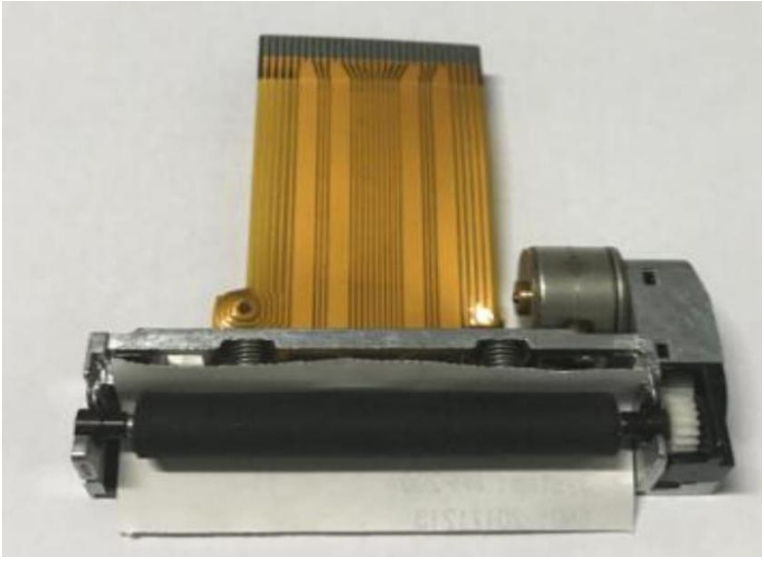
Miniature thermal printer machine

RT628



CONTENT

1 Introduction

1.1 RT628 Series thermal printers

The RT628 printers have the following character: small, wide voltage range, and high efficiency. The mechanism is designed as easy loading, high reliable and cost-effective.

1.2 RT628 Features

- ♦ Easy loading system
- ♦ Compact design Very light
- ♦ High speed (Up to 90mm/s printing speed)
- ♦ wide voltage range
- ♦ High Resolution (8dot/mm)
- ♦ Long life (50km or 100millions pulse)
- ♦ Low noise

1.3 User

This reference describes the electric and mechanism characters. It can be referred by hardware engineer, software engineer, and mechanism engineer. We reserves the right to make changes without notice to the specifications and materials contained herein and shall not be responsible for any damages (including consequential)caused by reliance on the materials presented, including but not limited to typographical,arithmetic, or listing errors.

2 Specifications

Item	RT628
Printing Method	Thermal
Dots/line	384dots/line
Resolution	8
Printing Width(mm)	48
Paper Width(mm)	58
Feed Resolution(mm)	0.0625
W x D x H(mm)	70.3x33x15.3
Head temperature detection	Thermistor
Paper detection	Photo-sensor
Axis detection	Mechanical
Operation voltage range(V)	5~9.5
Logical voltage(V)	2.7~7.0
Operating temperature(°C)	0 to 50(no condensation)
Operating humidity(RH)	20% to 85%(no condensation)
Storage temperature(°C)	-25 to 70(no condensation)
Storage humidity(RH)	10% to 90%(no condensation)

3 Thermal print head configuration

3.1 Outlines

Item	Specifications
Number of heated dots	384 dots/line
Dot pitch	0.125 mm
Printable width	48mm
Average resistance	176Ω±4%
Operating voltage	5V～9.5V
Pulse life	10^8 pulses
Mechanical life	50 km

The life expectancy conditions: 25°C, 12.5% printing duty or less.

3.2 Maximum Allowable Parameters

Parameter	Code	Specifications	Remarks
Heating energy	Eomax	0.2mJ/dot	1.25ms/line
Heating voltage	V_H	9.5V	Voltage across the connecting line
Logic voltage	Vdd	7V	
Operating temperature (℃)	Ta	0℃～50℃	recommended temperature: >5 ℃
Operating humidity (RH)		10%～90%RH	No condensation
Max. operating temperature	Ts	Last for 30 minutes at 65℃ Max. 80 ℃	When the temperature reaches 80℃, printing must be stopped until the temperature drops to 60℃.

3.3 Energy formula

Supply energy is defined by the following formula.

$$P_0 = I_0^{\,2} \times R_{ave} = \frac{V_H^{\,2} \times R_{ave}}{(R_{com} \times N + R_{ave} + R_{ic} + R_{lead})^2}$$

$$T_{on} = E_0 \div P_0$$

or

$$P_0 = E_0 \div T_{on}$$

$$V_H = \sqrt{(P_0 \div R_{ave})} \times (R_{com} \times N + R_{ave} + R_{ic} + R_{lead})$$

$R_{ave} = R_{res} + R_{lead}$ *3:	Average resistance	(Ex.)	176	(Ω)
N :	Number of dots firing at same time	(Ex.)	64	(dots)
R_{com} :	Common resistance	(Ex.)	0.05	(Ω)
R_{ic} :	Driver saturated resistance	(Ex.)	9	(Ω)

*3 R_{res}: Heater resistance, R_{lead}: Lead resistance

3.4 Recommended Parameters

Parameter		Code	Recommended value	Remarks
Heating power		Eo	0.27W/dot	$\overline{R}$ =176Ω
Heating voltage		VH	7.2V	Across the connecting line
Recommended speed			1.25ms/line	
Heating energy	5℃	Eo (ts)	0.16mJ/dot (0.61ms)	64 dots simultaneous heating
	25℃		0.13 mJ/dot (0.50 ms)	
	45℃		0.11 mJ/dot (0.42 ms)	
Current		Io	2.5A	$\overline{R}$ =176Ω

3.5 Electrical characteristics

Electrical characteristics of Circuit(V_{DD}=5V)

