



LTP01-245-11/12/18
THERMAL PRINTER MECHANISM
TECHNICAL REFERENCE

U00129248801

Seiko Instruments Inc.

LTP01-245-11/12/18 THERMAL PRINTER MECHANISM TECHNICAL REFERENCE

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PREFACE

This technical reference describes the specifications and basic operating procedures for the LTP01-245-11/12/18 thermal printer mechanism (hereinafter referred to as “printer”).

The printer has the following models.

- LTP01-245-11
- LTP01-245-12
- LTP01-245-18

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

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

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

It is possible to use the LTP01 series for replacing LTPZ245M-C384-E thermal printer mechanism (hereinafter referred to as "LTPZ245M").

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 following describes identifying the parts of the LTP01-245-11, LTP01-245-12, and LTP01-245-18 as an example of the LTP01-245-11. The figure of LTP01-245-12 and LTP01-245-18 illustrates only the differences from LTP01-245-11.

Printer mechanism

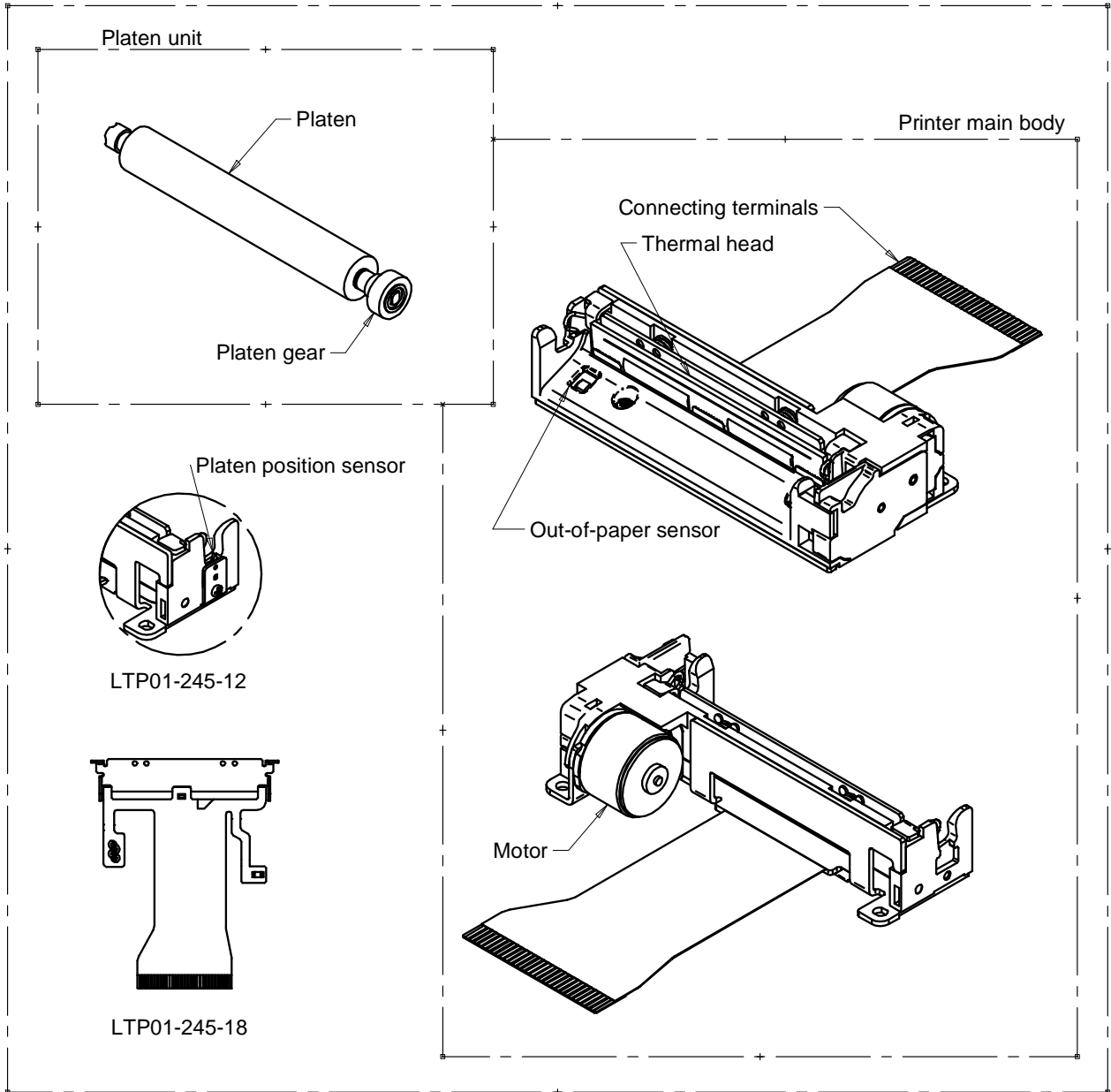


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CHAPTER 1

PRECAUTIONS

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

For the latest information, contact our sales representative.

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

SII shall not be liable for any 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.

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

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

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

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

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

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

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

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

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

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

- **Precautions for motor drive**

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

1.2 DESIGN AND HANDLING PRECAUTIONS

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

1.2.1 Design Precautions

- Apply power in the following manner:
At power on : (1) V_{dd} → (2) V_P
At shut down : (1) V_P → (2) V_{dd}
- A surge voltage between V_P and GND should not exceed 10V.
- For noise countermeasure, connect a 0.1 μ F capacitor between V_{dd} and GND pins near the connector.
- Make the wire resistance between the power supply (V_P and GND) and the printer (connecting terminals) as small as possible (below 50m Ω). Keep distance from signal lines to reduce electrical interference.
- The switch and the sensor may generate instantaneous abnormal signal. Design the firmware in order to prevent malfunction due to the abnormal signal.
- Keep the V_P power off during 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 DST signals of the thermal head.
- When turning the power on or off, or during not printing, always disable the DST terminals.
- To prevent the thermal head, out-of-paper sensor, motor, and platen detection switch from being damaged by static electricity:
 - (1) Connect the printer Frame Ground (FG) connecting area to the Frame Ground (FG) of the outer case. See Chapter 6 "OUTER CASE DESIGN GUIDE" for details.
 - (2) Connect the Signal Ground (GND) to the Frame Ground (FG) through approximately 1 M Ω resistance.
- Always detect the outputs of the platen position sensor and out-of-paper sensor. Never activate the thermal head when the platen unit is in open state and when there is no thermal paper. Incorrect activation of the thermal head may reduce the life of the thermal head and the platen and may damage them.
- A pause time between thermal head activations of the same heat element shall be secured more than 0.5ms. Pay attention to when using one division printing or when a thermal head activation time becomes longer. If activating for a long time without the pause time, the thermal head may become damaged.
- If too much energy is applied to the thermal head, it may overheat and become damaged. Always use the printer with the specified amount of energy shown in Chapter 3 "CONTROLLING THE ACTIVATION PULSE WIDTH FOR THERMAL HEAD".
- 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.
- Do not perform continuous printing to prevent the motor from overheating. Refer to Chapter 3 "Motor Drive Method" to set a pause time.

- Paper feeding may be confused with several dot lines when printing is started from waiting status. When printing and paper feeding are interrupted and then started printing, as this may cause the paper feeding be confused. When printing bit images and so on, always feed the thermal paper for more than 48 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 48 steps or more at the initialization, at a time after setting/releasing the platen unit, at a time after feeding the thermal paper backward, and a time after cutting with a paper cutter.
- Surface of thermal paper may get scratched by backward feed. The backward feed may cause paper skew and jams depending on paper roll layout and designing of paper holder. Be sure to confirm performance with your product before using the backward feed.
- If printing at a high print ratio for longer length, non-printing area may be colored due to an accumulation of heat. Verify the performance with your actual device.
- It is recommended that the door is guided by part of the outer case, when the platen unit is set into the printer main body. If the rotation fulcrum of the rotation system of the door is configured to the component mounting the printer main body, could design with high accuracy.
- A door on the outer case that holds the platen unit must be set by pushing the center of the platen unit. If only one end of the platen unit is set, a print defect, and/or a paper jam will occur. Verify the performance with your actual device. In order to be pushed the center of the platen to set it, put an indication to do so.
- If the printer main body and the platen unit are not placed in proper position, the print defect and the paper jam may occur. Therefore, pay special attention to it when designing the outer case. For the position relation between the printer main body and the platen unit, see Chapter 6 "OUTER CASE DESIGN GUIDE".
- 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 unit. 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 unit should be stable when it is in the close state.
- 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 paper detection difficulty will be caused and the surface of thermal paper may get scratched. Verify the performance with your actual device.
- Do not use labeling paper, 2-ply thermal paper, and the thermal paper with thickness of 75 μ m or thicker.
- 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 unit, so design the product so that the FPC has enough play after connected it. The tension force may cause some print problems and may damage the FPC.
- Metal parts may become discolored and rusted due to the operational environment. Consider these factors regarding appearance.
- Pressure or stress for direction where the platen unit is released should be applied only when the platen unit is actually released. Permanent pressure or stress for releasing the platen unit may cause slipping gears, negative influence on printing quality, and printing troubles during operation.
- Contrary to the LTPZ245M, it is required to prevent overheating in the printer. See "3.3.6 Motor Drive Precautions" for details.

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
- 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 the thermal paper for a while to recover deformation of the platen. If the thermal head is remained in contact with the platen without thermal paper for a long time, the platen and the thermal head may be stuck together and cause paper feed difficulty. If facing this problem, release the platen unit, and set it back again before starting printing.
- Never loosen the screws that fasten respective parts of the printer. Loosened screws may reduce the efficiency of the performance of the printer mechanism.
- Do not release the platen unit during printing; otherwise this may reduce the efficiency of the printer and may cause damage.
- Do not apply stress to the platen unit during printing. The print defect may occur.
- When setting the platen unit, the reduction gear may interfere with the platen gear and may cause the platen unit to not be set. In such a case, release the platen unit and set it again.
- Never pull out the thermal paper while the platen unit is set. The printer mechanism may become damaged.
- When handling the printer, make sure to use antistatic clothing and to ground yourself to prevent the electronic parts such as thermal head, out-of-paper sensor, motor, and platen detection switch from damaged by static electricity. Especially take care of the thermal head heat element and the connecting terminal.
- Do not hit or scratch the surface of the thermal head with any sharp or hard object. This could damage the thermal head.
- When printing at a high print ratio in a low temperature or high humidity environment, the vapor from the thermal paper during printing may cause condensation to form on the printer and soil the thermal paper itself. Prevent the thermal head from a drop of water. It may cause electrolytic corrosion of the thermal head. If condensed, do not activate electricity until dried.
- Connect or disconnect the connecting terminal after turn off the power.
- Do not apply stress to the FPC while connecting and disconnecting them. Otherwise the FPC may become damaged.
- Warn users not to pull the thermal paper and not to change the paper eject angle during printing. Otherwise, the paper jam or the cut failure may occur.

- In order to prevent the electronic parts such as thermal head, out-of-paper sensor, motor, and platen detection switch 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 the thermal paper.
- Do not use the paper roll with glued end or folded end. In case of using such paper roll, 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. Never use the printer in a dusty place, as it may damage the thermal head and paper drive system.
- Do not use the printer in corrosive gas and siloxane atmosphere as it may cause the contact failure.

1.2.3 Precautions on Discarding

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

* : Refer to the technical reference for other information on precautions.

CHAPTER 2

FEATURES

The printer is a compact printer that adopts a thermal line dot printing method. It 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**

Dimensions : W69.8mm x D32.7mm x H15.3mm (LTP01-245-11, LTP01-245-18)
W70.3mm x D32.7mm x H15.3mm (LTP01-245-12)

Mass : Approx. 44 g

- **High print speed***

Maximum 75mm/s print is available.

- **Easy operation**

Platen open mechanism provides easy paper installation.

- **Auto-loading function**

Automatic insertion of the thermal paper is enabled by the Auto-loading function.

- **Maintenance Free**

No cleaning and no maintenance required.

- **Low noise**

Thermal printing technology realizes low-noise print.

- **Replaceability**

Possible for full replacement from LTPZ245M.

*: Print speed differs depending on working conditions.

CHAPTER 3 SPECIFICATIONS

3.1 GENERAL SPECIFICATIONS

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

Table 3-1 General Specifications

(1/2)

Items	Specifications	
	LTP01-245-11/18	LTP01-245-12
Printing method	Thermal dot line printing	
Total dots per line	384 dots	
Printable dots per line	384 dots	
Simultaneously activated dots	64 dots max.	
Resolution	W 8 dots/mm × H 16 dots/mm	
Paper feed pitch	0.0625 mm	
Maximum print speed	75 mm/s ^{*1}	
Print width	48 mm	
Paper width	58 ₋₁ ⁰ mm	
Thermal head temperature detection	Thermistor	
Platen position detection	None	Mechanical switch
Out-of-paper detection	Reflection type photo interrupter	
Operating voltage range		
V _P line	4.75 V to 9.5 V	
V _{dd} line	3.0 V to 3.6 V, or 4.75 V to 5.25 V	
Current consumption		
V _P line Thermal head drive	3.76 A max. (at 9.5 V) ^{*2}	
Motor drive	0.65 A max.	
V _{dd} line Thermal head logic	0.1 A max.	

Items	Specifications	
	LTP01-245-11/18	LTP01-245-12
Operating temperature range	0°C to 50°C (Non condensing)	
Operating humidity range		
Storage temperature range	-25°C to 60°C (Non condensing)	
Life span (at 25°C and rated energy)	Activation pulse resistance	100 million pulses or more ^{*3}
	Abrasion resistance	50 km or more ^{*4}
Paper feed force	0.49 N (50 gf) or more	
Paper hold force	0.78 N (80 gf) or more	
Dimensions ^{*5}	W 69.8 mm × D 32.7 mm × H 15.3 mm	W 70.3 mm × D 32.7 mm × H 15.3mm
Mass	Approx. 44 g	
Specified thermal paper	Nippon Paper Oji Paper Co., Ltd. Papierfabrik August Koehler AG Mitsubishi Paper mills limited Jujo Thermal Mitsubishi Hi-Tech Paper KSP	TF50KS-E2D PD150R PD160R-N KT55F20 F220VP AF50KS-E AP50KS-FZ F5041 P300

*1 : Print speed changes according to the processing speed of the controller and print pulse width of the thermal head.

*2 : The value when the number of simultaneously activated dots is 64 dots.

*3 : Excluded when the same dots are printed continuously.

*4 : Excluding damage caused by dust and foreign materials.

*5 : Excluded convex part.

