YAEN206 *serial*

THERMAL PRINTER MECHANISM

TECHNICAL REFERENCE

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Thermal printer mechanism

YAEN206

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REVISION RECORDS

REV.	DATE	DESCRIPTION	Drawn	Checked	Approved

Contents

Chapter 1 Characters and operating precautions

1.1 Characters

1. Operating voltage range

The range of TPH operating voltage is 3.3～5.5V and the range of logic voltage is 2.7～5.5V.

2. Low volume Compact and light

The mechanism is compact and light, dimensions: 68.5mm (width) * 31mm (depth) * 22.0mm (height).

3. Printing with High resolution

A high-density printer head of 8 dots/mm make the printing clear and precise.

4. High speed printing

According to driving power and sensitivity of thermal paper, set different printing speed required. Max printing speed is 75 mm/ sec.

5. Easy paper loading

Detachable rubber roller structure makes the paper loading easier

6. Low noise

Thermal line dot printing is used to guarantee low-noise printing.

1.2 Operation precautions

1) When handling this printer, because TPH and photo interpreter is sensitive to static electricity, please take any preventive measures against static electricity, such as disposable static wrist strap, in order to prevent damages of inner parts of the printer caused by the static electricity.

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, don't attach any oil or grease and foreign materials on the rubber part.)

3) Never attempt to touch the thermal printer head surface with bear hands. Attaching any oil or grease such as oils from palms on the heating element part of 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 driver.

4) When assembling the platen to the platen retainer of the casing, make sure that the orientation is correct.

5) The thermal head and FPC 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. When connecting FPC, please make it sure under condition that the power of control circuit is off. Plug in / out FPC to control board, should less than 10 times, meanwhile make FPC parallel to connector socket.

6) Do not make FPC bend because it may cause FPC disconnection or broken. If FPC requires to be bent, it will be rework if the bending more than R1.

7) The printer has a structure such that the platen part is removed from the printer 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.

8) Wet paper can make it jammed, pay attention to the following items when using the printer:

*Turn off the power please when it is not used
*Do not load any wet paper please.
* Turn off the power to the head immediately when condensation occurs. Use the head only after the heads 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. Therefore, the environment should be considerably evaluated.

9) To separate the head and the platen after the paper run off, 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 troubles of the printer.

10) 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 75 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.

11) Make sure paper load smooth please.

12) Use high quality thermal paper, for the property of the paper have big effect on printing quality. The perforated paper may cause the damage to the thermal heads and even shorten lifetime.

Chapter 2 Specifications

2.1 General specifications

Printing	Print method	Thermal dot line printing
	Dots per line	384 dots
	Resolution	8 dots/mm
	Print width	48 mm
	Printing Speed(Max)	75mm/s
Paper	Paper width	57±1mm
	Paper feed pitch	0.0625mm
Detection	Head temperature detection	Via thermistor
	Out-of-paper detection	Via photo interrupter
life	Life span (at 25℃ and rated energy) Activation pulse resistance Abrasion resistance	110 million pulses or more (print ratio=12.5%) 50 km or more
Operating Environment	Operating temperature range (℃)	-10～50
	Operating humidity (RH)	20％～85％
	Storage temperature range (℃)	-20～60
	Storage humidity（RH）	5%～90%
Physical Characteristics	W x D x H（mm）	68.5×31.0×22.0mm
	Weight	

2.2 Heat element dimensions

YAEN206 contains a thermal head with 384 heat elements (dot–size)

