Micro thermal mechanism

TP-638K-101/103

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Revised records				
Version	Date	Modify the content	Draw up	Remarks
V1.0	2023.07.31	The first draft	Wu Shangzhen	-

Contents

1 Introduce

1.1 TP638K-101/103 Thermal mechanism

The TP-486K-103 thermal printer core has the characteristics of small size, wide working voltage, and high efficiency. The unique movement design makes it easy to pack and highly reliable.

1.2 TP638K-101/103 Features

- ◆ Easy paper loading
- ◆ Small vollum
- ◆ Light weight
- ◆ Fast printing speed (maximum printing speed 90mm/s)
- ◆ Wide working voltage
- ◆ High printing accuracy (8 dots/mm)
- ◆ Long lifespan（50 kilometers or 10^8pulses）
- ◆ Low noise

1.3 Directions

This manual describes the electrical and mechanical characteristics of TP638K-101/103. It can be used as a reference for designers.

Our company reserves the right to make changes to this manual. If you need the latest version of this manual, you can consult our company.

For designs that do not follow this manual, we do not guarantee the reliability of their work.

2 Specification

Item	Spec.
Print method	Thermal
Print dots	384 dots/line
Point density (points/mm）	8
Print width(mm)	72
Paper width(mm)	80
Paper feed accuracy (mm)	0.0625
WxDxH（mm）	91.8x33x15.3
Weight（G）	About 52
Heating head temperature detection	Thermistor
Paper shortage detection	Photoelectric detection
Head working voltage (V)	4.2～8.5
Logic working power supply (V)	2.7～5.25
Working temperature (℃)	0～50(No condensation allowed)
Working humidity (RH)	20％～85％(No condensation allowed)
Storage temperature (℃)	-25～70（(No condensation allowed)
Storage humidity (RH)	5％～95％(No condensation allowed)

3 Thermal head parameter

3.1Rating

Item	Spec.
Heat dots	576 dots
Dot pitch	0.125mm
Dot size	0.11mm x 0.10mm
Paper feeding accuracy	0.0625mm
Print width	72mm
Average resistance	176Ω±4%
Working power supply	4.2～8.5V
Pulse lifetime	10^8Pluse
Mechanical life	50KM

Life test conditions: 25 ℃, heating time ratio not greater than 12.5%.

3.2 Maximum allowed parameters

Parameter	Code	Spec.	Illustrate
Heating energy	Eomax	0.2mJ/dot	1.25ms/line
Heating voltage	V_H	8.5V	Voltage at both ends of the connecting line
Logic voltage	Vdd	7V	Including peak voltage
Ambient temperature	Ta	-30℃～50℃	Suggest above 5 ℃
Ambient humidity		10％～90％RH	Non condensing fog
Max operating temperature	Ts	Continuous at 65 ℃ for 30 minutes	When the temperature reaches 80 ℃, printing must be stopped until the temperature drops to 60 ℃
		Max.80℃	

3.3 Formula

The heating energy can be calculated by the following formula:：

$$E_o = I_o^{\,2}\overline{R}t_s = \frac{VH^2 \times R_{ave} \times t_s}{(R_{com} \times N + R_{ave} + R_{IC} + R_{lead})^2}$$

among：

R_{IC}	9Ω
t_s	Heating time
VH	eating voltage
R_{ave}	Average resistance value 176Ω
N	Simultaneous heating points 64dots
R_{com}	Common level resistance 0.05Ω
R_{lead}	Connecting wire resistance

3.4 Recommended parameters

Parameters	Code	Recommended working parameters	Illustrate
Power	Eo	0.27W/dot	R_{ave} =176Ω
Voltage	VH	7.2V	
Suggested speed		1.25ms/line	Vdd=5V

				64dots simultaneous heating
Heating energy	5℃	Eo (ts)	0.16mJ/dot(0.6ms)	
	25℃		0.13mJ/dot(0.49ms)	
	45℃		0.11mJ/dot(0.41ms)	
电流		Io	37.5mA/dot	

3.5 Electrical parameters

Ta=25±10%℃

Item	Code	Condition	Min.	Typical	Max.	Unit
Print voltage	V_H		-	-	8.5	V
Logic voltage	V_{dd}		2.7	5.0	5.25	V
Logic current	I_{dd}	$f_{DI}=f_{CLK}/2$			36	mA
Input voltage (high)	V_{IH}	STB,DI ,LAT, CLK	$0.8V_{dd}$		V_{dd}	V
Input voltage (low)	V_{IL}		0		$0.2\ V_{dd}$	V
Latch input current (h)	I_{IH}LAT	V_{IH}=Vdd=5V V_{IL}=GND			1.0	μA
Heating input current (h)	I_{IH}STB				55	
Clock input current (high)	I_{IH}CLK				1.0	
Data input current (high)	I_{IH}DI				0.5	
Latch input current (low)	I_{IL}LAT				-1.0	μA
Heating input current (l)	I_{IL}STB				-0.5	
Clock input current (low)	I_{IL}CLK				-1.0	
Data input current (low)	I_{IL}DI				-0.5	
Data output voltage (h)	V_{DOH}	Open status Vdd=4.5V	4.0			V
Data output voltage (low)	V_{DOL}				0.5	V