3.2 PRINT CONFIGURATION

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

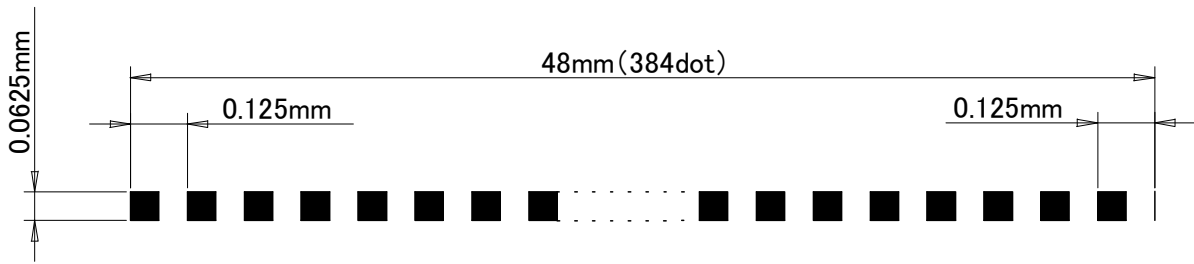


Figure 3-1 Print Dot Pitch

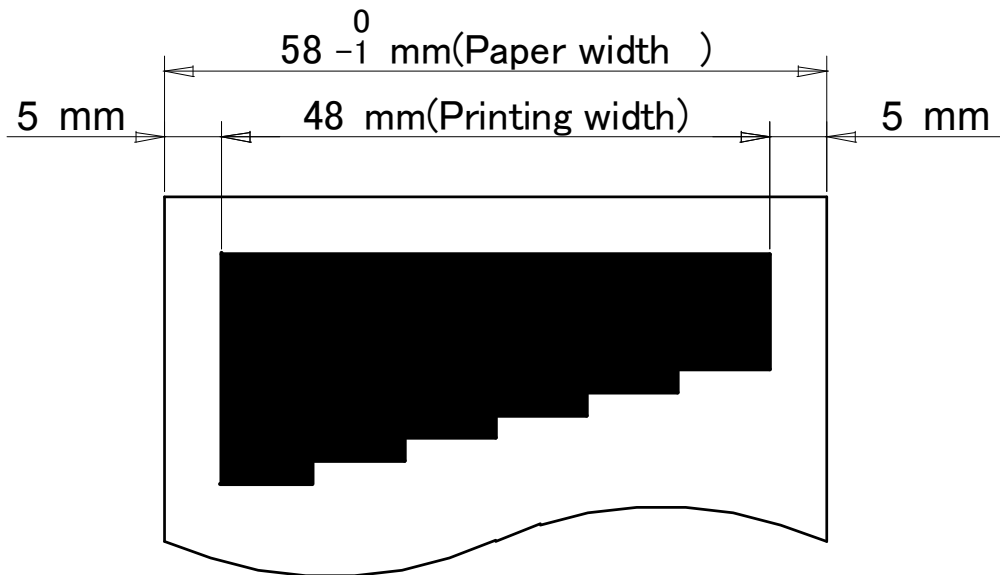


Figure 3-2 Print Area

3.3 STEP MOTOR

3.3.1 General Specifications

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

Table 3-2 General Specifications of the Step Motor

Item	Specifications
Type	PM type step motor
Drive method	Bi-polar chopper
Excitation	1-2 phase
Winding resistance per phase	10.5 Ω /phase \pm 10%
Motor drive voltage	V_P : 4.75 V to 9.5 V
Motor controlled current	325 mA/phase ^{*1} (450 mA/phase ^{*2})
Drive pulse rate	2400 pps max.

*1: During paper feeding/print.

*2: During auto-loading the thermal paper.

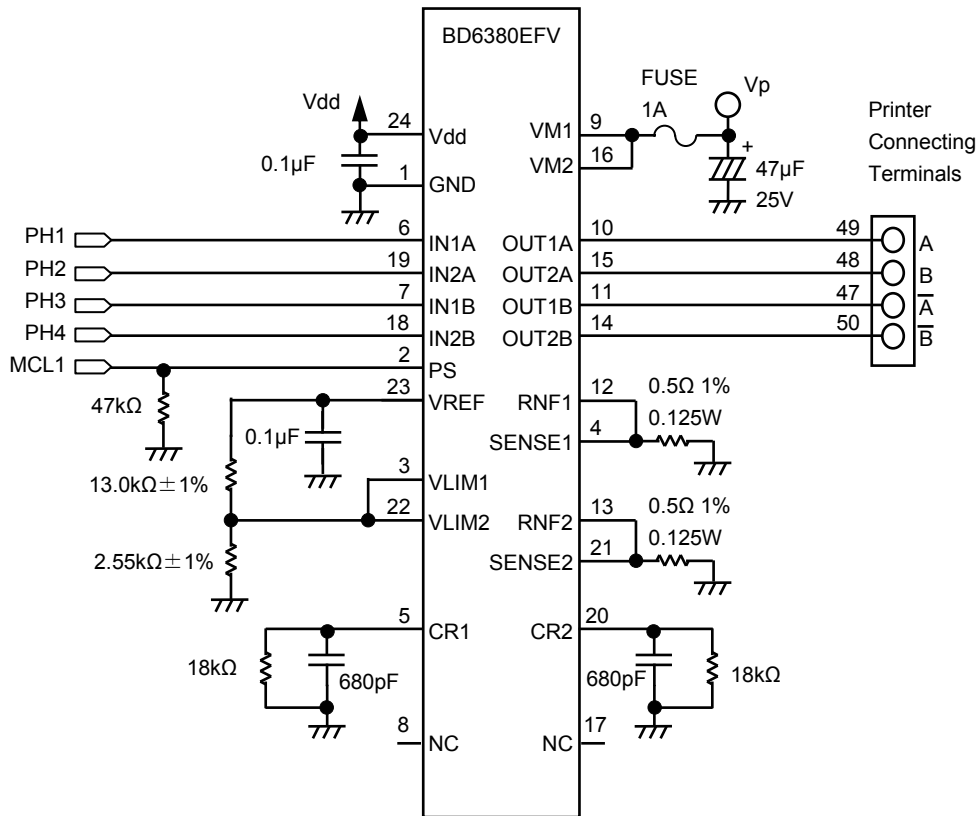
See "3.3.5 Motor Drive Method" for how to set the motor controlled current.

3.3.2 Sample Drive Circuit

(a) Motor current control with VREF signal

Figure 3-3 is a sample drive circuit when motor driver VREF signal (1.0V output) and resistance voltage division are used to perform the motor current control. It is not possible to use this sample circuit when auto-loading is used because the motor current switching control is required.

Drive Condition	Motor Controlled Current (Fixed)	VLIM Terminal Input Voltage
Paper feeding/Printing	325 mA	161 mV to 167 mV



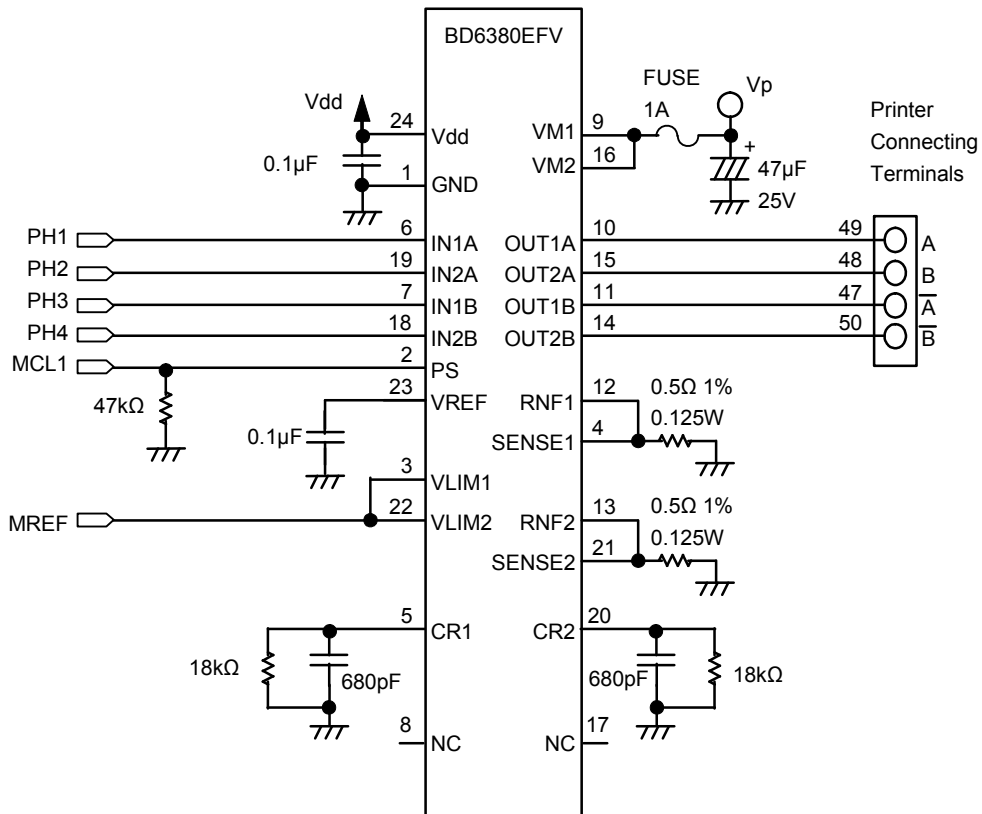
*: Recommended motor driver : BD6380EFV(Rohm)

Figure 3-3 Sample Drive Circuit 1

(b) Motor current control without VREF signal

Figure 3-4 is a sample drive circuit when the current control is performed without using motor driver VREF signal. The motor controlled current is switched by the MREF signal voltage.

Drive Condition	Motor Controlled Current	VLIM Terminal Input Voltage
Paper feeding/Printing	325 mA	161 mV to 167 mV
Auto-loading	450 mA	222 mV to 228 mV

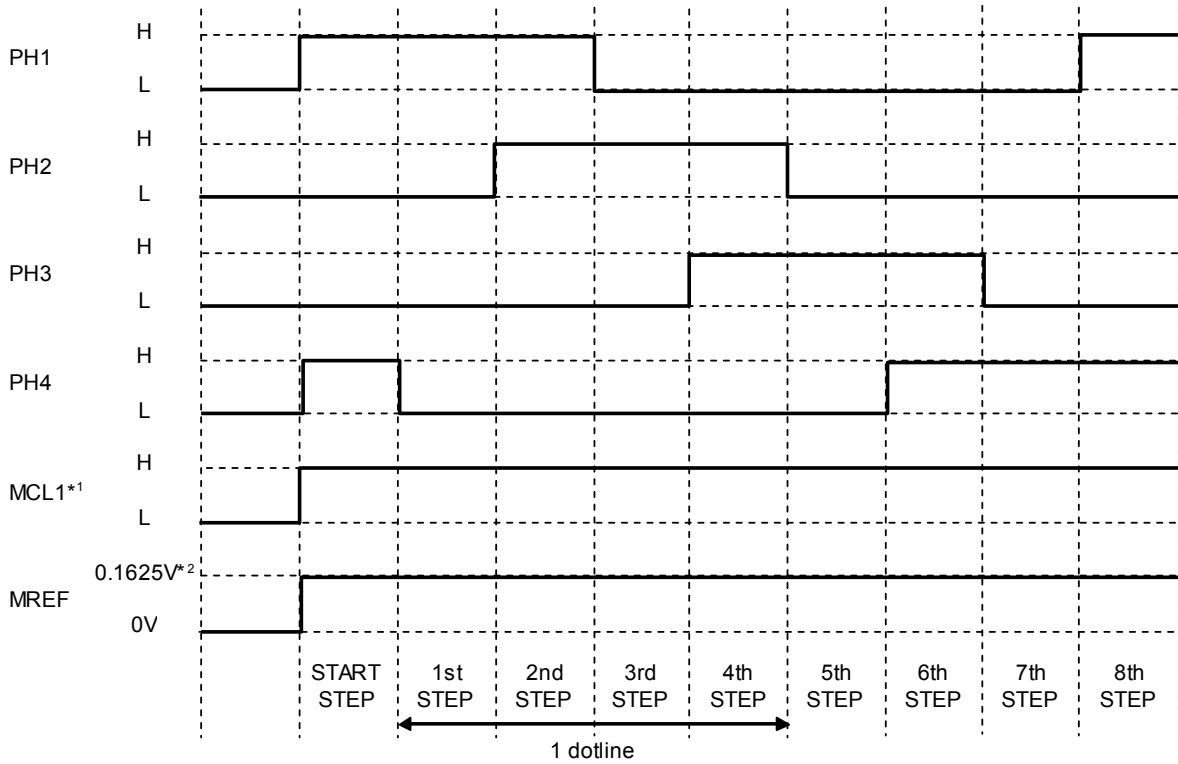


*: Recommended motor driver : BD6380EFV(Rohm)

Figure 3-4 Sample Drive Circuit 2

3.3.3 Excitation Sequence

Drive the motor with 1-2 phase excitation. One step of the motor drive signal feeds the thermal paper 0.03125 mm. One dot line is consisted of 4 steps. When the voltage signal shown in Figure 3-5 is input to the motor drive circuit shown in Figure 3-3, the printer feeds the thermal paper in the normal direction when the motor is excited in order of step 1, step 2, step 3, step 4, step 5, step 6, step 7, step 8, step 1, step 2, , as shown in Table 3-3.



*1: Set MCL1 to "High" while the motor is driven.
 *2: 0.1625V during paper feeding/print, 0.225V during auto-loading.

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

Table 3-3 Excitation Sequence

	Input Signal				Output Signal			
	PH1	PH2	PH3	PH4	A	B	\bar{A}	\bar{B}
Step 1	H	L	L	L	H	OPEN	L	OPEN
Step 2	H	H	L	L	H	H	L	L
Step 3	L	H	L	L	OPEN	H	OPEN	L
Step 4	L	H	H	L	L	H	H	L
Step 5	L	L	H	L	L	OPEN	H	OPEN
Step 6	L	L	H	H	L	L	H	H
Step 7	L	L	L	H	OPEN	L	OPEN	H
Step 8	H	L	L	H	H	L	L	H

3.3.4 Motor Start/Stop Method

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

(1) Start step

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

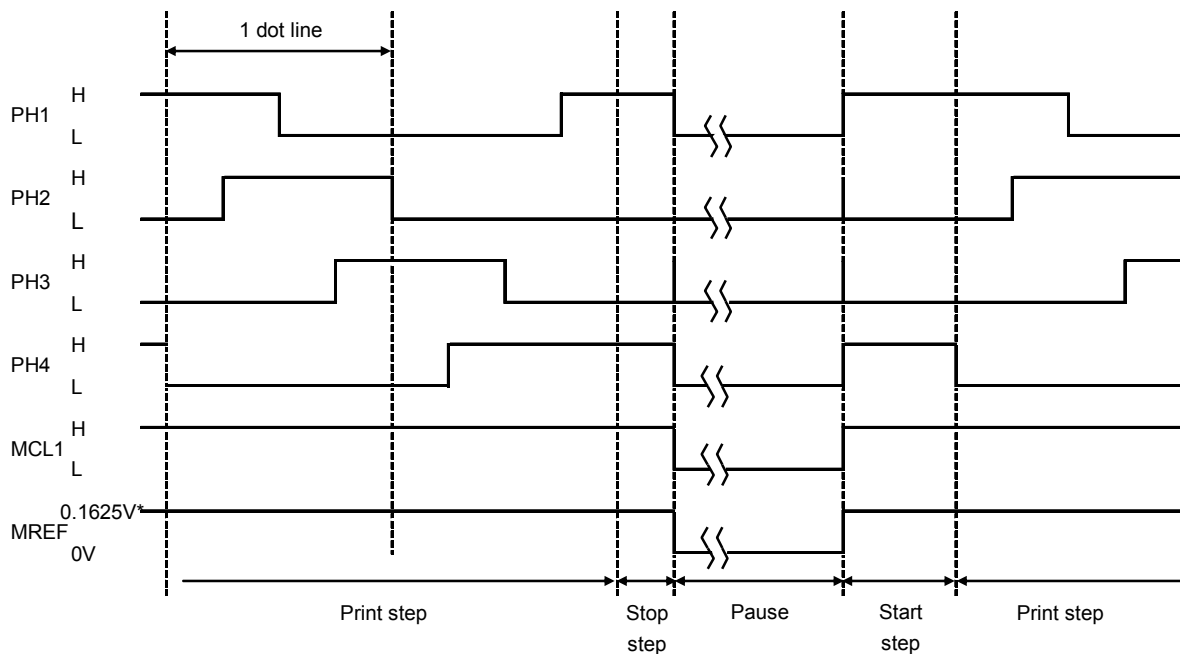
(2) Stop step

To stop the motor, excite the same phase as the last one in the printing step for 65 ms.