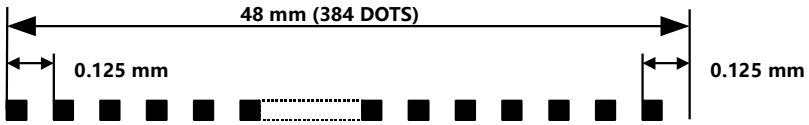


figure 2-1 Heat Element Dimensions

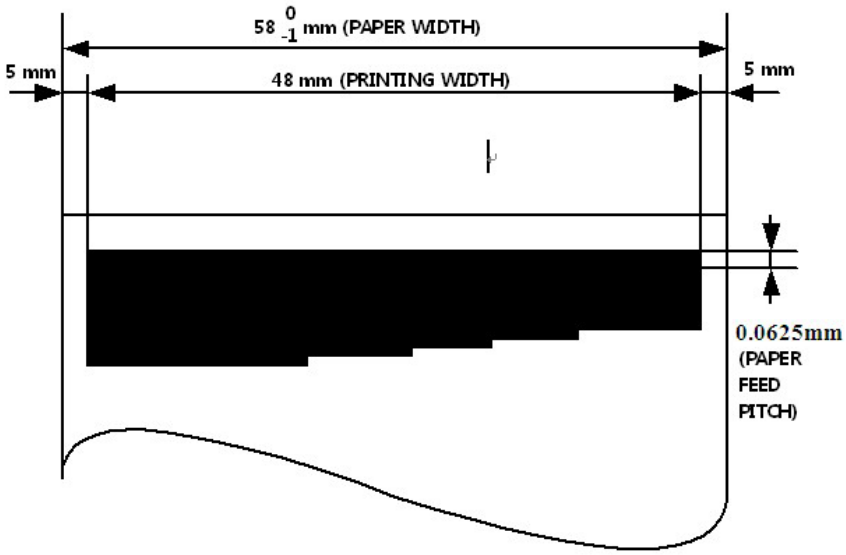


Figure 2-2 Print Area

2.3 Step motor characteristics

2.3.1 Step motor specifications

Item	Specification
Type	PM
Number of phases	2-phase
Excitation	2-2 phase
Winding resistance per phase	19Ω±7%
Rated voltage	5V
Drive frequency	50-1200pps(Depends driving voltage)

2.3.2 Excitation sequence

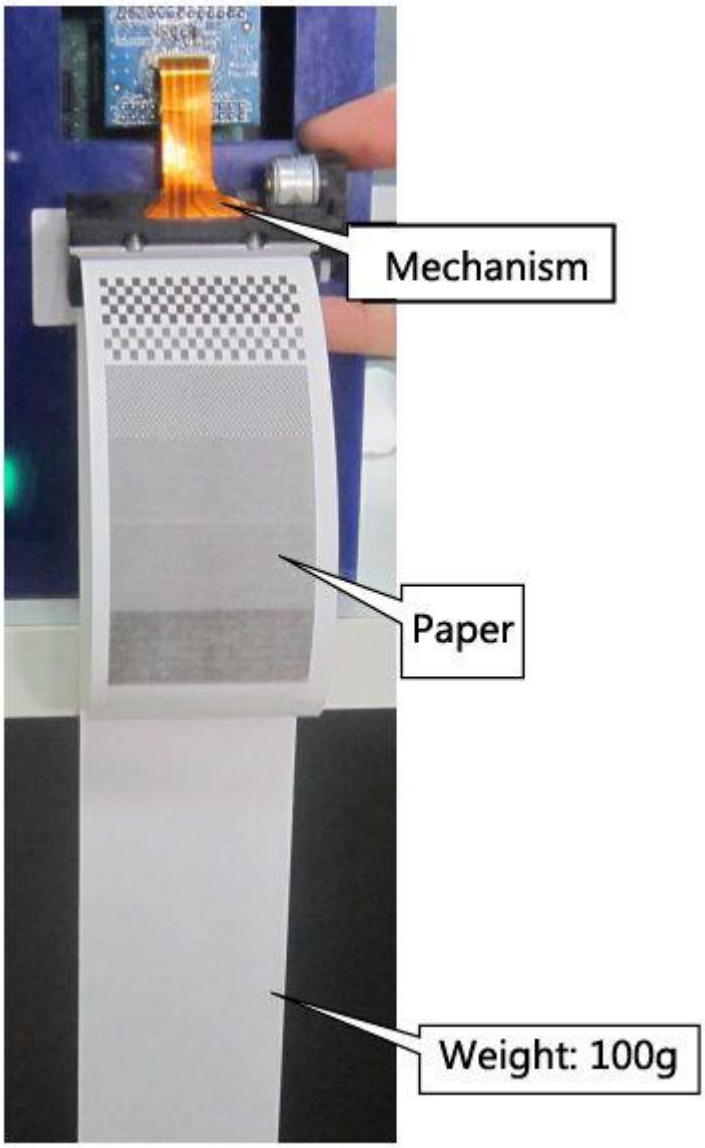
Signal name	Sequence			
	STEP1	STEP2	STEP3	STEP4
A	high	high	low	low
$\overline{A}$	low	low	high	high
B	low	high	high	low
$\overline{B}$	high	low	low	high