3.6 Temporal characteristic

Parameter	Code	Speed	Unit	Condition

		Min.	Typical	Max.		
Clock frequency	fCLK			8.0	MHZ	$3.0 \le V_{dd} \le 5.25$
				5.0	MHZ	$2.7 \le V_{dd} < 3.0$
Clock pulse amplitude	t_wCLK	30(50)			ns	See fig.3.6 $2.7 \le V_{dd} < 3.0$
Data setting time	t_{setup}DI	30(70)			ns	
Data retention time	t_{hold}DI	30(40)			ns	
Latch pulse amplitude	t_wLAT	100			ns	See fig.3.6
Latching setting time	t_{setup}LAT	100			ns	
Lock retention time	t_{hold}LAT	50			ns	
Heating setting time	t_{setup}STB	300			ns	
Data output delay time	t_dDO			90	ns	$3.0 \le V_{dd} \le 5.25$
				130	ns	$2.7 \le V_{dd} < 3.0$
Output delay time	t_{do}			10	μs	V_{dd}=5V

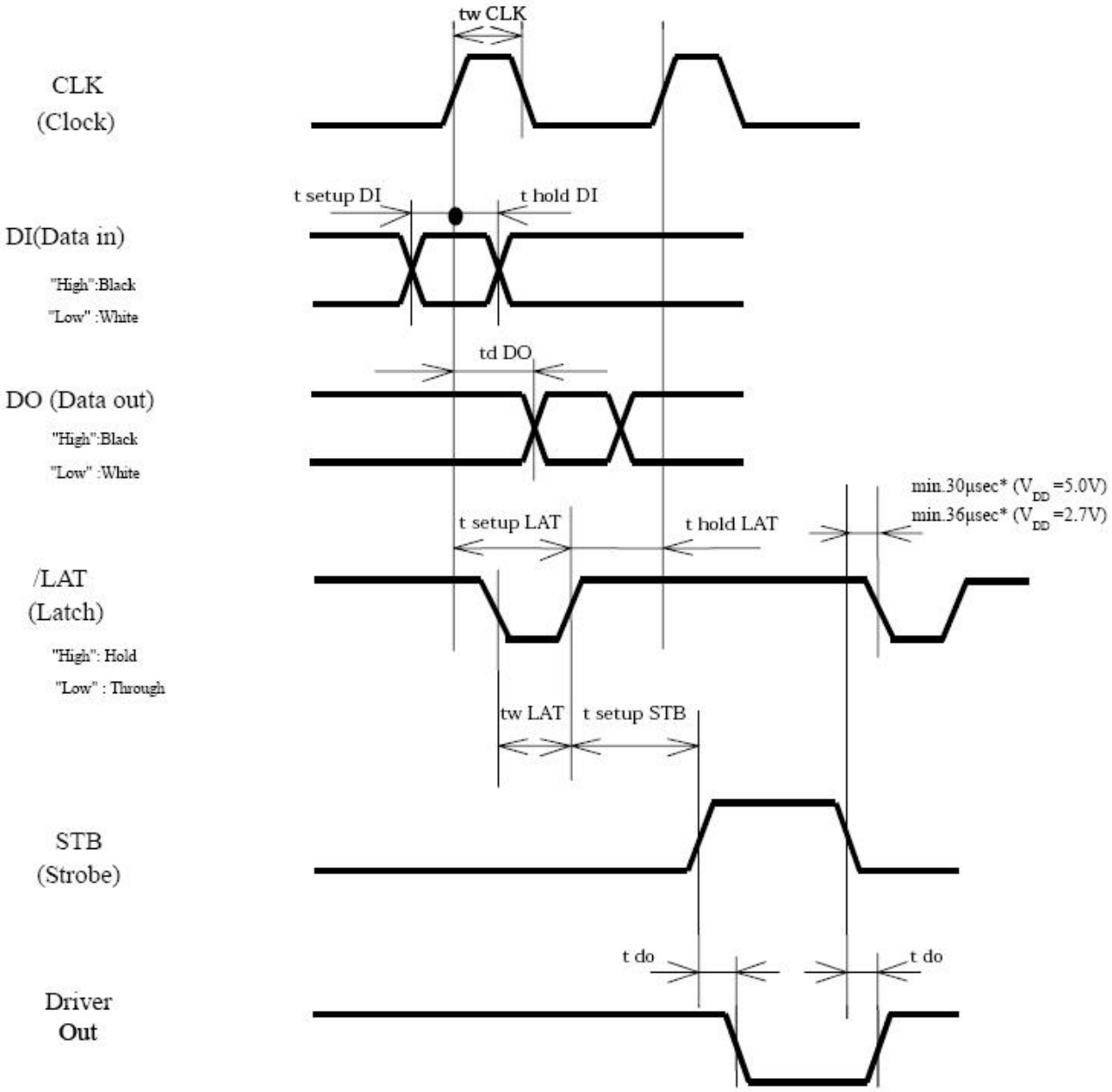
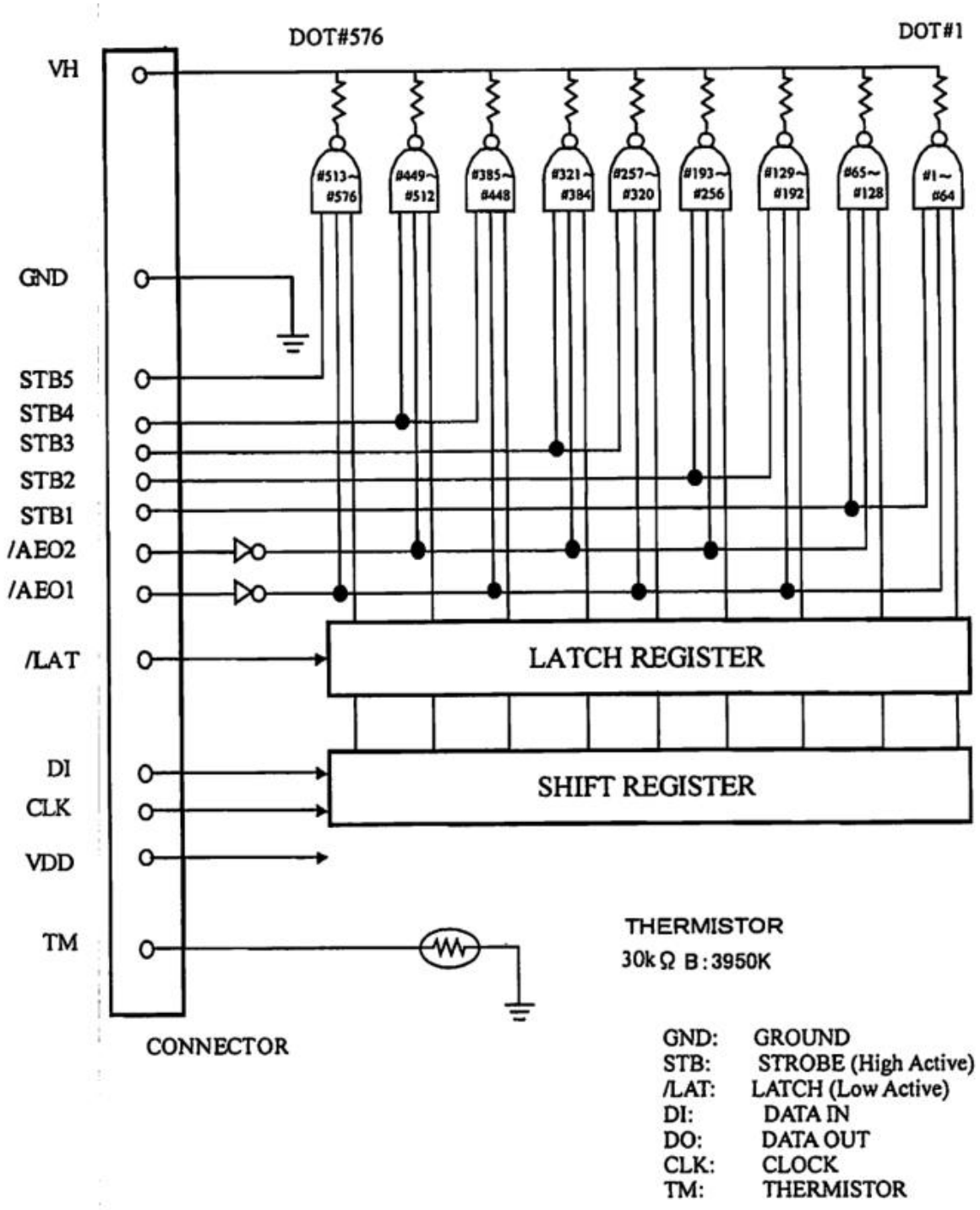

tw CLK
CLK
(Clock)
t setup DI
t hold DI
DI(Data in)
"High":Black
"Low" :White
td DO
DO (Data out)
"High":Black
"Low" :White
min.30µsec* (VDD=5.0V)
min.36µsec* (VDD=2.7V)
t setup LAT
t hold LAT
/LAT
(Latch)
"High": Hold
"Low" : Through
tw LAT
