SII

LTPZ245 B/J -C384-E

THERMAL PRINTER MECHANISM

TECHNICAL REFERENCE

U00092528801

Seiko Instruments Inc.

LTPZ245 B/J -C384-E THERMAL PRINTER MECHANISM TECHNICAL REFERENCE

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PREFACE

This reference manual describes the specifications and basic operating procedures for the LTPZ Series Line Thermal Printer Mechanism (hereinafter referred to as “printer”).

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

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

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

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CHAPTER 1

PRECAUTIONS

To use the printer properly, read though this manual.
Also, design the product in consideration of the detail precautions described in each section.

1.1 GENERAL PRECAUTIONS

- This manual describes information about printer specifications and basic printer drive method.
  This manual is subject to change without notice.
  Therefore, contact us to get the latest information.

- When using the printer with the method other than the method described in this manual, printer's action and quality cannot be guaranteed.
  Any damage or loss due to use with the method not described in this manual or inadequate handling will not be responsible for us.

- For safety use of the printer, design the system in consideration of the detailed precautions.
  Also, urge cautions to the end users by describing cautions such on the operational manual.

1.2 SAFETY PRECAUTIONS

To use the printer safely, design the product with in consideration of the following precautions. Additionally, caution end users by describing some directions in the instruction manual or paste the caution labels on the product.

- **Precautions to prevent the thermal head from overheating**
  If the thermal head heat element, which is always supplied electricity by the CPU, malfunctions, the thermal head may overheat and cause smoke and fire. Design to perform detection of abnormal temperatures by hardware as described in **Chapter 5**.
  Power off the printer immediately after an abnormality occurs.

- **Precautions against a rise in temperatures of the thermal head**
  Be sure to design the outer case to prevent the user from burning himself/herself by touching the thermal head directly since the thermal head is hot during and immediately after printing. Regarding head cleaning, prepare cautionary descriptions in the manual to perform these operations after the head temperature drops. To allow cooling, place clearance between the head and the outer case when designing the outer case.
  Refer to **Chapters 6** and **7** for dimensions.

- **Precautions against a rise in temperatures of the motor**
  Give warning to prevent the user from burning himself/herself by touching the motor and its surrounding metal parts directly since the motor and its surrounding metal parts are hot during and immediately after driving. To allow cooling, place clearance between the head and the outer case when designing the outer case.
  Refer to **Chapters 6** and **7** for dimensions.

- **Precautions for sharp edges of the printer body**
  The printer body or some parts may have some sharp edges. Be sure to design the outer case to prevent the user from injuring himself/herself by touching the sharp edges and give warning.

- **Precautions for motor drive**
  Design the motor drive circuit so that the motor will not be driven when the outer case and the platen block are in open status. The hair may be drawn into the motor gears because the motor gears are exposed.

1.3 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.

1.3.1 Design Precautions

- Follow the precautions when mounting the platen unit.
  Inadequate mounting of the platen unit may cause print difficulty or damage.
  (1) Design the mounting/unmounting system of the platen so that the platen unit can move horizontally to the printer mechanism.
  (2) Design the system so that the platen unit can be mounted securely on the printer mechanism.

- Design the outer case to prevent the paper feed out from being caught in the platen.
  (See **Chapter 6** for paper output direction.)

- Design the paper supply system in accordance with outer case design guide line.
  When the paper supply position is not proper, print difficulty or paper detection difficulty will be caused.

- When the printer is in the print waiting status that makes the thermal head in press status, always feed the paper 12 dots or more to prevent elastic distortion of the platen roller's rubber.

- Make sure that variation in the drive frequency does not lead to noise or a loss of paper feed force before making designs.

- The lower motor drive frequency generates the higher heat. Therefore, drive the motor at the highest possible high speed during continuous printing.

- Entering data and starting printing in the printing state where printing or feeding is paused may cause paper feed problems between dot lines of printing starting numbers. In particular, the problem is more likely to happen while printing bit images.

- Apply power in the following manner:
  When turning the power ON:1) Vdd (5 V) → 2) Vp
  At shut down: 1) Vp → 2) Vdd (5 V)

- Use C-MOS IC chips (74HC240 or equivalent) for interfacing the CLK, LATCH, DAT and DST signals of the thermal head.

- When turning the power ON/OFF, always make terminal DST "High".

- 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.

- The head activation time period may become longer according to the printing condition. If so, hold the phase of the motor and keep the pause time of the head activation for 0.5 msec or more. A continuous printing without a pause time may damage the thermal head.

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

  * Fix the printer to the Frame Ground (FG) by FG connection parts. (See **Chapter 6** for securing the printer.)
  * Connect the GND terminal (SG) to FG through an approximately 1 MΩ resistor.

- Keep the Vp power off while not printing in order to prevent the thermal head from being electrically corroded.
  In addition, design the printer so that the signal GND of the thermal head and the frame GND of the printer mechanism become the same electric potential.

- Wire resistance should be 50 mΩ or less (however the less the better) between the power supply and the Vp, and the GND terminals on the thermal head controller. Maintain a considerable distance from signal lines to reduce electrical interference.

- A surge voltage between Vp and GND should not exceed 10 V.

- As a noise countermeasure, connect the capacitor noted below near the printer mechanism connector.
  Vp-GND: approx. 47 μF
  Vdd-GND: approx. 0.1 μF

- Cut surfaces of metallic parts may become discolored and rusted due to the operational environment. Consider these factors regarding appearance.

- Do not apply any stress to the thermal printer connection FPC (Flexible Print Circuit).
  Stress may cause printing problems and thermal head damage.

- Do not use labeling paper, manifold paper, and thermal paper of more than 75 μm.

1.3.2 Handling Precautions

Incorrect handling may reduce efficiency of the printer and cause damage. Handle the printer with the following precautions.
Also, press operators for precautions.

- Always connect and remove the mechanism connection terminals after turning the printer off.
- Do not exert unreasonable pressure forcibly to the mechanism connecting FPC.
  Doing so, the mechanism connection FPC may be damaged.
- If the platen is left on press condition of thermal head, print quality may be inferior due to deformation of the platen.
  In this case, acclimate the platen by feeding paper for a while.
- To prevent the heat elements and ICs from electrostatic damage when mounting/unmounting the printer or replacing the paper, perform anti-static measure and ground the body before handing the printer.
  Pay special attention to heat elements on the thermal head surface and thermal head control terminals.
- If any paper other than that specified is used, high print quality and long life of the thermal head cannot be guaranteed.
  Problems that may occur:
  * Poor print quality due to low-sensitive paper
  * Abrasion of the thermal head due to a paper surface which is too rough
  * The thermal surface of the paper and the thermal head may stick together
  * Excessive noise during printing
  * Print fading due to low print preservation
  * Corroded thermal head due to poor thermal layer of the paper
- Always print or feed with the specified paper inserted to protect the platen and thermal head.
- Do not hit and scratch the surface of the thermal head with any sharp or hard objects as it may damage the heat element.
- When printing a black or checkered pattern at a high print rate in a low temperature or high humidity environment, the vapor from the paper during printing may cause condensation to form on the printer or may soil the paper.
  If water condenses on the printer, keep the thermal head away from water drops as it may corrode the thermal head, and turn printer power off until it dries.
- The printer uses metal parts for the frame and the motor.
  Especially the cutting section of the metal parts may be rusted in high temperature and high humidity environment.
- The printer is not water-proof. 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.

1.3.3 Disposing Precautions

When disposing of printer, follow the regulations or rules of each local government.

CHAPTER 2

FEATURES

The LTP Z 245B/J incorporates a compact printer mechanism that uses a thermal line dot print system.
It can be used together with an ECR, a POS, and a calculator.

The LTP Z 245B/J has the following features:

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

- **Compact**
  Dimensions: W70.1 x D32.7 x H15.3 mm
  Mass: approx. 40 g

- **Print speed***[1]
  Maximum 75 mm/sec print is available.

- **Easy operation**
  It is easy to mount thermal paper because the platen can be easily put on and took off.

- **Maintenance Free**
  No cleaning and maintenance need.

- **Low noise**
  Thermal line dot print is used to guarantee low-noise print.

- **Anti-static electricity function**
  All metal parts of the printer can be connected to Frame Ground (FG).
  The secondary radiation can be reduced.

*1 Print speed differs depending on working conditions.

CHAPTER 3

SPECIFICATIONS

3.1 GENERAL SPECIFICATIONS

Table3-1 lists the general specifications of the printer.

Table 3-1 General Specifications

Item	Specification
Print method	Thermal dot line printing
Dots per line	384 dots
Printable dots per line	384 dots
Common activatable dots per line	64 dots
Resolution	8 dots /mm (head scanning direction)
Maximum print speed *1	75 mm/sec
Print width	48 mm
Paper width	58 mm
Head temperature detection	Via a thermistor
Platen roller detection	None
Out-of-paper detection	Via photo interruptor
Operating voltage range Vp line Vdd line	 4.2 to 9.5 V 3.0 to 5.25 V
Current consumption Head drive (Vp) Motor drive (Vp) Head Logic (Vdd)	 Maximum 1.67 A (at 5.0 v), 2.41 A (at 7.2 V), 3.38 A (at 9.5 V) *2 0.6 A max. 0.1 A max.
Operating temperature range (No condensing)	-20 to 50 ℃ *3
Storage temperature range (No condensing)	-25 to 60 ℃

Table 3-1 General Specifications（Continued）

Item		Specification
Life span (at 25 °C and rated energy)	Activation pulse resistance	100 million pulses or more
	Abrasion resistance	50 km or more (excluding damage caused by dust and foreign materials)
Paper feed force		0.49 N (50 gf) or more
Paper hold force		0.78 N (80 gf) or more
Dimensions (excluding convex part) (width × depth × height)		70.1 × 32.7 × 15.3 mm
Weight		approx. 40 g
Specified thermal paper		PD150R Normal thermal paper Oji Paper Co., Ltd. PD160R-N Normal thermal paper Oji Paper Co., Ltd. KT55F20 Normal thermal paper Papierfabrik August Koehler AG

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

*2 The value when the number of commonly-activated dots is 64 dots.

*3 Printing may be faded in the condition under 0℃ and Vp:5V or lower.

3.2 HEAT ELEMENT DIMENSIONS

Figure 3-1 shows heat element dimensions of the LTPZ245.
Figure 3-2 shows print area of the LTPZ245.