2.3.3 Step motor driving

There are two step motor drivings: Constant current driving and constant voltage driving
The advantages and disadvantages of constant current driving and constant voltage driving:

	Constant current driving	constant voltage driving
advantages	1、Overall drive current is relatively small, motor heat is small. 2、Drive noise is small. 3、Power-saving.	1 、 Motor driving force is relatively large 2、Circuit is simple and cheap
disadvantages	1、Motor driving force is relatively small 2、Complex circuit, slightly higher cost	1、Drive current is large, motor heat is large 2、High noise 3、Current consuming

As printer head in use for some time, transmission resistance will increase. In the design, the driving power of motor should have some tolerance which avoid shrink line Recommending when the product design is completed, please test the towing power of motor (as the chart). Under the highest driver frequency, recommend the towing power might not be less than 100grams.



There are two common methods to drive the step motor: 2-2 phase drive (Full Step), 1-2 phase drive (Half Step).

For full step driving, the drive IC charges the two windings in step motor to the predetermined current in sequence. Each plus will drive the motor to rotate with a typical step angle. These methods result in a simple drive circuit and software, but also bigger noise in low speed.

Half step drive is more complicate than full step drive, such as charging on A phase, rotor teeth stop on stator poles, drive receive next pulse, for example, charging B phase and keep A phase in a charging situation, rotor teeth will move half step angle, stop in the middle of two nearby whole step. This can make the case without changing the motor, stepper motor angular resolution doubling. In this drive way, two phases may need to be energized, with the motor driving IC, control each step of each phase in the ratio of the current state; it can make the motor run quieter. But it also improves the complexity of control software to some extent.

Timing table of motor driving

STEP	Time(ms)	STEP	Time(ms)
1	2.890	10	0.687
2	1.786	11	0.651
3	1.381	12	0.621
4	1.157	13	0.600
5	1.014	14	0.572
6	0.914	15	0.552
7	0.838	16	0.533
8	0.777	17	0.516
9	0.728	18	0.500

2.4 Thermal head specifications

2.4.1 General characteristics

Item	Specification
Print width	48 mm
Number of heater elements	384 dots
Heater resolution	8 dots/mm
Heater pitch	0.125 mm
Heater resistance	$\overline{R}$ =176 Ω ±3%
Number of data inputs	1 serial input
Logic signals	1 STROBE and 1 LATCH

2.4.2 Maximum parameter

Parameter	Symbol	Specification	Note
Heater energy consumption	Eo max	2.5 ms/line 0.19 mJ/dot	Ta=25℃
Head voltage	VH max	5.5 V	TPH Connector
Logic voltage	VDD max	5.5V	
Number of heating dots simultaneously ON	Ndot max	96 dots	
Operating temperature*	Ta	-5 ℃ ～ +50 ℃	Non-condensing
Storage temperature		-40 ℃ ～ +80 ℃	
Operating humidity*		10～90%RH	Non-condensing
Storage humidity		5～90 %RH	
Maximum operating temperature	Ts	Continuous:65° C 30min. MAX. Peak75° C Thermistor temp.	Printing must be stopped, and wait until 60° C

NOTE:On the above conditions,TPH can’t ensure the printing quality and life.