t setup STB
STB
(Strobe)
t do
t do
Driver
Out

Fig3.6

3.7 Output delay time



Dot No.	1～64	65～128	129～192	193～256	257～320	321～384	385～448	449～512	513～576
STB No.	1	1	2	2	3	3	4	4	5
AEO No.	1	2	1	2	1	2	1	2	1

3.8 Thermistor

$$R = R_{25} e^{B(\frac{1}{T+273} - \frac{1}{25+273})}$$

其中

R_{25}	30KΩ±5%
B	3950K±2%
T	Temp.（℃）
Effective range	-20℃～+80℃

Thermistor thermometer:

Temp.(℃)	Resistance (KΩ)	Tem. (℃)	Resistance (KΩ)	Temp. (℃)	Resistance (KΩ)	Temp. (℃)	Resistance (KΩ)
-40	843	-10	161	20	37.5	50	10.8
-35	623	-5	124	25	30.0	55	8.91
-30	466	0	96.8	30	24.2	60	7.41
-25	352	5	75.7	35	19.6	65	6.2
-20	269	10	59.5	40	15.9	70	5.21
-15	208	15	47.1	45	13.1	75	4.4

3.9 Cautions

3.9.1 The TPH and photoelectric sensors on the movement are static sensitive devices. When using the movement, please take protective measures (such as wearing an electrostatic ring, ensuring humidity in the workshop, etc.) to prevent static electricity from damaging the internal components of the movement.