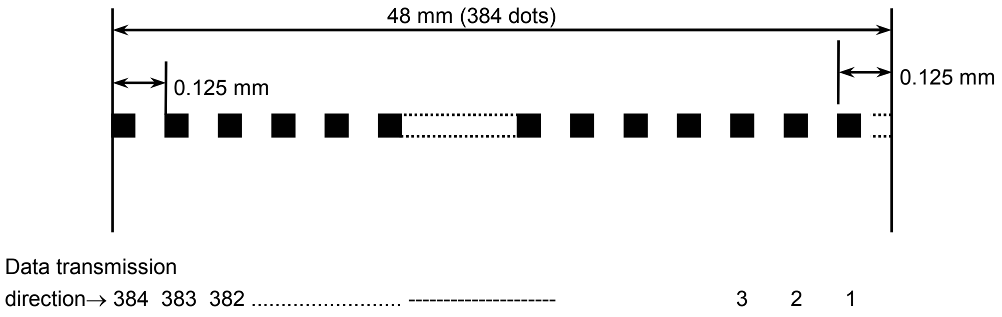


Figure 3-1 Heat Element Dimensions

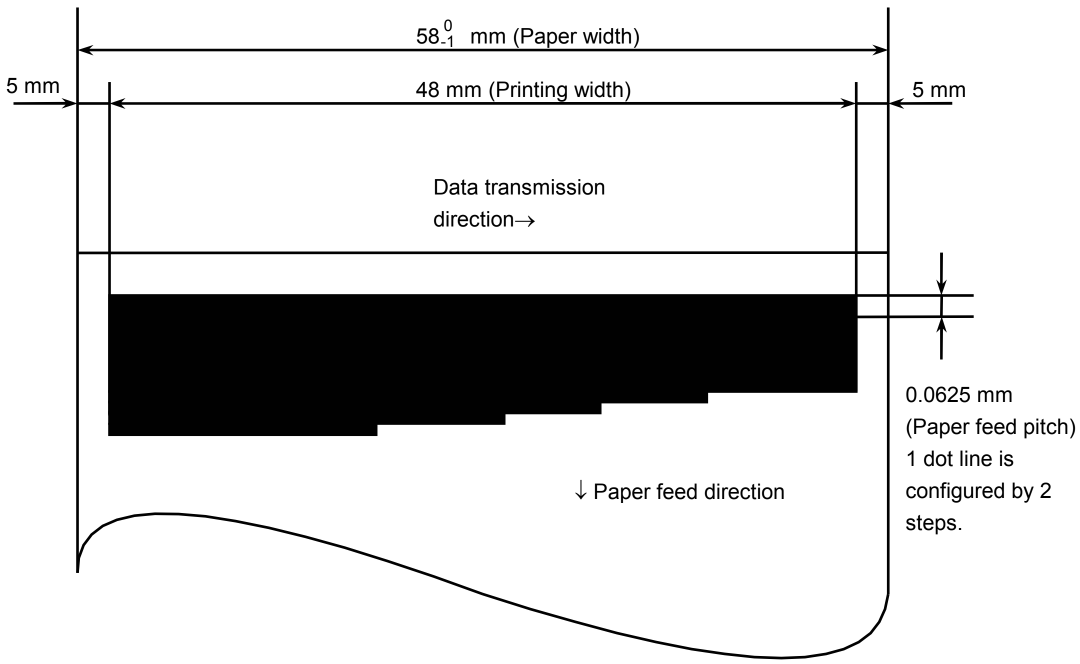


Figure 3-2 Print Area

3.3 STEP MOTOR

3.3.1 General Specifications

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

Table 3-2 General Motor Specifications

Item	Specification
Type	PM
Drive method	Bi-polar chopper
Excitation	2-2 phase
Winding resistance per phase	10 Ω/phase ±10%
Rated voltage	Vp: 4.2 to 9.5 V
Maximum current	300 mA/phase

3.3.2 Sample Drive Circuit

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

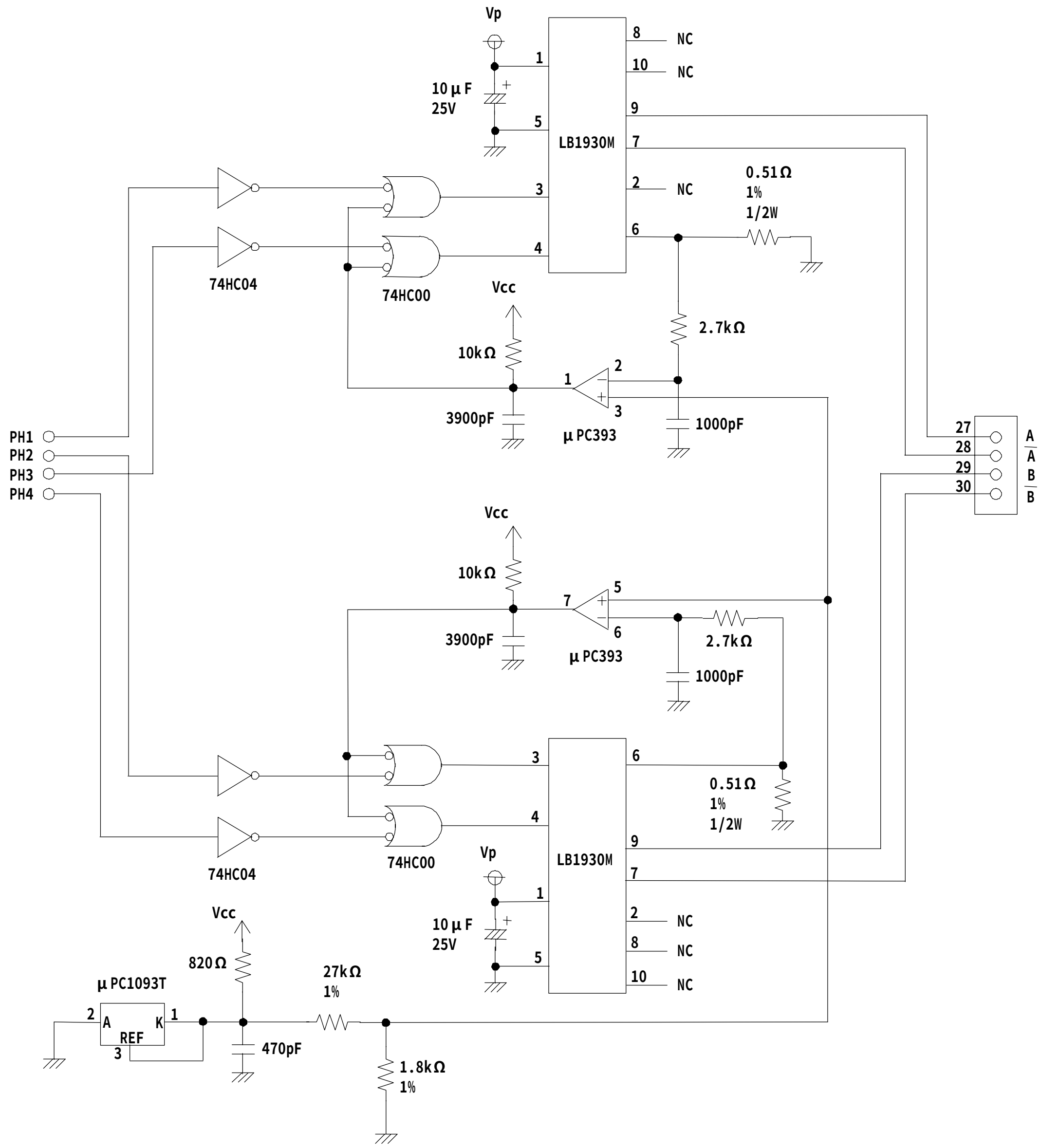


Figure 3-3 Sample Drive Circuit

3.3.3 Excitation Sequence

Drive the motor with 2-2 phase excitation. One step of the motor drive signal feeds the paper 0.0625 mm. One dot line is configured by 2 steps. When the motor shaft is rotated in a counterclockwise direction from the motor gear side view, the paper is fed to the normal direction. 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 paper in the normal direction when the motor is excited in the order of step 1, step 2, step 3, step 4, step 1, step 2, ... , as shown in **Table 3-3**.

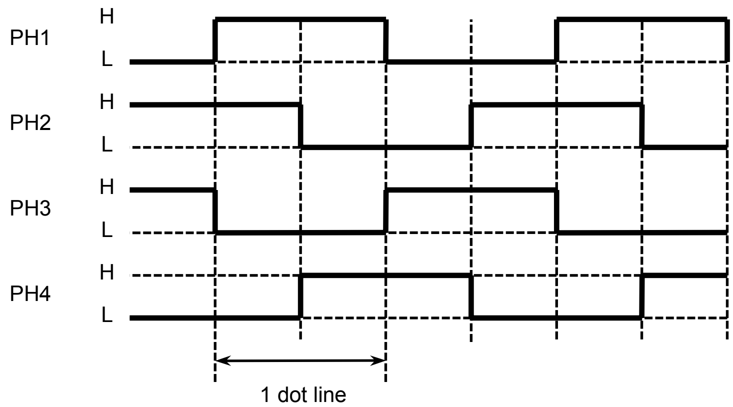


Figure 3-4 Input Voltage Signals for the Sample Drive Circuit

Table 3-3 Excitation Sequence

	Input Signal				**Output Signal**			
	PH1	PH2	PH3	PH4	A	B	$\overline{A}$	$\overline{B}$
Step 1	H	H	L	L	L	L	H	H
Step 2	H	L	L	H	L	H	H	L
Step 3	L	L	H	H	H	H	L	L
Step 4	L	H	H	L	H	L	L	H

3.3.4 Motor Timing

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

(1) Start step

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

(2) Stop step

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

(3) Pause state

- In the pause state, do not excite the step motor. Even when the step motor is not excited, it maintains force to prevent the paper from sliding.

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

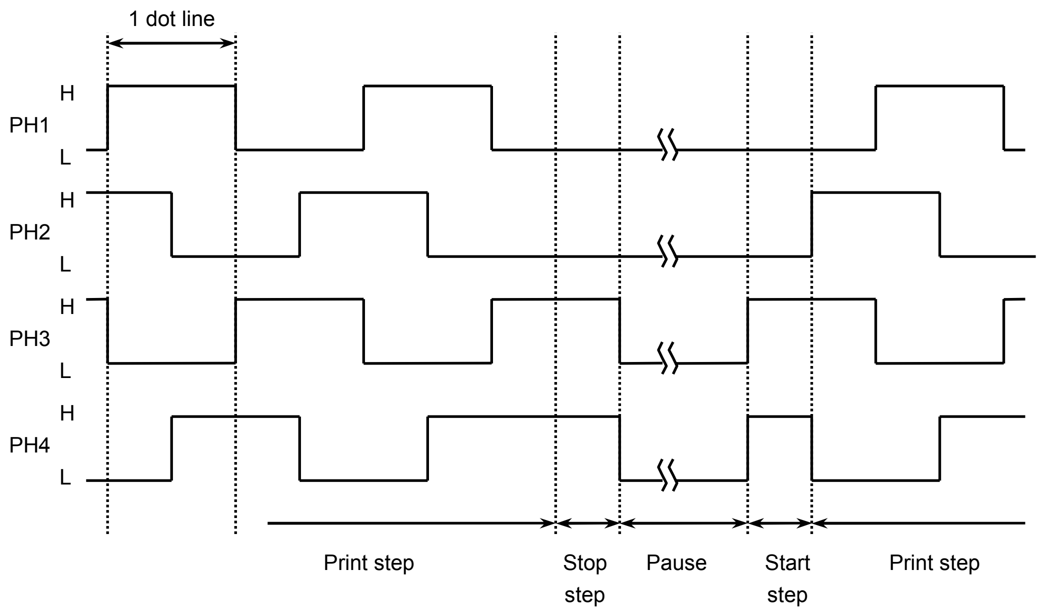


Figure 3-5 Motor Start/Stop Timing

3.3.5 Motor Driving

Drive the motor by the following methods.