Ta=25±10℃

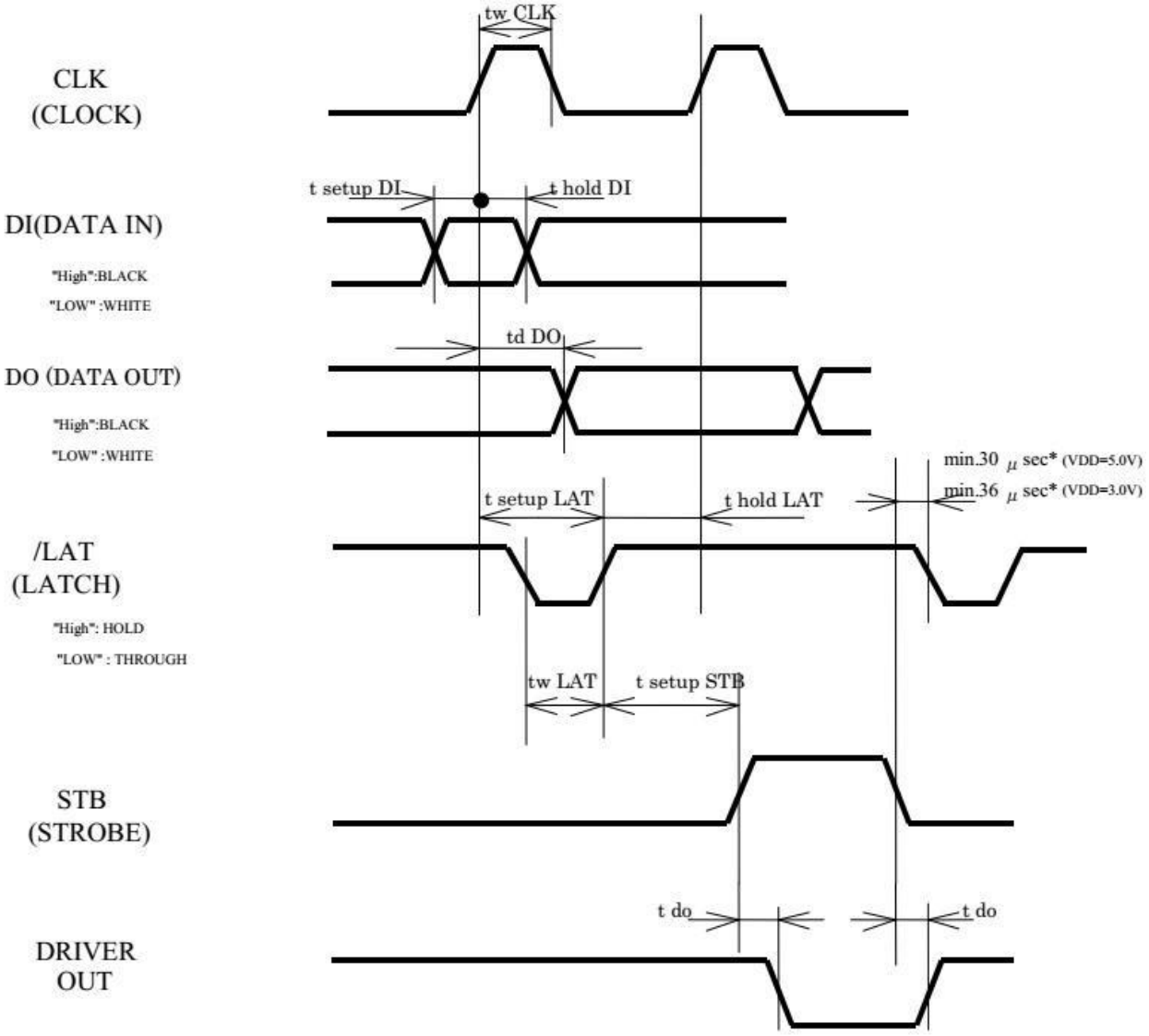
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
PRINT VOLTAGE		V_H	-	-	9.5	V	
LOGIC VOLTAGE		V_{DD}	4.75	5.00	5.25	V	
LOGIC CURRENT		I_{DD}	-	-	48	mA	fDI= fCLK/2 fCLK=10MHz
INPUT VOLTAGE	H	V_{IH}	$0.8V_{DD}$	-	V_{DD}	V	STB, DI, LAT, CLK
	L	V_{IL}	0	-	$0.2V_{DD}$	V	
DATA INPUT CURRENT (DI)	H	I_{IH} DI	-	-	0.5	μA	V_{IH}= 5V V_{IL}=0V
	L	I_{IL} DI	-	-	-0.5	μA	
STB INPUT CURRENT (HIGH ACTIVE)	H	I_{IH} STB	-	-	55	μA	
	L	I_{IL} STB	-	-	-0.5	μA	
CLOCK INPUT CURRENT (CLK)	H	I_{IH} CLK	-	-	1.0	μA	
	L	I_{IL} CLK	-	-	-1.0	μA	
LATCH INPUT CURRENT (LAT)	H	I_{IH} LAT	-	-	1.0	μA	
	L	I_{IL} LAT	-	-	-1.0	μA	
DO VOLTAGE (DO)	H	V_{DOH}	4.25	-	-	V	VDD=5.0V,I_{OH}= -0.5mA
	L	V_{DOL}	-	-	0.75	V	VDD=5.0V,I_{OL}= 0.5mA
CLOCK FREQUENCY		f CLK	-	-	10	MHz	See title 3.6
CLOCK WIDTH		tw CLK	30	-	-	ns	
DATA SET-UP TIME		tsetup DI	30	-	-	ns	
DATA HOLD TIME		thold DI	30	-	-	ns	
DATA OUT DELAY TIME		td DO	-	-	80	ns	
LAT WIDTH		tw LAT	40	-	-	ns	
LAT SET-UP TIME		tsetup LAT	60	-	-	ns	
LAT HOLD TIME		thold LAT	20	-	-	ns	
STB SET-UP TIME		tsetup STB	300	-	-	ns	
DRIVER OUT DELAY TIME		tdo	-	-	30	μs	

Electrical characteristics of Circuit(V_{DD}=3.0V)

