CAP9000 SERIES / LTP9000 SERIES
LINE THERMAL PRINTER UNIT
TECHNICAL REFERENCE

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PREFACE

This technical reference describes the specifications and basic operating procedures for the CAP9000 series (with an auto cutter) and LTP9000 series (without an auto cutter) line thermal printer unit (hereinafter referred to as “printer”).

The CAP9000 series / LTP9000 series have the following types of printers.

- CAP9247E-S448-E
- CAP9247F-C448-E
- CAP9247G-S448-E
- CAP9347E-S640-E
- CAP9347F-C640-E
- CAP9347G-S640-E
- LTP9247A-S448-E
- LTP9247B-C448-E
- LTP9347A-S640-E
- LTP9347B-C640-E

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

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

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

CAP9000 series / LTP9000 series complies with EU RoHS Directive(2011/65/EU).

CAP9000 series / LTP9000 series contains “Pb”, the details are described below.

CAP9000 series

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

LTP9000 series

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

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

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CHAPTER 1
PRECAUTIONS

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

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

SII shall not be liable for any 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 technical reference 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 technical reference 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 technical reference. Fully investigate the intellectual property rights of these circuits before using.

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

Follow the precautions listed below when designing a product for using safely. 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 for using safely. 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**

  Cut the thermal paper while the paper feed is in stop state. 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**

  To prevent the users from injuring himself/herself by touching the cutter blades while the autocutter is in operation and replacing the thermal paper, 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 unit into the outer case.

- **Precautions for cutting operation**

  The printer unit has a reset mechanism that returns the movable blade to its home position manually in case the autocutter stops due to a paper jam or some external causes while cutting the thermal paper. The reset mechanism works with the cutting motion so warn users not to touch the fixed blade directly while cutting the thermal paper.

- **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, causing smoke and fire.
  Follow the method described in Section 3 “Detecting abnormal temperatures by hardware” to monitor the temperature of the thermal head to prevent overheating.
  Turn the printer off immediately if any abnormal conditions occur.

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

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

- **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 unit**

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

- **Precautions for motor drive**

  The hair may get caught in the exposed platen. 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 initial level of performance of the printer and to prevent future problems from occurring, observe the following precautions.

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 32 V.

- As a noise countermeasure, connect the capacitor noted below between the Vdd and GND terminals near the thermal head control connector.
  Capacitor: 33μF/16 V (aluminum electrolytic)
  0.1μF/16V (ceramic)

- Make the wire resistance between the thermal head connector of the printer unit and the VP as well as GND terminals on the thermal head controller as small as possible (below 15mΩ and 30cm). Keep distance from signal lines to reduce electrical interference.

- The signal lines are influenced if there is large current flow wiring nearby. Therefore, in design of the board pattern and cable rooting, keep the thermal head control signal lines away from the large current flow like power supply.

- To reduce electrical interference, keep the thermal head control signal lines away from parts and wiring that generate a strong noise.

- 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 (74HC class) for the CLK , , DI, and signals of the thermal head.

- When turning the power on or off or during not printing, always DISABLE the terminals.

- To prevent the thermal head from being damaged by static electricity :
  1) Connect the printer unit to the Frame Ground (FG) See Chapter 6 “OUTER CASE DESIGN GUIDE” of the technical reference for details.
  2) Connect the GND terminal (GND) to FG through approximately 1 MΩ resistance.

- Always detect the outputs of the platen position detector and the out-of-paper sensor. Never activate the thermal head when the platen block is in open state and when there is no thermal paper. Incorrect activation of the thermal head may reduce the life of the thermal head and the platen or may damage them.

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

- If too much energy is applied to the thermal head, it may overheat and become damaged. Always use the printer unit with the specified amount of energy shown in “3.6 CONTROLLING THE HEAD ACTIVATION PULSE WIDTH” in Chapter 3. Do not input a pulse noise over than 2V and 20 ns to each signal terminal of the 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.
- 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, before starting printing, at a time after setting/releasing the platen block, at a time after feeding the thermal paper backward, a time after cutting with the autocutter, and a time after cutting with a paper cutter.
- The allowance of the backward feed depends on a kind of thermal paper and a minimum diameter. If the thermal paper is out of the holding status with the thermal head and the platen, the printer cannot feed. Verify the performance with your actual device.
- 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 perform the backward feed after cutting. It may cause a paper jam.
- Insert thermal paper using the auto loading system. It is unavailable to load thermal paper from the platen block even it is in the open state.
- If printing at a high print ratio for longer length, non-printing area may be colored due to an accumulation of heat. Verify the performance with your actual device.
- Do not run the autocutter without thermal paper; otherwise, the life of the autocutter may become shorten.
- When closing the platen block, always push the area where the green labels are attached. If not, only one end of the platen block may be locked, then an error message may appear, and eventually the printer unit may become damaged. Pay careful attention.

- Design the outer case to ensure enough space around the operating portion such as the platen release lever and the reset spindle of the autocutter. Otherwise the printer will be inoperable.
- The printer unit has a reset mechanism that allows the movable blade to return to its home position manually. Design the outer case to be handled in case the autocutter stops due to the paper jam or any other external cause while cutting the thermal paper. Refer to “Release procedures when the movable blade is locked” in Chapter 8.
- When closing the autocutter, always push the area where the green labels are placed. If not, the autocutter may become damaged. Pay careful attention.
- Design the product so that a tension force is not applied to the connecting terminal The connecting terminal could be moved by setting/releasing the platen block, so design the product so that the connecting terminal has enough play after connected it. The tension force may cause some print problems and may damage the connecting terminal.
- Design the outer case outlet shape so as not to cause a paper jam due to static electricity, humidity, and curl of thermal paper.

- SII does not guarantee the quality of print and cut as well as life if using thermal papers other than that specified. The following thermal papers are not applicable:

  (1) Label paper
  (2) 2-ply paper
  (3) Thermal paper that thickness is over 155μm (for straight path)
  (4) Thermal paper that thickness is over 70μm (for curl path)

- Design the product so that the connector does not receive tension. The tension may cause print defects and damage the thermal head. The connector moves when opening and closing the platen block, so keep slack in lead wires considering this matter.

- 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 thermal 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. If 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. If facing this problem, release the platen block and set it back again before starting printing.

- Never loosen the screws that fasten respective parts of the printer. Loosened screws may reduce the efficiency of the printer mechanism and 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 the autocutter, and soil the thermal paper itself. Prevent the thermal head from a drop of water. It causes electrolytic corrosion of the thermal head. If condensed, do not activate electricity until dried.
- Limit the maximum print speed when driving the motor in low temperature, because the paper feed load is increased in such an environment. See Chapter 5 “DRIVE METHOD” for control methods.
- Never connect or disconnect cables with the power on. Always power off the printer first.
- Do not apply stress to the connecting terminals while connecting and disconnecting them. Otherwise the connecting terminals wires may become damaged.
- Warn users not to pull the thermal paper and not to change paper eject angle during printing and cutting. Otherwise, the print defect, the paper jam, and/or the cut failure may occur.
- Do not print without the thermal paper; otherwise, the platen block or the thermal head may become damaged.
- In order to prevent the thermal head from damage and to avoid the print defect, warn the users not to touch the thermal head and the sensor directly when handling the printer like replacing thermal paper.
- Do not use the paper roll with glued end or folded end. In case of using such thermal papers, replace to a new one before the end of the paper roll is shown up.
- Prevent contact with water and do not operate with wet hands as it may damage the printer or cause a short circuit or fire.
- Never use the printer in a dusty place, as it may damage the thermal head and paper feeder.
- Do not use the printer in corrosive gas and siloxane atmosphere as it may cause contact failure.

1.2.3 Precautions on Discarding

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

CHAPTER 2
FEATURES

The CAP9000 series / LTP9000 series is a printer adopting a thermal line dot printing method and is used in ticket machines, KIOSK, and ATM as a compact and high speed printer. The CAP9000 series printer unit mounts a sliding auto cutter that has a fixed cutter blade and a movable cutter blade in one unit to improve safety.

The CAP 9000 series / LTP9000 series has the following features:

- **Ultra compact size**

  The mechanism has developed an ultra compact printer that measures 30mm in height with an auto cutter mounted on it.

- **High speed printing *1**

  250 mm/s for a maximum print speed is attainable.

- **High resolution printing**

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

- **Long life *2**

  The mechanism has developed a long life of 150 km of paper carrying length or 150 million pulses with 1 million cuts.

- **Low noise**

  Thermal line dot printing is used to guarantee low-noise printing.

- **Head cleaning**

  The removable platen block and the openable cutter unit allow easy cleaning.

- **Anti-static electricity function**

  All metal parts of the printer can be easily connected to Frame Ground (FG). The secondary discharge can be reduced.

∗1 Print speed differs depending on working conditions and environmental conditions.
∗2 This is based on the life span definition in the general specifications.
Paper cutting function is available only for the CAP9000 series.

CHAPTER 3
SPECIFICATIONS

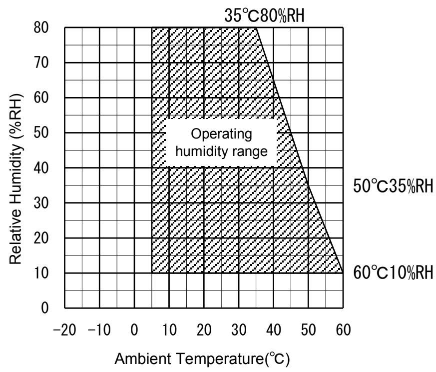
3.1 GENERAL SPECIFICATIONS

Table 3-1 General Specifications

Item	Specifications					
	CAP9247E LTP9247A	CAP9247F LTP9247B	CAP9247G	CAP9347E LTP9347A	CAP9347F LTP9347B	CAP9347G
Printing method	Thermal dot line printing					
Dots per line	448 dots			640 dots		
Printable dots per line	448 dots			640 dots		
Simultaneously activatable dots per line	448 dots			640 dots		
Resolution	W 8 dots/mm x H 8 dots/mm					
Maximum print speed *1	250 mm/s *1					
Paper width (Print width)	60^{0}_{-1} mm (56 mm) 58^{0}_{-1} mm (54 mm)			82.55^{0}_{-1} mm (80 mm) 80^{0}_{-1} mm (76 mm) *2		
Paper feed pitch	0.0625 mm					
Head temperature detection	Via a thermistor					
Platen position detection	Via a mechanical switch					
Out-of-paper detection	Via a photo interrupter					
Operating voltage range V_P line V_{dd} line	 24 V ±10% 5 V ±5%					
Current consumption used in : Head drive (V_P) — Number of simultaneously activated dots : 640	-			max. 29.4 A Rated 26.7 A		
Current consumption used in : Head drive (V_P) — Number of simultaneously activated dots : 448	max. 20.6 A Rated 18.7 A					
Current consumption used in : Head drive (V_P) — Number of simultaneously activated dots : 256	max. 11.8 A Rated 10.7 A					
Current consumption used in : Head drive (V_P) — Number of simultaneously activated dots :128	max 5.9 A Rated 5.4 A					

Table 3-1 General Specifications (Continued)

Item	Specifications					
	CAP9247E LTP9247A	CAP9247F LTP9247B	CAP9247G	CAP9347E LTP9347A	CAP9347F LTP9347B	CAP9347G
Current consumption used n: Motor drive (V_P) Head logic (V_{dd})	1.0 A max. 240 mA max.					
Auto cutter current consumption Motor drive (V_P)	1.2 A max.					
Paper cut method *3	Slide method					
Paper cut type *3	Full cut / Partial cut		Full cut	Full cut / Partial cut		Full cut
Minimum cut amount *3	10 mm					
Cutting time *4	2 s/cycle max.					
Cutting frequency *4	1 cut/2 s max.					
Operating temperature range (Non condensing)	-20°C to 60°C					
Operating humidity range	10 %RH to 80 %RH					



Storage temperature range (Non condensing)	-30°C to 70°C					
Storage humidity range	10 %RH to 90 %RH					
Life span (at 25°C and rated energy) Activation pulse resistance Abrasion resistance Paper cutting resistance	150 million pulses *5 *6 150 km *6 1 million cuts *7					
Paper feed force	0.98 N (100 gf) or more					
Paper hold force	0.98 N (100 gf) or more					
Dimensions (mm) (excluding lever and convex part) Mass	CAP9247			CAP9347		
	W 89.5 mm × H 30 mm × D 50 mm Approx.240 g			W 112 mm × H 30 mm × D 50 mm Approx.290 g		
	LTP9247			LTP9347		
	W 88.8 mm × H 29.7 mm × D 50 mm Approx.150 g			W 111.25 mm × H 29.7 mm × D 50 mm Approx.180 g		
Specified thermal paper	Oji paper PD450	Oji paper PD450	Oji paper PD450	Oji paper PD450	Oji paper PD450	Oji paper PD450
	Nippon paper TF11KS-ET TC11KS-LH TL69KS-LH TC98KS-LH		Nippon paper TF11KS-ET TC11KS-LH TL69KS-LH TC98KS-LH	Nippon paper TF11KS-ET TC11KS-LH TL69KS-LH TC98KS-LH		Nippon paper TF11KS-ET TC11KS-LH TL69KS-LH TC98KS-LH

*1 Print speed changes according to the processing speed of the controller and print pulse width.
*2 If the paper width is 82.55mm and the print width is over 78mm, refer to Chapter 6 "OUTER CASE DESIGN GUIDE". Verify performance with your actual device in advance.
*3 It shows the maximum simultaneous activated dots number of thermal head.
*4 Excluding the LTP9000 series.
*5 Excluded when the same dots are printed continuously.
*6 Excluding damages caused by dust and foreign materials.
*7 Paper cutting environment : Room temperature and humidity, the shape of the paper exit described in Chapter 6 of the technical reference.

3.2 HEATING ELEMENT DIMENSIONS

3.2.1 Heating Element Dimensions for the CAP9000 series / LTP9000 series

The CAP9000 series / LTP9000 series contains a thermal head with the following heating elements (dot-size).

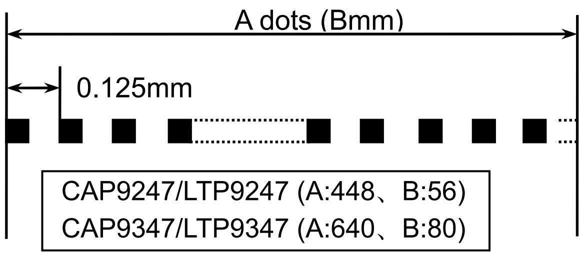


Figure 3-1 Heating Element Dimensions

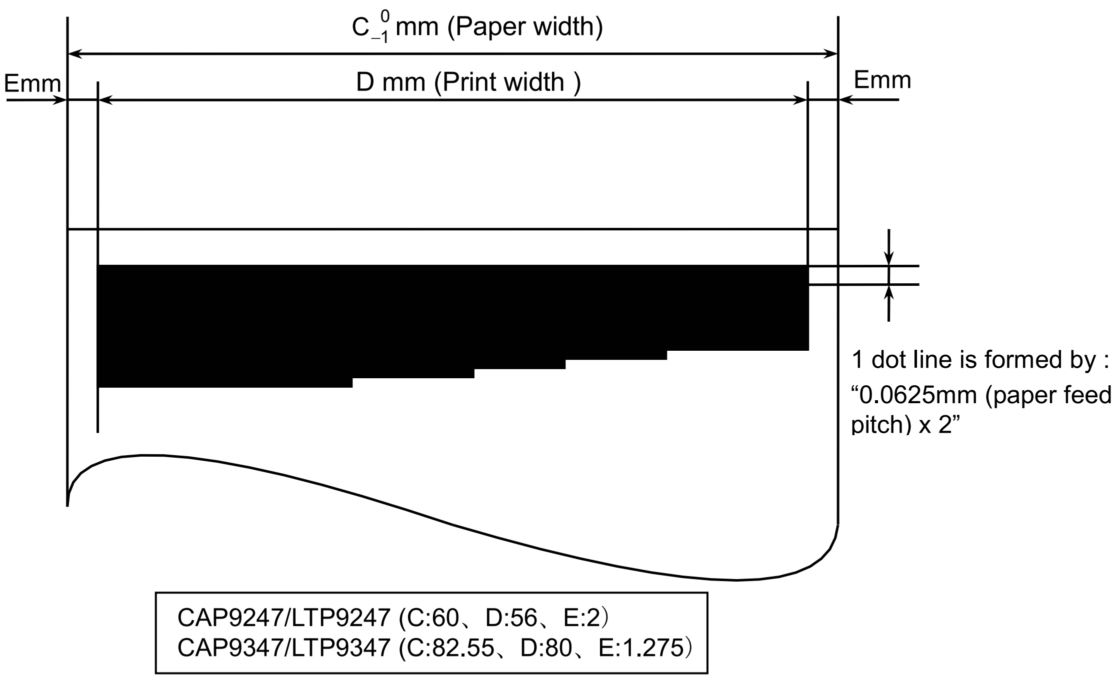


Figure 3-2 Print Area

3.3 PAPER FEED CHARACTERISTICS

- Use a bipolar constant current (chopper) drive method for the paper feed motor drive system.
- If something is used other than the drive circuit shown in “3.4.1 Paper Feed Motor Drive Circuit” it may be impossible to obtain regular performance.
- Drive the motor at 2-2 phase excitation. It feeds thermal paper 0.125 mm which is equivalent to 1 dot pitch for every two steps of the motor drive signal.
- 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, before starting printing, at a time after setting/releasing the platen block, at a time after feeding the thermal paper backward, a time after cutting with the autocutter and a time after cutting with a paper cutter.
- Limit the maximum print speed when driving the motor in low temperature, because the paper feed load is increased in such an environment. (For details, see CHAPTER 5 DRIVE METHOD).
- During printing, the paper feed motor drive frequency should be adjusted according to working conditions such as voltage, temperature, number of activated dots, etc. (For details, see CHAPTER 5 DRIVE METHOD).
- Drive the paper feed motor so that the activated pulse width of the head does not exceed the motor step time by changing the paper feed drive frequency during printing operations. (For details, see CHAPTER 5 DRIVE METHOD).
- Noise and vibration may increase depending on the paper feed motor drive frequency. Check these factors on actual printer.

3.4 PAPER FEED STEP MOTOR CHARACTERISTICS

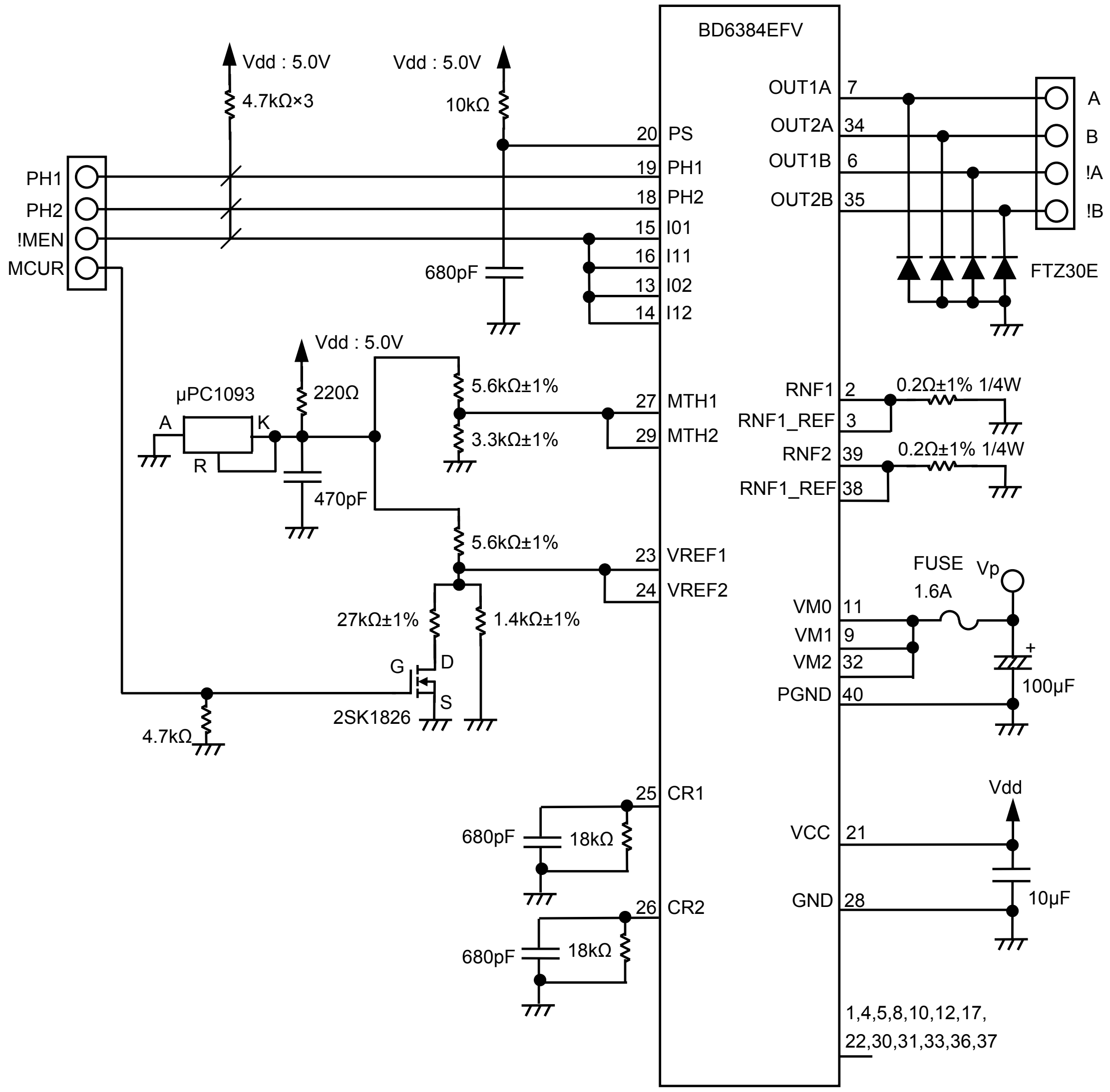
Table 3-2 General Motor Specifications

Item	Specification
Type	PM
Drive method	Bipolar chopper
Excitation	2-2 phase
Winding resistance per phase	4.9 Ω/phase ±7%
Rated voltage	V_P: 24 V ±10%
Set current	500 mA/phase

3.4.1 Sample Paper Feed Motor Drive Circuit

(1) Sample Paper Feed Motor Drive Circuit

Sample drive circuit for the paper feed motor is shown in Figure 3-3.

