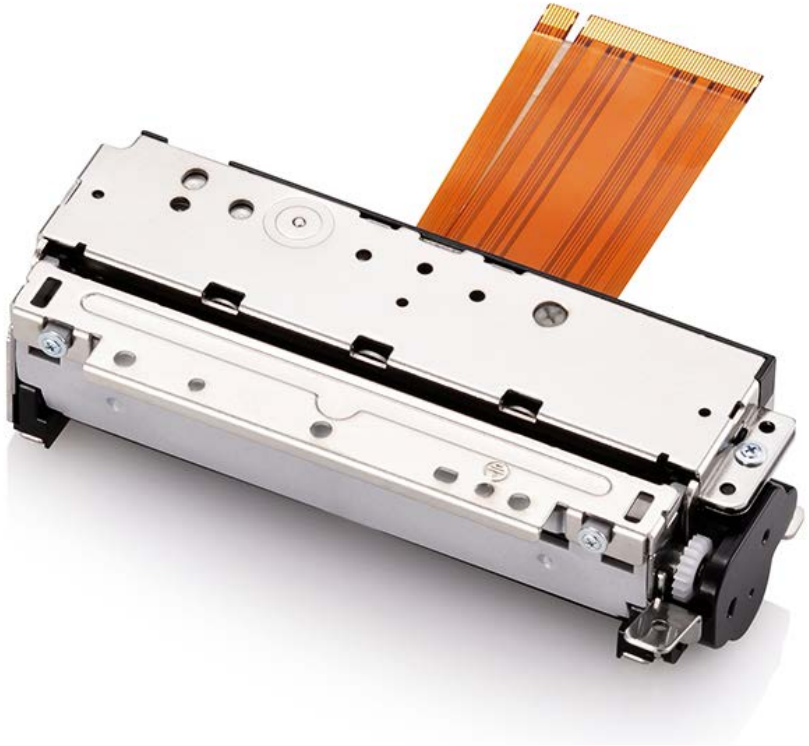
BIXOLON

User's Manual

SMP6350

Thermal Printer Mechanism

Rev. 2.03



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REVISION SHEET

Revisions		Design section			Revision	
REV.	Date	WRT	CHK	APL	Page	Description
1.00	27.06.17	K.H.JEON	K.H.JEON	J.S.LEE		
2.00	14.09.17	K.H.JEON	J.S.LEE	J.G.KIM	16~29	Modified TPH and STEPMOTOR spec.
2.01	20.09.17	K.H.JEON	J.S.LEE	J.G.KIM	17~23	Modified TPH spec.
2.02	30.11.17	K.H.JEON	J.S.LEE	J.G.KIM	42~42 46,52, 59~60	Modified Out View
2.03	15.05.20	J.S.LEE	J.S.LEE	J.G.KIM	3~4 6	Modified Contents & Spec revision

■ Table of Contents

※ Definition of Terms

The terms below help users to understand manual contents easy and fast who refer to the manual. Some terms may contain technical terminology of printers.

a) Printer mechanism (Mecha)
Machanism means SMP6350 which is simply referred to as Mecca in this manual.

b) Paper
A roll paper that is used to print and is discolored in response to heat.

c) Thermal head
Head is marked as a core part that applies heat to paper for printing.

d) Paper Feeding
It means ejecting paper after printing.

e) Paper Jam
it means paper-feed fail during printing

f) Platen roller block
It means assembly block containing a roller for paper feed. And it is marked as a roller block.

g) Auto cutters
It means a cutter that cuts paper after printing.

h) Movable cutter and fixed cutter
The fixed cutter blade of auto cutter is called a fixed cutter and a moving cutter blade is called a movable cutter.

i) Feed Motor
This means a motor that is operated during paper feed.

※ Precautions

Please read carefully and fully understand this user's manual when you design printers or terminals using the printer mechanism (SMP 6350).

BIXOLON is not responsible for any damage or loss occurred due to your company's configuration parts or usage not included in this user's manual or improper handling of the printer mechanism.

The printer mechanism is designed and manufactured for the purpose of installation to general purpose electronic equipment. Contact sales department of BIXOLON if it is to be used for products with higher responsibilities involved with injury to body or life and property loss as additional design or performance verification will be necessary.

The sample circuits included in this document were not verified for intellectual properties. You must check the intellectual properties related to these circuits sufficiently before using them.

BIXOLON makes continuous improvements for better functions and quality of the product. The specifications of the product and contents of this manual are subject to change without prior notice due to this reason.
Check the latest user's manual when you purchase the printer mechanism

※ Safety Precautions

Take care with the following items when designing products such as terminals using the printer mechanism, and include precautions required for user's manual so that users of the products such as terminals can use the products safely.

a) Precautions when cutting thermal paper

Before cutting thermal paper, check whether thermal paper supply is in stop state.
Paper powder can be generated due to the operation of automatic cutter. As the paper powder could cause problems with electric circuits, design the system so that paper powder does not pile up over the control device or power supply device.

b) Precautions with cutter blade

Thermal paper can be easily installed by isolating the platen roller block from the printer main body with this printer mechanism. The fixed cutter blade will be exposed if the platen roller block is open. In order to prevent injury to users by touching the blade while cutter is in operation or replacing the thermal paper, design the structure with a cover on outer case or attach a warning label to warn the users for safe operation.

c) Precautions with portable blade drive

Set the control so the motor does not operate when platen roller block is open. And design the paper exit so that users are not injured by touching the cutter while the cutter is in operation.

d) Precautions for preventing overheating of thermal head

When the thermal device of thermal head remains activated continuously due to a malfunction, the overheating of the thermal head may cause a fire. Design the system so that the thermal head does not malfunction even under abnormal conditions.

e) Precautions of temperature rise of thermal head

The temperature of the thermal head and peripheral devices is very high during printing. Design the system so that users do not get a burn injury by touching the thermal head. Attach a warning label so that users use the product safely.
When cleaning the thermal head, recommend cleaning work after the thermal head has cooled down. Leave enough space between the thermal head and outer case when designing the outer case for faster cooling of the thermal head.

f) Precaution about temperature rise of the motor

The temperature of step motor and the peripheral device is very high during or right after printing. Design the outer case so that users do not get a burn injury by touching the motor. Attach a warning label so that users can use the product safely. Leave enough space between the motor and outer case when designing the outer case for cooling the motor.

g) Precautions on sharp edges of the printer mechanism

The printer mechanism has many sharp corners and rough surface on the metal parts. Design the outer case so that users do not get injured by touching the sharp edges, and attach a label for the safety of users.

h) Precautions when driving the motor

Hair can be rolled into the platen roller and gears when they are closed.

Design the control so that the printer driver motor does not operate when the outer case and platen roller block are open. Also, design the outer case so that external objects do not contact the platen roller and gears, so preventing objects from jamming. Attach a warning label so that users can use the device safely.

※ Design Precautions

Take precautions with the following items when designing products such as terminals using the printer mechanism.

a) The sequence of applying power is as follows.
- Startup: Apply Logic Power (VDD) and then apply Head supply voltage (VH)
- Shutdown: Cut off Head supply voltage (VH) and cut off Logic Power (VDD)

b) The head power (VH) must have a TVS diode less than 28V.

c) To prevent noise from the Logic power supply, put a 0.1µF Cap near the connector.

d) Design the pattern resistance (or wire resistance) between the power input and the printer terminal to less than 50 mΩ. Also, design the power and signal so that they do not interfere with each other.

e) Protect the thermal head from electrolytic corrosion by blocking the head supply voltage (VH) while not printing. Also, design the product so that the GND signal of the thermal head and the frame ground of the printer mechanism maintain the same potential difference.

f) Use C-MOS IC for *CLK,/LAT , DI,/STB* signals of the thermal head.

g) Design the / Strobe signal to maintain a high level whenever the power is turned on or off, or not printing.

h) If the head is activated when the roller block is open or out of paper, the life of the head and roller may be reduced or damaged.

i) Do not drive the cutter when the roller is open or there is no paper. The life of the cutter may be reduced.

j) Strobe on (T-on) time of the head is Max. Control within T-on.
Max. Longer Trobe-on time in T-on standard may damage the head.

k) If excessive energy is applied to the head, the head may be damaged or the life span may be shortened due to overheating.

l) Noise and vibration during printing may differ depending on the pulse speed of the motor. Check performance by actually using the device.

m) Paper feeding force may decrease depending on the pulse speed of the motor. Check performance by actually using the device.

n) If the printer mechanical device is not used for a long time after cutting the thermal paper, the paper may jam. In order to prevent this situation, feed the paper up or print by more than 2 mm after cutting.

o) Do not feed the thermal paper backwards. If the thermal paper falls off from the thermal head or platen roller, the printer mechanical device may not able to feed paper anymore or it may be jammed.

p) Continuous printing may cause problems to the printer mechanism because of accumulated heat in the step motor. Therefore, when there is a need to print for longer than few minutes, stop the printing in the middle and restart printing after the step has sufficiently cooled down. Check performance by actually using the device.

q) If the main body with the moving cutter blade and platen roller block with the fixed cutter blade are not positioned correctly, it might cause printing defects, paper jam, or cutting failure. Therefore special care must be taken to position the outer case correctly when installing it.

r) Door pivot system in the outer case that holds platen roller block must be installed by pressing the center of platen roller block. If only one end of the platen roller block is pressed and installed, it might cause a problem such as printing defects, paper jam, cut failure, or damage to the cutter blade. Check performance by actually using the device. Mark the instruction to install platen roller block by pressing the center.

s) Provide sufficient space so that the lever can be removed easily with the fingers when designing the outer case.

t) Chattering might occur at the mechanical operating contact in auto cutter switch. Therefore, you must configure hardware chattering protection circuit or apply software chattering compensation program.

u) Printing quality cannot be guaranteed if thermal paper other than specified paper is used, and it may reduce the life of the thermal head.

v) The detection range of the paper detection sensor changes depending on the input and output resistance value. Refer to the paper sensor detection sample external circuits in 7-1-3. Check performance by actually using the device.

w) When initially turning on the power after product design or closing the platen roller block after disassembly, make sure to move the paper feed motor forward by 4~8 steps. Otherwise, the characters on the first line may overlap. Check performance by actually using the device.

x) Do not allow current to be applied to the motor when the step motor is not operating. It can cause the heating of the step motor.

※ Handling Precautions

Incorrect handling of the printer mechanism will reduce the efficiency and damage the system. Precaution must be taken with the following.

* When paper other than specified thermal paper is used.
  - Printing quality may drop due to low thermal sensitivity.
  - The thermal head will be worn out quickly due to rough surface of the thermal paper.
  - Printer might be jammed as the thermal layer of the thermal paper might stick to the thermal head, which may generate noise as well.
  - Maintainability of the thermal paper is lower so that color of the printed matter changes.
  - Electrolytic corrosion may occur due to poor quality paper.
  - Cutter may malfunction due to uneven thickness of thermal paper. (Uneven mechanical strength and paper density.)

a) When the printer mechanism is left unused for long time
Printing quality may drop due to the deformation of platen roller block. In this case, feed the thermal paper for a short period to correct the deformation of the roller. Paper feeding may become difficult when the thermal head touches with the roller without paper for long time. If this occurs, take out the platen roller and install the paper again before using it.

b) Do not clean the coating of the cutter (moving cutter blade and fixed cutter blade) with oil. The performance of the cutter may drop.

* Do not disassemble the platen roller block during printing or cutting. It might cause damage to the mechanical devices of the printer.

c) The reduction gear may obstruct the installation the platen roller block. In this case, separate the platen roller and install it again.

d) Never pull out the thermal paper while installing platen roller block. It might damage the
mechanical device of the printer.

e) Do not apply force to the platen roller block during printing or cutting. It might degrade the printing quality and paper cutting may not work.

f) Wear antistatic clothes while handling the printer mechanism, and touch the metal pieces before starting work to discharge the static electricity built up on the body in order to prevent damage to the thermal head by static electricity. Take extreme care with the thermal device and connection terminal of the thermal head.

g) Do not scratch or tap the thermal head with a sharp or heavy object. It might damage the thermal head.

h) When printing at high speed in an environment of low temperature or high humidity, water drops might form on the printer mechanism due to steam generated by the thermal paper and the thermal paper might be damaged. Do not apply power until the water drops are completely dried out.

i) After turning off the power to the printer mechanism, do not connect or separate the printer mechanism connection terminal (printer connection terminal).

j) Do not apply force to FPC while connecting or separating the connection terminal (printer connection terminal). FPC might be damaged.

k) Provide warning instructions so that users do not change the thermal paper exit angle or pull out the thermal paper during printing or cutting. It might cause a problem such as printing defects, paper jam, or cutting failure.

l) Provide warning instructions to users to carry out printing and cutting after removing the completely cut thermal paper. If the printing or cutting continues without removing the cut paper, it might cause a problem such as a paper jam or to the cutting paper depending on the mounting position.

m) When replacing the thermal paper due to damage to the thermal paper or printing defects, provide warning instructions to users not to touch the thermal head or sensor.

n) Do not use a paper roll with the glued or folded tip. When using this type of paper, replace with new paper before the tip of the paper roll appears.

o) Never unscrew the screws holding the corresponding parts of the printer mechanism. Unscrewing them may degrade the performance of the printer mechanism and the cutter.

p) The printer mechanism is not waterproof and is susceptible to water drops. Do not let it touch the water and do not operate with wet hands. It might damage the printer mechanism or cause a fire.

q) The printer mechanism is susceptible to dust. Do not use the printer mechanism in a dusty place. It might damage the thermal head or paper drive system.

r) Black carbon residues can accumulate on the surface of the thermal head or be discharged with paper during long-term use depending on the paper quality and operating conditions. Clean the head surface periodically.

■ Characteristics of SMP6350 Printer Mechanism

This printer mechanism has the following characteristics.

*** Integrated cutter**
- Guillotine-type cutter is included.

*** High speed printing**
- Printing speed can be up to 250mm/s printing.

*** High resolution printing**
- Smooth and accurate printing using the high-density printing head of 8 dots/mm.

*** Small and economic size**
- Printing function and cutting function are combined into a small-sized system.

*** No cutter jam**
- Cutter jam does not occur due to paper jam or unclosed cover.

*** One touch Jam Free**
- It is possible to relieve paper jam by opening cover.

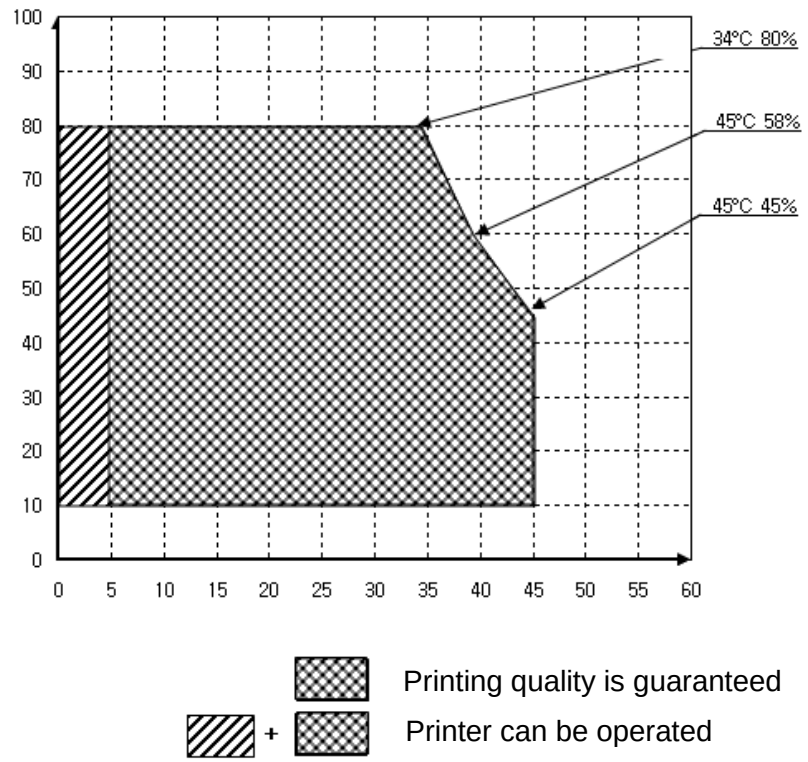
*** High reliability auto cutter**
- Cutting life of more than one million cuts is guaranteed.

*** Easy mounting platen roller block**
- The structure enables automatic mounting of the fixed cutter blade and the outer case can be designed easily.