(3) Pause state

In the pause state, do not excite the motor to prevent 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 3-6.



0.1625V during paper feeding/print, 0.225V during auto-loading.

Figure 3-6 Motor Start/Stop Timing Chart

3.3.5 Motor Drive Method

Drive the motor by the following methods.

(1) Motor drive pulse rate

During paper feeding with V_P under 7.5V, the motor should be driven lower than the value obtained by equation (1).

Equation (1):

$$P_M = V_P \times 400 - 600 \text{ (pps)}$$

- P_M : Maximum motor drive pulse rate at V_P (pps)
- V_P : Motor drive voltage (V)

*: The motor should be driven lower than 2400pps when V_P is 7.5V or higher.

Table 3-4 Maximum Motor Drive Pulse Rate

V_P	Maximum Motor Drive Pulse Rate
4.75 V	1300 pps
5.5 V	1600 pps
6.5 V	2000 pps
7.5 V	2400 pps
8.5 V	2400 pps
9.5 V	2400 pps

During auto-loading the thermal paper, the motor should be driven lower than the value obtained by equation (2).

Equation (2):

$$P_M = V_P \times 40 - 420 \text{ (pps)}$$

- P_M : Maximum motor drive pulse rate at V_P (pps)
- V_P : Motor drive voltage (V): 5V or higher

Table 3-5 Maximum Motor Drive Pulse Rate (During auto-loading)

V_P	Maximum Motor Drive Pulse Rate
5.0 V	620 pps
5.5 V	640 pps
6.5 V	680 pps
7.5 V	720 pps
8.5 V	760 pps
9.5 V	800 pps

(2) Motor speed control

When driving the motor, the acceleration control is required to maintain the paper feed force of start up. If acceleration of the motor does not perform correctly, the motor may not be able to rotate normally if it has a heavy workload. Accelerate the speed sequentially up to the maximum motor drive pulse rate P_M according to the Table 3-6 Acceleration Steps.

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

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

Available to print during acceleration.

Follow the procedures below if :

Unable to accelerate the speed according to the acceleration step as shown in Table 3-6 .

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 closest acceleration step time, which should be longer than the previous acceleration step time and the shortest.

(Example) In the case of Table 3-6 , if the motor acceleration step time of the previous step is $900\mu\text{s}$, the next step should be the 14th acceleration step ($921\mu\text{s}$).

Hereinafter, accelerate the speed sequentially up to the maximum motor drive pulse rate P_M . in accordance with the acceleration step as show in Table 3-6 .

Table 3-6 Acceleration Steps

Number of Steps	Drive pulse rate (pps)	Step Time (μs)	Number of Steps	Drive pulse rate (pps)	Step Time (μs)
Start	-	4654	33	1707	586
1	215	4654	34	1733	577
2	348	2876	35	1760	568
3	450	2221	36	1786	560
4	536	1865	37	1811	552
5	612	1635	38	1836	545
6	680	1471	39	1861	537
7	742	1348	40	1885	530
8	800	1251	41	1910	524
9	854	1171	42	1934	517
10	905	1105	43	1957	511
11	953	1049	44	1980	505
12	999	1001	45	2003	499
13	1044	958	46	2026	494
14	1086	921	47	2049	488
15	1127	887	48	2071	483
16	1167	857	49	2093	478
17	1205	830	50	2115	473
18	1242	805	51	2137	468
19	1278	782	52	2158	463
20	1313	761	53	2179	459
21	1348	742	54	2200	455
22	1381	724	55	2221	450
23	1414	707	56	2242	446
24	1446	692	57	2262	442
25	1477	677	58	2282	438
26	1508	663	59	2302	434
27	1538	650	60	2322	431
28	1567	638	61	2342	427
29	1596	627	62	2361	423
30	1624	616	63	2381	420
31	1652	605	64	2400	417
32	1680	595	-	-	-

(3) Preventing overheat

To prevent the motor from overheating, the maximum continuous drive time and drive ratio are limited. Table 3-7 shows the maximum continuous drive time and drive ratio when a print length is within 1m.

Set the drive time and pause time of the motor according to the values shown in Table 3-7.

Also, Table 3-8 shows the drive time and the paper length at temperature rise of 50°C. There is no limit when temperature rise is 75°C.

Temperature rise of the motor is different according to the use conditions. (ambient temperature, design of the outer case etc.) Keep the temperature of the motor outer case, 100°C or lower. However, do not mount a heat sink or other parts on the motor. Verify the performance with your actual device.

When the same control as the LTPZ245M is used, maximum continuous drive time and drive ratio vary. See Table 3-9, Table 3-10, and Table 3-11.

Table 3-7 Maximum Continuous Drive Time and Drive Ratio

Drive Pulse Rate(pps) (or more to less than)	Maximum Continuous Drive Time (sec)	Motor drive voltage $V_p(V)$					
		$9.5V \geq V_p > 8.5V$	$8.5V \geq V_p > 7.5V$	$7.5V \geq V_p > 6.5V$	$6.5V \geq V_p > 5.5V$	$5.5V \geq V_p > 4.75V$	4.75V
		Drive Ratio					
320 ~ 480	100	50%	50%	50%	50%	50%	60%
480 ~ 640	67	55%	55%	55%	55%	60%	70%
640 ~ 800	50	55%	55%	55%	55%	60%	75%
800 ~ 960	40	55%	55%	55%	55%	65%	80%
960 ~ 1120	33	55%	55%	55%	55%	65%	80%
1120 ~ 1280	29	55%	55%	55%	55%	65%	95%
1280 ~ 1440	25	55%	55%	55%	60%	70%	100%
1440 ~ 1600	22	55%	55%	60%	65%	75%	-
1600 ~ 1760	20	60%	60%	60%	70%	85%	-
1760 ~ 1920	18	60%	60%	60%	70%	-	-
1920 ~ 2080	17	60%	60%	65%	75%	-	-
2080 ~ 2240	15	60%	60%	65%	-	-	-
2240 ~ 2400	14	60%	60%	65%	-	-	-
2400	13	60%	60%	65%	-	-	-

- : Unusable

Set the Drive Pulse Rate according to "3.3.5 Motor Drive Method".

Table 3-8 Maximum Continuous Drive Time (min) and Paper Feed Length (m) at Temperature Rise 50°C

Drive Pulse Rate (pps)	Motor Drive Voltage V_p (V)											
	$9.5V \geq V_p > 8.5V$		$8.5V \geq V_p > 7.5V$		$7.5V \geq V_p > 6.5V$		$6.5V \geq V_p > 5.5V$		$5.5V \geq V_p > 4.75V$		4.75V	
	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)
320 ~ 480	7.1	4.3	7.3	4.4	7.3	4.4	7.2	4.3	7.6	4.5	9.4	5.7
480 ~ 640	7.3	6.5	7.1	6.3	7.4	6.6	7.3	6.6	8.5	7.6	9.0	8.1
640 ~ 800	7.3	8.7	6.7	8.0	7.3	8.7	6.9	8.3	8.4	10.1	9.3	11.1
800 ~ 960	7.1	10.7	6.5	9.7	7.3	10.9	6.5	9.8	9.6	14.4	10.1	15.1
960 ~ 1120	6.9	12.4	6.2	11.2	7.1	12.8	7.1	12.8	11.2	20.1	20.9	37.5
1120 ~ 1280	6.9	14.5	6.7	14.1	7.3	15.4	7.3	15.3	12.9	27.1	32.9	69.1
1280 ~ 1440	6.8	16.2	7.3	17.6	7.5	18.0	7.6	18.1	8.9	21.2	✓	✓
1440 ~ 1600	6.7	18.1	7.2	19.3	7.5	20.1	7.8	21.0	9.2	24.9	-	-
1600 ~ 1760	6.8	20.4	6.9	20.8	7.3	21.9	8.4	25.1	9.7	29.2	-	-
1760 ~ 1920	6.5	21.6	7.3	24.0	7.8	25.7	12.1	39.9	-	-	-	-
1920 ~ 2080	6.2	22.4	7.2	25.9	8.0	28.8	13.1	47.0	-	-	-	-
2080 ~ 2240	6.6	25.5	7.3	28.3	8.7	34.0	-	-	-	-	-	-
2240 ~ 2400	6.5	27.3	7.2	30.2	9.3	39.0	-	-	-	-	-	-
2400	6.6	29.6	7.7	34.4	9.8	44.0	-	-	-	-	-	-

- : Unusable ✓: No drive limitation

Set the Drive Pulse Rate according to "3.3.5 Motor Drive Method".

Table 3-9 Maximum Continuous Drive Time and Drive Ratio (When the Same Control as the LTPZ245M Is Used)

Drive Pulse Rate(pps) (or more to less than)	Maximum Continuous Drive Time (sec)	Motor drive voltage V_p (V)					
		$9.5V \geq V_p > 8.5V$	$8.5V \geq V_p > 7.5V$	$7.5V \geq V_p > 6.5V$	$6.5V \geq V_p > 5.5V$	$5.5V \geq V_p > 4.2V$	4.2V
		Drive Ratio					
320 ~ 400	50	60%	60%	60%	60%	65%	90%
400 ~ 480	40	60%	60%	65%	65%	65%	95%
480 ~ 560	33	60%	60%	65%	65%	70%	100%
560 ~ 640	29	60%	65%	65%	65%	70%	-
640 ~ 720	25	60%	65%	65%	70%	75%	-
720 ~ 800	22	60%	65%	65%	70%	80%	-
800 ~ 880	20	60%	65%	65%	70%	85%	-
880 ~ 960	18	60%	65%	65%	70%	-	-
960 ~ 1040	17	65%	65%	65%	75%	-	-
1040 ~ 1120	15	65%	70%	70%	-	-	-
1120 ~ 1200	14	65%	70%	70%	-	-	-
1200	13	65%	70%	70%	-	-	-

- : Unusable

Set the Drive Pulse Rate according to "3.3.5 Motor Drive Method".

**Table 3-10 Maximum Drive Time (min) and Paper Feed Length (m) at Temperature Rise 50°C
(When the Same Control as the LTPZ245M Is Used)**

Drive Pulse Rate (pps)	Motor Drive Voltage V_p (V)											
	$9.5V \geq V_p > 8.5V$		$8.5V \geq V_p > 7.5V$		$7.5V \geq V_p > 6.5V$		$6.5V \geq V_p > 5.5V$		$5.5V \geq V_p > 4.2V$		4.2V	
	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)
320 ~ 400	6.0	7.2	5.5	6.5	5.6	6.7	5.3	6.3	6.4	7.7	21.0	25.2
400 ~ 480	5.8	8.7	5.7	8.5	5.7	8.6	5.9	8.9	6.4	9.6	✓	✓
480 ~ 560	5.2	9.4	5.7	10.2	5.9	10.6	6.0	10.9	7.0	12.6	✓	✓
560 ~ 640	5.2	11.0	5.8	12.1	6.0	12.6	7.0	14.8	7.5	15.6	-	-
640 ~ 720	5.6	13.4	6.1	14.6	6.1	14.6	6.7	16.0	9.0	21.6	-	-
720 ~ 800	5.4	14.6	5.8	15.8	6.2	16.7	7.3	19.8	11.2	30.2	-	-
800 ~ 880	5.5	16.6	6.1	18.3	6.4	19.1	6.5	19.5	13.6	40.8	-	-
880 ~ 960	5.7	18.9	5.6	18.5	6.5	21.4	8.2	27.0	-	-	-	-
960 ~ 1040	5.8	20.7	6.2	22.4	7.2	25.7	8.5	30.6	-	-	-	-
1040 ~ 1120	5.3	20.8	5.7	22.2	7.3	28.4	-	-	-	-	-	-
1120 ~ 1200	5.4	22.8	5.9	24.7	7.4	31.2	-	-	-	-	-	-
1200	5.4	24.2	6.4	28.8	7.8	35.0	-	-	-	-	-	-

- : Unusable ✓: No drive limitation

Set the Drive Pulse Rate according to "3.3.5 Motor Drive Method".

**Table 3-11 Maximum Drive Time (min) and Paper Feed Length (m) at Temperature Rise 75°C
(When the Same Control as the LTPZ245M Is Used)**

Drive Pulse Rate (pps)	Motor Drive Voltage V_p (V)											
	$9.5V \geq V_p > 8.5V$		$8.5V \geq V_p > 7.5V$		$7.5V \geq V_p > 6.5V$		$6.5V \geq V_p > 5.5V$		$5.5V \geq V_p > 4.2V$		4.2V	
	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)	min	(m or longer)
320 ~ 400	27.1	32.5	27.2	32.7	29.8	35.8	25.8	30.9	✓	✓	✓	✓
400 ~ 480	41.6	62.5	43.6	65.4	39.5	59.2	38.6	57.9	✓	✓	✓	✓
480 ~ 560	24.6	44.2	61.9	111.3	56.4	101.6	44.9	80.9	✓	✓	✓	✓
560 ~ 640	24.5	51.5	✓	✓	✓	✓	✓	✓	✓	✓	-	-
640 ~ 720	52.8	126.7	✓	✓	✓	✓	✓	✓	✓	✓	-	-
720 ~ 800	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
800 ~ 880	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
880 ~ 960	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
960 ~ 1040	✓	✓	✓	✓	✓	✓	✓	✓	-	-	-	-
1040 ~ 1120	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-
1120 ~ 1200	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-
1200	✓	✓	✓	✓	✓	✓	-	-	-	-	-	-

- : Unusable ✓: No drive limitation

Set the Drive Pulse Rate according to "3.3.5 Motor Drive Method".

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 48 steps or more at the initialization, at a time after setting/releasing the platen unit, at a time after feeding the thermal paper backward, and a time after cutting with a paper cutter. During this time, drive the motor with constant speed at the 1st acceleration step.
- When printing, change the motor drive pulse rate depending on the operational conditions such as voltage, temperature, and the number of activated dots. (See Chapter 5 “PRINT DRIVE METHOD” for details)
- The lower motor drive frequency generates the higher heat. Therefore, drive the motor at high speed as much as possible when printing at a high print ratio for longer length.
- Do not perform continuous printing to prevent the motor from overheating. Refer to Chapter 3 “Motor Drive Method” to set a pause time.
- Surface of thermal paper may get scratched by backward feed. The backward feed may cause paper skew and jams depending on paper roll layout and designing of paper holder. Be sure to confirm performance with your product before using the backward feed.
- Do not print intermittently (Do not repeat printing and stopping in a short interval.) If doing so, print quality may be decreased due to unevenness of the paper feed pitch.
- Always perform the start and the stop steps for both character print and bit image print.
- For the motor stop, a minimum one dot line of motor feed is required from the step that thermal head was activated. If the motor is stopped at the step that the thermal head has been activated, paper feed difficulty may be caused due to sticking of the thermal paper to the thermal head.
- Sound and vibration during printing vary depending on the motor drive pulse rate. Verify the performance with your actual device.

