CAPD347H/M
AUTOCUTTER INTEGRATED
THERMAL PRINTER MECHANISM
TECHNICAL REFERENCE

Rev.02

Seiko Instruments Inc.

CAPD347H/M AUTOCUTTER INTEGRATED THERMAL PRINTER MECHANISM TECHNICAL REFERENCE

Rev.01	November 2017
Rev.02	November 2017

PREFACE

This technical reference (hereinafter referred to as "manual") describes the specifications and basic operating procedures for the CAPD347H/M autocutter integrated thermal printer mechanism (hereinafter referred to as “printer”).

The printer has the following model.

- CAPD347H-E
- CAPD347M-E

In the manual, unless otherwise described, information referring to CAPD347 is common to CAPD347H/M. If different information is applied to each model, it is clearly mentioned accordingly.

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 manual. Fully investigate the intellectual property rights of these circuits before using.

The printer complies with EU RoHS Directive (2011/65/EU)

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

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

*: Lead-containing items listed above are exempt from RoHS (2011/65/EU).

Identifying the parts of the printer as follows.

The printer main body of CAPD347M contains FG conduction plates. When the platen block is set to the printer main body properly, the FG conduction plate makes their electric potential to become equal.

Printer mechanism

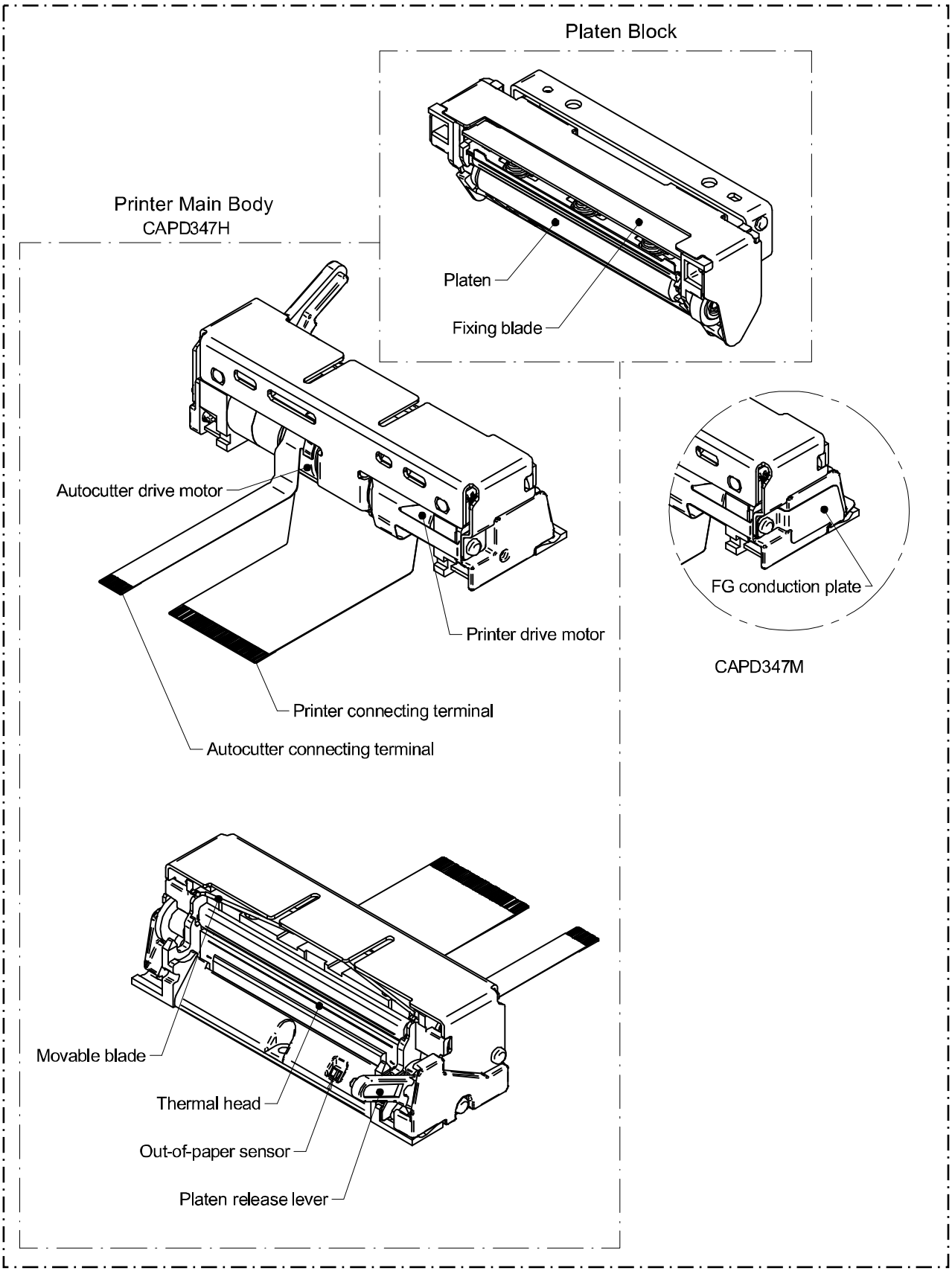


TABLE OF CONTENTS

CHAPTER 1
PRECAUTIONS

CHAPTER 2
FEATURES

CHAPTER 3
SPECIFICATIONS

CHAPTER 4
CONNECTING TERMIANLS

CHAPTER 5
DRIVE METHOD

CHAPTER 6
OUTER CASE DESIGN GUIDE

CHAPTER 7
EXTERNAL DIMENSIONS

CHAPTER 8
HANDLING METHOD

FIGURES

TABLES

CHAPTER 1
PRECAUTIONS

Read through this manual to design and to operate the printer properly.
Pay special attention to the precautions noted in each section for details. Information contained in this manual 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 and all claims, actions, lawsuits, demands, costs, liabilities, losses, damages and/or expenses that are caused by improper handling of the printer, any use not contained in this manual or that result from the outer case, unless such damages and/or loss originate from the printer itself.

SII makes no warrant that your products into which built the sample circuits included in this manual can work properly and safe. You shall evaluate and confirm sufficiently that such products can work properly and safe, and shall be liable for any and all claims, actions, lawsuits, demands, costs, liabilities, losses, damages and/or expenses arising out of or in relating to such products.

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.

The printer is designed and manufactured to be mounted onto general electronic equipment. When 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 for 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 for cutting the thermal paper**

  Make sure the thermal paper feed has been in a stop state when cutting the thermal paper. Paper powders can be caused while the autocutter is working. Be sure to design an outer case not to have the paper powders piled up on the control board and the power supply as this may cause short circuit failure.

- **Precautions for cutter blade**

  In this printer, the platen block is removable from a printer main body so that the thermal paper can be set easily. Therefore, when the platen block is in open state, the fixed cutter blade becomes exposed. To prevent users from injuring himself/herself by touching the cutter blades while the autocutter is in operation and replacing the thermal paper, design a structure such as a shutter in the outer case or place warning labels to warn users to ensure safe operation. Also, warn users not to touch the cutter blades directly during unpacking or assembling the printer into the outer case.

- **Precautions for the movable blade drive**

  Control the motor not to drive when the platen block is in open state. Also, be sure to design the paper exit to prevent users from injuring himself/herself by touching the autocutter directly while the autocutter is operating.

- **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 when 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 surface of the metal parts. Be sure to design the outer case to prevent 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 printer drive 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) Vdd → (2) Vp
  At shut down : (1) Vp → (2) Vdd

- A surge voltage between Vp and GND should not exceed 28 V.

- For noise countermeasure, connect a 0.1 µF capacitor between Vdd and GND pins near the connector.

- Make the wire resistance between the power supply (Vp and GND) and the printer (connecting terminals) as small as possible (below 50 mΩ). Keep distance from signal lines to reduce electrical interference.

- The switch and the sensor may generate instantaneous abnormal signal. Design the firmware in order not to trigger the malfunction caused by the abnormal signal.

- Keep the Vp 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 (GND) 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 and the effect of the noise by static electricity, the printer main body and the platen block are connected to the 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.
  When the platen block is set properly to the printer main body of CAPD347M, the FG conduction plate makes their electric potential to become equal. Note that the electrical connection between the printer main body and the platen block is cut off while the platen block is in release state. Recommend that connect the platen block to the Frame Ground (FG) of the outer case to prevent the thermal head from being deteriorated and the effect of the noise by static electricity when the platen block has set again. 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 paper. Incorrect activation of the thermal head may reduce the life of the thermal head and the platen or may damage them.

- Always detect the outputs of the platen position sensor and out-of-paper sensor. Never activate the cutter drive motor when the platen block is in open state and when there is no thermal paper. Cannot set the platen block. And incorrect activation of the cutter drive motor may reduce the life of the autocutter.

- A pause time between thermal head activations of the same heat element shall be secured more than 0.1 ms. Pay attention to when using one division printing or when a thermal head activation time becomes longer. When activating for a long time without the pause time, the thermal head may become damaged.

- When 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".

- Operation sound 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.
- Refer to Chapter 3 "Printer Drive Motor Drive Method" and "Autocutter Drive Motor Drive Method" to prevent the motor from overheating. And make sure the temperature of the motor outer case is 100°C or less. Verify the performance with your actual device.
- 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. When printing bit images and so on, always feed the thermal paper for more than 24 steps at start up and 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 24 steps or more at the initialization, at a time after setting/releasing the platen block, at a time after feeding the thermal paper backward, and a time after cutting with the autocutter.
- The printer has been left for long period of time after cutting the thermal paper, may occur the paper jam. To prevent this case, printing or feeding 2 mm or more after cutting.
- Do not feed the thermal paper backwards more than 7 mm after cutting end. When the thermal paper is out of the holding status with the thermal head and the platen, the printer cannot feed. The surface of thermal paper may get scratched by backward feed. The backward feed may cause paper skew and jams depending on the paper roll layout and designing of the paper holder. Verify the performance with your actual device.
- Do not feed thermal paper backwards after cutting with the partial cut. The part of the partial cut (tab left at the center) may be cut off.
- When printing at a high print ratio for longer length, non-printing area may be colored due to an accumulation of heat in the thermal head. Verify the performance with your actual device.
- Design the structure so that the rotation system of the door for the platen block presses the recommended pressure position when setting the platen block. When pushing improper position, it may generate abnormal pressure and result in damage of the printer. Verify the performance with your actual device. For the recommended pressure position, refer to Chapter 6 "OUTER CASE DESIGN GUIDE".
- 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. When only one end of the platen block is set, a print defect, a paper jam, the cut failure and/or the cutter blade damage may 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.
- When the printer main body with the movable blade and the platen block with the fixed blade are not placed in proper position, the print defect, the paper jam, and/or the cut failure 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 around the operating portion such as the platen release lever. Otherwise the printer will be inoperable.
- When 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. When 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 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 thermal paper supply position is improper, print difficulty or the thermal 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 the paper except specified thermal paper. Do not use labeling paper, 2-ply thermal paper, and perforated thermal paper.

- The amount of paper powder generated by cutting paper depends on the thermal paper used. Verify the performance with your actual device to select the thermal paper.

- Design the outer case 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 outer case 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 the thermal 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
  (6) Cutter failure due to variety of the thermal paper thickness (and mechanical strength and paper density).

- 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. When the thermal head is remained in contact with the platen without the thermal paper for a long time, the platen and the thermal head may be stuck together and cause paper feed difficulty. When 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 printer mechanism and the autocutter.

- Do not wipe oil that coating on the autocutter (movable blade and the fixed blade). It may reduce the efficiency of the autocutter.

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

- Do not apply stress to the platen block while printing and cutting. The print defect and the cut failure 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 mechanism and soil the thermal paper itself. Prevent the thermal head from a drop of water. It causes electrolytic corrosion of the thermal head. When condensed, do not activate electricity until dried.
- Connect or disconnect the connecting terminal (the printer connecting terminal and the autocutter connecting terminal) after turn off the power of the printer.
- Do not apply stress to the FPC while connecting and disconnecting the connecting terminal (the printer connecting terminal and the autocutter connecting terminal). Otherwise the FPC may become damaged.
- Warn users not to pull the thermal paper and not to change the paper eject angle during printing and cutting. Otherwise, the print defect, the paper jam, and/or the cut failure may occur.
- Warn users to remove the thermal paper which is cut with the full cut, then perform the next printing or cutting. When the thermal paper does not remove and perform the next printing or cutting, it may cause of the paper jam or cut failure depending on the mounting position.
- In order to prevent the thermal head from damage and to avoid the print defect, warn users not to touch the thermal head and the sensor directly when handling the printer like replacing thermal paper.
- Do not use the paper roll with glued end or folded end. In case of using such 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. When use the printer in a dusty place, it may damage the thermal head, paper drive system or reduce the efficiency of the autocutter.
- 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 printer, discard them according to the disposal regulations and rules of each respective district.

CHAPTER 2
FEATURES

The printer which has the thermal line dot printing method integrated the autocutter with the slide cutting 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 and light weight**

  The printer realizes reduction in size and weight by the printer integrated the autocutter.

- **High print speed***

  Maximum 200 mm/s print is available.

- **High reliability autocutter**

  The original platen block positioning structure can assure the certain cutting performance constantly.

- **Easy operation**

  Platen block open mechanism provides easy paper installation.

- **Auto-loading**

  The printer has the auto-loading function to load the thermal paper automatically.

- **Maintenance free**

  No cleaning and no maintenance required.

- **Low noise**

  Thermal printing technology realizes low-noise print.

∗: Print speed is different according to use conditions.

CHAPTER 3
SPECIFICATIONS

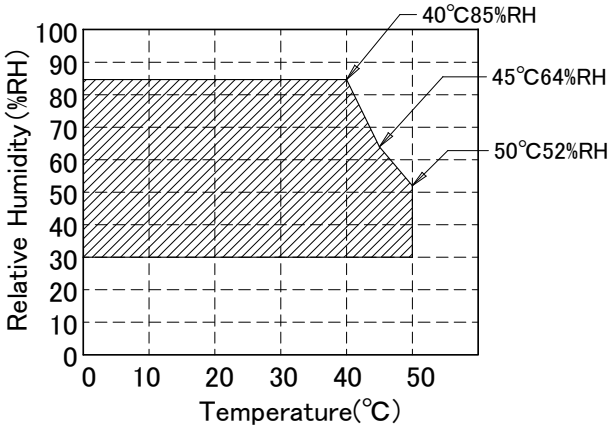
3.1 GENERAL SPECIFICATIONS

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

Table 3-1 General Specifications

(1/3)

Item	Specifications	
	CAPD347H	CAPD347M
Printing method	Thermal dot line printing	
Total dots per line	576 dots	
Printable dots per line	576 dots	
Simultaneously activated dots	288 dots	
Resolution	W 8 dots/mm × H 8 dots/mm	
Paper feed pitch	0.0625 mm	
Maximum print speed	200 mm/s (170 mm/s)*1,*2	
Print width	72 mm	
Paper width	80^{0}_{-1} mm	
Thermal head temperature detection	Thermistor	
Platen position detection	Mechanical switch	
Out-of-paper detection	Reflection type photo interrupter	
Cutter home position detection	Transmission type photo interrupter	
Operating voltage range Vp line Vdd line	 21.6 V to 26.4 V 2.7 V to 3.6 V, 4.75 V to 5.25 V	
Printer current consumption Vp line Thermal head drive Motor drive Vdd line Thermal head Logic	 5.23 A max. (at 26.4 V)*3 0.52 A max.*4 0.10 A max.	
Autocutter current consumption Vp line Motor driving	 0.64 A max.	

Item		Specifications	
		CAPD347H	CAPD347M
Paper cutting method		Slide cutting	
Type of paper cutting		Full cut and Partial cut (1.5 ±0.5 mm tab left at the center)	
Paper curling tendency		Fixed blade side and Movable blade side	
Minimum paper core diameter		ϕ 8 mm	
Minimum paper cutting length		10 mm	
Cutting processing time		Approx. 0.5 s/cycle	
Cutting frequency		1 cut / 2 s max.	
Operating temperature range		-10°C to 50°C (Non condensing)[*2]	
Operating humidity range			
Storage temperature range		-20°C to 60°C (Non condensing)	
Life span (at 25ºC and rated energy)	Activation pulse resistance	100 million pulses or more[*5]	
	Abrasion resistance	100 km or more[*6]	
	Paper cutting resistance	1,000,000 cuts or more[*7]	
Paper feed force		0.98 N (100 gf) or more	
Paper hold force		0.98 N (100 gf) or more	
FG conduction plate[*8]		-	✓
Dimensions[*9] (Dimensions including mounting part)		W: 105.1 mm D: 35.4 mm (43.9mm) H: 27.2 mm (27.4 mm)	W: 105.4 mm D: 35.4 mm (43.9 mm) H: 27.2 mm (27.4 mm)
Mass		Approx. 154 g	Approx. 155 g

Item	Specifications	
	CAPD347H	CAPD347M
Specified thermal paper Ⅰ *10,*11	Nippon Paper	TF50KS-E2D TP50KJ-R
	Oji Paper	PD160R-63 PD160R-N
	Mitsubishi Paper mills limited	P220VBB-1
	Papierfabrik August Koehler AG	KT55F20
Specified thermal paper Ⅱ *2,*7,*10,*11	Jujo Thermal	AP50KS-D AF50KS-E
	Mitsubishi Hi-Tech Paper	F5041
	KSP	P300
	KANZAN	KF50

*1: Print speed changes according to the processing speed of the controller and print pulse width.
*2: Maximum print speed is 170 mm/s in the following case：
・When operating temperature range is from -10°C to 0°C.
・When using the thermal paper in specified thermal paper Ⅱ.
*3: The value when the number of simultaneously activated dots is 288 dots.
*4: Printer current consumption is different according to motor controlled current. When motor controlled current is 0.26 A/phase, the maximum current consumption is 0.52 A.
*5: Excluded when the same dots are printed continuously.
*6: Excluding damage caused by dust and foreign materials
*7: Paper cutting environment: Room temperature and humidity, the shape of the paper exit described in Chapter 6.
When using the thermal paper in specified thermal paper Ⅱ, paper cutting resistance is 700,000 cuts or more.
*8: When the platen block is set properly to the printer main body of CAPD347M, the structure for the product using the FG conduction plate makes their electric potential to become equal. See Chapter 6 "OUTER CASE DESIGN GUIDE" for the connecting method.
*9: Excluded convex part.
*10: Do not use perforated thermal paper.
*11: The amount of paper powder generated by cutting paper depends on the thermal paper used.
Verify the performance with your actual device to select the thermal paper.

3.2 PRINT CONFIGURATION

Figure 3-1 shows dot pitch. Figure 3-2 shows print area.

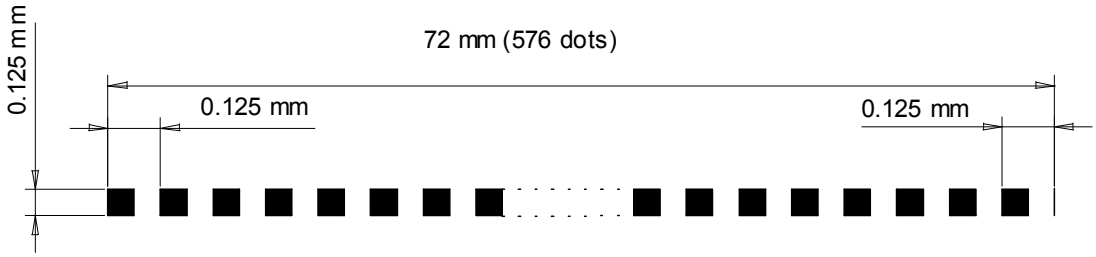


Figure 3-1 Dot Pitch

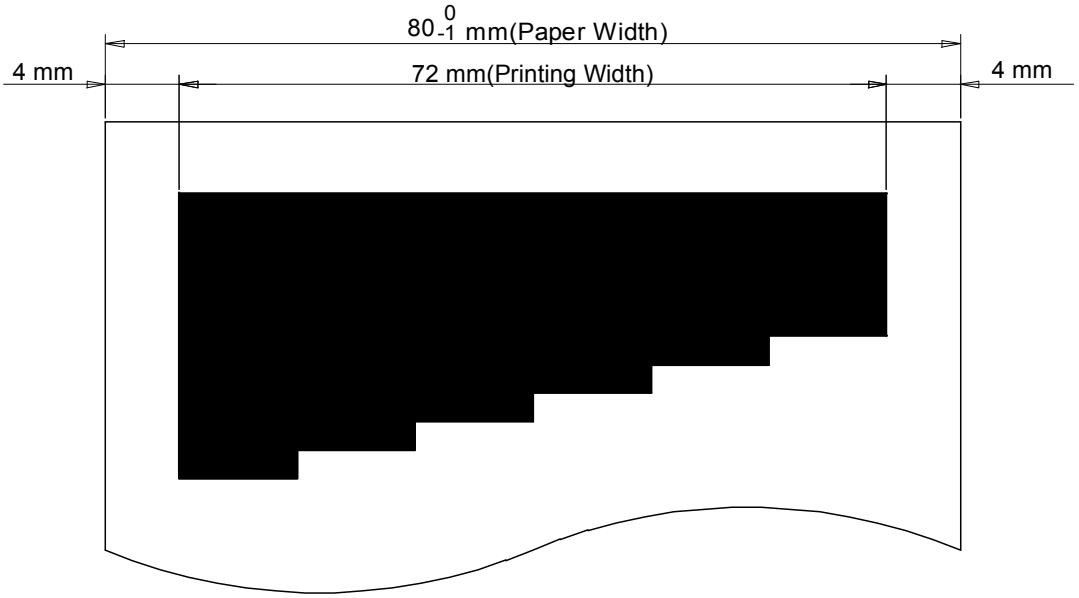


Figure 3-2 Print Area

3.3 STEP MOTOR (PRINTER DRIVE 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

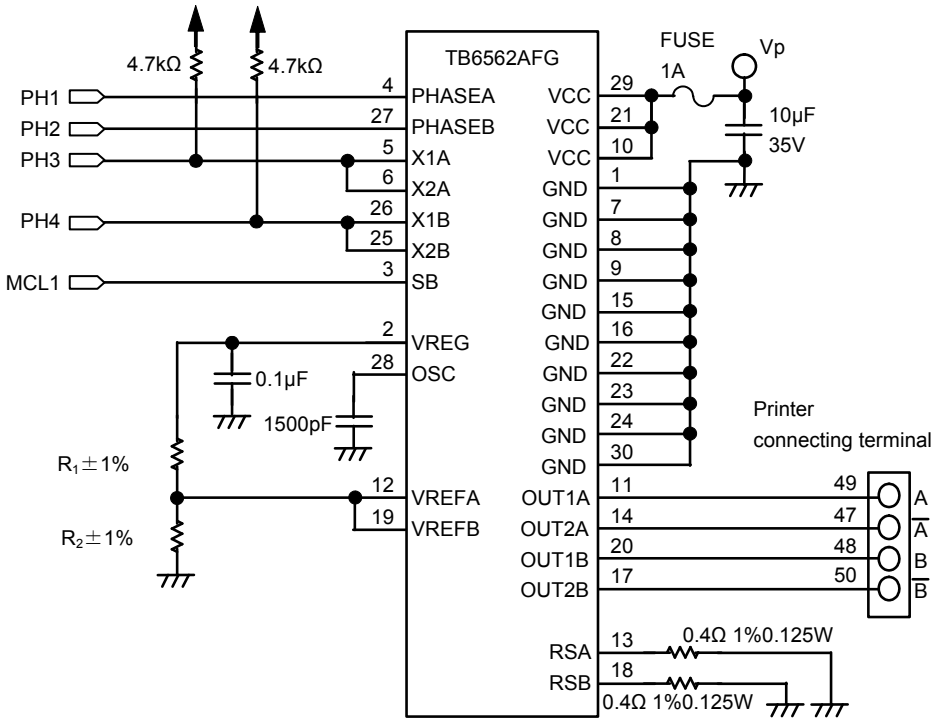
Item	Specifications	
Type	PM type step motor	
Drive method	Bi-polar chopper	
Excitation	2-2 phase	
Winding resistance per phase	26 Ω/phase ±10%	
Motor drive voltage	Vp: 21.6 V to 26.4 V	
Motor controlled current	260 mA/phase*1	220 mA/phase*1
Drive pulse rate	3200 pps max. *1	2720 pps max.*1

*1: Maximum drive pulse rate is 2720 pps in the following case :

- When operating temperature range is from -10°C to 0°C.
- When using the thermal paper in specified thermal paper Ⅱ.