*** Low noise**
- Printing noise is low due to thermal printing type.

1. Specifications

Printing type	Thermal Dot Line Printing
Dot Density	8 dots/mm
Number of dots per line	576dots
Printing width	72mm
Printing speed	Max. 250mm/s
Paper feed pitch	0.125mm
Paper width	80mm 0, -1 mm
Paper diameter	Max. 80mm
Head temperature sensing	Via Thermistor
Paper sensing	Via Photo interrupter
Platen roller block sensing	Via Photo interrupter
Operating voltage	TPH, Step Motor(VH line): 24VDC±10% Logic(Vdd line): 3.3V or 5V
Power consumption	Head: Max. 17.7 A(at 576dots, 24VDC) Motor auto cutter: Max. 0.6A/Phase Motor paper feed: Max. 0.385A/Phase Head Logic: Max. 55mA
Paper cutting type	Guillotine
Paper cutting method	Full cut and Partial cut
Cutter operating time	Max. 30 cuts/min.
Product life (at 25°C and rated energy)	Activation pulse resistance: 100million Abrasion resistance : 100km Auto cutter : 1,000,000 cuts
Impact resistance	Package: Bixolon standard package Height: 75cm Directions: 1 corner, 3edges and 6 surfaces
Recommended paper	A. TF50KS-E(Paper thickness : 65 µm) of Nippon paper Industries Co., Ltd B. PD 160R(75 µm) of New Oji Paper Mfg, Co., Ltd. C. P350(62 µm) of Kanzaki Specialty Paper, Inc.(USA) D. Hansol Thermo 65(65 µm) of Hansol Paper Co., Ltd.(Korea)
Dimension (WxLxH)	100.8mm x 27.3(41.5)mm x 27.3mm
Weight	170g
Temperature range	Operating: 0°C to 45°C Storage: -20°C to 60°C (no condensation)
Humidity range	Operating: 10 to 80% RH Storage: 90% RH

Operating conditions For temperature / humidity	

2. Connector pin arrangement

2-1 Main FPC cable (50Pin)

PIN NO	SIGNAL	Description
1	P_FEED_AM	Feeding motor
2	P_FEED_BM	Feeding motor
3	P_FEED_AP	Feeding motor
4	P_FEED_BP	Feeding motor
5	GND	TPH Ground
6	GND	TPH Ground
7	GND	TPH Ground
8	COVER_IN	COVER Sensor Input
9	GND	COVER Sensor Ground
10	COVER_OUT	COVER Sensor Output
11	NC	No connection
12	VH	TPH Supply voltage
13	VH	TPH Supply voltage
14	VH	TPH Supply voltage
15	VH	TPH Supply voltage
16	NC	No connection
17	CLK	TPH Clock
18	nLAT	TPH Latch
19	nSTB2	TPH Strobe 2
20	nSTB1	TPH Strobe 1
21	NC	No connection
22	TH	TPH Thermistor
23	GND	TPH Ground
24	GND	TPH Ground
25	GND	TPH Ground
26	GND	TPH Ground
27	GND	TPH Ground
28	GND	TPH Ground
29	GND	TPH Ground
30	GND	TPH Ground
31	GND	TPH Ground
32	GND	TPH Ground
33	GND	TPH Ground
34	NC	No connection
35	VDD	TPH Logic voltage
36	VDD	TPH Logic voltage
37	NC	No connection
38	nSTB4	TPH Strobe 4
39	nSTB3	TPH Strobe 3
40	SI	TPH Data input
41	NC	No connection
42	VH	TPH Supply voltage
43	VH	TPH Supply voltage
44	VH	TPH Supply voltage
45	VH	TPH Supply voltage
46	VH	TPH Supply voltage
47	NC	No connection
48	PS_OUT	Paper End Sensor Output
49	GND	Paper End Sensor Ground
50	PS_IN	Paper End Sensor Input

2-2 SUB FPC cable (8Pin)

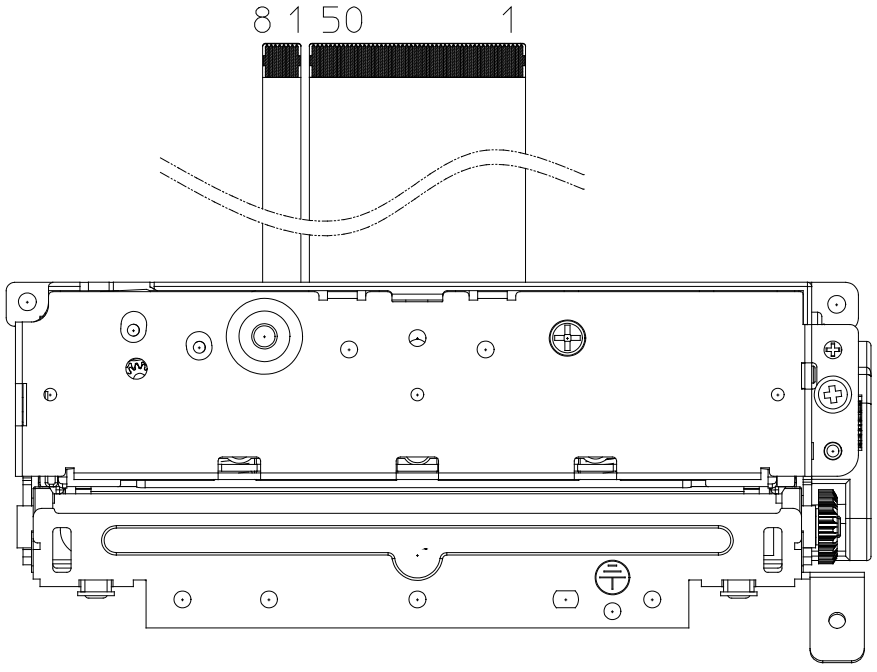
PIN NO	SIGNAL	Description
1	CUT_IN	Cutter Home Sensor Input
2	CUT_OUT	Cutter Home Sensor Output
3	GND	Cutter Home Sensor Ground
4	GND	Cutter Home Sensor Ground
5	C_FEED_AM	Cutter Feeding motor
6	C_FEED_AP	Cutter Feeding motor
7	C_FEED_BP	Cutter Feeding motor
8	C_FEED_BM	Cutter Feeding motor

※ User recommended connector

- Number of terminals
  50 pin with 0.5mm pitch, 50 pin (MAIN FPC) / 8 pin (SUB FPC)
- Recommended connector
  50 pin: KYOCERA ELCO 04 6274 050 000 xxx
  MOLEX: 501951-5019
  8 pin: MOLEX 052559-0853

※**Caution)**

Using non-ZIF type connectors could cause shorting failures between the terminals due to the peeling of FPC plated film. ZIF type connectors must be used.



3. Thermal Printer Head

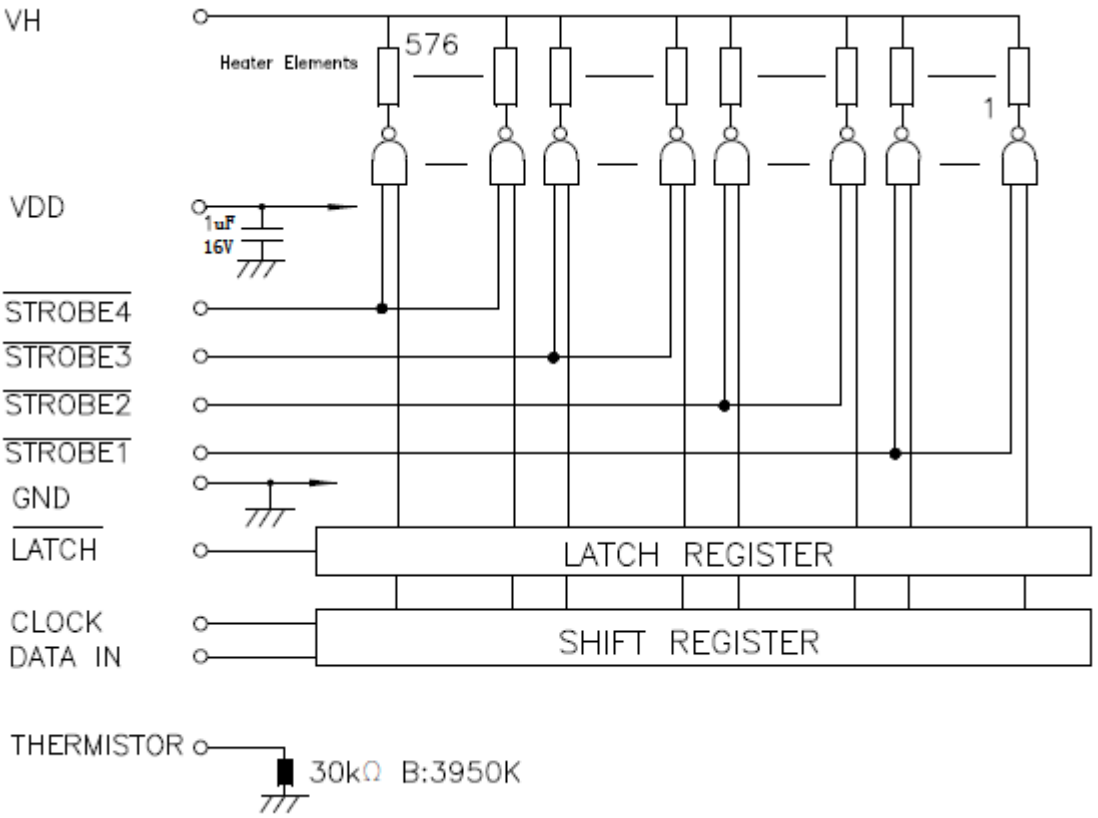
Thermal head is configured with a thermal device and thermal head drive that drives and controls the thermal device. Data input from the DI terminal is “High” for printing and “Low” for not printing. Data from DI terminals are transferred to the shift registers at the rising edge of the CLK.

After transferring one line of data, the data is stored to the latch register by making the /LAT signal “Low”. Depending on the stored printing data, the thermal device is activated by making /STB signal “Low”.

3-1 Specification

Printing width	72mm
Total number of dots	576 dots
Dot density	8 dots/mm
Dot pitch	0.125mm

3-2 Block Diagram of the Head



* Number of strobe dots by TPH manufacturer

AOI TPH

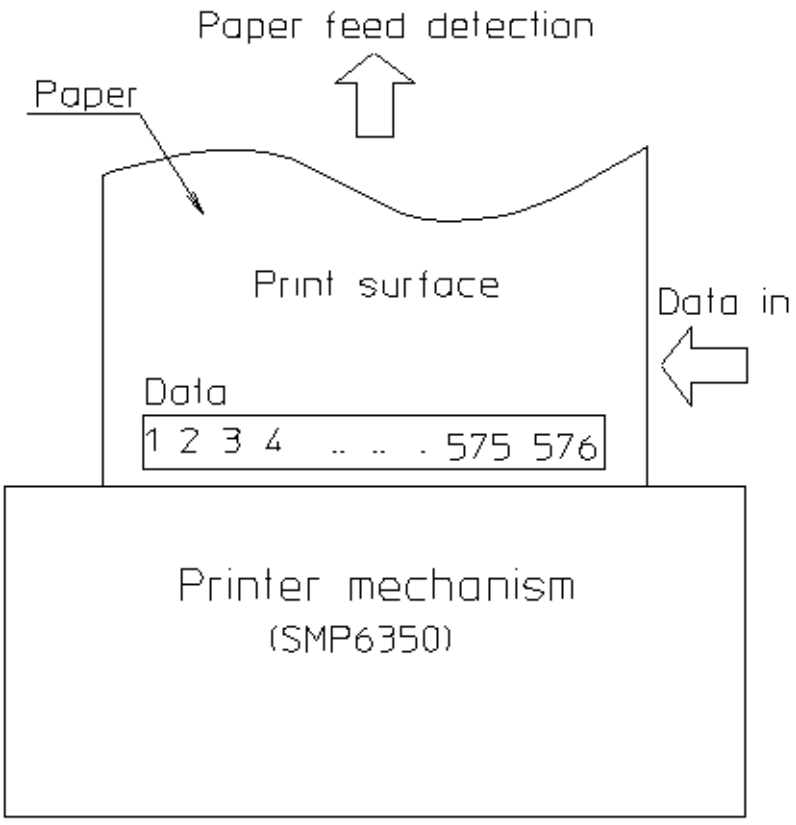
Block No.	Strobe number	Heating element number	Dots / STB
1	/STROBE1	1 ~ 192	192
2	/STROBE2	193 ~ 320	128
3	/STROBE3	321 ~ 448	128
4	/STROBE4	449 ~ 576	128

SHEC TPH

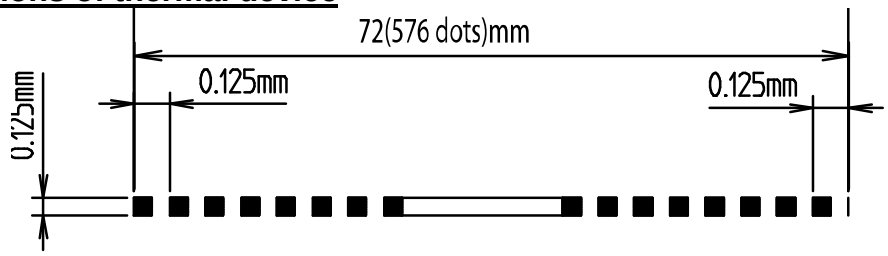
Block No.	Strobe number	Heating element number	Dots / STB
1	/STROBE1	1 ~ 144	144
2	/STROBE2	145 ~ 288	144
3	/STROBE3	289 ~ 432	144
4	/STROBE4	433~ 576	144

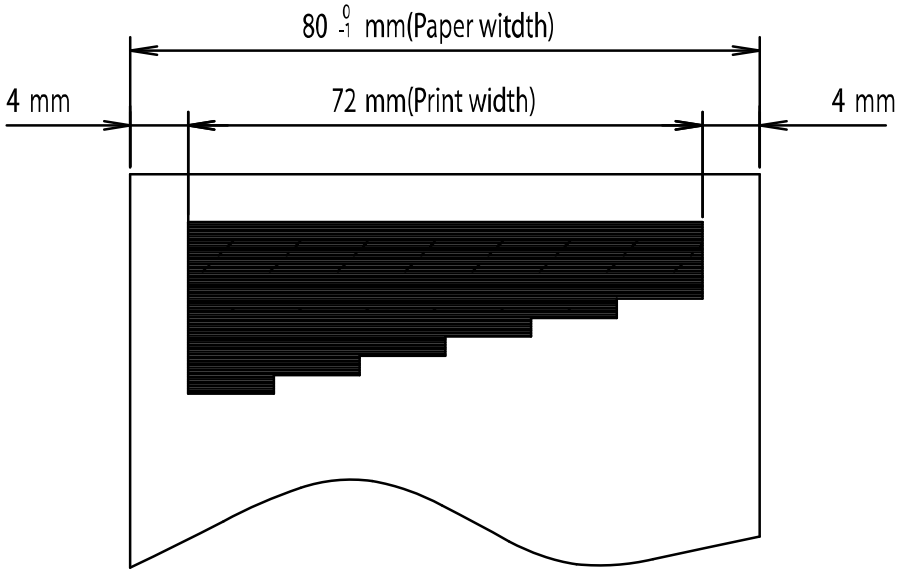
※Caution: Split control is not recommended because there may be variation in print density.