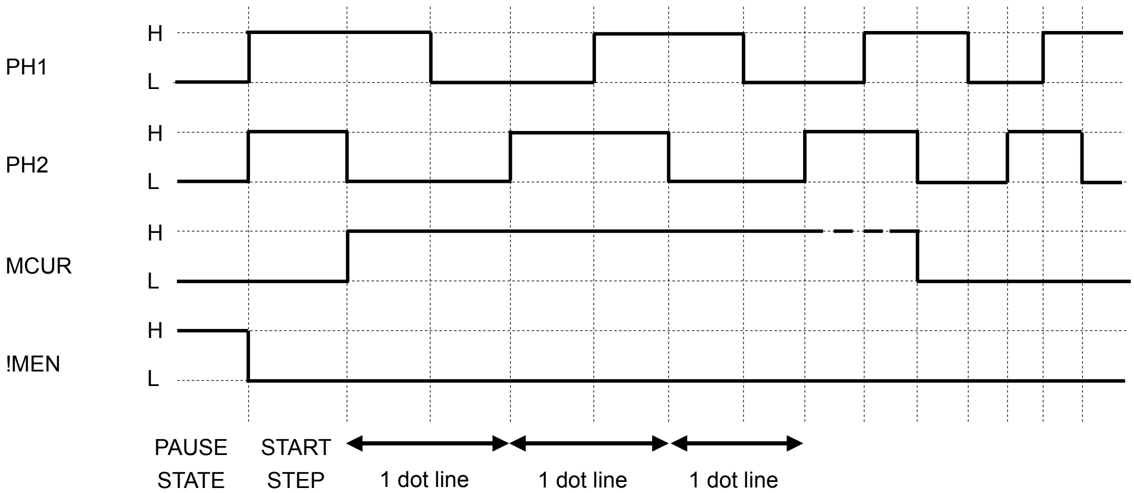


* Motor driver : BD6384EFV (ROHM)

Figure 3-3 Sample Paper Feed Motor Drive Circuit

(2) Paper Feed Motor Excitation Sequence

Drive the motor with 2-2 phase excitation. One step of the motor drive signal feeds the thermal paper 0.0625mm. One 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 3-3, 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 and then thermal paper is fed forward.



*: The motor current is controlled in 500mA when MCUR is "Low" and in 480mA when MCUR is "High".
Control the MCUR according to the procedures written in "3.4.3 Precautions for Driving the Paper Feed Motor".

Figure 3-4 Input Voltage Signals for the Sample Drive Circuit

Table 3-3 Excitation Sequence

	Input Signal			Output Signal			
	PH1	**PH2**	**!MEN**	**A**	$\overline{B}$	$\overline{A}$	**B**
Step 1	H	H	L	H	H	L	L
Step 2	H	L	L	H	L	L	H
Step 3	L	L	L	L	L	H	H
Step 4	L	H	L	L	H	H	L

3.4.2 Paper Feed Motor Start and Stop Timing

Refer to the timing chart in Figure 3-5 when designing the control circuit and/or software for starting and stopping the paper feed motor. Also take note of the following precautions:

<u>Precautions for Designing the Motor Control Circuit and Software</u>

(1) Stop step

- To stop the paper feed motor, excite for 33 ms with a phase that is the same as the final one in the printing step.

(2) Pause state

- In the pause state, do not excite the paper feed motor to prevent the motor from overheating. Even when the paper feed motor is not excited, it maintains a holding force to prevent thermal paper from sliding.

(3) Start step

- To restart the motor from the stop step, immediately shift the motor into the printing sequence.
- To restart the motor from the pause (no excitation) state, shift the motor into the printing sequence after outputting a single step of a phase that is the same as that of the stop step for the 1st step period of the acceleration step.

The motor start/stop timing is shown in Figure 3-5.

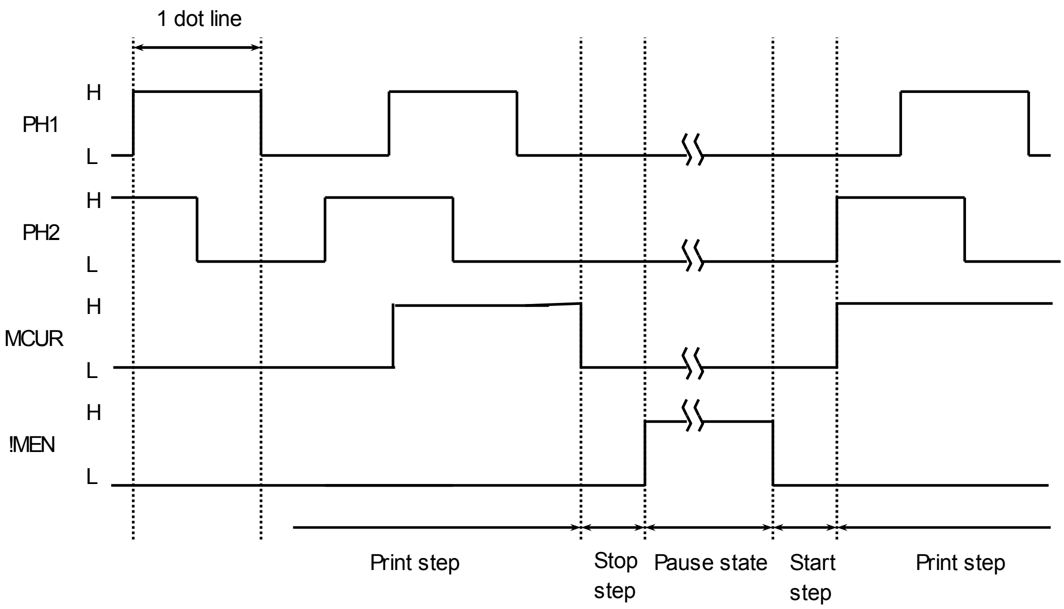


Figure 3-5 Paper Feed Motor Start/Stop Timing

(4) Other

- Do not print thermal paper in intermittent feed mode. Doing so may deteriorate the printing quality due to irregular paper feeding pitch.
- To print characters and bit images, always follow the start step and stop step.
- When the motor step is stopped in the dot lines where head activation was performed, the thermal head may stick to the surface of the thermal paper. This defect may cause paper feed problems. Therefore, stop the motor drive in the dot lines where head activation is not performed.

3.4.3 Precautions for Driving the Paper Feed Motor

[Current Control]

In the following conditions, if the motor is driven in low speed, motor drive noise becomes bigger or improper feed pitch may occur due to motor vibration.

- In low temperature environment.
- When printing is divided into multi-division method.

Reducing the current applied to the motor is able to control these defects.

In order to change the current values applied to the motor, switch MCUR signal shown in Figure 3-3. (Set to 500mA when MCUR is "Low" and 480mA when MCUR is "High".)

Regarding the motor steps, if the motor step time Tm (ms) is more than 1.0ms, change the motor current value to approximately 480mA.

If the motor step time is 1.0ms or below, do not change the motor current value. Keep it at 500mA.

When the motor step time is more than 1.0 ms and the previous step is 1.0ms or below, this is exceptional. Do not change the motor current value. Keep it at 500mA.

Set the motor current value at approximately 500mA for the start and the stop steps and do not change the motor current value.

[Acceleration / Deceleration Control]

When driving the paper feed motor, acceleration control is needed to start paper feeding.

Drive the paper feed motor to the maximum driving speed, according to the acceleration steps in Table 3-4. If a variation of speed occurs due to delay of completion of the print condition or some factors of driving condition, adjust the acceleration control referring to the acceleration table.

The method for accelerating the motor is as follows:

1. Output the start step time.
2. Output the first step for the first acceleration step time.
3. Output the second step for the second acceleration step time.
4. Output the nth step for the nth step acceleration time
5. After accelerating up to the maximum motor driving speed P_M, drive the motor in constant speed.

The method for reducing the motor is as follows:

1. Output the 1st step of the reducing step by the m-d step time of the acceleration step.
2. Output the 2nd step of the reducing step by the m-2d step time of the acceleration step.
3. Output the 3rd step of the reducing step by the m-3d step time of the acceleration step.
4. Keep repeating the procedures above until reached to a targeted speed in sequentially.
5. After reaching a targeted speed, drive the motor in constant speed.

Printing is available during acceleration and reducing.

m : current acceleration step
d : reducing step ; The reducing step should be set within step 1 to 5.

Table 3-4 Acceleration Step

(1/2)

Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)	Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)	Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)
Start	-	3472	43	1635	612	86	2332	429
1	440	2273	44	1655	604	87	2345	426
2	440	2273	45	1674	597	88	2359	424
3	440	2273	46	1693	591	89	2373	421
4	448	2232	47	1712	584	90	2386	419
5	511	1957	48	1731	578	91	2399	417
6	568	1761	49	1749	572	92	2413	414
7	620	1613	50	1767	566	93	2426	412
8	668	1497	51	1785	560	94	2439	410
9	713	1403	52	1803	555	95	2453	408
10	756	1323	53	1821	549	96	2466	406
11	796	1256	54	1838	544	97	2479	403
12	835	1198	55	1856	539	98	2492	401
13	872	1147	56	1873	534	99	2504	399
14	907	1103	57	1890	529	100	2517	397
15	942	1062	58	1907	524	101	2530	395
16	975	1026	59	1924	520	102	2543	393
17	1007	993	60	1940	515	103	2555	391
18	1038	963	61	1957	511	104	2568	389
19	1068	936	62	1973	507	105	2580	388
20	1097	912	63	1989	503	106	2593	386
21	1126	888	64	2006	499	107	2605	384
22	1154	867	65	2021	495	108	2617	382
23	1181	847	66	2037	491	109	2630	380
24	1208	828	67	2053	487	110	2642	379
25	1234	810	68	2069	483	111	2654	377
26	1260	794	69	2084	480	112	2666	375
27	1285	778	70	2099	476	113	2678	373
28	1309	764	71	2115	473	114	2690	372
29	1333	750	72	2130	469	115	2702	370
30	1357	737	73	2145	466	116	2714	368
31	1381	724	74	2160	463	117	2726	367
32	1404	712	75	2175	460	118	2738	365
33	1426	701	76	2189	457	119	2749	364
34	1448	691	77	2204	454	120	2761	362
35	1470	680	78	2218	451	121	2773	361
36	1492	670	79	2233	448	122	2784	359
37	1513	661	80	2247	445	123	2796	358
38	1534	652	81	2262	442	124	2807	356
39	1555	643	82	2276	439	125	2819	355
40	1575	635	83	2290	437	126	2830	353
41	1596	627	84	2304	434	127	2841	352
42	1616	619	85	2318	431	128	2853	351

Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)	Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)	Number of Steps	Drive Pulse Rate (pps)	Step Time (μs)
129	2864	349	172	3312	302	215	3707	270
130	2875	348	173	3322	301	216	3716	269
131	2886	347	174	3332	300	217	3724	269
132	2898	345	175	3341	299	218	3733	268
133	2909	344	176	3351	298	219	3741	267
134	2920	342	177	3361	298	220	3750	267
135	2931	341	178	3370	297	221	3759	266
136	2942	340	179	3380	296	222	3767	265
137	2953	339	180	3389	295	223	3776	265
138	2963	337	181	3399	294	224	3784	264
139	2974	336	182	3408	293	225	3793	264
140	2985	335	183	3418	293	226	3801	263
141	2996	334	184	3427	292	227	3810	262
142	3007	333	185	3436	291	228	3818	262
143	3017	331	186	3446	290	229	3827	261
144	3028	330	187	3455	289	230	3835	261
145	3039	329	188	3464	289	231	3843	260
146	3049	328	189	3474	288	232	3852	260
147	3060	327	190	3483	287	233	3860	259
148	3070	326	191	3492	286	234	3868	259
149	3081	325	192	3501	286	235	3877	258
150	3091	324	193	3511	285	236	3885	257
151	3101	322	194	3520	284	237	3893	257
152	3112	321	195	3529	283	238	3902	256
153	3122	320	196	3538	283	239	3910	256
154	3132	319	197	3547	282	240	3918	255
155	3143	318	198	3556	281	241	3926	255
156	3153	317	199	3565	281	242	3935	254
157	3163	316	200	3574	280	243	3943	254
158	3173	315	201	3583	279	244	3951	253
159	3183	314	202	3592	278	245	3959	253
160	3194	313	203	3601	278	246	3967	252
161	3204	312	204	3610	277	247	3975	252
162	3214	311	205	3619	276	248	3983	251
163	3224	310	206	3628	276	249	3991	251
164	3234	309	207	3637	275	250	4000	250
165	3244	308	208	3646	274			
166	3253	307	209	3654	274			
167	3263	306	210	3663	273			
168	3273	306	211	3672	272			
169	3283	305	212	3681	272			
170	3293	304	213	3689	271			
171	3303	303	214	3698	270			

3.5 THERMAL HEAD

The thermal head consists of heating elements and head drivers which drive and control the heating elements.

Serial print data input from the DI terminal is transferred to the shift register synchronously with the CLK signal, and then stored in the latch register at the timing of the LATCH signal.

Input of the head print activation signal ($\overline{\text{DST}}$1, 2, 3, 4 ・・・) activates the heating elements in accordance with the print data stored in the latch register.

This printer can be printed by dividing printing into blocks for every 128 dots.

Divided printing is effective for a high print ratio printing because the peak current can be lowered with a reduction in the average print speed.

3.5.1 Structure of the Thermal Head

The following shows the structure of CAP 9347 as an example.

Figure 3-6 shows the thermal head block diagram.

Table 3-5 shows the relationship between $\overline{\text{DST}}$ blocks and activated heating elements.

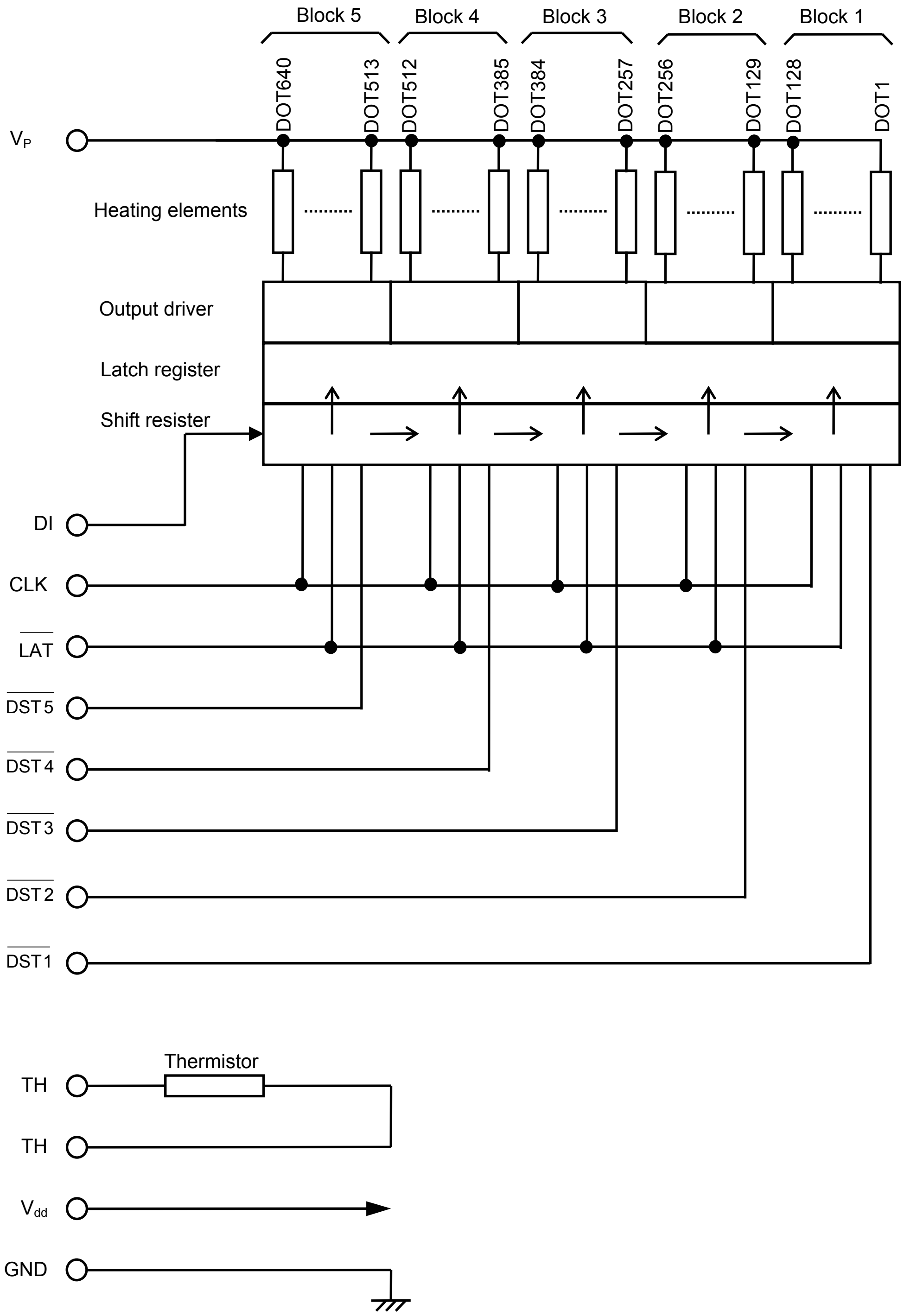


Figure 3-6 Thermal Head Block Diagram (CAP9347)

Table 3-5 $\overline{DST}$ Blocks and Activated Heating Elements

$\overline{DST}$ Number	Heating Element Number	Dots/ $\overline{DST}$	
		CAP9247 LTP9247	CAP9347 LTP9347
$\overline{DST}$ 1	1 to 128	128	128
$\overline{DST}$ 2	129 to 256	128	128
$\overline{DST}$ 3	257 to 384	128	128
$\overline{DST}$ 4	385 to 512	64	128
$\overline{DST}$ 5	513 to 640	-	128

3.5.2 Printed Position of the Data

As an example, the following figure shows position relation between the transferred data and the print position of CAP9347.

640 data dots from No. 1 to No. 640 which are transferred through DI terminal are printed in the position shown in Figure 3-7.