3.4 THERMAL HEAD

The thermal head consists of heat elements and a thermal head driver that drives and controls the heat elements.

The 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 LAT signal "Low" after one line data is transferred. The heat elements are activated by making DST signal "High" in accordance with the stored print data.

In this printer, a division printing by 6 blocks is available. Each block has 64 dots heat elements.

3.4.1 Structure of the Thermal Head

Figure 3-7 shows the thermal head block diagram the printer.

Table 3-12 show the relationship between DST terminals and activated heat elements.

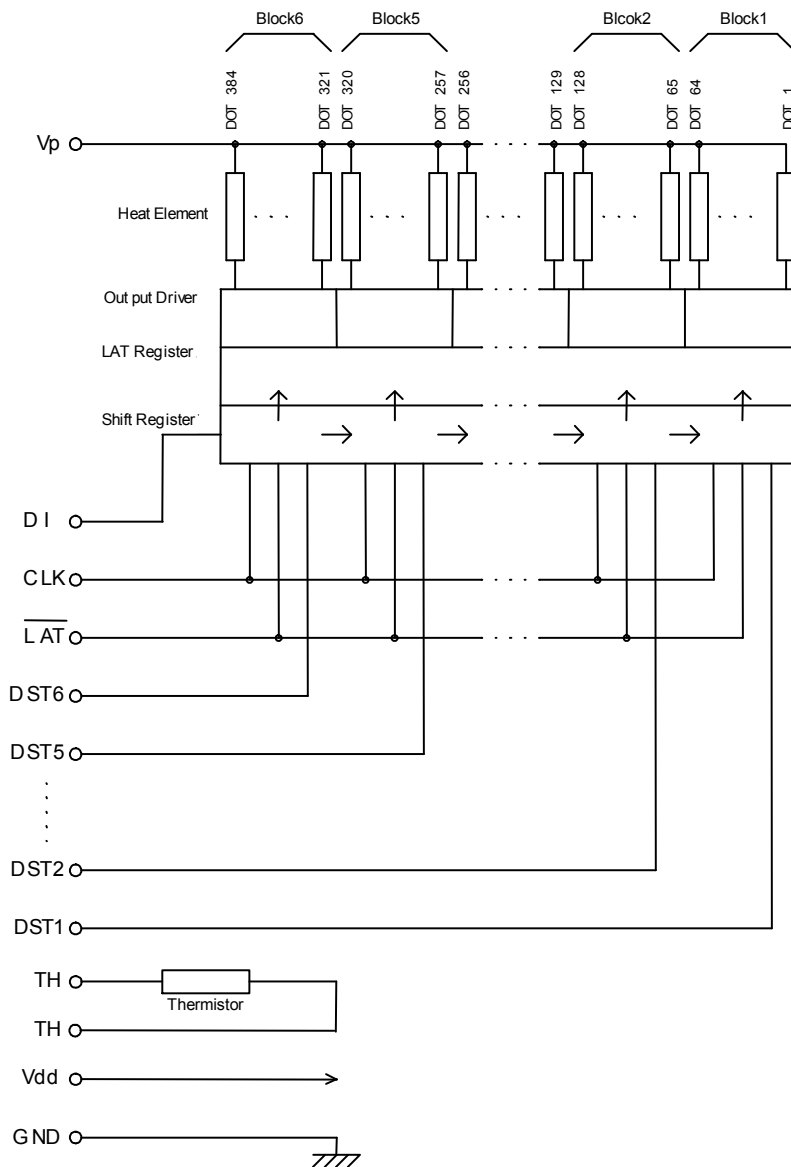


Figure 3-7 Thermal Head Block Diagram

Table 3-12 DST Terminals and Activated Heat Elements

Block	DST No.	Heat Element No.	Dots Number/ DST
1	DST1	1 to 64	64
2	DST2	65 to 128	64
3	DST3	129 to 192	64
4	DST4	193 to 256	64
5	DST5	257 to 320	64
6	DST6	321 to 384	64

3.4.2 Print Position of the Data

384-bit data (#1 to #384) transferred through DI terminals are printed as shown in Figure 3-8.

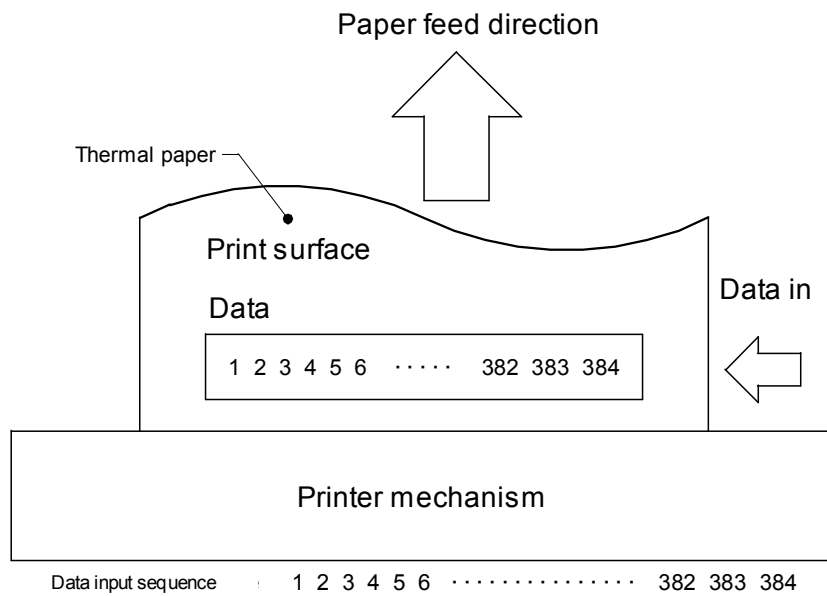


Figure 3-8 Transfer Data and Print Position

3.4.3 Electrical Characteristics of Thermal Head

Table 3-13 shows electrical characteristics of thermal head.

Table 3-13 Electrical Characteristics of Thermal Head

(at 25 °C)

Item	Symbol	Conditions	Rated value			Unit	
			Min.	Typ.	Max.		
Thermal head heat element resistance	R_H		162.0	180.0	198.0	Ω	
Thermal Head drive voltage	V_P		4.2	—	9.5	V	
Thermal Head drive current	I_p	at the number of simultaneously activated dots = 64	—	—	3.76	A	
Logic voltage	V_{dd}		3.0	3.3	3.6	V	
			4.75	5.0	5.25		
Logic current	I_{dd}	$f_{DI}=1/2f_{CLK}$	—	—	15.0 [*]	mA	
Input voltage	High	V_{IH}	CLK, DI, \overline{LAT} , DST	0.8 V_{dd}	—	V_{dd}	V
	Low	V_{IL}	CLK, DI, \overline{LAT} , DST	0	—	0.2 V_{dd}	V
DI input current	High	$I_{IH DI}$	$V_{IH}=V_{dd}$	—	—	0.5	μA
	Low	$I_{IL DI}$	$V_{IL}=0 V$	—	—	-0.5	μA
DST input current (High active)	High	$I_{IH DST}$	$V_{dd}=5.0 V, V_{IH}=V_{dd}$	—	—	55.0	μA
	Low	$I_{IL DST}$	$V_{IL}=0 V$	—	—	-0.5	μA
CLK input current	High	$I_{IH CLK}$	$V_{IH}=V_{dd}$	—	—	1.0	μA
	Low	$I_{IL CLK}$	$V_{IL}=0 V$	—	—	-1.0	μA
\overline{LAT} input current	High	$I_{IH \overline{LAT}}$	$V_{IH}=V_{dd}$	—	—	1.0	μA
	Low	$I_{IL \overline{LAT}}$	$V_{IL}=0 V$	—	—	-1.0	μA
CLK frequency	f_{CLK}		$3.0 \leq V_{dd} \leq 3.6 V$	—	—	8.0	MHz
			$4.75 \leq V_{dd} \leq 5.25 V$				
CLK pulse width	t_1	See the Timing Chart.	$3.0 \leq V_{dd} \leq 3.6 V$	—	—	—	ns
			$4.75 \leq V_{dd} \leq 5.25 V$				
DI setup-time	t_2	See the Timing Chart.	$3.0 \leq V_{dd} \leq 3.6 V$	—	—	—	ns
			$4.75 \leq V_{dd} \leq 5.25 V$				
DI hold time	t_3	See the Timing Chart.	$3.0 \leq V_{dd} \leq 3.6 V$	—	—	—	ns
			$4.75 \leq V_{dd} \leq 5.25 V$				
\overline{LAT} setup time	t_4	See the Timing Chart.	$3.0 \leq V_{dd} \leq 3.6 V$	—	—	—	ns
			$4.75 \leq V_{dd} \leq 5.25 V$				
\overline{LAT} pulse width	t_5	See the Timing Chart.	$3.0 \leq V_{dd} \leq 3.6 V$	—	—	—	ns
			$4.75 \leq V_{dd} \leq 5.25 V$				
\overline{LAT} hold time	t_6	See the Timing Chart.	$3.0 \leq V_{dd} \leq 3.6 V$	—	—	—	ns
			$4.75 \leq V_{dd} \leq 5.25 V$				
DST setup time	t_7	See the Timing Chart.	$3.0 \leq V_{dd} \leq 3.6 V$	—	—	—	ns
			$4.75 \leq V_{dd} \leq 5.25 V$				

(at 25 °C)

Item	Symbol	Conditions		Rated value			Unit
				Min.	Typ.	Max.	
$\overline{\text{LAT}}$ wait time	t8	See the Timing Chart.	$3.0 \leq V_{\text{dd}} \leq 3.6 \text{ V}$	8	—	—	μs

*: The value at Vdd=5V. 7.5mA at Vdd=3.3V.

3.4.4 Timing Chart

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

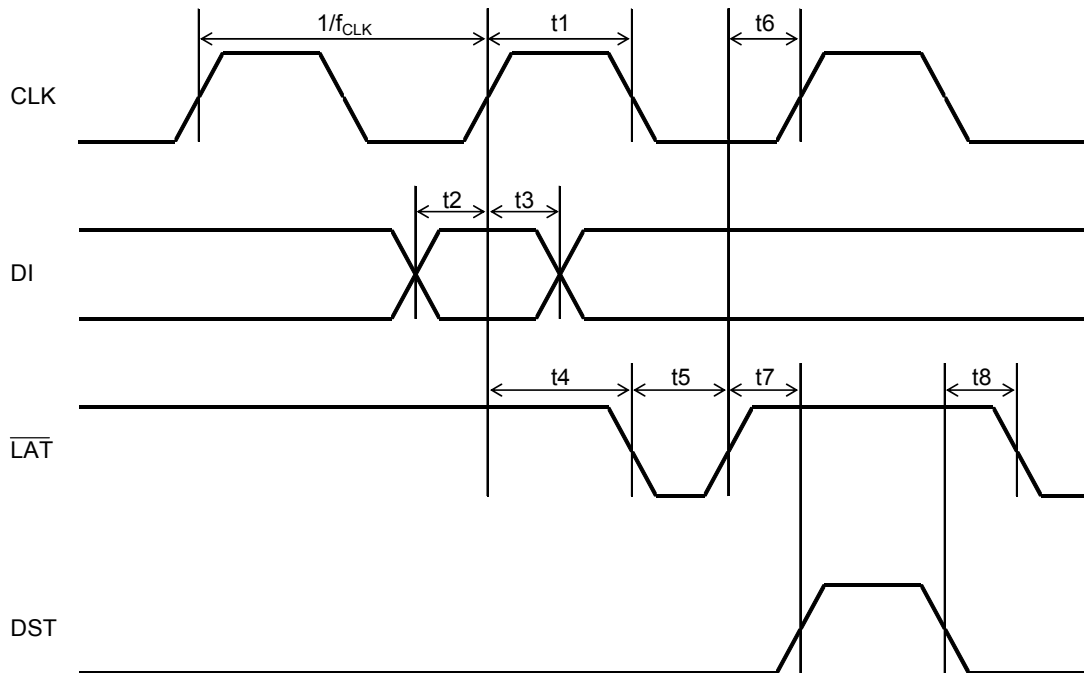


Figure 3-9 Thermal Head Drive Timing Chart

3.4.5 Thermal Head Heat Element Resistance

Table 3-14 shows resistance of the thermal head heat element of the printer.

Table 3-14 Thermal Head Heat Element Resistance

Thermal Head Heat Element Resistance
162.0 Ω to 198.0 Ω

3.4.6 Maximum Current Consumption

Since the maximum current consumption may reach the values calculated using equation (2) 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 (2):

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

- I_P : Maximum current consumption (A)
- N_{SA} : Number of simultaneously activated dots
- V_P : Thermal head drive voltage (V)
- $R_{H \min}$: Minimum thermal head heat element resistance 162.0 (Ω)

3.5 CONTROLLING THE ACTIVATION PULSE WIDTH FOR THERMAL HEAD

To execute high quality printing using the printer, the activation pulse width according to printer use condition must be used. Control printing with the activation pulse width calculated by the following sequence. Printing at too high voltage or too long activation pulse width may shorten the life of the thermal head. This product is possible to be driven by the same control specified for LTPZ245M.

3.5.1 Calculation of Activation Pulse Width

Each value can be calculated according to the steps in Section 3.5.2 to 3.5.6 and the activation pulse width “t” can be calculated by substituting each value into the equation (3).

Equation (3):

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

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

3.5.2 Calculation of Printing Energy

The printing energy “E” can be calculated using equation (4) as the appropriate printing energy is different depending on each specified thermal paper and the temperature of the thermal head.

Equation (4):

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

E	:	Printing energy	
E ₂₅	:	Standard printing energy	See Table 3-15.
T _C	:	Temperature coefficient	See Table 3-15.
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 Temperature Characteristics of the Thermistor.

Table 3-15 Standard Printing Energy and Temperature Coefficient

Specified thermal paper		Standard printing energy (mJ)	Temperature coefficient (T _C)	
Nippon Paper	TF50KS-E2D	0.2853	0.002803	
Oji Paper Co., Ltd.	PD150R	0.3558	0.002432	
	PD160R-N	0.3238	0.002245	
Mitsubishi Paper mills limited	F220VP	0.3374	0.002683	
Jujo Thermal	AF50KS-E	T _X ≥ 25°C	0.3061	0.003542
		T _X ≤ 25°C	0.3061	0.002260
	AP50KS-FZ	0.3237	0.003306	
Mitsubishi Hi-Tech Paper	F5041	0.3376	0.002703	
Papierfabrik August Koehler AG	KT55F20	T _X ≥ 25°C	0.3503	0.004436
		T _X ≤ 25°C	0.3503	0.001339
KSP	P300	0.3254	0.003478	

3.5.3 Adjustment of Thermal Head Resistance

The adjusted resistance “R” can be calculated using equation (5) to adjust the thermal head resistance as a voltage drop is caused by wiring resistance.