*:In the temperature which is out of range(+5° C~+40 ° C),it will influence the printing quality.

2.4.3 Characteristics recommended

Item		Symbol	Recommended conditions		Note
Printing speed			2.5 ms/line	1.25 ms/line	
Heater power consumption		Po	0.238W/dot	0.336 W/dot	$\overline{R}$ =176Ω
Heat voltage		VH	7.2V	8.5V	Connect both sides
Supply energy	5℃	Eo (ts)	0.20mJ/dot(0.84ms)	0.17mJ/dot(0.51ms)	$\overline{R}$ =176Ω See 2.4.7
	25℃		0.18mJ/dot(0.76ms)	0.14mJ/dot(0.42ms)	
	40℃		0.16mJ/dot(0.67ms)	0.13mJ/dot(0.39ms)	
Supply current		Io	36.8mA/dot	43.7mA/dot	

2.4.4 Electrical characteristics

1) Limited parameter

Item	Symbol	Text condition	Rated value	Rated value
Supply voltage	VDD	Surge	0~5.5	V
	VH	Surge	0~6	V
Logic input voltage	VIN		0～VDD+0.3	V
Drive supply current	Ih		70	mA

2) Recommended parameter

Item	Symbol	Text condition	Reference			Unit
			Min.	Typ.	Max.	
Supply voltage	VDD		2.7	3.0	5.5	V
	VH		—	3.3	5.5	V
Logic input voltage	VIH		0.7*VDD	—	VDD	V
	VIL		0	—	0.3*VDD	V
Clock frequency	fclk	Duty 50%	—	—	5	MHz