3-3 Printing position of transferred data



3-4 Dimensions of thermal device





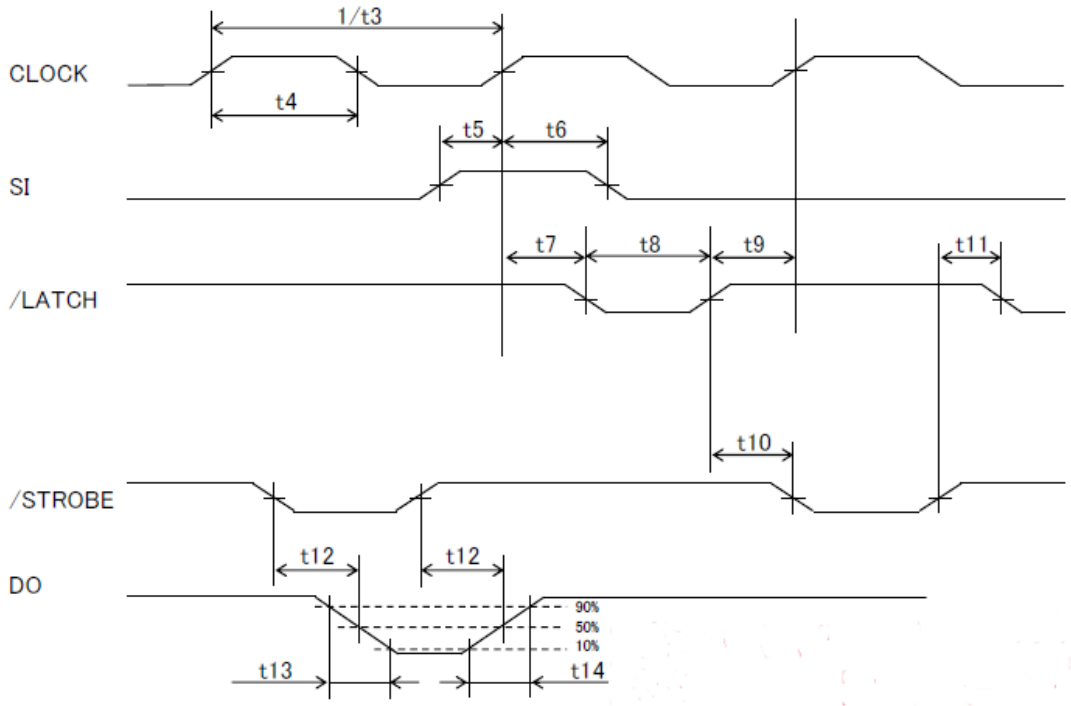
3-5 Electrical Characteristics of the Thermal Head

Ta = 25℃ ±10°C

Item		Symbol	MIN.	TYP.	MAX.	Umix	Remarks
Supply voltage		V_H	-	24.0	26.5	V	
Logic voltage		V_{DD}	4.75	5.0	5.25	V	@ 5.0V
			2.7	3.3	3.6		@ 3.3V
Logic current		I_{DD}	-	-	30	mA	*ALL-HIGH*
Input voltage	High	V_{IH}	$0.7xV_{DD}$	-	V_{DD}	V	@ 5.0V
			$0.8xV_{DD}$	-	V_{DD}	V	@ 3.3V
	Low	V_{IL}	0	-	$0.3xV_{DD}$	V	@ 5.0V
			0	-	$0.2xV_{DD}$	V	@ 3.3V
High input current	/LATCH	I_{IH}	-	-	1.5	μA	V_{IH} = VDD
	/STROBE		-	-	1.5	μA	
	CLOCK		-	-	1.5	μA	
	DATA IN		-	-	1.5	μA	
Low input current	/LATCH	I_{IL}	-	-	1.5	μA	V_{IL} = GND
	/STROBE		-	-	165	μA	
	CLOCK		-	-	1.5	μA	
	DATA IN		-	-	1.5	μA	
CLOCK Frequency		t3	-	-	16	MHz	
CLOCK Pulse Width		t4	70	-	-	ns	
DATA setup time		t5	50	-	-	ns	@ 5.0V
			40	-	-	ns	@ 3.3V
DATA Hold Time		t6	10	-	-	ns	@ 5.0V
			40	-	-	ns	@ 3.3V
/LATCH Setup Time		t7	100			ns	
/ LATCH Pulse Width		t8	100	-	-	ns	
/LATCH-/STROBE Setup Time		t10	100	-	-	ns	
/STROBE-/LATCH Hold Time		t11	15			μs	
DRIVE OUTPUT Delay Time		t13	-	-	13	μs	
			-	-	13	μs	
		t14					

※Caution: The MIN. time should be adjusted greater than 0μs

3-6 Thermal Head Drive Timing Diagram



3-7 Maximum Condition (Ambient temperature of the printer head: 25℃)

Items	Maximum condition	Condition
TPH drive voltage (V_H)	26.4V	Include Peak Voltage
Supply Energy (E0)	0.18mJ/dot	S.L.T. = 0.50ms (at 250mm/s)
Head Temperature (Tmax)	70℃	Temperature detected by Thermistor
Logic Supply Voltage (V_{DD})	5.25V	-

3-8 Standard conditions (head supply voltage and temperature)

Input voltage on TPH side is as follows.

Item		Range
Head drive voltage	V_H	24V ± 10%
Head logic voltage	V_{DD}	5V ± 5% 2.7V ~ 3.6V
Head Temperature	T	60℃

3-9 Pulse Width Control of the Head

3-9-1 Head Voltage and the pulse width when temperature changes

Control the width of the pulse depending on the operating voltage to maintain stable printing quality. Detect temperature changes by reading the thermistor resistor values built into the thermal head. It is advisable to calibrate the pulse width to adjust the energy with the thermal head for the temperature changes of the thermal head and installation environment temperature. Stop printing if the detected temperature exceeds 60℃.

Refer to below table to check pulses width for temperature.

None Historical control conditions

Item		Symbol	Standard Conditions	Maximum Conditions	Unit	Note
			Supply Voltage 24V			
Print Speed		S.L.T	0.5		ms/line	At 250mm/s
Heater power consumption		Po	0.62		W/dot	Ndot= 576dot
Head on Time	5℃	Ton	180	-	μs	
	25℃		150	280		
	40℃		110	-		
Supply current		Io	17.7		A	

Historical control conditions

Item		Symbol	Maximum Conditions		Unit	Note
			Supply Voltage 24V			
Print Speed		S.L.T	0.5		ms/line	At 250mm/s
Heater power consumption		Po	0.76		W/dot	Ndot= 576dot
Head on Time	구분	Ton	Cool Dot	Hot Dot		
	5℃		390	240	μs	
	25℃		360	220		
	40℃		330	200		
Supply current		Io	17.7		A	

※Caution

1) Controlling above the max conditions in upper table causes shorter head life. Please make sure to control it based on the table provided.
2) The head pulse value by temperature in the above conditions is the standard for density of paper recommended by BIXOLON.

3-9-2 Thermistor specifications

- Electrical Specifications of Thermistor

▷ Rating

1) Operating temperature: -40 ~ +80 ℃
2) Time constant: Max. 5 sec (in the air)

▷ Electrical Requirements

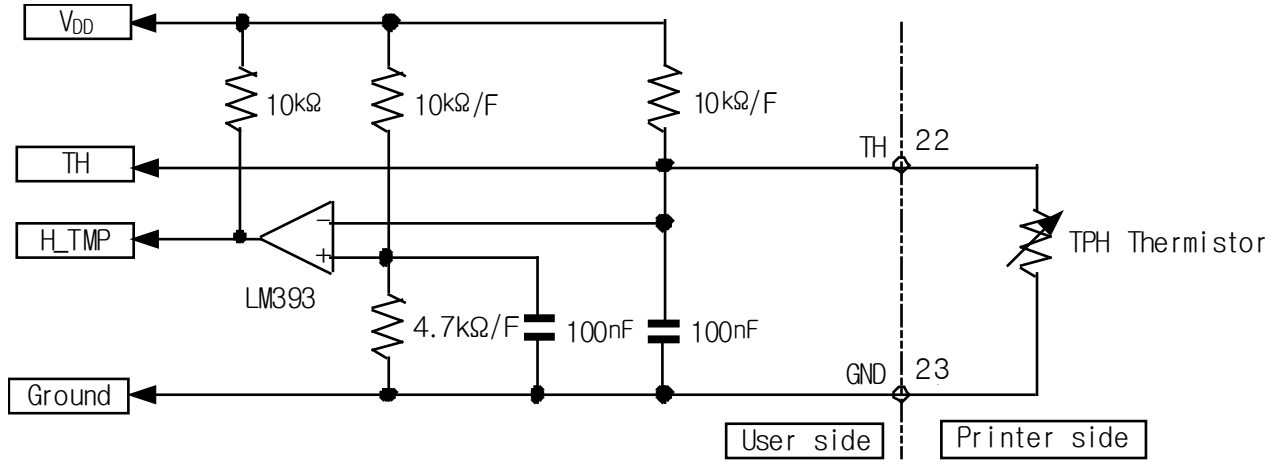
1) Resistance $R_{25:}$ 30 kΩ ± 5% (at 25℃)
2) B value(constant): 3,950 K ± 3%

$$R_X=R_{25}\times EXP(B\times(1/T_X-1/T_{25}))$$

(T: Absolute Temperature)

Temperature(℃)	R std (kΩ)	Temperature(℃)	R std (kΩ)
-40	1205.579	25	30.000
-35	844.731	30	24.111
-30	600.612	35	19.517
-25	432.951	40	15.904
-20	316.154	45	13.044
-15	233.694	50	10.765
-10	174.737	55	8.935
-5	132.078	60	7.458
0	100.862	65	6.259
5	77.774	70	5.280
10	60.524	75	4.475
15	47.511	80	3.811
20	37.606		

※ Recommended Thermistor circuit



3-9-3 Detection of abnormal temperature of thermal head

In order to protect the thermal head and to guarantee the safety of the user, abnormal temperature of the thermal head must be detected from both hardware and software sides.

▷ Detection of abnormal temperature with software
When the software detects a temperature higher than 60°C from the thermistor of the thermal head, the software must stop the operation of the heating element, and reactivate the heating element when the temperature drops below 50°C. Continuous operation of thermal head at a temperature above 60°C may reduce the life of thermal head significantly.

▷ Detection of abnormal temperature through hardware
If the software fails to detect head overheating due to malfunction, this is considered as an abnormal behavior. Ensure that the hardware is designed to shut off the power supply at 75°C to prevent fire or other secondary damage due to abnormal behavior.

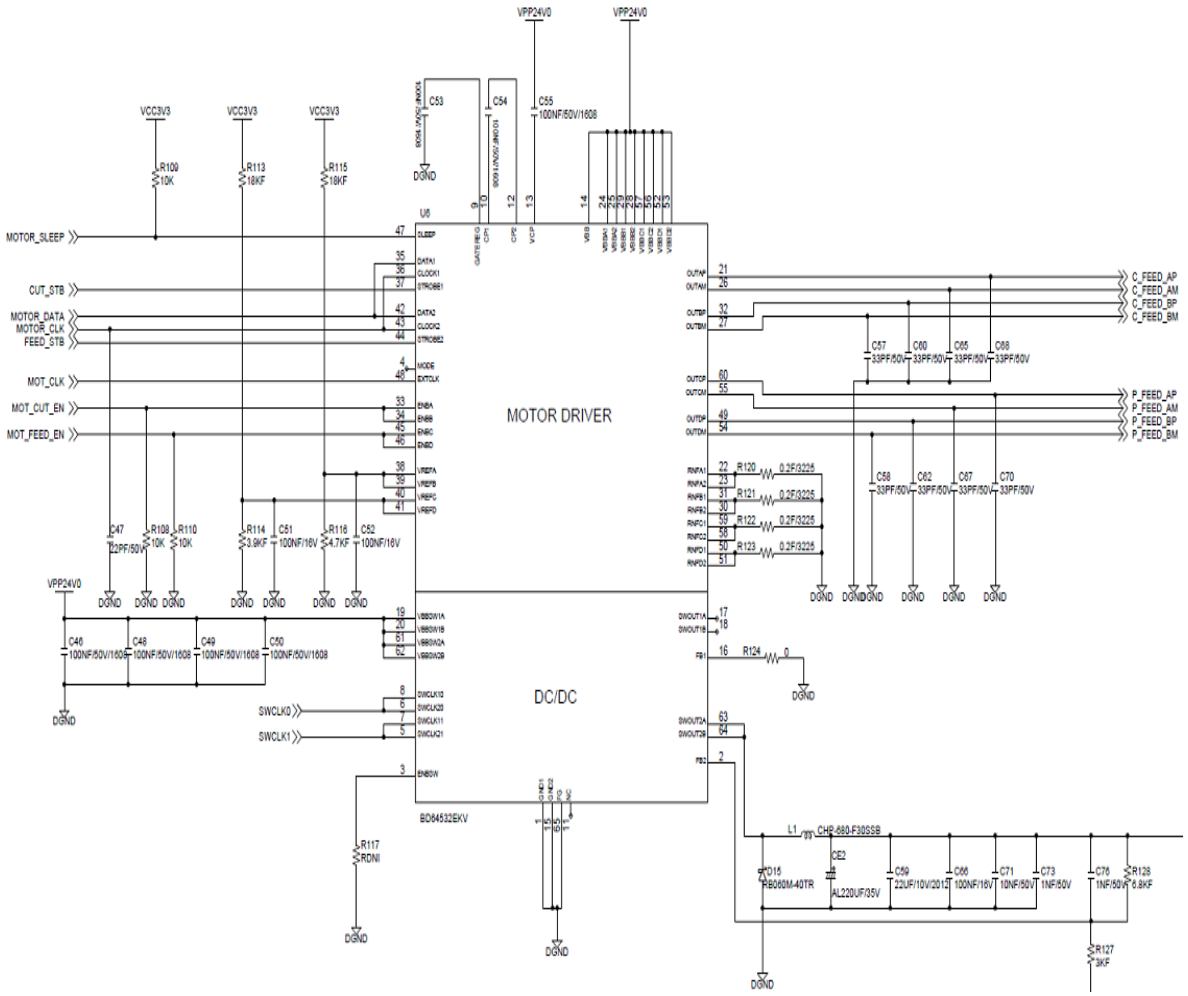
4. Step Motor (Paper Feed)

4-1 Specifications

Item	Specifications
Type	PM type Step Motor
Drive method	Bi-polar chopper
Excitation type	2-2 Phase
Terminal voltage	DC 21.6V ~ 26.4V
Wiring resistance	26Ω/Phase ±10%
Motor control current	Max. 0.385A/Phase
Motor drive pulse	Max 2,003 pps.

4-2 Example drive circuits

- 3.3V Drive circuit



Maximum motor drive time must be limited in order to prevent overheating of the motor. When driving the motor continuously, make sure to conform to the drive ratio (30%).

- Maximum drive time: 120 seconds (1601 pps)
- Pause time during between maximum drive: 270 seconds
- Drive ratio: 30%

$$\text{Drive ratio (\%)} = \frac{\text{Drive time}}{\text{Drive time + Pause time}} \times 100$$

※Caution : Do not exceed 90 seconds of maximum drive time.
Control over the driving ratio causes motor over heat and performance degradation.

4-3 Drive sequence (Motor rotates in counterclockwise direction)

Motor drive input pulse	Step 1	Step 2	Step 3	Step 4
PH1	H	H	L	L
PH2	H	L	L	H

Motor drive input pulse	Step 1	Step 2	Step 3	Step 4
P_FEED_AM	H	H	L	L
P_FEED_AP	L	L	H	H
P_FEED_BM	H	L	L	H
P_FEED_BP	L	H	H	L

※ H: High, L: Low

※ Precaution in designing motor control circuit and software
In order to stop the motor, apply excitation for one step period using the same phase as the last phase of the printing step.

4-4 Drive Frequency Acceleration (Acceleration Control)

Acceleration control is required to maintain driving power when driving the motor.

Drive the motor according to the acceleration step in the table shown below.

The procedure for accelerating the motor is as follows.
- Produce the step signal start time
- Produce the first step during the first step acceleration time
- Produce the second step during the second step acceleration time
- Produce the nth step during the nth step acceleration time
- After the motor accelerates to reach the drive speed, drive the motor with constant speed

Printing can be done during acceleration.