3.9.2 When installing the rubber roller components onto the bracket, please be careful not to damage the rubber part of the rubber roller, the rubber roller gear, and other bearing components (especially do not apply any oil or stick other foreign objects to the rubber part).

3.9.3Do not touch the thermosensitive head directly with your hands. When any oil stains are adhered to the thermosensitive head, it will greatly shorten the service life of the thermosensitive head. If any oil or foreign objects are stuck to the thermosensitive head, please wipe it with a cotton cloth dipped in alcohol and wait for the alcohol to completely dry before continuing to use. In addition, please do not use hard objects to strike or scratch the thermosensitive head.

3.9.4 The golden finger end of FPC should not be directly touched by hand or hit or scraped with hard objects. When designing the structure of the entire machine, it should be in a relatively relaxed state in spatial position and should not be tightened or subjected to additional forces; During assembly, operators are not allowed to forcefully pull the FPC. When inserting or

unplugging the FPC of the movement, it must be done with the power supply of the drive board of the movement turned off; Do not plug and unplug the FPC to the driver board more than 10 times, and ensure it is parallel to the socket when plugging and unplugging.

3.9.5 Do not bend the FPC as it may cause damage or wire breakage. If FPC is to be bent, the curvature must be greater than R1.

3.9.6 Due to the easy to fit paper structure of this movement, the rubber roller can be removed by slightly pulling on it with force. If there is a paper jam, pulling too hard on the paper can cause the rubber roller gear to fall off or be damaged. Please do not pull the paper too hard.

3.9.7 If you continue to use the thermal head or printing paper even when it is damp, it will cause electrolytic erosion of the thermal head and cause damage. Therefore, please pay attention to the following clauses when using the movement:

A: Turn off the printer's power when not in use.

B: Please do not use damp paper.

C: If there is water condensation caused by humidity, please do not turn on the power. If it occurs, please immediately turn off the power. Allow the thermal head to dry before use. The use of the movement is related to the environment (low temperature or high humidity), and condensed water may be caused by the evaporation of the paper used during high-speed printing of the movement. Therefore, please pay attention to the environment in which the movement is placed.

D: When condensation occurs, please immediately turn off the printer power and wait until it is completely dry before continuing to use.

3.9.8 If the mechanism is out of paper or not in use for a long time, please pay attention to separating the thermal head from the rubber roller. If there is no paper during the printing process, please stop the printing of the movement. If printing continuously without paper, it can cause damage to the printer core.

3.9.9 During continuous printing, the temperature of the thermal head circuit board (detection temperature of the thermistor) of the movement should not exceed 65 ℃ to protect the internal IC of the thermal head; The surface temperature of the motor cannot exceed 90 ℃, which is also to better protect the motor coil.

3.9.10 Keep the paper feed smooth when printing.

3.9.11 Please use high-quality thermal paper, as the thermal sensitivity of thermal paper has a significant impact on the printing effect. At the same time, rough paper can cause severe wear on the printing head, which can shorten the lifespan of the printing head.

3.9.12When not printing, the printing power must be turned off. Ensure that the heating control signal is in the off state when the printer core voltage is turned on/off.

3.9.13 To turn on/off the printer, follow the following sequence:

When opened: 1) Vdd → 2) VH

When closed: 1) VH → 2) Vdd

4 Step motor

The stepper motor advances the paper by 0.0625 millimeters every step forward.

4.1 Stepper motor phase

The stepper motor of TP638K-101/103 adopts a 2-2 phase drive method, with 4 positions. As shown in the table below:

Location	STEP1	STEP2	STEP3	STEP4
PA	-	-	+	+
PB	-	+	+	-
/PA	+	+	-	-
/PB	+	-	-	+

4.2 Stepper motor parameters

Item	Spec.	Condition
Rated voltage	4.2～8.5V	
Step distance	0.0625 mm	
Phase Resistance	10Ω±7％	20℃
Phase current	0.357A	
Service life	3000H	

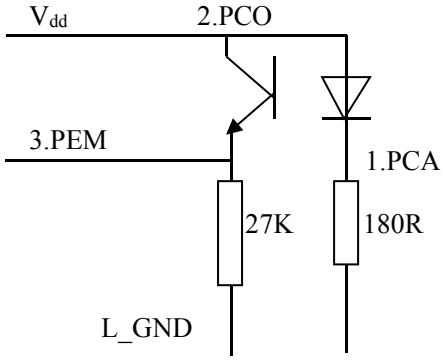
4.3 Stepper motor drive

It is recommended to use PWM method to drive the stepper motor, such as L3967 and other driving chips. Use different driving currents for different motor speeds. This can effectively reduce the heating of the stepper motor and effectively reduce the noise during printing the stepper.
In low voltage operation, it is recommended to use Rohm's 6846 and Sanyo's 1836 and 1838.