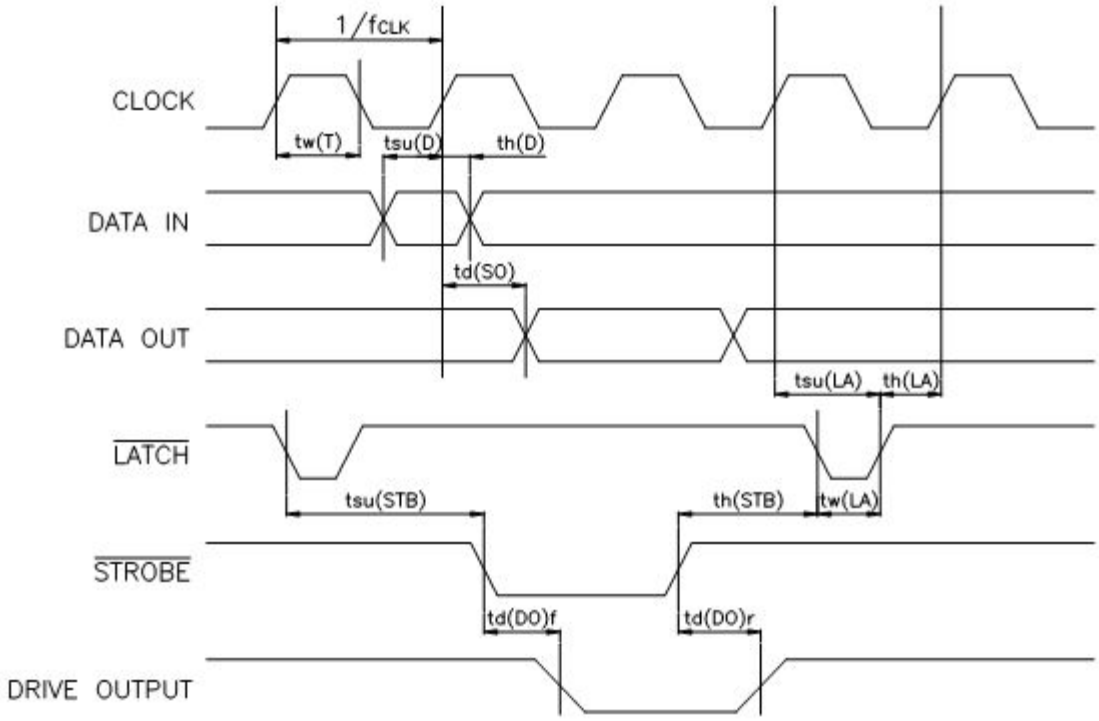
3) Electrical characteristics

Item		Symbol	Test conditions	Min.	Typ.	Max.	Unit
Logic input current	$\overline{LATCH}$	I_{IH}	VDD=3.0V VIH= 3.0V	-	-	4.0	μA
	$\overline{STROBE}$			-	-	4.0	
	CLOCK			-	-	4.0	
	DATAIN			-	-	4.0	
	$\overline{LATCH}$	I_{IL}	VDD=3.0V VIL=0V	-240	-	-	μA
	$\overline{STROBE}$			-240	-	-	
	CLOCK			-4.0	-	-	
	DATAIN			-1.0	-	-	
Drive output voltage(Low)		V_{DOL}	VDD=3V IDOL=50mA	-	0.3	0.6	V
Drive Leak current		I_{LEAK}	VDD=3V IDOL=50mA	-	0	1.0	μA/dot
Logic supply current		IDD	fCLK=2MHz DI=1/2fCLK	-	20	40	mA

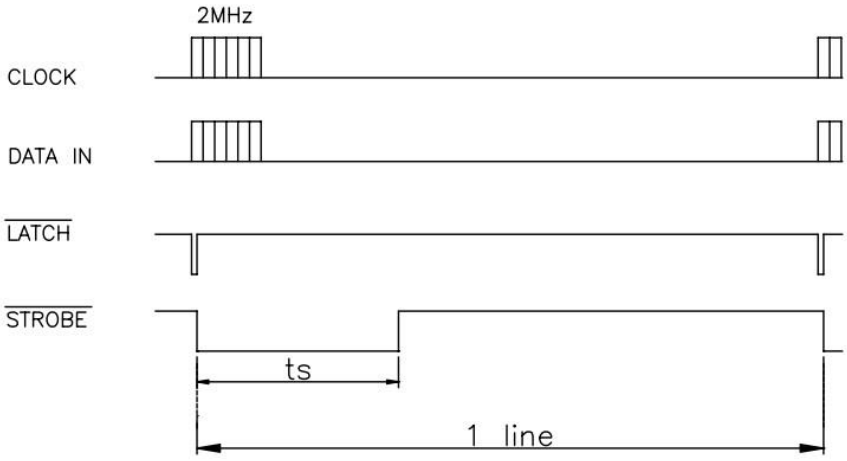
Note：Each STROBE includes pull-up resistance of 75KΩ ±50% per IC.

2.4.5 Timing characteristics

Parameter	Symbol	Ratings			
		Min.	Typ.	Max.	unit.
Clock frequency	f_{CLK}	-	-	5	MHZ
Clock pulse width	$t_w(T)$	70	-	-	ns
Data setup time	$t_{su}(D)$	40	-	-	ns
Data hold time	$t_h(D)$	40	-	-	ns
Latch setup time	$t_{su}(LA)$	100	-	-	ns
Latch pulse width	$t_w(LA)$	100	-	-	ns
Latch to Strobe setup time	tsu(STB)	100	-	-	ns
Strobe to Latch setup time	th(STB)	10	-	-	ns
Clock to Data out delay time	$t_d(SO)$	-	-	120	ns
Strobe to driver Output delay time	$t_d(DO)r$	-	-	60	μs
	$t_d(DO)f$	-	-	15	μs