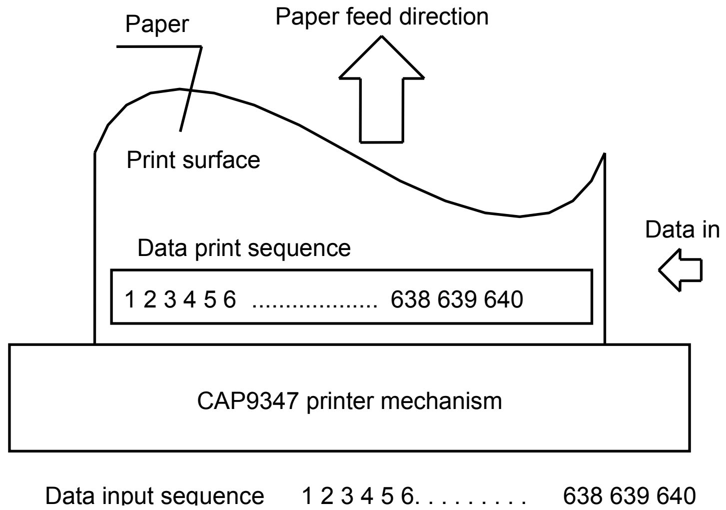


Figure 3-7 Printed Position of the Data (CAP9347)

3.5.3 Thermal Head Electrical Characteristics

Table 3-6 Thermal Head Electrical Characteristics

(Ta=25 ± 10°C)

Item		Symbol	Conditions	Rated Value			Unit
				Min.	Typ.	Max.	
Head resistance		R_H		576.0	600.0	624.0	Ω
Head drive voltage		V_P		21.6	24.0	26.4	V
Head drive current		I_P	At max. simultaneously activated dots number =*1	-	*2	*3	A
Logic block voltage		V_{dd}		4.75	5.00	5.25	V
Logic block current		I_{dd}	V_{dd}=5.0V, f_{CLK}=12MHz	-	-	*4	mA
			When each signals are in waiting state	-	-	*5	mA
Input voltage	"High"	V_{IH}		0.8×V_{dd}	-	V_{dd}	V
	"Low"	V_{IL}		0	-	0.2×V_{dd}	V
DI input current	"High"	I_{IH} DI	V_{IH} = 5V	-	-	1.0	μA
	"Low"	I_{IL} DI	V_{IL} = 0V	-	-	–1.0	μA
$\overline{DST}$ input current (LOW-ACTIVE)	"High"	I_{IH} $\overline{DST}$	V_{dd}=5.0V, V_{IH}=5.0	-	-	1.0	μA
	"Low"	I_{IL} $\overline{DST}$	V_{dd}=5.0V, V_{IL}=0.0	-	-	–40	μA
CLK input current	"High"	I_{IH} CLK	V_{dd}=5.0V, V_{IH}=5.0	-	-	1.0	μA
	"Low"	I_{IL} CLK	V_{dd}=5.0V, V_{IL}=0.0	-	-	–1.0	μA
$\overline{LAT}$ input current	"High"	I_{IH} $\overline{LAT}$	V_{dd}=5.0V, V_{IH}=5.0	-	-	1.0	μA
	"Low"	I_{IL} $\overline{LAT}$	V_{dd}=5.0V, V_{IL}=0.0	-	-	–1.0	μA
CLK frequency		f CLK	DUTY50% (±5%)	-	-	12.0	MHz
DI setup time		t1	See Timing Chart	50	-	-	ns
DI hold time		t2	↑	20	-	-	ns
$\overline{LAT}$ pulse width		t3	↑	100	-	-	ns
$\overline{LAT}$ setup time		t4	↑	150	-	-	ns
$\overline{DST}$ setup time		t5	↑	150	-	-	ns

*1 CAP9247/LTP9247:448.0 / CAP9347/LTP9347:640.0
*2 CAP9247/LTP9247:17.9 / CAP9347/LTP9347:25.6
*3 CAP9247/LTP9247:20.6 / CAP9347/LTP9347:29.4
*4 CAP9247/LTP9247:160.0 / CAP9347/LTP9347:240.0
*5 CAP9247/LTP9247:2.2 / CAP9347/LTP9347:3.2

3.5.4 Timing Chart

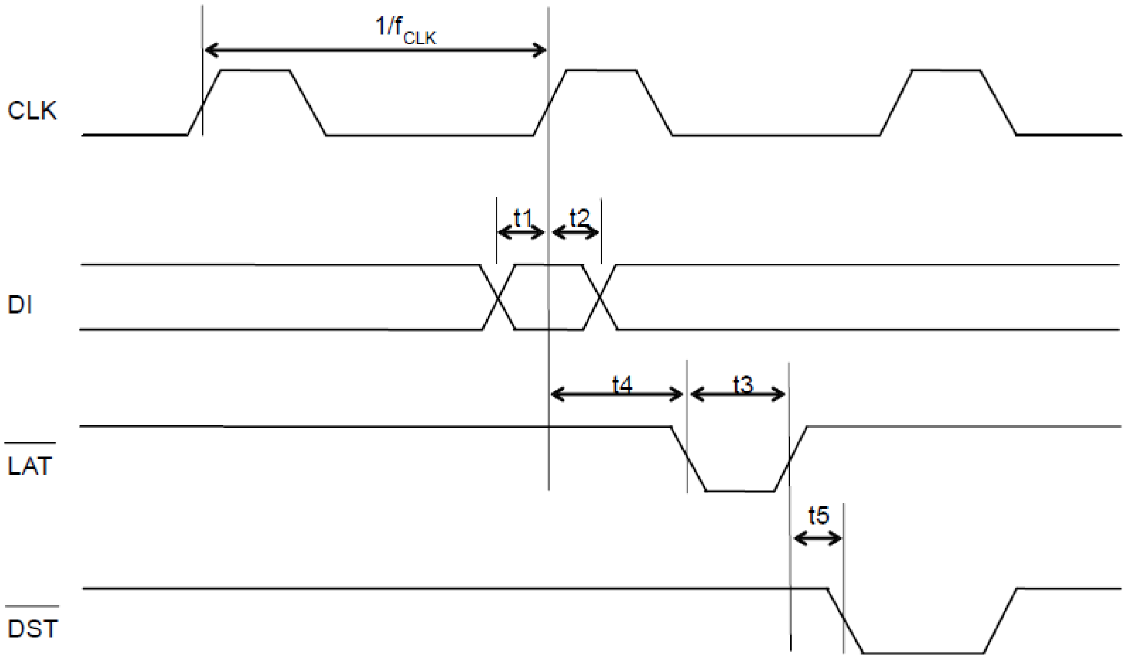


Figure 3-8 Timing Chart

3.5.5 Head Resistance

The head resistance of the printer is as shown in Table 3-7.

Table 3-7 Head Resistance

Head Resistance
576 Ω to 624 Ω

3.5.6 Head Voltage

The printer has built-in head driver ICs. Table 3-8 shows the head voltage.

Table 3-8 Head Voltage

Item		Voltage Range
Head drive voltage	V_P	21.6 V to 26.4 V
Head logic voltage	V_{dd}	4.75 V to 5.25 V

3.5.7 Peak Current

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

Equation (1):

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

I_P : Peak current (A)
N : Number of dots that are driven simultaneously
V_P : Head drive voltage (V)
RH : Head resistance (Ω)

3.6 CONTROLLING THE HEAD ACTIVATION PULSE WIDTH

3.6.1 Calculation of the Head Activation Pulse Width

To execute high quality printing, the value calculated using the following equation (2) must be adjusted according to the environment the printer is used in. Calculate each value according to the steps in Sections 3.6.2 to 3.6.5 and control the head so that the pulse width, with the "t" value obtained by substituting each value into the equation (2), is applied.

Equation (2):

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

t	:	Heat pulse width (ms)	
V	:	Applied voltage (V)	
E	:	Standard applied energy (mJ)	Refer to Section 3.6.2.
R	:	Head resistance (Ω)	Refer to Section 3.6.3.
C	:	Head activation pulse term coefficient	Refer to Section 3.6.4.
D	:	Heat storage coefficient	Refer to Section 3.6.5.

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

3.6.2 Calculation of the Applied Energy

The applied energy should be in accordance with the temperature of the thermal head and the environment the printer is used in.

The thermal head has a built-in thermistor. Measure the temperature using a resistance of the thermistor.

The applied energy also differs according to the thermal paper used. The applied energy is calculated by substituting a temperature coefficient and thermal paper coefficient into the equation (3).

Equation (3):

$$E = E_0 \times \{ 1 - TC (T_X - 25) \}$$

E	:	Print energy (mJ)	
E_0	:	Standard applied energy	
		PD450	0.150 (mJ)
		TF11KS-ET	0.180 (mJ)
		TC11KS-LH, TL69KS-LH, TC98KS-LH	0.220 (mJ)
T_X	:	Detected temperature using the thermistor (°C) *1	
T_C	:	Temperature correction factor	
		PD450	0.0093
		TF11KS-ET	0.0100
		TC11KS-LH, TL69KS-LH, TC98KS-LH	0.0080

∗1 Refer to Section 3.6.9 Thermistor Resistance for a resistance at T_X (°C).

3.6.3 Adjustment of the Head Resistance

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

Equation (4):

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

RH	:	Head resistance RH = 600 (Ω)
Ri	:	Wiring resistance in the thermal head Ri=8.5 (Ω)
R_C	:	Common electric terminal wiring resistance in the thermal head R_C = 0.07 (Ω)
rc	:	Wiring resistance of V_P and GND (Ω) *1
N	:	Number of dots driven at the same time

*1 This resistance value is equal to the resistance of the wire used between the thermal head control terminals and the power supply including the resistance of switching circuit of relay, etc.

3.6.4 Head Activation Pulse Term Coefficient

According to equation (5), calculate the compensation coefficient of the head activation pulse term (equal motor drive frequency) to get the constant printing density even when changing the printing speed such as start-up acceleration control.

Equation (5):

$$C = Ca - \frac{Cb}{C_X + W}$$

Ca;	PD450	: 2.5
	TF11KS-ET	: 2.7
	TC11KS-LH, TL69KS-LH, TC98KS-LH	: 3.0
Cb;	PD450	: 2.25
	TF11KS-ET	: 4.73
	TC11KS-LH, TL69KS-LH, TC98KS-LH	: 4.34
Cx;	PD450	: 1.0
	TF11KS-ET	: 2.28
	TC11KS-LH, TL69KS-LH, TC98KS-LH	: 1.67

W : Head activation cycle of one dot line (ms)
W = 2000/motor drive frequency (pps)

Note) When the head activation cycle is more than W=5.0ms, set "W=5.0ms".
If the temperature is below -5℃, set the W as follows :

PD450	: W=1.05
TF11KS-ET	: W=1.10
TC11KS-LH, TL69KS-LH, TC98KS-LH	: W=5.00

3.6.5 Heat Storage Coefficient

A difference between an actual rise in temperature of the thermal head due to the head activation and the detected temperature by the thermistor occurs in high-speed printing.

Therefore, correction of the activation pulse through simulation of a rise in thermal head temperature is needed.

A correction may not be needed when the print ratio is low. Set “1” as the heat storage coefficient at this time.

The heat storage coefficient is calculated with the manner as follows:

(1) Prepare the heat storage software counters for each block to simulate the heat storage.

(a) Heat storage due to the head activation
The heat storage counter counts up in each print cycle as follows.

$$T' = T + \frac{64 \times N}{B}$$

T : Heat storage counter value
N : Number of the activated dots
B : Total dot number of each physical block

(b) Radiation due to time
The heat storage counter value is multiplied by the radiation coefficient in each 1 ms.

$$T' = T \times K$$

K : Radiation coefficient 0.997

(2) Calculate the heat storage coefficient with the following equation, using the heat storage counter.

Equation (6):

$$D = 1 - \frac{T}{93726}$$

3.6.6 Correction for Total Head Pulse Width

When the motor is driven in low speed continuously in low temperature and with the multi-division method, the total head pulse width for 1 dot line becomes longer and this has resulted in that the motor speed will be reduced. In such a condition, print defects could occur. The total head pulse width for 1 dot line should be corrected to avoid a drop of the motor drive speed.

If the head pulse width becomes longer than the values calculated in the equations below, it should be limited to be the values below.

$$t = \frac{PW}{n}$$

t = Head activation pulse width
PW = total head pulse width
n = Number of the head division
V_P = V_P voltage

PD450
-5℃ or over : $PW=17.5 \times V_P^2 - 969 \times V_P + 14800$
Below -5℃ : $PW=27 \times V_P^2 - 1407 \times V_P + 19500$
Make calculation with V_P =26.0 when V_P >26.0V.

TF11KS-ET
-5℃ or over : $PW=2950-37.5 \times V_P$
Below -5℃ : $PW=26 \times V_P^2 - 1354 \times V_P + 19025$
Make calculation with V_P=26.0 when V_P >26.0V.

TC11KS-LH, TL69KS-LH, TC98KS-LH
Entire temperature range : $PW=1612800/ V_P^2$
Make calculation with V_P =26.0 when V_P >26.0V.

3.6.7 2 Time-Heat Activation Control

When the motor is driven in low speed continuously in low temperature and multi-division method, noise and print disorder may be caused.

If driving the motor with its drive speed at 1600pps (100mm/s) or lower, divide the head pulse width half so as the printing is divided into two per one step.

3.6.8 Preheating Control

When driving the motor below -5°C, preheat the thermal head with one-eighth of the pulse width of standard energy in preliminary feeding steps before printing to prevent sticking.

3.6.9 Thermistor Resistance

The resistance of the thermistor at the operating temperature TX (°C) is determined using the following equation (7).

Equation (7):

$$R_X = R_{25} \times EXP\left\{ B \times \left(\frac{1}{273.15 + T_X} - \frac{1}{298.15} \right) \right\}$$

R_X	:	Resistance at operating temperature T_X (°C)
R_{25}	:	30kΩ ± 5% (25°C)
B	:	3800K ± 2%
T_X	:	Operating temperature (°C)
EXP (A)	:	The Ath power of natural logarithm e (2.71828)

[Rating]
Operating temperature range: -40 °C to 125 °C

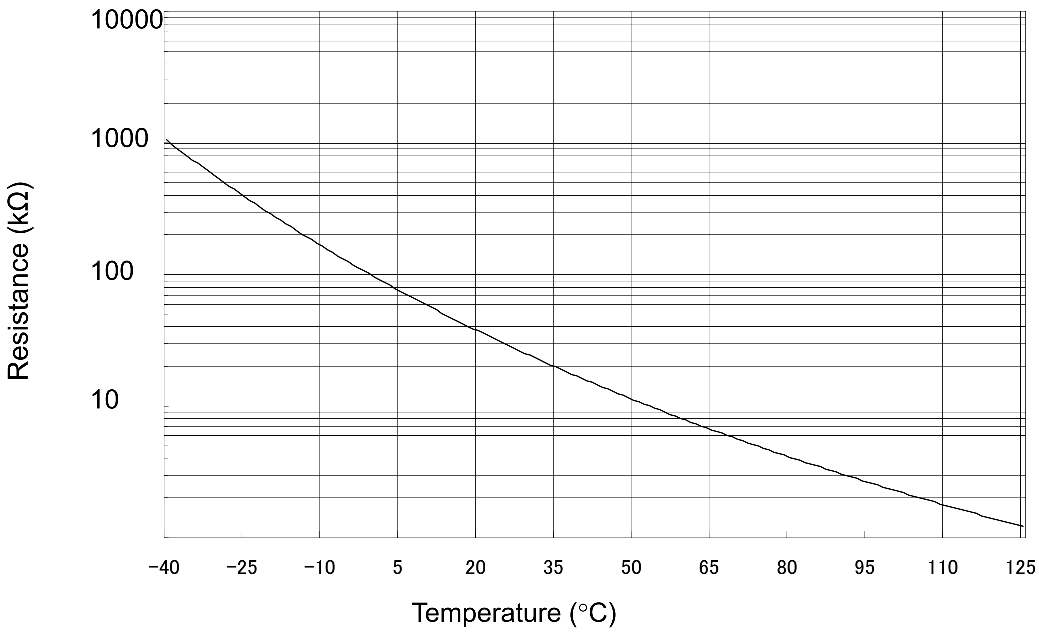


Figure 3-9 Thermistor Resistance vs. Temperature

Table 3-9 Temperature and Corresponding Thermistor Resistance

Temperature (°C)	Thermistor Resistance(kΩ)
-40	1047.8
-35	744.2
-30	536.0
-25	391.2
-20	289.1
-15	216.2
-10	163.4
-5	124.8
0	96.3
5	75.0
10	58.9
15	46.7
20	37.3
25	30.0
30	24.3
35	19.8
40	16.3
45	13.5
50	11.2
55	9.4
60	7.9
65	6.6
70	5.6
75	4.8
80	4.1
85	3.5
90	3.1
95	2.7
100	2.3
105	2.0
110	1.8
115	1.6
120	1.4
125	1.2

3.6.10 Detecting Abnormal Temperatures of the Thermal Head

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

- Detecting abnormal temperatures by software

  Design software that will deactivate the heat elements if the thermal head thermistor (TH) detects a temperature of 80°C or more (thermistor resistance $R_{TH} \leq 4.1$ kΩ), and keep deactivating until the temperature goes to 70°C or lower ($R_{TH} \geq 5.6$ kΩ). If the thermal head continues to be activated at a higher temperature than 80°C, the life of the thermal head may be shortened significantly.

- Detecting abnormal temperatures by hardware

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

  Always use hardware in conjunction with software for detecting abnormal temperature to ensure safety. (If the control unit malfunctions, it may be impossible to prevent damage to the thermal head even if detection of abnormal temperature is detected by hardware.)

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

(a) Overheating of the thermal head (approximately 100°C or higher ($R_{TH} \leq 2.3$ kΩ))

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

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

3.7 PAPER CUTTING CHARACTERISTICS

This printer has two types of different cuttings, full cut and partial cut (incomplete cut in the middle of the thermal paper). These are available by selecting the motor rotation direction clockwise or counterclockwise

Figure 3-10 shows states of the full cut and the partial cut.

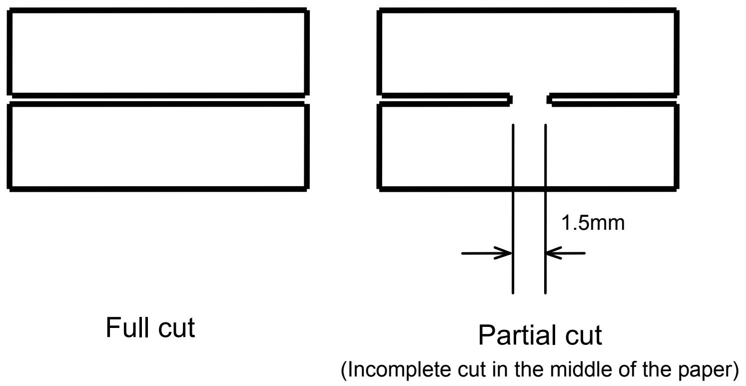


Figure 3-10 Paper Cutting State

Do not drive the cutter motor while the paper feed motor is operating to prevent a trouble. Also, do not drive the paper feed motor while the cutter motor is operating.

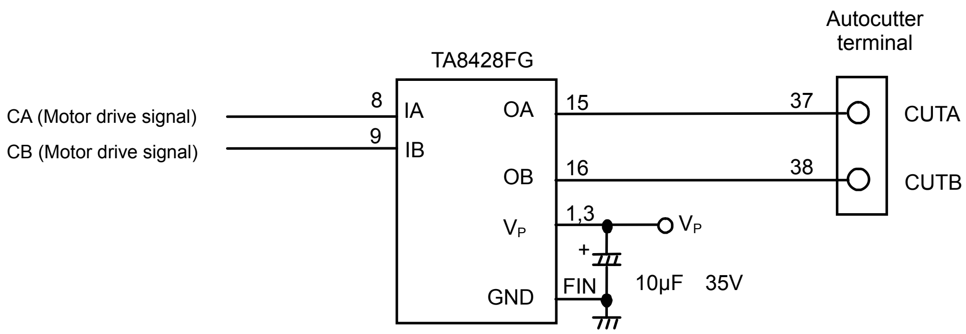
3.8 CUTTER MOTOR CHARACTERISTICS (DC MOTOR)

If the motor shaft (movable blade) has stopped due to some outside factors and electricity is applied to the motor continuously, a motor burn out may occur and burn yourself as well. Protect the motor refereeing the "3.8.3 Cutter Flowchart".

Make sure the thermal paper is completely stopped before cut.

3.8.1 Sample Cutter Motor Drive Circuit

Sample cutter motor drive circuit is shown in Figure 3-11.



* Motor driver : TA8428FG (Toshiba)

Figure 3-11 Sample Cutter Motor Drive Circuit

3.8.2 Drive Sequence of Cutter Motor

Table 3-10 shows the cutter motor drive sequence.

Table 3-10 Drive Sequence of Cutter Motor (Figure 3-11 Sample Circuit)

	Input Terminals		Connector Terminals	
	A	B	37	38
Full cut	H	L	H	L
Partial cut	L	H	L	H
Break	H	H	L	L
Waiting	L	L	OFF	OFF

3.8.3 Cutter Drive Flow Chart

Figure 3-12 shows drive flow chart.