3.3.2 Sample Drive Circuit

Figure 3-3a shows the sample drive circuit 1, when the current is controlled with VREG of the motor driver output.



*: Recommended motor driver: TB6562AFG (Toshiba)

Motor Controlled Current	R_1	R_2
220 mA	5.1 kΩ	1.1 kΩ
260 mA	6.8 kΩ	1.8 kΩ

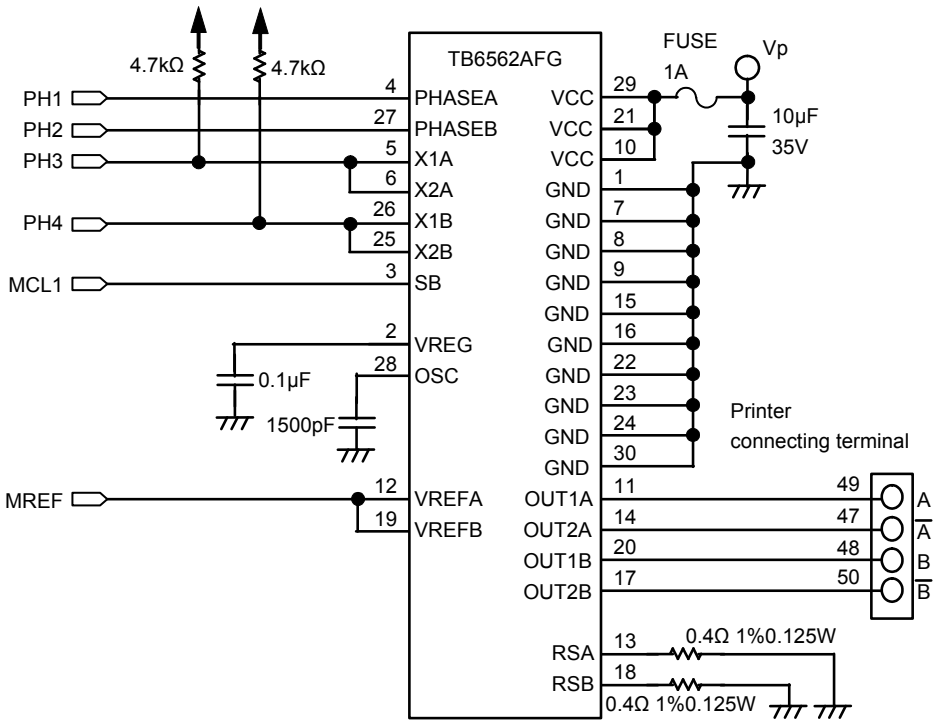
Figure 3-3a Sample Drive Circuit 1

Figure 3-3b shows the sample drive circuit 2, when the current is controlled without VREG of the motor driver output. (using the D/A converter etc.)

- **MREF signal**

  MREF signal is the reference signal for the motor current control. The motor drive setting current is set by the MREF signal setting voltage.

Motor Controlled Current	MREF Setting Voltage
220 mA	880 mV±5%
260 mA	1040 mV±5%

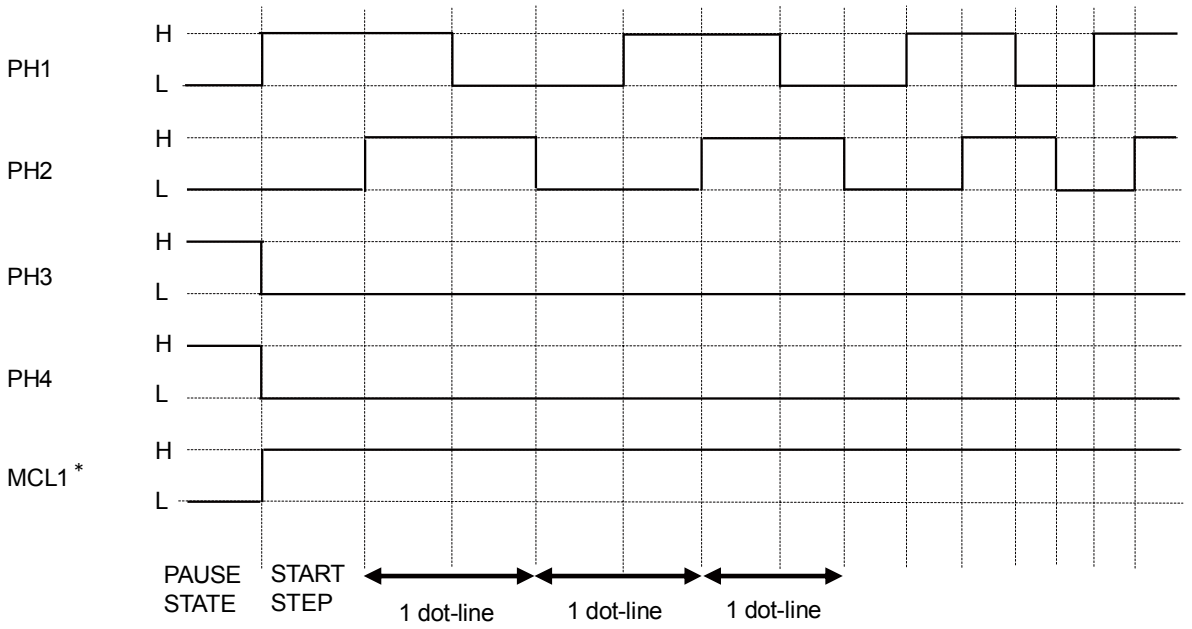


*: Recommended motor driver:TB6562AFG (Toshiba)

Figure 3-3b Sample Drive Circuit 2

3.3.3 Excitation Sequence

Drive the motor with 2-2 phase excitation. 1 step of the motor drive signal feeds the thermal paper 0.0625 mm. 1 dot-line is consisted of 2 steps. When the voltage signal shown in Figure 3-4 is input to the motor drive circuit shown in Figure 3-3a or Figure 3-3b, the printer feeds the thermal paper to the forward direction when the motor is excited in order of step 1, step 2, step 3, step 4, step 1, step 2, ... , as shown in Table 3-3.



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

Figure 3-4 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	H	H	L	L	H	H	L	L
Step 2	L	H	L	L	L	H	H	L
Step 3	L	L	L	L	L	L	H	H
Step 4	H	L	L	L	H	L	L	H

3.3.4 Printer Drive Motor Start/Stop Method

Refer to the timing chart in Figure 3-5 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 start step time.
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 print 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 thermal paper from moving.

Input signals for a sample drive circuit are shown in Figure 3-5.

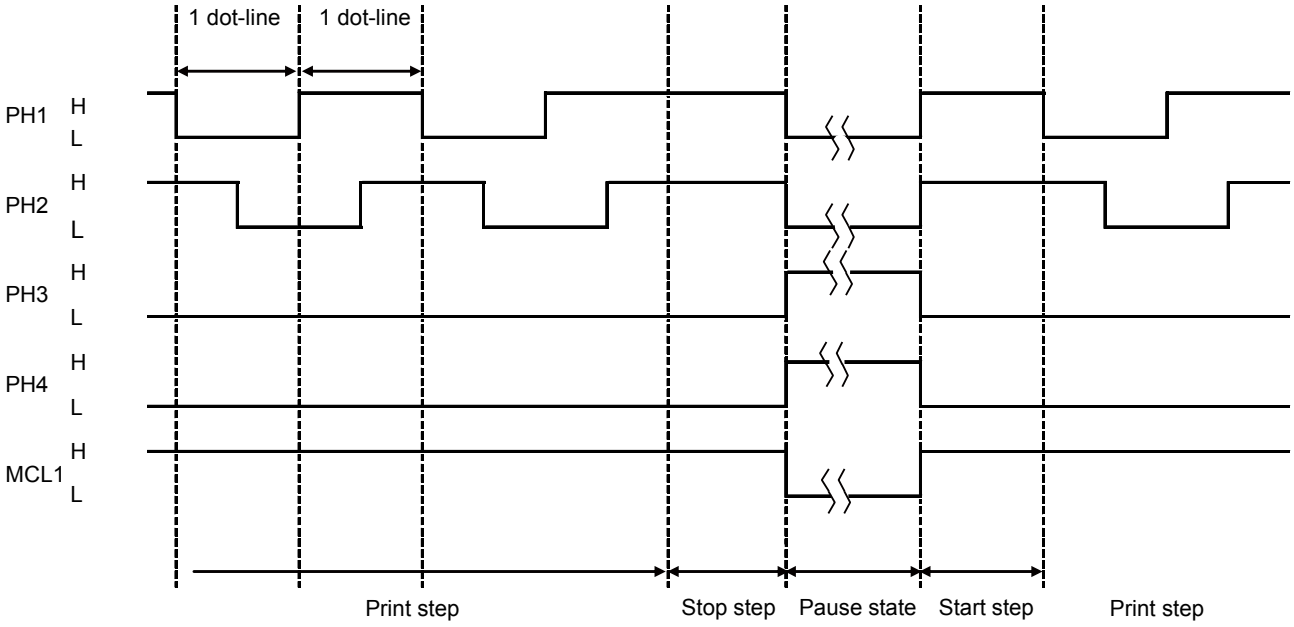


Figure 3-5 Printer Drive Motor Start/Stop Timing Chart

3.3.5 Printer Drive Motor Drive Method

Drive the printer drive motor by the following methods.

(1) Motor Drive Pulse Rate

During paper feeding, the motor should be driven equal to or lower than the maximum motor drive pulse rate P_M of 3200 pps.

Maximum motor drive pulse rate P_M is different depending on conditions of use (refer to Table 3-2).

The motor drive pulse rate while auto-loading, it is different according to the length of the auto-loading performed.
The length of the auto-loading is 300 mm or shorter, the motor is driven by the motor drive pulse rate at 320 pps.
The length of the auto-loading is longer than 300 mm, the motor is driven by the motor drive pulse rate at 320 pps until the auto-loading length is 300 mm, and after that, the motor is driven by the maximum motor drive pulse rate P_M.

(2) Acceleration Control

When driving the printer drive motor, the acceleration control is required to maintain the paper feed force of start up (include during auto-loading). When acceleration of the motor does not perform correctly, the motor may step out when it has a heavy workload. Accelerate the speed sequentially up to the maximum motor drive pulse rate P_M according to the acceleration steps of the printer drive motor shown in Table 3-4.

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.
When 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 Section 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. When 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, 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 of acceleration step 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)

(Example)
In the case of Table 3-4, when there is 1 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=0.888ms.
2. Find the acceleration step number from Table 3-4.
   Current acceleration step time of motor：368 μs -> Acceleration step number=120
   Calculated acceleration step time of motor：446 μs -> Acceleration step number=82
   (Necessary acceleration step time based on the calculated activation pulse width is 0.888/2×1000＝444 μs.
   The nearest acceleration step time which is longer than 444 μs and smallest is 446 μs.)
3. Find the number of row of acceleration step to decelerate from current acceleration step number to next step (an) using the following equation.

$$a20 = \frac{(120 - 82)}{20} = 2$$

According to the maximum value a20=2 by calculated value of "an" (a1 to a40), next acceleration step time of the next step should be 371 μs at the 118th acceleration step which reduced the row by 2 rows from the current 120th acceleration step.

When 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 when:
Unable to accelerate the speed according to the acceleration steps of the printer drive motor shown in Table 3-4 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.

(Example)
In the case of Table 3-4, when the motor acceleration step time of the previous step is 901 μs, the next step should be the22nd acceleration step (880 μs).

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

Table 3-4 Acceleration Steps of the Printer Drive Motor

(1/3)

Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)	Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)
Start	-	5653	31	1360	735
1	177	5653	32	1383	723
2	286	3494	33	1405	712
3	371	2698	34	1427	701
4	442	2265	35	1449	690
5	504	1986	36	1470	680
6	560	1787	37	1491	671
7	611	1637	38	1512	662
8	658	1519	39	1532	653
9	703	1423	40	1552	644
10	745	1343	41	1572	636
11	785	1274	42	1592	628
12	823	1215	43	1611	621
13	859	1164	44	1630	613
14	894	1118	45	1649	606
15	928	1078	46	1668	599
16	960	1041	47	1687	593
17	992	1008	48	1705	586
18	1023	978	49	1723	580
19	1052	950	50	1741	574
20	1081	925	51	1759	569
21	1109	901	52	1777	563
22	1137	880	53	1794	557
23	1164	859	54	1811	552
24	1190	840	55	1828	547
25	1216	822	56	1845	542
26	1241	806	57	1862	537
27	1266	790	58	1879	532
28	1290	775	59	1895	528
29	1314	761	60	1912	523
30	1337	748	-	-	-

Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)	Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)
61	1928	519	91	2364	423
62	1944	514	92	2377	421
63	1960	510	93	2390	418
64	1976	506	94	2403	416
65	1992	502	95	2416	414
66	2007	498	96	2429	412
67	2023	494	97	2442	410
68	2038	491	98	2455	407
69	2053	487	99	2467	405
70	2068	483	100	2480	403
71	2083	480	101	2492	401
72	2098	477	102	2505	399
73	2113	473	103	2517	397
74	2128	470	104	2530	395
75	2142	467	105	2542	393
76	2157	464	106	2554	392
77	2171	461	107	2566	390
78	2186	458	108	2579	388
79	2200	455	109	2591	386
80	2214	452	110	2603	384
81	2228	449	111	2615	382
82	2242	446	112	2627	381
83	2256	443	113	2638	379
84	2270	441	114	2650	377
85	2283	438	115	2662	376
86	2297	435	116	2674	374
87	2310	433	117	2685	372
88	2324	430	118	2697	371
89	2337	428	119	2708	369
90	2351	425	120	2720	368

Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)	Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)
121	2731	366	151	3055	327
122	2743	365	152	3065	326
123	2754	363	153	3076	325
124	2766	362	154	3086	324
125	2777	360	155	3096	323
126	2788	359	156	3106	322
127	2799	357	157	3116	321
128	2810	356	158	3126	320
129	2821	354	159	3136	319
130	2832	353	160	3146	318
131	2843	352	161	3156	317
132	2854	350	162	3166	316
133	2865	349	163	3176	315
134	2876	348	164	3185	314
135	2887	346	165	3195	313
136	2898	345	166	3200	312
137	2909	344	-	-	-
138	2919	343	-	-	-
139	2930	341	-	-	-
140	2941	340	-	-	-
141	2951	339	-	-	-
142	2962	338	-	-	-
143	2972	336	-	-	-
144	2983	335		-	-
145	2993	334	-	-	-
146	3004	333	-	-	-
147	3014	332	-	-	-
148	3024	331	-	-	-
149	3035	330	-	-	-
150	3045	328	-	-	-

(5) Preventing Overheat

To prevent the motor from overheating, the drive time and drive ratio are limited.
Keep the temperature of the motor outer case, 100°C or lower.

When a print length is within 1m, set a pause time of the motor not to exceed the drive ratio below:

When the motor controlled current is 220 mA/phase, the drive ratio is 32%.
When the motor controlled current is 260 mA/phase, the drive ratio is 27%.

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

Table 3-5 and Table 3-6 show the motor drive time and the paper feed length at temperature rise of 50°C and 75°C.

Temperature rise of the motor is different according to the use conditions. (ambient temperature, design of the outer case etc.) Verify the performance with your actual device.

Table 3-5 Drive Time and Paper Feed Length at Motor Controlled Current of 220 mA/phase

Drive Pulse Rate (pps) (or more to less than)	Temperature Rise of 50°C		Temperature Rise of 75°C	
	Maximum Drive Time (min)	Paper Feed Length (m)	Maximum Drive Time (min)	Paper Feed Length (m)
400 to 800	3.75	5.6 or longer	7.08	10.6 or longer
800 to 1200	3.67	11.0 or longer	6.75	20.3 or longer
1200 to 1600	3.42	15.4 or longer	6.25	28.1 or longer
1600 to 2000	3.17	19.0 or longer	5.92	35.5 or longer
2000 to 2400	3.00	22.5 or longer	5.58	41.9 or longer
2400to 2720	2.92	26.3 or longer	5.42	48.8 or longer

Table 3-6 Drive Time and Paper Feed Length at Motor Controlled Current of 260 mA/phase

Drive Pulse Rate (pps) (or more to less than)	Temperature Rise of 50°C		Temperature Rise of 75°C	
	Maximum Drive Time (min)	Paper Feed Length (m)	Maximum Drive Time (min)	Paper Feed Length (m)
400 to 800	2.63	4.0 or longer	4.70	7.1 or longer
800 to 1200	2.47	7.4 or longer	4.38	13.2 or longer
1200 to 1600	2.35	10.6 or longer	4.18	18.8 or longer
1600 to 2000	2.23	13.4 or longer	4.03	24.2 or longer
2000 to 2400	2.18	16.4 or longer	3.95	29.6 or longer
2400 to 2800	2.15	19.4 or longer	3.97	35.7 or longer
2800 to 3200	2.13	22.4 or longer	4.05	42.5 or longer
3200	2.18	26.2 or longer	4.23	50.8 or longer

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 thermal paper for 24 steps or more at the initialization, at a time after setting/releasing the platen block, at a time after feeding the thermal paper backward, and a time after cutting with the autocutter. 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)
- The activation time of the thermal head can 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, the 1st step time and the 2nd step time of the dot line, divide equally of the thermal head activation time. (See Chapter 5 "PRINT DRIVE METHOD" for details).
- Do not feed the thermal paper backwards more than 7 mm after cutting end. When the thermal paper is out of the holding status with the thermal head and the platen, the printer cannot feed. The surface of thermal paper may get scratched by backward feed. The backward feed may cause paper skew and jams depending on the paper roll layout and designing of the paper holder. Verify the performance with your actual device.
- Do not print intermittently. (Do not repeat printing and stopping in a short interval.)
  When 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 1 dot-line of motor feed is required from the step that thermal head was activated. When 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.
- Do not drive the printer drive motor while the autocutter drive motor is driving (paper feed).
  It cause of the damage of the printer.

3.4 THERMAL HEAD

The thermal head consists of heat elements and a thermal head driver that drives and controls the heat elements.
The data input from the DI terminal, print is "High" and non print is "Low". 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 1 line data is transferred. The heat elements are activated by making $\overline{DST}$ signal "Low" in accordance with the stored print data.

In the printer, a division printing by 144 dots in 4 blocks each is 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 3-6 shows the thermal head block diagram.

Table 3-7 show the relationship between $\overline{DST}$ terminals and activated heat elements.

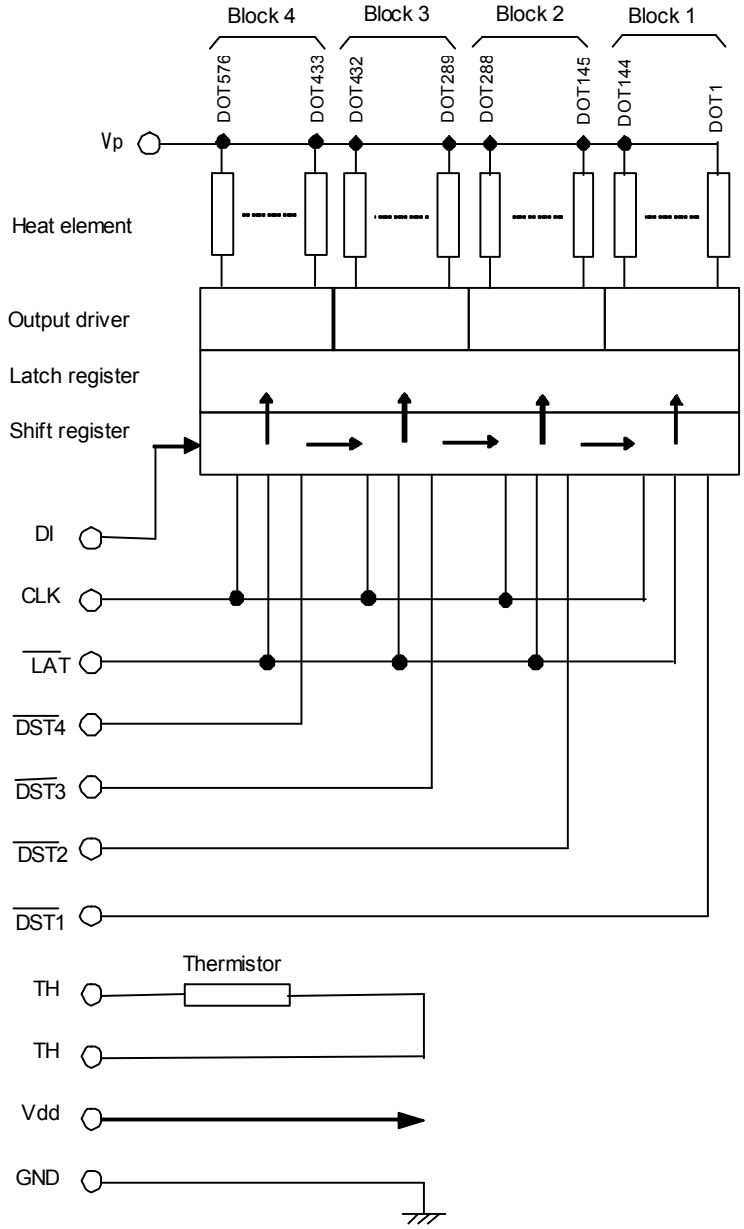


Figure 3-6 Thermal Head Block Diagram

Table 3-7 $\overline{\text{DST}}$ Terminals and Activated Heat Elements

Block	$\overline{\text{DST}}$ Number	Heat 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 Connection of Transfer Data and Print Position

The following describes the print position of the data.

