the cutter blade does not touch with a platen block when the platen block is set and released.
- Use a well-cut cutter so that the thermal paper can be cut with less force than paper holding force.
- Design the blade edge of the cutter as shown in the right figure of Figure 6-10 so that the blade edge can guide the thermal paper edge after cutting. If designing the blade edge as shown in the left figure, the paper edge may be caught by the blade edge and result in the thermal paper edge to be caught inside of the cutter.
- Set the paper cutter to a position that allows to feed the paper backwards up to 9mm.

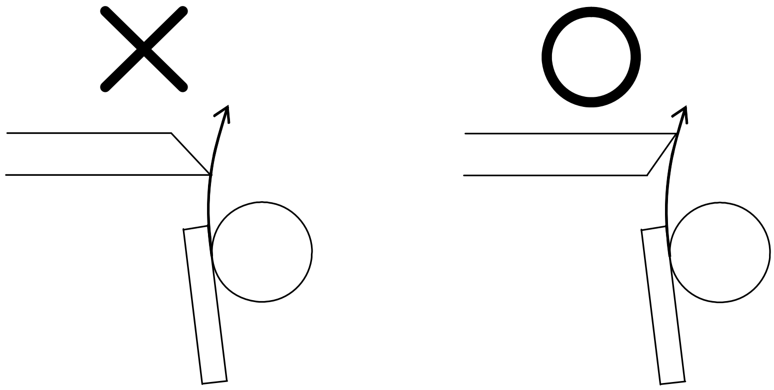


Figure 6-10 Blade Edge

6.8 PRECAUTIONS FOR DESIGNING THE OUTER CASE

- The thermal paper with a small winding diameter may cause the paper jam in the printer main body and a gap between the printer mechanism and the outer case. If using such a thermal paper with the small diameter, verify the performance with your actual device.

- Design the outer case to ensure enough space to allow the users to handle the platen release lever easily with fingers.
  See Chapter 8 “PROCEDURES for INSTALLING/UNINSTALLING THERMAL PAPER” for specific procedures. Also, see 6.4 “DESIGN THE PLATEN RELEASE LEVER” for its motion.

- Design the outer case so that it and parts for the outer case will not apply any load to the printer main body and the platen block. The load may affect printing, and also may damage the printer mechanism. Secure 1.0mm (min.) space between the printer main body and platen block and the outer case.

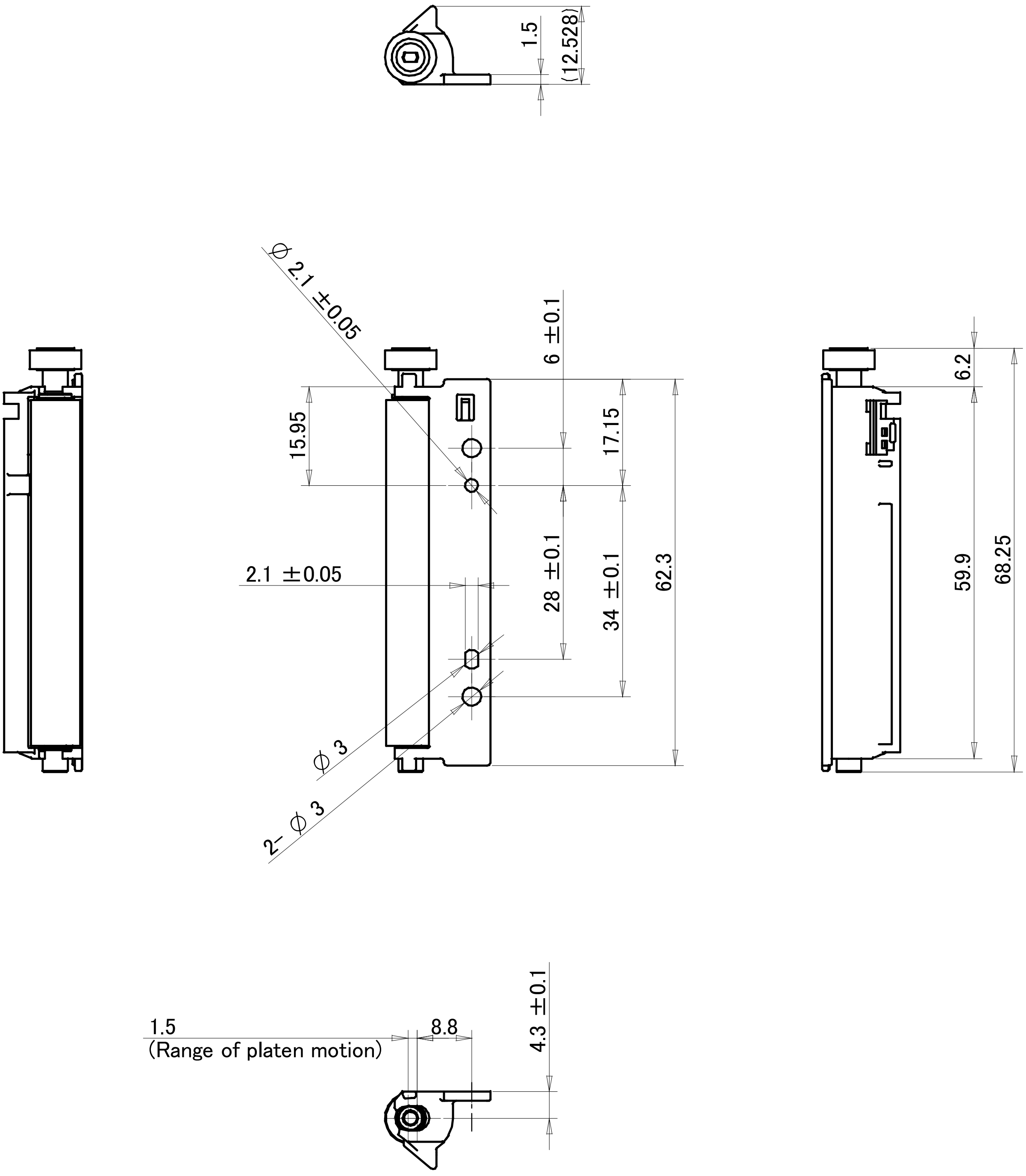
- Temperature of the thermal head and its peripherals rises very high during and immediately after printing. Be sure to design the outer case to prevent users from burn injuries by touching them. Place warning labels to warn users to ensure safe operation. As for thermal head cleaning, warn users to allow the thermal head to cool before cleaning. In order to allow cooling, secure clearance between the thermal head and the outer case when designing the outer case.