Equation (5):

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

R _H	:	Thermal head heat element resistance	180.0 (Ω)
R _i	:	Wiring resistance in the thermal head	9.0 (Ω) *1
R _C	:	Common terminal wiring resistance in the thermal head	0.279 (Ω)
r _C	:	Wiring resistance between V _P and GND (Ω) *2	
N _{SA}	:	The number of simultaneously activated dots	

*1 : The value at V_{dd} = 3.3V. When the value at V_{dd} = 5.0V, R_i becomes 6Ω.

*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 (6) and (7) as the printing density changes by the difference of the thermal head drive voltage.

Equation (6)

$$V=1.142 \times V_P-1.347(5.5V \leq V_P \leq 9.5V)$$

Equation (7)

$$V=1.370 \times V_P-2.601(4.75V \leq V_P \leq 5.5V)$$

V_P : Thermal head drive voltage (V)

3.5.5 Setting of Activation Pause Time

In order to protect the thermal head heat elements, when the same heat element dots are activated continuously on the successive dot line, determine the activation pulse cycle (the time from the start of the preceding activation to the start of the current activation) which meets equation (8) to secure the pause time.

Equation (8):

$$W > t + 500 (\mu s)$$

W : The activation cycle (μs)^{*1}

*1: The activation cycle W is the driving time of the printer drive motor for 2 steps (one-half dot line).

3.5.6 Adjustment by Thermal Head Activation Cycle

The thermal head activation pulse cycle coefficient "C" can be calculated using equations (9) as the printing density varies by the thermal head activation pulse cycle (equivalent for motor drive pulse rate).

Equation (9):

$$C = 1 - \frac{1450 \times V_p \cdot 68}{(V_p - 3.15) \times (W' + 1580) + 4800}$$

W' : A time between the beginning of the last thermal head activation and the beginning of present thermal head activation (μ s)

Figure 3-10 shows how to calculate the thermal head activation cycle "W'" as an example.

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

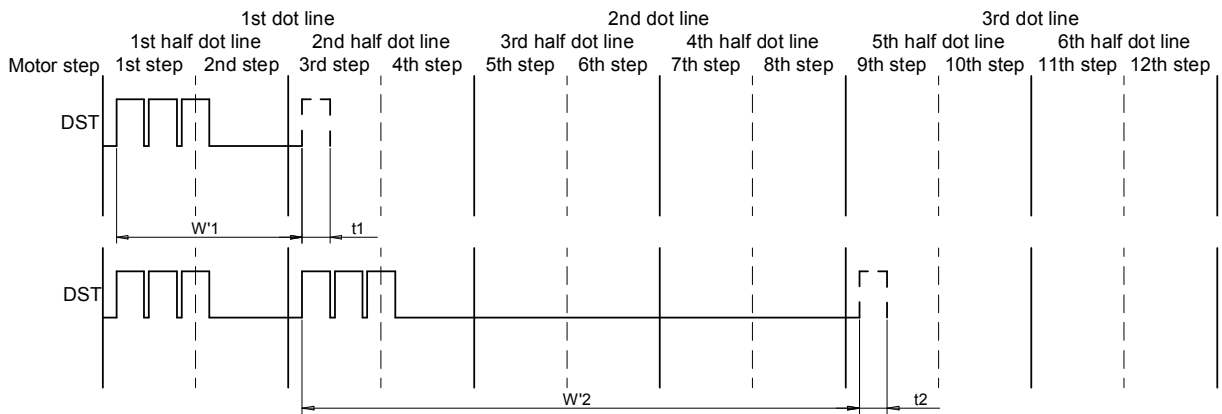


Figure 3-10 Time from the start of the preceding thermal head activation to the start of the current thermal head activation (W')

3.5.7 Calculation Sample for the Activation Pulse Width

Table 3-16 lists the calculation samples of the activation pulse width calculated using equation (3) and the values obtained using equations (4) to (8).

Table 3-16 Activation Pulse Width

Unit : ms

V _P (V)	T _x (°C)	Motor drive pulse rate (pps)								
		480	720	960	1200	1440	1680	1920	2160	2400
4.75	0	2.838	2.329	1.995	1.758	-	-	-	-	-
	10	2.614	2.145	1.837	1.620	-	-	-	-	-
	20	2.390	1.961	1.680	1.481	-	-	-	-	-
	30	2.166	1.778	1.523	1.342	-	-	-	-	-
	40	1.943	1.594	1.365	1.204	-	-	-	-	-
	50	1.719	1.410	1.208	1.065	-	-	-	-	-
	60	1.495	1.227	1.051	0.926	-	-	-	-	-
70	1.271	1.043	0.893	0.788	-	-	-	-	-	
5.5	0	1.971	1.646	1.424	1.263	1.140	-	-	-	-
	10	1.816	1.516	1.311	1.163	1.050	-	-	-	-
	20	1.660	1.386	1.199	1.063	0.960	-	-	-	-
	30	1.505	1.256	1.087	0.964	0.870	-	-	-	-
	40	1.349	1.127	0.975	0.864	0.780	-	-	-	-
	50	1.194	0.997	0.862	0.765	0.691	-	-	-	-
	60	1.038	0.867	0.750	0.665	0.601	-	-	-	-
70	0.883	0.737	0.638	0.565	0.511	-	-	-	-	
6.5	0	1.398	1.184	1.034	0.922	0.836	0.768	0.712	-	-
	10	1.288	1.091	0.952	0.850	0.770	0.707	0.656	-	-
	20	1.177	0.998	0.871	0.777	0.704	0.647	0.600	-	-
	30	1.067	0.904	0.789	0.704	0.638	0.586	0.543	-	-
	40	0.957	0.811	0.708	0.631	0.572	0.525	0.487	-	-
	50	0.847	0.717	0.626	0.559	0.506	0.465	0.431	-	-
	60	0.736	0.624	0.545	0.486	0.440	0.404	0.375	-	-
70	0.626	0.531	0.463	0.413	0.375	0.344	0.319	-	-	
7.5	0	1.033	0.884	0.776	0.695	0.632	0.582	0.540	0.505	0.476
	10	0.952	0.814	0.715	0.641	0.582	0.536	0.497	0.465	0.438
	20	0.870	0.744	0.654	0.586	0.533	0.490	0.455	0.426	0.401
	30	0.789	0.675	0.593	0.531	0.483	0.444	0.412	0.386	0.363
	40	0.707	0.605	0.531	0.476	0.433	0.398	0.370	0.346	0.326
	50	0.626	0.535	0.470	0.421	0.383	0.352	0.327	0.306	0.288
	60	0.544	0.466	0.409	0.366	0.333	0.306	0.284	0.266	0.251
70	0.463	0.396	0.348	0.311	0.283	0.260	0.242	0.226	0.213	
8.5	0	0.792	0.682	0.601	0.540	0.492	0.454	0.422	0.395	0.372
	10	0.729	0.628	0.554	0.498	0.454	0.418	0.388	0.364	0.343
	20	0.667	0.574	0.507	0.455	0.415	0.382	0.355	0.333	0.313
	30	0.605	0.520	0.459	0.413	0.376	0.346	0.322	0.302	0.284
	40	0.542	0.467	0.412	0.370	0.337	0.311	0.289	0.270	0.255
	50	0.480	0.413	0.364	0.327	0.298	0.275	0.255	0.239	0.225
	60	0.417	0.359	0.317	0.285	0.259	0.239	0.222	0.208	0.196
70	0.355	0.305	0.269	0.242	0.221	0.203	0.189	0.177	0.167	
9.5	0	0.625	0.541	0.479	0.431	0.393	0.363	0.338	0.316	0.298
	10	0.576	0.498	0.441	0.397	0.362	0.334	0.311	0.291	0.275
	20	0.526	0.455	0.403	0.363	0.331	0.306	0.284	0.267	0.251
	30	0.477	0.413	0.365	0.329	0.300	0.277	0.258	0.242	0.228
	40	0.428	0.370	0.328	0.295	0.269	0.248	0.231	0.217	0.204
	50	0.379	0.327	0.290	0.261	0.238	0.220	0.205	0.192	0.181
	60	0.329	0.285	0.252	0.227	0.207	0.191	0.178	0.167	0.157
70	0.280	0.242	0.214	0.193	0.176	0.163	0.151	0.142	0.134	

- : Unusable

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

- Use of thermal paper "TF50KS-E2D"
- V_P and GND wiring resistance r_c = 0
- The number of simultaneously activated dots : N_{SA} =64

3.5.8 Temperature Characteristics of the Thermistor

Calculate the resistance of the thermistor (R_x) at the operating temperature T_x ($^{\circ}\text{C}$) using the following equation (9). Variation of resistance by temperature is shown in Figure 3-11 and Table 3-17.

Equation (9):

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

R_x	:	Resistance at T_x $^{\circ}\text{C}$ (Ω)	
R_{25}	:	Resistance at 25°C	$30 \pm 5\%$ ($\text{k}\Omega$)
B	:	B value	$3950\text{K} \pm 2\%$
T_x	:	Temperature detected by thermistor ($^{\circ}\text{C}$)	
EXP (A)	:	The "A" th power of natural logarithm e (2.71828)	

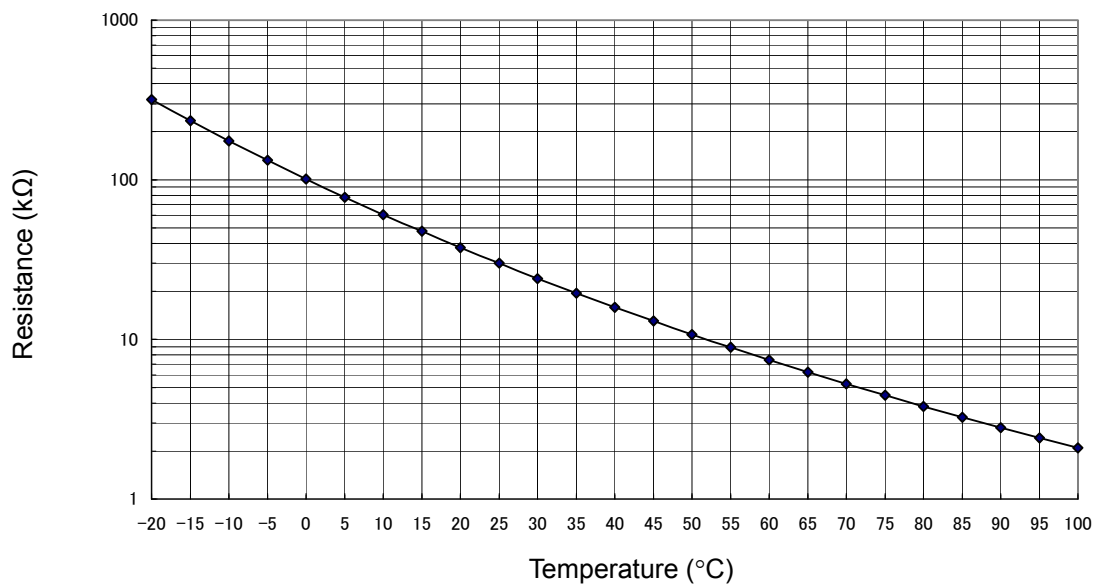


Figure 3-11 Temperature Characteristics of the Thermistor

Table 3-17 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 if the thermal head thermistor (TH) detects a temperature higher than 70°C (thermistor resistance $R_{TH} \leq 5.27 \text{ k}\Omega$), and reactivate the heat elements when a temperature lower than 60°C ($R_{TH} \geq 7.45 \text{ k}\Omega$) is detected. If the thermal head continues to be activated at a temperature higher than 70°C, the life of the thermal head may be shortened significantly.

(2) Detecting abnormal temperatures by hardware

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

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

- (a) Overheating of the thermal head
(approximately 100 °C or higher ($R_{TH} \leq 2.09 \text{ k}\Omega$))
- (b) Faulty thermistor connection (the thermistor may be open or short-circuited).

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

3.6 PLATEN POSITION SENSOR

LTP01-245-12 has a built-in platen position sensor for detecting whether the platen unit is set. This sensor is a mechanical switch which is designed to be ON when the platen unit is set and to be OFF when it is released.

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

Activate the thermal head when the platen is set by detecting the output from the platen position sensor, and in the paper state by detecting the output from the out-of-paper sensor.

3.6.1 General Specifications

Table 3-18 shows about the general specification.

Table 3-18 General Specifications of Platen Position Sensor

Item	Specifications
Rated voltage	5.0 VDC
Rated current	1 mA
Contact resistance	3 Ω max.

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

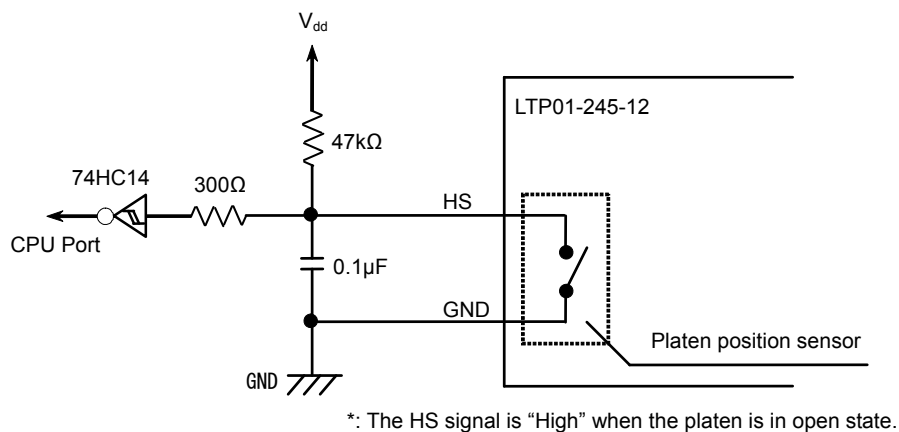


Figure 3-12 Sample External Circuit of the Platen Position Sensor

3.6.2 Precautions for the Platen Position Sensor

- Be sure that there is a time lag between the time when the thermal head is set and the time when the platen position sensor actually starts detecting.
- Always use the capacitor shown in Figure 3-12 to prevent the switch from malfunctioning due to chattering.
- The platen position sensor may generate instantaneous abnormal signal. Design the firmware in order to prevent malfunction due to the abnormal signal. (Recommended frequency: detecting twice every 10 ms)

3.7 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. An external circuit should be designed so that it detects output from the out-of-paper sensor and does not activate the thermal head and motor when there is no paper. Doing not so may cause damage to the thermal head or platen or shorten the life of the thermal head significantly. If the motor is driven when there is no paper, a load is put on the paper drive system and the life of the printer may be shortened significantly.

3.7.1 General Specifications

Table 3-19 shows about the out-of-paper sensor used for this printer.

Table 3-19 Out-of-Paper Sensor

Item	Specifications
Model	GP2S60B
Manufacturer	Sharp Corporation

Figure 3-13 shows sample external circuit of the out-of-paper sensor.