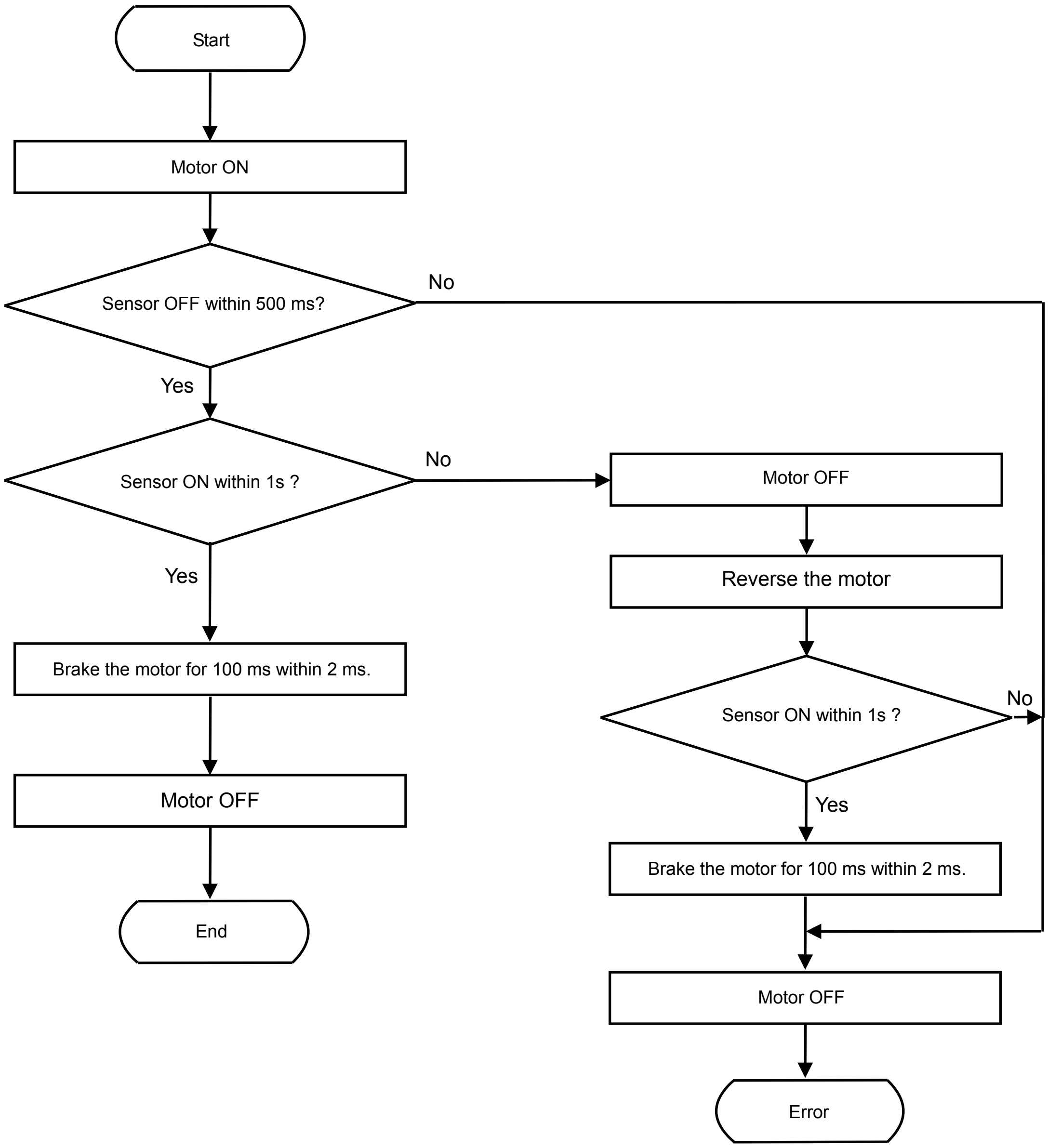


Figure 3-12 Flow chart

3.8.4 Cutter Timing Chart

Figure 3-13 and Figure 3-14 show drive timing in the sample cutter motor drive circuit (Figure 3-11).

- Full cut

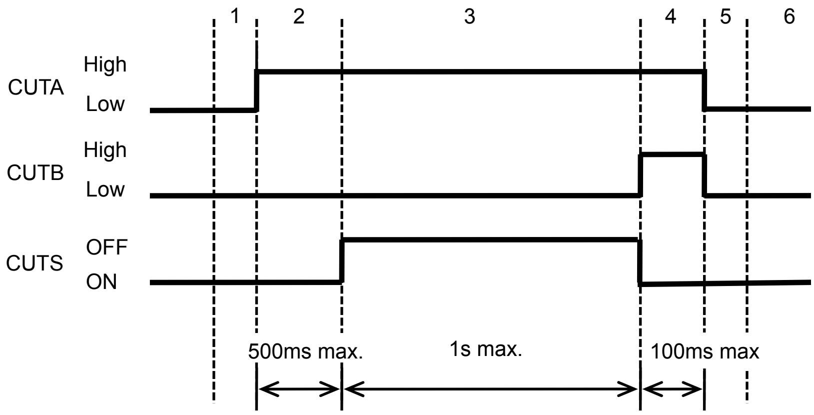


Figure 3-13 Timing Chart for Full Cut (Figure 3-11 Sample Circuit)

- Partical cut

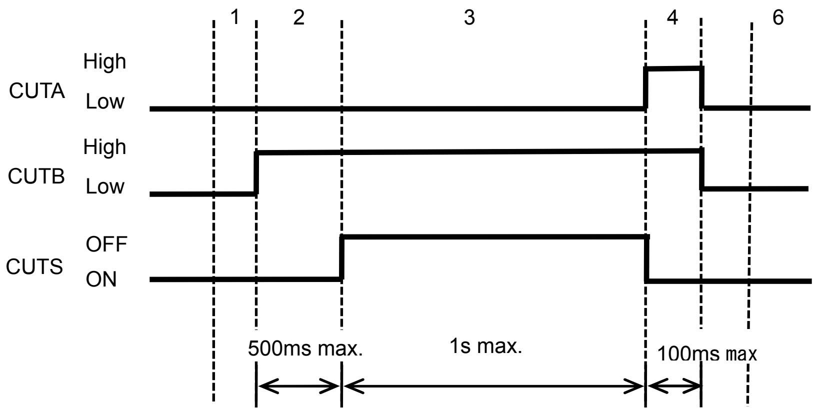


Figure 3-14 Timing Chart for Partial Cut (Figure 3-11 Sample Circuit)

3.9 PAPER DETECTOR AND TIMING MARK DETECTOR

The printer has two built-in detectors (reflection type photo-interrupter) to detect a timing mark and whether thermal paper is present or not.

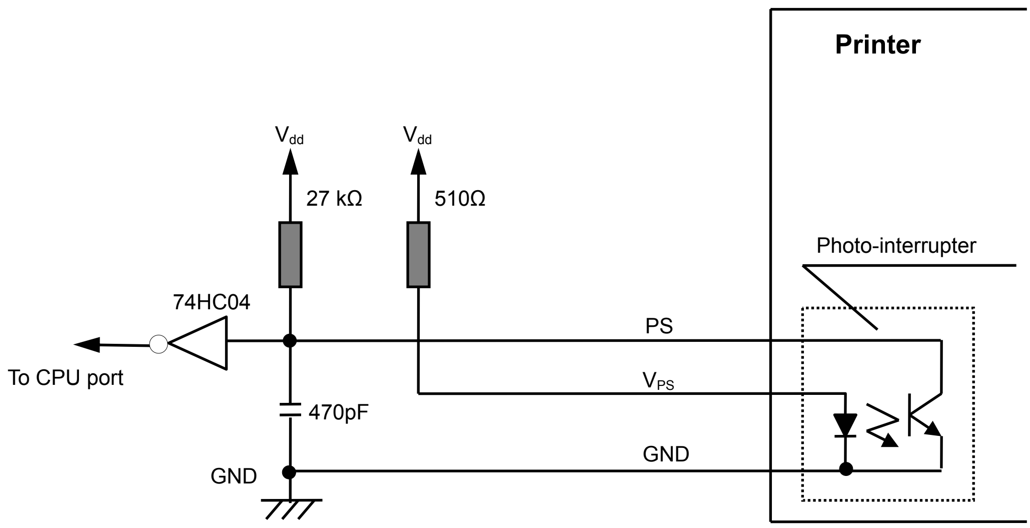
An external circuit should be designed so that it detects the output from the detectors and does not activate the thermal head when there is no thermal paper. Doing not so may cause damage to the thermal head or platen roller or shorten the life of the thermal head significantly.

Table 3-11 shows about the out-of-paper sensor used for this printer.

Table 3-11 Out-of-paper Sensor

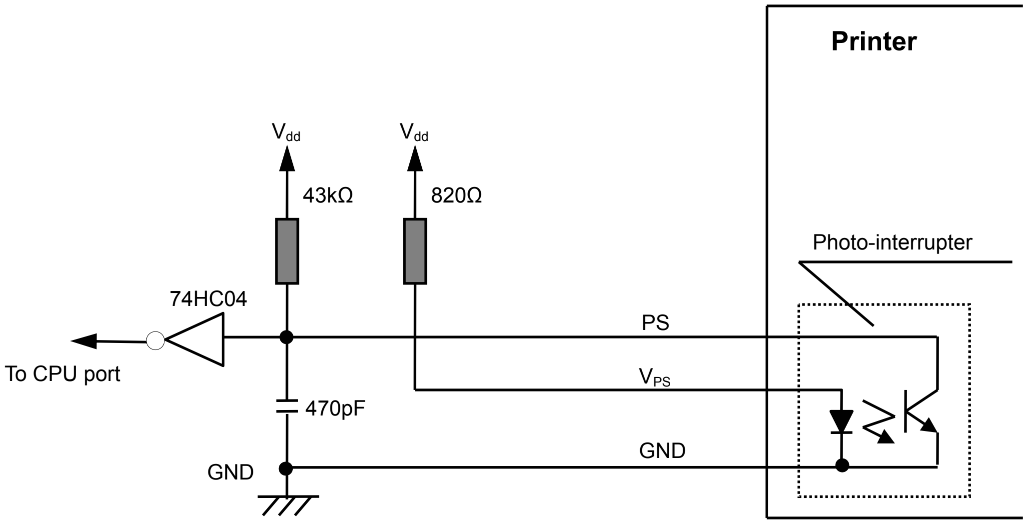
Item	Specifications
Type	Reflection type photo interrupter
Model	KU163B-23-TR
Manufacturer	STANLEY ELECTRIC CO., LTD.

3.9.1 Sample External Circuit



∗ The PS signal is high when there is no thermal paper.
∗ At V_{dd}:3.3V±5%

Figure 3-15 Sample External Circuit of the Paper/Timing Mark Detector ① (V_{dd}=3.3V)



* The PS signal is high when there is no thermal paper.
* At Vdd:5.0V±5%

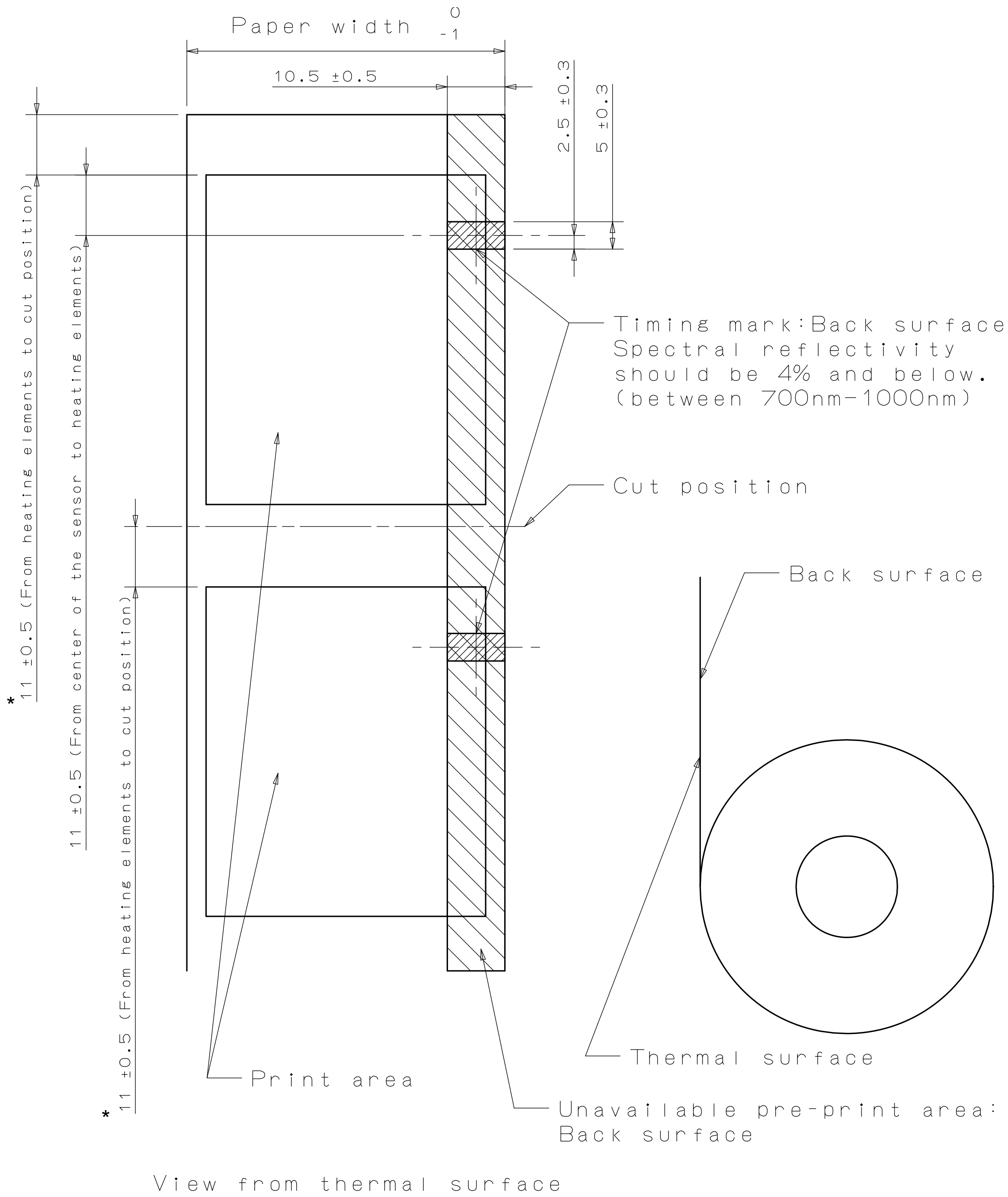
Figure 3-16 Sample External Circuit of the Paper/Timing Mark Detector ② (V_{dd}=5.0V)

3.9.2 Paper/Timing Mark Detector Position

Table 3-12 shows the detector position. Figure 3-17 and Figure 3-18 show the timing mark, length between the detectors and the heating element, and length between the heating element and cut position (excluding LTP9000 series).

Table 3-12 Detector Position

Model	Sensor Position	
	PS1（Detector 1）	**PS2（Detector 2）**
CAP9247E/LTP9247A CAP9247G CAP9347E/LTP9347A CAP9347G	Center of printing surface (thermal surface)	Lever side of back surface (non-thermal surface)
CAP9247F/LTP9247B CAP9347F/LTP9347B	Lever side of printing surface (thermal surface)	Gear side of printing surface (thermal surface)

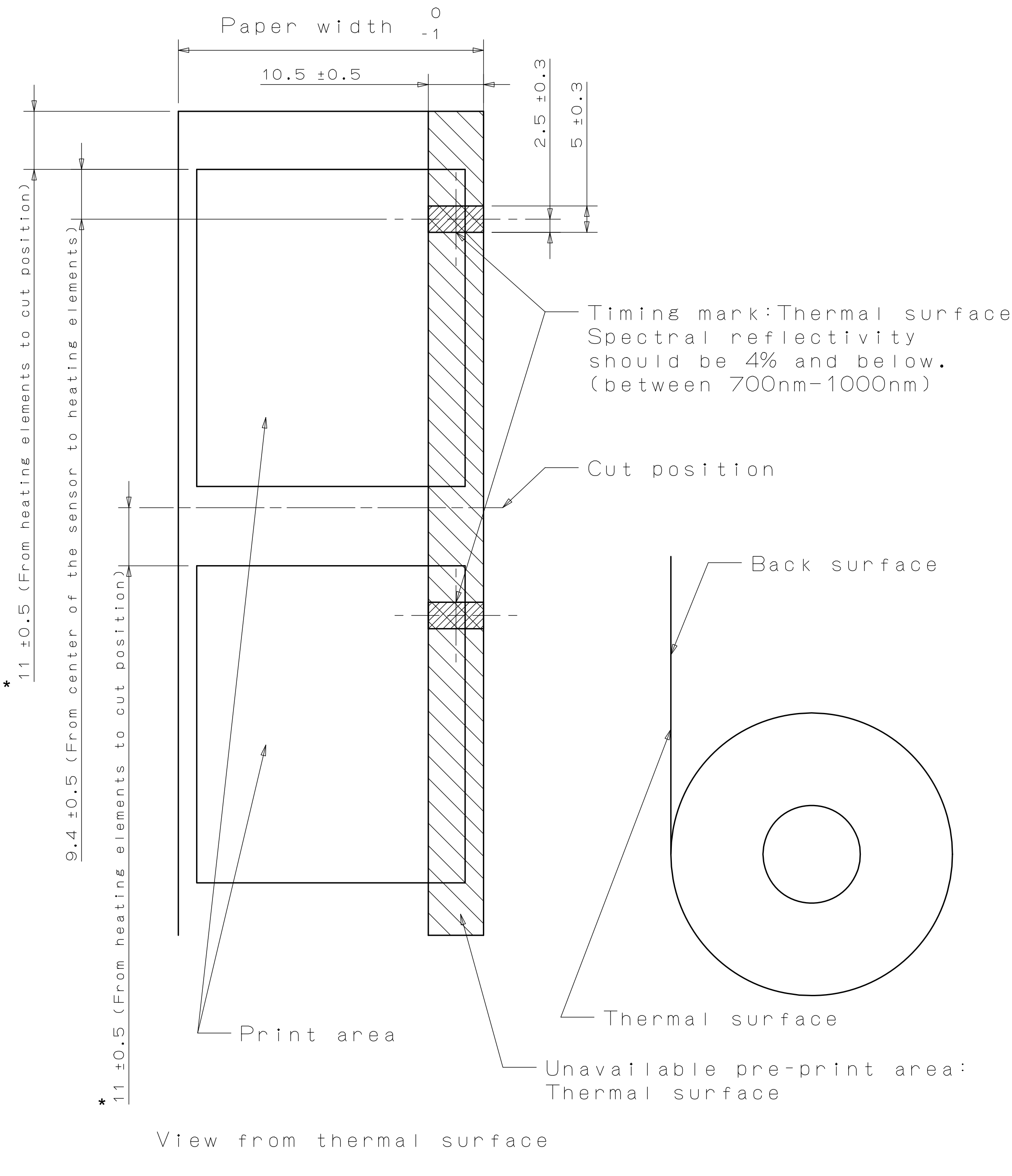


* : Excluding LTP9000 series

Unit : mm

Figure 3-17 Example of Timing Mark ①

(When using CAP9*E-S***-E / LTP9***A-S***-E ; PS2 as timing mark)**
(When using CAP9*G-S***-E)**



* : Excluding LTP9000 series

Unit : mm

Figure 3-18 Example of Timing Mark ②

(When using CAP9*F-C***-E / LTP9***B-C***-E ; PS1 as timing mark)**

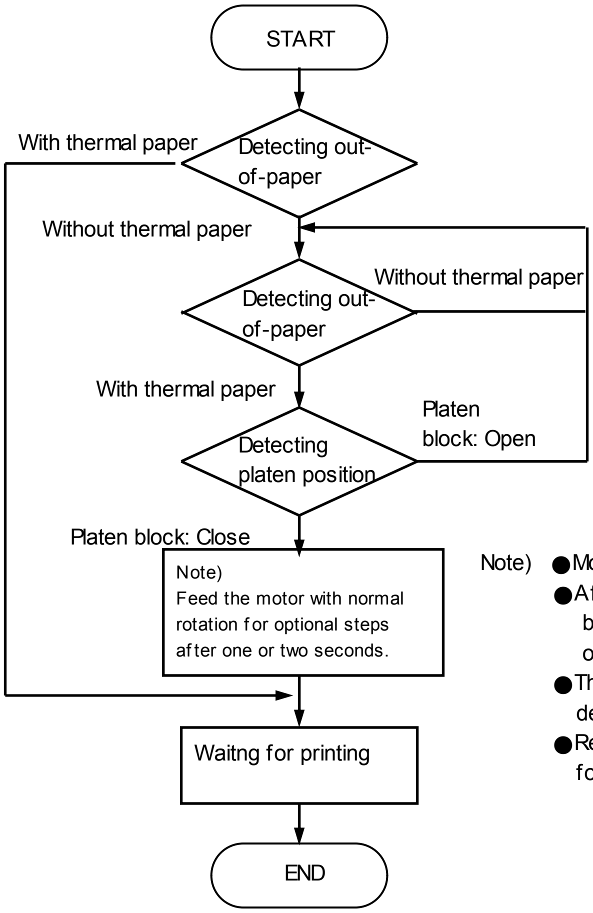
3.9.3 Application of The Out–of-Paper Detection

Paper auto loading system is available using the out-of-paper detection.

When using the auto loading system, remove thermal paper and have the platen block closed.

Insert thermal paper until it meets resistance. Make sure to cut the leading edge of the paper roll straight across to prevent paper skew. When facing the paper skew, feed thermal paper until it becomes straight. Another way is to open the platen and release sticking and try again.