- Temperature of the motor and its peripherals rises very high during and immediately after printing. Be sure to design the outer case to prevent users from burn injuries by touching them. Place warning labels to warn users to ensure safe operation. In order to allow cooling, secure clearance between the motor and the outer case when designing the outer case.

CHAPTER 7
EXTERNAL DIMENSIONS

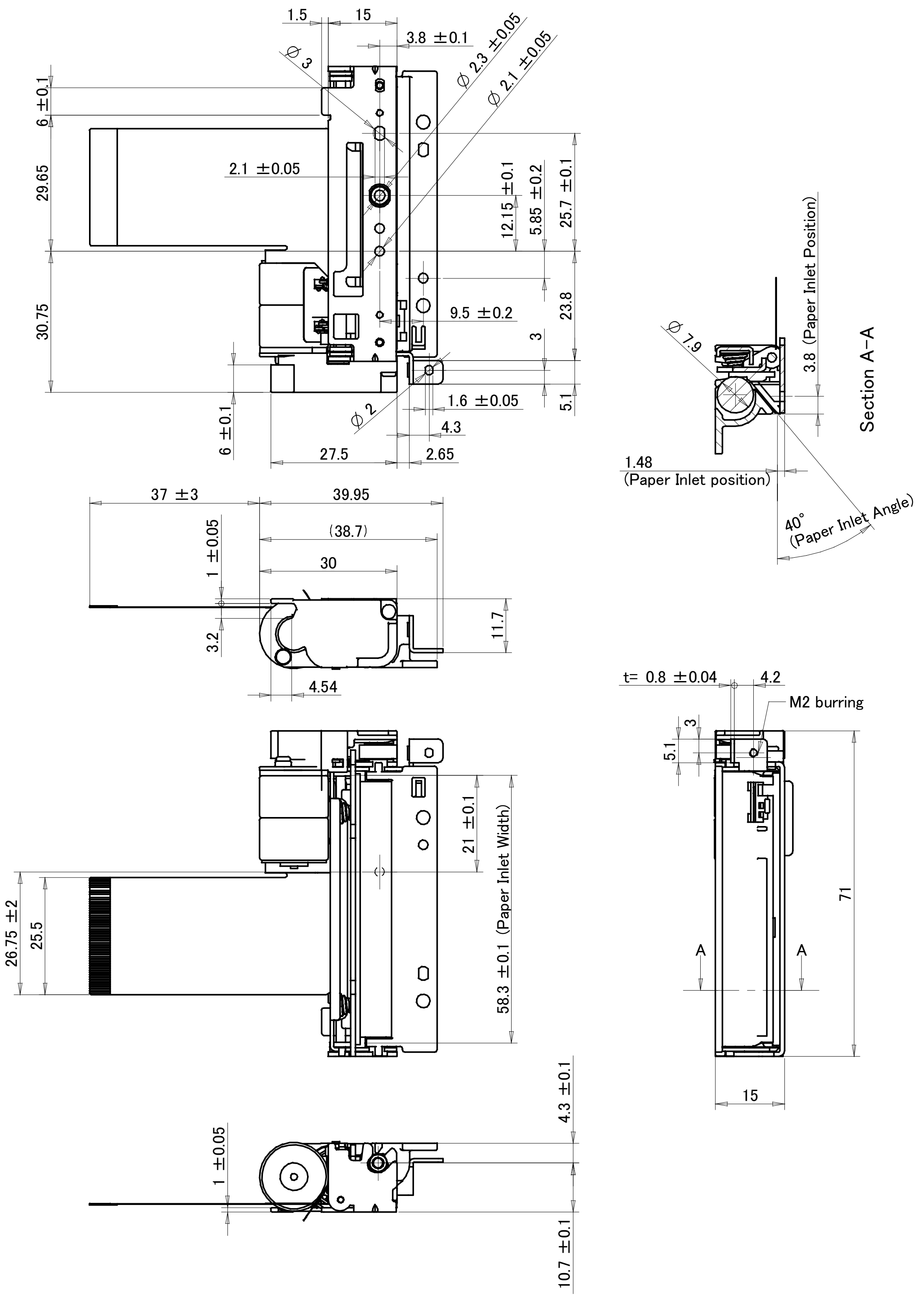
Figure 7-1 shows external dimensions of the platen block for LTPD247 and Figure 7-2 and Figure 7-3 show external dimensions of the printer LTPD247A and LTPD247B.