※ Acceleration step

Step	Speed (pps)	Step time (μs)	Step	Speed (pps)	Step time (μs)	Step	Speed (pps)	Step time (μs)
1	400	2,500	37	1,206	829	73	1,658	603
2	443	2,258	38	1,221	819	74	1,669	599
3	482	2,076	39	1,236	809	75	1,681	595
4	518	1,931	40	1,250	800	76	1,689	592
5	552	1,813	41	1,264	791	77	1,701	588
6	583	1,715	42	1,279	782	78	1,712	584
7	613	1,630	43	1,292	774	79	1,721	581
8	642	1,558	44	1,307	765	80	1,733	577
9	669	1,494	45	1,321	757	81	1,742	574
10	696	1,437	46	1,333	750	82	1,754	570
11	721	1,387	47	1,348	742	83	1,764	567
12	746	1,341	48	1,361	735	84	1,773	564
13	769	1,300	49	1,374	728	85	1,783	561
14	792	1,262	50	1,387	721	86	1,795	557
15	815	1,227	51	1,401	714	87	1,805	554
16	837	1,195	52	1,412	708	88	1,815	551
17	858	1,166	53	1,425	702	89	1,825	548
18	879	1,138	54	1,437	696	90	1,835	545
19	899	1,112	55	1,449	690	91	1,842	543
20	919	1,088	56	1,462	684	92	1,852	540
21	938	1,066	57	1,475	678	93	1,862	537
22	957	1,045	58	1,486	673	94	1,873	534
23	976	1,025	59	1,499	667	95	1,883	531
24	994	1,006	60	1,511	662	96	1,890	529
25	1,012	988	61	1,522	657	97	1,901	526
26	1,030	971	62	1,534	652	98	1,912	523
27	1,047	955	63	1,546	647	99	1,919	521
28	1,064	940	64	1,558	642	100	1,931	518
29	1,081	925	65	1,570	637	101	1,938	516
30	1,098	911	66	1,580	633	102	1,949	513
31	1,114	898	67	1,592	628	103	1,957	511
32	1,130	885	68	1,603	624	104	1,965	509
33	1,145	873	69	1,616	619	105	1,976	506
34	1,161	861	70	1,626	615	106	1,984	504
35	1,176	850	71	1,637	611	107	1,993	502
36	1,192	839	72	1,647	607	108	2,003	499

5. Sensor

5-1 Paper Detection Sensor and Black Mark Detection Sensor

5-1-1 Absolute maximum rating

(Ta = 25℃)

Parameter		Symbol	Rating	Unit
Input	Forward current	IF	50	mA
	Reverse current	VR	5	V
	Power consumption	PD	75	mW
Output	Collector-Emitter voltage	VCEO	30	V
	Emitter-Collector Voltage	VECO	3	V
	Collector current	Ic	20	mA
	Collector power consumption	Pc	50	mW
Operating temperature		TOPR	-25~+85	℃
Storage temperature		TSTG	-30~+100	℃

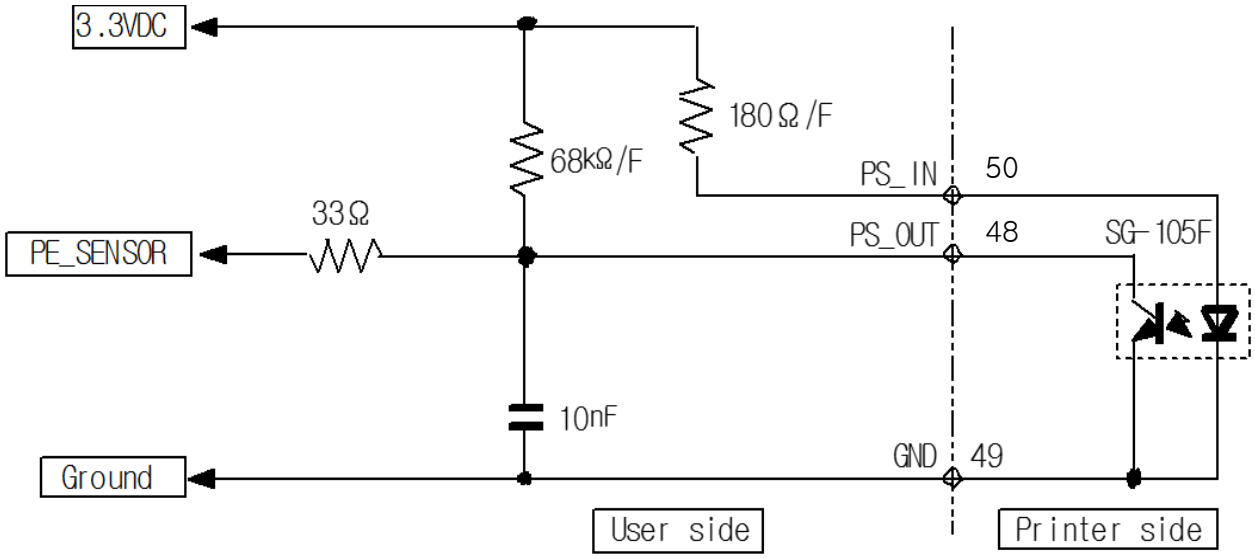
5-1-2 Electrical Characteristics

(Ta = 25°C)

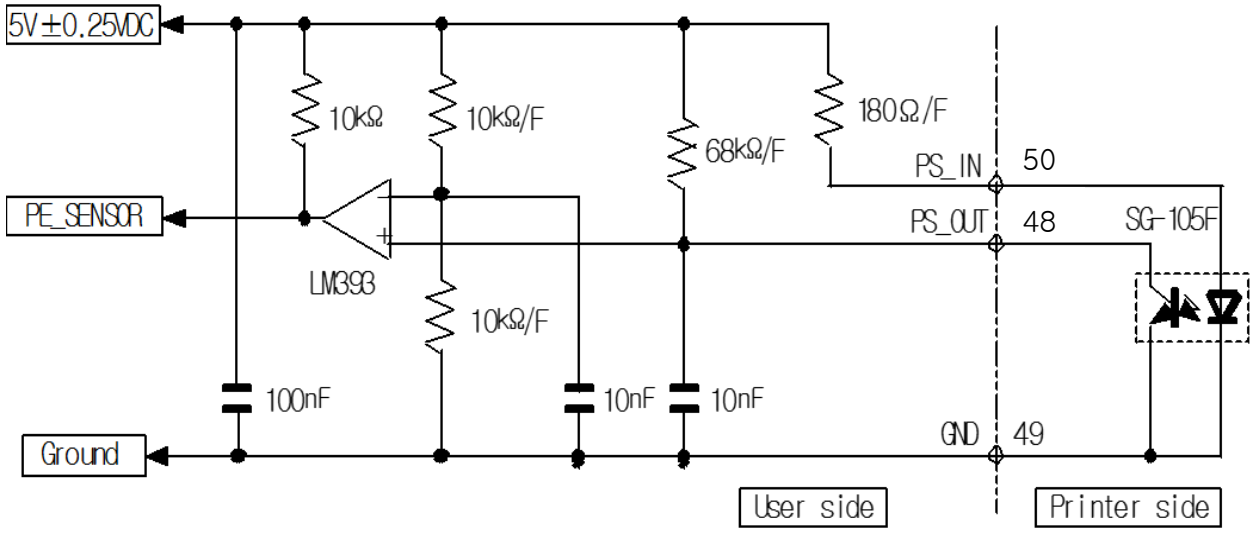
Parameter		Symbol	MIN.	TYP.	MAX.	Unit	Conditions
Input	Forward current	VF	--	--	1.3	V	IF=10mA
	Reverse current	IR			10	μA	VR =5V
Output	Collector current	IC	180	--	440	μA	VCE=5V IF=10 d=1mm
	Leakage current	ICECO	--	--	0.2	μA	VCE=5V IF=10mA
	Falling/Rising time	tf/tr	--	25/30	--	μs	Vcc=2V Ic=0.1mA RL=1kΩ

5-1-3 Paper Detection Sensor Sample External Circuits

- 3.3V Drive Circuits



- 5V Drive Circuits



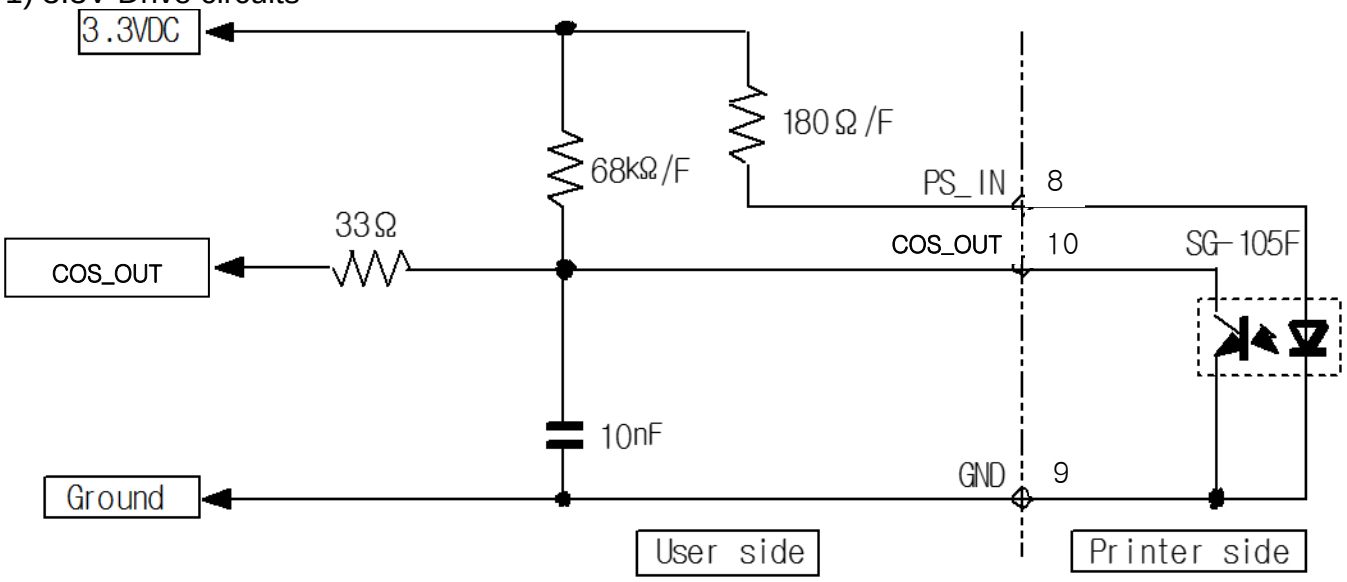
Paper detection	Signal level of paper detection sensor (PS_OUT)
Paper is detected	Low
Paper is not detected	High

※Caution : As the detection voltage difference changes depending on the reference voltage of LM393 and input/output resistance of the sensor for paper detection, check performance by actually using the device.

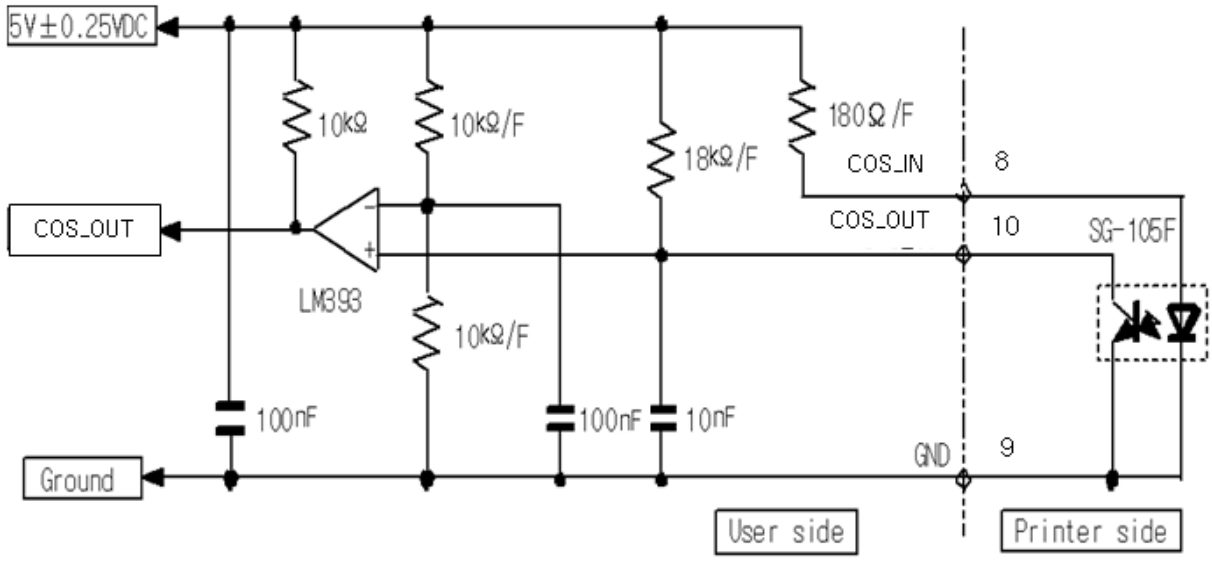
5-2 Platen Roller Block Detection Switch

- Reference circuit diagram for platen roller block detection

1) 3.3V Drive circuits



2) 5V Drive circuits



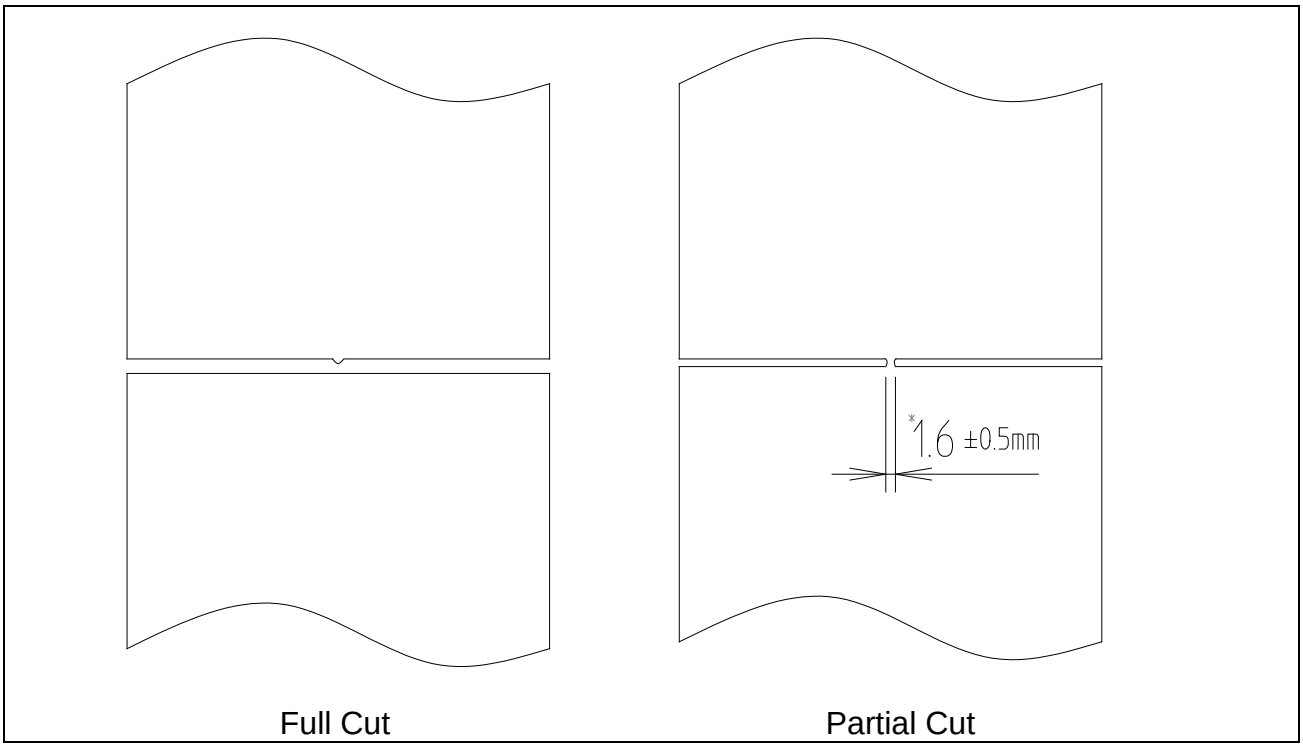
Platen Roller Block	Platen roller block detection sensor signal level
Platen Roller Block is detected	Low
Platen Roller Block is not detected	High

5-3 Auto Cutter

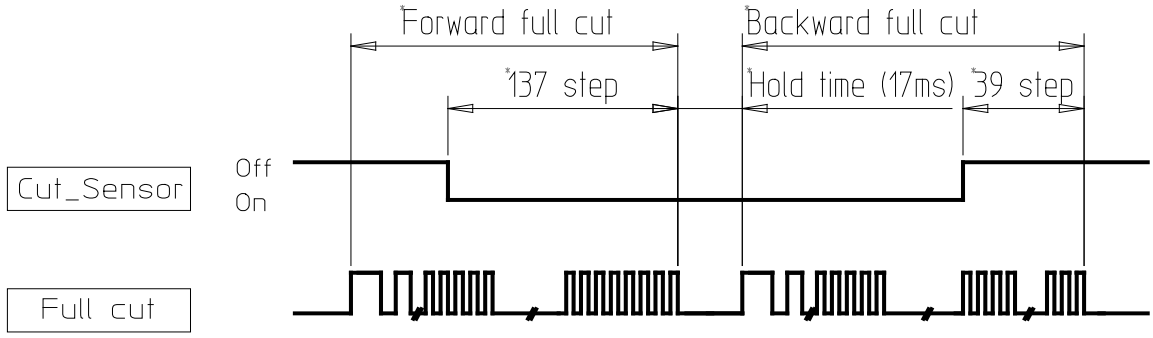
To cut the paper automatically after printing

- Cutting paper: Single layer thermal paper of general paper (Thickness: 50~100㎛)
- Rated voltage
  - Motor : DC 24V±5%
  - Current consumption : Max. 0.6A/Phase
  - Sensor : DC 5V±5%
- Paper cutting guaranteed life
  - Paper thickness of 65㎛: Cut 1,000,000 times
  - Guaranteed life depends on the thickness of the paper
- Cutting period: less than 30 cycle/min
- Cutting speed: maximum 0.39sec / 1 Cycle (7-4-4 is based on deceleration table.)
- Environment condition
  - Operation temperature and humidity: 0℃ ~ 45℃, 10~80% RH (non-condensing)
  - Storage temperature and humidity: -20℃ ~ 60℃, 90% RH
- Paper cutting condition
  - Thermal paper cutting mode of the auto cutter can be selected to Full Cut or Partial Cut by changing the number of drive steps of cutter drive motor.