576-bit data (#1 to #576) transferred through DI terminals are printed as shown in Figure 3-7.

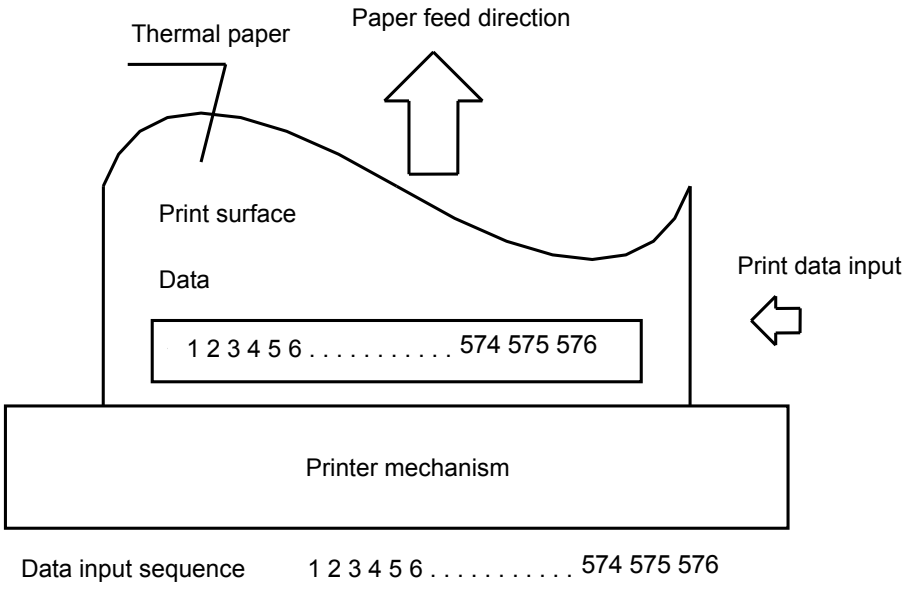


Figure 3-7 Transfer Data and Print Position

3.4.3 Electrical Characteristics of Thermal Head

Table 3-8 shows electrical characteristics of thermal head.

Table 3-8 Electrical Characteristics of Thermal Head

(at 25 °C)

Item		Symbol	Conditions		Rated value			Unit
					Min.	Typ.	Max.	
Thermal head heat element resistance		R_H			1455.0	1500.0	1545.0	Ω
Thermal head drive voltage		Vp			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		Vdd			2.7	3.3	3.6	V
					4.75	5.00	5.25	V
Logic current		I_{dd}	$f_{DI}=1/2f_{CLK}$		—	—	48.0	mA
Input voltage	High	V_{IH}	CLK, DI, $\overline{LAT}$, $\overline{DST}$		0.8Vdd	—	Vdd	V
	Low	V_{IL}	CLK, DI, $\overline{LAT}$, $\overline{DST}$		0	—	0.2Vdd	V
DI input current	High	I_{IH} DI	V_{IH} = Vdd		—	—	0.5	μA
	Low	I_{IL} DI	V_{IL} = 0 V		—	—	-0.5	μA
$\overline{DST}$ input current	High	I_{IH} $\overline{DST}$	Vdd = 5.0 V, V_{IH} = Vdd		—	—	0.5	μA
	Low	I_{IL} $\overline{DST}$	V_{IL} = 0 V	2.7 V ≤ Vdd ≤ 3.6 V	—	—	-16.0	μA
				4.75 V ≤ Vdd ≤ 5.25 V	—	—	-24.5	μA
CLK input current	High	I_{IH} CLK	V_{IH} = Vdd		—	—	2.0	μA
	Low	I_{IL} CLK	V_{IL} = 0 V		—	—	-2.0	μA
$\overline{LAT}$ input current	High	I_{IH} $\overline{LAT}$	V_{IH} = Vdd		—	—	2.0	μA
	Low	I_{IL} $\overline{LAT}$	V_{IL} = 0 V		—	—	-2.0	μA
CLK frequency		f_{CLK}	2.7 V ≤ Vdd ≤ 3.6 V		—	—	8.0	MHz
			4.75 V ≤ Vdd ≤ 5.25 V		—	—	16.0	MHz
CLK pulse width		t1	See the Timing Chart.	2.7 V ≤ Vdd ≤ 3.6 V	56	—	—	ns
				4.75 V ≤ Vdd ≤ 5.25 V	28	—	—	ns
DI setup-time		t2	See the Timing Chart.	2.7 V ≤ Vdd ≤ 3.6 V	30	—	—	ns
				4.75 V ≤ Vdd ≤ 5.25 V	15	—	—	ns
DI hold time		t3	See the Timing Chart.	2.7 V ≤ Vdd ≤ 3.6 V	10	—	—	ns
				4.75 V ≤ Vdd ≤ 5.25 V	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
$\overline{DST}$ setup time		t7	See the Timing Chart.		300	—	—	ns
$\overline{LAT}$ wait time		t8*	See the Timing Chart.	2.7 V ≤ Vdd ≤ 3.6 V	30	—	—	μs
				4.75 V ≤ Vdd ≤ 5.25 V	15	—	—	μs

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

3.4.4 Timing Chart

Figure 3-8 shows a thermal head drive timing chart.

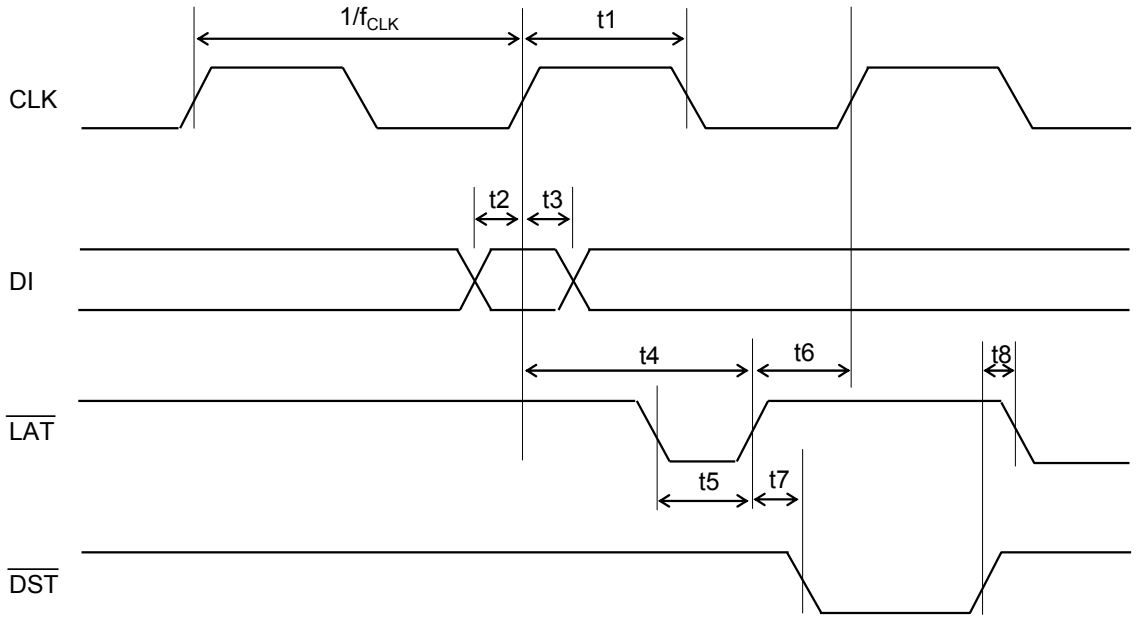


Figure 3-8 Thermal Head Drive Timing Chart

3.4.5 Thermal Head Heat Element Resistance

Table 3-9 shows resistance of the thermal head heat element of the printer.

Table 3-9 Thermal Head Heat Element Resistance

Thermal Head Heat Element Resistance
1455.0 Ω to 1545.0 Ω

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):

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

I_P : Maximum current consumption (A)
N_{SA} : Number of simultaneously activated dots
Vp : 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 is controlled according to use conditions. 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 3.5.5 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 cycle coefficient	See section 3.5.5

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 3-10
T_C	:	Temperature coefficient	See Table 3-10
T_X	:	Temperature detected by thermistor (°C) *	

*: 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 3-10 Standard Printing Energy and Temperature Coefficient

Thermal Paper		Standard Printing Energy (mJ)	Temperature Coefficient	
			Below 25°C	25°C or higher
Nippon Paper	TF50KS-E2D	0.3106	0.003394	0.003394
	TP50KJ-R	0.4216	0.005074	0.005074
Oji Paper	PD160R-63	0.4012	0.002099	0.004402
	PD160R-N	0.3270	0.001291	0.003487
Mitsubishi Paper mills limited	P220VBB-1	0.3190	0.003575	0.003575
Papierfabrik August Koehler AG	KT55F20	0.3684	0.004595	0.004595
Jujo Thermal	AP50KS-D	0.3460	0.003631	0.003631
	AF50KS-E	0.3074	0.003197	0.003197
Mitsubishi Hi-Tech Paper	F5041	0.3901	0.003528	0.004551
KSP	P300	0.4404	0.004647	0.004647
KANZAN	KF50	0.3621	0.003152	0.003152

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)
R_i	:	Wiring resistance in the thermal head	40 (Ω) *1
R_C	:	Common terminal wiring resistance in the thermal head	0.32 (Ω)
r_C	:	Wiring resistance between Vp and GND (Ω) *2	

*1: Vdd is 5.0 V. Ri is 55 (Ω) when Vdd is 3.0 V or 3.3 V
*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):

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

3.5.5 Adjustment by Thermal Head Activation Pulse Cycle

The thermal head activation cycle coefficient "C" can be calculated using equations (6) as the printing density varies by the time from the start of the preceding thermal head activation to the start of the current thermal head activation (thermal head activation cycle "W' "). However, when the calculated value is C>1, the value should be used as C=1.

Equation (6):

When the thermal head activation cycle is less than 2640(μs):

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

When the thermal head activation cycle is 2640(μs) or more:

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

W': Thermal head activation cycle(μs)
Time from the start of the preceding thermal head activation to the start of the current thermal head activation.

Figure 3-9 shows how to calculate the thermal head activation cycle "W' " as an example.

To calculate the activation pulse width "t1" for 2nd dot-line (at 3rd step and 4th step), "W'1" shown in the figure below should be set as "W' ".
To calculate the activation pulse width "t2" for 5th dot-line (at 9th step and 10th step), "W'2"shown in the figure below should be set as "W' ".

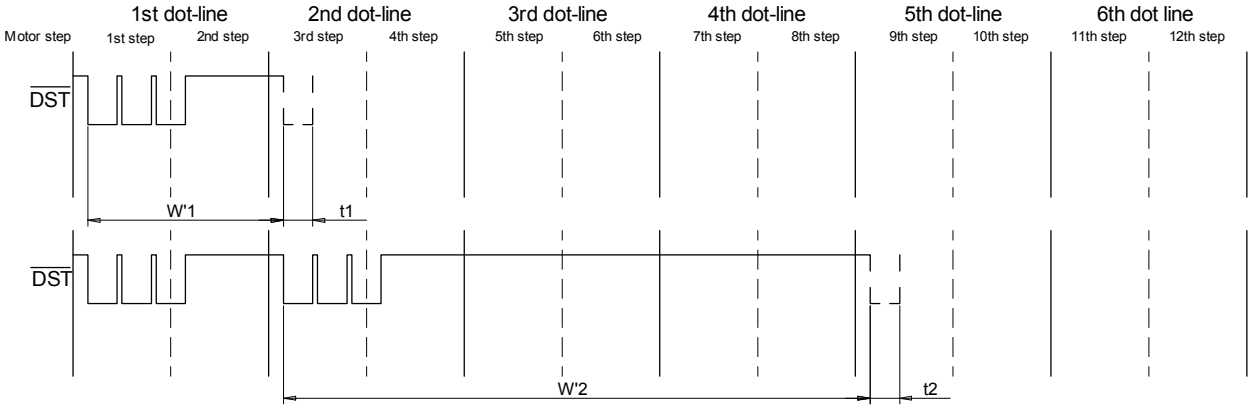


Figure 3-9 Sample of the Thermal Head Activation Cycle "W' "

3.5.6 Setting of Activation Pause Time

In order to protect the thermal head heat elements, when the same heat element dots are activated, set the time from the start of the current thermal head activation to the start of the next thermal head activation (thermal head activation cycle "W") to secure pause time for 100 μs or more.

Equation (7):

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

W: Thermal head activation cycle(μs)
Time from the start of the current thermal head activation to the start of the next thermal head activation.

3.5.7 Calculation Sample for the Activation Pulse Width

Table 3-11 lists the calculation samples of the activation pulse width calculated using equation (2) and the values obtained using equations (3) to (6).

Table 3-11 Activation Pulse Width

Unit: ms

Vp (V)	TX (°C)	Motor Drive Pulse Rate (pps)														
		400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
21.6	-10	1.664	1.415	1.276	1.154	1.073	1.014	0.971	0.937	0.910	0.888	0.869	0.853	0.840	0.828	0.818
	0	1.532	1.303	1.175	1.063	0.988	0.934	0.894	0.863	0.838	0.817	0.800	0.786	0.774	0.763	0.753
	10	1.401	1.191	1.074	0.972	0.903	0.854	0.817	0.789	0.766	0.747	0.732	0.718	0.707	0.697	0.689
	20	1.269	1.079	0.974	0.880	0.818	0.774	0.741	0.715	0.694	0.677	0.663	0.651	0.641	0.632	0.624
	30	1.138	0.968	0.873	0.789	0.733	0.694	0.664	0.641	0.622	0.607	0.594	0.584	0.574	0.566	0.559
	40	1.006	0.856	0.772	0.698	0.649	0.614	0.587	0.567	0.550	0.537	0.526	0.516	0.508	0.501	0.495
	50	0.875	0.744	0.671	0.607	0.564	0.533	0.510	0.493	0.478	0.467	0.457	0.449	0.442	0.435	0.430
	60	0.743	0.632	0.570	0.516	0.479	0.453	0.434	0.419	0.406	0.396	0.388	0.381	0.375	0.370	0.365
	70	0.612	0.520	0.469	0.424	0.394	0.373	0.357	0.344	0.334	0.326	0.320	0.314	0.309	0.305	0.301
	80	0.480	0.408	0.368	0.333	0.310	0.293	0.280	0.270	0.263	0.256	0.251	0.246	0.242	0.239	0.236
24.0	-10	1.340	1.139	1.028	0.929	0.864	0.817	0.782	0.754	0.733	0.715	0.700	0.687	0.676	0.667	0.659
	0	1.234	1.049	0.946	0.856	0.795	0.752	0.720	0.695	0.675	0.658	0.644	0.633	0.623	0.614	0.607
	10	1.128	0.959	0.865	0.782	0.727	0.688	0.658	0.635	0.617	0.602	0.589	0.579	0.569	0.562	0.555
	20	1.022	0.869	0.784	0.709	0.659	0.623	0.596	0.576	0.559	0.545	0.534	0.524	0.516	0.509	0.503
	30	0.916	0.779	0.703	0.635	0.591	0.559	0.535	0.516	0.501	0.489	0.479	0.470	0.463	0.456	0.451
	40	0.810	0.689	0.622	0.562	0.522	0.494	0.473	0.456	0.443	0.432	0.423	0.416	0.409	0.403	0.398
	50	0.704	0.599	0.540	0.489	0.454	0.429	0.411	0.397	0.385	0.376	0.368	0.361	0.356	0.351	0.346
	60	0.598	0.509	0.459	0.415	0.386	0.365	0.349	0.337	0.327	0.319	0.313	0.307	0.302	0.298	0.294
	70	0.493	0.419	0.378	0.342	0.318	0.300	0.287	0.277	0.269	0.263	0.257	0.253	0.249	0.245	0.242
	80	0.387	0.329	0.297	0.268	0.249	0.236	0.226	0.218	0.211	0.206	0.202	0.198	0.195	0.193	0.190
26.4	-10	1.102	0.937	0.845	0.764	0.710	0.672	0.643	0.621	0.603	0.588	0.576	0.565	0.556	0.549	0.542
	0	1.015	0.863	0.778	0.704	0.654	0.619	0.592	0.571	0.555	0.541	0.530	0.521	0.512	0.505	0.499
	10	0.928	0.789	0.712	0.644	0.598	0.566	0.541	0.522	0.507	0.495	0.485	0.476	0.468	0.462	0.456
	20	0.841	0.715	0.645	0.583	0.542	0.513	0.491	0.473	0.460	0.448	0.439	0.431	0.424	0.419	0.413
	30	0.754	0.641	0.578	0.523	0.486	0.459	0.440	0.424	0.412	0.402	0.394	0.387	0.380	0.375	0.371
	40	0.666	0.567	0.511	0.462	0.430	0.406	0.389	0.375	0.364	0.356	0.348	0.342	0.336	0.332	0.328
	50	0.579	0.493	0.444	0.402	0.373	0.353	0.338	0.326	0.317	0.309	0.303	0.297	0.292	0.288	0.285
	60	0.492	0.419	0.378	0.341	0.317	0.300	0.287	0.277	0.269	0.263	0.257	0.252	0.249	0.245	0.242
	70	0.405	0.345	0.311	0.281	0.261	0.247	0.236	0.228	0.222	0.216	0.212	0.208	0.205	0.202	0.199
	80	0.318	0.270	0.244	0.221	0.205	0.194	0.186	0.179	0.174	0.170	0.166	0.163	0.161	0.158	0.156

*: The table above is applicable under the following conditions:

- Vdd = 5.0 V.
- 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 the 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 3-12.

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)
EXP (A)	:	The "A" th power of natural logarithm e (2.71828)	

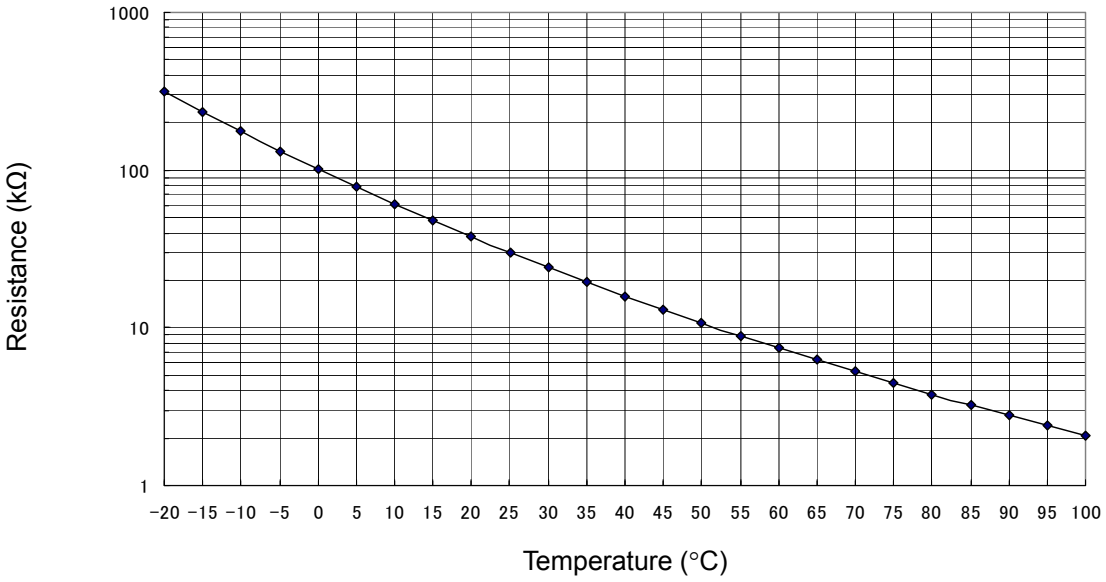


Figure 3-10 Temperature Characteristics of the Thermistor

Table 3-12 Temperature Characteristics of the Thermistor

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 when the thermal head thermistor (TH) detects a temperature higher than 80°C (thermistor resistance $R_{TH} \leq 3.80k\Omega$), and reactivate the heat elements when a temperature lower than 60°C ($R_{TH} \geq 7.45k\Omega$) is detected. When 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

When 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. (When the control unit malfunctions, it may be impossible to prevent damage on the thermal head even when 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 ($R_{TH} \leq 2.09k\Omega$))

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

When abnormal condition is detected, immediately turn off the power supply. Reactivate the heat elements after they have returned to normal.

3.6 THERMAL PAPER CUTTING CONDITIONS

The autocutter of this printer can select the method to cut the thermal paper in full cut or partial cut (tab left at the center) by changing the number of driving steps for autocutter drive motor.

Full cut	:	630 steps
Partial cut	:	544 steps

Figure 3-11 shows the full cutting method and the partial cutting method for the thermal paper.

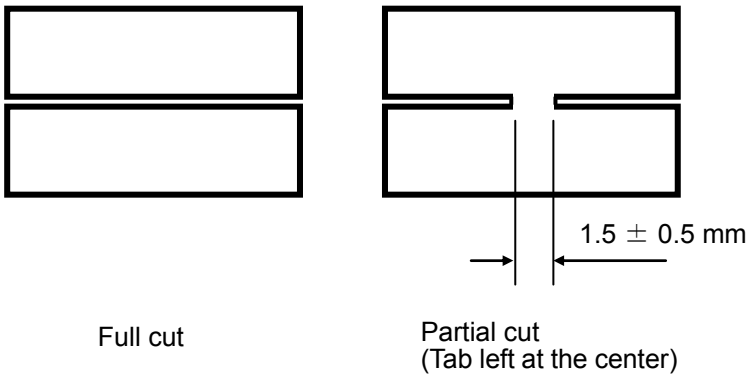


Figure 3-11 Thermal Paper Cut Condition

3.7 STEP MOTOR (AUTOCUTTER DRIVE MOTOR)

3.7.1 General Specifications

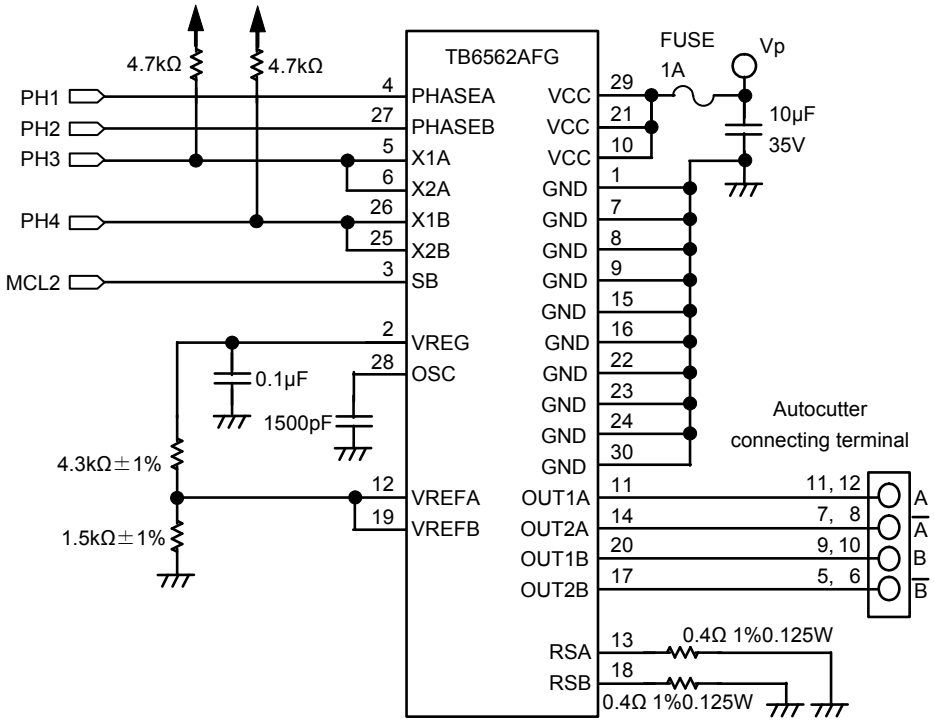
Table 3-13 shows general specifications of the step motor.