(1) Motor Current Control

- When the motor speed decreases during printing because of the division drive method, the contents of print data, or input data transfer speed, noise and overheating of the motor may occur due to over- torque of the motor. When driving the motor, always set the current for each phase at 300mA or less.

(2) Driving frequency

- During paper feeding, the motor should be driven lower than the value obtained by equation (1).

Equation (1):

$$Vp \times 200 - 300 \text{ (pps)}$$

- The motor should be driven lower than 1200pps when Vp is 7.5V or higher.

Table 3-4 Motor driving frequency

Voltage(V)	Drivimg frequency
4.2	540 pps
5.0	700 pps
6.0	900 pps
7.2	1140 pps
8.0	1200 pps
9.5	1200 pps

(3) Acceleration Control

- In the pause state, do not excite the step motor. Even when the step motor is not excited, it maintains force to prevent the paper from sliding. When driving the motor, acceleration control is needed to start paper feeding. When the motor is to be driven at the maximum motor drive frequency that is calculated using equation (1), the motor may come out of step under heavy load.Drive the motor to the maximum driving speed that is calculated using equation (1), according to the acceleration steps in **Table 3-5**.

- The method for accelerating the motor is as follows;
  1. Output start step 1852(μs)
  2. Output first step for the first acceleration step time
  3. Output second step for the second acceleration step time
  4. Output nth step for the nth step acceleration time
  5. After outputting the time calculated using equation (1), the motor is driven at a constant speed.

- The printer can print during acceleration.

Table 3-5 Acceleration Steps

Number of Steps	Speed (pps)	Step Time (μs)
start	——	1852
1	540	1852
2	605	1653
3	663	1508
4	715	1399
5	764	1309
6	810	1235
7	853	1172
8	894	1119
9	933	1072
10	971	1030
11	1007	993
12	1042	960
13	1075	930
14	1108	903
15	1139	878
16	1170	855
17	1200	833

3.3.6 Motor Driving Precautions

- Using the motor drive circuit other than the circuit shown in "**Section 3.3.2 Motor Drive Circuit**" may not ensure the specified efficiency.

- To prevent degradation in the print quality due to the backlash of the paper drive system, turn the motor counterclockwise for 24 steps, viewed from the motor gear at the initialization (includes after opening/closing the platen unit).

- Drive the paper feed in 200 to 1200 pps.

- Change the motor drive frequency for printing depending on the operational conditions (voltage, temperature, and the number of activated dots). (For details see "**Chapter 5 DRIVE METHOD**.")

- Change the motor drive frequency for printing so that the activate pulse width of the head does not exceed the motor step time. (For details, see " **Chapter 5 DRIVE METHOD**.")

- To prevent overheat of the motor due to the continuous printing, do not drive the motor continuously at a low speed for long hours.

- Do not rotate the motor clockwise, viewed from the motor gear side.

- 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 start and stop steps for both character print and bit image print.

- If the motor step is stopped on the activated dot line, paper feed difficulty may be caused due to sticking of the thermal paper to the thermal head.
  Stop the motor drive on an inactivated dot line.

3.4 THERMAL HEAD

The thermal head consists of heat elements and a head driver that drives and controls the heat elements.
Serial print data input from the DAT terminal is transferred to the shift register synchronously with the CLK signal, then stored in the latch register at the timing of the LATCH signal.
The DAT signal is high active. (Print: high, No-print: low)
The DAT (data) signal is read at the rising edge of the CLK input signal.
One line data is read into the latch register by making LATCH signal "Low" after one line data transmission. The heat elements are activated by making print activation signal DST "High" according to the stored print data.
The printer prints in 6 divisions, each of which contains 64-dot heat elements.

3.4.1 Structure of the Thermal Head

Figure 3-6 shows the thermal head block diagram for the printer.

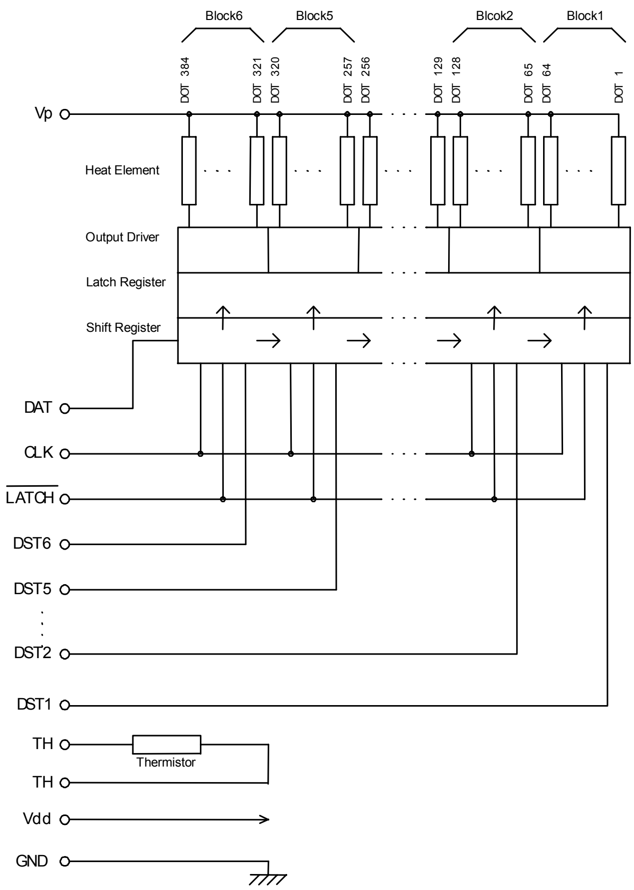


Figure 3-6 Thermal Head Block Diagram

3.4.2 Thermal Head Electrical Characteristics

Table 3-6 shows thermal head electrical characteristics of the printer.

Table 3-6 Thermal Head Electrical Characteristics

(Ta=25 ± 10 °C)

Item		Symbol	Conditions	Rated value			Unit
				MIN	TYP	MAX	
Head resistance		RH		169	176	183	Ω
Head drive voltage		Vp		4.2	–	9.5	V
Head drive current		Ip	At common activated dots number=64	1.31	–	3.38	A
Logic block voltage		Vdd		3.0	5	5.25	V
Logic block current		Idd	fDI=1/2fclk	–	–	54	mA
Input voltage	"High"	VIH	CLK, DI, LATCH, DST	0.8 Vdd	–	Vdd	V
	"Low"	VIL	CLK, DI, LATCH, DST	0	–	0.2 Vdd	V
DAT input current	"High"	IIH DAT	VIH=Vdd	–	–	0.5	μA
	"Low"	IIL DAT	VIL=0 V	–	–	-0.5	μA
DST input current (High active)	"High"	IIH DST	Vdd=5 V, VIH=Vdd	–	–	30	μA
	"Low"	IIL DST	VIL=0 V	–	–	-0.5	μA
CLK input current	"High"	IIH CLK	VIH=Vdd	–	–	3.0	μA
	"Low"	IIL CLK	VIL=0 V	–	–	-3.0	μA
LATCH input current	"High"	IIH LAT	VIH=Vdd	–	–	3.0	μA
	"Low"	IIL LAT	VIL=0 V	–	–	-3.0	μA
CLK frequency		f CLK	Vdd=5.0 V	–	5	8	MHz
CLK pulse width		t1	See the Timing Chart.	30	–	–	ns
DAT setup-time		t2	See the Timing Chart.	30	–	–	ns
DAT hold time		t3	See the Timing Chart.	10	–	–	ns
LATCH setup time		t4	See the Timing Chart.	200	–	–	ns
LATCH pulse width		t5	See the Timing Chart.	100	–	–	ns
LATCH hold time		t6	See the Timing Chart.	50	–	–	ns
DST setup time		t7	See the Timing Chart.	300	–	–	ns
Output delay time		t8	See the Timing Chart.	–	–	10	μs

3.4.3 Timing Chart

Figure 3-7 shows a thermal head drive timing chart of the printer.

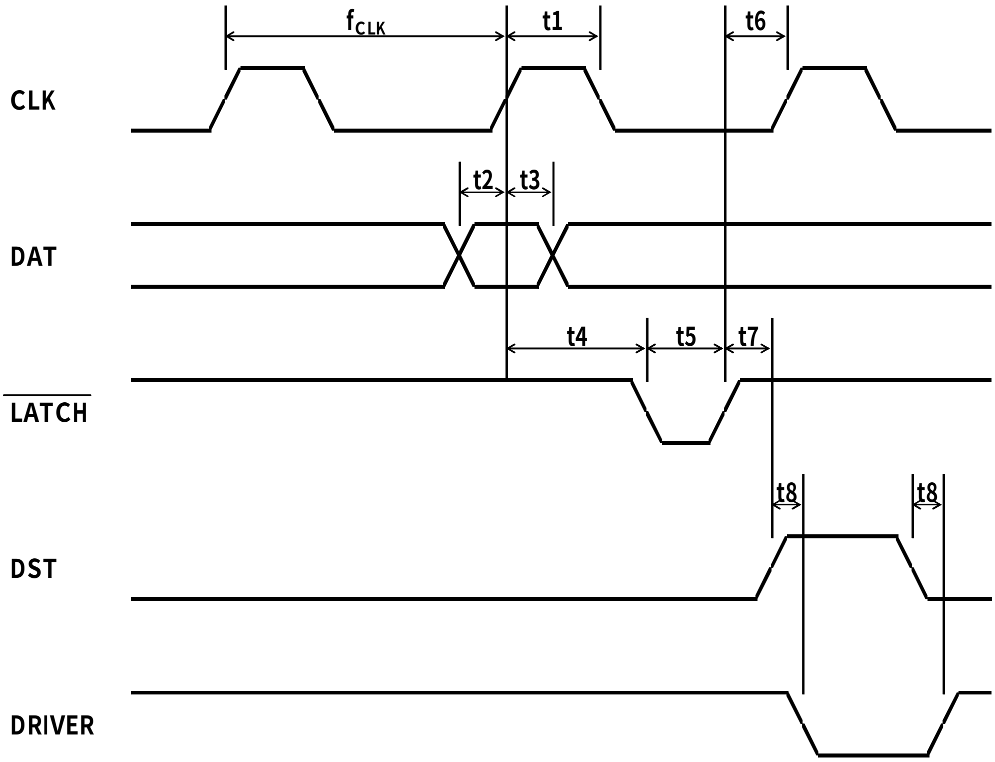


Figure 3-7 Timing Chart

3.4.4 Head Resistance

Resistance of thermal head of LTPZ245 is only one rank. Therefore, the adjustment by the difference in resistance is not required.

Table 3-7 Head Resistance

Head Resistance
169 to 183 Ω

3.4.5 Peak Current

Since the peak current (maximum current) may reach the values calculated using equation (2) when the thermal head is driven, number of dots activated simultaneously 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):

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

I_P: Peak current (A)
N: Number of dots to be driven at the same time
V_P: Head drive voltage (V)
RH: Head resistance (Ω)

3.4.6 Thermistor Resistance

The resistance of the thermistor at the operating temperature T_X (°C) is determined using the following equation (3). Variation of resistance by temperature is shown in **Figure3-8** and **Table3-8**.