Figure 3-19 shows a flow chart of the auto loading system.



Note)
- Motor to drive with 800pps that is its maximum frequency.
- After passing the detectors, it may take one or twe seconds before the platen starts pulling paper. This time can be set optionally.
- The number of motor drive steps can be set optionally depending on length up to the paper exit.
- Refer to Figure 3-17, Figure 3-18, Figure 6-2, and Figure 6-3 for length between the detectors and the heating element.

Figure 3-19 Flow Chart of the Paper Auto Loading System

3.10 PLATEN POSITION DETECTOR

The printer has a built-in platen position detector for detecting whether the platen block is opened or closed. This detector is a mechanical switch which is designed to be in an ON state when the platen block is closed and to be in an OFF state when it is opened.

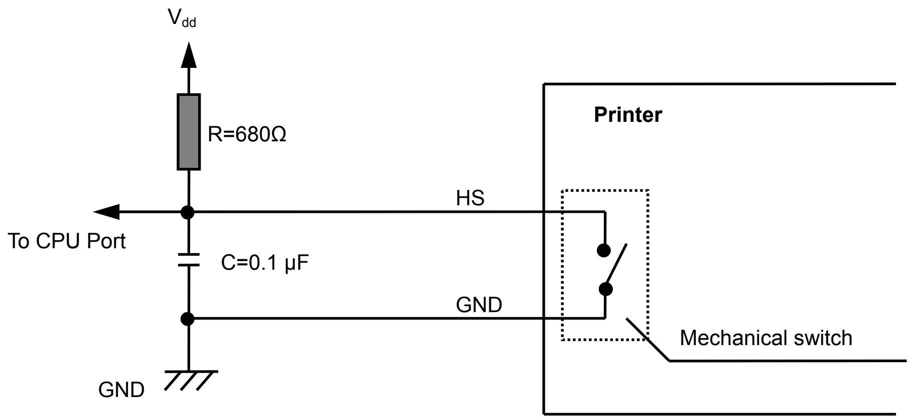
The combination of the platen position detector with the paper detector/timing mark detector in Section 3.9 makes it possible to detect the position of the platen.

The external circuit should be designed so that it detects output from the platen position detector in order to detect the platen OPENED state, or, so that it detect output from the paper detector/timing mark detector in Section 3.9, so as not to activate the thermal head without thermal paper. Otherwise, the thermal head may be damaged or the life of the head may be shortened significantly. Activate the thermal head when the platen block is CLOSED by detecting the output from the platen position detector, and in the paper presence state by detecting the output from the paper detector.

3.10.1 General Specifications

Maximum rating : DC 30V, 0.1A
Contact resistance : 200 mΩ max.

3.10.2 Sample External Circuit



*At home position : HS="High"
*Vdd : 3.3V±5%

Figure 3-20 Sample External Circuit of the Platen Position Detector

Note that there is a time lag between the time when pressure is applied to the thermal head and the platen completely and when the platen position detector starts to operate.

Always use the capacitor shown in Figure 3-20 to prevent the switch from malfunctioning due to chattering.

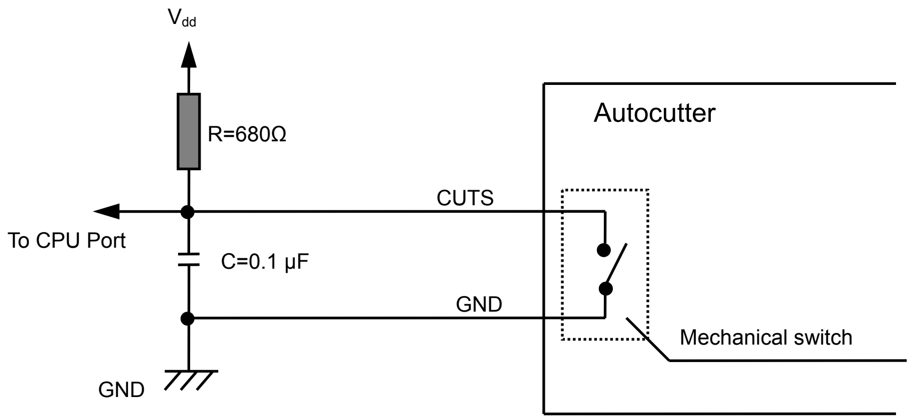
3.11 CUTTER HOME POSITION SENSOR

The CAP9000 series printer has a movable cutter blade home position detection sensor.
The movable cutter blade home position sensor turns ON when the movable cutter blade exists in the home position and turns OFF when the movable cutter blade exists in the position except the home position.
Design the control circuit so that the external circuit detects the output signal of the movable cutter blade home position sensor and does not activate the thermal head and the paper feed motor when the movable cutter blade exists in the position except the home position.
If activating them in error, the thermal head may be damaged, the life span of the thermal head may be shortened, or an injury by the movable cutter blade or damage of the movable cutter blade and the fixed cutter blade may be caused.

3.11.1 Cutter Home Position Sensor Specifications

Maximum rated voltage	:	DC 16 V, 100mA
Contact resistance	:	1Ω max.

3.11.2 Sample External Circuit



*At home position : CUTS="Low"
*V_{dd} : 3.3V±5%

Figure 3-21 Sample of the Cutter Home Position Sensor

Always use the capacitor shown in Figure 3-21 to prevent the switch from malfunctioning due to chattering.

CHAPTER 4
CONNECTING TERMINALS

The CAP9000 series / LTP9000 series is equipped with the connecting terminal for external connection.

A printer and a cutter are connected by a single connecter mentioned above.

Use the recommended connector for external circuit connection listed in Table 4-1.

Table 4-1 Connecting Terminal

Number of Pins	Recommended Connector
40	LY10-DC40BR (JAE)

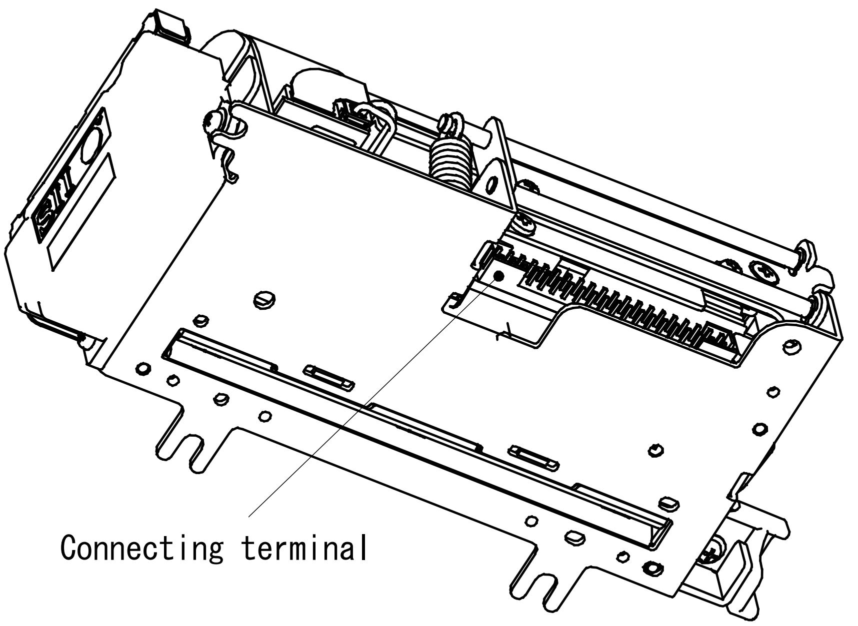


Figure 4-1 Connecting Terminal for External Circuit (Bottom perspective view)

4.1 CONNECTING TERMINAL

Figure 4-2 shows the terminal configuration and Table 4-2 shows their terminal assignments.

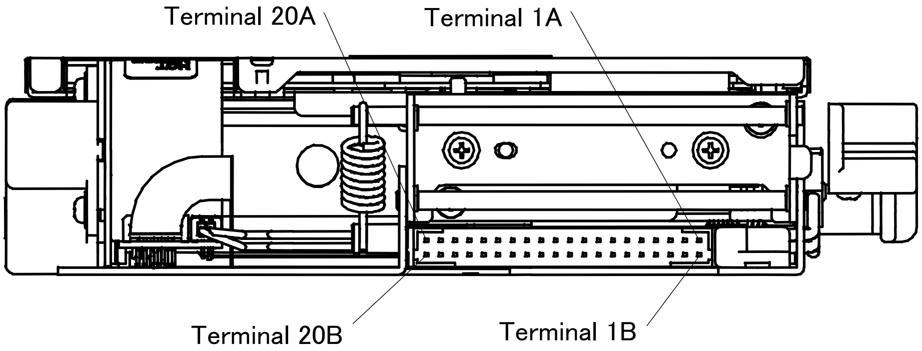


Figure 4-2 Connecting Terminal (Back view)

Table 4-2 Terminal Assignments

Terminal Number	Signal Name	Function
1A	$V_{PS}1$	PS1 ; LED anode (power supply side)
1B	PS1	PS1 ; Photo transistor collector (out put side)
2A	$V_{PS}2$	PS2 ; LED anode (power supply side)
2B	PS2	PS2 ; Photo transistor collector (out put side)
3A	V_P	Head drive power
3B	V_P	Head drive power
4A	V_P	Head drive power
4B	DI	Print data input (serial input)
5A	CLK	Print data transfer synchronize signal
5B	$\overline{\text{LAT}}$	Print data latch (memory storage)
6A	$\overline{\text{DST1}}$	Head print activation instruction signal
6B	$\overline{\text{DST2}}$	Head print activation instruction signal
7A	$\overline{\text{DST3}}$	Head print activation instruction signal
7B	$\overline{\text{DST4}}$	Head print activation instruction signal
8A	TH	Thermister
8B	GND	GND
9A	GND	GND
9B	GND	GND
10A	GND	GND
10B	GND	GND

Terminal Assignments (Continued)

Terminal Number	Signal Name	Function
11A	GND	GND
11B	GND	GND
12A	V_{dd}	Logic power supply
12B	$\overline{DST5}$	Head print activation instruction signal (CAP9247,LTP9247: N.C.)
13A	N.C.	No connection
13B	N.C.	No connection
14A	V_P	Head drive power
14B	V_P	Head drive power
15A	V_P	Head drive power
15B	V_P	Head drive power
16A	A	Paper feed motor drive signal
16B	$\overline{A}$	Paper feed motor drive signal
17A	B	Paper feed motor drive signal
17B	$\overline{B}$	Paper feed motor drive signal
18A	HS	Platen position detector output
18B	GND	Platen position detector GND
19A	CUTA	Cutter motor drive signal (LTP9000:N.C.)
19B	CUTB	Cutter motor drive signal (LTP9000:N.C.)
20A	CUTS	Cutter home position sensor output (LTP9000:N.C.)
20B	GND	Cutter home position sensor GND (LTP9000:N.C.)

CHAPTER 5
DRIVE METHOD

5.1 PAPER FEED MOTOR AND THERMAL HEAD DRIVE TIMING

In order to actually print, it is necessary to drive the paper feed motor and the head simultaneously.

Table 5-1 shows a drive method in ambient temperature.　In a low temperature environment, print disorder and printing blurs may occur if the motor is driven in multi-division method.　Set the maximum print speed, the number of maximum head division drive, and preheating control as the Table 5-1 shown.

No matter what temperature it is at, divide the print pulse into two times (2 Time-Heat Activation) if driving the motor with its speed at 1600pps or lower.　If the drive speed is over 1600pps, drive with single print pulse (1 Time-Heat Activation).　(See 3.6.7　2 Time-Heat Activation Control)

When driving the motor below -5℃, preheat the thermal head with one-eighth of the pulse width of standard energy in preliminary steps before printing to prevent sticking.　(See "3.6.8 Preheating Control" of the technical reference.

Table 5-1 Ambient Temperature and Drive Method

Ambient temperature	Maximum print speed	The number of max. head division drive	Preheating control	2 Time-heat activation
0℃≦"temp."≦60℃	250mm/s	5	Unnecessary	Necessary when　the drive speed is 1600pps (100mm/s) or lower
-5℃≦"temp."＜0℃	100mm/s	3		
-20℃≦"temp."＜-5℃			Necessary	

* "temp." : Ambient temperature

Figure 5-1 is a timing chart for the 5 division-printing. See CAP9347 as an example. In these examples, acceleration control of the paper feed motor, data transmission to the head, and division drive of the head are performed.

Turn the paper feed motor 24 steps (including a step to remove a backlash) at start of printing, initialization, opening / closing the platen block, and cutting the thermal paper using the auto cutter to prevent print quality deterioration and to remove elastic deformation of the platen roller rubber due to the backlash of paper feeding system.　Always start printing after above actions.

5.1.1 Timing Chart (5-Divisions)

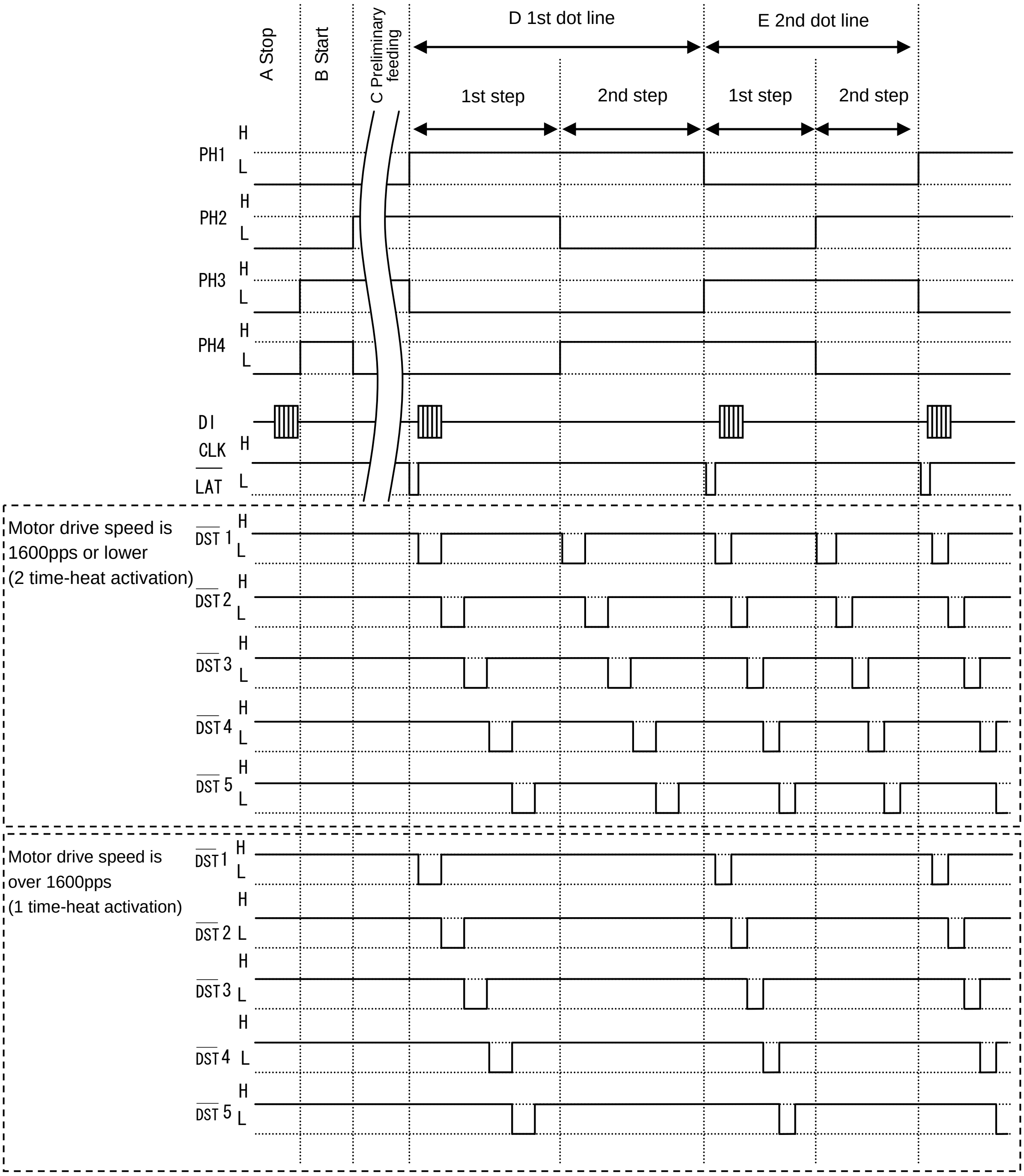


Figure 5-1 5-Division Printing Timing Chart

<Motor drive speed is 1600pps or lower (2 time-heat activation)>

(A) Pause state

Transfer the print data for the 1st dot line to the "SHIFT REGISTER" of the thermal head.

(B) Startup step

Excite the phase which is output just before the paper feed motor stops for the time of the acceleration 1st step.

(C) Preliminary step

Output the preliminary steps for 24 steps sequentially from the 1st step of the acceleration steps.

(D) 1st dot line

1st step

(1) Drive the paper feed motor for one step.

(2) Store the print data for one dot line transferred in (A) noted above in the “LATCH REGISTER” of the thermal head, and start activation of the thermal head through $\overline{\text{DST}}$ 1 to 5. At the beginning, set $\overline{\text{DST}}$1 to “Low”.

After setting $\overline{\text{DST}}$1 to “Low”, set it to “High” when a half of the driving time calculated in “3.6.1 Calculation of Head Activation Pulse Width” has been reached.

Then, after setting $\overline{\text{DST}}$2 to “Low”, set $\overline{\text{DST}}$2 to “High” when a half of the driving time calculated in “3.6.1 Calculation of Head Activation Pulse Width” has been reached, in the same manner as the $\overline{\text{DST}}$1.

Repeat these steps in $\overline{\text{DST}}$3 to 5 in the same way.

(3) Transfer the next print data to the thermal head.

(4) Move to the 2nd step after completion of the 1st step time of the paper feed motor and activation of all blocks.

2nd step

(1) Drive the paper feed motor for one step.

(2) Move to the 2nd dot line after completion of the 2nd step time of the paper feed motor and activation of all blocks. In the 2nd step, the same dots as the 1st step are activated.

(E) 2nd dot line

1st step

(1) Drive the paper feed motor for one step.

(2) Store the print data for one dot line transferred in (D) noted above in "LATCH REGISTER" of the thermal head, and start activation of the thermal head through $\overline{\text{DST}}$1 to 5.

(3) Transfer the next print data to the thermal head.

(4) Move to the 2nd step after completion of the 1st step time of the paper feed motor and activation of all blocks.

2nd step

(1) Drive the paper feed motor for one step.

(2) Move to the 3rd dot line after completion of the 2nd step time of the paper feed motor and activation of all blocks. In the 2nd step, the same dots as the 1st step are activated.

The printer advances a step in the same manner to start activation of the head and also transmits the next data to be printed in the next step to the head.

Data transmission and head activation time may become longer than the step time of the paper feed motor due to thermal paper type, the printed contents or working conditions, etc. In such cases, adjust the paper feed motor speed depending on the acceleration step to secure enough time to transfer data and activate the head. Moreover, secure a pause time of 0.1 ms or more after head activation.

Although there is especially no particular problem in transmitting the 1st step data to the head during output of the startup step in (B) noted above, data are transmitted before the output of the startup step.

<Motor drive speed is over 1600pps (1 time-heat activation)>

(A) Pause state

Transfer the print data for the 1st dot line to the "SHIFT REGISTER" of the thermal head.

(B) Startup step

Excite the phase which is output just before the paper feed motor stops for the time of the acceleration 1st step.

(C) Preliminary step

Output the preliminary steps for 24 steps sequentially from the 1st step of the acceleration steps.

(D) 1st dot line

1st step

(1) Drive the paper feed motor for one step.

(2) Store the print data for one dot line transferred in (A) noted above in the “LATCH REGISTER” of the thermal head, and start activation of the thermal head through $\overline{DST}$1 to 5. At the beginning, set $\overline{DST}$1 to “Low”.

After setting $\overline{DST}$1 to “Low”, set it to “High” when the driving time calculated in “3.6.1 Calculation of Head Activation Pulse Width” has been reached.

Then, after setting $\overline{DST}$2 to “Low”, set $\overline{DST}$2 to “High” when the driving time calculated in “3.6.1 Calculation of Head Activation Pulse Width” has been reached, in the same manner as the $\overline{DST}$1.

Repeat these steps in $\overline{DST}$3 to 5 in the same way.

(3) Transfer the next print data to the thermal head.

(4) Move to the 2nd step after completion of the 1st step time of the paper feed motor and activation of all blocks.

2nd step

(1) Drive the paper feed motor for one step.

(2) Move to the 2nd dot line after completion of the 2nd step time of the paper feed motor.

(E) 2nd dot line

1st step

(1) Drive the paper feed motor for one step.

(2) Store the print data for one dot line transferred in (D) noted above in "LATCH REGISTER" of the thermal head, and start activation of the thermal head through $\overline{\text{DST}}$1 to 5.