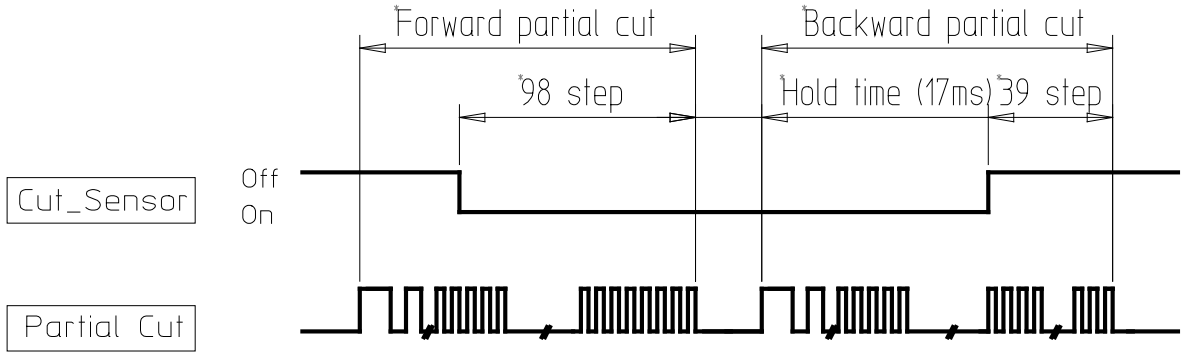
Unit: mm



- Full cut
  Forward full cut: 137 steps after Sensor OFF
  Backward full cut: 39 steps after Sensor ON



- Partial cut
  Forward full cut: 98 steps after Sensor OFF
  Backward full cut: 39 스텝 steps after Sensor ON

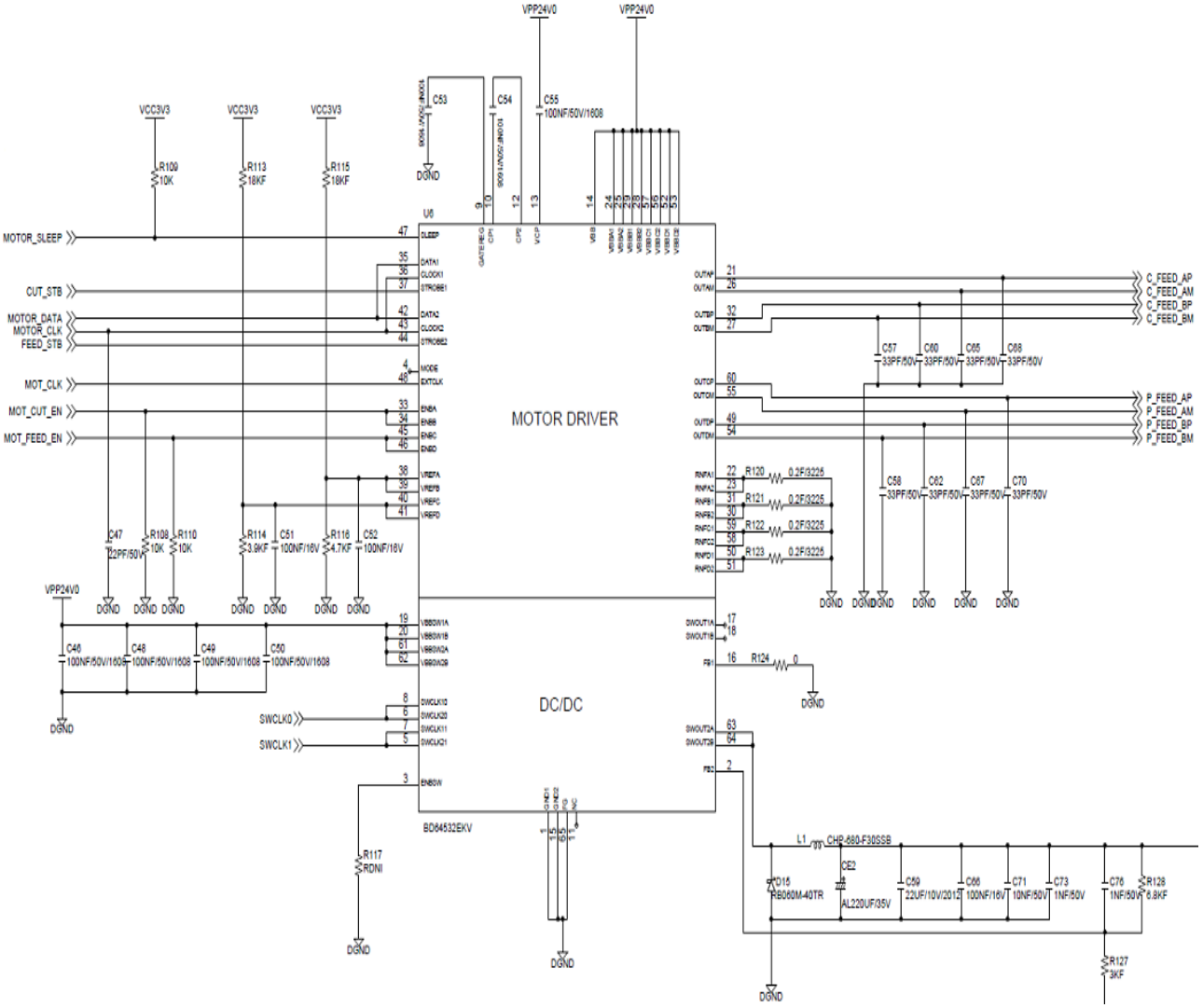


5-4 Step Motor (Auto Cutter)

Type	PM type stepping motor
Drive method	Bi-polar chopper
Excitation method	2-2 Phase
Motor drive voltage	DC 21.6V~26.4V
Wiring resistance	8.5 Ω/Phase ±10%
Motor control current	Max. 0.6A/Phase
Motor drive pulse	Max.1,172pps

5-4-1 Auto Cutter Drive Circuits

- 3.3V Drive Circuits



5-4-2 Auto Cutter Sensor(Home Sensor)

- Absolute max. ratings.

(Ta = 25℃)

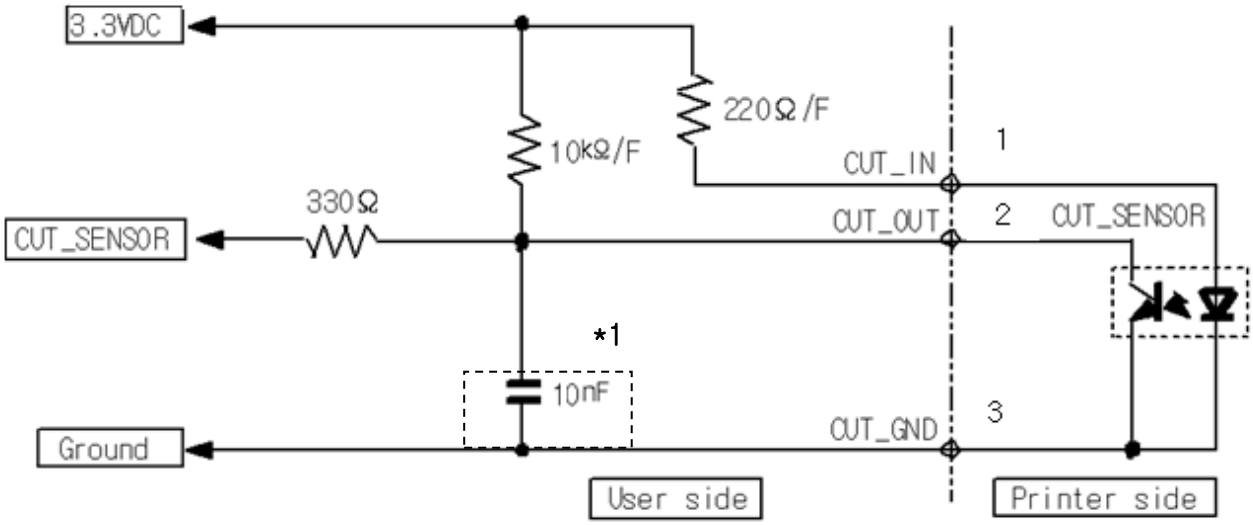
Parameter		Symbol	Rating	Unit
Input (LED)	Forward current	I_F	50	mA
	Reverse voltage	V_R	5	V
	Power dissipation	P_D	80	mW
Output (Photo-TR)	Collector-emitter voltage	V_{CEO}	30	V
	Collector-emitter voltage	V_{ECO}	4.5	V
	Collector current	Ic	30	mA
	Collector power dissipation	Pc	80	mW
Operating temperature		Topr	-30~+85	℃
Storage temperature		Tstg	-40~+85	℃

- electrical optical characteristics

(Ta = 25℃)

Parameter		Symbol	MIN.	TYP.	MAX.	Unit	Conditions
Input	Forward voltage	V_F	--	1.8	2.3	V	I_F =50mA
	Reverse current	I_R			10	μA	V_R =5V
Output	Collector current	I_C	0.1	--	5	mA	V_{CE}=5V I_F=5mA
	Dark current	I_{CEO}	--	--	0.1	μA	V_{CE}=10V
	Collector-emitter saturation voltage	$V_{CE(sat)}$	--	--	0.4	V	I_F=20mA Ic=0.1mA
	Rise time /Fall time	tf/tr	--	30	150	μs	Vcc=5V Ic=0.1mA R_L=1kΩ

- Sensor Drive Circuit

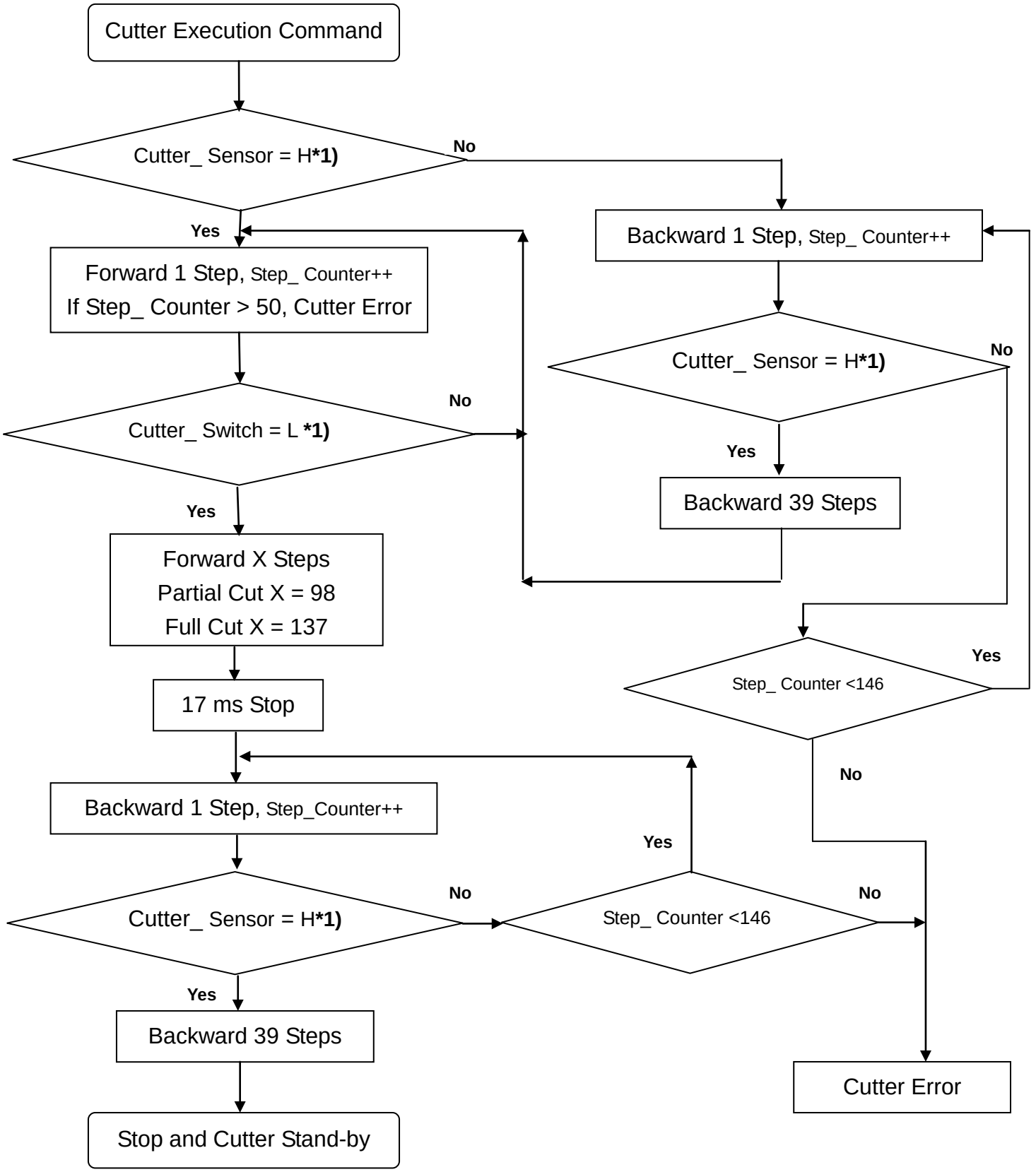


※Caution

Auto Cutter sensor can cause chattering by circuit operating characteristic. Chattering protection circuit (hardware) or program (software) is compulsory.

*1 The number of corrective action increase may lead sensor recognition time delay which results in cutting issues. Measure the cutter sensor raise/lower signal to determine the number of corrective actions for the cutter motor to operate within 2Setp.

5-4-3 Auto Cutter Flow Chart



※Caution : ***1)*** Auto Cutter sensor can cause chattering by circuit operating characteristic. Chattering protection circuit (hardware) or program (software) is compulsory.

5-4-4 Acceleration Step

Step	Speed (pps)	Step time (µs)	Step	Speed (pps)	Step time (µs)	Step	Speed (pps)	Step time (µs)
1	400	2,500	18	768	1,302	35	1,010	990
2	430	2,326	19	784	1,276	36	1,022	978
3	459	2,179	20	800	1,250	37	1,034	967
4	486	2,058	21	816	1,225	38	1,047	955
5	511	1,957	22	831	1,203	39	1,059	944
6	535	1,869	23	846	1,182	40	1,070	935
7	558	1,792	24	861	1,161	41	1,082	924
8	581	1,721	25	876	1,142	42	1,094	914
9	602	1,661	26	890	1,124	43	1,105	905
10	623	1,605	27	904	1,106	44	1,117	895
11	643	1,555	28	918	1,089	45	1,128	887
12	662	1,511	29	932	1,073	46	1,139	878
13	681	1,468	30	945	1,058	47	1,150	870
14	699	1,431	31	958	1,044	48	1,161	861
15	717	1,395	32	971	1,030	49	1,172	853
16	734	1,362	33	984	1,016			
17	751	1,332	34	997	1,003			

6. Case Design

6-1 Mounting Position

6-1-1 Method of mounting the printer mechanism

The figure below shows the dimensions required to position and fix the printer mechanism.
Fixed the printer firmly by applying a Hook feature to the front, such as SECTIOIN B-B' Go ahead.