Figure 7-4 shows external dimensions of the platen block for LTPD347 and Figure 7-5 and Figure 7-6 show external dimensions of the printer LTPD347A and LTPD347B.



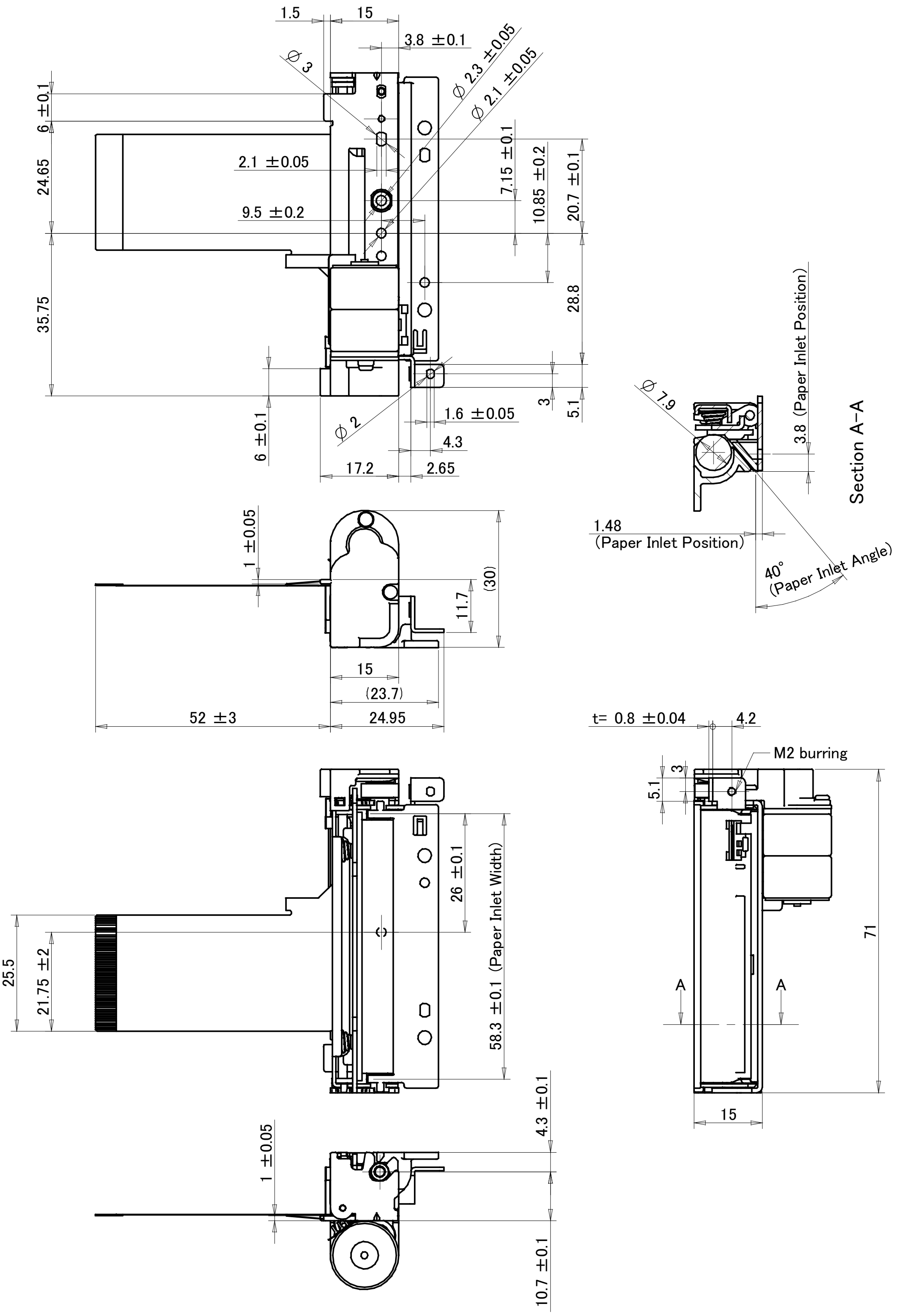
Unit : mm
General tolerance : ± 0.5

Figure 7-1 External Dimensions of the Platen Block (LTPD247)