Table 3-13 General Specifications of the Step Motor

Item	Specifications
Type	PM type step motor
Drive method	Bi-polar chopper
Excitation method	1-2 phase
Winding resistance per phase	22 Ω / phase ±10%
Motor drive voltage	Vp: 21.6 V to 26.4 V
Motor controlled current	320 mA/ phase
Drive pulse rate	2916 pps max. (Outward) 3154 pps max. (Homeward)

3.7.2 Sample Drive Circuit

Figure 3-12a shows the sample drive circuit 1, when the current is controlled with VREG of the motor driver output.



*: Recommended motor drive: TB6562AFG (Toshiba)

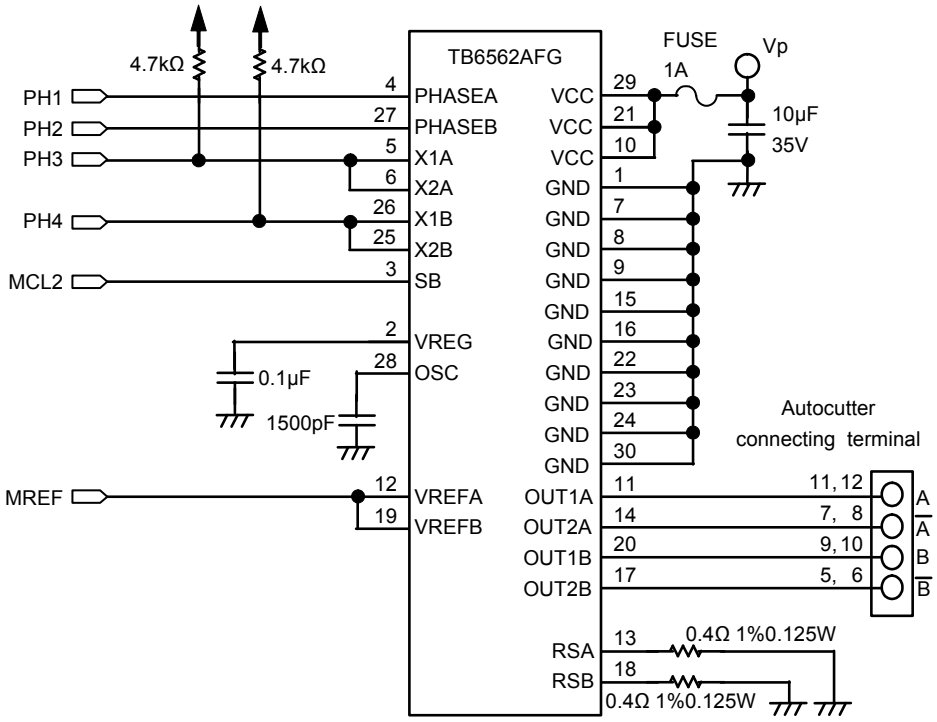
Figure 3-12a Sample Drive Circuit 1

Figure 3-12b shows the sample drive circuit 2, when the current is controlled without VREG of the motor driver output. (using the D/A converter etc.)

- **MREF signal**

  MREF signal is the reference signal for the motor current control. The motor drive setting current is set by the MREF signal setting voltage.

Motor Controlled Current	MREF Signal Voltage
320 mA	1280 mV±5%



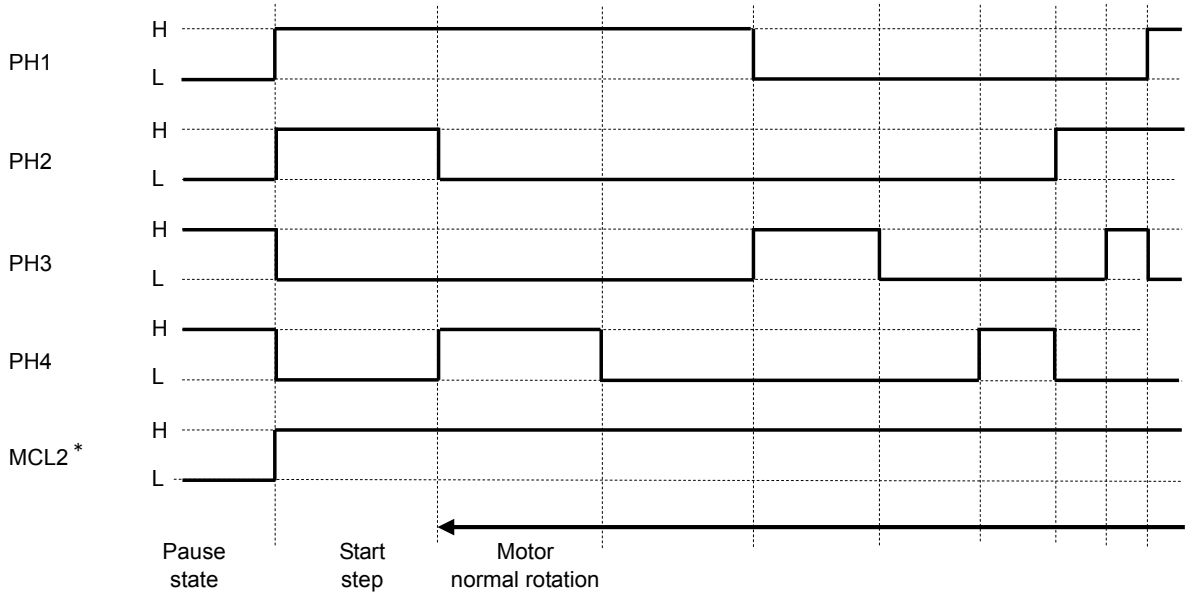
*: Recommended motor driver: TB6562AFG (Toshiba)

Figure 3-12b Sample Drive Circuit 2

3.7.3 Excitation Sequence

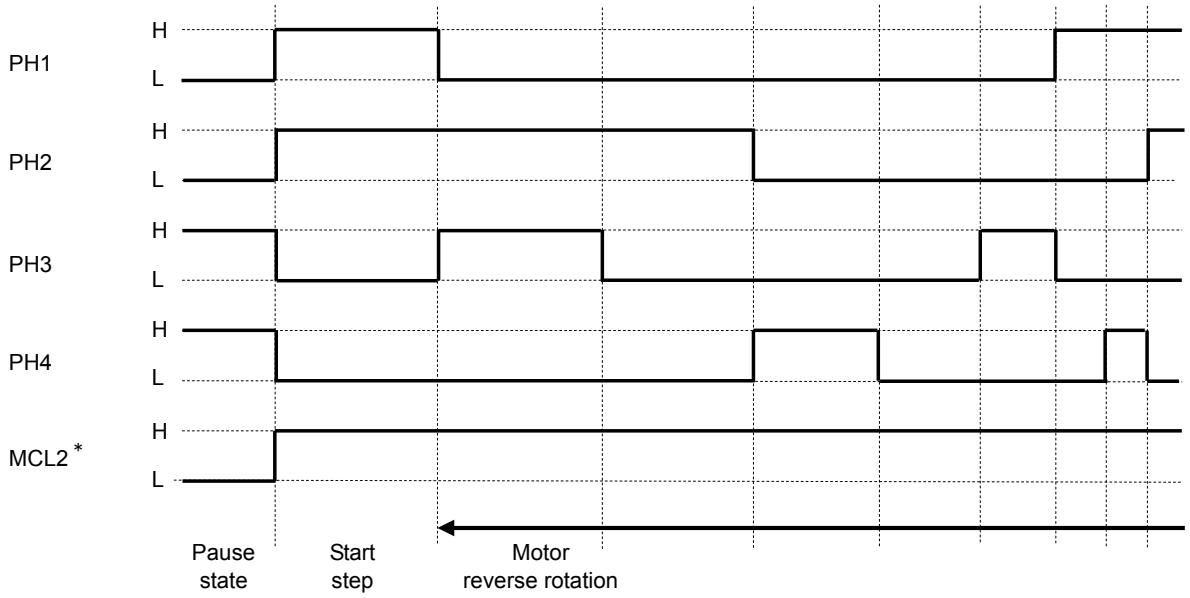
Drive the motor with 1-2 phase excitation. The voltage wave forms shown in Figure 3-13a put to the motor drive circuit shown in Figure 3-12a or Figure 3-12b, the motor drives in the normal rotation, the movable blade is moved to the fixed blade direction (Outward) and cut the thermal paper when the motor 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 3-14.

The voltage wave forms shown in Figure 3-13b put to the motor drive circuit shown in Figure 3-12a or Figure 3-12b the motor is rotated in the reverse direction, the movable blade is moved to the home position direction (Homeward) when the motor is excited in order of step 1, step 8, step 7, step 6, step 5, step 4, step 3, step 2, step 1, step 8, ... , as shown in Table 3-14.



*: Set MCL2 to "High" while the motor is driven.

Figure 3-13a Input Voltage Waveforms for the Sample Drive Circuit (Outward)



*: Set MCL2 to "High" while the motor is driven.

Figure 3-13b Input Voltage Waveforms for the Sample Drive Circuit (Homeward)

Table 3-14 Excitation Sequence

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

3.7.4 Autocutter Drive Motor Start/Stop Method

Design the control circuit and software to stop/start for autocutter drive motor, refer Figure 3-14 Timing Chart.

(1) Start Step

To start the motor from the pause (no excitation) state, shift the motor to the sequence of cut step after exciting the same phase as that of the stop step for the first acceleration step time of the acceleration step.
Perform the start step by the 2 phase excitation condition.

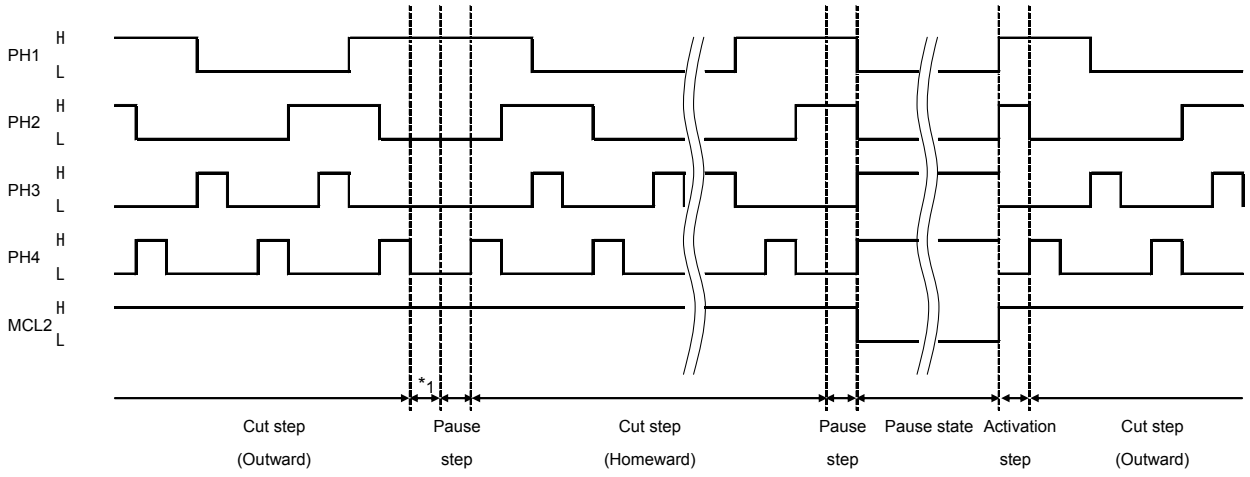
(2) Stop Step

To stop the motor, excite the same phase as the last one in the cut step for 20ms.
However, when the final cut step is 1 phase excitation, forward 1 cut step to become the final cut step as 2 phase excitation.

(3) Pause State

In the pause state, do not excite the motor to prevent to the motor from overheating.

The voltage wave forms of the sample drive circuit is shown in Figure 3-14.



*1: Because the final cut step is 1 phase excitation, 1 cut step is inserted before the pause step.

Figure 3-14 Autocutter Drive Motor Start/Stop Timing Chart

3.7.5 Autocutter Drive Motor Drive Method

To drive the autocutter drive motor, follow the method below.

(1) Drive Frequency

The motor is normal rotation (Outward) : 2916 pps max.
The motor is reverse rotation (Homeward) : 3154 pps max.

(2) Speed Control

When driving the motor, the acceleration control is required. When acceleration of the motor does not perform correctly, the motor may step out. Accelerate the speed sequentially up to the maximum motor drive pulse rate P_M according to the acceleration steps of the autocutter drive motor shown in Table 3-15.

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.

(3) Preventing Overheat

It is possible to drive the autocutter drive motor continuously, within the specifications.

Temperature rise of the motor is different according to the use conditions (ambient temperature, designing the outer case etc.). Keep the temperature of the motor outer case, 100°C or lower. Verify the performance with your actual device.

Table 3-15 Acceleration Steps of the Autocutter Drive Motor

Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)	Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)
Start	-	5000	37	2274	440
1	270	3707	38	2305	434
2	436	2291	39	2337	428
3	565	1769	40	2367	422
4	673	1485	41	2398	417
5	768	1302	42	2428	412
6	853	1172	43	2457	407
7	931	1074	44	2487	402
8	1004	996	45	2515	398
9	1072	933	46	2544	393
10	1136	880	47	2572	389
11	1197	836	48	2600	385
12	1255	797	49	2628	381
13	1310	763	50	2655	377
14	1364	733	51	2683	373
15	1415	707	52	2709	369
16	1465	683	53	2736	365
17	1513	661	54	2762	362
18	1560	641	55	2788	359
19	1605	623	56	2814	355
20	1649	606	57	2840	352
21	1692	591	58	2865	349
22	1734	577	59	2891	346
23	1775	563	60	2916	343
24	1815	551	61	2940	340
25	1854	539	62	2965	337
26	1893	528	63	2989	335
27	1930	518	64	3013	332
28	1967	508	65	3037	329
29	2004	499	66	3061	327
30	2039	490	67	3085	324
31	2075	482	68	3108	322
32	2109	474	69	3131	319
33	2143	467	70	3154	317
34	2176	459	-	-	-
35	2209	453	-	-	-
36	2242	446	-	-	-

3.7.6 Precaution of the Autocutter Drive Motor

- It cannot give the specified performance, when using except Section 3.7.2 "Sample Drive Circuit".
- Do not drive the autocutter drive motor while the printer drive motor is driving. Otherwise it may cause damage.

3.8 OUT-OF-PAPER SENSOR

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

The printer drive 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.

The autocutter drive motor is driven when there is no paper, the life of the autocutter may be shortened significantly.

For the out-of-paper sensor dimension, refer to Chapter 6 "LAYOUT OF THE PRINTER MECHANISM AND THE THERMAL PAPER".

3.8.1 General Specifications

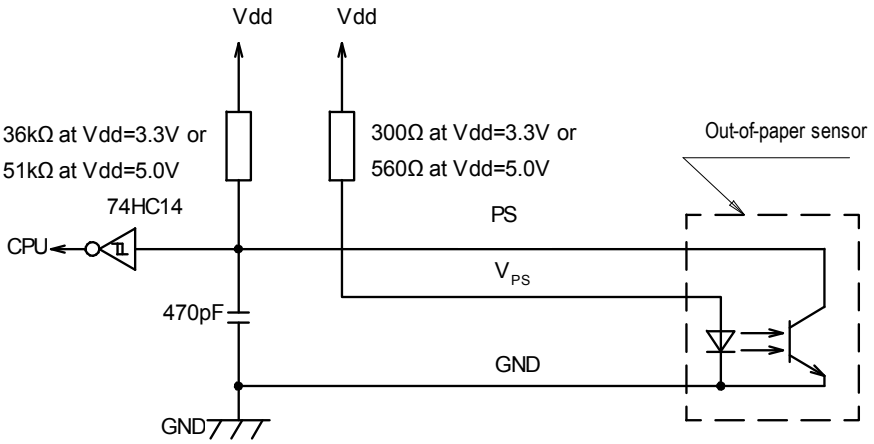
Table 3-16 shows about the out-of-paper sensor used for this printer.

Table 3-16 Out-of-paper Sensor

Item	Specifications
Model	NJL5902R (Rank B)
Manufacturer	New Japan Radio Co.,Ltd.

3.8.2 Sample External Circuit

Figure 3-15 shows sample external circuit of the out-of-paper sensor.



*: The PS signal is "High" when there is no paper.

Figure 3-15 Sample External Circuit of the Out-of-paper Sensor

3.8.3 Precautions for the Out-of-Paper Sensor

- The out-of-paper sensor may generate instantaneous abnormal signal. Design the firmware in order not to trigger the malfunction caused by the abnormal signal. (Recommended frequency: detect 2 consecutive abnormal signals in every 10 ms.)

3.9 PLATEN POSITION SENSOR

The printer has a built-in platen position sensor for detecting the platen block is set or opened. 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 opened.

The external circuit should be designed so that it detects output from the platen position sensor and does not activate the thermal head, the printer drive motor and the autocutter drive motor when the platen block is in open state. Otherwise, the thermal head may become damaged or its life may be shortened significantly.

The printer drive motor is driven when the platen block is in open state, the hair may get caught in the drive gears.

The autocutter drive motor is driven when the platen block is in open state, it is dangerous users can touch the movable blade directly.

3.9.1 General Specifications

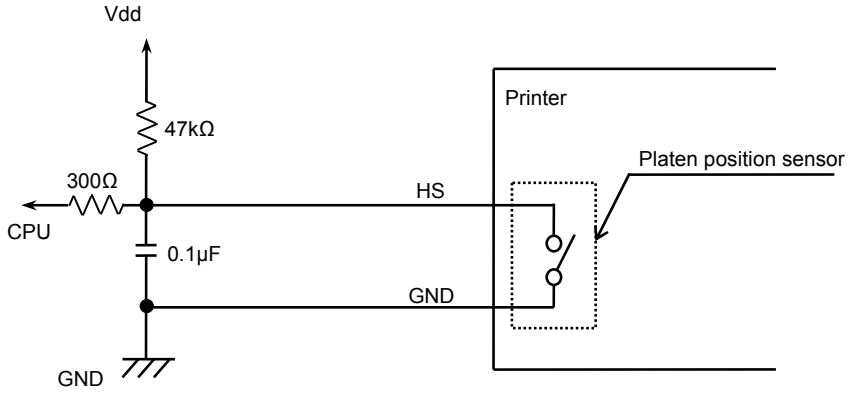
Table 3-17 shows about the general specification

Table 3-17 General Specifications of the Platen Position Sensor

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

3.9.2 Sample External Circuit

Figure 3-16 shows sample external circuit of the platen position sensor.



*: The HS signal is "High" when the platen is in open state.

Figure 3-16 Sample External Circuit of the Platen Position Sensor

3.9.3 Platen Position Sensor Precautions

- Be sure that there is a time lag between the time when the thermal head is set and the platen position sensor actually starts detecting.
- Always use the capacitor shown in Figure 3-16 to prevent the switch from malfunctioning due to chattering.
- The platen position sensor may generate instantaneous abnormal signal. Design the firmware in order not to trigger the malfunction caused by the abnormal signal. (Recommended frequency: detect 2 consecutive abnormal signals in every 10 ms.)

3.10 CUTTER HOME POSITION SENSOR

The printer has a built-in cutter home position sensor (transmission type photo interrupter) for detecting the position of the movable blade. The external circuit should be designed so that the cutter home position sensor detects where the movable blade is and it will not drive the motor unless the movable blade is in its home position.

When the movable blade is driven out of the home position, it may cause paper jam or damage of the movable blade.

3.10.1 General Specifications

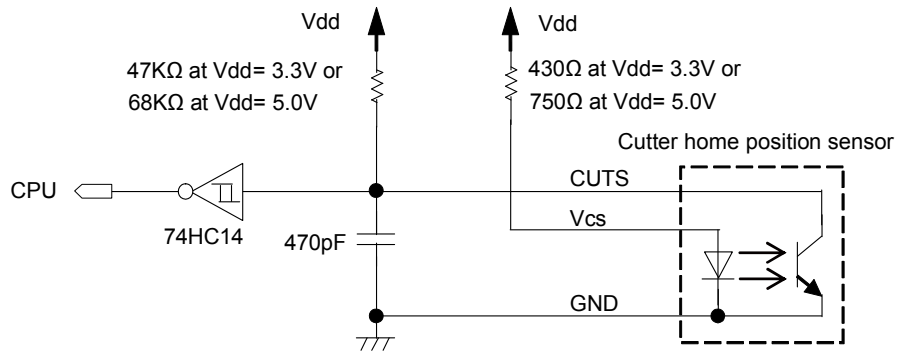
Table 3-18 shows the specifications of the cutter home position sensor.

Table 3-18 Cutter Home Position Sensor

Item	Specifications
Model	GP1S092HCPIF
Manufacturer	Sharp Corporation

3.10.2 Sample External Circuit

Figure 3-17 shows the sample external circuit of the cutter home position sensor.



*: The CUTS signal is "High" when the movable blade is in its home position.

Figure 3-17 Sample External Circuit of the Cutter Home Position Sensor

3.10.3 Cutter Home Position Sensor Precautions

- The cutter home position sensor may generate instantaneous abnormal signal. Design the firmware in order not to trigger the malfunction caused by the abnormal signal. (Recommended frequency: detect 2 consecutive abnormal signals in every cutter drive steps.)