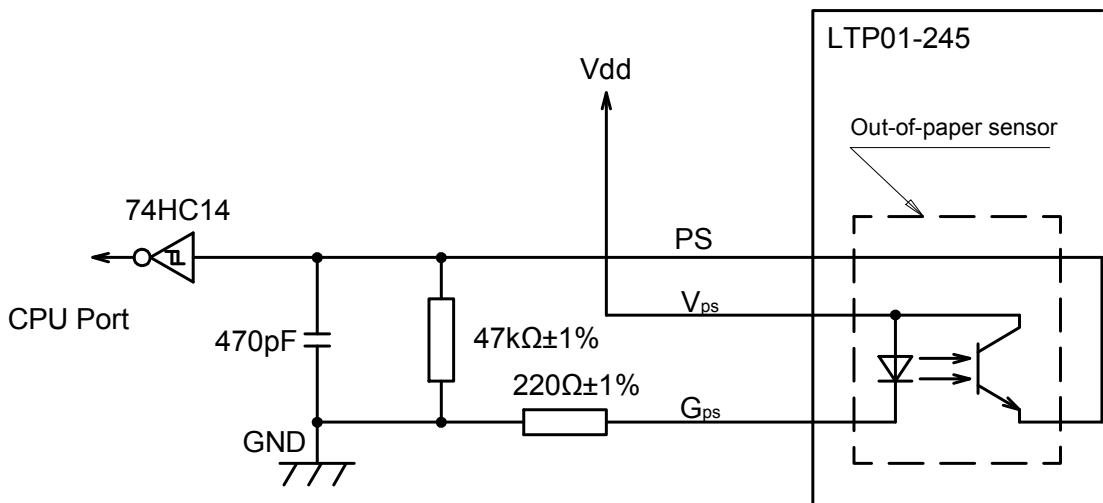


Figure 3-13 Sample External Circuit of the Out-of-Paper Sensor

3.7.2 Precautions for the Out-of-Paper Sensor

- The out-of-paper sensor may generate instantaneous abnormal signal. Design the firmware in order to prevent malfunction due to the abnormal signal. (Recommended frequency: detecting twice every 10 ms)

CHAPTER 4 CONNECTING TERMINALS

4.1 RECOMMENDED CONNECTOR FOR EXTERNAL CIRCUITS

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

Table 4-1 Recommended Connectors

Number of Terminals	Recommended Connectors
30	FCI INC: SFW30R-2STE1LF (right angle, top contact) SFW30S-2STE1LF (vertical) SLW30S-1C7LF (vertical) MOLEX INC: 0522073060 (right angle, top contact) 0520893019 (right angle, top contact) 0526103072 (vertical) 0520303029 (vertical)

4.2 CONNECTING TERMINALS

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

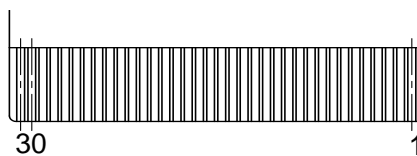


Figure 4-1 Connecting Terminals

Table 4-2 Terminal Assignments of the Connecting Terminal

Terminal Number	Signal Name	Function	
		LTP01-245-11/18	LTP01-245-12
1	Gps	GND of the out-of-paper sensor (LED cathode)	
2	Vps	Power supply of the out-of-paper sensor (LED anode, Photo-transistor collector)	
3	PS	Output signal of the out-of-paper sensor (photo-transistor emitter)	
4	GND	No connection	Platen position sensor GND
5	HS	No connection	Platen position sensor output
6	Vp	Thermal head drive power supply	
7	Vp	Thermal head drive power supply	
8	DI	Print data input (serial input)	
9	CLK	Synchronizing signal for print data transfer	
10	GND	GND	
11	GND	GND	
12	DST6	Thermal head print activation instruction signal (#6 block)	
13	DST5	Thermal head print activation instruction signal (#5 block)	
14	DST4	Thermal head print activation instruction signal (#4 block)	
15	Vdd	Logic power supply	
16	TH	Thermistor (the one is used for GND)	
17	TH		
18	DST3	Thermal head print activation instruction signal (#3 block)	
19	DST2	Thermal head print activation instruction signal (#2 block)	
20	DST1	Thermal head print activation instruction signal (#1 block)	
21	GND	GND	
22	GND	GND	
23	LAT	Print data latch (memory storage)	
24	NC	No connection	
25	Vp	Thermal head drive power supply	
26	Vp	Thermal head drive power supply	
27	A	Motor drive signal	
28	\bar{A}	Motor drive signal	
29	B	Motor drive signal	
30	\bar{B}	Motor drive signal	

CHAPTER 5 PRINT DRIVE METHOD

5.1 MOTOR AND THERMAL HEAD DRIVE METHOD

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

The printer uses the thermal head with heat elements which size is a half-dot size of the feed direction. One dot is, therefore, composed of two of the half dots. The motor feeds the thermal paper for one dot line with four steps. In order to print one dot line, feed the thermal paper for four steps and activate the thermal head once in every two steps.

Figure 5-1 shows a timing chart for driving using six division printing and one division printing. First dot line indicates six division printing and second dot line indicates one division printing on the below timing chart. (The number of simultaneously activated dots should not exceed 64dots.)

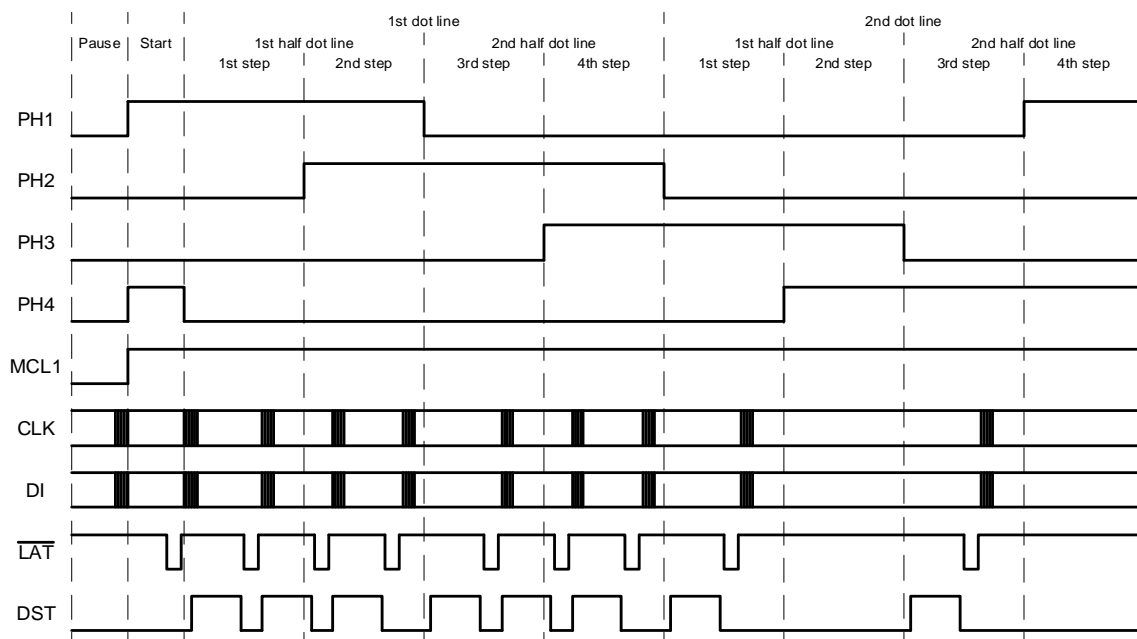


Figure 5-1 Timing Chart for Division Printing

The drive method using division printing is described below (See Figure 5-1):

(1) Pause state

Inactivate the motor and always make DST signal of the thermal head "Low".

(2) Start step

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

(3) 1st dot line

Drive the motor for one step.

Activate the thermal head once in every two steps of the motor drive signal. Configure 1 dot line with 4 steps of the motor drive signal.

At the 1st step of the motor drive signal, start activation of the thermal head by synchronizing DST with the motor, and print the 1st half dot line at the 1st dot line by using DST.

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.)

After printing the 1st half dot line at the 1st dot line, start activation of the thermal head at the 2nd step of the motor drive signal by synchronizing DST1 with the motor, and print the 2nd half dot line at the 1st dot line by using DST1 to DST6.

After the 3rd step of the motor drive signal is completed, input its 4th step. (It is not necessary to synchronize the activation of the thermal head.)

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

(4) Procedures that follows the 2nd dot line

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

5.2 THERMAL HEAD DIVISION DRIVE METHOD

In the thermal head of the printer, there are 6 blocks in 1 dot line. Each block has 64 dots. Division drive method is applicable using these blocks. These blocks are called physical blocks. DST signal is allocated to each physical block to activate it. To drive the thermal head, physical blocks are activated in groups. The group of physical blocks is called a logical block.

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

(1) Fixed division method

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

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

(2) Dynamic division method

Logical blocks are predetermined so that number of dots of the physical block does not exceed the specified maximum number of the activating dots for every 1 dot line printing. Logical blocks are predetermined for every 1 dot line printing.

The maximum current consumption can be controlled within a constant value.

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

5.3 PRECAUTIONS FOR PRINT DRIVE

- 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 condition. In that case, hold the motor step until printing is completed.
- When activating the all the blocks at once, a pause time between thermal head activations of the same heat element shall be secured more than 0.5ms.
- The number of the maximum thermal head division in a half dot line should be 6 or lower to maintain print quality. The number of the simultaneously activated dots should be 64 dots or less.

CHAPTER 6

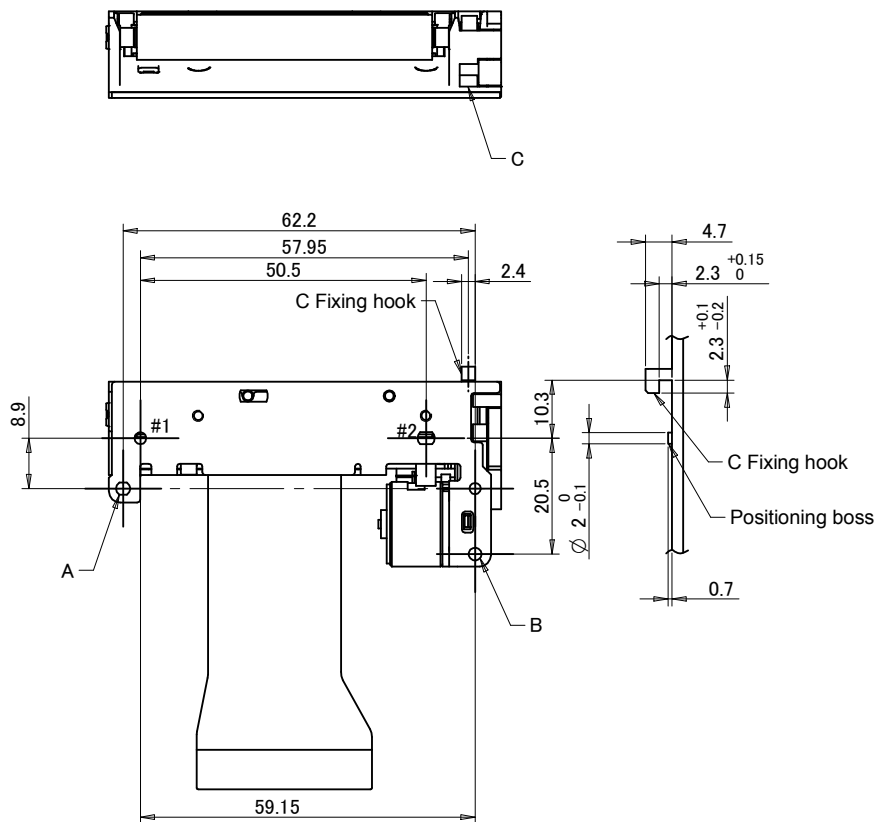
OUTER CASE DESIGN GUIDE

6.1 SECURING THE PRINTER MAIN BODY

6.1.1 How to Mount the Printer Main Body

Figure 6-1 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 0.7 ± 0.1 mm.
- Secure the printer main body using screws at the holes A and B.
- Design a hook for the concave C.



Unit : mm
General tolerance for dimensions : ± 0.1

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

6.1.2 Recommended Screws

The recommended mounting screw is as follows:

- JIS B1111 : M2 cross-recessed pan head screw

6.1.3 Precautions for Securing the Printer Main Body

- Prevent from excessive stress, deformation, and torsion for securing the printer, otherwise poor printing quality, paper skewing, paper jamming, and noise during printing may be caused.
- The printer main body to be mounted on a flat surface and prevent from vibration.
- To prevent the thermal head from being damaged by static electricity, connect the hole A and B shown in Figure 6-1 to the Frame Ground (FG).
- Connect the signal ground (GND) to frame ground (FG) using a 1M Ω resistor so that the electric potential of the signal ground (GND) of the thermal head and that of the frame ground (FG) of the printer are equal.
- Pay attention not to damage the FPC when securing the printer main body with the screw.
- Metal parts may become discolored and rusted due to the operational environment. Consider these factors regarding appearance.

6.2 SECURING THE PLATEN UNIT (RECOMMENDED SHAPE AND DIMENSIONS)

Design the platen holder at the outer case to mount the platen unit.

6.2.1 Recommended Shape of the Platen Holder

Figure 6-2 shows a recommended shape of the Platen Holder.

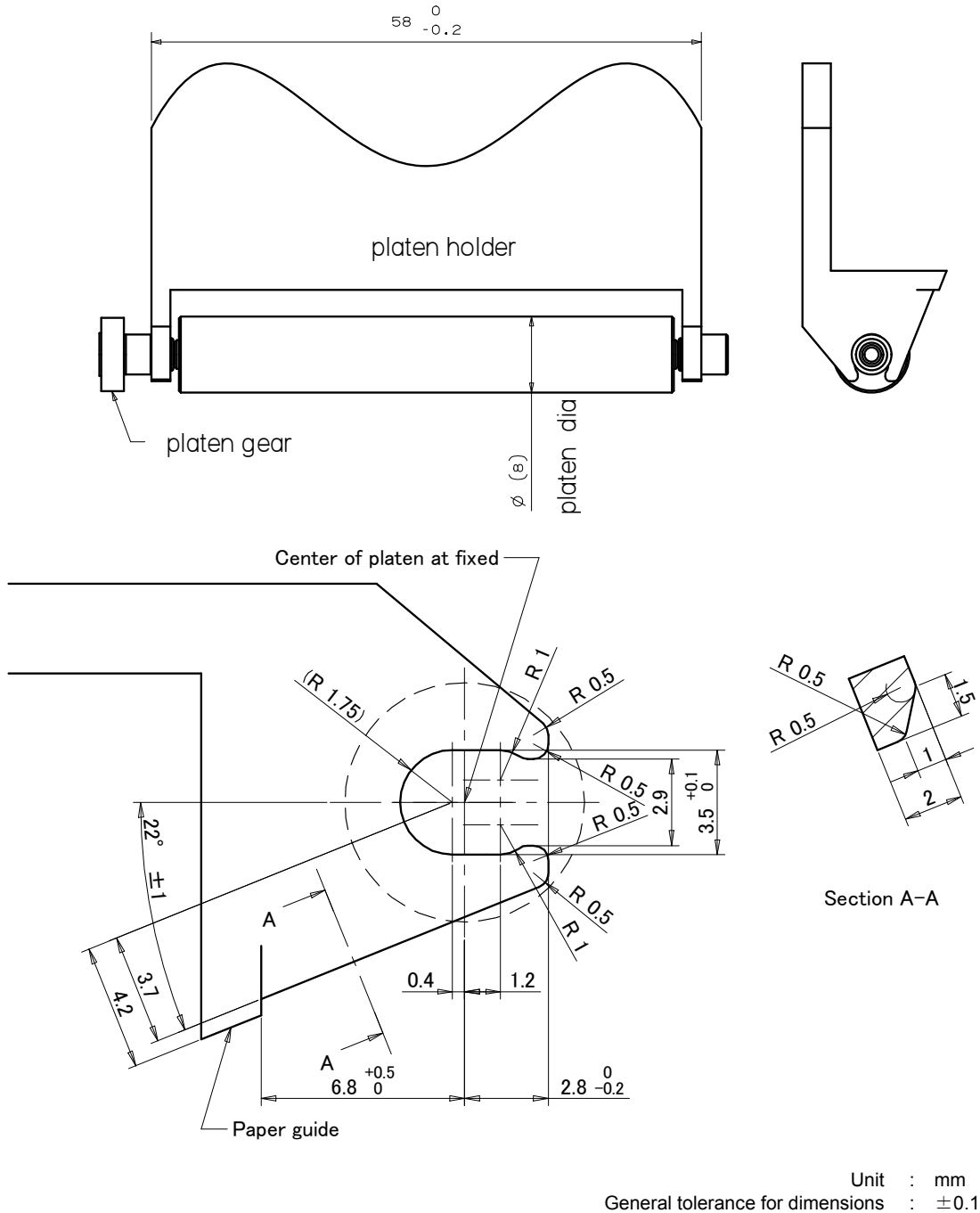


Figure 6-2 Dimensions for Positioning and Securing the Platen Unit

6.2.2 Dimensions for Positioning and Securing the Platen Holder

Figure 6-3 shows the working range of center of the rotation system for the platen holder when opening/closing the platen unit mounted on the outer case.