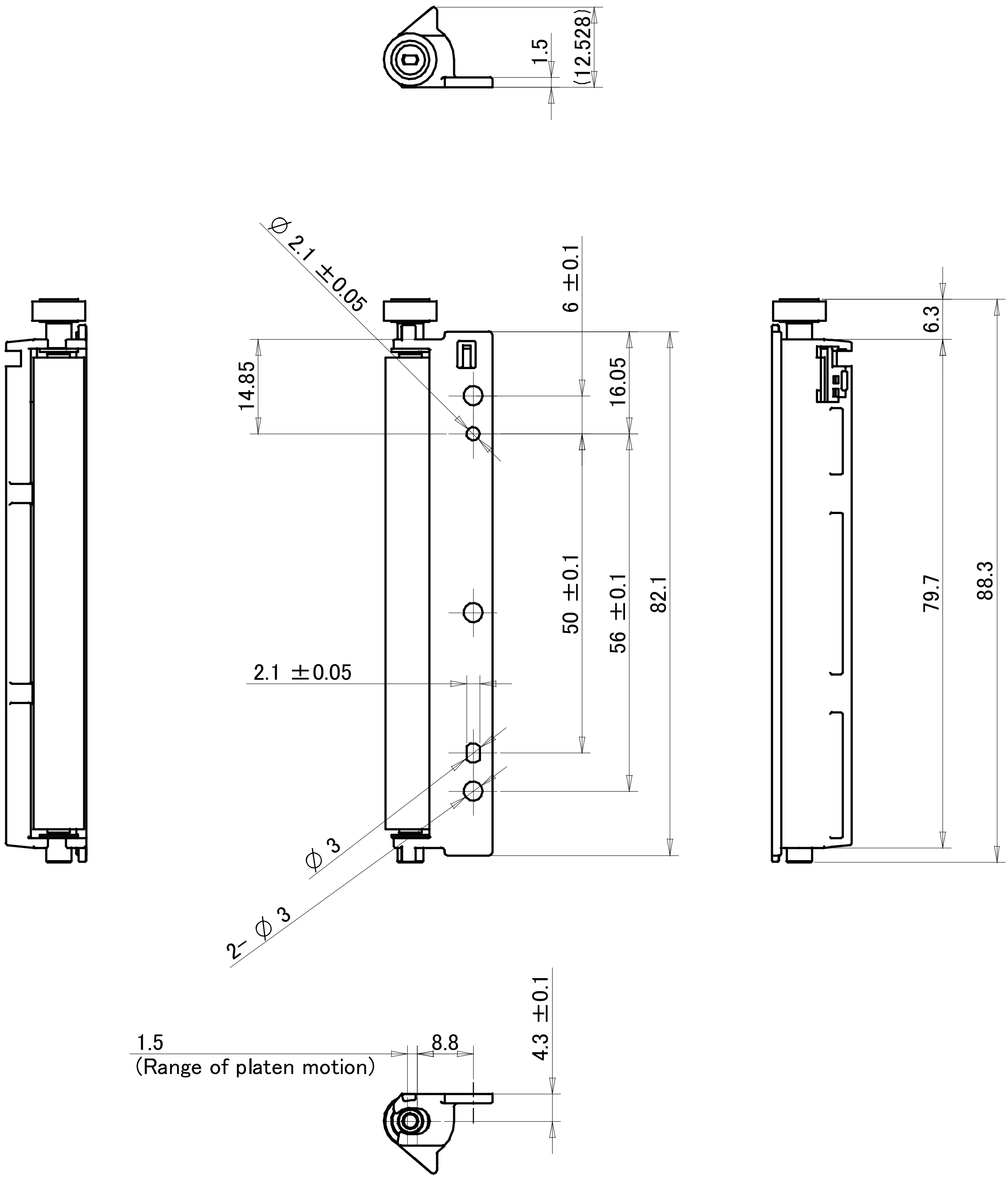
Unit : mm
General tolerance : ±0.5

Figure 7-2 External Dimensions of the Printer (LTPD247A)