Equation (3):

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

x:	Resistance at operating temperature Tx (°C)
R_{25}:	30 kΩ ± 10% (25 °C)
B:	3950 k ± 2 %
T_X:	Detected temperature (°C)
EXP (A) :	The "A" th power of natural logarithm e (2.71828)

Operating temperature range: -40 °C to 125 °C

Figure 3-8 Thermistor Resistance vs. Temperature

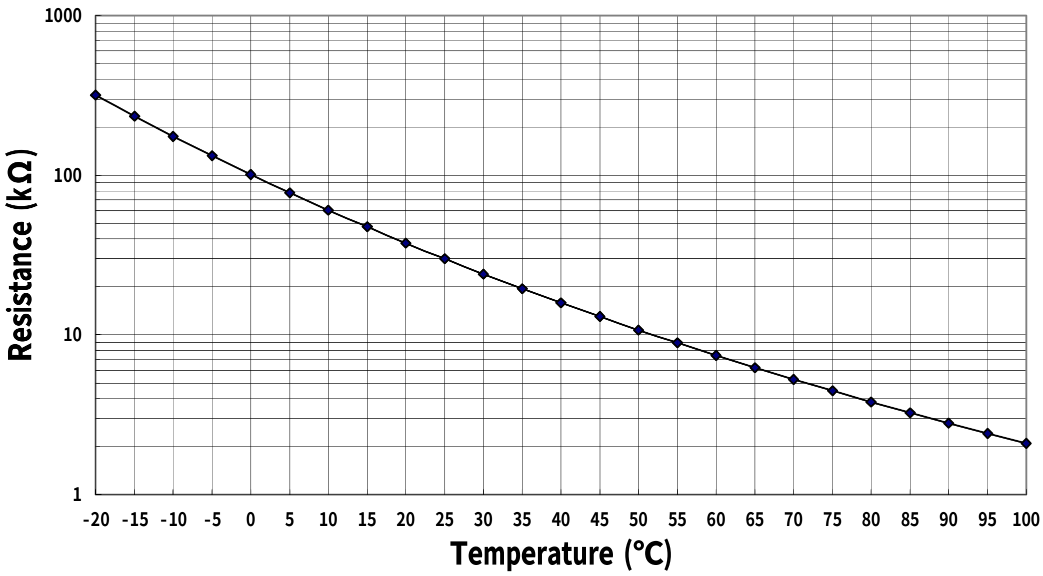


Table 3-8 Temperature and Corresponding Thermistor Resistance

Temperature (°C)	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 PAPER DETECTOR

The printer has a built-in paper detector (reflection type photo interruptor) to detect whether paper is present or not.

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

3.5.1 General Specifications

Table 3-9 Absolute Maximum Ratings of Detectors

(at 25°C)

Item		Symbol	Rating
LED (input)	Forward current	I_F	50 mA
	Reverse voltage	V_R	5 V
	Allowable current	P	70 mW
Phototransistor (output)	Collector-to-emitter voltage	V_{CEO}	20 V
	Emitter-to-collector voltage	V_{ECO}	5 V
	Collector current	I_C	20 mA
	Collector loss	P_C	70 mW
Operating temperature		T_{opr}	-20°C to + 80°C
Storage temperature		T_{stg}	-30°C to + 100°C

Table 3-10 Detectors Input/Output Conditions

(at 25°C)

Item		Symbol	Conditions	Min.	Standard	Max.
LED (input)	Forward voltage	V_F	I_F=10 mA	1.0 V	1.2 V	1.6 V
	Reverse current	I_R	V_R=5 V		–	10 μA
Photo-transistor (output)	Dark current	I_{CEO}	I_F=0 mA, V_{CE}=10 V		–	200 nA
Transfer characteristics	Photo electric current	I_C	I_F=10 mA, V_{CE}=5 V	150 μA	–	300 μA
	Leak current	I_{LEAK}	I_F=10 mA, V_{CE}=5 V		–	1 μA
	Collector saturation voltage	$V_{CE}(sat)$	I_F=10 mA, I_C=50 μA		–	0.5 V
	Response time (at rise)	t_r	I_C=1 mA, V_{CC}=5 V		5 μs	-
	Response time (at fall)	t_f	R_L=100 Ω		5 μs	–

3.5.2 External Sample Circuit

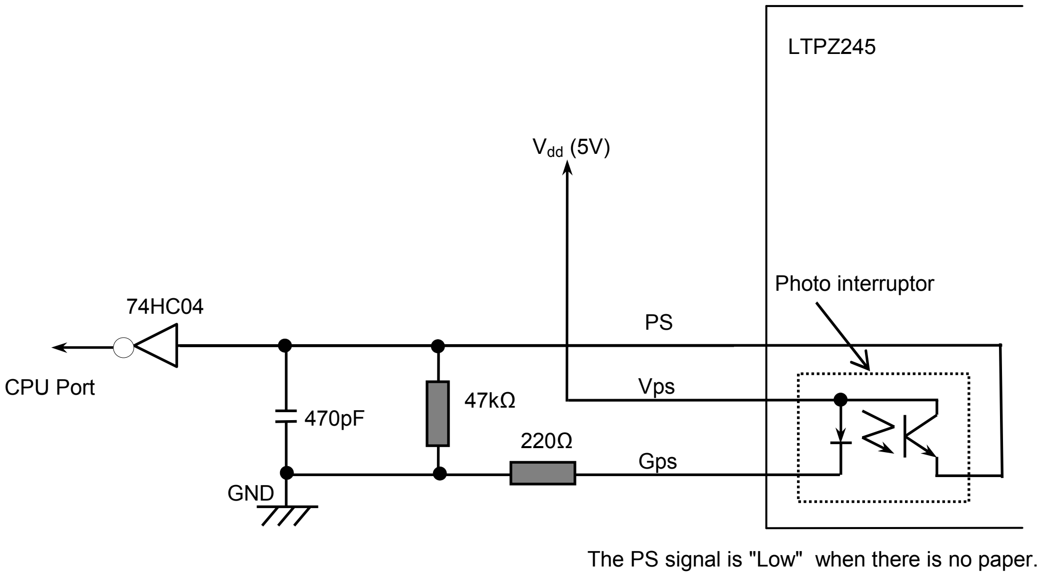


Figure 3-9 External Sample Circuit of the Lever Position Detector

CHAPTER 4

CONNECTING TERMINALS

4.1 RECOMMENDED CONNECTOR

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

Table 4-1 Recommended Connectors

Name	Number of Terminals	Recommended Connectors
Printer mechanism Connecting terminals FPC	30	FCI: SFW30R-2STE1LF (right angle type) SFW30S-2STE1LF,SLW30S-1C7LF (vertical type) MOLEX INC: 52207-3085,52089-3019 (right angle type) 52610-3071,52030-3029 (vertical type)

4.2 PRINTER MECHANISM CONNECTING TERMINALS

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

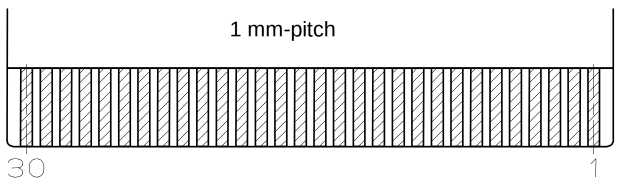


Figure 4-1 Printer Mechanism Connecting Terminals

Table 4-2 Terminal Assignments of the Printer Mechanism Connecting Terminal

Terminal Number	Signal name	Description
1	Gps	GND of the paper detector(LED cathode)
2	Vps	Power supply of the paper detector(LED anode)
3	PS	Output signal of the paper detector (Emittor output of a photo-transistor)
4	NC	Not used
5	NC	Not used
6	Vp	Thermal head drive voltage
7	Vp	Thermal head drive voltage
8	DAT IN	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
13	DST5	Thermal head print activation instruction signal
14	DST4	Thermal head print activation instruction signal
15	Vdd	Logic power supply (5V)
16	TH	Thermistor
17	TH	Thermistor
18	DST3	Thermal head print activation instruction signal
19	DST2	Thermal head print activation instruction signal
20	DST1	Thermal head print activation instruction signal
21	GND	GND
22	GND	GND
23	$\overline{\text{LATCH}}$	Print data latch (memory storage)
24	NC	Not used
25	Vp	Thermal head drive voltage
26	Vp	Thermal head drive voltage
27	A	Motor drive signal
28	$\overline{\text{A}}$	Motor drive signal
29	B	Motor drive signal
30	$\overline{\text{B}}$	Motor drive signal

CHAPTER 5

DRIVE METHOD

5.1 MOTOR AND HEAD DRIVE METHOD

When drive the motor and the thermal head at the same time printing, **Figure 5-1** shows a timing chart for driving using two divisions. **Figure 5-2** shows a timing chart for driving using one division.
(The number of dots which can be activated simultaneously should not exceed 64dots.)