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

No.	Connector for External Circuits	Number of Terminals	Recommended Connectors
1	Printer connecting terminals (FPC)	50	MOLEX INC: 0541045031 (Right angle type, top contact, gold plated)
2	Autocutter connecting terminals (FPC)	12	MOLEX INC: 0545501271 (Right angle type, top contact, gold plated)

4.2 PRINTER CONNECTING TERMINALS

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

Figure 4-1 Printer Connecting Terminals

Table 4-2 Terminal Assignments of the Printer Connecting Terminal

(1/2)

Terminal No.	Signal Name	Function
1	Vp	Thermal head drive power supply
2	Vp	Thermal head drive power supply
3	Vp	Thermal head drive power supply
4	Vp	Thermal head drive power supply
5	Vp	Thermal head drive power supply
6	Vp	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	Vdd	Logic power supply
19	TH2	Thermistor (Connecting to GND and use)
20	TH2	Thermistor (Connecting to GND and use)
21	TH1	Thermistor
22	N.C.	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 No.	Signal Name	Function
31	$\overline{LAT}$	Print data latch (memory storage) signal
32	Vp	Thermal head drive power supply
33	Vp	Thermal head drive power supply
34	Vp	Thermal head drive power supply
35	Vp	Thermal head drive power supply
36	Vp	Thermal head drive power supply
37	Vp	Thermal head drive power supply
38	N.C.	No connection
39	PS	Output signal of the out-of-paper sensor (Photo-transistor collector)
40	V_{PS}	Power supply of the out-of-paper sensor (LED anode)
41	GND	GND of the out-of-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	$\overline{A}$	Printer drive motor drive signal
48	B	Printer drive motor drive signal
49	A	Printer drive motor drive signal
50	$\overline{B}$	Printer drive motor drive signal

4.3 AUTOCUTTER CONNECTING TERMINALS

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

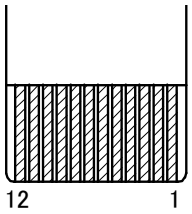


Figure 4-2 Autocutter Connecting Terminals

Table 4-3 Terminal Assignments of the Autocutter Connecting Terminal

Terminal No.	Signal Name	Function
1	N.C.	No connection
2	V_{CS}	Power supply of the cutter home position sensor (LED anode)
3	GND	GND of the cutter home position sensor (LED cathode, photo-transistor emitter)
4	CUTS	Output signal of the cutter home position sensor (Photo-transistor collector)
5	$\overline{B}$	Autocutter drive motor drive signal
6	$\overline{B}$	Autocutter drive motor drive signal
7	$\overline{A}$	Autocutter drive motor drive signal
8	$\overline{A}$	Autocutter drive motor drive signal
9	B	Autocutter drive motor drive signal
10	B	Autocutter drive motor drive signal
11	A	Autocutter drive motor drive signal
12	A	Autocutter drive motor drive signal

CHAPTER 5
DRIVE METHOD

5.1 PRINT DRIVE METHOD

5.1.1 Printer Drive Motor and Thermal Head Drive Method

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

The following describes the drive method.
Figure 5-1 shows a timing chart for using fixed 2 division printing.
Figure 5-2 shows a timing chart for using batch printing.

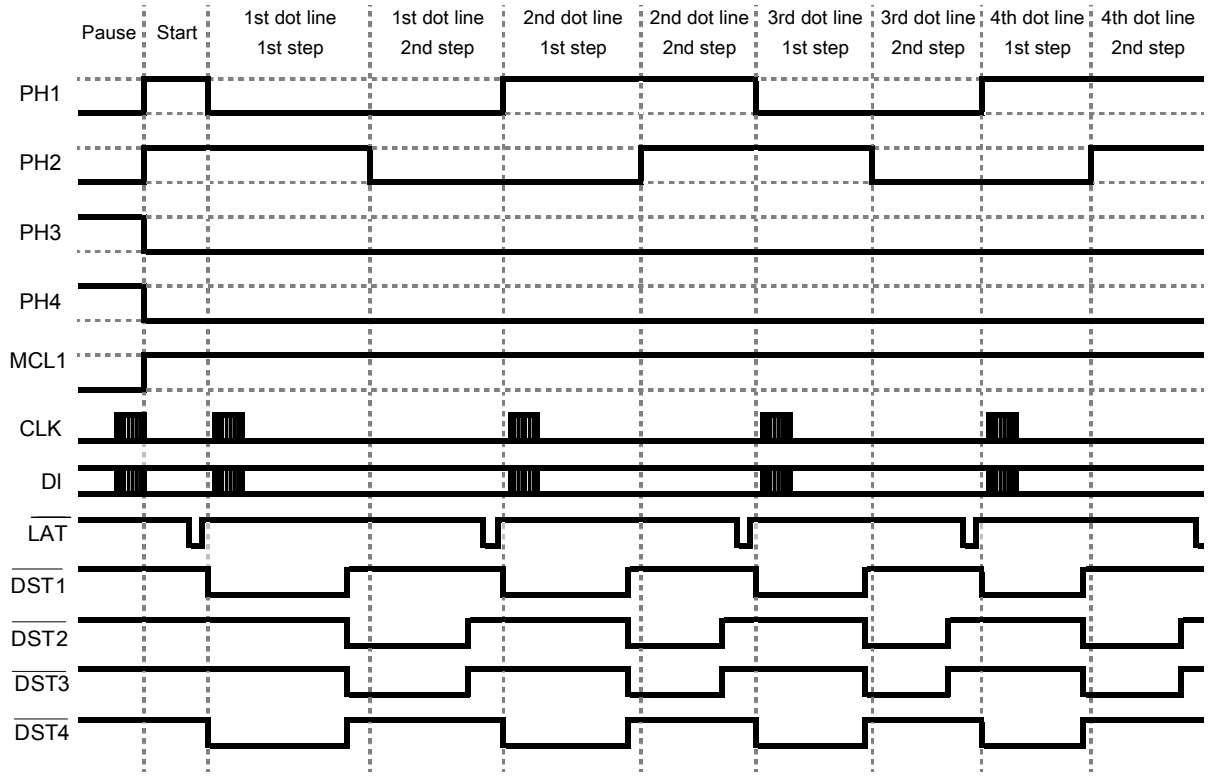


Figure 5-1 Timing Chart for Using Fixed 2 Divisions Printing

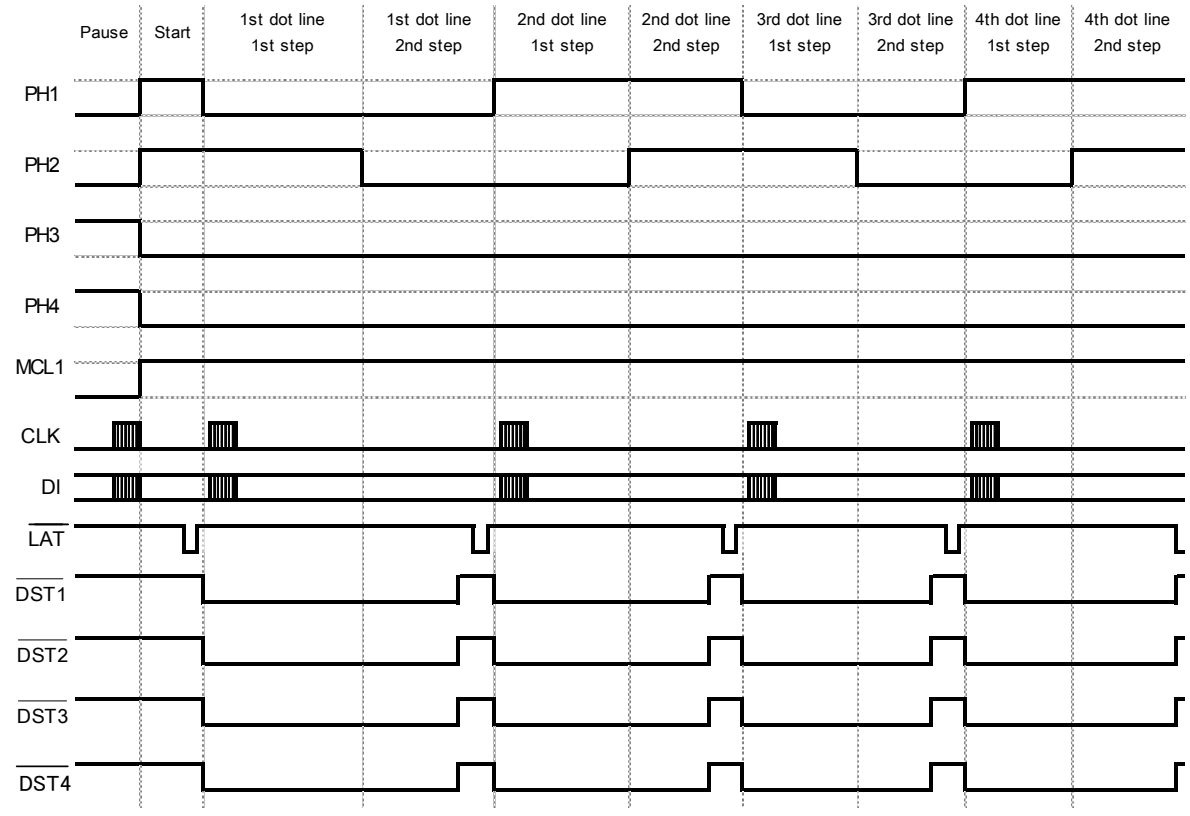


Figure 5-2 Timing Chart for Using Batch Printing

The drive method using fixed 2 divisions is explained below (See Figure 5-1):

(1) Pause State

Inactivate the motor and always make $\overline{DST}$ 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 with 2 steps of the motor drive signal.

At the 1st step of the motor drive signal, start activation of the thermal head by synchronized $\overline{DST1}$ and $\overline{DST3}$, $\overline{DST2}$ and $\overline{DST4}$ with the motor, printing 1st dot-line by $\overline{DST1}$ to $\overline{DST4}$.

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

Input the $\overline{DST}$ 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 $\overline{LAT}$ 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.

5.1.2 Thermal Head Division Drive Method

In the thermal head of the printer, there are 4 blocks (every 144 dots) in 1 dot-line for the printer. These blocks are called physical blocks. $\overline{DST}$ 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 2 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. When print quality is regarded as important, printing in fixed division method is recommended.

5.1.3 Precautions for Print Drive

- The activation time of the thermal head can 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, the 1st step time and the 2nd step time divide equally of the thermal head activation time.
- When using batch printing for physical blocks, 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 1 dot-line should be 8 or lower for the printer to maintain print quality. The number of the simultaneously activated dots should be 288 dots or less.

5.2 AUTOCUTTER DRIIVE METHOD

5.2.1 Timing Chart for Autocutter Drive

Change the speed according to the timing chart shown in Figure 5-3. Follow the acceleration steps of autocutter drive motor which is shown in Table 3-16 of Chapter 3, and accelerate to the maximum motor drive pulse rate in order.

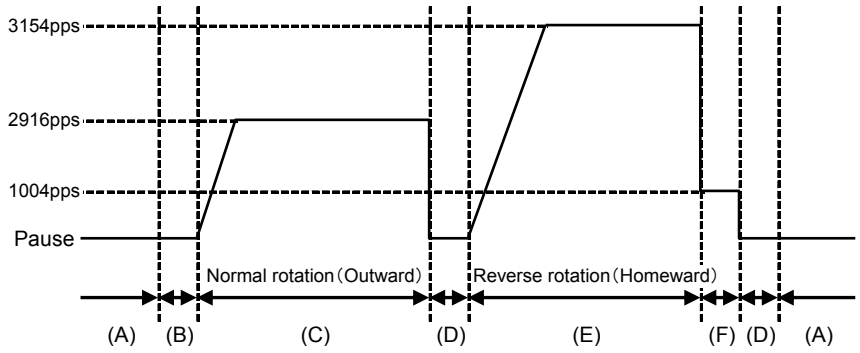


Figure 5-3 Timing Chart for Autocutter Drive

(A) Pause state

Inactivate the motor.

(B) Start step

Excite the motor by the same phase which is output just before the motor stops.
Perform the start step by the 2 phase excitation condition.

(C) Cut performance step (Outward)

Perform the acceleration control till maximum motor drive pulse rate of the outward, and drive the motor (normal rotation) according to the cut condition. (Full cut / Partial cut)

Full cut	:	630 steps
Partial cut	:	544 steps

(D) Stop step

Excite the stop step for 20ms.
However, when the final cut step is 1 phase excitation, forward 1 cut step to become the final cut step as 2 phase excitation.

(E) Cut performance step (Homeward)

Perform the acceleration control till maximum motor drive pulse rate of the homeward, and drive (reverse rotation) for the motor.

(F) Cutter home position detecting step

Detects CUTS= "High", and drive (reverse rotation) 50 steps by 1004 pps of the motor drive pulse rate.
The cutter home position sensor may generate instantaneous abnormal signal. Design the firmware in order not to trigger the malfunction caused by the abnormal signal. (Recommended frequency: detect 2 consecutive abnormal signals in every cutter drive steps.)

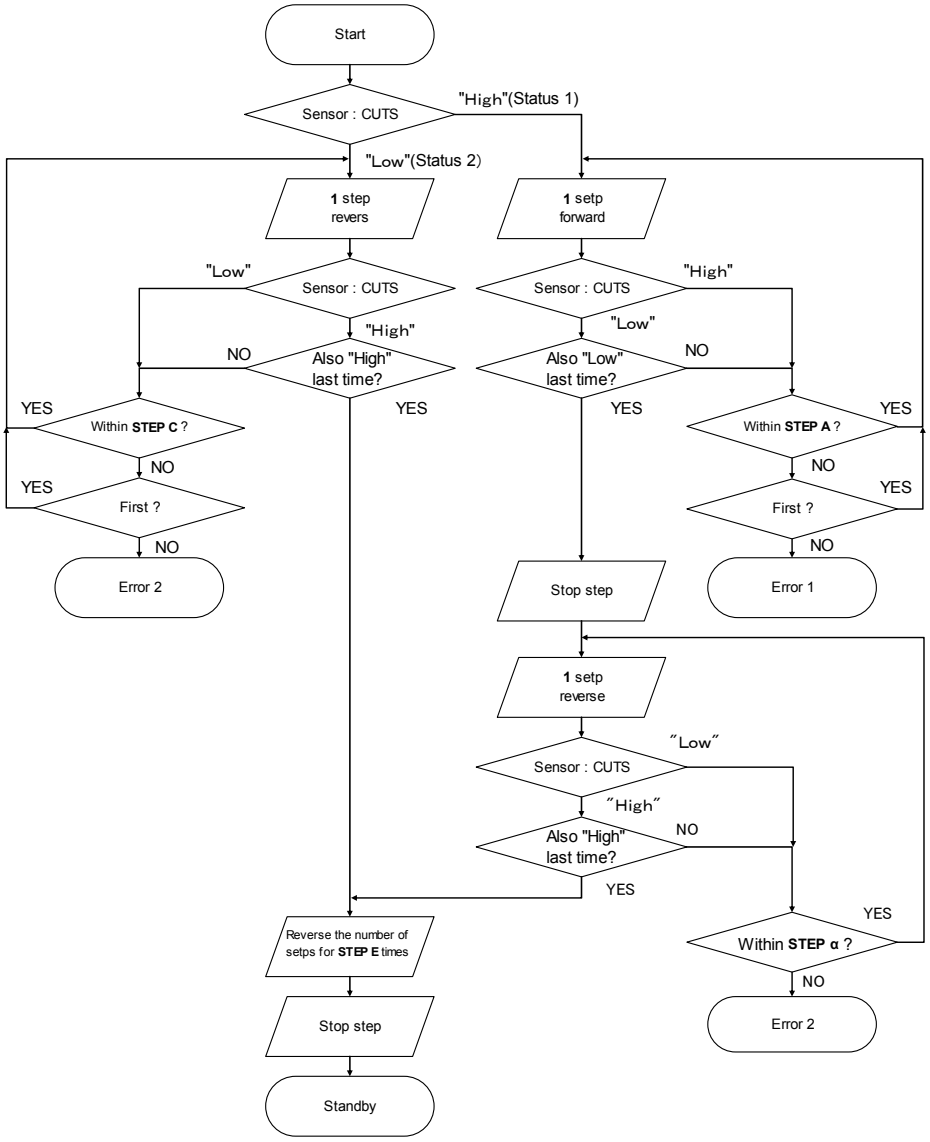
(D) Stop step

Excite the stop step for 20ms.
However, when the final cut step is 1 phase excitation, forward 1 cut step to become the final cut step as 2 phase excitation.

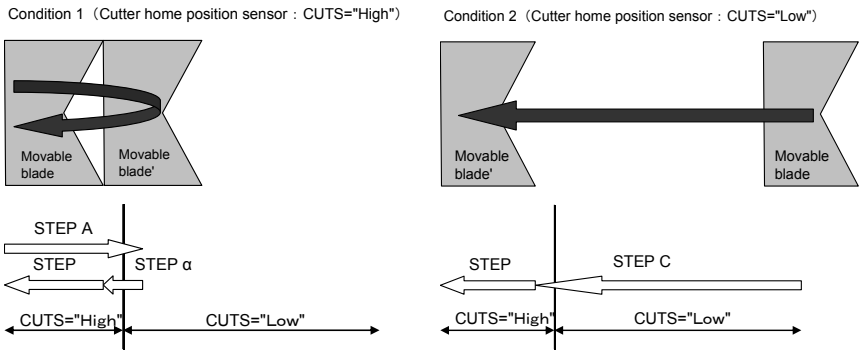
5.2.2 Flow Chart for Autocutter Drive

(1) Initializing Performance

When turn the power on or the resetting, perform the initializing performance to return the movable blade to the home position. The flow chart of initializing performance is shown in Figure 5-4.



Error 1: It is possible that the printer mechanism failure or the poor connection is occurred.
Error 2: It is possible that the cutter error is occurred. Refer to Chapter 8 "INSTALLING/UNINSTALLING THE THERMAL PAPER" for releasing method when the cutter error is occurred.

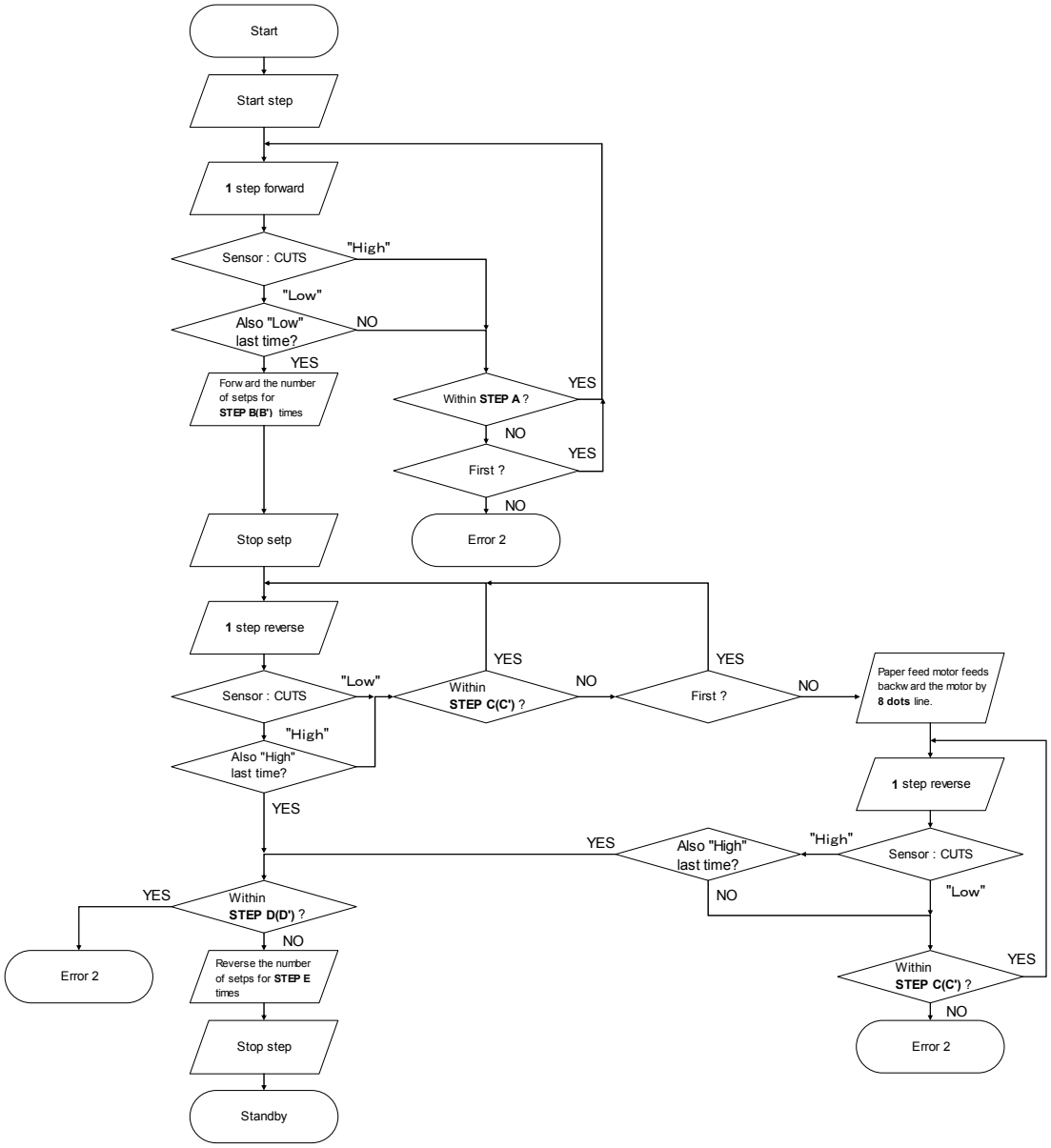


Item	Number of steps
STEP A	230
STEP C	830
STEP E	50
STEP α	200

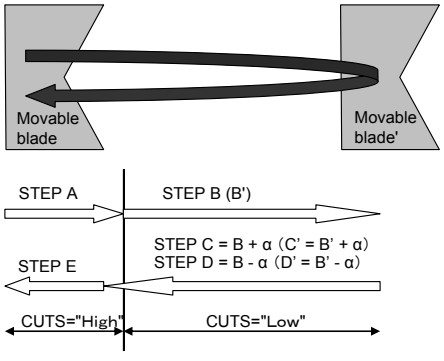
Figure 5-4 Autocutter Flow Chart : Initializing

(2) Cut Performance

The flow chart of cut performance is shown in Figure 5-5.



Error 2: It is possible that the cutter error is occurred. Refer to Chapter 8 "INSTALLING/UNINSTALLING THE THERMAL PAPER" for releasing method when the cutter error is occurred.
The cutter error is the function to detect the malfunction of autocutter performance. Note that the cutter error cannot be used to determine whether the paper cutting is completed correctly.