5 Paper End detection and rubber roller in place detection

The TP638K-101/103 printer has a reflective photoelectric detection switch. As shown in the following figure, when there is a shortage of paper or the paper pressing shaft is not pressed properly, the light emitted by the photoelectric detection cannot be reflected, and a high level is output.
When both the paper and the paper pressing shaft are normal, the light emitted by the photoelectric detection is reflected and received by the receiving tube, outputting a low level.
The circuit drive of the photoelectric switch is shown in the following figure, and the logic voltage can be used either 3.3V or 5V.

Do not start the printer to heat up when there is paper end or the paper roller is not ready; When there is paper end, the feeding speed must be



Optoelectronic parameters

Item		Code	Condition	Value			Unit
Input	Forward voltage	V_F	I_F=20mA	1.0	1.2	1.5	V
	Reverse current	I_R	V_R=5V			10	μA
Output	Collector to emitter breakdown voltage	BV_{CEO}	I_C=0.5mA	30			V
	Breakdown voltage from emitter to collector	BV_{ECO}	I_E=0.1mA	5			V
	Collector dark current	I_{CEO}	V_{CE}=10V			100	nA
Coupling characteristics	Saturation voltage drop from collector to emitter	$V_{CE(SAT)}$	I_C=2mA E_e=1mW/cm^2			0.4	V
	Detection distance	d					mm
	Leakage current	I_{LEAK}	I_F=10mA V_{CE}=5V No reflective surface			50	μA
	Rise/fall time	t_r/t_f	V_{CE}=5V I_C=1mA R_L=1000Ω			15/15	μs

6 Rubber roller in place detection

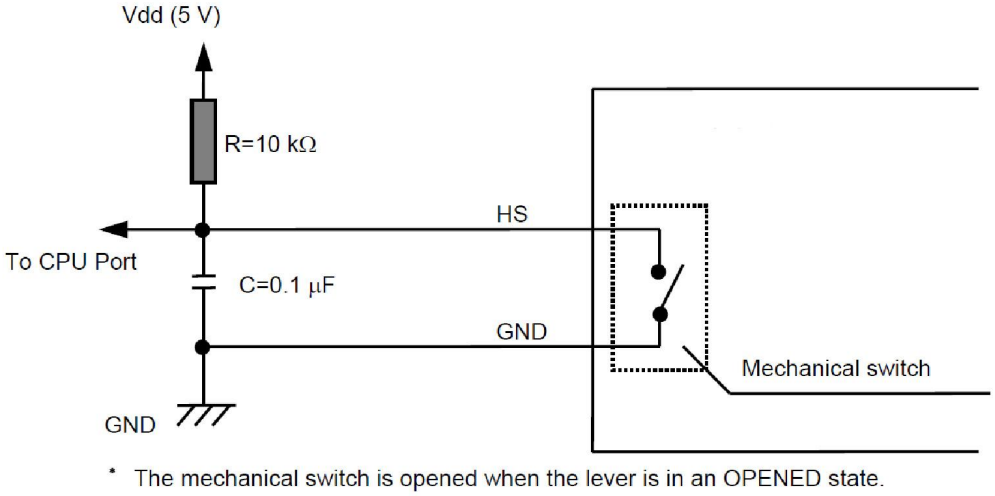
The movement has a rubber roller ready detection switch, which is turned on when the rubber roller is in place; When the rubber roller leaves, the detection switch is

disconnected.

Detection switch parameters:

Rated voltage	5 VDC，1 mA
Allowable current	0.1-100 mA
Contact resistance	1Ω

Circuit Design Reference：

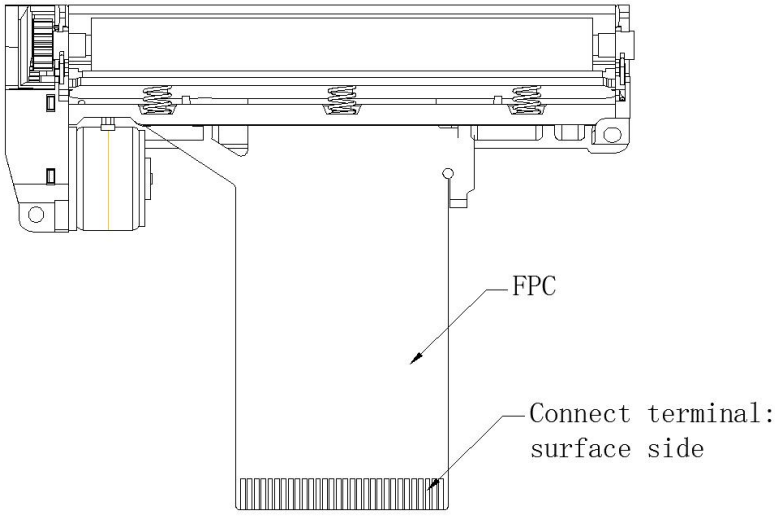


* The mechanical switch is opened when the lever is in an OPENED state.