Ta=25±10℃

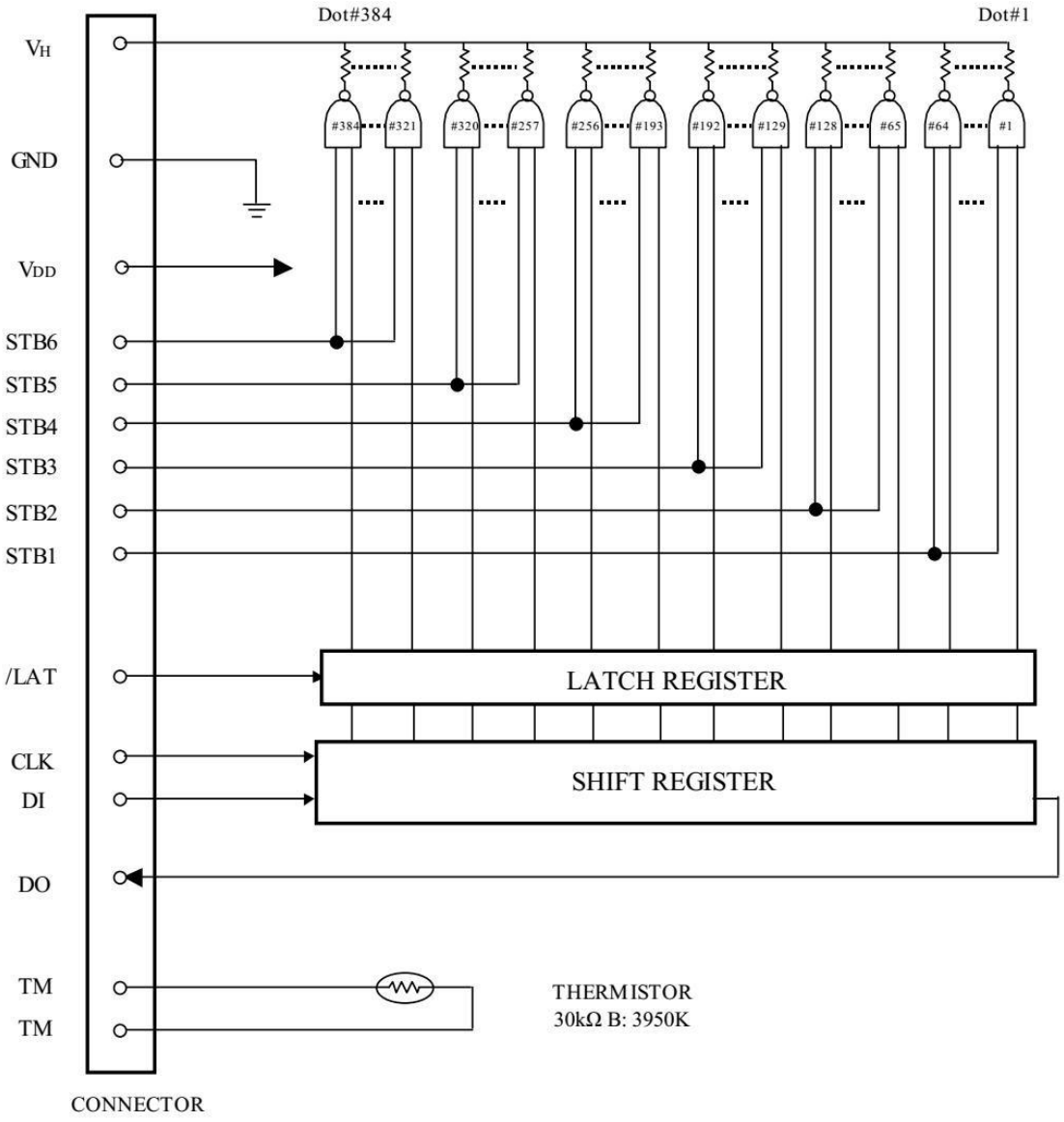
ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
PRINT VOLTAGE		V_H	-	-	9.5	V	
LOGIC VOLTAGE		V_{DD}	2.7	3.0	3.9	V	
LOGIC CURRENT		I_{DD}	-	-	18	mA	fDI= fCLK/2 fCLK=6MHz
INPUT VOLTAGE	H	V_{IH}	$0.8V_{DD}$	-	V_{DD}	V	STB, DI, LAT, CLK
	L	V_{IL}	0	-	$0.2V_{DD}$	V	
DATA INPUT CURRENT (DI)	H	I_{IH} DI	-	-	0.5	μA	V_{IH}= 3.3V V_{IL}=0V
	L	I_{IL} DI	-	-	-0.5	μA	
STB INPUT CURRENT (HIGH ACTIVE)	H	I_{IH} STB	-	-	15	μA	
	L	I_{IL} STB	-	-	-0.5	μA	
CLOCK INPUT CURRENT (CLK)	H	I_{IH} CLK	-	-	1.0	μA	
	L	I_{IL} CLK	-	-	-1.0	μA	
LATCH INPUT CURRENT (LAT)	H	I_{IH} LAT	-	-	1.0	μA	
	L	I_{IL} LAT	-	-	-1.0	μA	
DO VOLTAGE (DO)	H	V_{DOH}	2.55	-	-	V	VDD=3.0V,I_{OH}= -0.5mA
	L	V_{DOL}	-	-	0.45	V	VDD=3.0V,I_{OL}= 0.5mA
CLOCK FREQUENCY		f CLK	-	-	6	MHz	See title 3.6
CLOCK WIDTH		tw CLK	50	-	-	ns	
DATA SET-UP TIME		tsetup DI	70	-	-	ns	
DATA HOLD TIME		thold DI	40	-	-	ns	
DATA OUT DELAY TIME		td DO	-	-	130	ns	
LAT WIDTH		tw LAT	100	-	-	ns	
LAT SET-UP TIME		tsetup LAT	100	-	-	ns	
LAT HOLD TIME		thold LAT	40	-	-	ns	
STB SET-UP TIME		tsetup STB	300	-	-	ns	
DRIVER OUT DELAY TIME		tdo	-	-	36	μs	

3.6 Time characteristics



*If delay time for Driver Out can not be secured enough, there is a possibility that VH would fluctuate greatly. Please design the circuit so that VH does not exceed peak voltage (Vp).

3.7 Schematic Diagram



STB No.	Dot No.	Dots/STB.
1	1 ~ 64	64
2	65 ~ 128	64
3	129 ~ 192	64
4	193 ~ 256	64
5	257 ~ 320	64
6	321 ~ 384	64

GND: GROUND
STB: STROBE (High Active)
/LAT: LATCH (Low Active)
DI: DATA IN
DO: DATA OUT
CLK: CLOCK
TM: THERMISTOR

3.8 Thermistor

Electrical requirements;

1) Resistance R_{25} : 30kΩ ± 5% at 25℃
2) B value : 3950K ± 2%
3) Resistance vs. Temperature : Fig.4

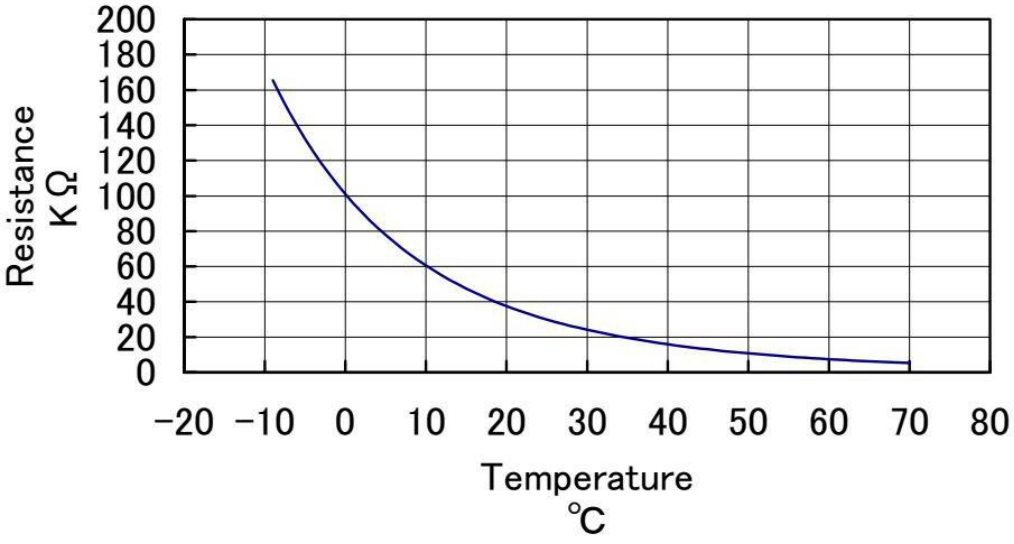
Rating;