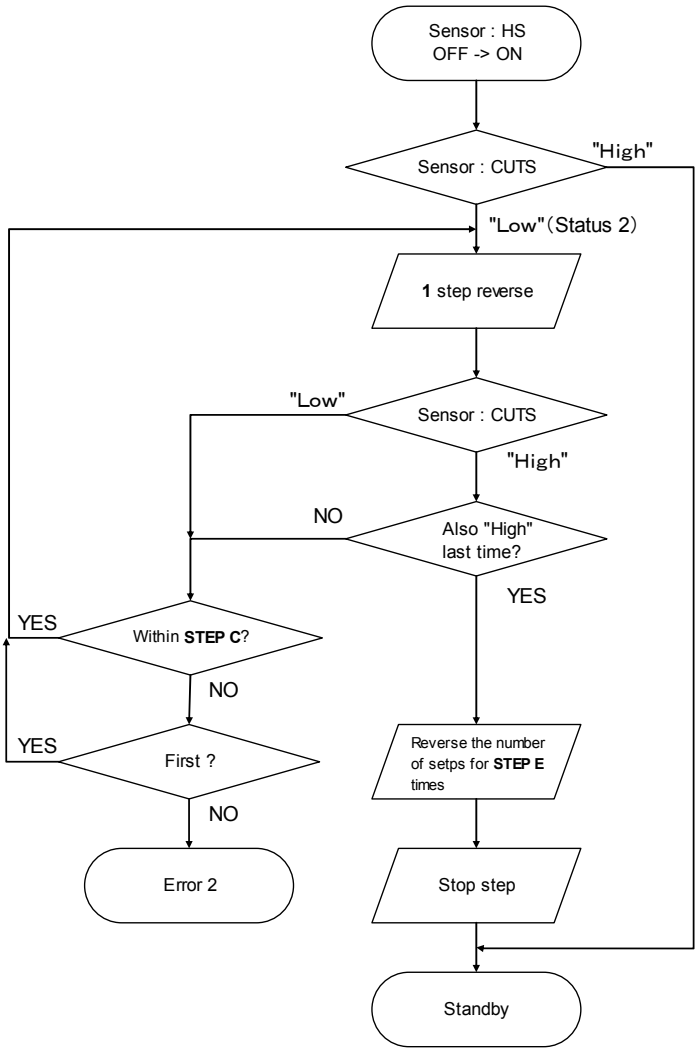


Item	Number of steps
STEP A	230
STEP B (Full cut)	630
STEP B' (Partial cut)	544
STEP C (Full cut)	830
STEP C'(Partial cut)	744
STEP D (Full cut)	430
STEP D'(Partial cut)	344
STEP E	50
STEP α	200

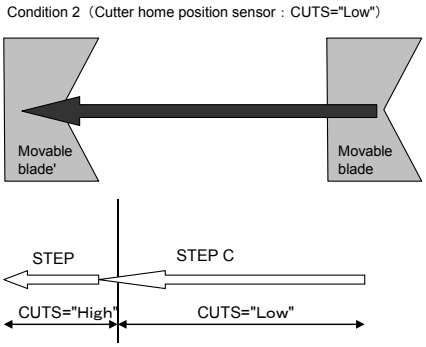
Figure 5-5 Autocutter Flow Chart : Cut Performance

(3) Detecting the Platen Position Performance

Make sure to operate according to the flow chart shown in Figure 5-6 when the platen position sensor detects a status change from OFF (the platen block is in the releasing status) to ON (the platen block is in set status).



Error 2: It is possible that the cutter error is occurred. Refer to Chapter 8 "INSTALLING/UNINSTALLING THE THERMAL PAPER" for releasing method when the cutter error is occurred.



Item	Number of steps
STEP C	830
STEP E	50

Figure 5-6 Autocutter Flow Chart : Detecting the platen position

5.2.3 Precautions for Using the Autocutter

- Figure 5-7 shows how to make the most efficient use of the thermal paper that margin from print area to cut area, printing "Print B" after next "Print A" is printed and cut.
  The distance of the cut position and the heat elements at the thermal head is approximately 9 mm. Do not print over the cut position.
  When "Print A" and "Print B" are printed as continuous pattern, its cutting operation which pauses printing during cutting the thermal paper causes a little gap between "Print A" and "Print B".

- Remove the thermal paper which is cut with the full cut, then perform the next printing or cutting. When the printer performs the next printing or cutting without removing the thermal paper, it may cause of the paper jam or cut failure depending on the mounting position. Verify the performance with your actual device.

- The printer has been left for long period of time after cutting the thermal paper, may occur the paper jam. To prevent this case, printing or feeding 2 mm or longer after cutting.

- Do not feed paper backwards after cutting with the partial cut. The part of the partial cut (tab left at the center) may be cut off.

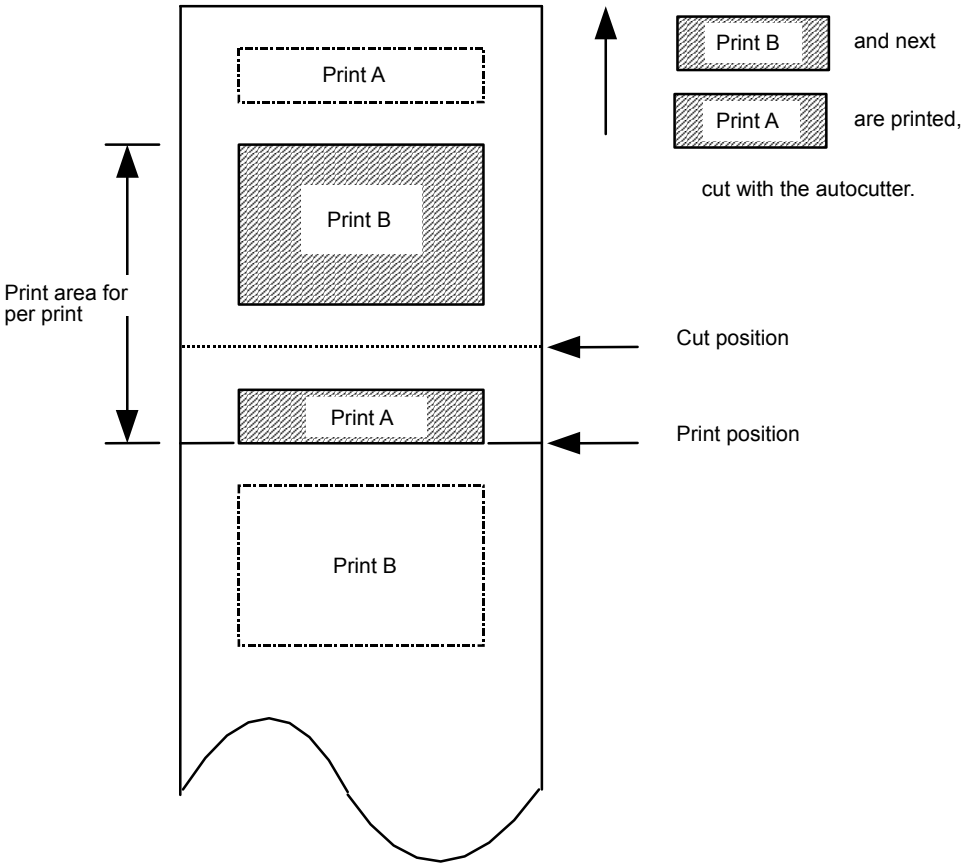
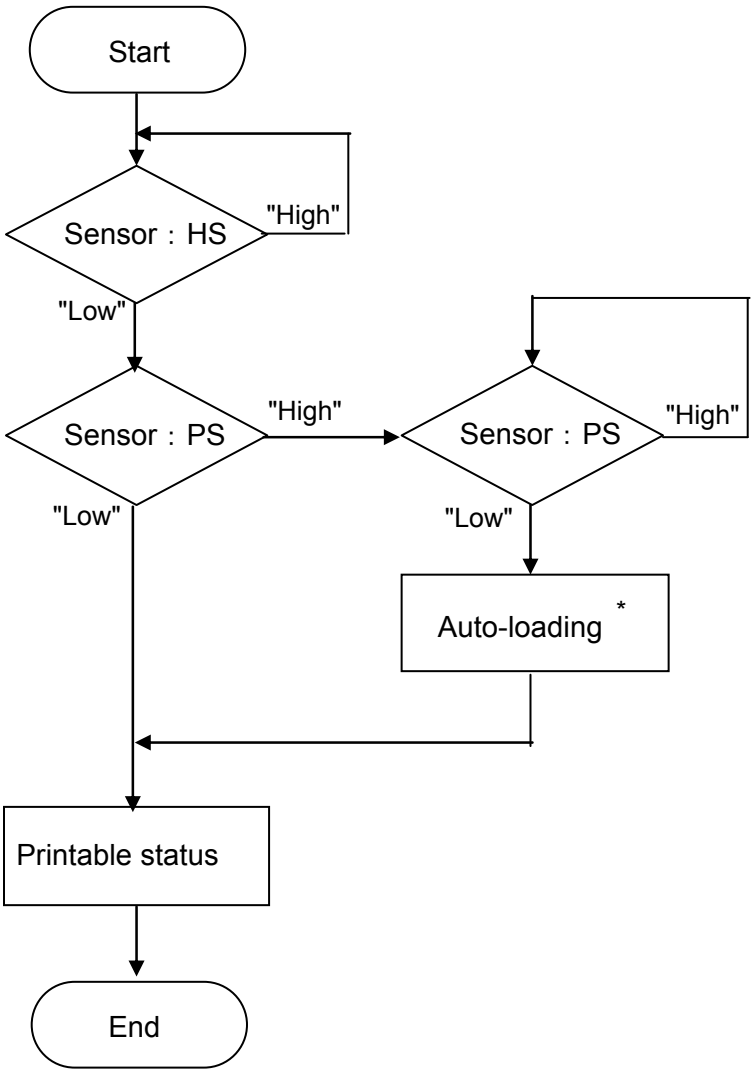


Figure 5-7 Effective Use of the Cutting Thermal Paper

5.3 AUTO-LOADING METHOD FOR THE THERMAL PAPER

It is possible auto-loading the thermal paper with out-of-paper sensor, described Chapter 3.
Control the auto-loading follow the flow chart in Figure 5-8.

Procedures for installing the thermal paper by the auto-loading, refer to Chapter 8 "Procedures for Installing the Thermal Paper".



*: ・Drive the printer drive motor normal rotation.
・The auto-loading length is set arbitrarily.
The distance of cutting position between the heat elements and the autocutter is approximately 9 mm.
・The motor drive pulse rate while auto-loading, it is different according to the length of the auto-loading performed.
The length of the auto-loading is 300 mm or shorter, the motor is driven by the motor drive pulse rate at 320 pps.
The length of the auto-loading is longer than 300 mm, the motor is driven by the motor drive pulse rate at 320 pps until the auto-loading length is 300 mm, the motor is driven by the maximum motor drive pulse rate at P_M.
・It needs few seconds, the thermal paper is fed by the platen roller after passing the out-of-paper sensor.
This time is set arbitrarily.
The distance of the thermal paper between the out-of-paper sensor and the heat elements is approximately 10 mm.

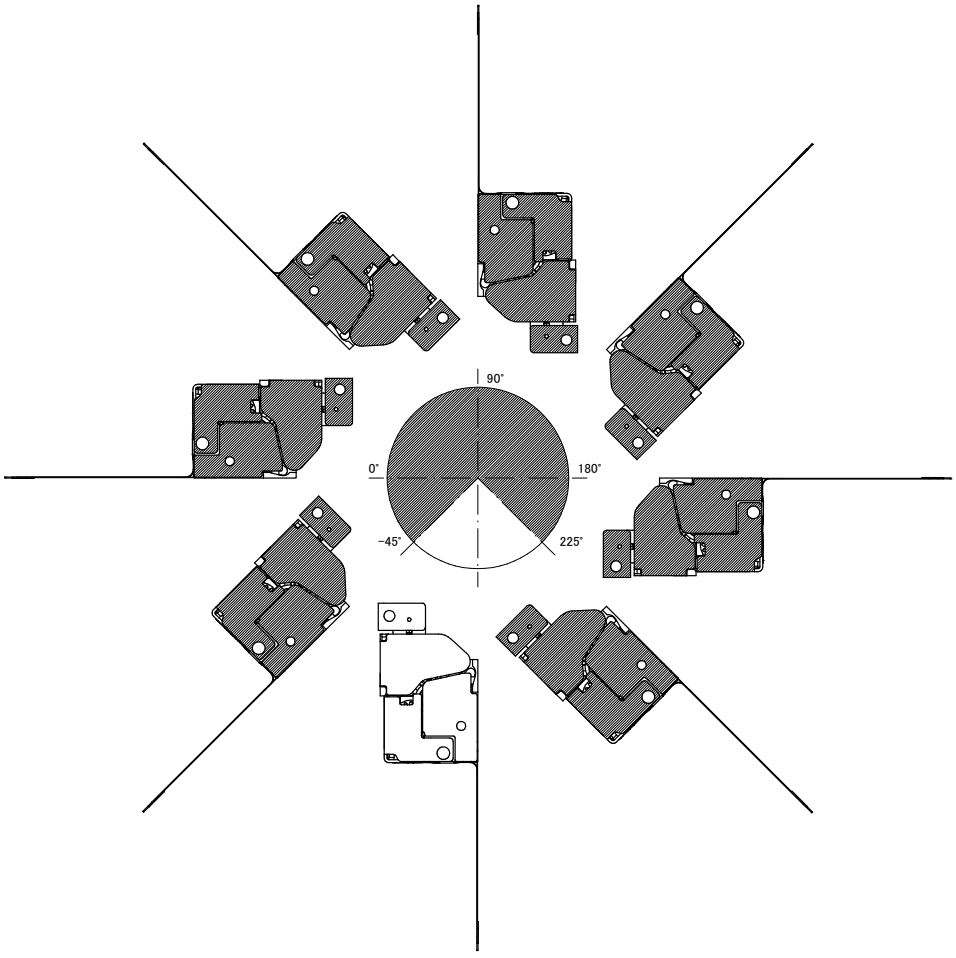
Figure 5-8 Flow Chart for Auto-loading the Thermal Paper

CHAPTER 6
OUTER CASE DESIGN GUIDE

6.1 MOUNTING POSITION

Figure 6-1 shows the possible mounting position (θ). This printer is able to be mounted at an angle of -45° to 225° (shaded area).

Remove the thermal paper which cut with the full cut, then perform the next printing or cutting.
When the printer performs the next printing or cutting without removing the thermal paper, it may cause the paper jam or cut failure depending on the mounting position. Verify the performance with your actual device.



*: The printer is able to be mounted the position (θ) at shaded area. Refer to Table 6-2 for the details.

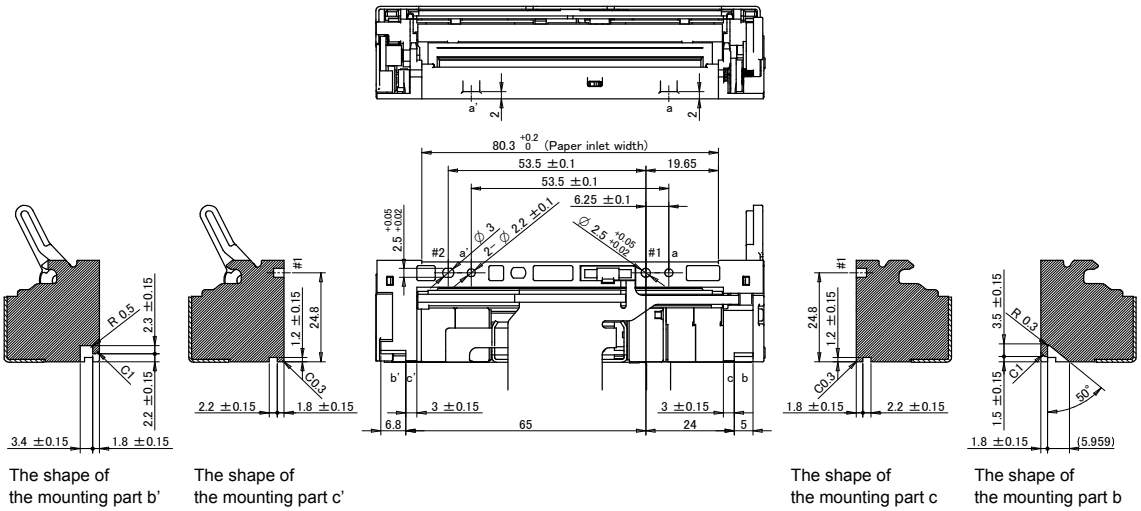
Figure 6-1 Mounting Position

6.2 SECURING THE PRINTER MAIN BODY

6.2.1 How to Mount the Printer Main Body

Figure 6-2 shows dimensions for positioning and securing the printer main body.

- Holes #1 and #2 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. The height of the bosses on the outer case must be 1.5 mm (Max.)
- Secure the pritner using the holes “a” and “a’” by the screws.
- Design the fixing hook to the part of b and b’, c and c’.



The shape of the mounting part b’ | The shape of the mounting part c’ | The shape of the mounting part c | The shape of the mounting part b

Unit : mm
General tolerance for dimensions : ±0.3
General tolerance for angle : ±1°

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

Figure 6-3, Figure 6-4 and Figure 6-5 show samples for positioning and securing the printer main body.

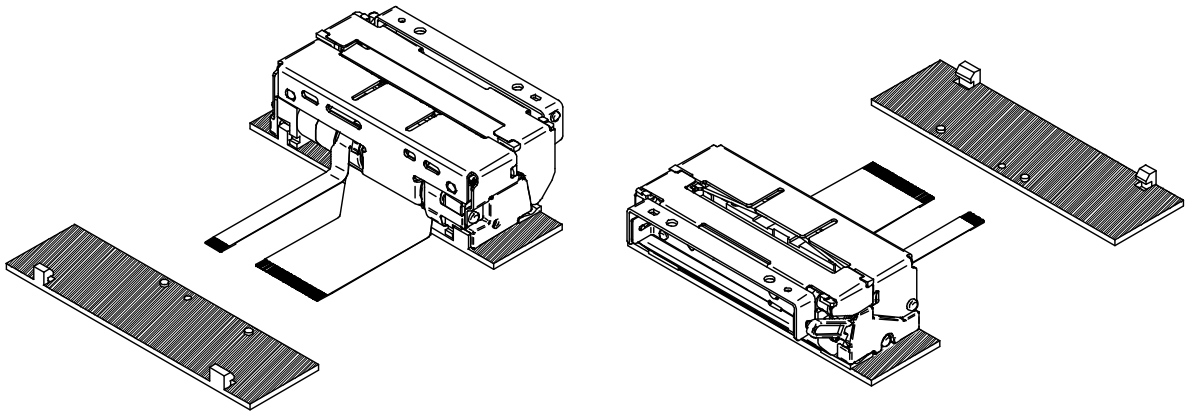


Figure 6-3 Sample for Positioning and Securing the Printer Main Body (1)
(Fixed by the Mounting Part a, a', b and b')

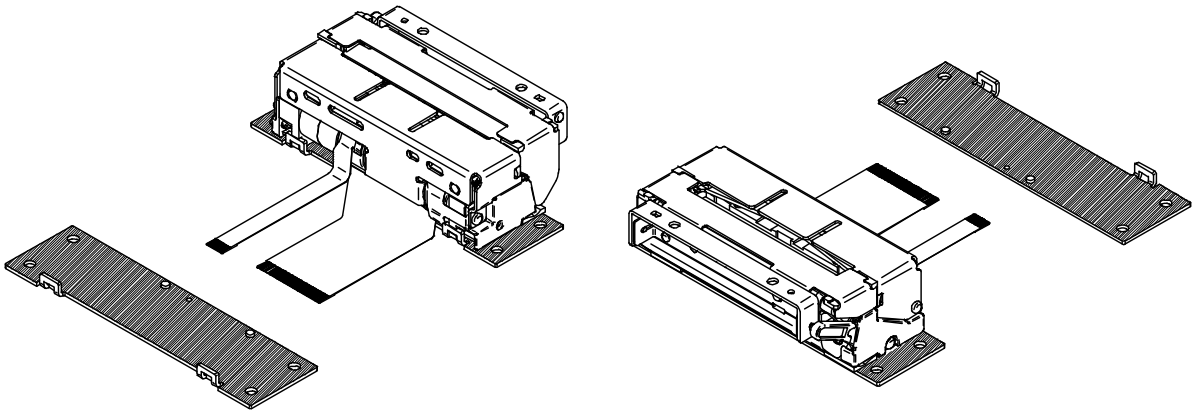


Figure 6-4 Sample for Positioning and Securing the Printer Main Body (2)
(Fixed by the Mounting Part a, a', c and c')

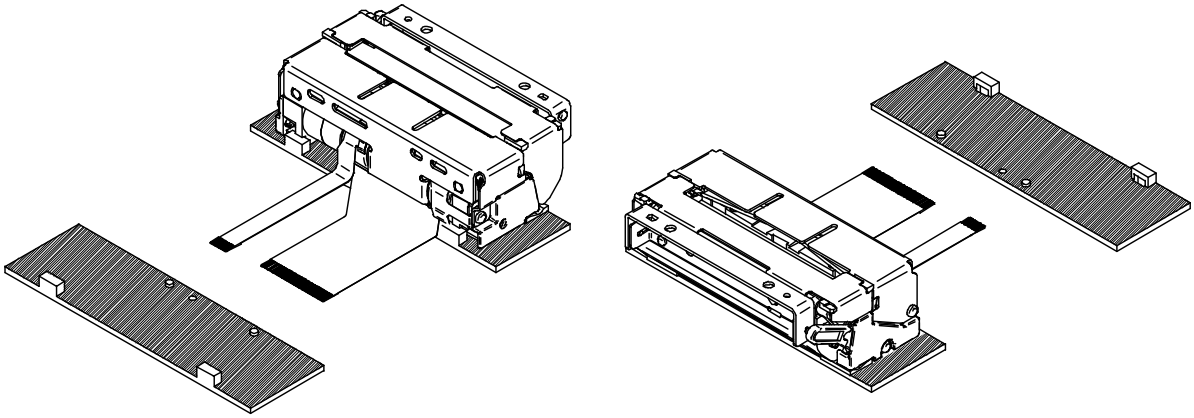


Figure 6-5 Sample for Positioning and Securing the Printer Main Body (3)
(Fixed by the Mounting Part a, a', c and c')

6.2.2 Recommended Screws

The recommended mounting screw is as follows:

(1) JIS B1111: M2.0 cross-recessed pan head machine screw

(2) Tapping screw for resin: 2.0 cross-recessed pan head machine screw

6.2.3 Precautions for Securing the Printer Main Body

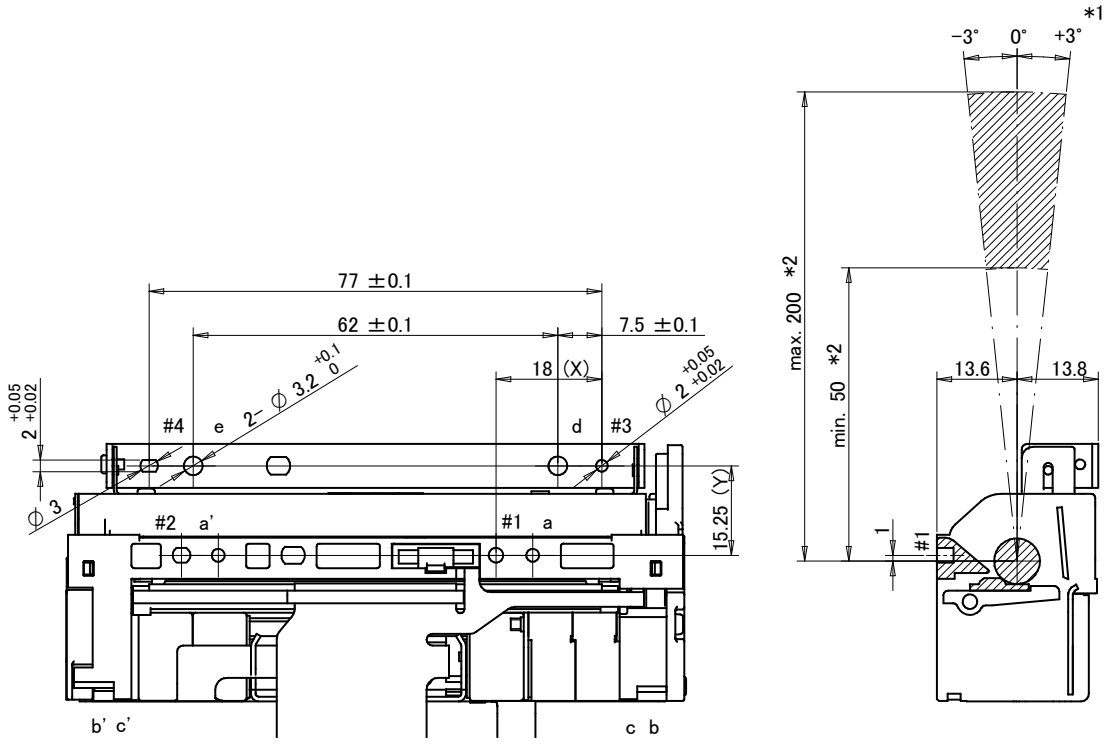
- Prevent from excessive stress, deformation, and torsion for securing the printer, otherwise poor printing quality, paper skew, paper jam, and noise during printing may be caused.
- The printer main body to be mounted on a flat surface and prevent from vibration.
- The strength of the fixing hook, verify with your actual device.
- Pay attention not to damage on the FPC when securing the printer main body.