When there is paper end or the rubber roller is not ready, do not start the printer heating; When there is a shortage of paper, the feed speed must be lowered.

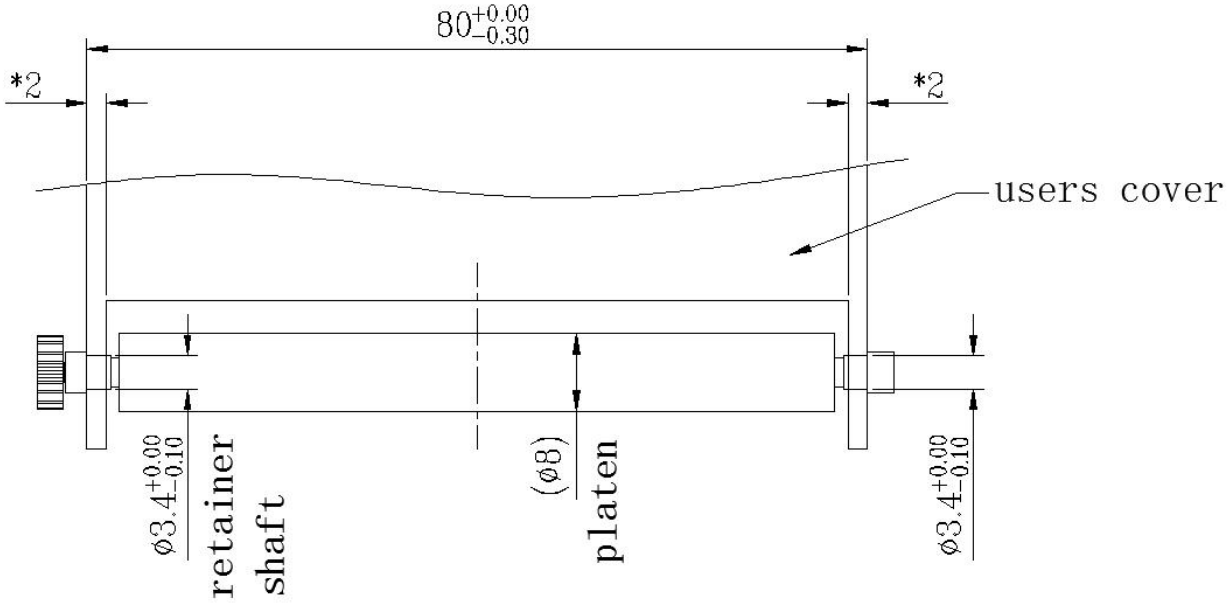
7 Pin definition

引脚	信号	Illustrate
1	PHK	C-pole of the transmitting tube
2	VSEN	The collector of the photoelectric transistor and the A-pole of the emission tube
3	PHE	Emitter of phototransistor
4～5	SW	Rubber roller in place detection switch
6～7	VH	Printing power supply
8	DI	Print data input
9	CLK	Print clock input
10～11	P_GND	Printing grounding
12	STB5	The sixth heating allows control of the foot
13	STB4	The fifth heating allows control of the foot
14	STB3	The fourth heating allows control of the feet
15	Vdd	Logic voltage
16	TM	Thermistor terminal
17	STB2	Thermistor terminal
18	STB1	The third heating allows control of the feet
19	AEO2	The second heating allows for control of the feet
20	AEO1	
21～22	P_GND	The first heating allows control of the feet
23	\LAT	Printing grounding
24	DO	Data latch control
25～26	VH	Print Data Output
27	PA	Printing power supply
28	\PA	Stepper motor winding 1 pin 1
29	PB	Stepper motor winding 1 pin 2
30	\PB	Stepper motor winding 2 pin 1