1) Operating temperature : -20 ～ +80℃
2) Time constant: Max. 30sec (in the air)

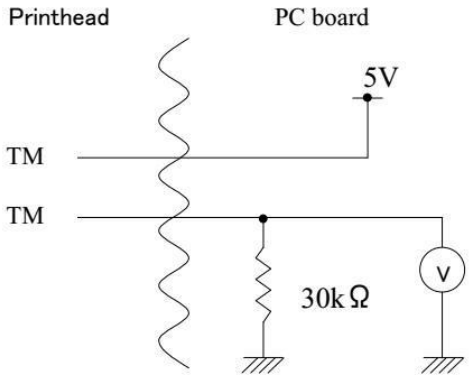
Fig.4 Temperature characteristic of Thermistor

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

(T; Absolute temperature)



Recommended Circuit



3.9 Warning during use

3.9.1 When handling this printer, be sure to take any preventive measure against static electricity such as Disposable Wrist Strap in order to prevent damages of inner parts of the printer caused by the static electricity.

3.9.2 When attaching the platen part to the platen retainer, pay attention not to flaw or damage or smear the rubber part of the platen, the platen gear, and the bearing part (particularly, do not attach any oil or grease and foreign material on the rubber part).

3.9.3 Never attempt to touch the thermal head surface with bear hands. Attaching any oil or grease such as oils from palms on the heating element part may be shortening the lifetime of the thermal head. In case that any oil and grease or foreign materials are attached on it, perform the cleaning immediately. In addition, pay attention not to hit it with something hard such as a driver.

3.9.4 The thermal head and FPC/FFC are shipped as they are connected. When installing the printer, do not pull or apply any extra force in order to avoid the connected part of the thermal head and FPC from being disconnected or deviated. Using the printer with the part is deviated may destroy the head.

Never attempt to touch FPC/FFC and the probe part of the signal line of FFC/FFC (parts which are soldering-plated) and not to hit them with something hard.

3.9.5 Do not perform the contact bending of FPC because it may cause the disconnection. If FPC requires to be bent, the bending should be more than R1.

3.9.6 This printer has a structure such that the platen part is removed from the printer cabinet; therefore, applying the load on the platen part allows removal of the part from the cabinet. Therefore, if any paper ejected from this printer is pulled away with an unnecessarily strong force, it may cause the platen gear to get off the track and damage the gear. Do not attempt to pull any paper ejected from the printer. In addition, when stopping the paper feeding with the hand cutter attached on the main body side, take extra care not to let the gear get of the track. Furthermore, installing any licking system on the casing side of the main body side is recommended.

3.9.7 If any voltage is applied to the thermal head when the head or paper is wet due to condensation, it may be damaged by electrolytic corrosion; therefore, when using the printer, pay attention to the following items.

- Do not apply any electric power to the printer when it is not used.
- Do not perform the printing with any wet paper.
- Do not apply any electric power to the printer under any environment where any dew condensation is possible to occur.
- Turn off all electric power to the head immediately when condensation occurs. Use the head only after the head is completely dried.
- Depending on the environment where the printer is used (the low temperature or high humidity), condensation may be caused by water vapor generated from the used paper when performing the printing of the high printing rate (solid fills, zigzag printing); therefore, the environment should be considerably evaluated.

3.9.8 When any paper is not set at the printer, be sure to separate the head and the platen. If the paper is run out during the printing, stop all actions of the printer in order to prevent the printing without the paper fed. If the printing is continued without any paper fed, it may cause the trouble of the printer.
3.9.9 When using this printer for the continuous actions, the temperature of the head printer board (the detected temperature with the thermistor) should be equal or less than 65 degrees Centigrade for the temperature protection of IC inside of the printer as well as the surface temperature of the motor should be equal or less than 90 degrees Centigrade for the temperature protection of the motor coil.
3.9.10 Never attempt to any back feeding action of the paper.
3.9.11 Regarding the printing quality and lifetime; therefore, carefully confirm the property of the paper before using.
3.9.12 When the printer is on standby, the thermal head (VH) must be switched off. During head power supply ON/OFF sequence, strobes should be kept "disable". If the voltage including surge exceeds maximum rating of driver IC, the TPH may burn out by latch-up. Care should be taken especially when head current changes by strobes or at the ON/OFF sequence. The voltage shall be kept within the following voltage.

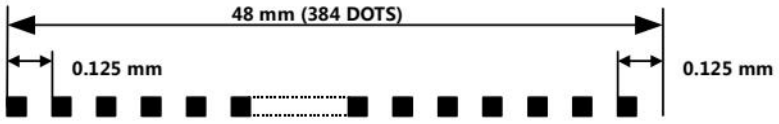
VH : 0V ~ 9.5V
Vdd : 0V ~ 7V
Other signals : GND ~ Vdd+0.5V

3.9.13 When turning the power on or off, perform the VH and Vdd in the order of 1) and 2) as follows:

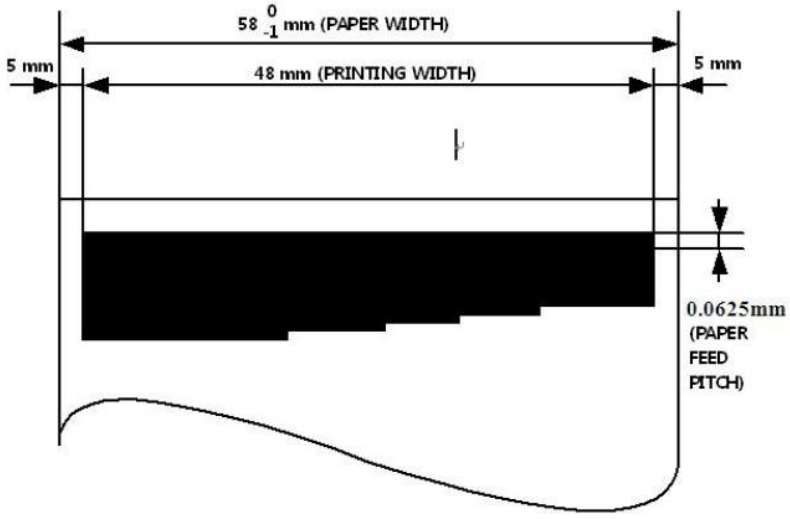
At power on: 1) Vdd → 2) VH

At power OFF: 1) VH → 2) Vdd

4 Heating unit size



Heating unit size



print size

5 Stepping motor

The paper will be feed 0.0625 mm depends on the each single step.