6.3 SECURING THE PLATEN BLOCK

6.3.1 How to Mount the Platen Block

Figure 6-6 shows an engagement position of the printer main body and the platen block when setting or releasing the platen block mounted on the outer case, and the rotation center area for the platen block rotation system of the door (shaded area).

- The holes #3 and #4 must be used for positioning the platen block. Design the bosses for the positioning holes #3 and #4 on the outer case.
- Secure the platen block using the screw holes d and e.



Unit : mm
General tolerance for dimensions : ±0.3

*1: The area of the possible mounting angle (θ_Z) is different according to the mounting position and distance. Refer to Table 6-2 for the details.
*2: The area of the possible mounting distance (L_Y) is different according to the mounting position and angle. Refer to Table 6-2 for the details.

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

Table 6-1 Allowable Dimensions

Unit: mm

Allowable X dimension	Allowable Y dimension
18 ± 0.1	15.25 ± 0.2

Table 6-2 Rotation Center Area for the Platen Block Rotation System of the Door

Mounting position	Angle	Distance (mm)					
		$200 \geq L_Y \geq 175$	$175 > L_Y \geq 150$	$150 > L_Y \geq 125$	$125 > L_Y \geq 100$	$100 > L_Y \geq 75$	$75 > L_Y \geq 50$
$-45° \leq \theta \leq 0°$	$-3° \leq \theta_Z < 0°$	✓	✓	✓	✓	✓	✓
	$0°$	✓	✓	✓	✓	✓	✓
	$0° < \theta_Z \leq 3°$	✓	✓	✓	✓	✓	✓
$0° < \theta \leq 45°$	$-3° \leq \theta_Z < 0°$	✓	✓	✓	✓	✓	✓
	$0°$	✓	✓	✓	✓	✓	✓
	$0° < \theta_Z \leq 3°$	✓	✓	✓	✓	✓	✓
$45° < \theta \leq 90°$	$-3° \leq \theta_Z < 0°$	✓	✓	✓	✓	✓	✓
	$0°$	✓	✓	✓	✓	✓	✓
	$0° < \theta_Z \leq 3°$	✓	✓	✓	✓	-	-
$90° < \theta \leq 135°$	$-3° \leq \theta_Z < 0°$	✓	✓	✓	✓	✓	-
	$0°$	✓	✓	✓	✓	-	-
	$0° < \theta_Z \leq 3°$	-	-	-	-	-	-
$135° < \theta \leq 180°$	$-3° \leq \theta_Z < 0°$	✓	✓	✓	✓	✓	-
	$0°$	✓	✓	✓	✓	-	-
	$0° < \theta_Z \leq 3°$	-	-	-	-	-	-
$180° < \theta \leq 225°$	$-3° \leq \theta_Z < 0°$	✓	✓	✓	✓	✓	-
	$0°$	✓	✓	✓	✓	-	-
	$0° < \theta_Z \leq 3°$	-	-	-	-	-	-

6.3.2 Recommended Screw

The recommended mounting screw is as follows:

(1) JIS B1111 : M3.0 cross-recessed pan head machine screw

(2) Tapping screw for resin : 3.0 cross-recessed pan head machine screw

6.3.3 Recommended Pressure Position for Setting the Platen Block

Figure 6-7 shows the recommended pressure position for setting the platen block. Design the structure so that the rotation system of the door for the platen block presses the recommended pressure position.

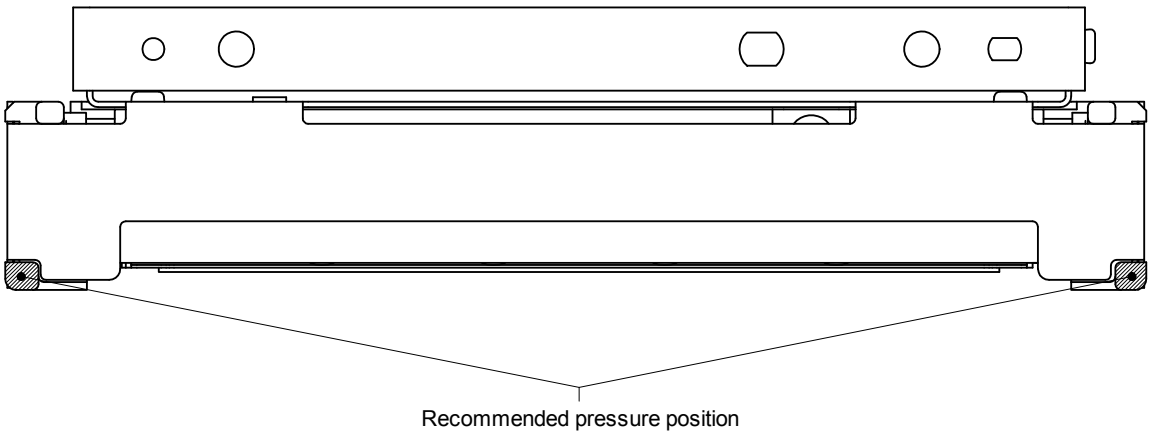


Figure 6-7 Recommended Pressure Position for Setting the Platen Block

6.3.4 Precautions for Securing the Platen Block

- Design the mounting position of the platen block that X and Y dimensions as shown in Figure 6-6 is within the allowable dimensions as shown in Table 6-1.

- Design the positioning hole #3-#4 of the platen block and the positioning hole #1-#2 of the printer main body that the parallelism are 0.2 or less.

- Design the platen block mounting surface to be parallel to the printer main body mounting surface :
  The parallelism of the cross direction is 0.2 or less.
  The parallelism of the width direction is 0 ± 2° or less.

- Design the rotation system of the door so that the center of the rotation is in the shaded area as shown in Figure 6-6. The platen block of the printer that structure is fluctuation of the cross direction, to keep the constant tangency angle between the movable blade and the fixed blade. According to the mounting position, it may interfere when the platen block is setting/releasing. Check the rotation center area of the rotation system of the door by Table 6-2. Verify the performance with your actual device.

- Design the rotation axis for the rotation system of the door, the positioning hole #1-#2 and the mounting surface of the printer main body that the parallelism are 0.2 or less.

- It is recommended that the rotation system of the door is guided by part of the outer case when the platen block is set into the printer main body. When the rotation fulcrum of the rotation system of the door is configured to the mounting component of the printer main body, could design with high accuracy.

- Prevent from excessive stress, deformation, and torsion for securing the platen block. It may cause of the print defect, the paper skew, the paper jam, the noise, the cut failure and the damage of the cutter blade.

- Design the rotation system of 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 for the rotation system 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.

- When the printer main body and the rotation system of the door are not placed in proper position, the print defect, the paper skew, the paper jam, the noise, the cut failure and the damage of the cutter blade may occur.

- Design the structure so that the rotation system of the door for the platen block presses the recommended pressure position when setting the platen block as shown in Figure 6-7. When pushing improper position, it may generate abnormal pressure and result in damage of the printer. Verify the performance with your actual device.

- Design the outer case for the rotation system of the door that holds the platen block must be set by pushing the center of the platen block. When only one end of the platen block is set, the print defect, the paper jam, the cut failure and the damage of the cutter blade may 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.

- When 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. When 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.

6.4 CONNECT TO THE FRAME GROUND (FG)

To prevent the thermal head from being damaged and the effect of the noise by static electricity, it is recommended that the printer main body and the platen block are connected to frame ground (FG) of the outer case. Verify the performance with your actual device.

6.4.1 How to Connect to the 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.

- Connect the platen block to the mounting hole d or e at the Frame Ground (FG) of the outer case with the metal screw (screw with nickel coating and star washer).

- When the platen block is set properly to the printer main body of CAPD347M, the FG conduction plate makes their electric potential to become equal. Note that the electrical connection between the printer main body and the platen block is cut off while the platen block is in release state. Recommend that connect the platen block to the Frame Ground (FG) of the outer case to prevent the thermal head from being deteriorated and the effect of the noise by static electricity when the platen block has set again. Verify the performance with your actual device.

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

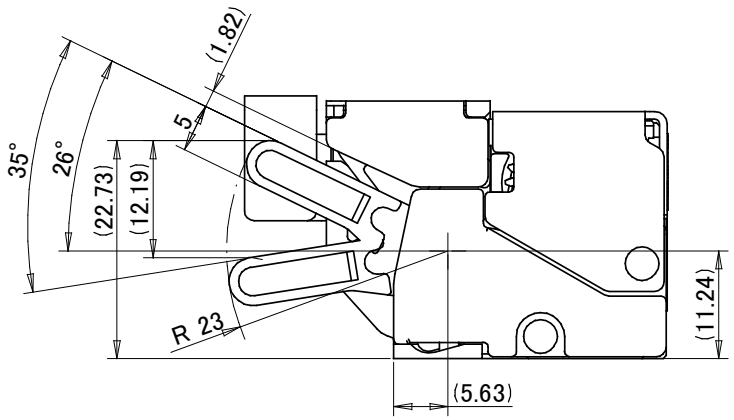
- Connect the Signal Ground (GND) to the Frame Ground (FG) through approximately 1 MΩ resistance.

6.5 DESIGN THE PLATEN RELEASE LEVER

Figure 6-8 shows working area of the platen release lever and Figure 6-9 shows external dimensions of the platen release lever.

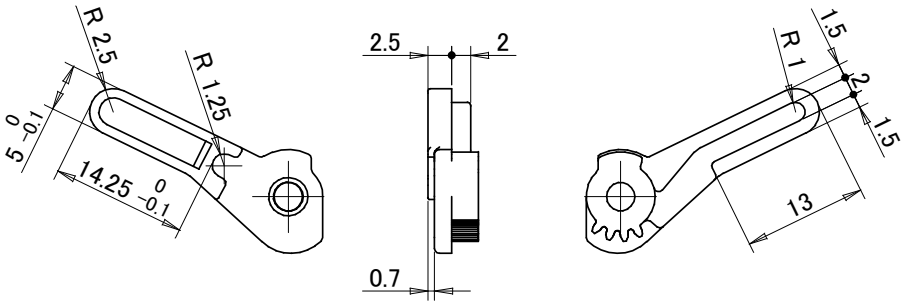
When designing the button or the lever that will operate simultaneously with the platen release lever, follow the precautions below.

- Design the button or the lever and its motion so that the platen release lever is pushed to an angle of 35 degrees of the released position. Set the stopper to prevent the damage of the lever when exceeding 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 for dimensions : ±0.5

Figure 6-8 Working Area of the Platen Release Lever



Unit : mm
General tolerance for dimensions : ±0.1

Figure 6-9 External Dimensions of the Platen Release Lever

Figure 6-10 shows design example of the external lever for the platen release lever.

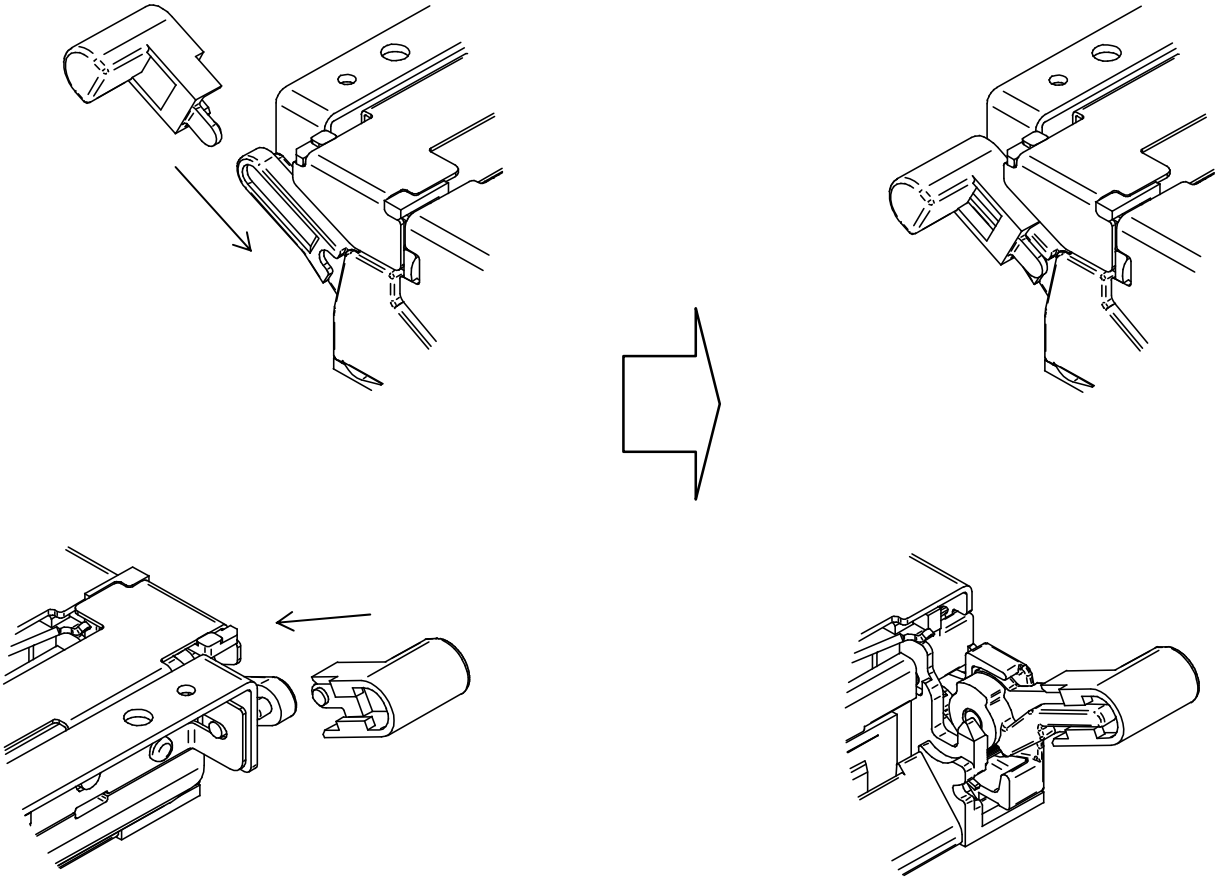
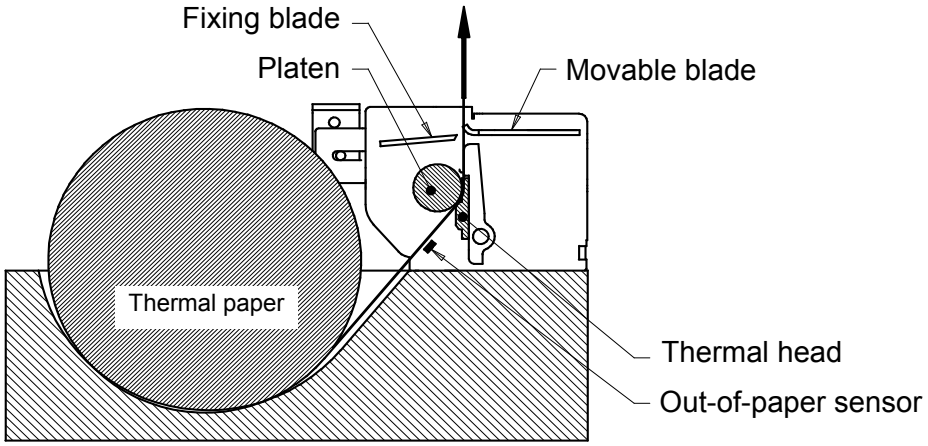


Figure 6-10 Design Example of the External Lever

6.6 LAYOUT OF THE PRINTER MECHANISM AND THE THERMAL PAPER

The printer can be laid out as follows.



*: The thermal paper feeding distance between the out-of-paper sensor and the heat element is approximately 10 mm.
*: The thermal paper feeding distance between the heat element and the autocutter cut position is approximately 9 mm.

Figure 6-11 Recommended Layout between the Printer Mechanism and the Thermal Paper

Figure 6-12 shows the out-of-paper sensor dimension.

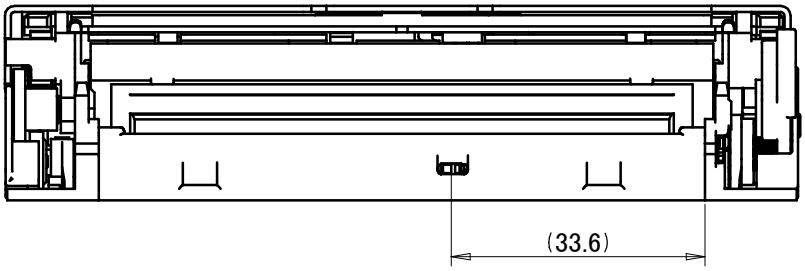


Figure 6-12 Out-of-paper Sensor Dimension

6.7 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 6-13.

- Keep 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.

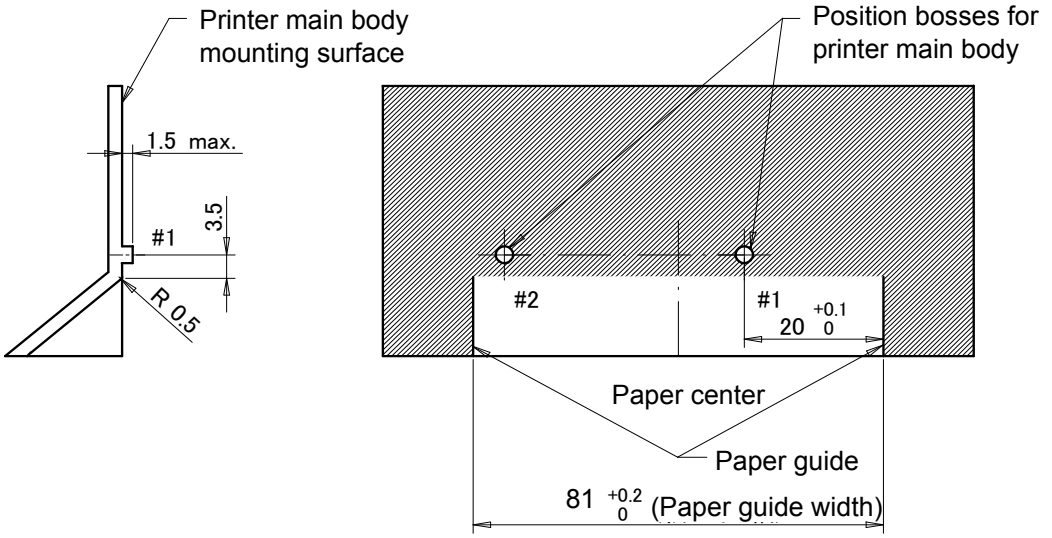
- Design the paper holder so that the paper feed load should be 0.98 N (100 gf) or less. Be aware that the printing problem and paper feed problem may occur in the following case even when it is below 0.98 N. Design the paper holder so as not to make these conditions and verify the performance with your actual device.

  (Example)
  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 feeding the thermal paper backwards, secure enough space in the paper holder so that the thermal paper can return to the paper holder smoothly. Otherwise the backward feed may cause paper skew and jam.
  Do not feed the thermal paper backwards more than 7 mm after cutting end. When the thermal paper is out of the holding status with the thermal head and the platen, the printer cannot feed.



Unit : mm

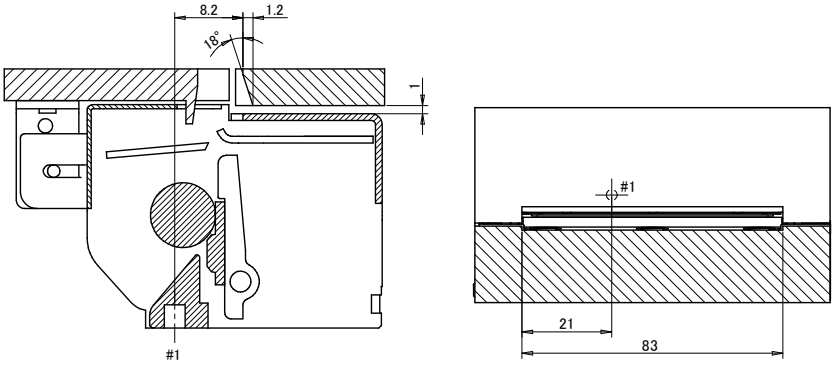
Figure 6-13 Recommended Paper Holder Dimensions

6.8 DESIGN THE PAPER EXIT

6.8.1 Design the Shape of the Paper Exit

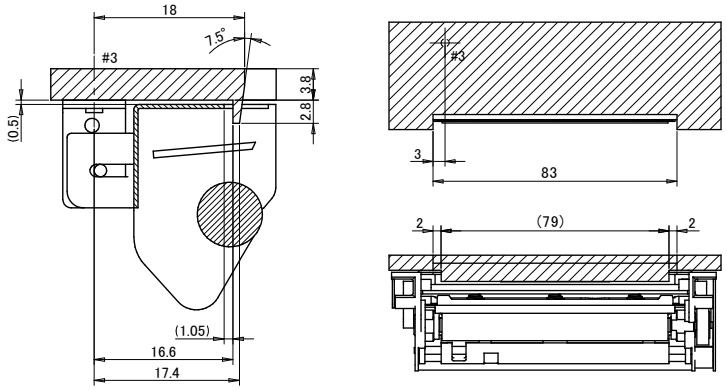
When designing the paper exit, note the followings.