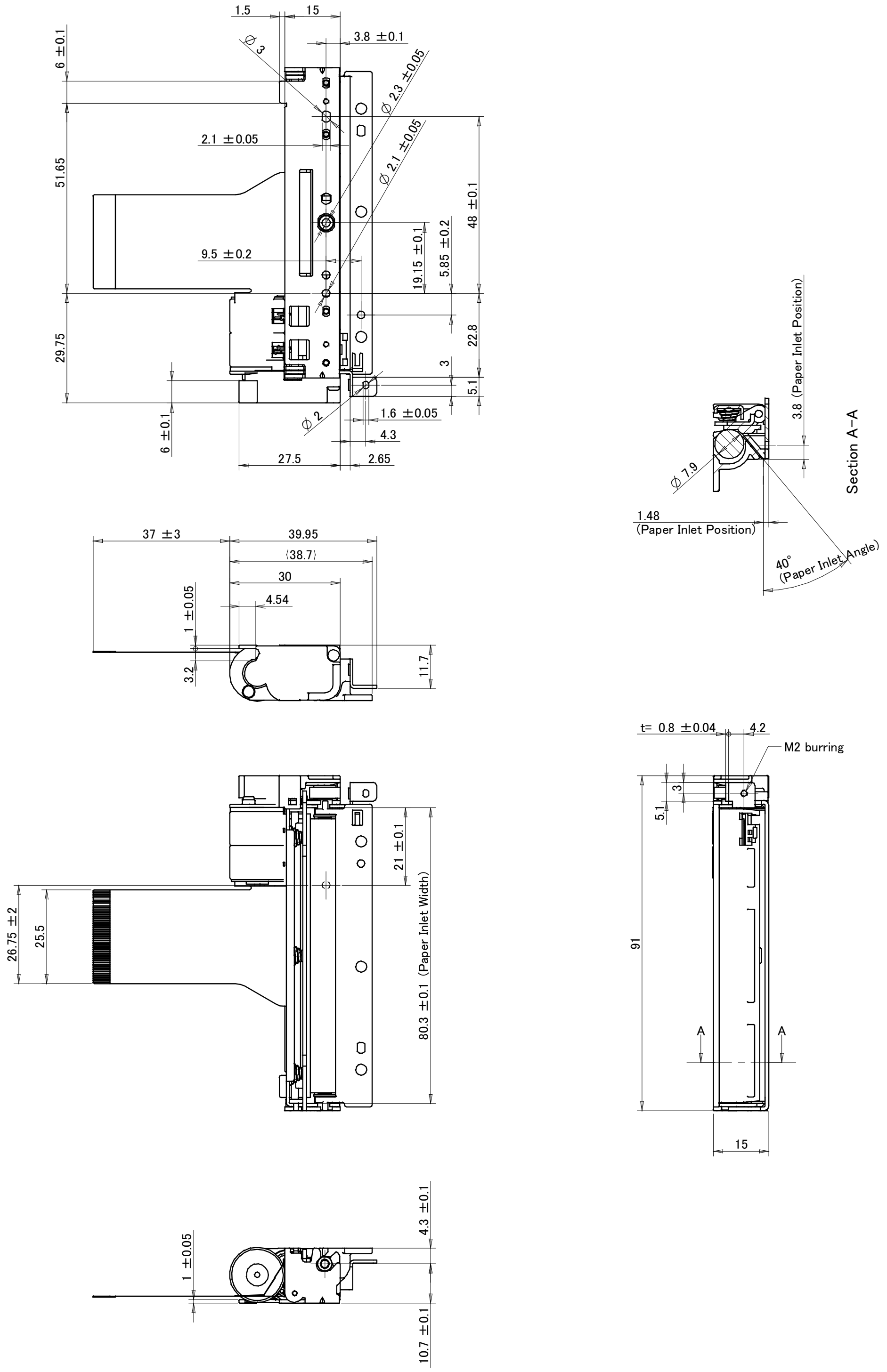
Unit : mm
General tolerance : ±0.5

Figure 7-3 External Dimensions of the Printer (LTPD247B)