(3) Transfer the next print data to the thermal head.

(4) Move to the 2nd step after completion of the 1st step time of the paper feed motor and activation of all blocks.

2nd step

(1) Drive the paper feed motor for one step.

(2) Move to the 3rd dot line after completion of the 2nd step time of the paper feed motor.

The printer advances a step in the same manner to start activation of the head and also transmits the next data to be printed in the next step to the head.

Data transmission and head activation time may become longer than the step time of the paper feed motor due to thermal paper type, the printed contents or working conditions, etc. In such cases, adjust the paper feed motor speed depending on the acceleration step to secure enough time to transfer data and activate the head. Moreover, secure a pause time of 0.1 ms or more after head activation.

Although there is especially no particular problem in transmitting the 1st step data to the head during output of the startup step in (B) noted above, data are transmitted before the output of the startup step.

5.2 THERMAL HEAD DIVISION DRIVE METHOD

The following methods as a division drive system of a thermal head are available.

(1) Fixed division

A fixed division is the method of determining the logical block (a group of the physical block driven simultaneously) beforehand.

Since a physical block is always driven in the same turn, high quality printing can be performed.

CAP9247/LTP9247 is available to set from 1 to 4 fixed divisions.

CAP9347/LTP9347 is available to set from 1 to 5 fixed divisions.

(2) Dynamic division

A dynamic division is the method of summarizing a physical block so that the dot number for each physical block counted does not exceed the number of the maximum activated dots being set, to determine a logic block, when a 1-dot line is printed.

The determination of a logical block is performed in each 1-dot line print.

CAP9247/LTP9247 is available to set the maximum drive dot number from 128 to 448 dots.

CAP9347/LTP9347 is available to set the maximum drive dot number from 128 to 640 dots.

CHAPTER 6

OUTER CASE DESIGN GUIDE

6.1 SECURING THE PRINTER

6.1.1 Printer Mounting Method

In order to mount CAP9000 series / LTP9000 series printer unit, secure the printer unit to four points (3 U-shaped holes (a, b, c) and M3 tapped hole (d)) or three points (3 U-shaped holes (a, b, c)) shown in Figure 6-1 and Figure 6-2. Holes #1 and #2 are used for positioning the printer. See “CHAPTER 7 APPEARANCE AND DIMENSIONS” for dimensions.

If securing the printer with the three points (a, b, c), make sure to design an outer case that will be mounted on it firmly.

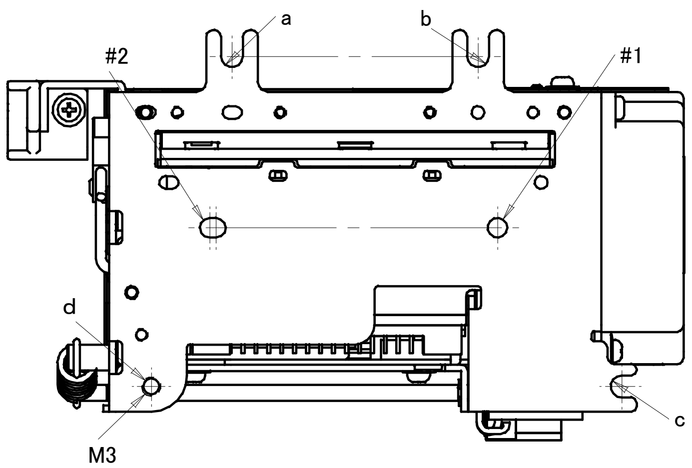


Figure 6-1 Printer Unit Mounting Surface ①
(CAP92XX, LTP92XX)

Prepare the following tapped holes and pins on the mounting face for the printer unit.

(1) Two pins for the positioning holes (#1, #2)

(2) Three M3 tapped holes for the 3 U-shaped holes (a, b, c)

(3) One fixed hole for the M3 tapped hole (d)

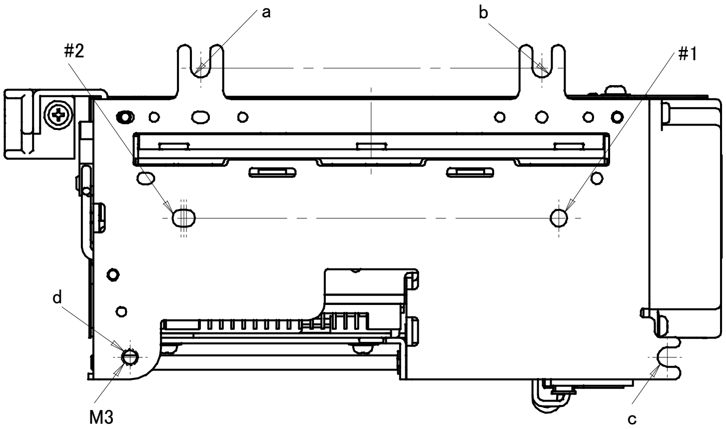


Figure 6-2 Printer Unit Mounting Surface ②
(CAP93XX, LTP93XX)

Prepare the following tapped holes and pins on the mounting face for the printer unit.

(1) Two pins for the positioning holes (#1, #2)

(2) Three M3 tapped holes for the 3 U-shaped holes (a, b, c)

(3) One fixed hole for the M3 tapped hole (d)

6.1.2 Recommended Screw

The recommended mounting screws are as follows:

(1) Combination of : M3 cross-recessed pan head screw and small round plain washer 3.

(2) M3 Cross recessed binding screw

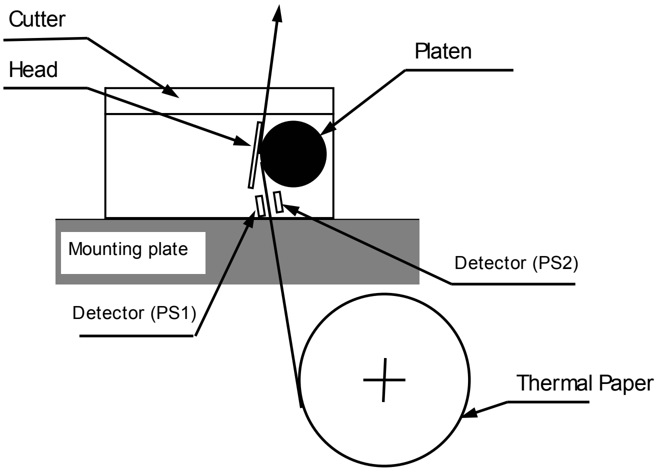
(3) M3 Cross recessed TP screw

6.1.3 Precautions for Securing the Printer

- Prevent excessive force or torsion when securing the printer. Deformation and torsion of printer may cause deterioration of print quality, paper skew, paper Jam, noise, or damage.
- Install the printer on a flat surface in a location free from vibrations. Rubber vibration insulator is also effective.
- When securing the printer unit, ensure the mounting accuracy relative to the platen block by utilizing the positioning holes #1 and #2 shown Figure 6-1, and Figure 6-2.
- To prevent the thermal head from being damaged by static electricity, it is recommended that the printer unit be connected to the frame ground using a nickel plated screw with a toothed washer at one of the holes “a, b, c, and d” shown in Figure 6-1, and Figure 6-2.
- Connect the GND (Signal Ground) to FG using a 1MΩ resistor so that the electric potential of the GND of the thermal head and the FG of the printer unit are equal.
- Be careful not to damage the FPC when securing the printer unit to the outer case with screws.
- Close the platen block when mounting the printer to the outer case. Design the outer case so that a loose torque should be 19.6N (2kgf) or over.

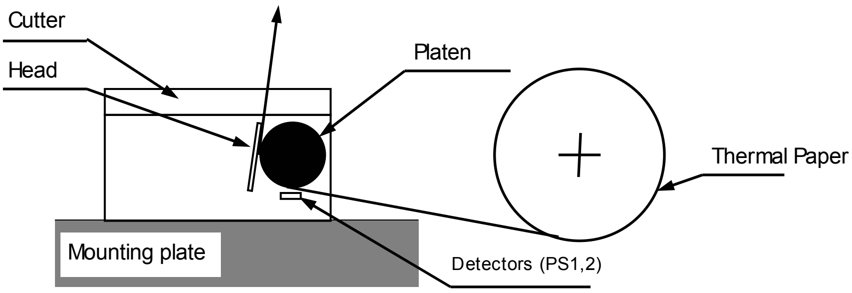
6.2 LAYOUT OF PRINTER MECHANISM AND THERMAL PAPER

The following layouts are available for this printer mechanism.



* The paper feeding distance between the paper detectors (PS1, PS2) and the heating element is approximately 11 mm. (for the straight path)
* The paper feeding distance between the heating element and the paper cut position is approximately 11 mm.

Figure 6-3 Layout of Printer Mechanism and Thermal Paper #1 (Straight path type)



* The paper feeding distance between the paper detectors (PS1, PS2) and the heating element is approximately 9.4 mm. (for the curl path)
* The paper feeding distance between the heating element and the paper cut position is approximately 11 mm.

Figure 6-4 Layout of Printer Mechanism and Thermal Paper #2 (Curl path type)

6.3 WHERE TO MOUNT THE PAPER HOLDER

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

- When the paper roll is used, hold the thermal paper so that the thermal paper is straight to the paper inlet without any horizontal shifting, and the center axis of the paper roll is parallel with the printer.
- Keep the paper feed load to 0.98 N (100 gf) or less.
  However, keep in mind that a printing problem may occur when it changes rapidly even if paper feed force is below 0.98 N. Set a tension roller to see its performance on your actual product.
- If the paper width is 82.55mm and the print width is over 78mm, the center line of thermal paper or of a paper roll to be within a tolerance of ±0.2mm based on positioning hole #1. Design the paper holder and the paper guide to provide paper adjustment mechanism that brings the paper roll to the center of the paper holder. The print may run off the edge of the thermal paper depending on setting the paper holder and the paper guide. Pay attention to design the outer case in advance and verify the performance with your actual device.

6.4 MOUNTING ATTITUDE

Mount the CAP9000 series / LTP9000 series printer with the attitude 0° to 360° shown in Figure 6-5.

Although the cutter unit is secured to the printer with a spring, design the outer case so that the cutter unit is not opened during printing and cutting operation. Especially, when mounting the printer at an angle within the range of 90° to 270°, design the outer case so that the cutter unit is not opened due to vibration or any other shocks.

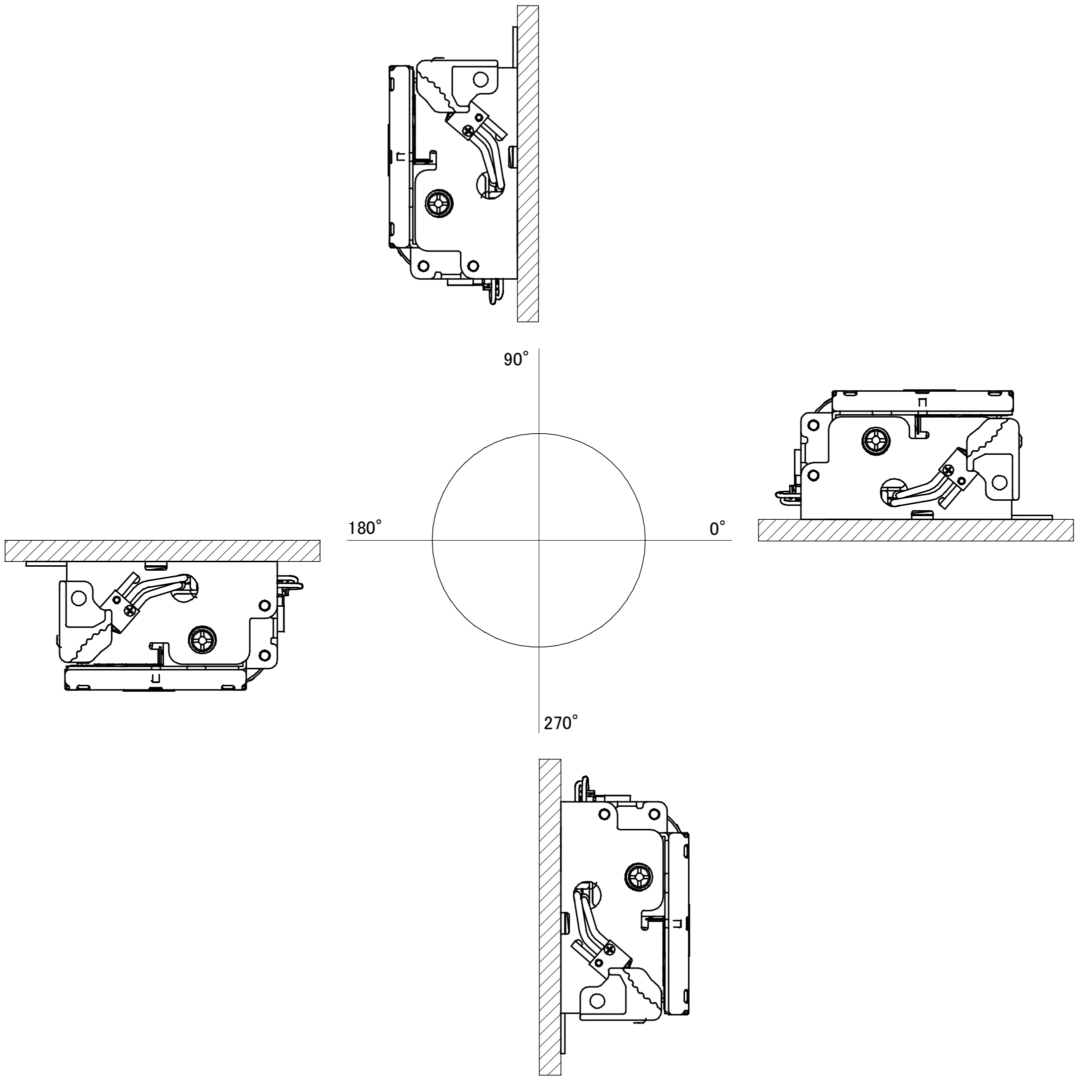


Figure 6-5 Mounting Attitude

6.5 PAPER EXIT

6.5.1 Paper Exit Shape

- Design the shape of a paper exit so that stress is not applied to the paper fed out.
- The paper exit design should not interfere with the paper eject direction. Design paper exit of the outer case not to change paper eject direction and not interfere with paper feeding.

6.6 PRECAUTIONS FOR DESIGNING THE OUTER CASE

(1) The CAP9000 series has pursued thin body, so the fixed blade and the movable blade are located near the paper exit. Design the shape of the outer case (including the shape of the cover) so that the user does not touch the cutter blades during cutting operation when the thermal paper is replaced or jammed paper is removed. Attach caution labels at an easy-to-see position on the casing to alert the user. In addition, take measures to protect the user from a direct touch to the cutter blades during unpacking or assembling of the printer.

(2) Do not design the shape of the paper exit that changes the direction of paper movement rapidly near the paper exit.

(3) CAP9000 series can open the cutter and the platen blocks. This allows easy to remove the thermal paper when the thermal paper gets jammed. Design the outer case so that it dose not interfere with the cutter and the platen blocks when they are opened.

(4) The use of thermal paper with a small core may cause the thermal paper to be jammed in the printer unit or between the cutter and the outer case. If such a thermal paper is used unavoidably, appropriate evaluation and confirmation are required when designing the outer case.

(5) The platen release lever is operated manually by the user. Provide enough space for easy operation. For operating procedures, see Chapter 8.

(6) Design the outer case so that no stress is applied from the outer case parts to the printer unit and platen block, except the operation block. An external stress affects the printing and paper cutting functions, and causes the mechanism damage. To avoid this, ensure a space at least 1.0 mm between the printer unit/platen block and the outer case parts.

(7) Do not apply a stress to the platen release lever from outside, except when the platen is released; otherwise the printer unit may become damaged.

(8) Design the outer case so that the platen release lever and the cutter unit do not exceed the maximum range of movement.

(9) The CAP9000 series / LTP9000 series has pursued thin body, so the paper guide is shorter than our other products. Pay attention to the location of the paper guide and the paper holder up to the paper inlet of the printer unit. If the location of paper guide, the paper holder, and the printer unit are not appropriate each other, a paper skew and a paper jam may occur. Confirm it on actual machine before use.

(10) Paper powders or paper fibers might be generated upon cutting at the paper cutter. Depending on the paper feed towards the paper cutter, large quantities of paper powders or paper fibers might be generated. Pay attention not to have paper powders or paper fibers piled up on the control board and power supply. As this may cause short circuit to the set. Confirm it on actual machine before use.

6.7 PRECAUTIONS FOR USE

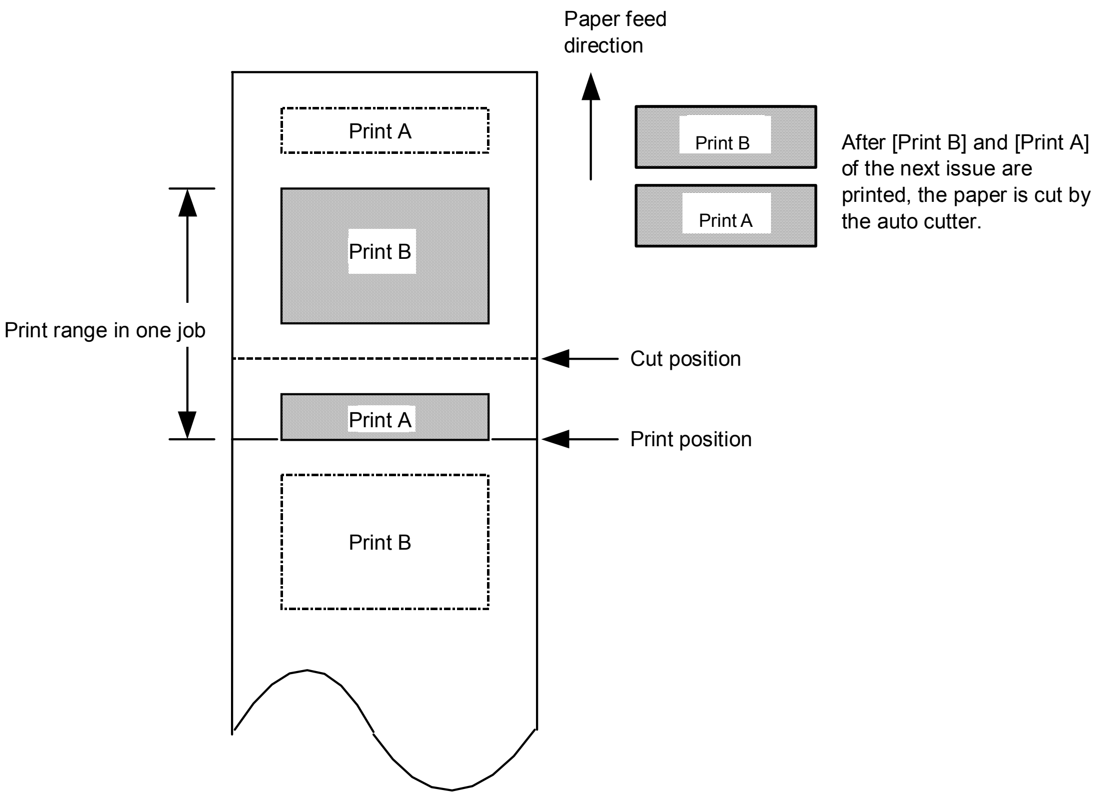
(1) The allowance of the backward feed depends on a kind of thermal paper and a minimum diameter. If the thermal paper is out of the holding status with the thermal head and the platen,the printer cannot feed. Verify the performance with your actual device.

(2) If the thermal paper is cut after B was printed and then A of the next issue was printed as shown in Figure 6-6, the margin of thermal paper from the print position up to the cut position can be used effectively.

(3) The distance between the paper cut position and the thermal head heating element is about 11 mm.

(4) Do not apply a stress to the printer unit and the cutter unit during printing and cutting operation. It could cause print defects and a paper jam.

(5) Do not exceed the maximum range of movement of the platen release lever and the cutter unit.



* Do not print continuously over print A and print B.