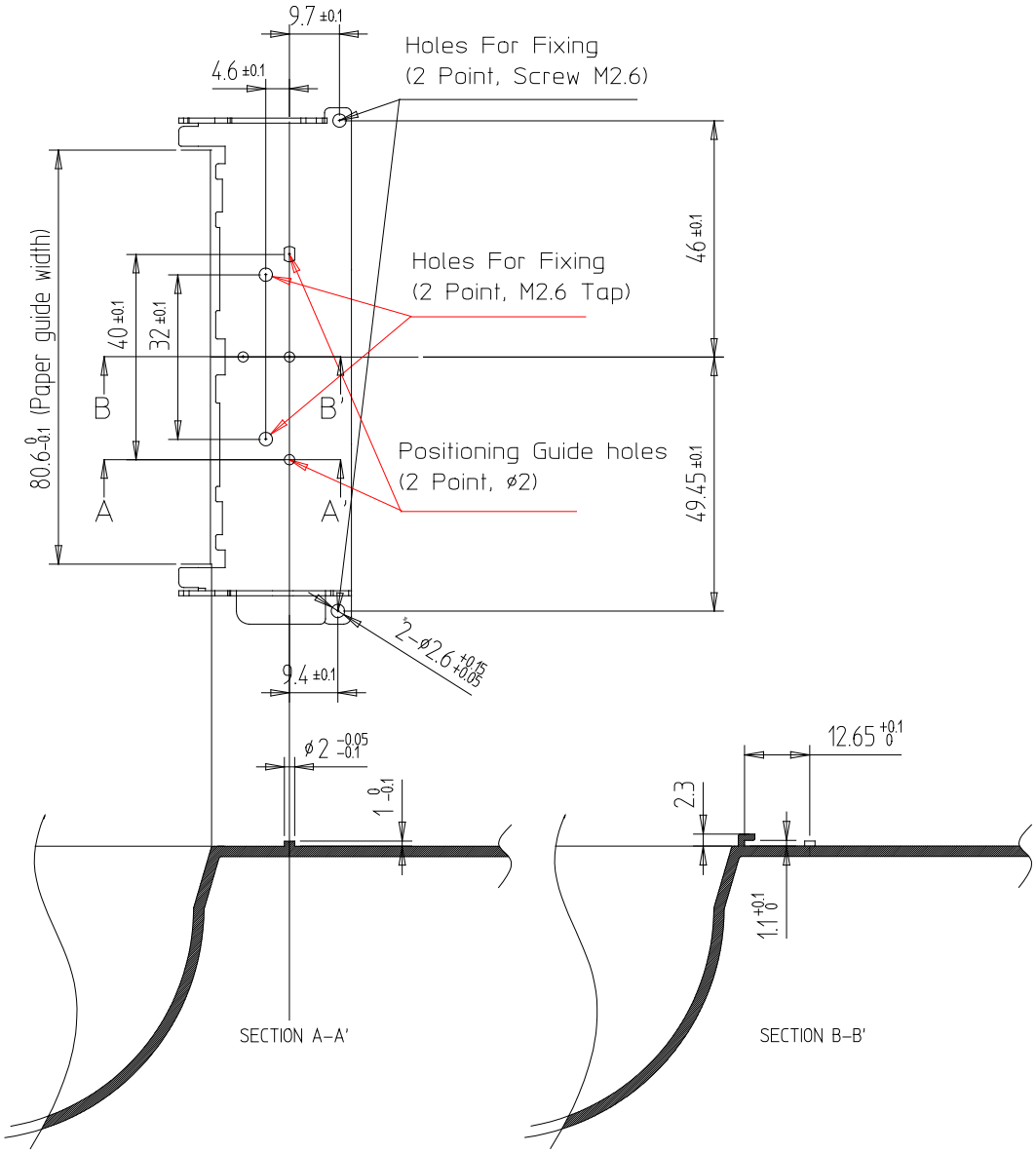


Fig 6-1 Position holes and boss dimension for mounting the mechanism

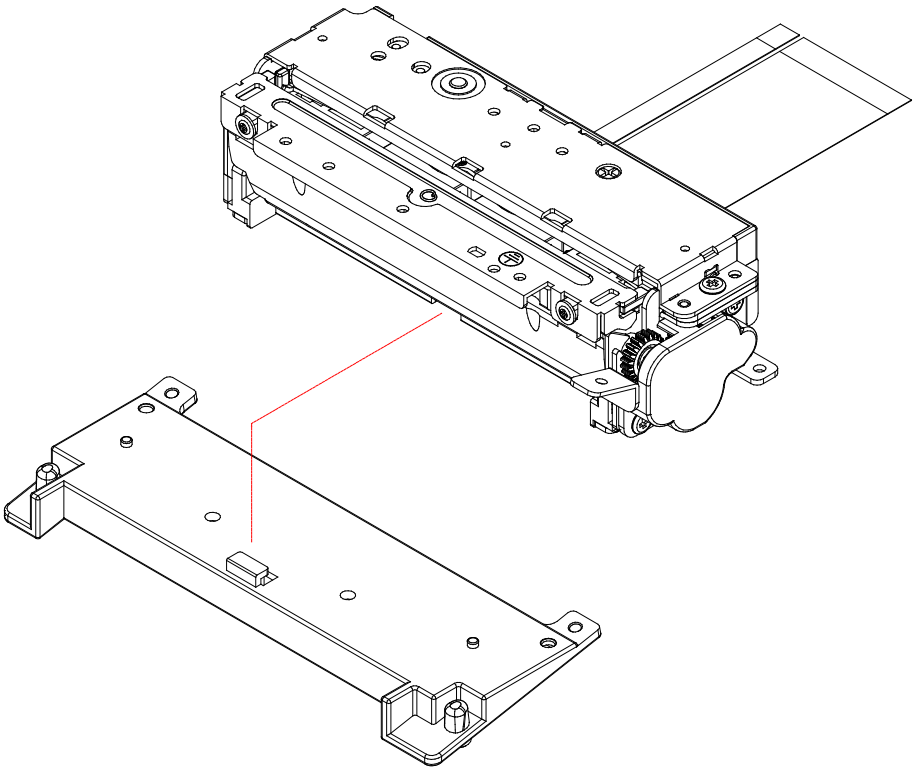


Fig 6-2 How to mount the mechanism on the hook

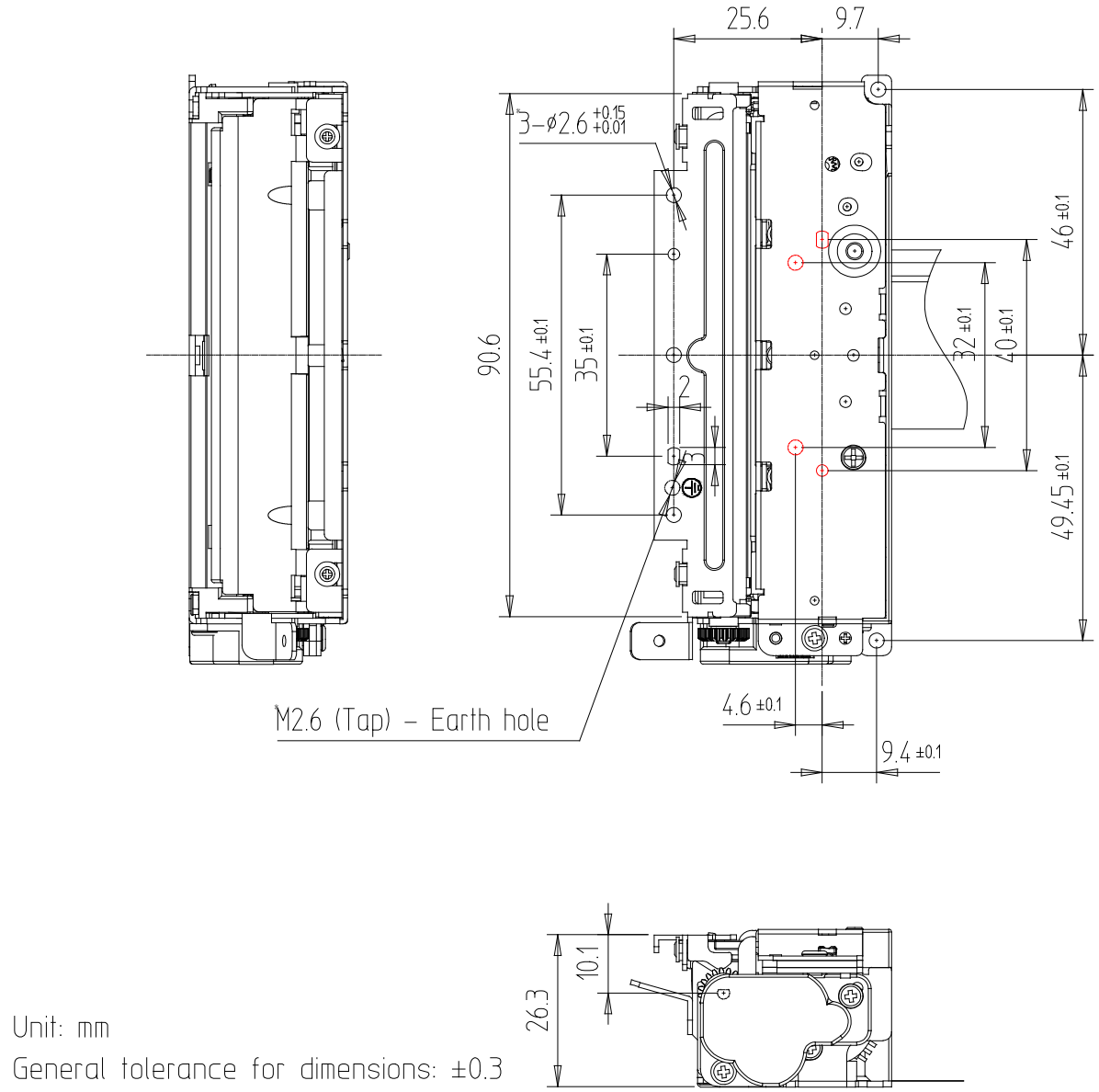


Fig 6-3 Dimension related to mounting

6-1-2 Recommended Screws

- JIS B1111 M2.6 Cross Fluted Pan Head Machine Screw

6-1-3 Precautions during mounting the printer body

- Care must be taken not to make excessive impact, deformation, or twist while mounting the printer. Otherwise, it might cause degradation of printing quality, paper tilting, paper jam, or printing noise.
- Mount the printer on a flat surface and set the printer so that it does not move.
- Care must be taken to avoid damage in FPC such as folding or denting while mounting the printer main body.

6-2 Possible Mounting Angle of the Printer Mechanism

The printer mechanism can be mounted within a 120° range as shown in the following picture. Check performance by actually mounting the device. Be sure to check the recommended paper layout in Section 9.

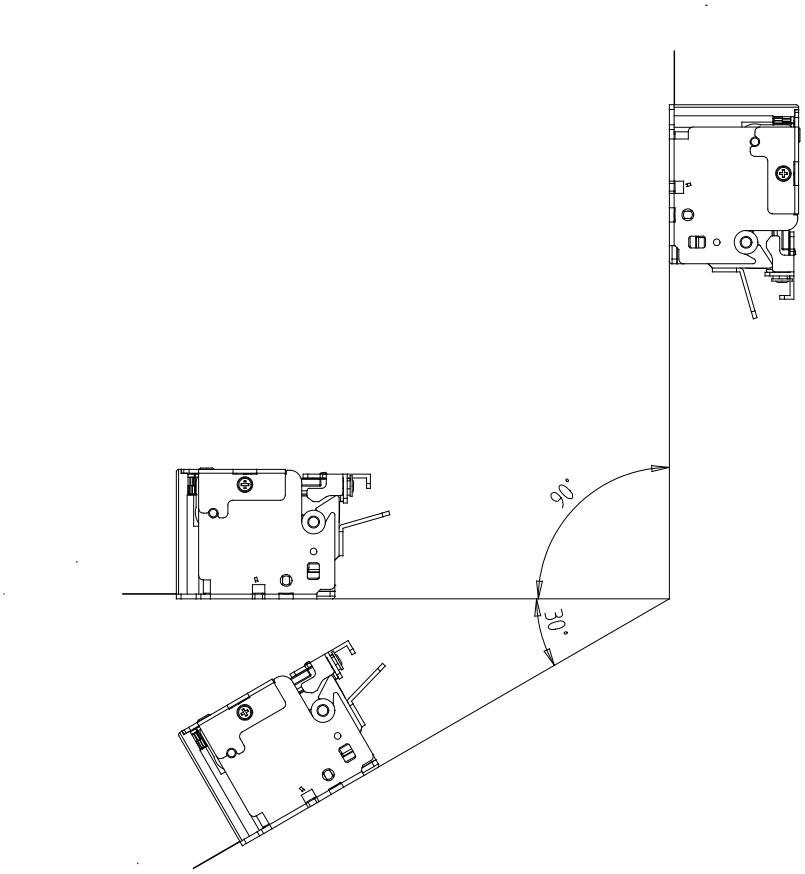


Fig 6-4 Possible Mounting Angle of the Mechanism

6-3 Installation of Platen Roller Block

6-3-1 Pivot center area of platen roller block

The platen roller block can be mounted in the area between min 50 mm and max 200 mm from the outer case, and the installation area depends on the distance.
Mount the roller block rotation system of the case within the hatched area in Figure 6-5.

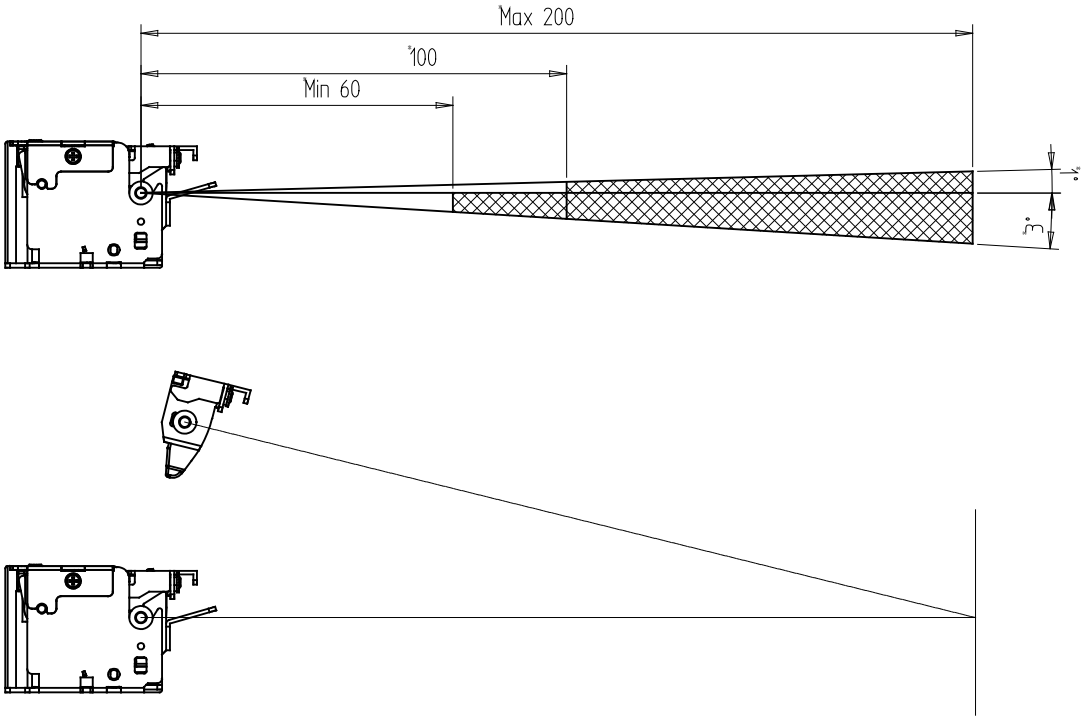


Fig 6-5 Pivot Center Area of Platen Roller Block

6-3-2 Parallel design of the platen roller block

When the platen roller block is mounted on the printer mechanism, two blocks must be aligned to be parallel. Otherwise it might cause cutting failure and reduce life of cutter. Check performance after installation.

6-3-3 Mounting platen roller block

Fig 6-6 dimension drawing shows the position and usage of holes to mount the platen roller block on the pivot system of the outer case.
The dimensions of 8.6 mm and 10.1 mm in the picture that determine the mounting position of the platen roller block are important numbers that define the mounting performance of platen roller block and cutting status, and these dimensions must be controlled exactly as shown in the picture when designing the outer case. Incorrect dimensions may cause serious problems such as incomplete cutting or partial cutting.

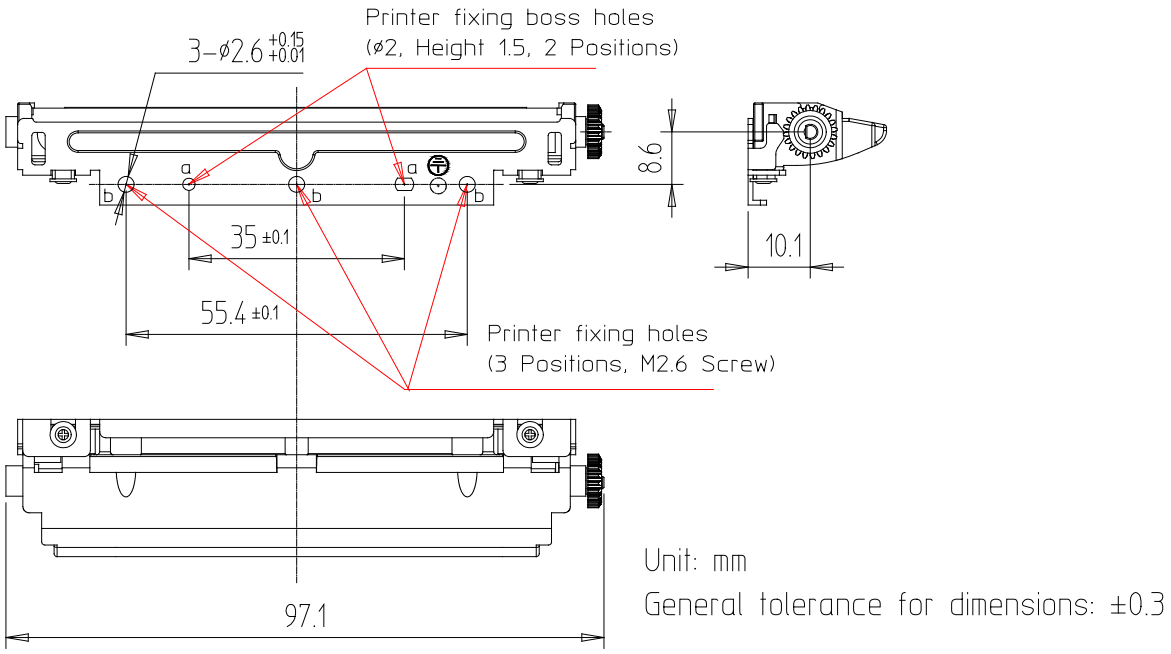


Fig 6-6 Dimensions related to the mounting of the platen roller block

- Holes at ‘a 2’ positions are for setting the position of the platen roller block, design the boss for these two holes. The size and height of the boss shall be within Φ2, and1.2mm respectively.
- Holes at ‘b 3’ positions are for fixing the platen roller block using screws(M2.6).