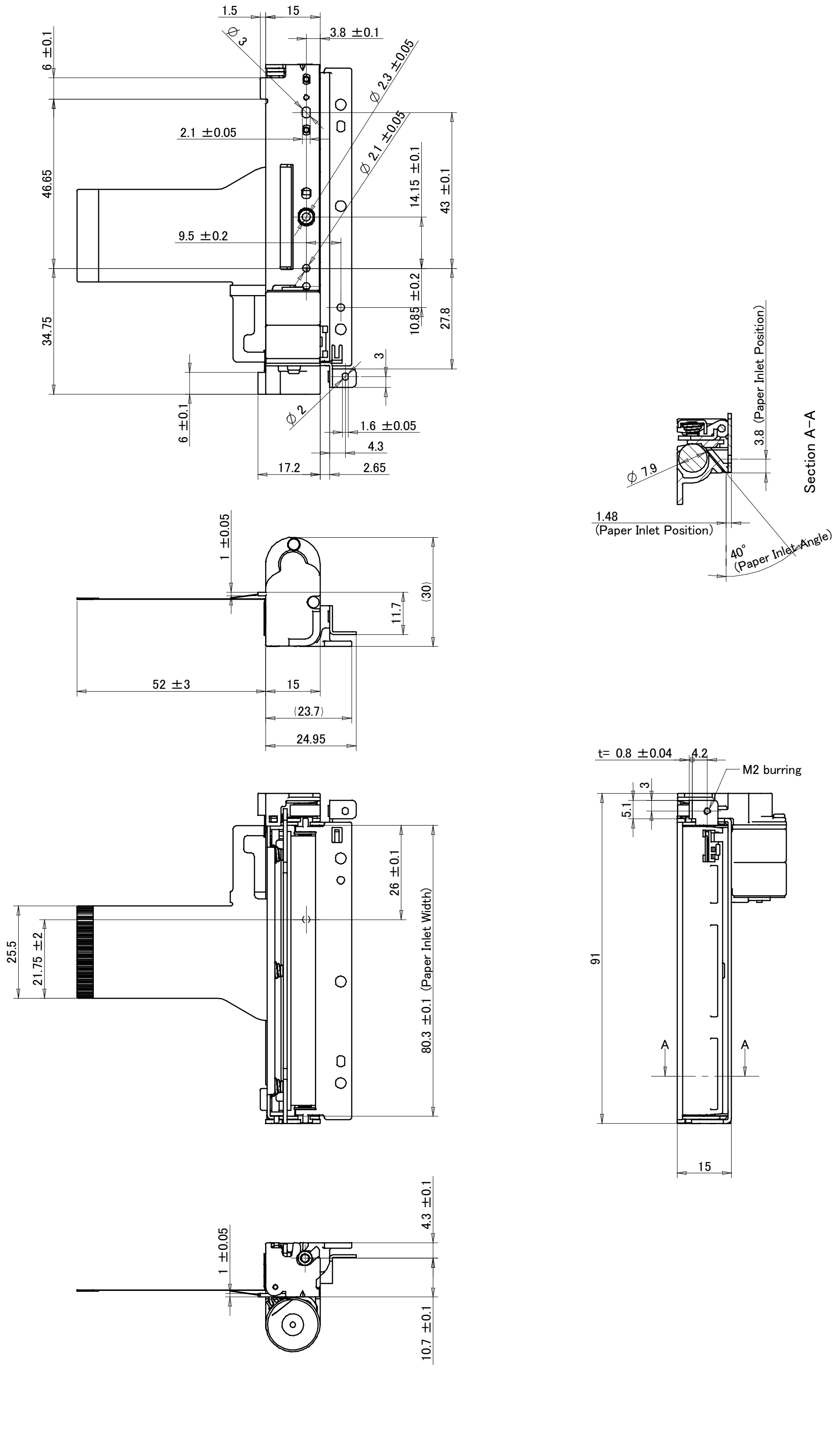
Unit : mm
General tolerance : ±0.5

Figure 7-4 External Dimensions of the Platen Block (LTPD347)