5.1 Stepping motor phase

Drive the motor with the 2-2 phase excitation of the bipolar. The reference excitation method is described below.

POSITIO	STEP	STEP	STEP	STEP
A	+	+	-	-
B	-	+	+	-
/A	-	-	+	+
/B	+	-	-	+

5.2 Stepping motor configuration

Item	Spec.	Cond.
Working voltage	5V	
Feed resolution	0.0625mm	
Coil resistance	10Ω±7%	At 25°C
Coil current	0.357A	
Life	3000Hour	

5.3 Driving the bipolar transistor

5.3.1 Drive the motor by the fixed current control for the output torque stabilization to the applied voltage change. Applying any excessive electric current will cause the abnormal generation and the excessive torque, which will end in mechanical damages. Therefore, do not apply any electric current that exceeds the requirement.
5.3.2 Determine the motor driving requirements after confirming effects of load variations caused by temperature, the humidity, and types of paper. If the motor is driven by any excessive torque, the gears may be damaged when the paper is locked; therefore, attention should be paid.
5.3.3 In the low-speed drive (the low driving frequency), abnormal noises and the torque reduction may occur due to resonance of the motor. In the low-speed drive, be sure to perform sufficient evaluation and confirmation.
5.3.4 At the start of the high-speed printing and the start of the printing after turning off the motor excitation, perform the speedup control.

6 Paper detector and platen position detector

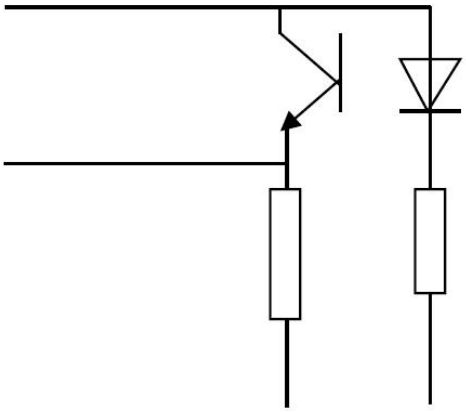
6.1 Paper detector

The RT628 printer has a reflective photoelectric detection switch. As shown in the figure below, when the paper or paper is not pressed, the light emitted by the photoelectric detection can not be reflected and output low.

When both the paper and platen are normal, the light emitted by the photoelectric detection is reflected by the receiving tube and the output is high.

Photoelectric switch circuit drive as shown below, the logic voltage can be used 3.3V, can also use 5V.

Do not activate the printer when the paper or paper is not ready.When paper is missing, the paper must be reduced.



General Specifications

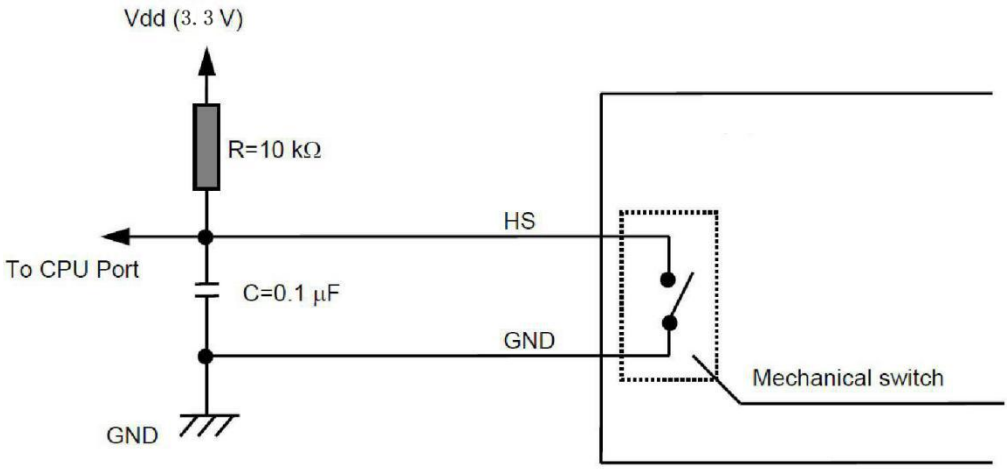
Item		Symbol	condition	Value			Unit
input	forward voltage	V_F	I_F=20mA		1.2	1.6	V
	Backward current	I_R	V_R=5V			10	μA
output	Collector-emitter saturation voltage	$V_{CE(sat)}$	I_C=2mA E_e=1mW/cm^2			0.4	V
	Dark current	I_{CEO}	V_{CE}=10V			100	nA
Coupling property	Collector current	$I_{C(ON)}$	V_{CE}=5V I_F=20mA	0.18		0.44	mA
	Leak current	I_{LEAK}				1	μA
	Rise/Fall Time	t_r/t_f	V_{CE}=2V I_C=100μA R_L=1000Ω			20/20	μsec

6.2 Axis in the place detection

There is a cots ready detection switch in the machine. When the cots are in place, the detection switches are turned on; when the cots leave, the detection switches are disconnected. Detect switch parameters.

Rated voltage	3.3 VDC，1 mA
Acceptable current	0.1-100 mA
Contact resistance	1Ω

Circuit design reference：

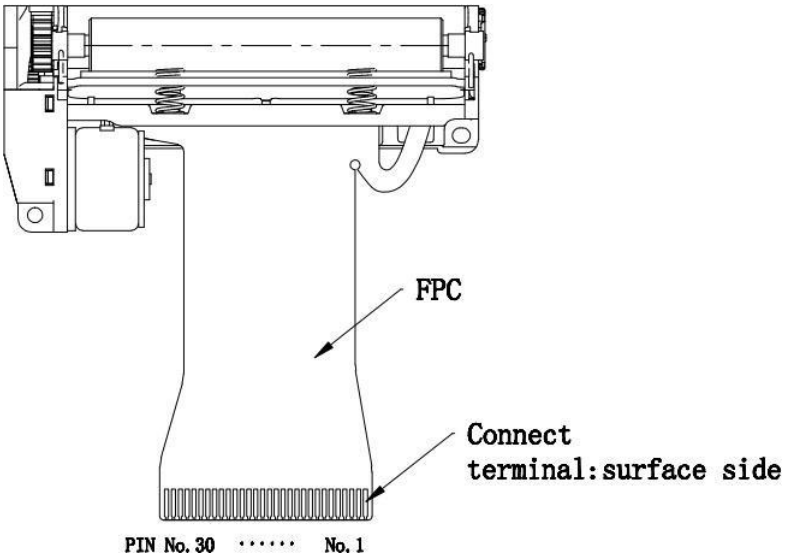


Do not start the printer heating when the paper or rubber roll is not ready. The paper must be fed at low speed when it is out of paper.