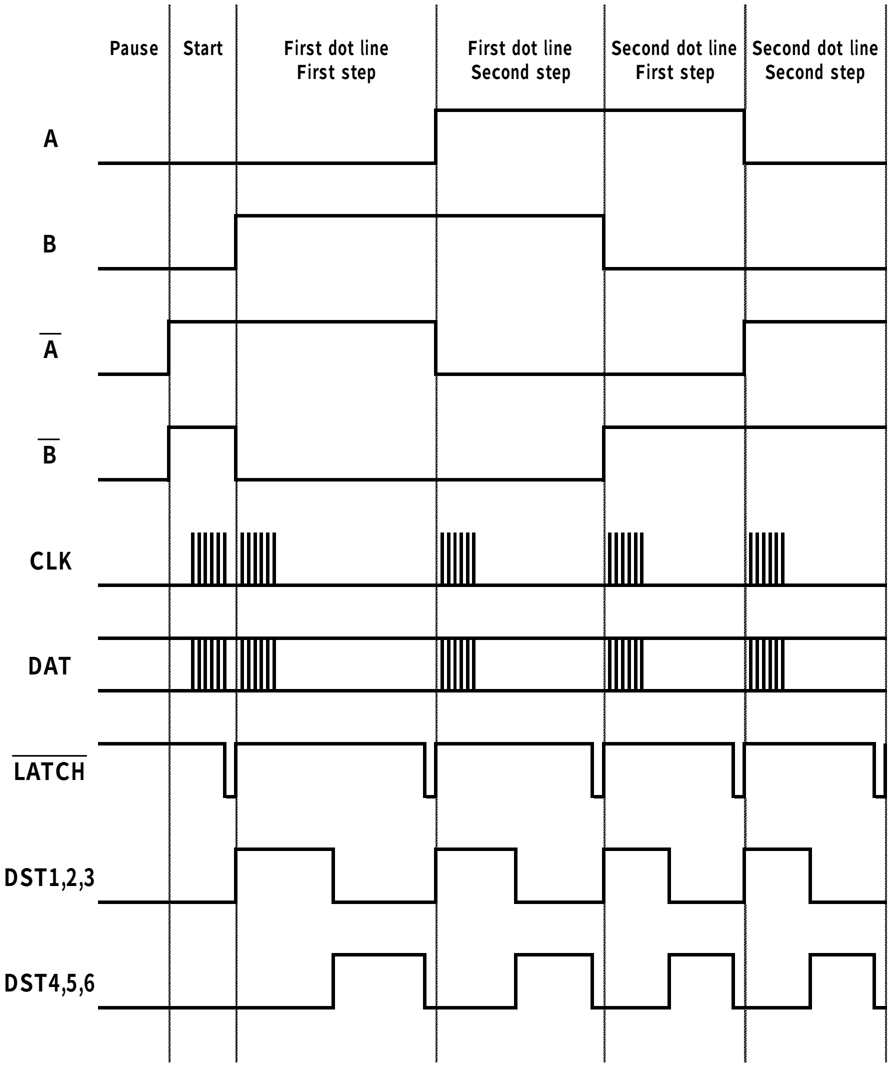


Figure 5-1 Timing Chart for Driving Using Two Divisions

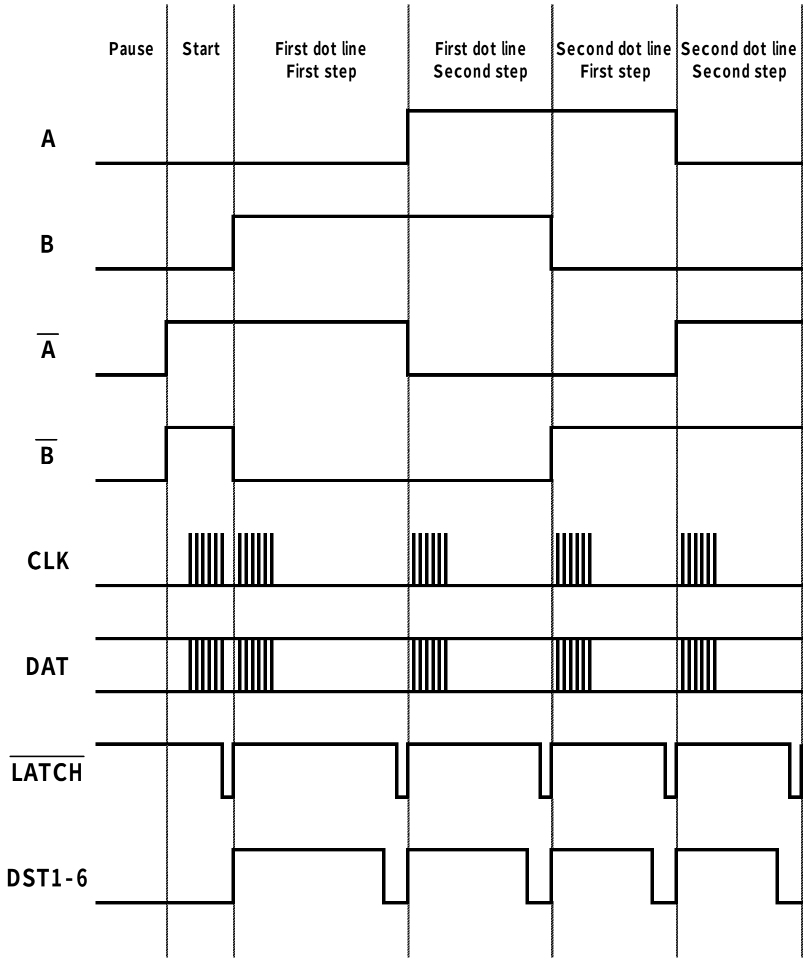


Figure 5-2 Timing Chart for Driving Using One Division

The drive method using two divisions is explained below:

Pause state

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

Start step

Output the phase signal that has been output just before stop of the motor. Data latch by LATCH signal after 1st step data of 1st dot-line is input to the head.

1st line, 1st step

Drive the motor by one step. Print simultaneously by turning signals DST 1, 2 and 3 "High". Calculate the activation time, referring to "**Section 5-3 CONTROLLING THE HEAD ACTIVATION (DST) PULSE WIDTH**."
Activate signals DST 4, 5 and 6 by turning "High" to "print." The 2nd step data of the 1st line can be input during printing.
Input the same data as 1st step's for 2nd step data because 1 dot-line is composed of 2 steps.
Input LATCH signal after printing to latch the 2nd step data.

1st line, 2nd step

Drive the motor by one step. Print simultaneously by turning signals DST 1, 2 and 3 "High". Calculate the activation time, referring to "**Section 5.3 CONTROLLING THE HEAD ACTIVATION (DST) PULSE WIDTH**." The activation time will be shorten than 1st step's because the printer prints for 1st step.
Activate signals DST 4, 5 and 6 by turning "High" to "print."
The 1st step data of the 2nd line can be input during printing.
Input LATCH signal after printing to latch the 1st step data of the 2nd Line.

Repeat the steps in the same way. Transfer the data that will be printed in the next step to the thermal head while starting the activation of the thermal head.
The data transfer time and head activation time may be longer than the motor step time depending on to the type of the thermal paper, printing data and operational environment.
In this case, hold the motor step until completion of printing.
When using one division, keep 0.5 msec for the pause time after head activation.

5.2 HEAD DIVISION DRIVE METHOD

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

Fixed division method

Logical blocks (physical blocks to be driven at the save time) are predetermined for the fixed division method.
High quality printing is available because the physical blocks are always driven in the same order.
Also, when there is a spare for the power supply capacity, high speed printing is available by reducing the number of divisions regardless of print contents.

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 peak current can be controlled within a constant value.

5.3 CONTROLLING THE HEAD ACTIVATION (DST) PULSE WIDTH

5.3.1 Calculation of Head Activation Pulse Width

Head activation pulse width is calculated using the following equation (4).
To execute high quality printing using the LTPZ245B and H, the value calculated using the following equation (4) must be adjusted according to the printer's installation environment. Calculate each value used according to the steps in **Section 5.3.2** to **5.3.5** and apply the pulse width with the "t" value obtained by substituting each into the equation (4).

Equation (4):

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

t	:	Head pulse width (ms)
V	:	Applied voltage (V)
E	:	Standard applied energy (mj) ....See **Section 5.3.2**
R	:	Head resistance (Ω)...See **Section 5.3.3**
C	:	Head pulse term coefficient....................................See **Section 5.3.4**
D	:	Heat storage coefficient..See **Section 5.3.5**

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

5.3.2 Calculation of Applied Energy

Applied energy should be in accordance with the temperature of the thermal head and the printer's installation environment.
The thermal head has a built-in thermistor. Measure the temperature using thermistor resistance.
Calculate the printing energy using equation (5), the paper coefficient and temperature coefficient.

Equation (5):

$$E = P \times (E_{25} - Tc\,(Tx - 25))$$

E	:	Printing energy (mj)		
E_{25}	:	Standard printing energy		0.179 (mj)
Tc	:	Temperature coefficient		0.001969
Tx	:	Detected temperature using the thermistor (°C) *1		
P	:	Thermal paper coefficient		
		PD150R	(Oji paper)	1.1
		PD160R-N	(Oji paper)	1.1
		KT55F18	(Koehler)	1.2

*1 The thermistor resistance value at Tx (°C). See **Section 3.4.6**.

5.3.3 Adjustment of Head Resistance

Adjustment of head resistance is to be in accordance with equation (6).
There is a drop in voltage caused by wiring resistance.

Equation (6):

$$R = (RH + Ri + (Rc+rc) \times N)^2 / RH$$

RH : Head resistance 176(Ω)
Ri : Wiring resistance in the thermal head 10(Ω) *1
Rc : Common terminal wiring resistance in the thermal head: 0.073 (Ω)
rc : Wiring resistance between Vp and GND (Ω) *2
N : Number of dots driven at the same time

*1 The value at Vdd=5.0V. When the voltage is low, Ri becomes larger.

*2 The resistance is the resistance of the wire used between the head control terminal of thermal head, the power supply, the serial resistance of switching circuit of relay, etc.

5.3.4 Head Activation Pulse Period Coefficient

Make adjustments using the head activation pulse period coefficient (equal motor drive frequency) as the printing density changes by the printing speed.
According to equations (7), calculate compensation coefficient "C" of the heat pulse.

Equation (7):

$$C = W / 12.29 + 0.42 \quad (C < 2.0)$$

W: 1 step (1000/motor drive frequency) activation cycle (ms)

5.3.5 Heat Storage Coefficient

In high-speed printing, a difference in temperature arises between the rise in temperature of the thermal head due to head activation and the temperature detected by the thermistor. Therefore, the activation pulse must be corrected by simulating a rise in the temperature of the thermal head.
No correction is needed when the print ratio is low. When correction is not needed, set “1” as the heat storage coefficient.

The heat storage coefficient is calculated as follows:

1) Prepare the heat storage counters to simulate heat storage.

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

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

T: Heat storage counter value
N: Number of the activated dots
B: Number of entire dots for each physical block

(b) Radiation
The heat storage counter value is multiplied by the radiation coefficient in each 1 msec.

$$T' = T \times K$$

K: Radiation coefficient 0.995

2) Calculate the heat storage coefficient with the following equation (8).

Equation (8)

$$D = 1 - \frac{T}{43410}$$

5.3.6 Calculation Sample for the Head Activation Pulse Width

Table 5-1 lists the calculation samples of the head activation pulse width calculated using equation (4) and the values obtained using equations (5) to (8).

Table 5-1 Activation Pulse Width

Unit(ms)

Head drive voltage(V)	Thermistor temp.(°C)	Motor drive frequency (pps) 400	500	600	700	800	900	1000	1100	1200
5	0	1.29	1.21	1.15	1.11					
	10	1.18	1.10	1.05	1.02					
	20	1.07	1.00	0.95	0.92					
	30	0.96	0.90	0.85	0.82					
	40	0.85	0.79	0.75	0.73					
	50	0.74	0.69	0.66	0.63					
	60	0.62	0.58	0.56	0.54					
	70	0.51	0.48	0.46	0.44					
	80	0.40	0.37	0.36	0.34					
6	0	0.90	0.84	0.80	0.77	0.75	0.74			
	10	0.82	0.77	0.73	0.71	0.69	0.67			
	20	0.74	0.69	0.66	0.64	0.62	0.61			
	30	0.67	0.62	0.59	0.57	0.56	0.54			
	40	0.59	0.55	0.52	0.51	0.49	0.48			
	50	0.51	0.48	0.46	0.44	0.43	0.42			
	60	0.43	0.40	0.39	0.37	0.36	0.35			
	70	0.36	0.33	0.32	0.31	0.30	0.29			
	80	0.28	0.26	0.25	0.24	0.23	0.23			
7	0	0.66	0.62	0.59	0.57	0.55	0.54	0.53	0.52	
	10	0.60	0.56	0.54	0.52	0.50	0.49	0.48	0.48	
	20	0.55	0.51	0.49	0.47	0.46	0.45	0.44	0.43	
	30	0.49	0.46	0.44	0.42	0.41	0.40	0.39	0.39	
	40	0.43	0.40	0.39	0.37	0.36	0.35	0.35	0.34	
	50	0.38	0.35	0.33	0.32	0.31	0.31	0.30	0.30	
	60	0.32	0.30	0.28	0.27	0.27	0.26	0.26	0.25	
	70	0.26	0.24	0.23	0.22	0.22	0.21	0.21	0.21	
	80	0.20	0.19	0.18	0.18	0.17	0.17	0.16	0.16	
8	0	0.51	0.47	0.45	0.43	0.42	0.41	0.41	0.40	0.40
	10	0.46	0.43	0.41	0.40	0.39	0.38	0.37	0.37	0.36
	20	0.42	0.39	0.37	0.36	0.35	0.34	0.34	0.33	0.33
	30	0.37	0.35	0.33	0.32	0.31	0.31	0.30	0.30	0.29
	40	0.33	0.31	0.29	0.28	0.28	0.27	0.27	0.26	0.26
	50	0.29	0.27	0.26	0.25	0.24	0.24	0.23	0.23	0.22
	60	0.24	0.23	0.22	0.21	0.20	0.20	0.20	0.19	0.19
	70	0.20	0.19	0.18	0.17	0.17	0.16	0.16	0.16	0.16
	80	0.16	0.15	0.14	0.13	0.13	0.13	0.13	0.12	0.12

Do not use this area because paper feed errors may occur because of the motor torque.