Unit : mm
General tolerance : ±0.5

Figure 7-5 External Dimensions of the Printer (LTPD347A)



Unit : mm
General tolerance : ±0.5

Figure 7-6 External Dimensions of the Printer (LTPD347B)

CHAPTER 8
HANDLING METHOD

8.1 PROCEDURES FOR INSTALLING/UNINSTALLING THE THERMAL PAPER

8.1.1 Procedures for Installing/Uninstalling the Thermal paper

① Installing the thermal paper

- Push the platen release lever in the direction of the arrow in the Figure 8-1.

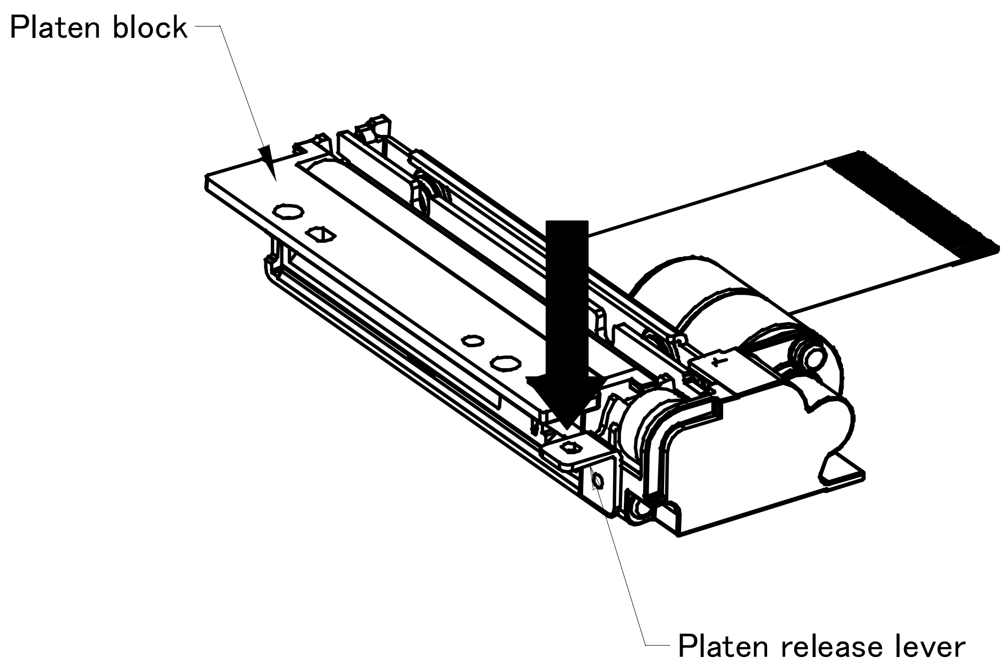


Figure 8-1 Loading the Thermal Paper (1)

- Pull up the platen block after making sure that the platen block is released from the printer main body. (Open state)
- Set the thermal paper straight to the printer and leave at least 5cm of the thermal paper come out from the printer in the Figure 8-2.

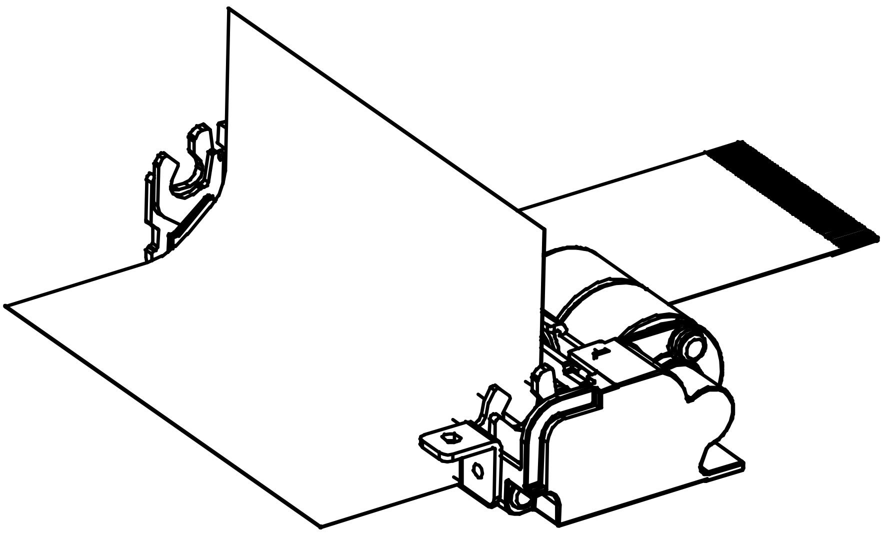


Figure 8-2　Loading the Thermal Paper (2)

- Set the platen block after making sure that the thermal paper is set straight. (Close state)

② Uninstall the thermal paper

- Uninstall the thermal paper in the same manner for installing the thermal paper.