8 Mechanical Design Reference

8.1 Design reference for easy to pack paper structure



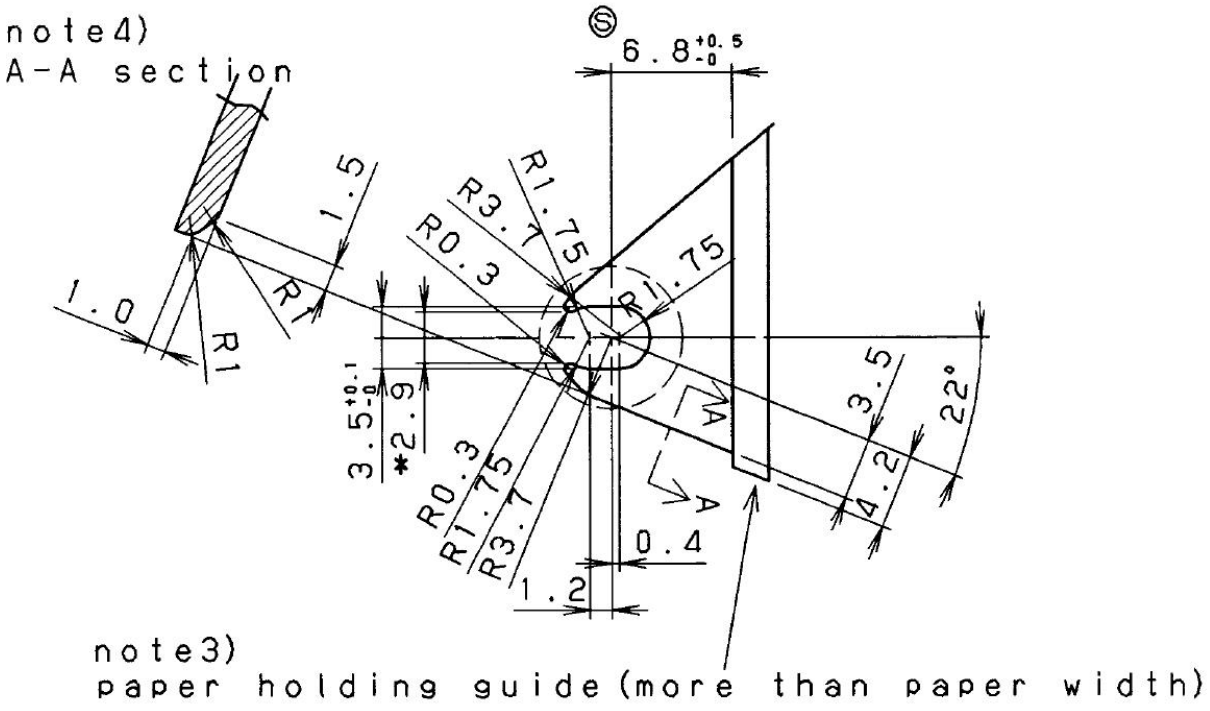
Remarks:

1) The size marked with '*' is the recommended size.

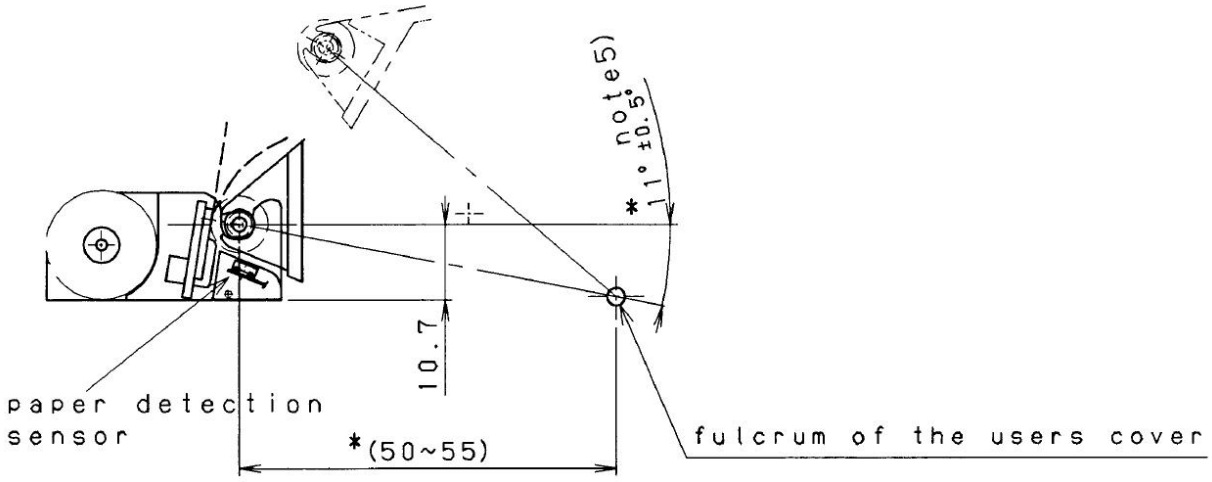
2) The following images shows the center of the printer.

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

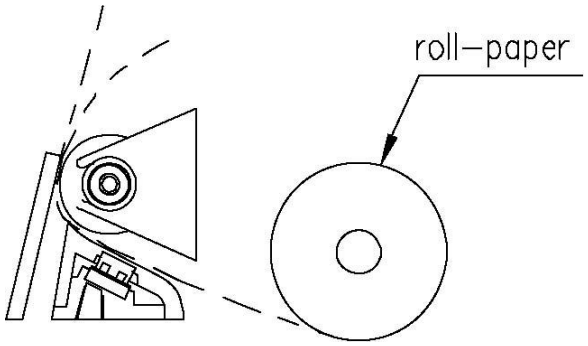
4) The two sides of the easy to pack paper structure need to have guide angles (as shown in the sectional view of Figure A-A below), so that the rubber rollers can be easily removed and installed from the movement during paper loading.