Note) The above table shows values for thermal paper PD160R-N or equivalent thermal paper, Rc+rc=0.073,the number of commonly-activated dots=64, and D=1.
In the shaded areas, the drive pulse width exceeds the allowable activation pulse width or the activation pulse width exceeds the motor drive frequency. Therefore, use the motor drive frequency shown in the unshaded area.

5.3.7 Detecting Abnormal Temperature 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:

(1) Detecting abnormal temperatures by software

Design software that will deactivate the heat elements if the thermal head thermistor (TH) detects a temperature higher than 80 °C (thermistor resistance RTH≦3.80 kΩ), and reactivate the heat elements when a temperature lower than 60 °C (RTH≦7.45 kΩ) is detected. If the thermal head continues to be activated at a temperature higher than 80 °C, the life of the thermal head may be shortened significantly.

(2) Detecting abnormal temperatures by hardware

If the control unit (CPU) malfunctions, the software for detecting abnormal temperatures may not function properly, resulting in overheating of the thermal head. Overheating of the thermal head may damage the thermal head or cause skin burns.
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 detector, design hardware that detects the following abnormal conditions:

(a) Overheating of the thermal head (approximately 100 °C or higher (RTH≦2.09 kΩ))

(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.

CHAPTER 6

PRINTER MOUNT AND HOUSING DESIGN GUIDE

6.1 FIXING THE PRINTER

6.1.1 Mounting of The Printer

Position the printer with embedding housing by the hole A and the concave B.
Then, fix by screws at the screw hole C and D.
Height of positioning pin on the housing should be 0.7 +/- 0.1mm.
See **Figure 6-1** for reference.

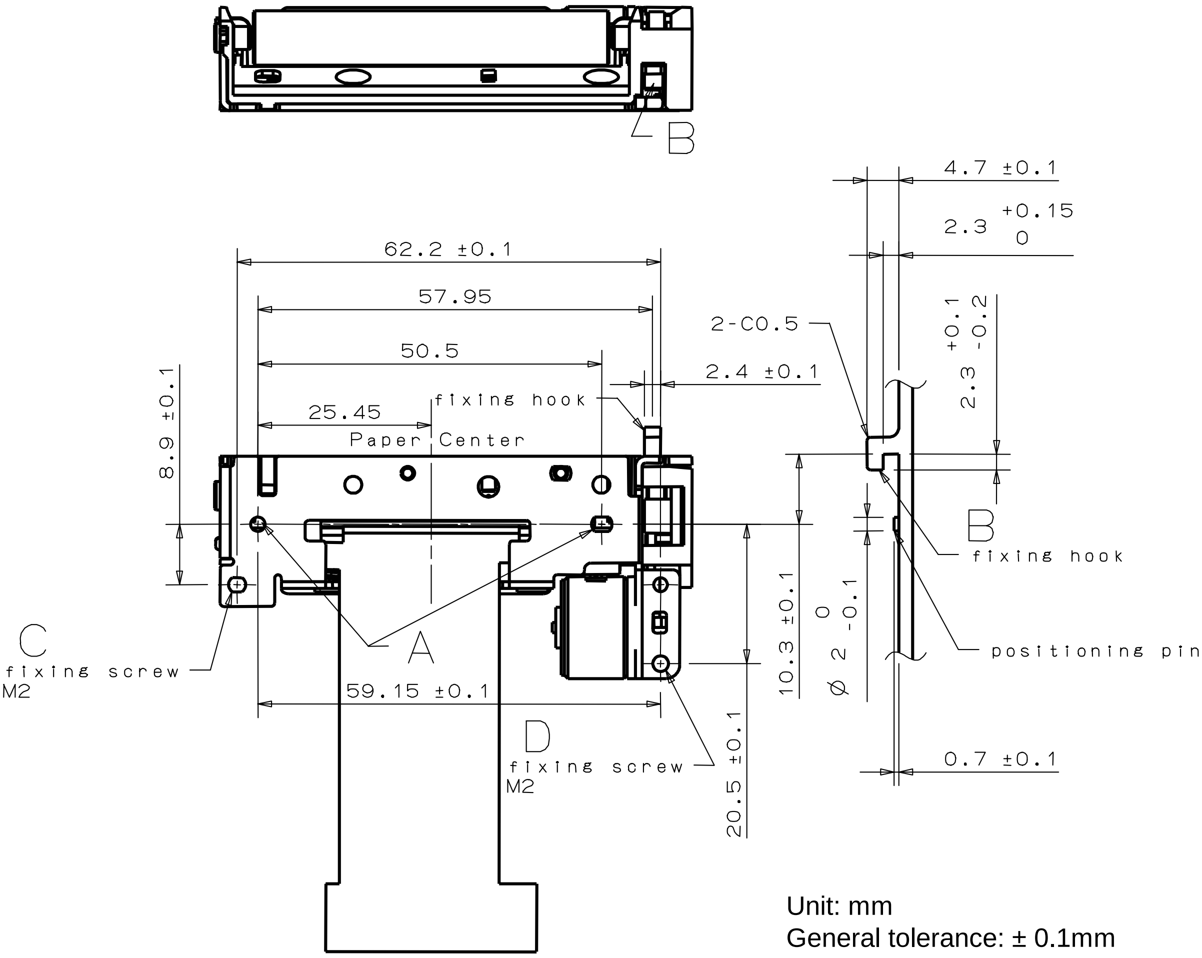


Figure 6-1 Dimensions and Layout for Positioning and Fixing the Printer

6.1.2 Recommended Screws

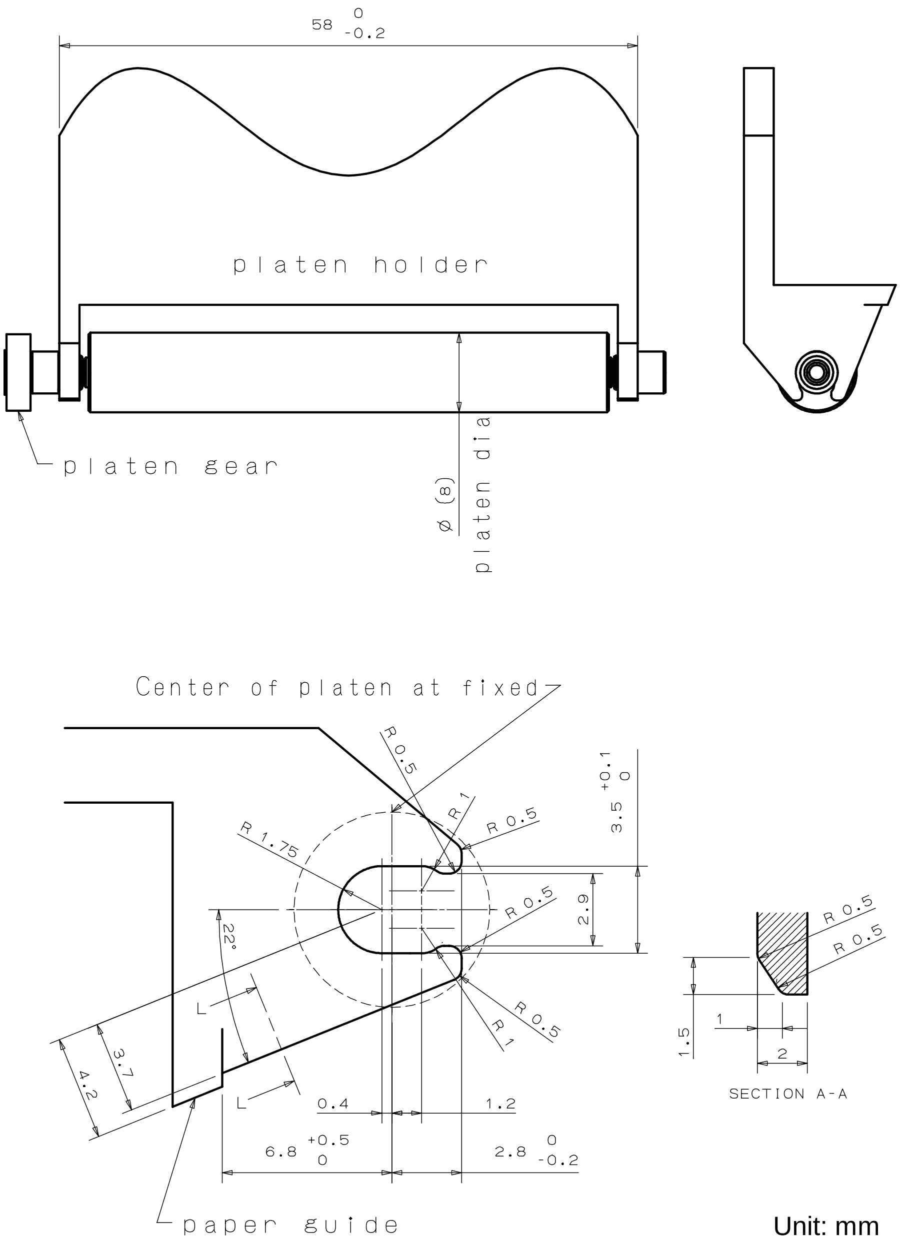
M2 cross-recessed pan head screw

6.1.3 Precautions for Securing The Printer

- Prevent from excessive stress, deformation, and torsion for fixing the printer, otherwise less printing quality, paper skewing, paper jamming, and noise during printing may be caused.
- The printer to be mounted on flat place, and prevent from vibration.
- Frame ground to be taken through the C and D using conductive screws in order to avoid damage on thermal head caused by electrostatics.
- Frame ground and signal ground to be connected via 1M ohms resistance in order to keep same electrical potential.
- Pay attention not to damage on the FPC when fix the printer with screws.
- The metal frame may have rust but no influence on printer functionality.