Figure 6-6 Effective Use of Thermal Paper during Cutting

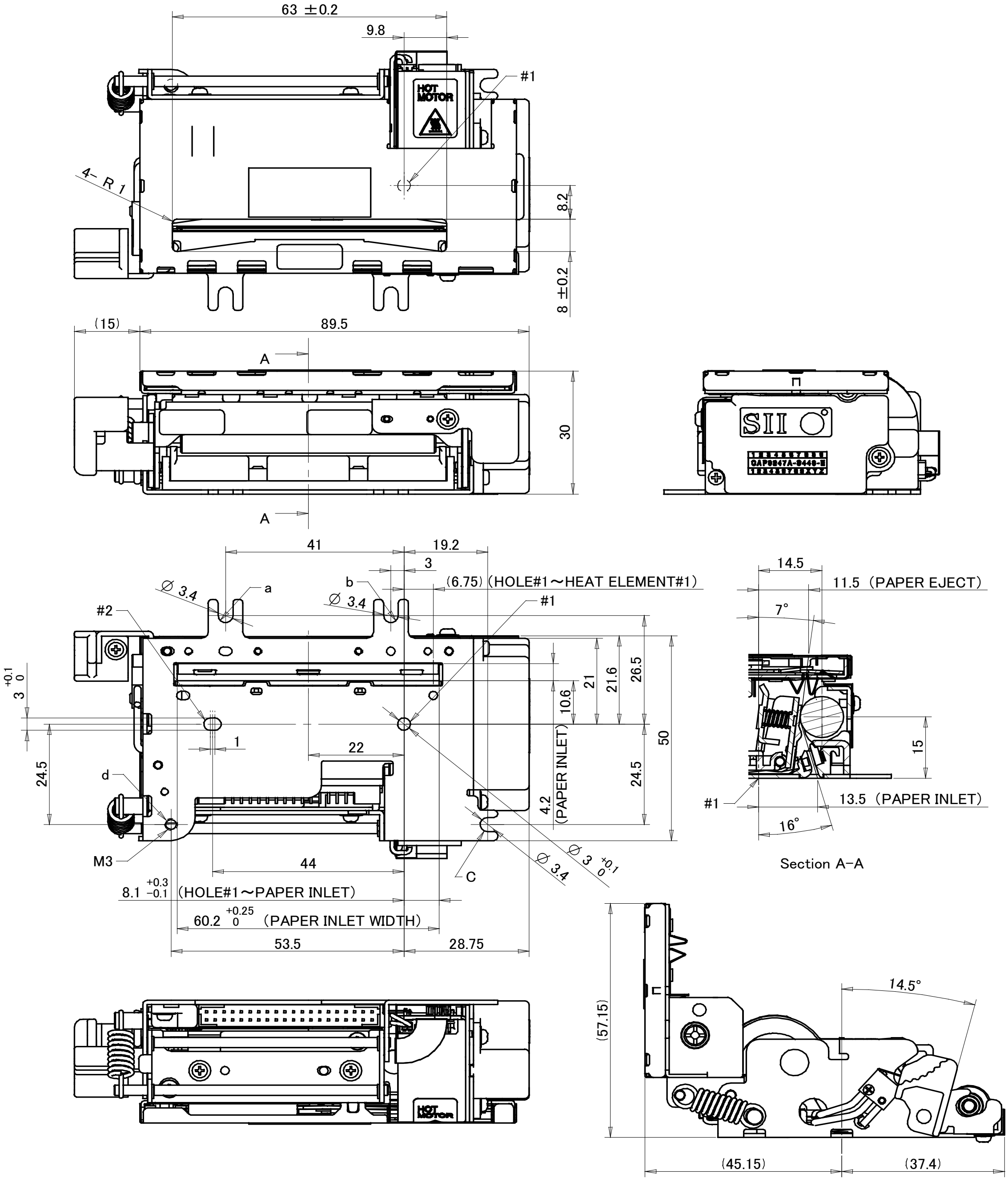
CHAPTER 7
EXTERNAL DIMENSIONS

Figure 7-1 and Figure 7-2 show the external dimensions of the CAP9247 series printer unit.

Figure 7-3 and Figure 7-4 show the external dimensions of the CAP9347 series printer unit.

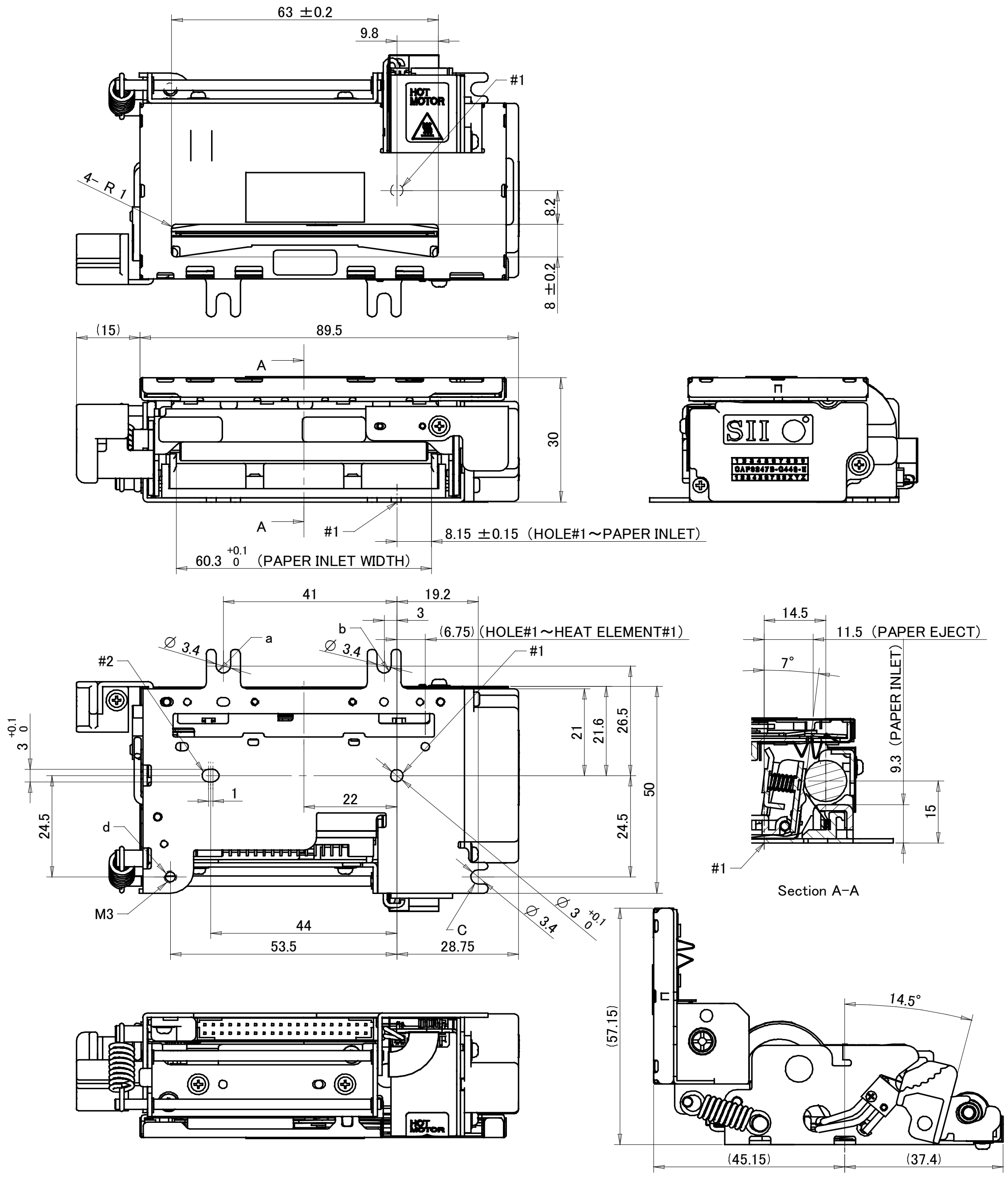
Figure 7-5 and Figure 7-6 show the external dimensions of the LTP9247 series printer unit.

Figure 7-7 and Figure 7-8 show the external dimensions of the LTP9347 series printer unit.



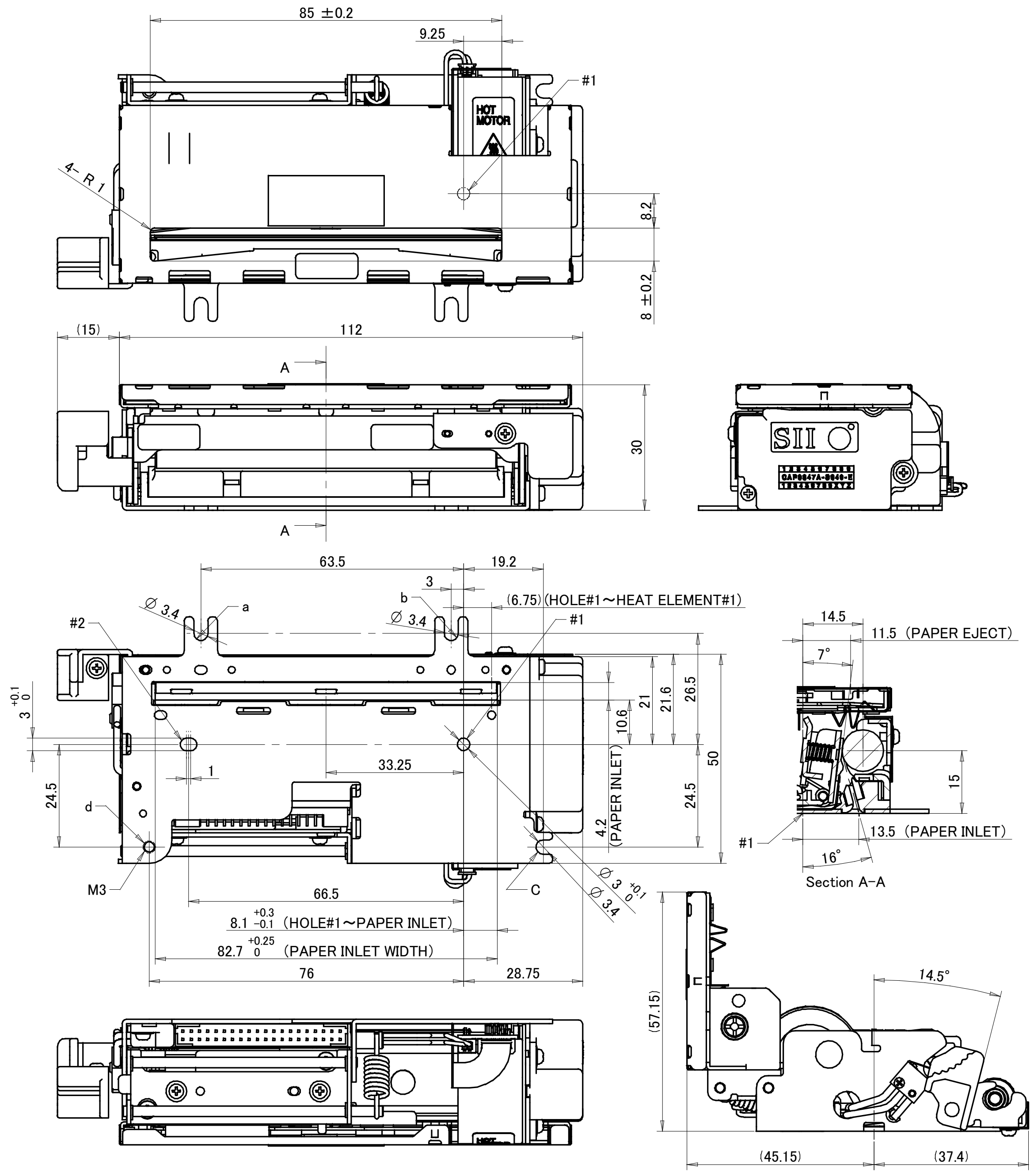
Unit : mm
General tolerance for dimension : ±0.5
General tolerance for angle : ±2°

Figure 7-1 Appearance and Dimensions of the CAP9247E-S448-E/CAP9247G-S448-E



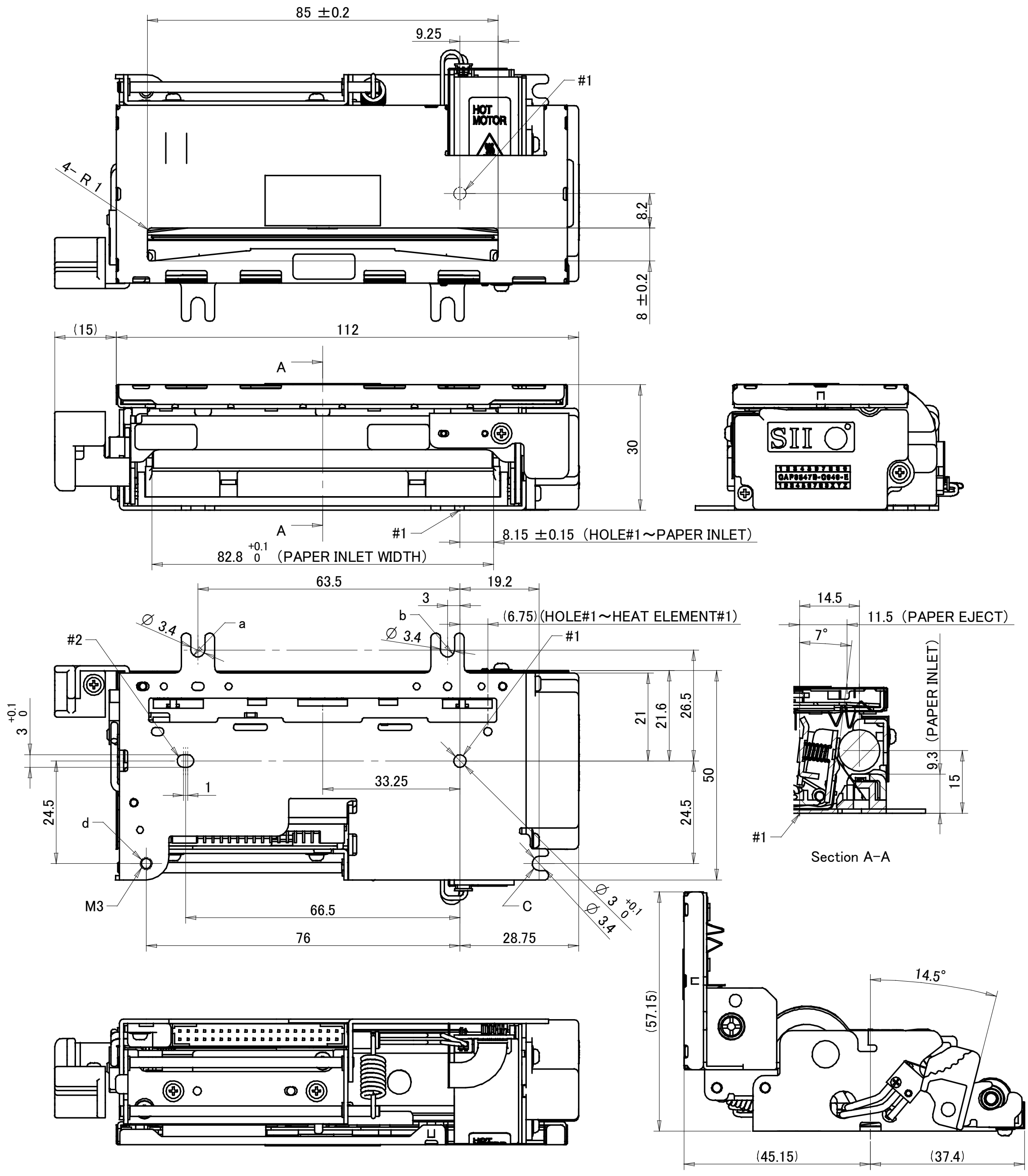
Unit : mm
General tolerance for dimension : ±0.5
General tolerance for angle : ±2°

Figure 7-2 Appearance and Dimensions of the CAP9247F-C448-E



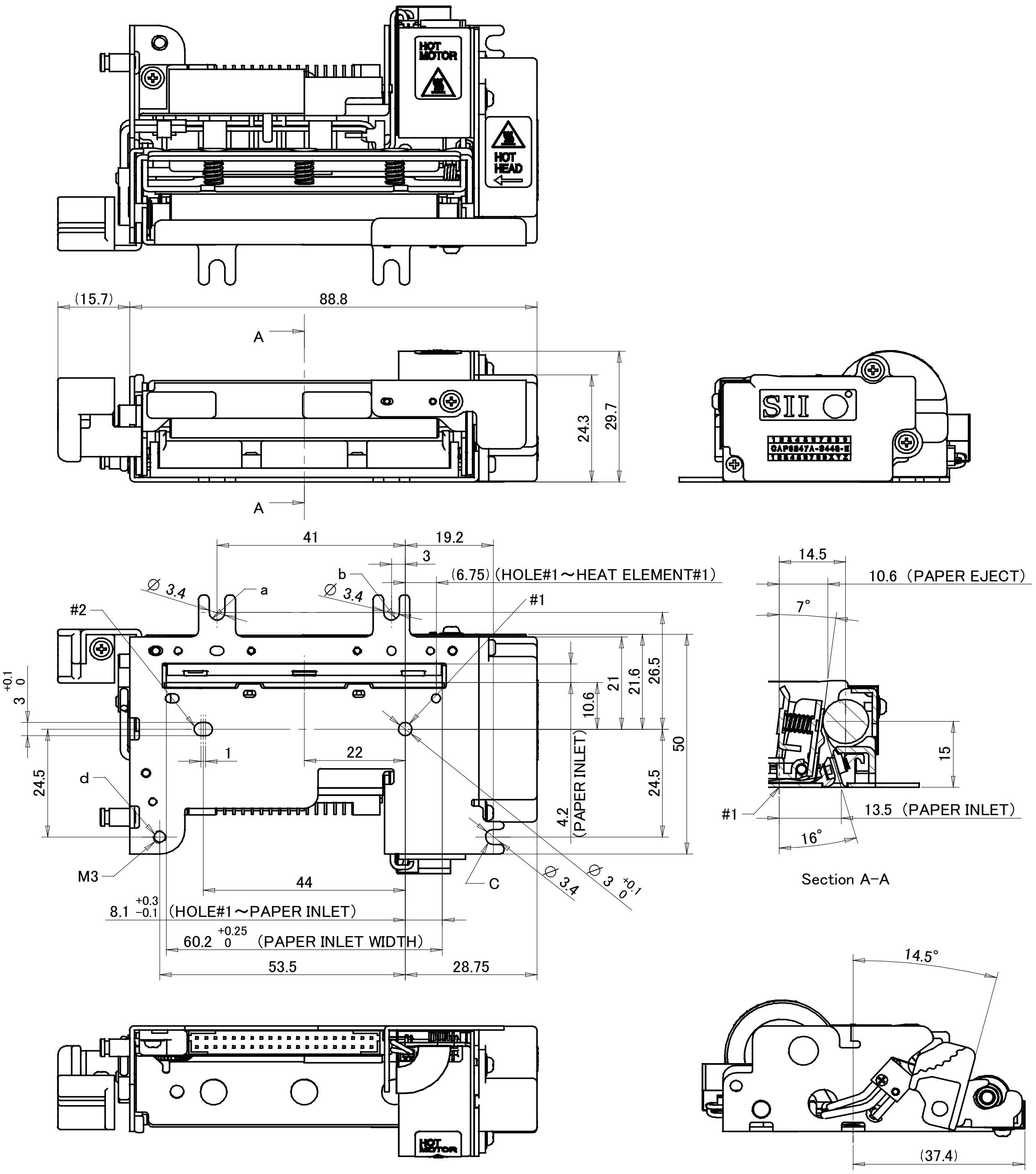
Unit : mm
General tolerance for dimension : ±0.5
General tolerance for angle : ±2°