7 Pin Assignment

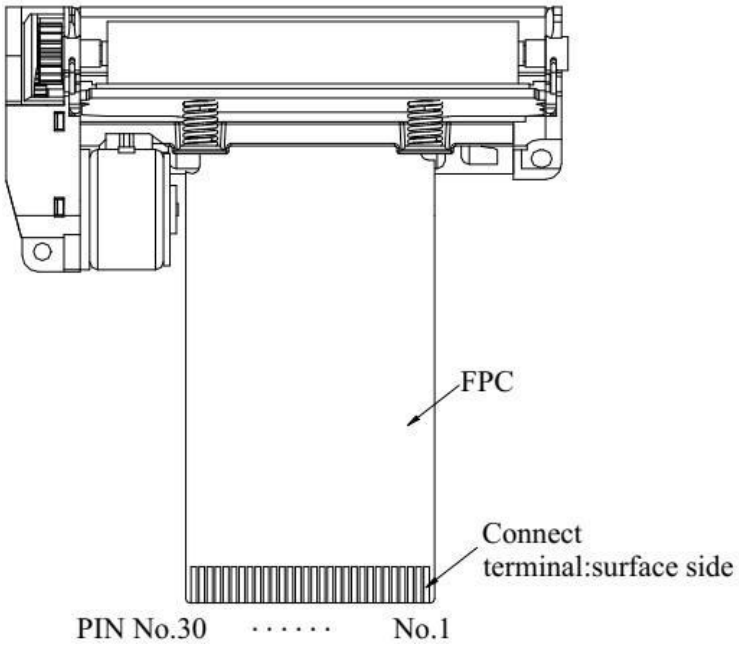
7.1Without axis detection

Pin	Name	Note
1	PHK	Photodiode in cathode
2	VSEN	Photoelectric detection power supply
3	PHE	Phototube triode emitter
4～5	NC	NC
6-7	VH	Head drive power
8	DI	Data input
9	CLK	Serial clock
10～11	GND	GND
12	STB6	Heating allowable control
13	STB5	Heating allowable control
14	STB4	Heating allowable control
15	Vdd	Logic voltage
16	TM	Temperature Detection 1
17	TM	Temperature Detection 2
18	STB3	Heating allowable control
19	STB2	Heating allowable control
20	STB1	Heating allowable control
21～22	P_GND	GND
23	/LAT	Data latch control
24	DO	Print data output
25～26	VH	Head drive power
27	A	Motor drive A
28	/A	Motor drive A
29	B	Motor drive B
30	/B	Motor drive B



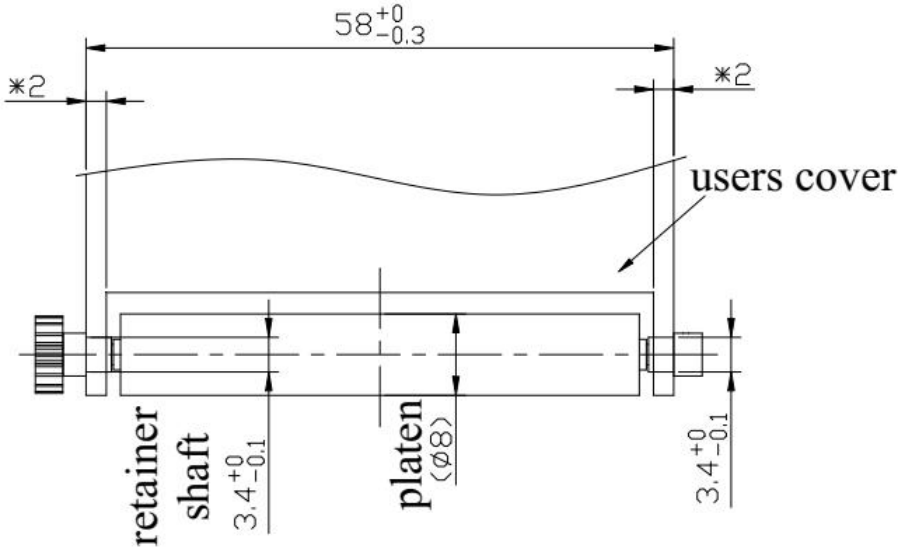
7.2With axis detection

Pin	Name	Note
1	PHK	Photodiode in cathode
2	VSEN	Photoelectric detection power supply
3	PHE	Phototube triode emitter
4～5	HS	Roller detection switch
6-7	VH	Head drive power
8	DI	Data input
9	CLK	Serial clock
10～11	GND	GND
12	STB6	Heating allowable control
13	STB5	Heating allowable control
14	STB4	Heating allowable control
15	Vdd	Logic voltage
16	TM	Temperature Detection 1
17	TM	Temperature Detection 2
18	STB3	Heating allowable control
19	STB2	Heating allowable control
20	STB1	Heating allowable control
21～22	P_GND	GND
23	/LAT	Data latch control
24	DO	Print data output
25～26	VH	Head drive power
27	A	Motor drive A
28	/A	Motor drive A
29	B	Motor drive B
30	/B	Motor drive B



8 Mechanism Design

8.1 Reference for design of paper structure



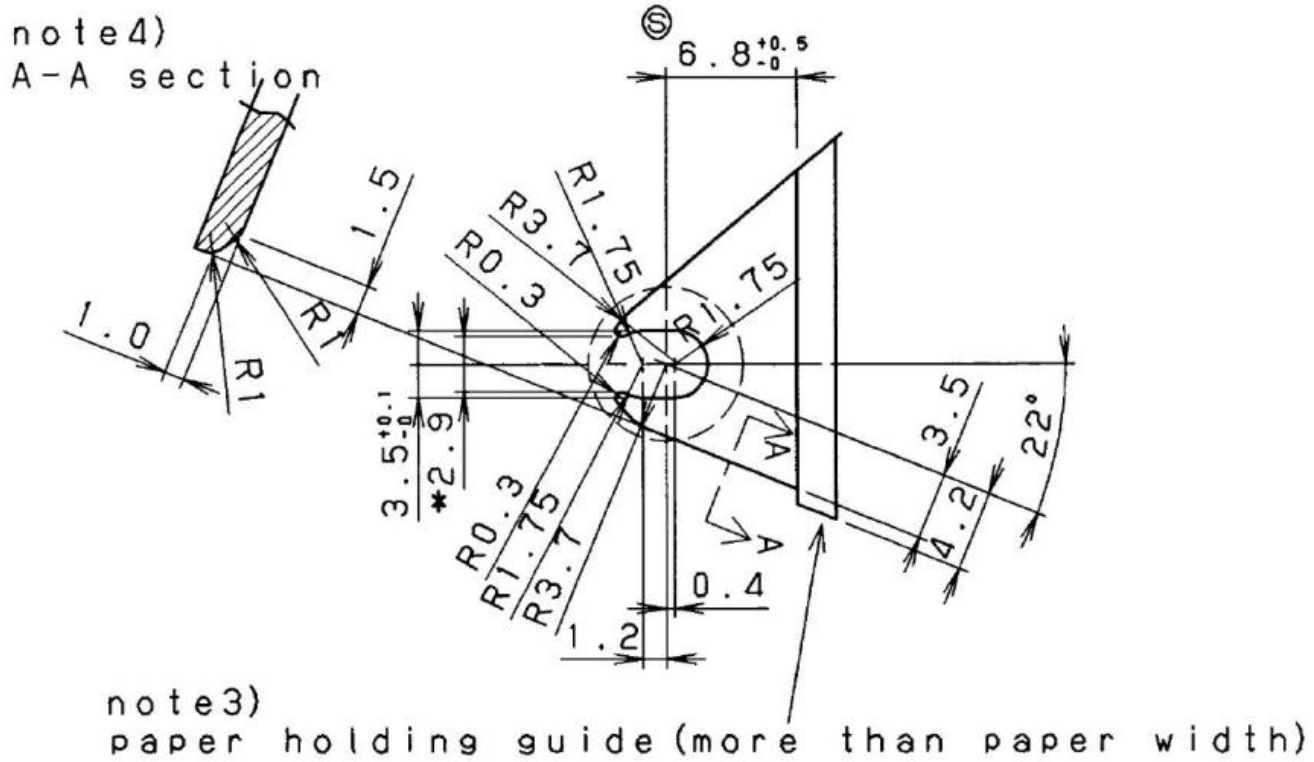
Notes:

1.The size of "*" is recommended size.

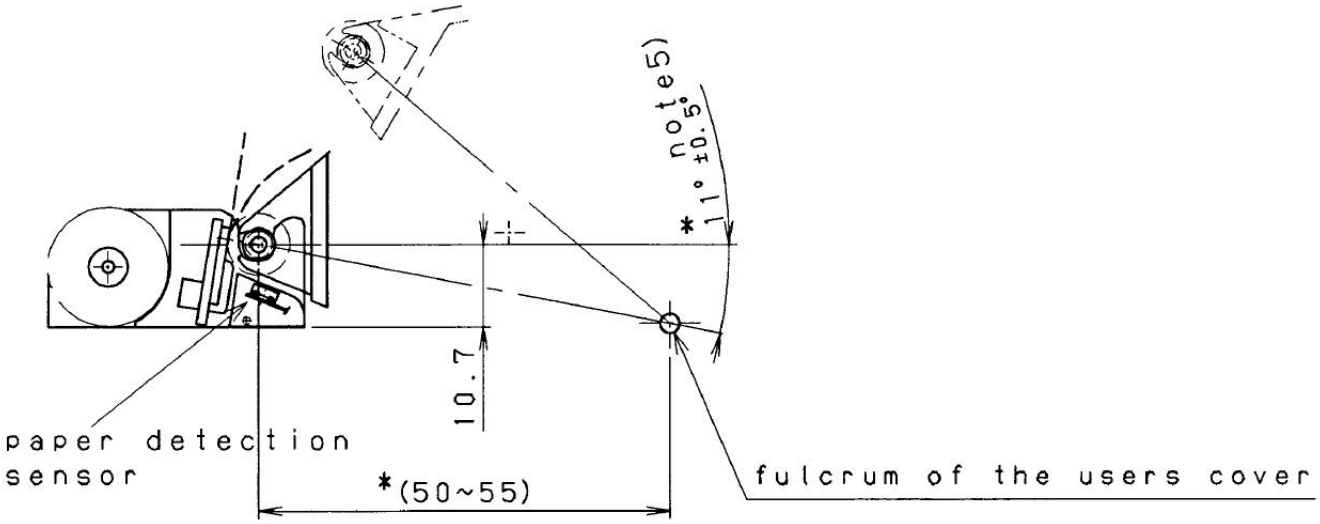
2."Ⓢ"Shows the center line of the platen set in the main body of the printer.

3. A paper guide device is required to ensure the stability of the electrical detection signal output during paper feeding.

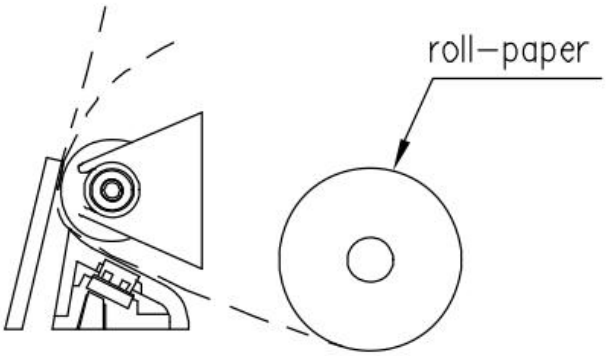
4. The two sides of the paper loading structure shall have leading angle (As shown in the cross section of Figure A-A below). It is convenient to pack the paper when the rubber covered roller is easy to take out and put in from the movement.



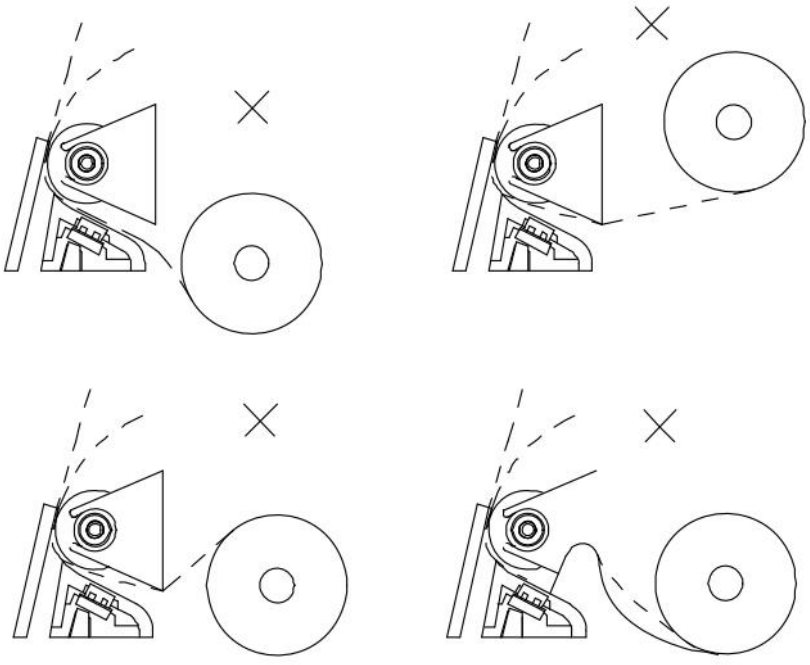
Design reference for the rotation axis position of the papermaking device:



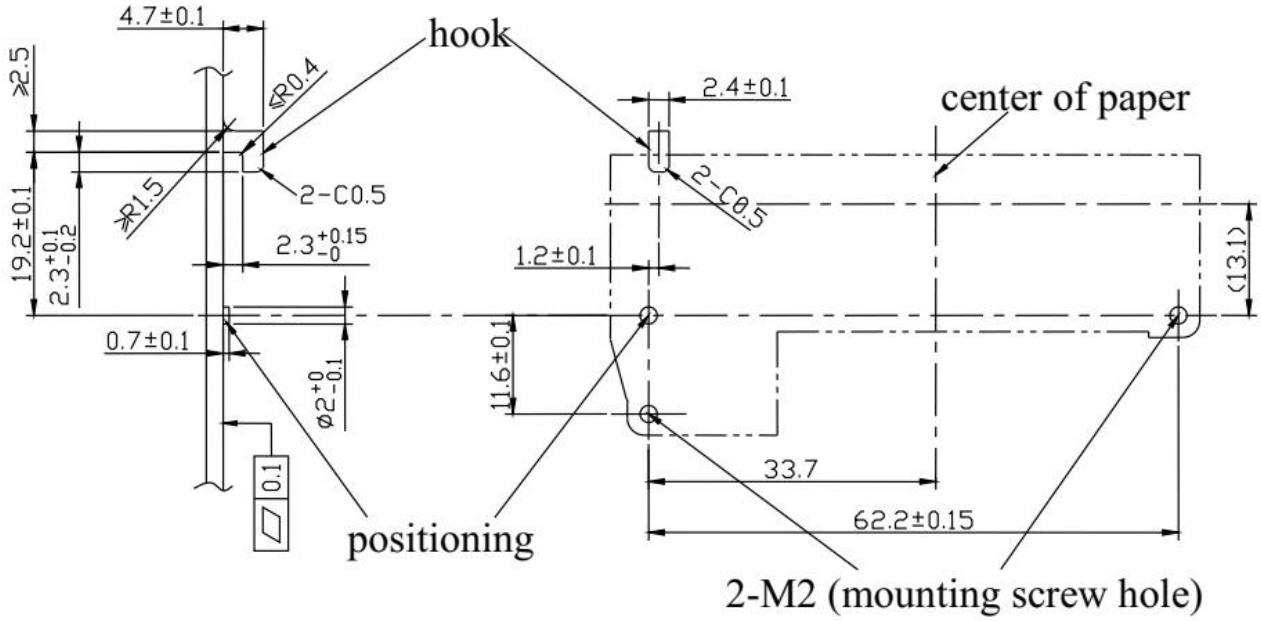
8.2 Paper roll mounting position



Wrong installation method:

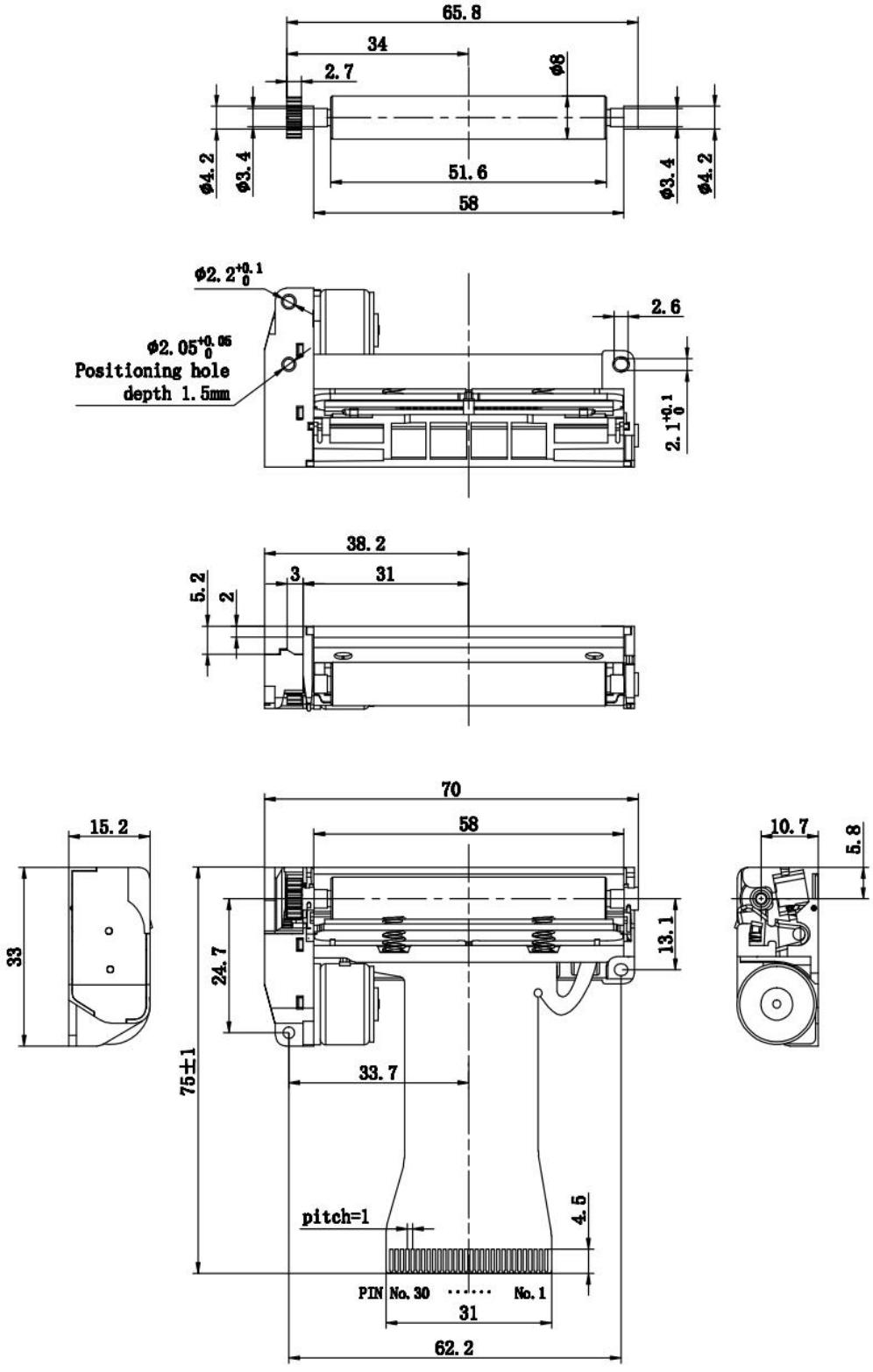


8.3 Machine core installation dimensions



8.4 External dimensions

Without axis detection



With axis detection