※ Recommended screws specifications: M2.6 x 6 Tapping Screws(Screw head over Φ4 is recommanded)

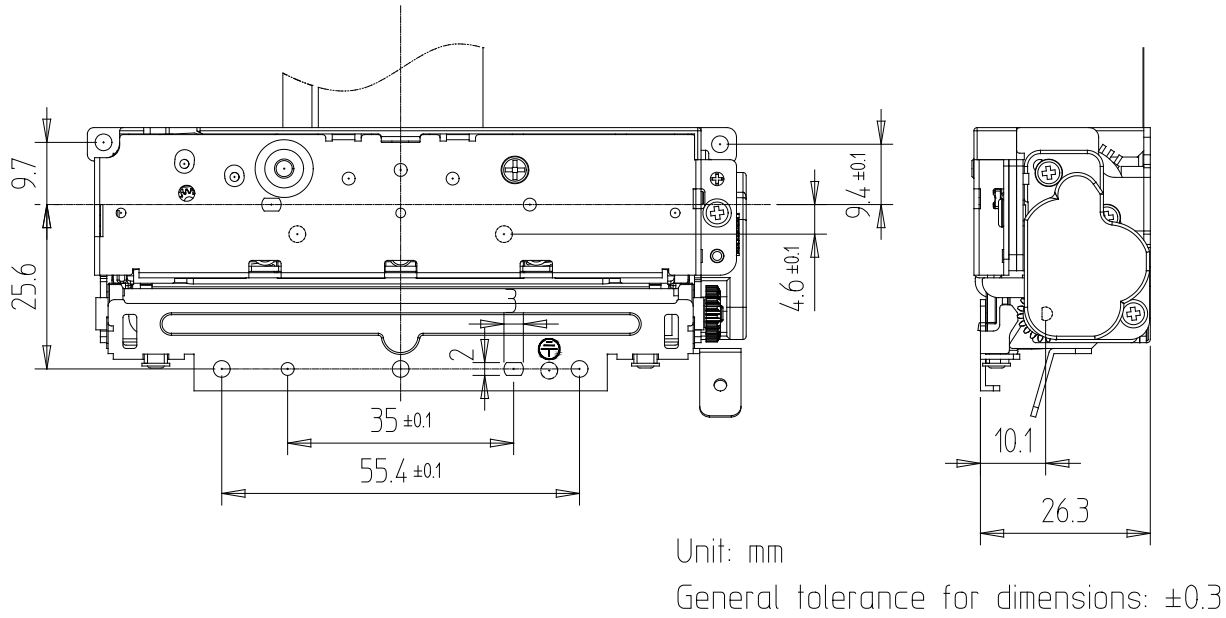


Fig 6-7 Dimensions of mechanism related to the mounting of the platen roller block

6-3-4 Precautions during mounting platen roller block

- The outer case that the platen roller block is mounted on must be designed to have sufficient strength to avoid impact, twist, deformation by external force, or moving, and the pivot axis for mounting the outer case must be designed to have no slack in front and back or left and right direction. Otherwise it may cause problems such as paper cutting failure, paper jam, or degradation of printing quality due to unstable closing of the outer case. Conduct sufficient verification by actually using the device.

- Design the secure door pivot system as the force is applied to the outer case while installing or removing the platen roller block. Use shaft materials for the pivot axis of the door pivot system, and the platen roller block must be mounted in a stable fashion.

- If the printer mechanism and the door pivot system are not installed correctly, the platen roller block may not be installed correctly, or it may case problems such as printing failure, cutting failure, rough cutting surface, or shorten the life of the cutter.

- When installing new thermal paper, install it while pressing the center of the outer case of the door pivot system. Installing by pressing just one side may cause problems in installing the platen roller block, which may result in printing failure or cutting failure. Guide the users so that they always press the center of the outer case to install new paper.

7. Recommended Placement of Thermal Paper

Design the path of the paper in printer mechanism as shown in Fig 9-1.
Design the paper path angle within a range of 30 degrees, as shown in the drawing below. The larger the paper path angle, the significantly reduced paper feed force on the printer and the result of paper feed fail.

※ If the paper path angle increases, the friction between the paper and the roller block increases and the load increases.

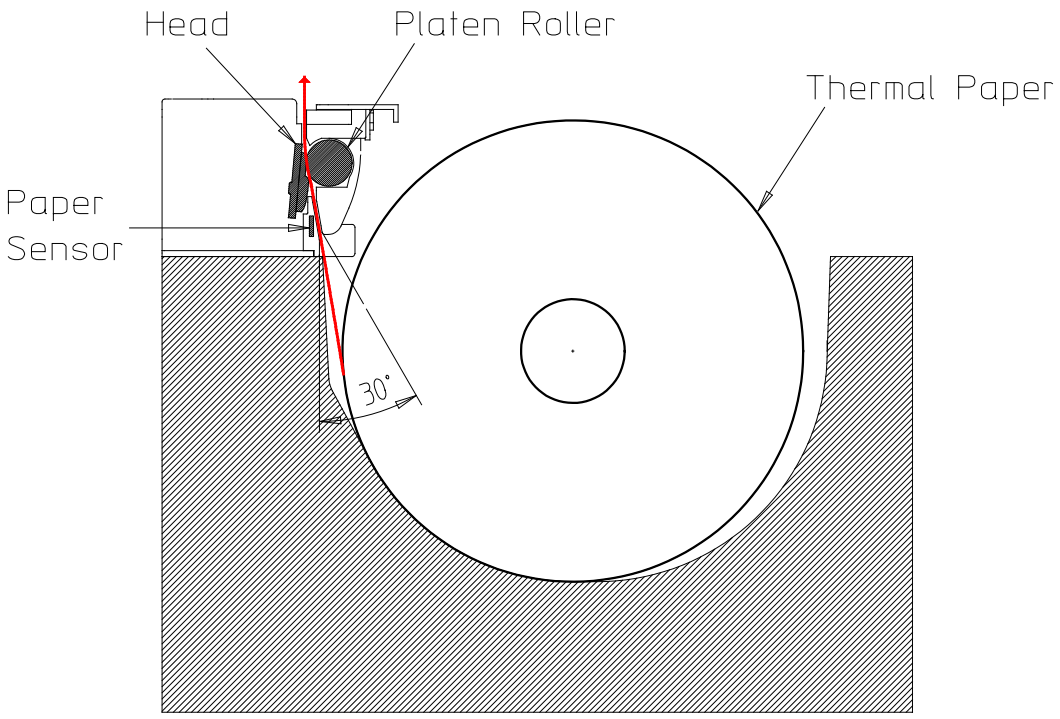


Fig 7-1 Paper Path

8. Designing Platen Roller Block Removal Lever

The following Fig 8-1 shows the operating area position of the platen roller block removal lever.

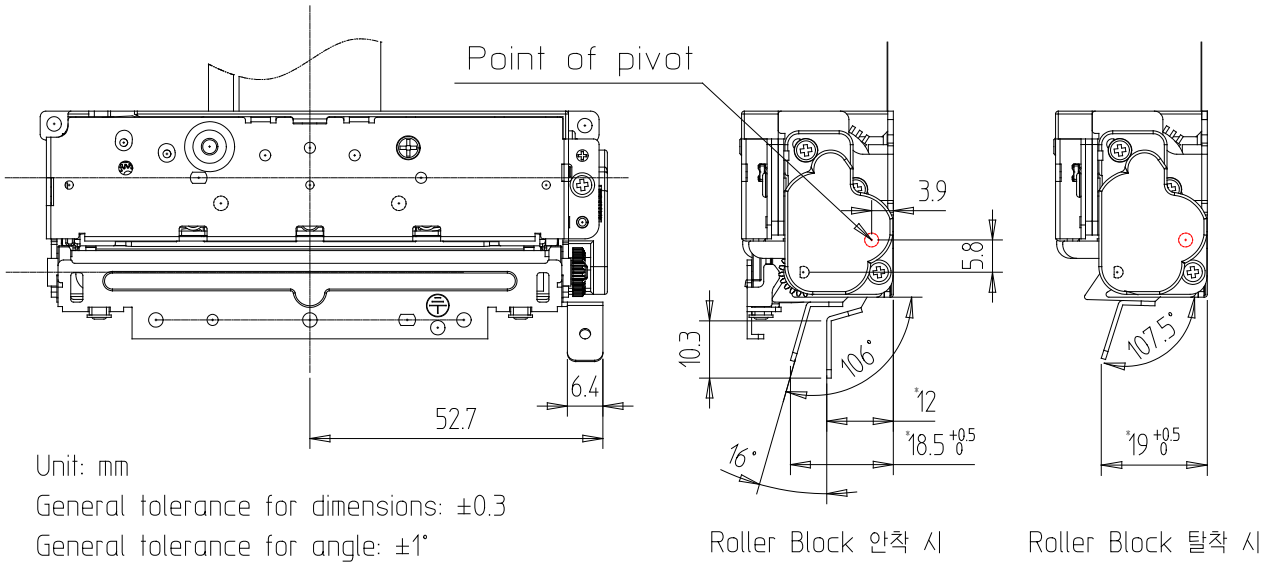


Fig 8-1 Dimensions related to the operation of the platen roller block removal lever

Take precautions with the following while designing lever or button for removing the platen roller block.

- Design the operating area of the lever so that the platen roller block removal lever position is pressed by 16˚.
- Install the stopper in the outer case to prevent deformation of the printer mechanism when the removal lever is pressed with excessive force.

9. Designing Thermal Paper Feed Holder

- Design the paper feed hold so that the feeding load of the paper becomes lower than 0.98N (100gf). Design additional devices to meet the requirements of paper load. Feed load bigger than 0.98N may cause a printing defect or paper feed failure. Conduct sufficient verification by actually using the device.

- Follow the following recommendations when designing the position of the paper holder. When roll paper is used, design the center axis of the roll paper to be parallel with the printer mechanism so that the paper is not shifted to the side axis during printing. Conduct sufficient verification by actually using the device.

- Refer to Fig. 9-1 for designing the width of the paper guide device.

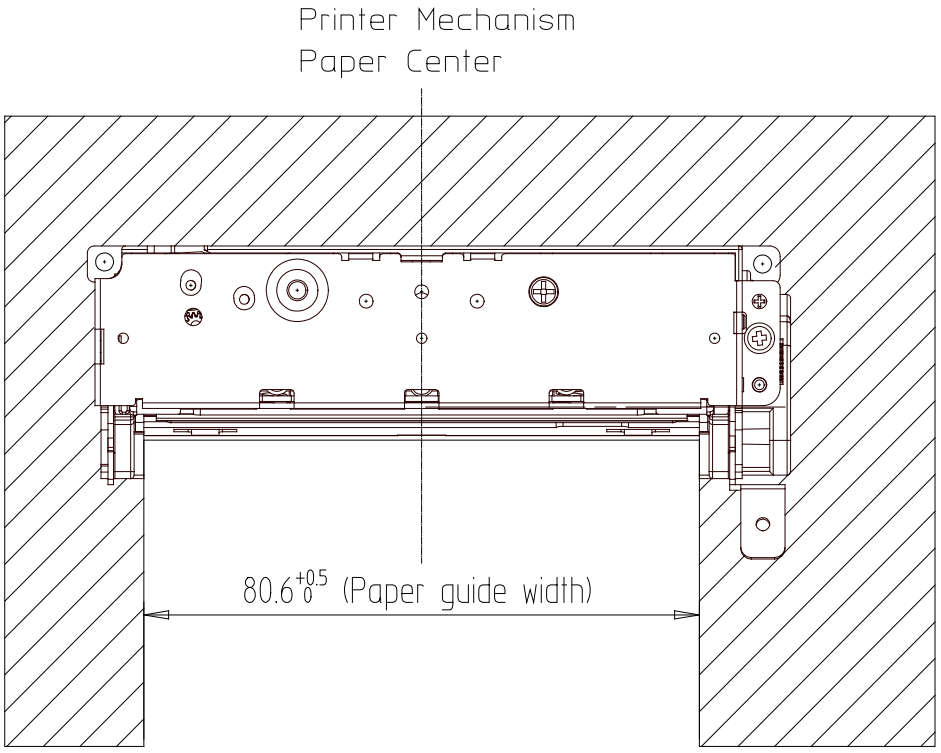


Fig 9-1 Dimension of width and position of the paper guide device

※ If the width of the paper guide device is designed to be narrower than required, it may cause problems in paper feeding.

10. Designing the device to release the jamming of moving blade

When the power is off while the moving blade is in a forward position or when moving blade is used manually, the moving blade may be jammed with the fixed blade causing problems in releasing the platen roller block.

- In order to release the condition when the system stops while the moving blade is in a forward position, turn off the terminal, and turn it on again to release the condition. Conduct sufficient verification by actually using the device.

- If the power cycling does not clear the condition, then select and design one of the four methods to clear the cutter jam condition.

Designing the structure to clear the condition using tools

- Designing the structure to clear the condition using tools
  When designing the structure to release the cutter jam using thin and long tools such as a screwdriver or pen to push the button, refer to the following.

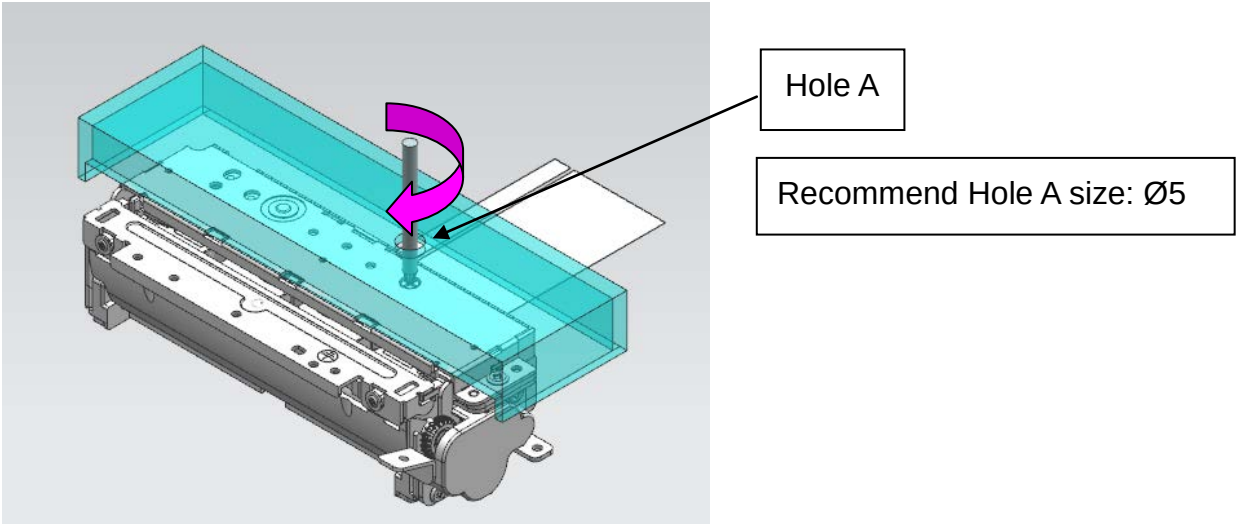


Fig 10-1 Recommended size of holes in outer case

- When the cutter jam occurs, turn the hand driver in the direction of the arrow shown in Fig 10-1 until it does not turn anymore to resolve the problem. It will not turn anymore when the problem is resolved. (Number of turns: Max.1.2 turns)

11. Thermal Paper Exit Design

Take the following precautions when designing the paper exit

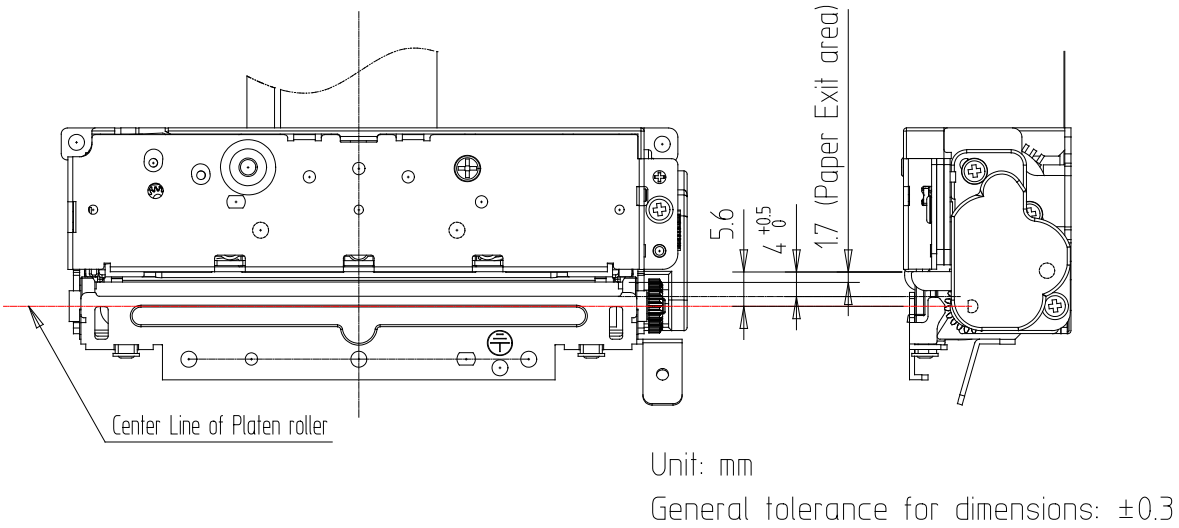


Fig 11-1 Dimensions related to the paper exit

- Secure enough space so that paper exit is free from external force during printing. Among the dimensions shown in Fig 11-1, especially incorrect dimension about 4 +0.5 ,0 may cause problems such as shortening the life of cutter or paper jam, therefore design the system with the correct dimensions. Check performance by actually using the device.