2.4.6 Timing chart



*: While printing, data transmission is possible

2.4.7 Equation:

Calculate the printing energy using this equation：

$$E_O = I_o^2 \overline{R} t_s = \frac{(VH - V_{com})^2 \cdot \overline{R} \cdot t_s}{(\overline{R} + R_{ic})^2}$$

R_{ic} =11.7Ω : Driver IC “ON” resistance

t_s : Strobe pulse width

VH : Head voltage

$\overline{R}$: Heater average resistance

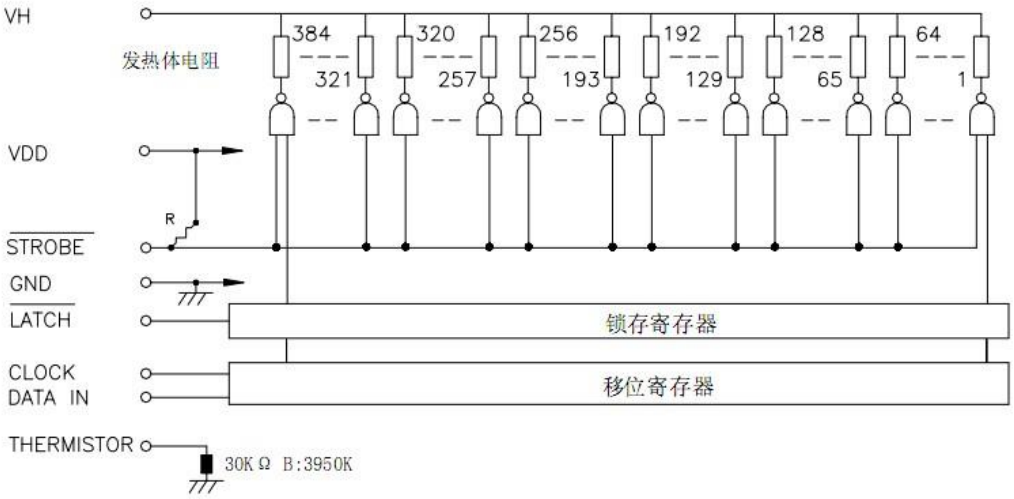
V_{com} =0.3 V

2.4.8 Thermistor resistance

R_{25} = 30KΩ±5%, B $_{CONST}$= 3950kelvin±3%, $R = R_{25}e^{B(1/T-1/T_{25})}$

Temperature (° C)	Thermistor Resistance (R)		
	Min.(KΩ)	Typ.(KΩ)	Max.(KΩ)
-40	717	843	989
-35	535	623	723
-30	405	466	535
-25	308	352	400
-20	238	269	303
-15	185	208	232
-10	145	161	178
-5	113	124	137
0	88.7	96.8	105
5	69.9	75.7	81.7
10	55.4	59.5	63.8
15	44.1	47.1	50.1
20	35.4	37.5	39.6
25	28.5	30	31.5
30	22.8	24.2	25.5
35	18.3	19.6	20.8
40	14.9	15.9	17.1
45	12.1	13.1	14.1
50	9.92	10.8	11.7
55	8.16	8.91	9.7
60	6.76	7.41	8.12
65	5.62	6.2	6.83
70	4.7	5.21	5.77
75	3.95	4.4	4.9
80	3.34	3.74	4.18

2.4.9 Structure figure



STROBE No.	Dot No.	Number of Dots
1	1 ~ 384	384

2.4.10 Operating precautions

In order to prevent the printer head does not appear hot spot overheating and burned up phenomenon, when we designing products, need to pay attention to several points as follows:

In hardware terms:

1. When the power on, the order should be VDD-VH.
2. When the power is on or stand by, make sure that the STROBE signal is in invalid state.
3. Make sure if program is abnormal (such as system halted), VH voltage should be shut off automatically.
4. During the printing, Detecting thermistor temperature, make sure that the thermal printer head (TPH) is not overheated.