6.2 FIXING THE PLATEN UNIT (RECOMMENDATION)

6.2.1 Dimensions of The Platen Holder

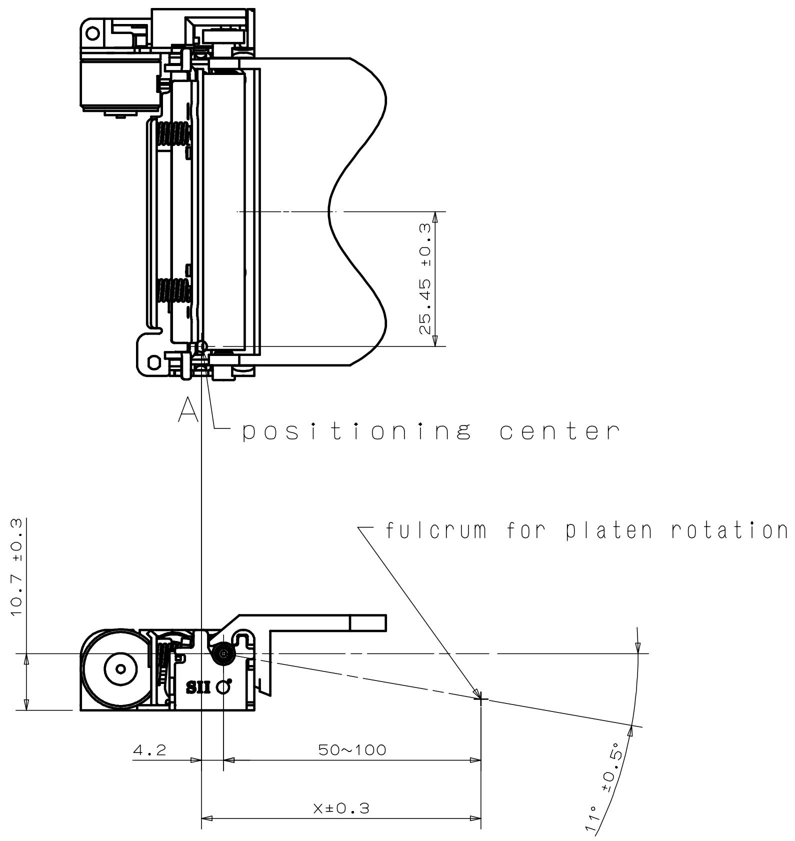


Unit: mm
General tolerance: ± 0.1 mm

Figure 6-2 Dimensions of The Platen Holder

Note) Edge cutting of the platen holder is required as shown on the section A-A in order to improve fitting with the printer body.
Also, paper guide is required on the paper holder as shown on the **Figure 6-2** so paper is led to paper inlet of the printer properly in order to improve paper detection stability.

6.2.2 Fixing of The Platen Unit



Unit: mm

Figure 6-3 Fixing of The Platen Unit

6.2.3 Precautions for fixing the platen unit

- The platen holder to be designed not to contact with thermal head block.
- Fulcrum of platen unit rotation to be located in range shown on the **Figure 6-3**.
- It is recommended to have guide on the platen holder so the platen is led to the printer body smoothly.
- It may influence on printing quality due to incorrect mating between the platen unit and the printer body if position of fulcrum is not appropriate.
- Parallel degree between the platen shaft and the fulcrum axis for platen rotation should be 0.2 or less.
- The platen holder to be strong enough to stand against stress applied during mating and release of the platen unit.
- Metal stuff is not recommended for the platen holder material as the platen bearing (plastic material) may be deformed and/or damaged.
- Pressure or stress for direction where the platen roller is released should be applied only when the platen roller is really released. Permanent pressure or stress for releasing the platen roller may cause slipping gears, irregular paper feed pitch, and negative influence on printing quality during operation.

6.3 LAYOUT OF PRINTER AND PAPER

- The printer and paper to be laid out as shown on the **Figure 6-4**.
- The paper guide is required on the paper holder as shown on the figure 2 so paper is led to paper inlet of the printer properly in order to improve paper detection stability.
- Otherwise, paper insertion angle is designed to be -22 degree or more as shown on the **Figure 6-2**.
- Applied load to the printer for paper supply is to be 0.49N (50 gf) or less. Paper supply to be done smoothly even if applied load to the printer is 0.49N (50 gf) or less.
- Paper outlet angle to be 60-90 degrees.
- For winding paper with a take up device, paper outlet angle should be kept as specified (60-90 degrees) for minimum 4mm before changing direction to the take up device. Printing quality may be worse if paper is pulled to the take up device at the point just after paper outlet. Winding torque should not exceed paper holding strength of the printer, otherwise slipping gears may be caused.

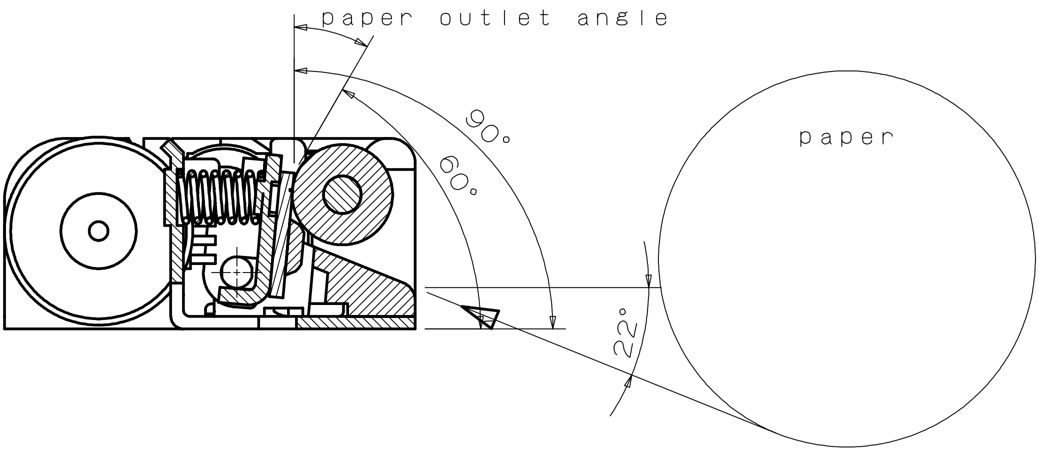


Figure 6-4 Recommended Layout Between The Printer and The Paper

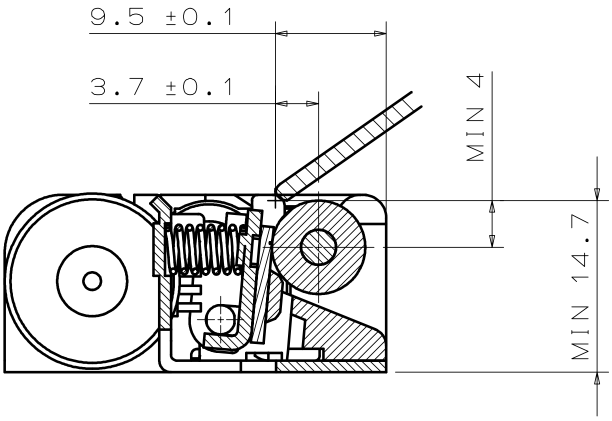


Figure 6-5　Recommended Paper Output Angle

6.4 WHERE TO MOUNT THE PAPER HOLDER

When determining the layout of paper holder, note the following.
The recommended configuration of the paper holder is shown in **Figure 6-6**.

- When you use a paper roll, mount the holder so that the paper will be straight to the paper inlet port without any horizontal shifting, and the center axis of the paper roll will be parallel to the printer.
- Adjust the load using the paper holder when paper is supplied to the printer at 0.49 N (50 gf) or less.

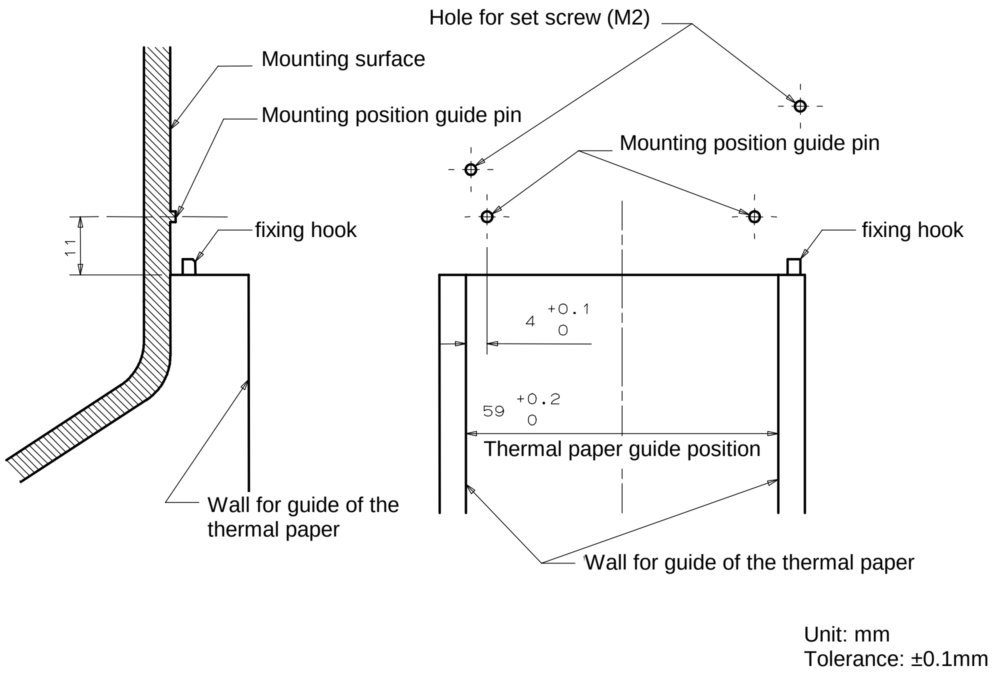


Figure 6-6 Recommended Paper Holder Dimensions

6.5 PAPER CUTTER MOUNTING POSITION

- Design paper cutter mounting position so the edge of the paper cutter blade does not touch with a platen block when the platen block is opened or closed.
- Use a well-cut cutter so paper can be cut with power less than paper holding power.

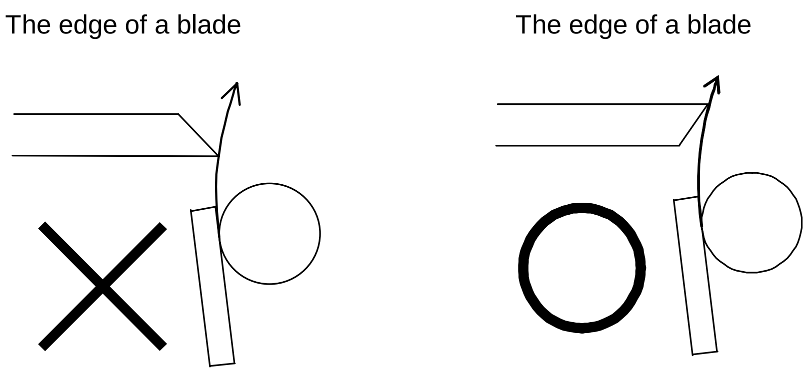


Figure 6-7 Blade Figure

In the left cutter mechanism, the cut paper may be caught by the edge of the blade, and caught inside.
Design cutter figure so the cutter figure can guide the paper after cutting.