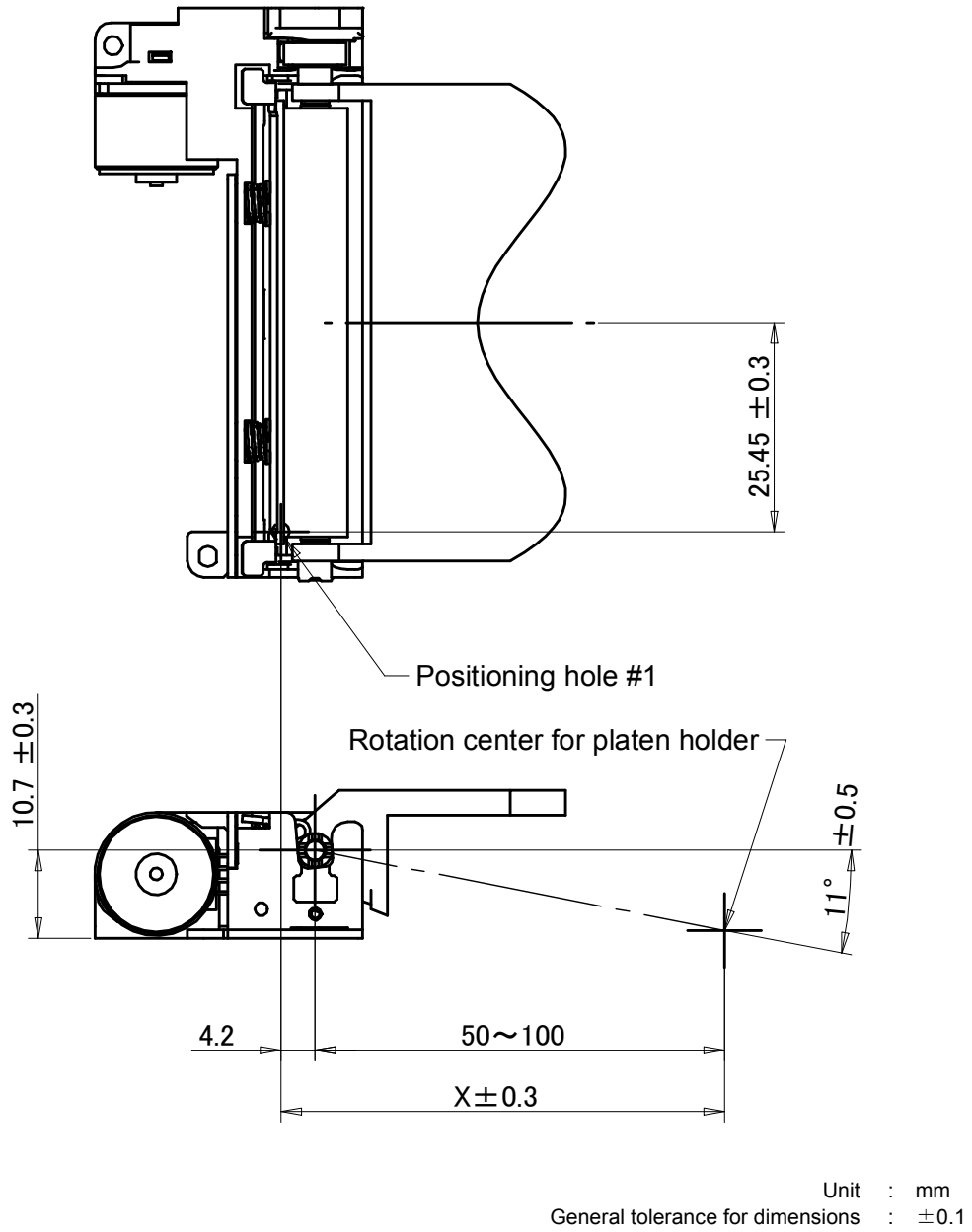


Figure 6-3 Dimensions for Positioning and Securing the Platen Unit

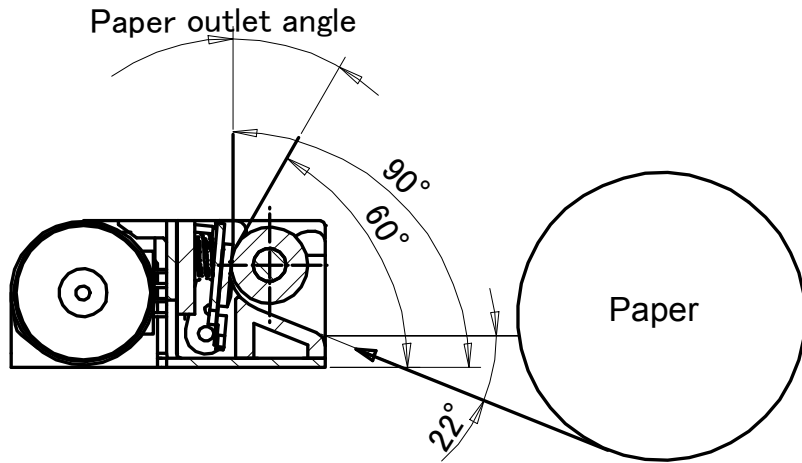
6.2.3 Precautions for Securing the Platen Holder

- Design the platen holder to avoid contact with the thermal head.
- It is recommended to have guide on the platen holder so that the platen is easy to be released and set. (Refer to the hatched area : slope and R0.5). It is also recommended that the rotation system of the platen holder be designed on the same base which the printer main body is mounted
- Design the rotation system of the platen holder so that the center of the rotation is in the position as shown in Figure 6-3, 11 degrees (± 0.5 degrees) to horizontal to the center of the platen and 50 mm to 150 mm away from the center of the platen.
- If the mounting position for the rotation center of the platen holder is inadequate position, so the printer main body and the platen unit are not in engagement position, the print defect may occur.
- Parallelism between the positioning holes #1-#2 and the center of platen holder rotation should be 0.2 or less.
- Design the platen holder with special care to its intensity so that it can withstand the force caused by opening/closing the printer main body and the platen unit.
- Do not use materials such as metal material for the platen holder. If using, the platen unit cannot be set into the platen holder. Verify the performance with your actual device.
- A door on the outer case that holds the platen unit must be set by pushing the center of the platen unit. If only one end of the platen unit is set, a print defect, and/or a paper jam will occur. Verify the performance with your actual device. In order to be pushed the center of the platen unit to set it, put an indication to do so.
- Pressure or stress for direction where the platen unit is released should be applied only when the platen unit is actually released. Permanent pressure or stress for releasing the platen unit may cause slipping gears, negative influence on printing quality, and printing troubles during operation.

6.3 LAYOUT OF THE PRINTER MECHANISM AND THE THERMAL PAPER

Note the following precautions for the layout of the thermal paper.

- Figure 6-4 shows recommended lay out of the printer mechanism and the thermal paper.
- The paper guide is required on the paper holder as shown on the Figure 6-2 so the thermal paper is led to paper inlet of the printer properly in order to improve paper detection stability. If the paper guide cannot be set up, design paper insertion angle constantly to be 22 degrees or more as shown on the Figure 6-2.



Unit : mm

Figure 6-4 Recommended Layout between the Printer Mechanism and the Thermal Paper

6.4 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 6-5.

- Design the paper holder and the paper guide so that the thermal paper will be straight to the paper inlet port without any horizontal shifting and so that the center axis of the paper roll will be parallel to the printer when using paper roll.
- Design the paper holder so that the paper feed load should be 0.49N (50gf) or less. Be aware that the printing problem and paper feed problem may occur in the following case even if it is below 0.49N. Design the paper holder so as not to make these conditions and verify the performance with your actual device.

ex)

In case that the paper roll wobbles in the paper holder.

In case that tension of the thermal paper between the paper roll and the printer changes rapidly.

In addition, do not use following types of the paper roll:

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

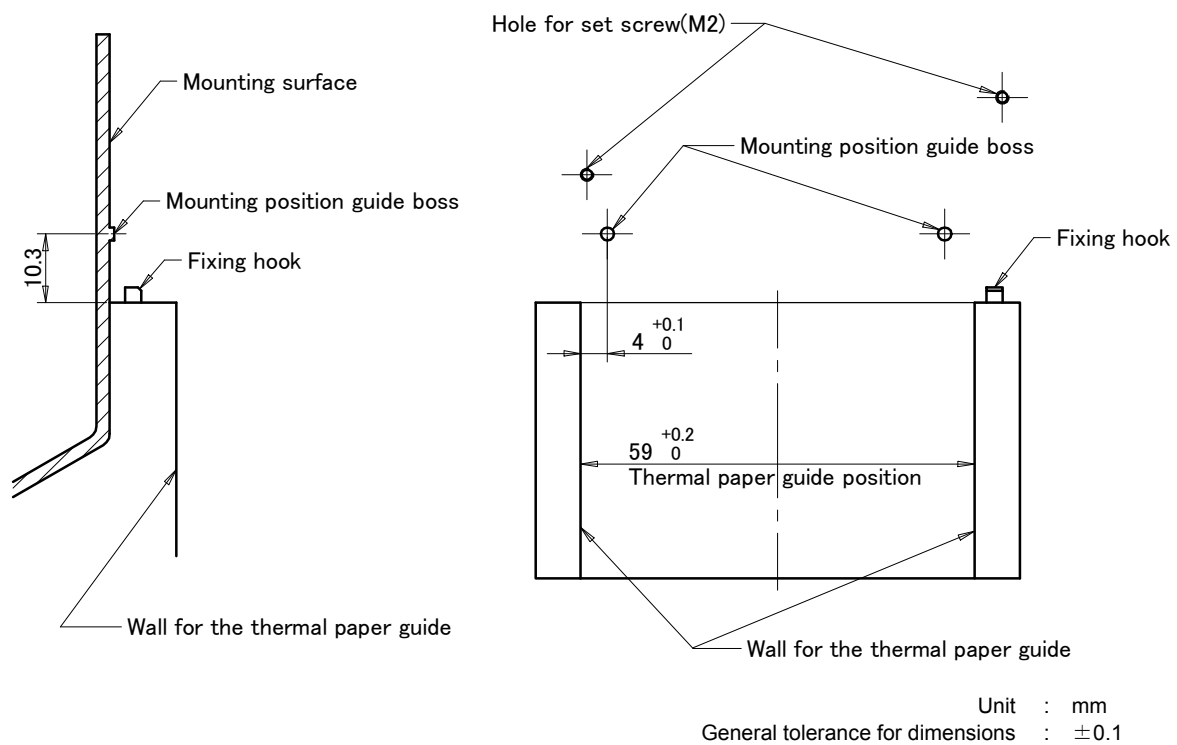


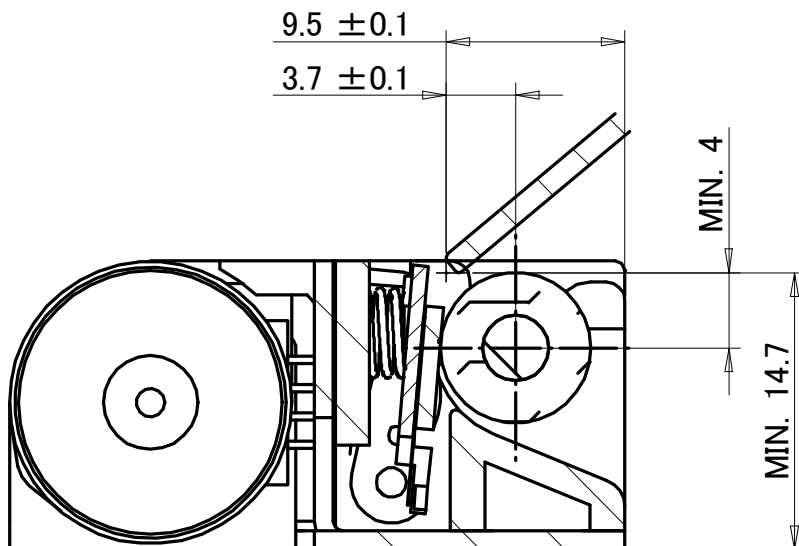
Figure 6-5 Recommended Paper Holder Dimensions

6.5 DESIGN THE PAPER EXIT

6.5.1 Design the Shape of the Paper Exit

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

- Design the shape of the paper exit of outer case so that stress is not applied to the thermal paper to be ejected.
- Design the paper exit of the outer case and the platen holder so that the thermal paper eject angle must be within of 60° to 90° as shown in Figure 6-4. However design the paper exit of outer case so that thermal paper can be ejected without changing its eject direction. Do not change the paper eject direction around the paper exit of printer mechanism. If changing the paper eject direction, verify the performance with your actual device.
- If using a paper winder to wind the thermal paper, allow the paper to exit naturally for at least 4mm in length from the center of the platen. Design the outer case referring to Figure 6-6. Verify the performance with your actual device. Otherwise, printing defects may occur or also the motor may step out of the position.



Unit : mm
General tolerance for dimensions : ± 0.1

Figure 6-6 Paper Path

6.5.2 Mount the Paper Cutter

- Design paper cutter mounting position so the edge of the cutter blade does not touch with a platen unit when the platen unit is set and released.
- Use a well-cut cutter so that the thermal paper can be cut with less force than paper holding force.
- Design the blade edge of the cutter as shown in the right figure of so that the blade edge can guide the thermal paper edge after cutting. If designing the blade edge as shown in the left figure of Figure 6-7, the paper edge may be caught by the blade edge, and result in the thermal paper edge to be caught inside. of the cutter.