Figure 7-3 Appearance and Dimensions of the CAP9347E-S640-E/CAP9347G-S640-E



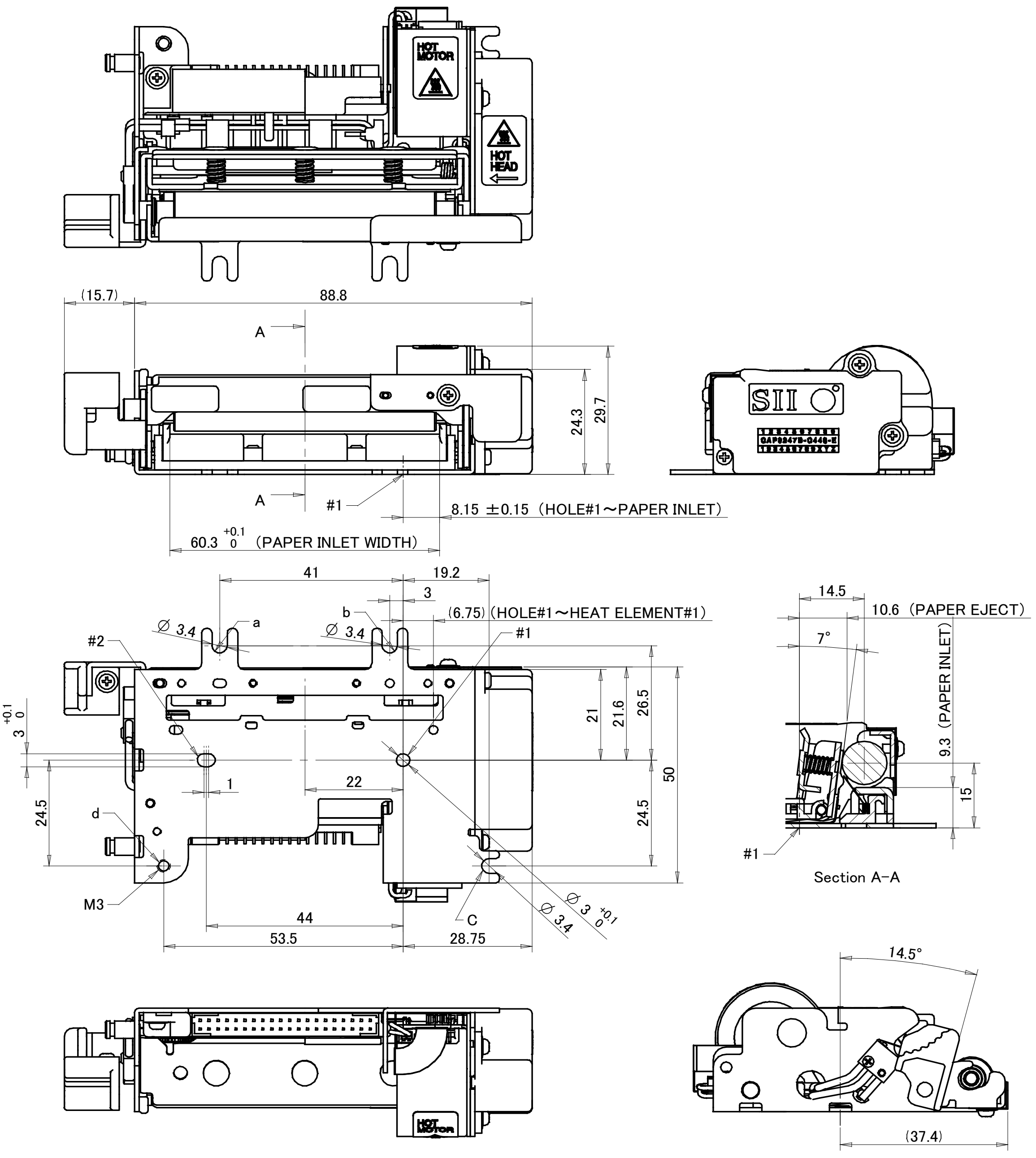
Unit : mm
General tolerance for dimension : ±0.5
General tolerance for angle : ±2°

Figure 7-4 Appearance and Dimensions of the CAP9347F-C640-E



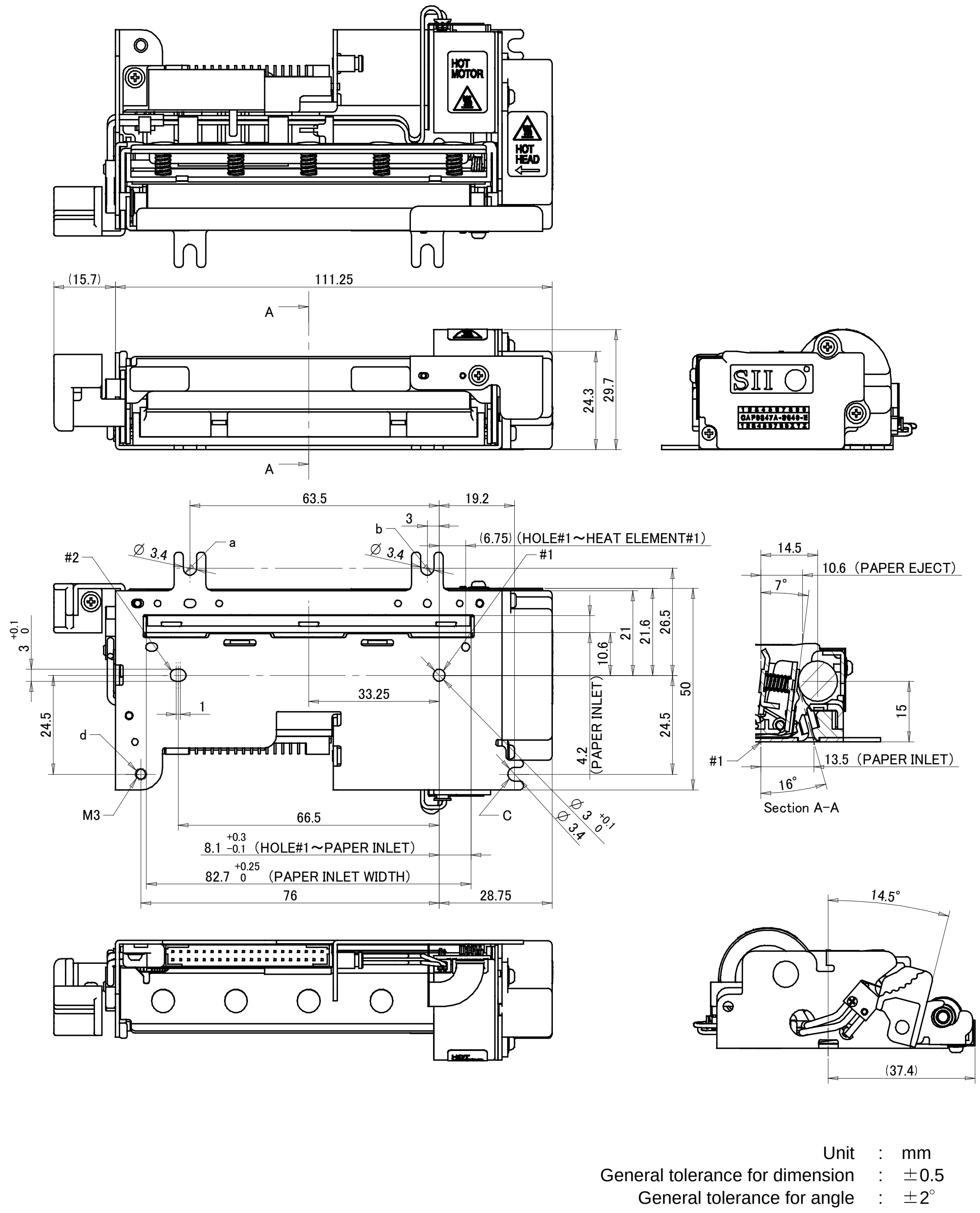
Unit : mm
General tolerance for dimension : ±0.5
General tolerance for angle : ±2°

Figure 7-5 Appearance and Dimensions of the LTP9247A-S448-E



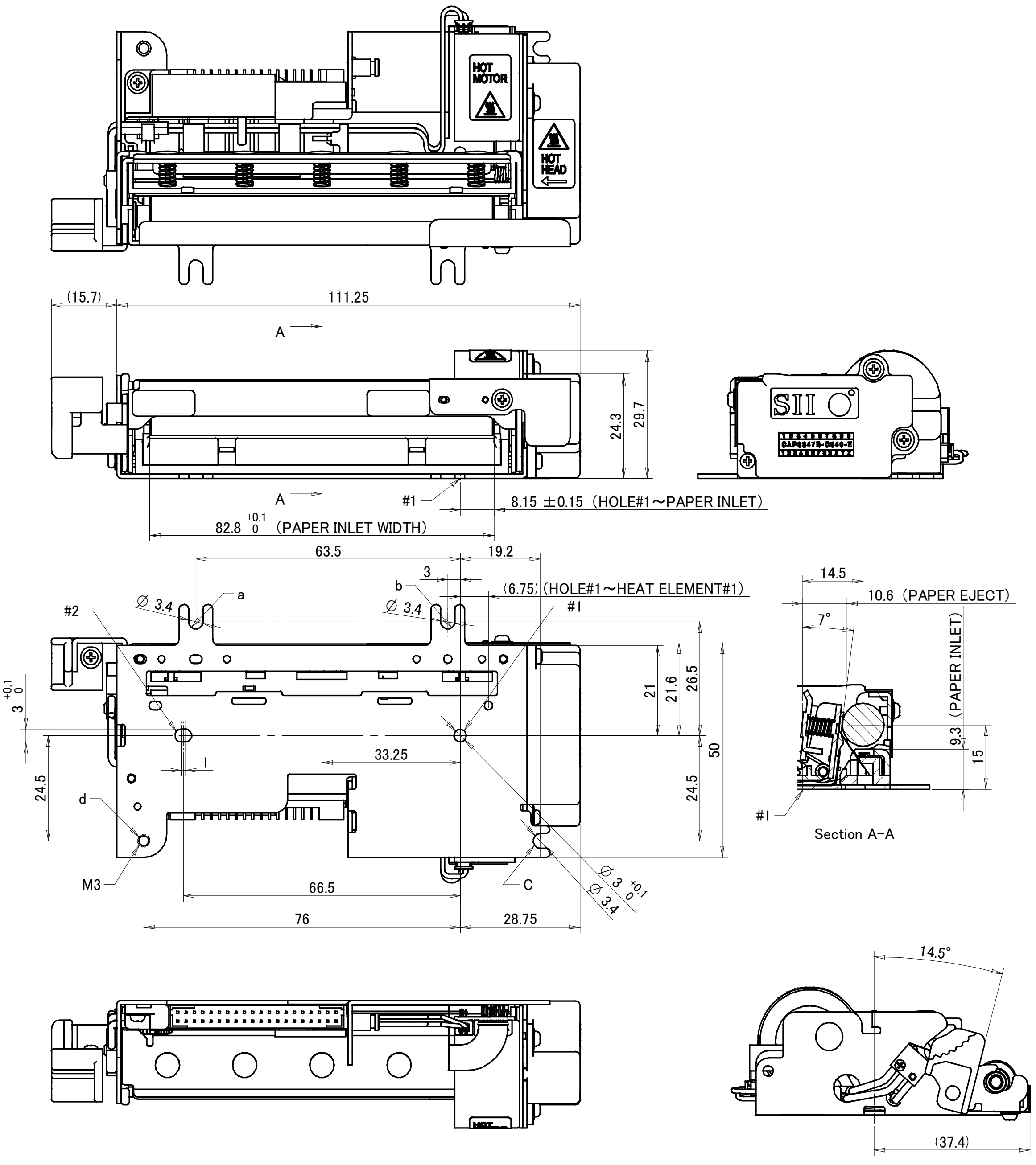
Unit : mm
General tolerance for dimension : ±0.5
General tolerance for angle : ±2°

Figure 7-6 Appearance and Dimensions of the LTP9247B-C448-E



Unit	:	mm
General tolerance for dimension	:	±0.5
General tolerance for angle	:	±2°

Figure 7-7 Appearance and Dimensions of the LTP9347A-S640-E



Unit : mm
General tolerance for dimension : ±0.5
General tolerance for angle : ±2°

Figure 7-8 Appearance and Dimensions of the LTP9347B-C640-E

CHAPTER 8

LOADING/UNLOADING THERMAL PAPER AND HEAD CLEANING

8.1 LOADING/UNLOADING THERMAL PAPER PROCEDURES

(1) Loading thermal paper

- Make sure that the cutter unit and the platen block are in close state. Insert thermal paper using the auto loading system. (See Figure 8-1)
- Push the green labels shown by arrow marks in the Figure 8-1 to close the cutter unit and the platen block. Pushing other areas may cause print defects or cutting defects.
- When the platen block is closing, it may stop in the midway depending on the gear meshing.
  In such a case, open the platen block by using the platen release lever and then close it again.
  (See Figure 8-1)
- In order to adjust paper skew, open the cutter unit and the platen block and then insert thermal paper again.

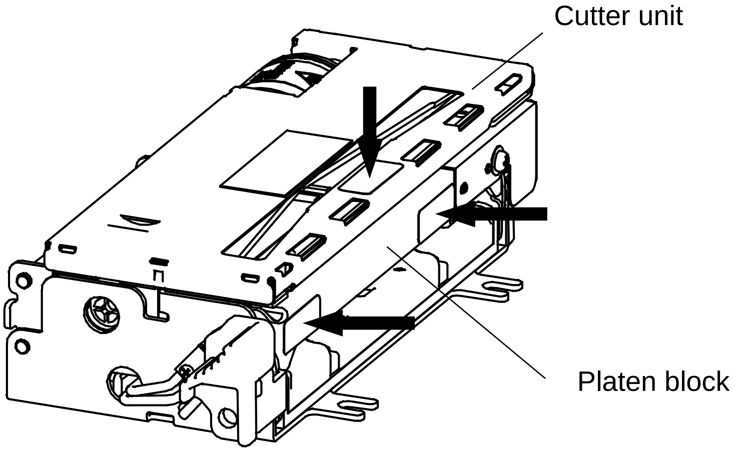


Figure 8-1 How to Close the Cutter Unit and the Platen Block

- Refer to “3.9.4 Application of the Out-of-Paper Detector” for control method.
- If the printer is being left with the platen block closed for a long period of time, the auto loading system may not work due to that the thermal head and the platen stick together. When facing this problem, open the platen block to release the sticking and try again.
- Cut the leading edge of the paper roll straight across as the Figure 8-2 shown.

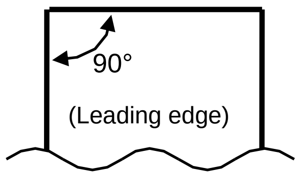


Figure 8-2 Leading Edge of the Paper Roll

Note) Refer to “3.9.3 Paper/Timing Mark Detector Position” for the paper detector position.

- Insert the thermal paper until it meets resistance. To prevent paper skew, design a paper guide so it fits snugly against the sides of the thermal paper.

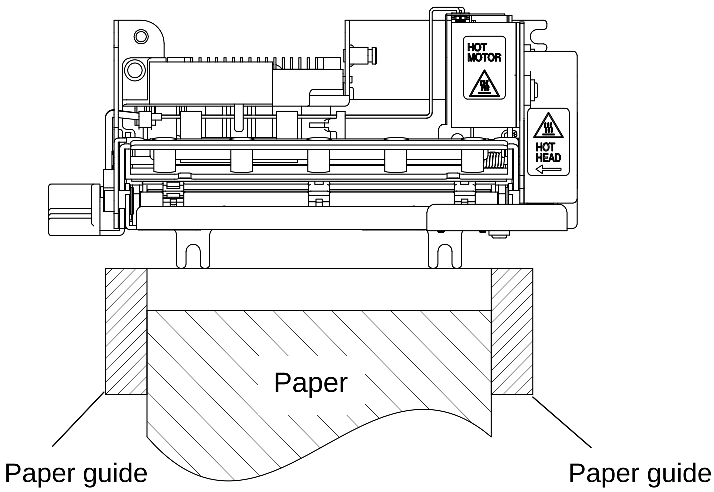


Figure 8-3 Example of Paper Guide

- When facing the paper skew, feed thermal paper until it becomes straight. Another way is to open the platen block and release sticking and try again.
- In an environment with high temperature and high humidity, paper may loose firmness and may result in auto loading difficulty or paper jam. Verify a performance under the use environment.
- When roll diameter becomes smaller and curling becomes stronger, difficulty of paper insertion may occur.

(2) Unloading thermal paper

- Unload thermal paper after making sure that the cutter unit and the platen block are in open state.
- In order to open the cutter unit, lift it up to the direction of the arrow mark shown in the Figure 8-4. Push the platen release lever down to open the platen block. Pushing other areas may cause print defects or cutting defects.
- Ensure that the platen, the platen gear, FPC, and sensors do not get damaged when opening and closing the cutter unit and the platen block.

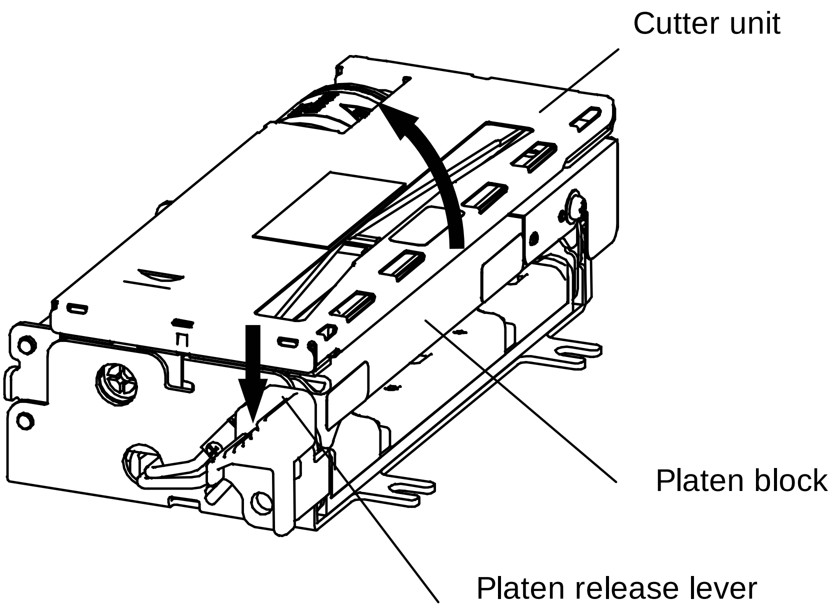


Figure 8-4 How to Open the Cutter Unit and the Platen Block

(3) Removing jammed paper

- Remove the thermal paper by the same operation as the procedure of unloading thermal paper.

(4) Release procedure when the movable blade is locked

If the thermal paper is jammed (the movable blade is locked), release it through the procedures given below.

1) Stop the power supply to the cutter motor immediately.

2) To return the movable blade to the home position, supply the power again so as to reverse the cutter motor.

3) After the movable blade is returned to the home position, stop the power supply to the cutter motor, and remove an external cause (for instance, remove jammed paper or foreign substances).

4) If the movable blade does not return to the home position, stop the power supply to the cutter motor immediately. Insert the Phillips screwdriver into the gutter at the leading end of the motor shaft on the side of the printer and rotate it to move the movable blade from the paper feed space to the home position and remove external cause. (See Figure 8-5)

Rotate the screwdriver toward the direction in which the movable blade returns.

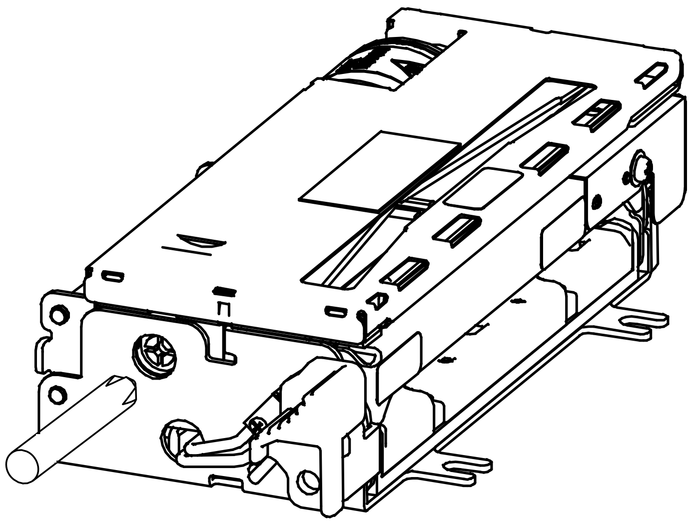


Figure 8-5 Release Procedures When Cutter Motor (Movable Blade) is Locked

8.2 HEAD CLEANING PRECAUTIONS AND PROCEDURES

8.2.1 Precautions

(1) Do not clean the head unit and its periphery immediately after printing because the head unit and its periphery are hot during and after printing.

(2) Do not use sandpaper, a cutter knife, or anything which may damage the heat element for cleaning.

(3) Ensure that the thermal head, the platen, the FPC, and the sensors do not get damaged.

8.2.2 Procedures

(1) Set the cutter unit and the platen block in open state by the same operation as the unloading thermal paper.

(2) Clean the heating elements using ethyl alcohol or isopropyl alcohol and a cotton swab. (See Figure 8-6)

(3) Wait until the alcohol dries before closing the cutter unit and the platen block.

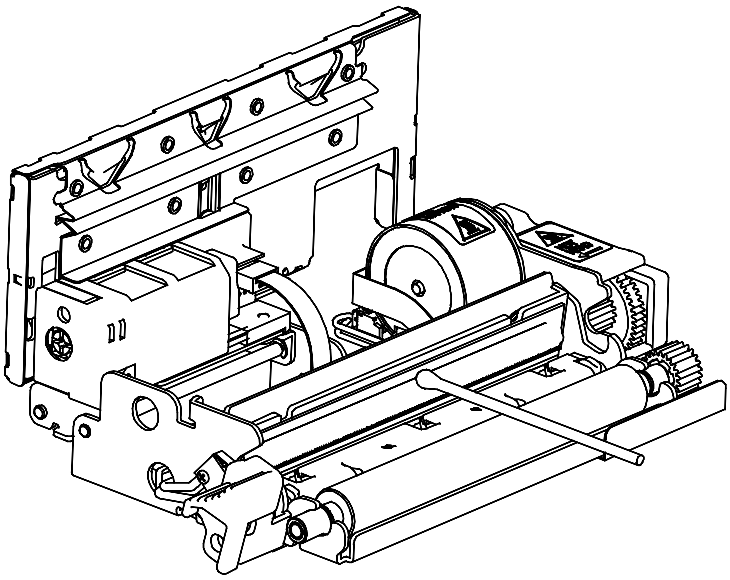


Figure 8-6 Head Cleaning Procedures