6.6 LOADING/UNLOADING PAPER

6.6.1 Loading Paper

(1) Lift the platen to the arrow direction shown in **Figure 6-8** to remove it.

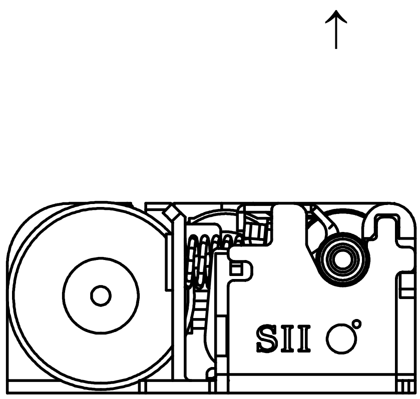


Figure 6-8 Platen Release Direction

(2) Mount the paper straight so that edge of the paper comes out 5 cm or more from the upper surface of the printer mechanism.

(3) Confirm the paper is mounted straight and then secure the platen unit to the printer mechanism.

(4) When the paper is skewed, adjust the paper feeding until the paper goes straight or set the paper again.

6.6.2 Unloading Paper

In case of paper jam, first the platen unit in the same manner as that for loading, second remove the paper.

6.7 HEAD CLEANING PROCEDURE AND PRECAUTIONS

6.7.1 Head Cleaning Procedure

Normally, head cleaning is not necessary. If you want to clean the head, follow the procedures below:

(1) Make the platen unit the open status by performing the same operation as that for paper loading.

(2) Clean the heat elements with a cotton swab that has been dampened with ethyl alcohol or isopropyl alcohol.

(3) Close the platen after the alcohol has completely dried. (Close state)

6.7.2 Head Cleaning Precautions

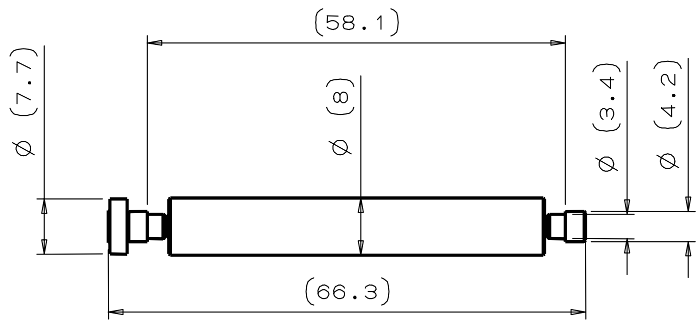
(1) Do not clean the head just after printing because the thermal head unit and its periphery are hot.

(2) Do not use sandpaper, cutter, etc. when cleaning. They will damage the heat elements.

CHAPTER 7

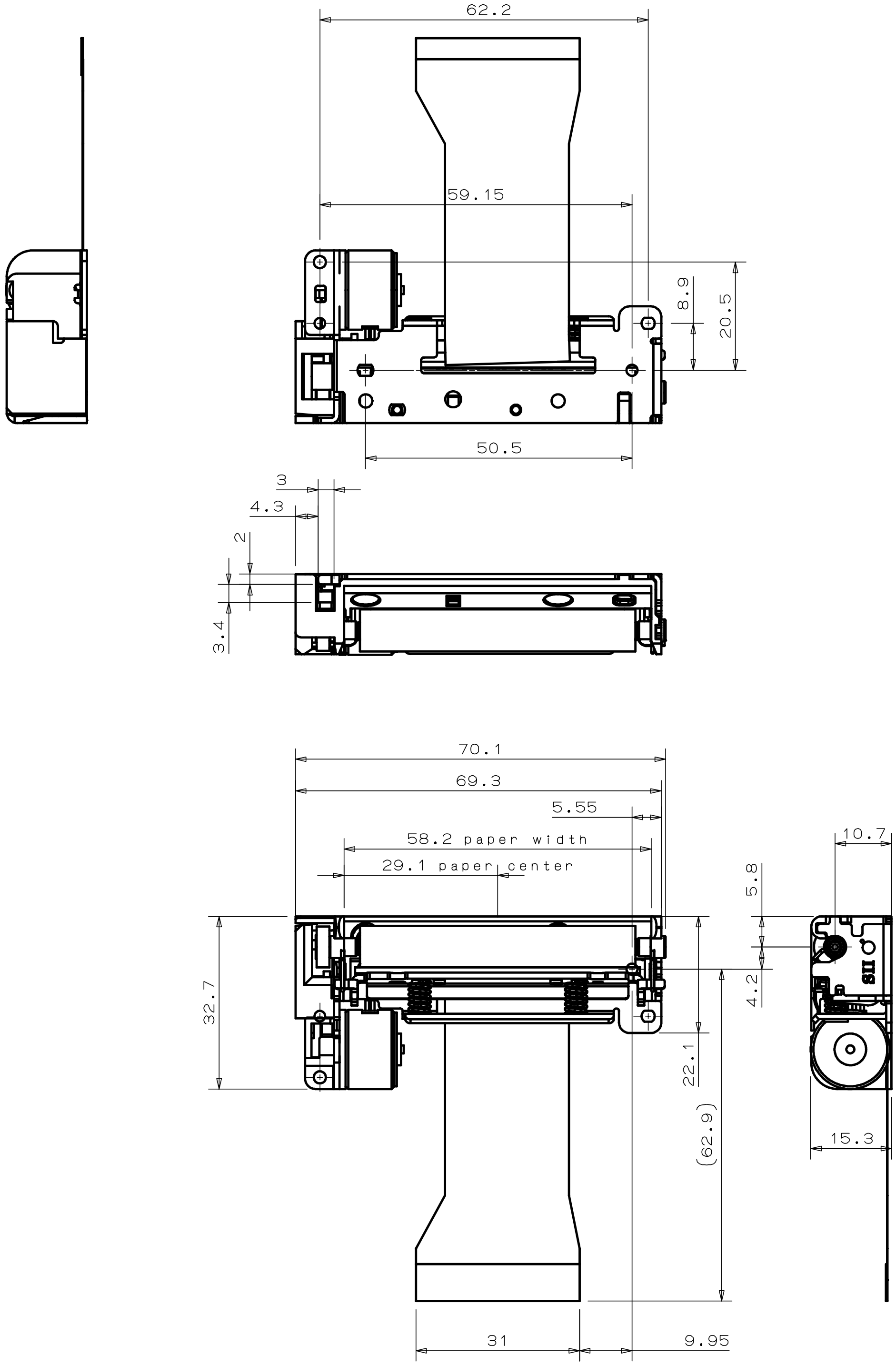
APPEARANCE AND DIMENSIONS

Figure 7-1 shows appearance of the platen unit and **Figure 7-2** shows appearance and dimensions for LTPZ245B and **Figure 7-3** for LTPZ245J printer mechanism.



Unit: mm

Figure 7-1 Appearance of The Platen Unit



Unit: mm
General tolerance: ±0.5 mm

Figure 7-2 Appearance and Dimensions for Printer Mechanism (LTPZ245B-C432-E)

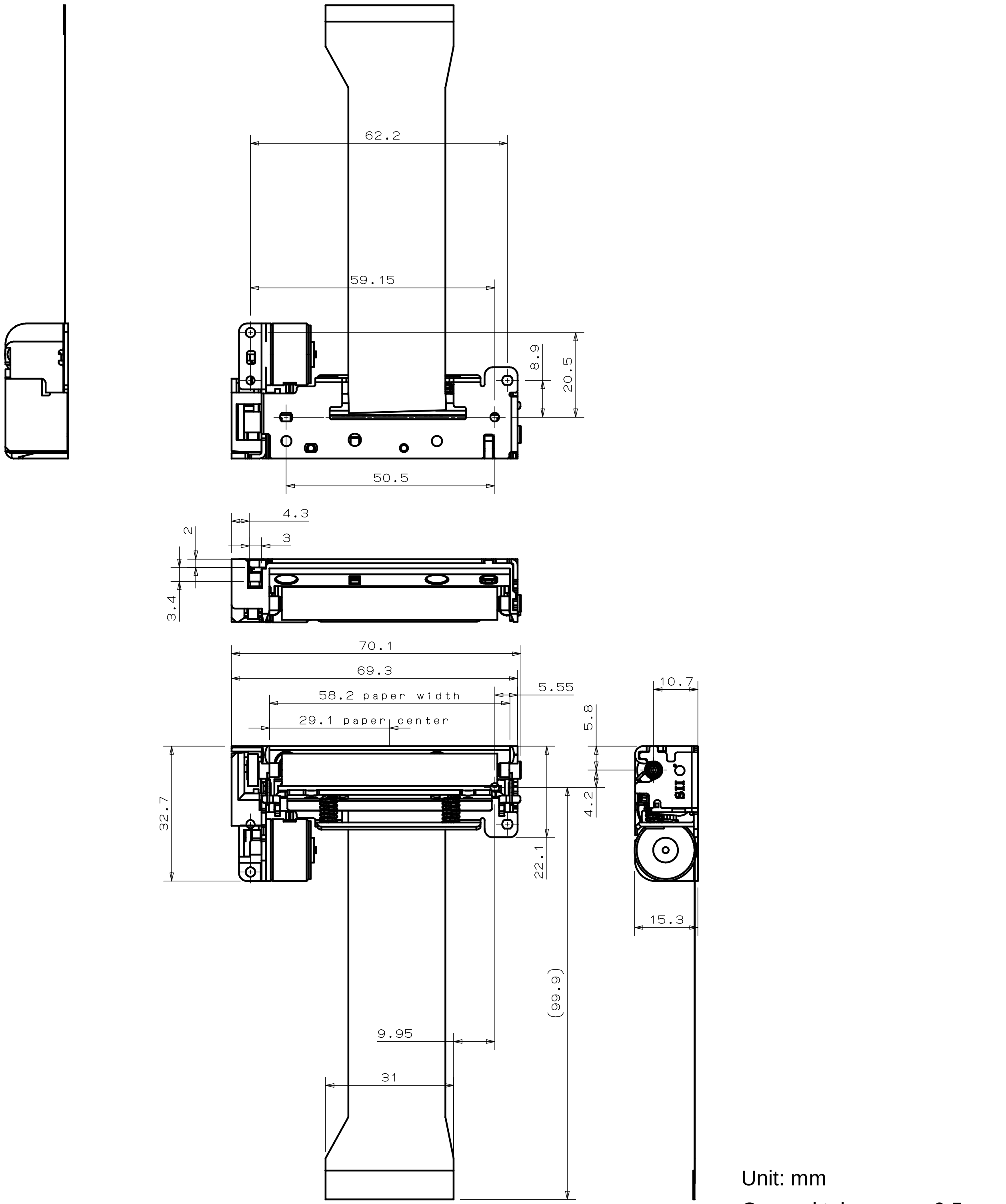


Figure 7-3　Appearance and Dimensions for Printer Mechanism (LTPZ245J-C384-E)