- Design the paper exit of a size so that human fingers cannot enter. Otherwise, people may get injured by the cutter.

- The surface of the paper exit should not have bumps, scratches in the direction of paper exit, or molding parting line. Otherwise it might cause problems such as printing failure, paper jam, or paper cutting failure.

12. Precautions for Outer Case Design

- Fixed cutter blade in the platen roller block will be exposed when installing the printer mechanism. People may be injured by the fixed cutter blade during operation of the cutter or replacing thermal paper. In order to prevent accidental injury, install the structure on the outer case or attach a warning label.

- As the amount of thermal paper on the roll decreases, curling of the paper is more likely to occur causing printing failure, paper jam, or paper cutting failure as the paper may be jammed on the outer case. Use thermal paper that has severe curling effects and check performance.

- When designing the outer case, secure enough space for the parts close to the printer mechanism except for parts that are connected to the mechanism directly so that they are not loaded by external forces. Loading by external forces may cause problems such as printing failure, paper jam, or paper cutting failure.

- When designing the outer case, block the paper powder or residue generated by paper cutting or usage of thermal paper for a prolonged period of time so that they do not pile up on the control panel or power supply parts.

- The environment temperature increases during thermal printing. Design the system so that the generated heat can be dissipated to the outside easily and prevent burn injury to the users by the heat. Attach a warning label for safety of the users.

13. Frame Ground

It is advisable to connect the printer body and the platen roller block to the FG (frame ground) of the outer case to prevent damage to the thermal head by static electricity. Check performance by actually using the device.

Frame ground connection method

- Connect the frame ground terminal (FG: terminal No. 8, 9) of the FPC cable (50-pins) to the frame ground (FG) of the outer case.

- Connect the frame ground (FG) of the outer case to the earth hole of the platen roller block. Use the metal screws (screws and star washers coated with nickel) and the cable of AWG18 or higher.

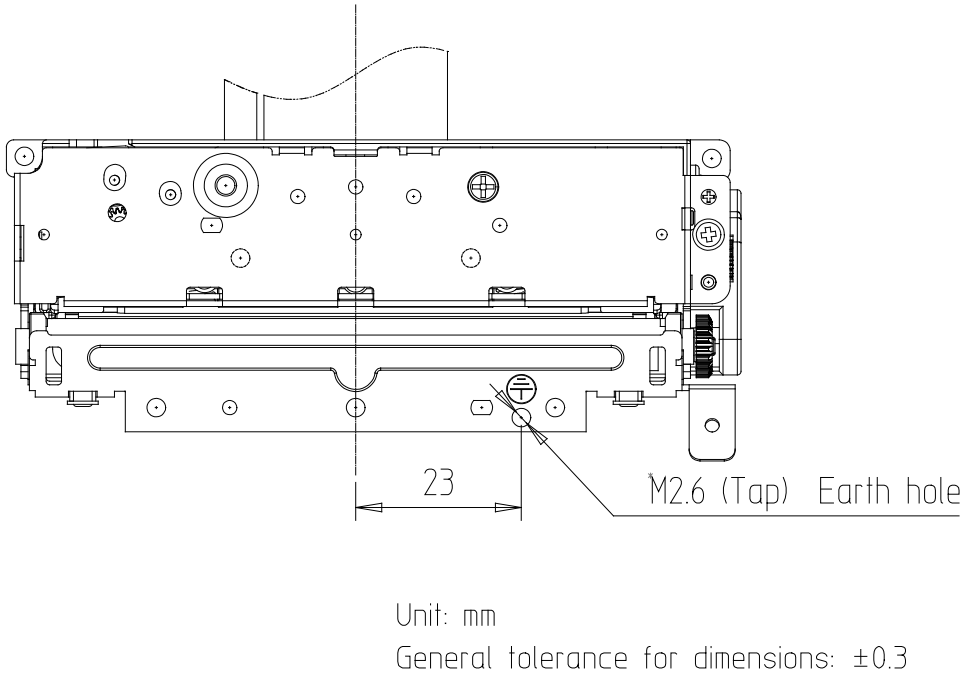


Fig 13-1 Frame ground dimensions

- Electric potential of all frame ground must be the same.

- Depending on the operating conditions, connect the GND terminal (SG) to FG, or put a resistor of 1MΩ between GND terminal (SG) and FG.

14. Printer Mechanism Handling Method

14-1 Installation of thermal paper

- Press the platen roller block release lever of the printer mechanism.

- Install thermal paper at the correct position between the paper guide device of the printer mechanism, and put the tip of the thermal paper upward by more than two inches (about 5 cm).

- After installing the paper correctly, press and install the platen roller block.

14-2 Removing thermal paper

- Press the release lever of the platen roller block.

- Move up the platen roller block and remove the thermal paper.

14-3 Procedure to clear thermal paper jam

- Press the release lever of the platen roller block.

- Remove the jammed paper or paper residue.

14-4 Procedure to clear cutter jam

- Method to clear the jam through power recycling
  When the cutter jams and normal operation is not possible, turn off the power and turn it on again to clear the jam.

- How to remove the jamming by opening the cover
  Opening the cover resolve paper jam.

- Method to clear the cutter jam using hand driver (Refer to Fig 12-8)

14-5 Precautions when installing/removing thermal paper

- Automatic loading may not work if the thermal head touches the platen roller for a long time without thermal paper as they might get stuck together. If this problem occurs, remove the platen roller block and install it again.

- Tilted installation of thermal paper may cause printing problems. Feed the paper until the paper comes out straight or install again after removing the platen roller block.

- Do not pull the paper with excessive force as it might cause problems to the printer mechanism.

- Thermal papers loose elasticity in an environment of high humidity, which causes problems in printing and cutting. Check the performance sufficiently in high humidity situations.

14-6 Cleaning thermal head

The thermal head must be cleaned as dirt built up on the surface of the thermal head may cause printing problems when it is used for a long time without cleaning.

Clean the head after it has cooled down sufficiently as the temperature of the thermal and peripherals right after printing can be very high.

The procedure for cleaning is as follows.

- Turn off the printer.

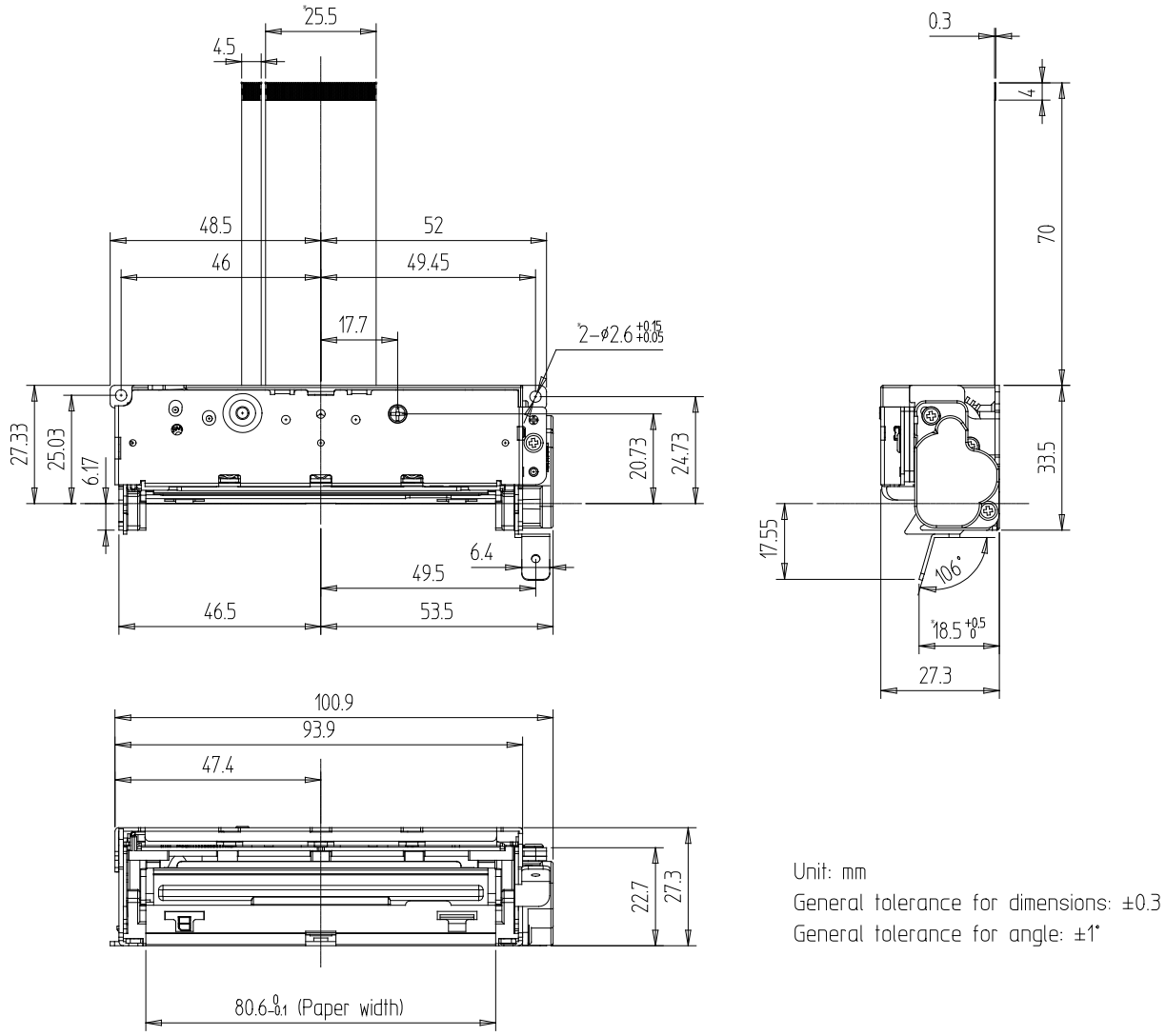
- Press the platen roller block separation lever and move the block up and open.

- Soak the soft cotton swab in alcohol, and clean the dirt from the thermal head with the swab.

- When the alcohol is completely dried, install the platen roller block.

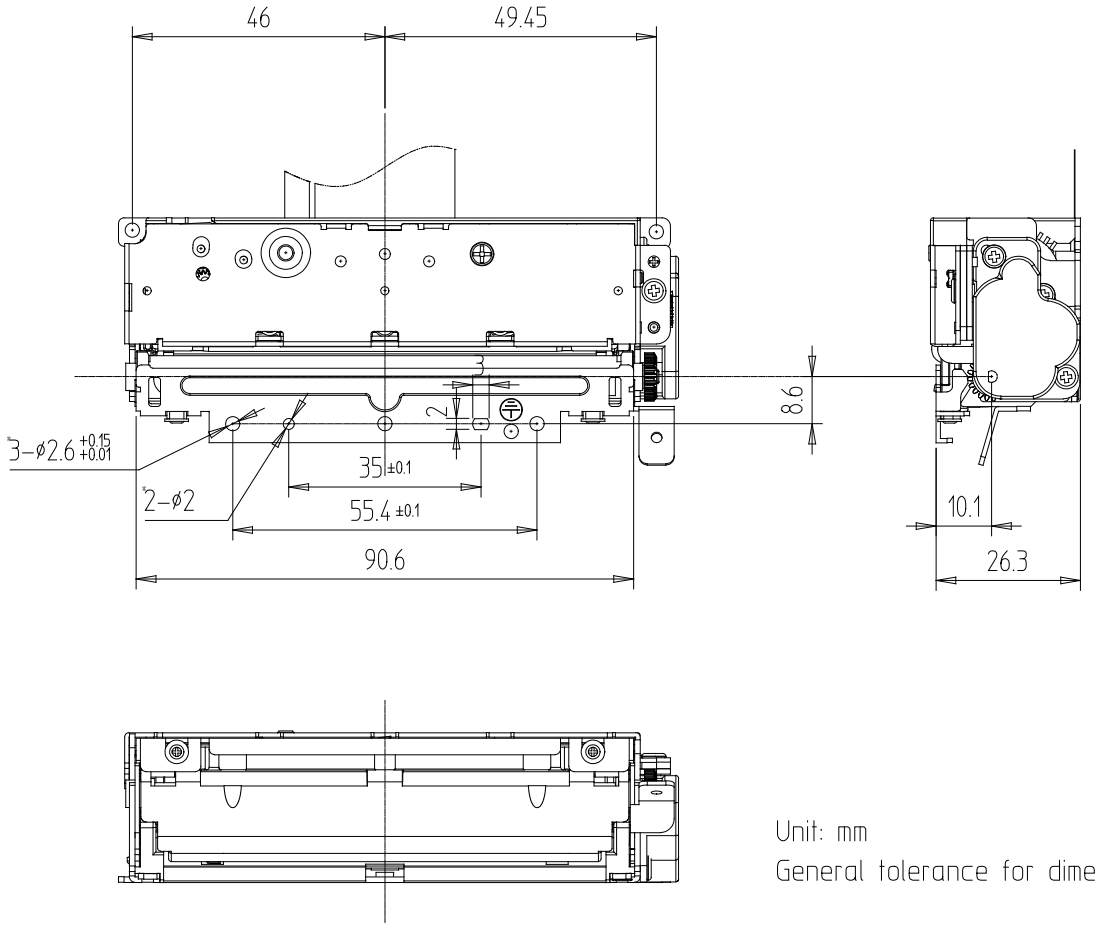
15. Appearance and Dimensions

- Assembly (Excluding Platen Roller Block)



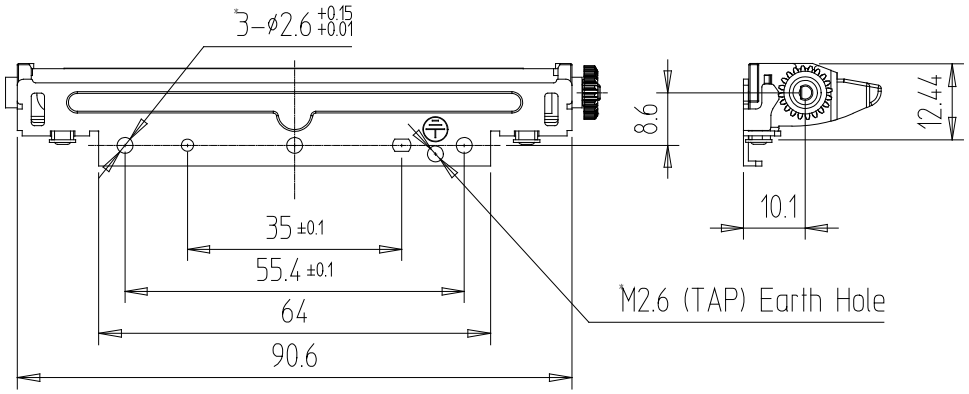
Unit: mm
General tolerance for dimensions: ±0.3
General tolerance for angle: ±1°

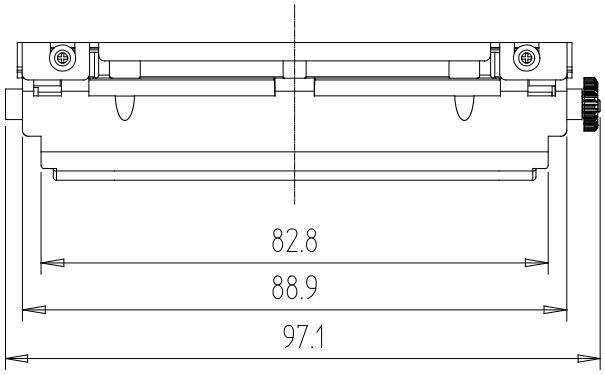
- Assembly (Including Platen Roller Block)



Unit: mm
General tolerance for dimensions: ±0.3

- Platen Roller Block





Unit: mm
General tolerance for dimensions: ±0.3

※ Product Approval Sheet

Product Name	**SMP6350**
Manufacturer	**BIXOLON**
Product Specifications	**SMP6350 User's Manual Rev.2.03**
Customer	
Approved Date	
Approver	
Signature	