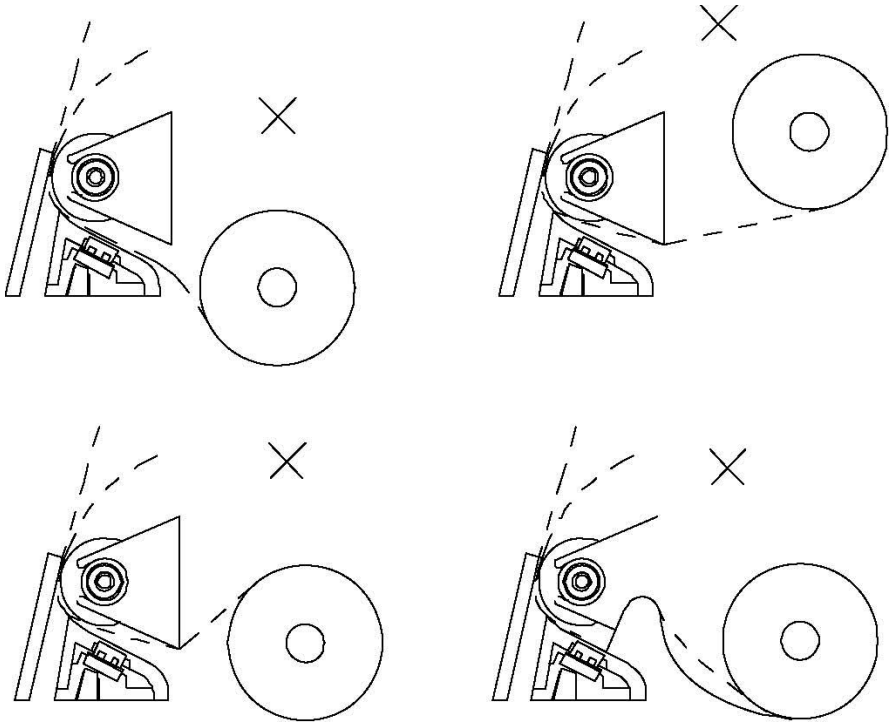
Design reference for the position of the rotating shaft of the easy to pack paper device



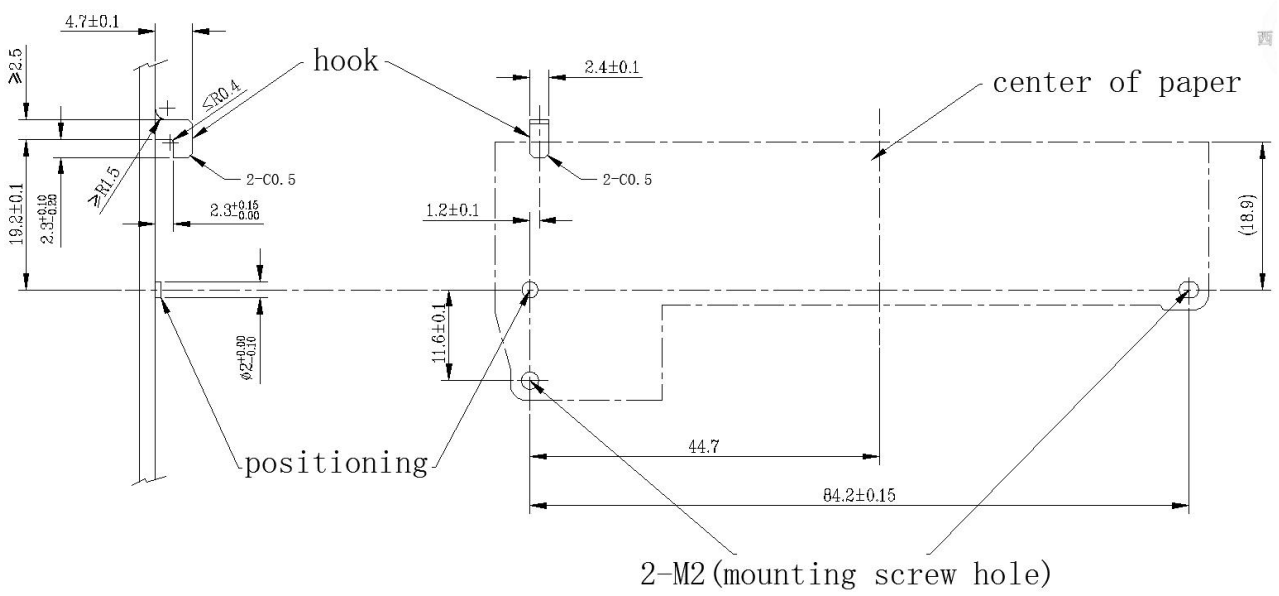
8.2 Paper roll placement position



Wrong installation method:



8.3 Installation dimensions of the mechanism


4.7±0.1
≥2.5
hook
2.4±0.1
center of paper
≤R0.4
2-C0.5
2-C0.5
≥R1.5
19.8±0.1
2.3+0.10 -0.20
2.3+0.15 -0.00
1.2±0.1
(18.9)
11.6±0.1
φ2+0.00 -0.10
positioning
44.7
84.2±0.15
2-M2(mounting screw hole)

8.4 Attached mechanism dimension diagram