- Design the shape of the paper exit of outer case so that stress is not applied to the thermal paper to be ejected.
- Design the paper exit of outer case as shown in Figure 6-14a and Figure 6-14b. Design the paper exit of outer case so that the thermal paper can be ejected without changing its eject direction. Do not change the paper eject direction around the paper exit of printer mechanism.
  When changing the paper eject direction, verify the performance with your actual device.
- Design the upper surface of the printer main body, to keep the specified space shown in the Figure 6-14a. Otherwise the cut failure may occur.
- Design the paper exit with the dimensions shown in the Figure 6-14b, to prevent the outer case of the platen block side (paper exit) from touching the movable blade during cutting.
- Design the paper exit to prevent from inserting a finger.
- Design the through paper side, there are not projection, scratch and burr. It may occur the paper jam and scratch on the thermal paper.



Unit : mm
General tolerance for dimensions : ±0.1
General tolerance for angle : ±1°

Figure 6-14a Recommended Sample of the Paper Exit (Printer main body side)



Unit : mm
General tolerance for dimensions : ±0.1
General tolerance for angle : ±1°

Figure 6-14b Recommended Sample of the Paper Exit (Platen block side)

CHAPTER 7
EXTERNAL DIMENSIONS

7.1 EXTERNAL DIMENSIONS

Figure 7-1 shows external dimensions of CAPD347H and Figure 7-2 shows external dimensions of CAPD347M.

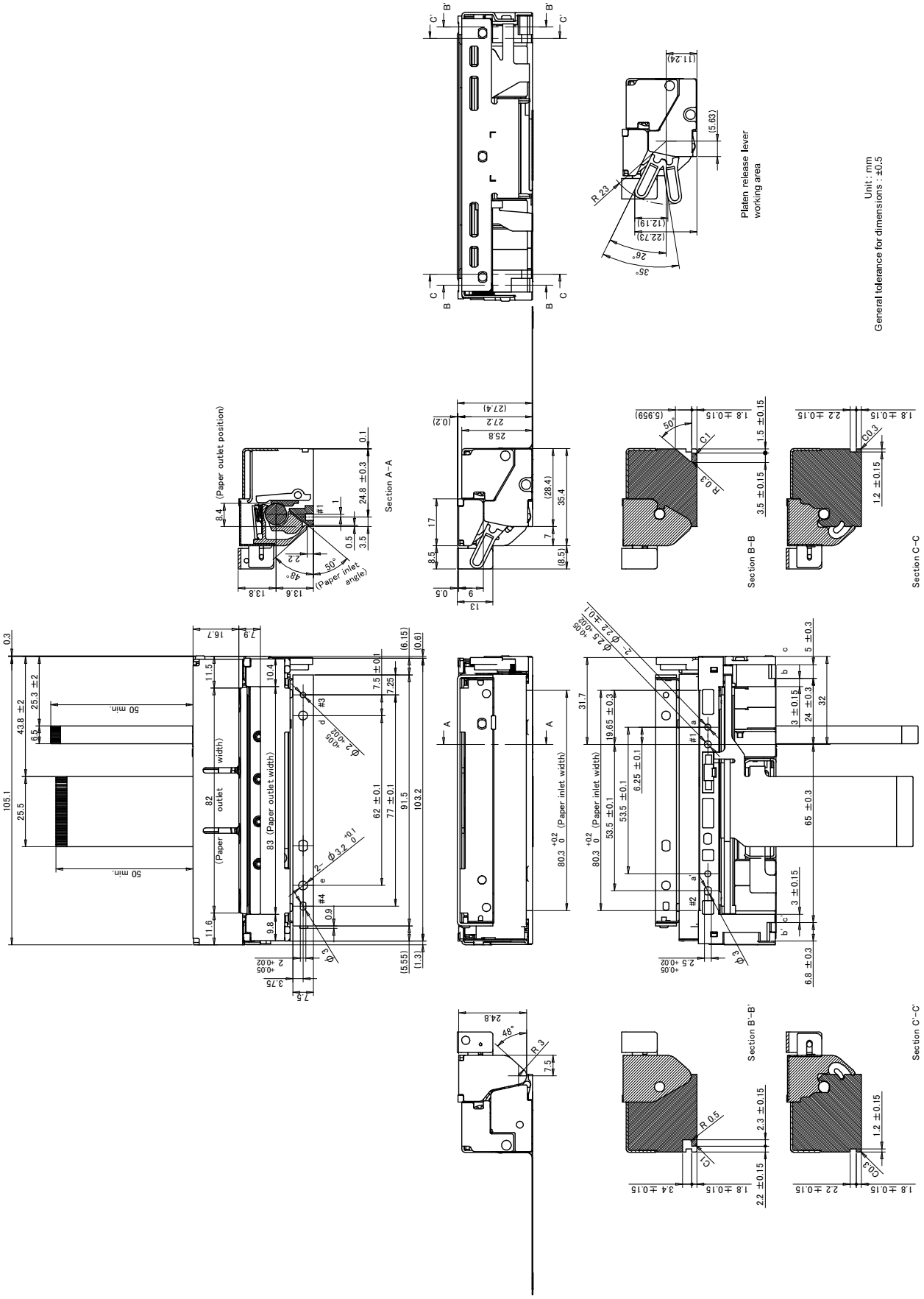


Figure 7-1 External Dimensions (CAPD347H)

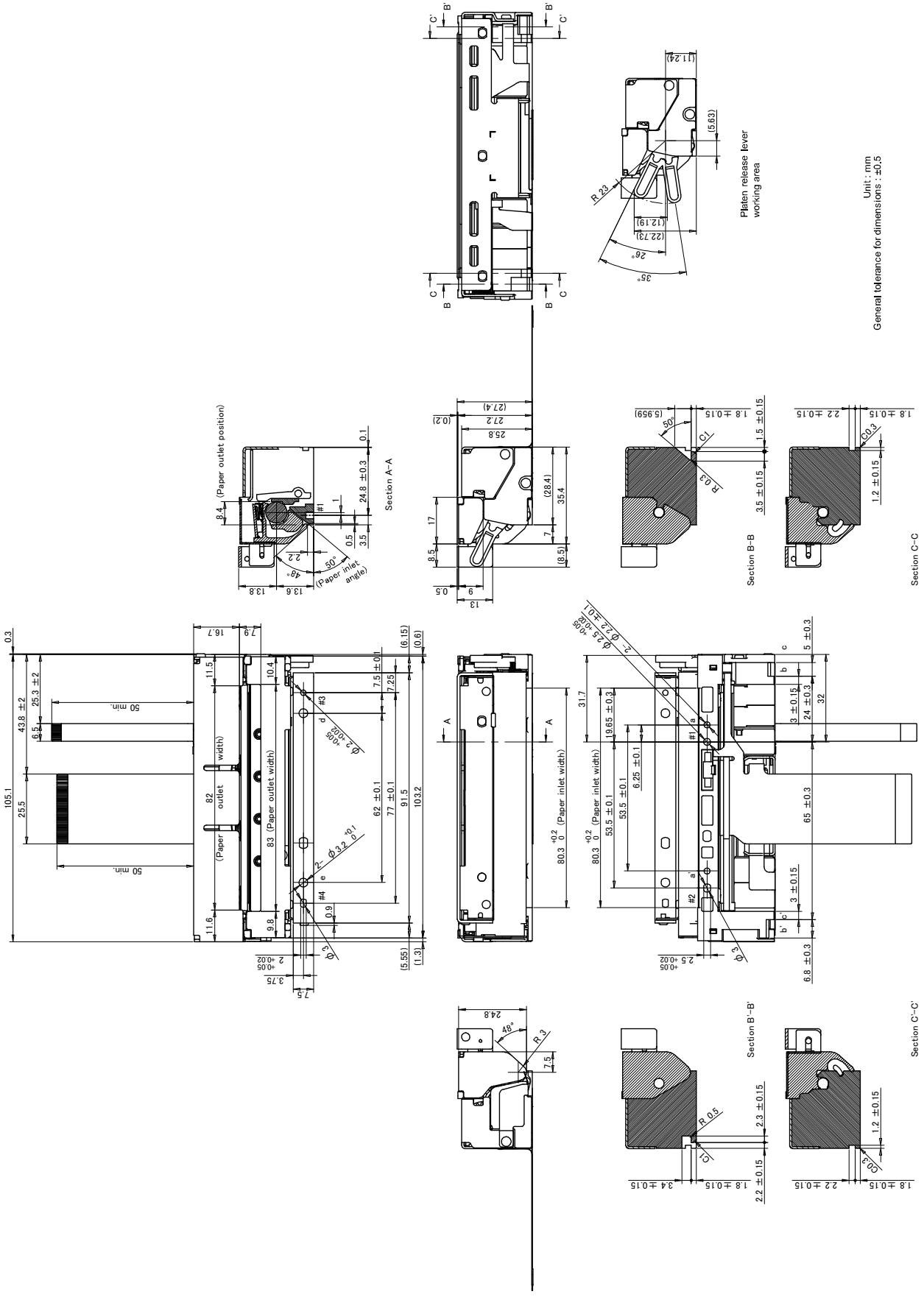
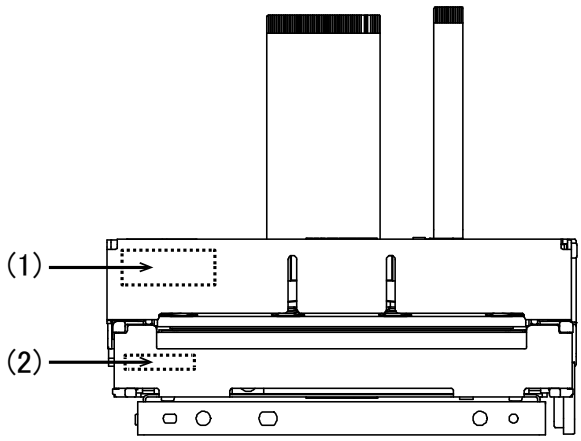


Figure 7-2 External Dimensions (CAPD347M)

7.2 MODEL INDICATION

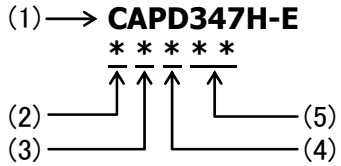
7.2.1 Indication Position



(1) Indication position (Printer main body side)

(2) Indication position (Platen block side)

7.2.2 Indication



(1) Model code (printer main body side only)

(2) Internal code

(3) Manufacturing year code (last 1 digit)

Code	A	B	C	D	E	F	G	H	J	K
Year	1	2	3	4	5	6	7	8	9	0

(4) Manufacturing month code

Code	1	2	3	4	5	6	7	8	9	X	Y	Z
Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.

(5) Manufacturing date code

<e.g.> August 18, 2017 → *GH18

CHAPTER 8
HANDLING METHOD

8.1 INSTALLING/UNINSTALLING THE THERMAL PAPER

8.1.1 Procedures for Installing the Thermal Paper

(1) Procedure for Installing the Thermal Paper by the Easy Operation (Setting and Releasing the Platen Block)

- Push the platen release lever in the direction of the arrow in the Figure 8-1a.
- 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 set the thermal paper until its edge is ejected for 5 cm and more from the top surface of the printer mechanism as shown in the Figure 8-1b.
- Set the platen block in the Figure 8-1c after making sure that the thermal paper is set straight. (Close state)

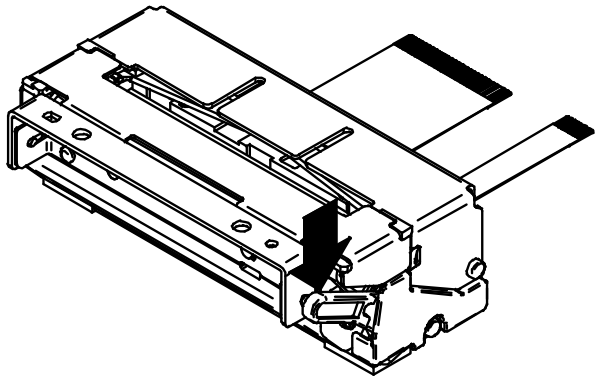


Figure 8-1a Installing the Thermal Paper by the Easy Operation

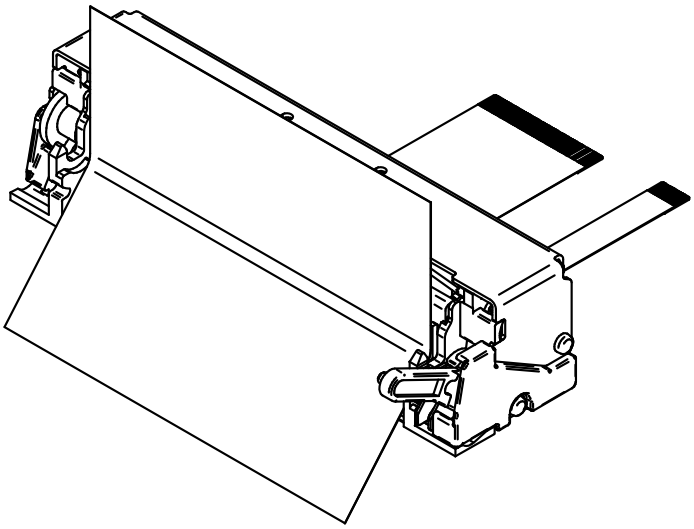


Figure 8-1b Installing the Thermal Paper by the Easy Operation

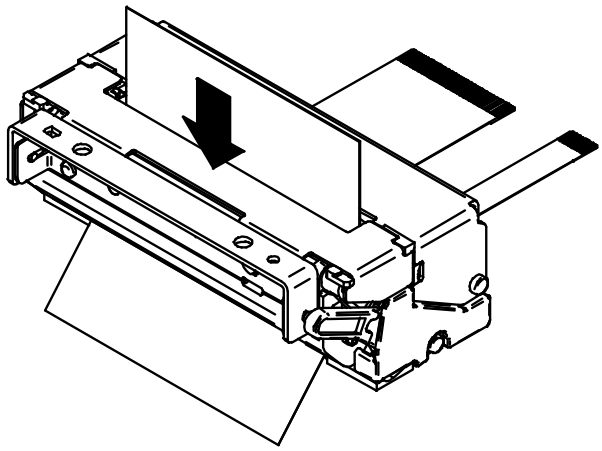


Figure 8-1c Installing the Thermal Paper by the Easy Operation

(2) Procedure for Installing the Thermal Paper by the Auto-loading (the Platen Block in the Close State)

- Set the platen block in the close state.
- Well-cut the thermal paper edge with scissors and cutter knife. Cutting the thermal paper edge perpendicular to paper feed direction, shown in Figure 8-2.
- Load the thermal paper from the paper inlet to run into the edge, shown in Figure 8-3.
- Feed the thermal paper while inserting the thermal paper. Refer to Chapter 5 “Auto-loading Method for the Thermal Paper” for control method.

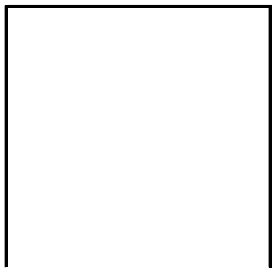


Figure 8-2 Shape of the Thermal Paper Edge

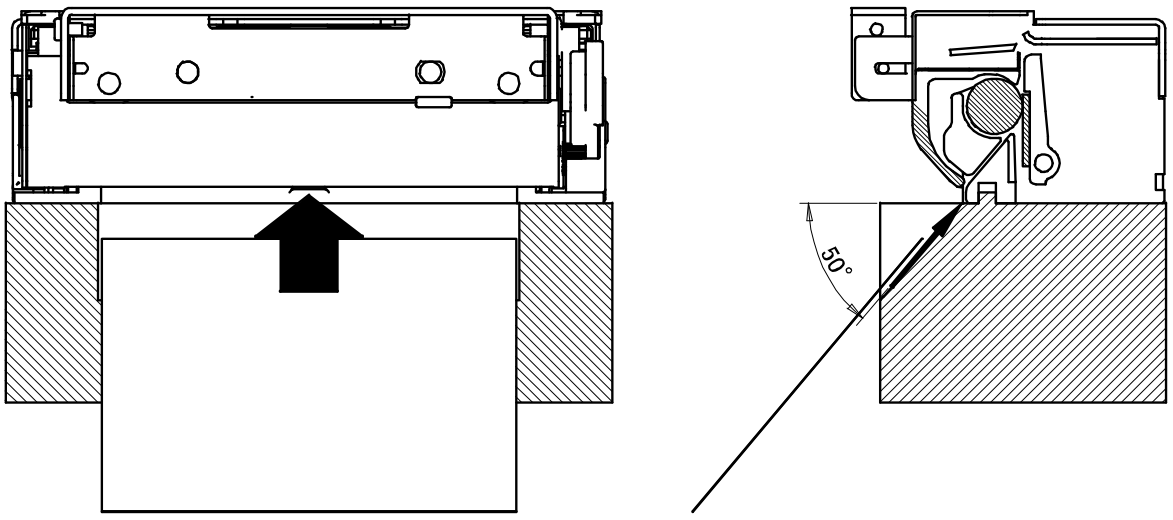


Figure 8-3 Installing the Thermal Paper by the Auto-loading

8.1.2 Procedures for Uninstalling the Thermal Paper

(1) Procedures for Uninstalling the Thermal Paper by Paper Feed

It is possible uninstalling the thermal paper without releasing the platen block.

- Cut the thermal paper near the paper inlet.
- Feed paper until all thermal paper is discharged.

(2) Procedures for Uninstalling the Thermal Paper by Releasing the Platen Block

- Push the platen release lever in the direction of the arrow in the Figure 8-1a.
- Pull up the platen block after making sure that the platen block is released from the printer main body.
- Remove the thermal paper.

8.1.3 Procedures for Removing the Paper Jam

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

(2) Pull up the platen block after making sure that the platen block is released from the printer main body.

(3) Remove the thermal paper.

8.1.4 Procedures for Releasing when the Movable Blade is Stopped

When the movable blade is stopped during cutting performance, release the movable blade the following procedures and back to the home position.

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

(2) When the movable blade cannot release at once, repeat the motion of the above to return the movable blade its home position.

Operating the platen release lever while the movable blade is in the freeze state may cause the locking problem in the platen block. In that case, set the platen block to the printer main body and then operate the platen release lever again.
To return the movable blade the home position faster, operate the platen release lever while pressing down the platen block (or the outer case etc.), to keep the platen block its position.

However, even when in the above operation, stopped movable blade may be released because of the platen position detection performed by Section 5.2.2 "Flow Chart for Autocutter Drive (3) Detecting the platen position sensor".

(3) Release the platen block in the same way as “Procedures for Removing the Paper Jam” to remove the cause of stopping the movable blade.

(4) After releasing stopped movable blade, push/pull up the platen release lever once before the platen block is set. Even when releasing the platen block, the movable blade may not return to the home position, which might not be able to set the platen block properly.

8.1.5 Precautions for Installing/Uninstalling the Thermal Paper

- 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.
- When the thermal head is remained in contact with the platen without the thermal paper for a long time, the platen and the thermal head may be stuck together and cause the auto-loading difficulty. When facing this problem, release the platen block and set it back again before starting printing.
- When the thermal paper is skewed, feed the thermal paper until the thermal paper becomes straight, or release the platen block and install the thermal paper again.
- Release the platen block to remove jamming paper. Do not pull the thermal paper by force because severe damages may occur.
- The thermal paper is not elastic at high temperature or high humidity environment. It may cause the thermal paper insertability by the auto-loading is decreased and the paper jam. Verify the performance at the usage environment.
- The thermal paper with a small winding diameter and strong curl may cause the thermal paper insertability by the auto-loading is decreased and the paper jam.

8.2 CLEANING THE THERMAL HEAD

When 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

(1) Turn the power off.

(2) Push the platen release lever to the direction of the arrow in the Figure 8-1a.

(3) Pull up the platen block after making sure that the platen block is released from the printer main body.

(4) Clean the heat element shown in Figure 8-4 using a cotton swab dipped in ethyl alcohol or isopropyl alcohol.

(5) Set the platen block after the alcohol has dried completely.

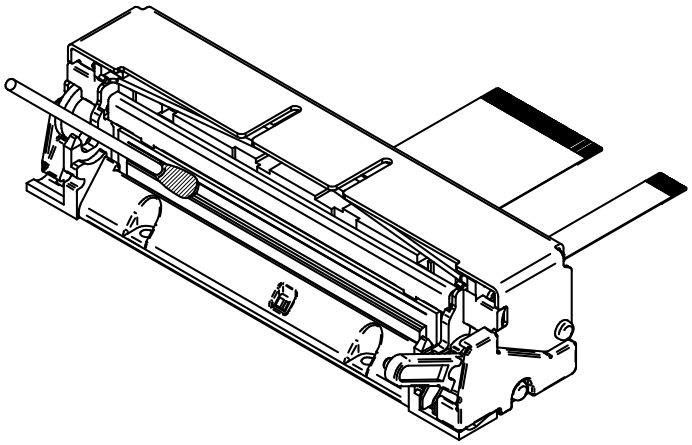


Figure 8-4 Cleaning Position of the Thermal Head

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 or anything which may damage the heat element for cleaning.

6.9 PRECAUTIONS FOR DESIGNING THE OUTER CASE

- In this printer, the platen block is removable from a printer main body so that the thermal paper can be set easily. Therefore, when the platen block is in open state, the fixed cutter blade becomes exposed. To prevent users from injuring himself/herself by touching the cutter blades while the autocutter is in operation and replacing the thermal paper, design a structure such as a shutter in the outer case or place warning labels to warn users to ensure safe operation.

- The thermal paper with a small winding diameter may cause the paper jam in the printer main body and a gap between the printer and the outer case. When 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 users to handle the platen release lever easily with fingers.
  See Chapter 8 “PROCEDURES for INSTALLING/UNINSTALLING THERMAL PAPER” for specific procedures. Also, see Section 6.5 “DESIGN THE PLATEN RELEASE LEVER” for its motion.

- Design the outer case will not apply any load from outside to the printer main body and the platen block except the operation part. The load may cause the print defect, the paper jam, the cut failure and the damage of the printer. Secure 1 mm (Min.) space between the printer main body and platen block and the outer case.

- Paper powders can be caused while the autocutter is working. Be sure to design an outer case not to have the paper powders piled up on the control board and the power supply as this may cause short circuit failure. Paper powders came out from the bottom of printer main body, the window on the back of printer main body or the window on the back of platen block. Powdered place is depending on its mounted position. Verify the performance with your actual device.

- 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.