③ Clearing a paper jam

- Uninstall the thermal paper in the same manner for installing the thermal paper.

8.1.2 Precautions for Installing the Thermal Paper

- Install the thermal paper with the platen block released.　Automatic loading is not allowed.
- Set the thermal paper straight to the printer and leave at least 5 cm of the thermal paper come out from the printer.
- When setting the platen block, the reduction gear may interfere with the platen gear and may cause the platen block to not be set.　In such a case, release the platen block and set it again.
- If the thermal paper is skewed, feed the thermal paper until the thermal paper becomes straight or install the thermal paper again.
- Remove the jamming paper with the platen block released.　Do not pull the thermal paper by force because severe damages may occur.

8.2 PRECAUTIONS FOR CLEANING THE THERMAL HEAD

If the surface of the thermal head exposed to dirt, ensure to clean the thermal head to avoid a print defect.

8.2.1 Procedures for Cleaning the Thermal Head

- Turn off the power before cleaning.
- Push the platen release lever to the direction of the arrow in the Figure 8-1Figure 8-3.　Pull up the platen block after making sure that the platen block is released from the printer main body.
- Clean the heat element shown in Figure 8-3 using a cotton swab dipped in ethyl alcohol or isopropyl alcohol.
- Set the platen block after the alcohol has dried completely.

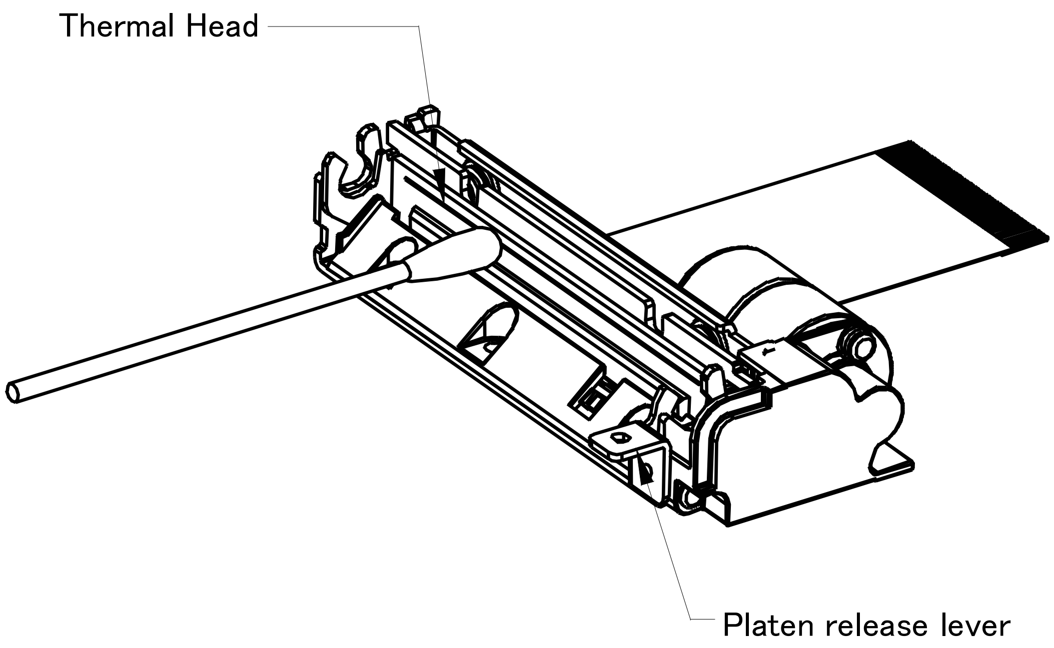


Figure 8-3　Cleaning Position of the Thermal Head

8.2.2 Precautions for Cleaning the Thermal Head

- Do not clean the thermal head immediately after printing because the temperature of the thermal head and its peripherals rises very high during and immediately after printing.
- Clean the thermal head with the platen block released.
- Do not use sandpaper, a cutter knife and etc. for cleaning.　They will damage the thermal head.