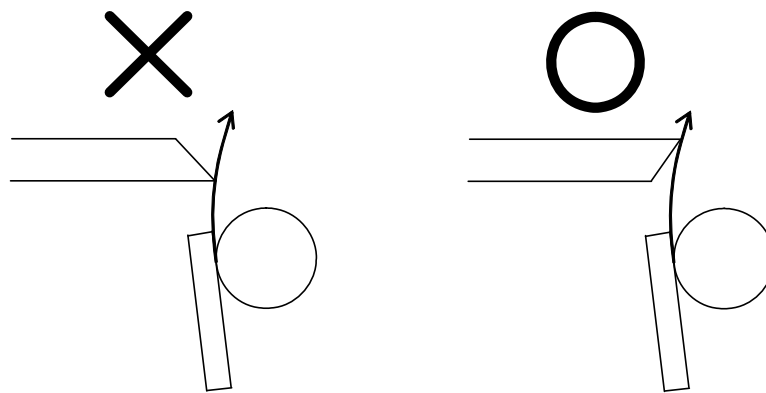


Figure 6-7 Blade Edge

6.6 HOW TO CONNECT A PAPER WINDER

6.6.1 Precautions for Connecting the Paper Winder

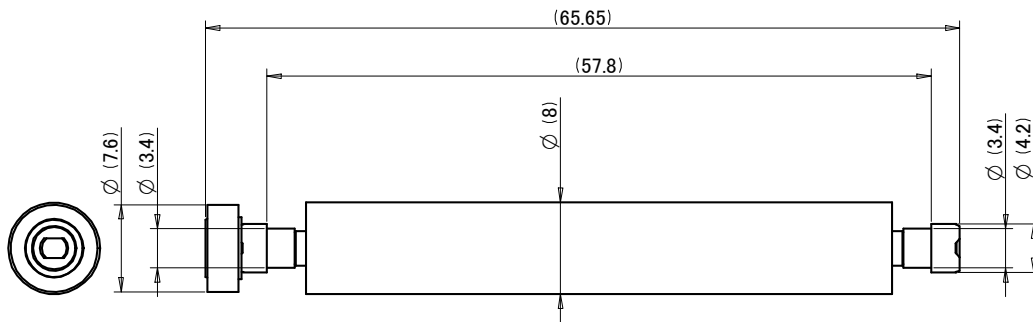
- Do not feed winded thermal paper backwards. Backward feed may cause a failure of winding.
- The winding force should be 0.49N (50gf) or less. Be aware that the printing problem may occur when the tension changed rapidly even though the winding force is below 0.49N.
- Be careful not to touch the platen and also prevent any objects from getting caught in the paper winder.

CHAPTER 7

EXTERNAL DIMENSIONS

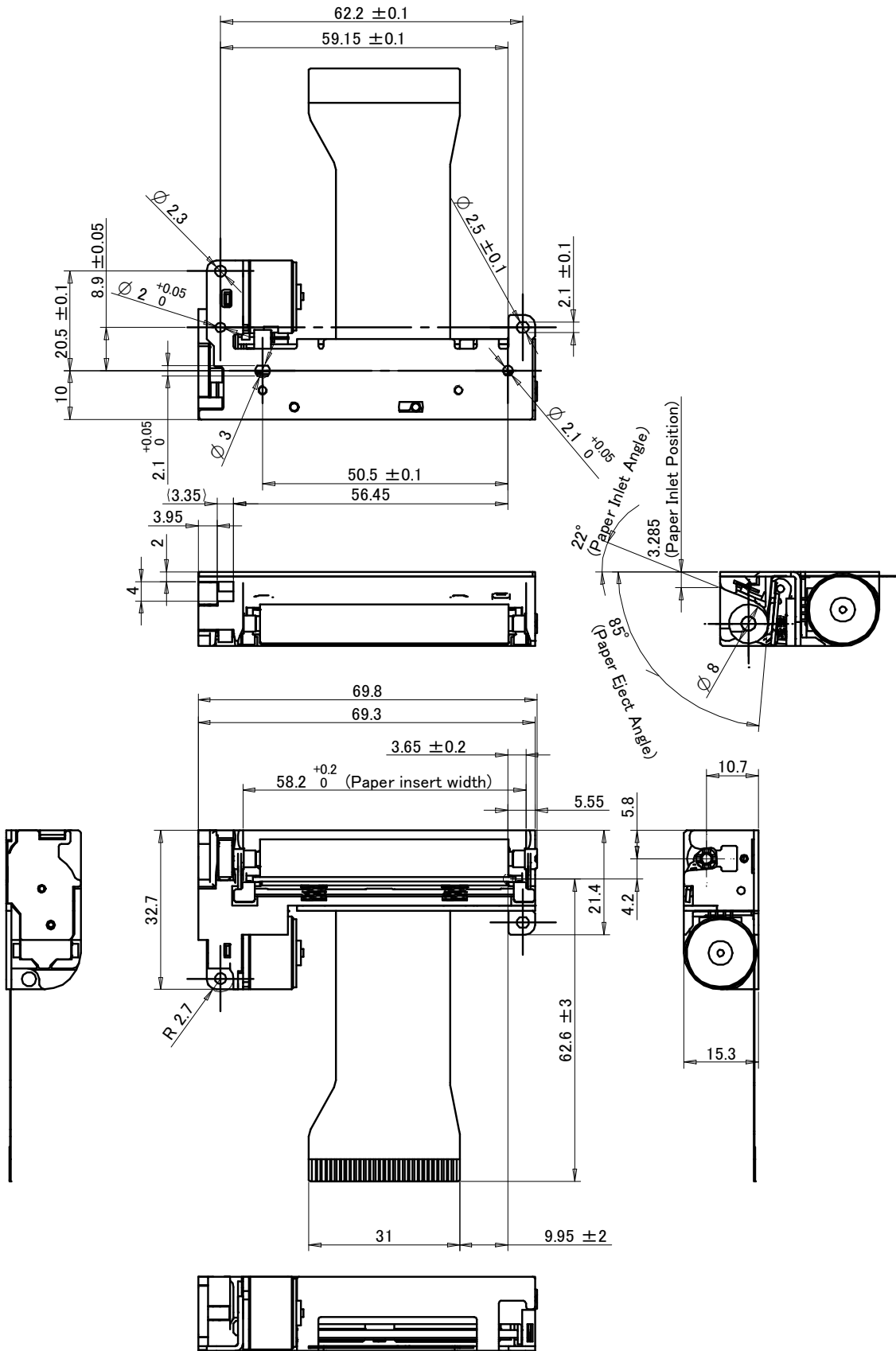
Figure 7-2 shows the external dimensions of the platen unit.

Figure 7-3 and Figure 7-3 show the external dimensions of LTP01-245-11, LTP01-245-12, and LTP01-245-18 respectively.



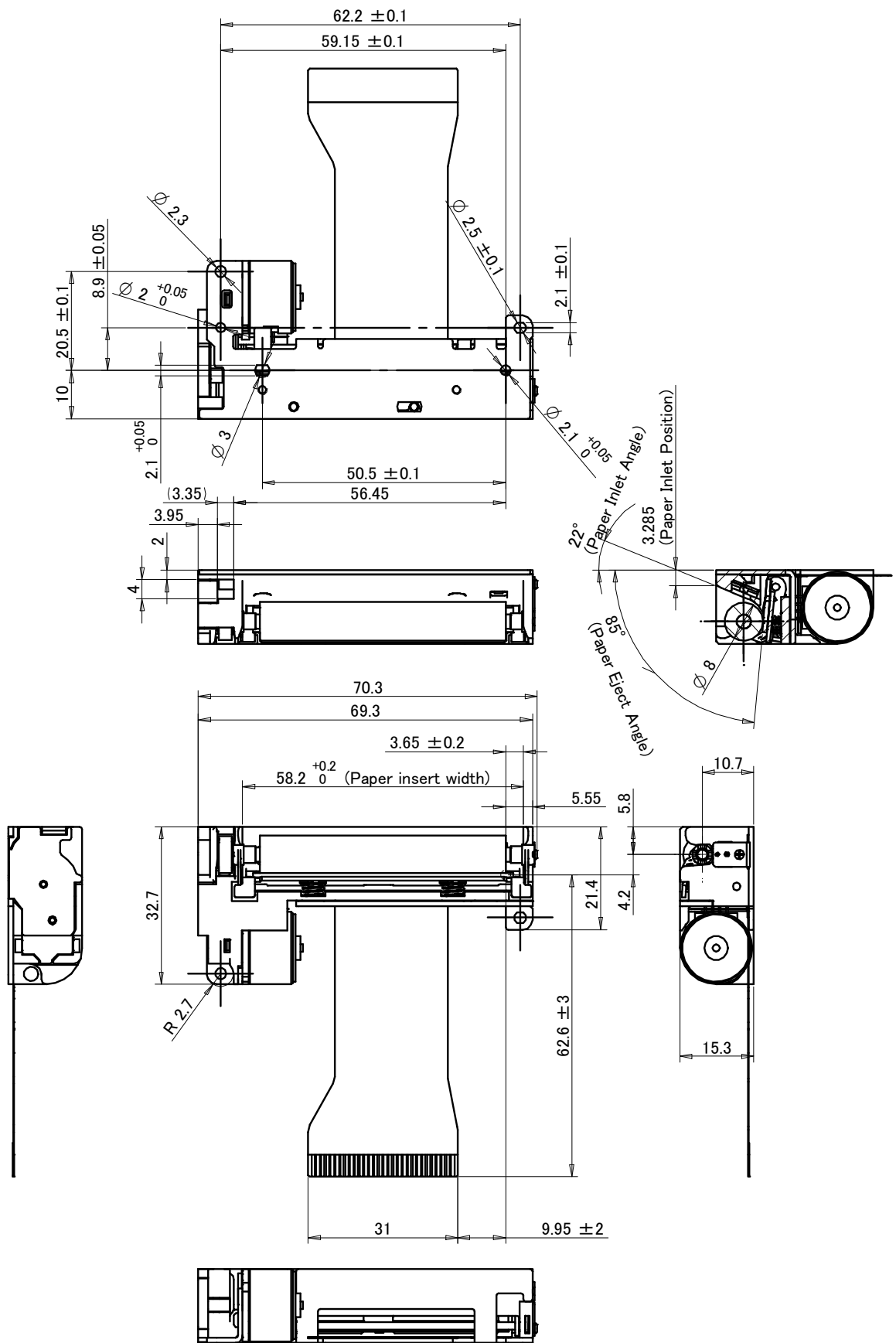
Unit : mm

Figure 7-1 External Dimensions of the Platen Unit



Unit : mm
 General tolerance : ± 0.5

Figure 7-2 External Dimensions of the Printer (LTP01-245-11/18)



Unit : mm
 General tolerance : ± 0.5

Figure 7-3 External Dimensions of the Printer (LTP01-245-12)

CHAPTER 8 HANDLING METHOD

8.1 INSTALLING/UNINSTALLING THE THERMAL PAPER

8.1.1 Procedures for Installing/Uninstalling the Thermal Paper

- (1) Procedures for installing the thermal paper by the easy operation (setting and releasing the platen block)
 - (a) Installing the thermal paper
 - Install the thermal paper with the platen unit released.
 - 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.
 - (b) Uninstall the thermal paper
 - Uninstall the thermal paper in the same manner for installing the thermal paper.
 - (c) Clearing a paper jam
 - Uninstall the thermal the paper in the same manner for installing the thermal paper.
- (2) Procedures for installing the thermal paper by auto-loading function (automatic insertion when the platen block is in set status)
 - (a) Procedures for Installing the Thermal Paper
 - Well-cut the thermal paper edge with scissors and cutter knife. Cutting the thermal paper edge perpendicular to paper feed direction, shown in Figure 8-1.

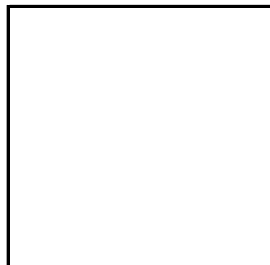


Figure 8-1 Shape of the Thermal Paper Edge

- Insert the thermal paper straight all the way in. Feed the thermal paper pushing it. See "3.3.5 Motor Drive Method" for motor drive pulse rate.
- (b) Procedures for Uninstalling the Thermal Paper
- Cut the thermal paper near the paper inlet of the printer mechanism.
 - Feed paper until all thermal paper is ejected.
- (c) Procedures for Removing the Paper Jam
- Remove the thermal paper by following the procedures for uninstalling the thermal paper.
 - When the thermal paper cannot be removed by the above method, release the platen block, and remove the thermal paper.

8.1.2 Precautions for Installing/Uninstalling the Thermal Paper

- Install the thermal paper with the platen unit released. Auto-loading is not allowed.
- 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.
- When setting the platen unit, the reduction gear may interfere with the platen gear and may cause the platen unit to not be set. In such a case, release the platen unit and set it again.
- If the thermal paper is skewed, feed the thermal paper until the thermal paper becomes straight or install the thermal paper again.
- Remove the jamming paper with the platen unit released. Do not pull the thermal paper by force because severe damages may occur.
- 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 the auto-loading difficulty. If facing this problem, release the platen block and set it back again before starting printing.

8.2 CLEANING THE THERMAL HEAD

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

8.2.1 Procedures for Cleaning the Thermal Head

- Turn off the power before cleaning.
- Clean the thermal head with the platen unit released.
- Clean the heat element using a cotton swab dipped in ethyl alcohol or isopropyl alcohol.
- Set the platen unit after the alcohol has dried completely.

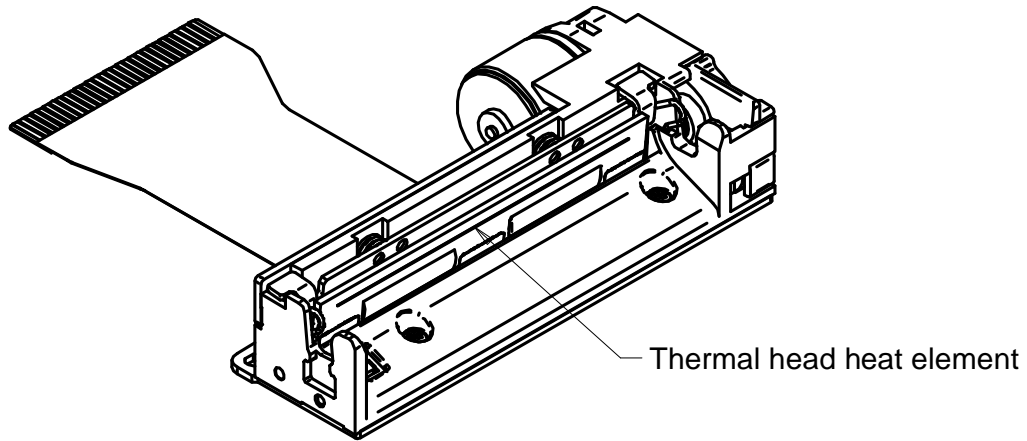


Figure 8-2 Cleaning Position of the Thermal Head

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 unit released.
- Do not use sandpaper, a cutter knife, or anything which may damage the heat element for cleaning.