In software terms:

1. STROBE time should not be too long.
2. In the following two cases, do not start:
   ① when the motor is stationary; ② When the paper is out.
3. When the power is on or completed each printing task, it is recommended to send data to the printer blank line, so it can protect when some hardware failure on the control board will not damage the printer.
4. Over-temperature protection:The printer stops working when heating temperature greater than 75℃,and start working again when the temperature reached 60℃.

2.5 Pin assignment

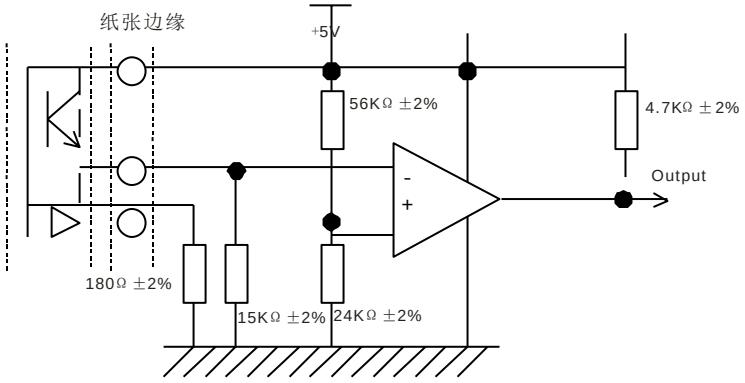
NO.	Signal name
1	VH
2	VH
3	VH
4	DATA IN
5	CLOCK
6	GND
7	GND
8	GND
9	VDD
10	$\overline{\text{STROBE}}$
11	THERMISTOR
12	GND
13	GND
14	GND
15	$\overline{\text{LATCH}}$
16	VH
17	VH
18	PS
19	GPS
20	VPS
21	A
22	$\overline{\text{A}}$
23	B
24	$\overline{\text{B}}$

2.6 Photo interpreter specification

TMP206 has a reflexive sensor. These two situations might destroy the reflection, and output the high level: Platen released or paper out. As follows:

When everything is normal, the sensor will output low level. The circuit driver of opto detection as follows: The logic voltage could be 3.3V or 5V.

When the paper out or platen released, do not start printer.



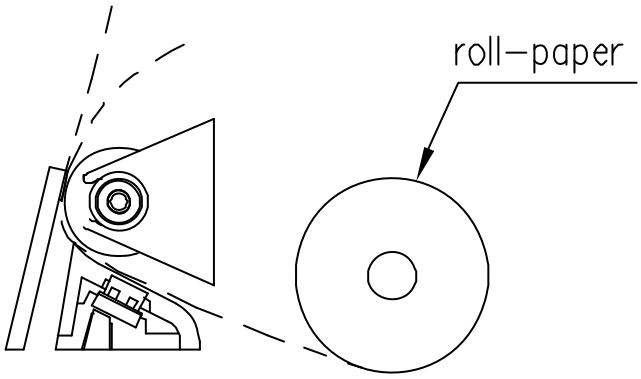
Electro-Optical Characteristics (Ta=25℃)

Parameter		Symbol	Number			Unit	Condition
			Min.	Typ.	Max.		
Input	Forward Voltage	V_F	---	1.2	1.4	V	I_F=20mA
	Reverse Current	I_R	---	---	10	μA	V_R=5V
Output	Collector-Emitter Voltage	BV_{CEO}	30	---	----	V	I_C=0.5mA
	Emitter-Collector Voltage	BV_{ECO}	5	---	---	V	I_E=0.1mA
	Dark Current	I_{CEO}	---	1	100	nA	V_{CE}=10V
Transfer Characteristics	Light Current	I_C(ON)	100	380	750	μA	V_{CE}=2V I_F=2mA
	Leakage Current	I_{CEOD}	---	---	20		
	Rise time	t_r	---	30	100	μsec	V_{CE}=2V I_C=100μA R_L=1KΩ
	Fall time	t_f	---	25	100	μsec	

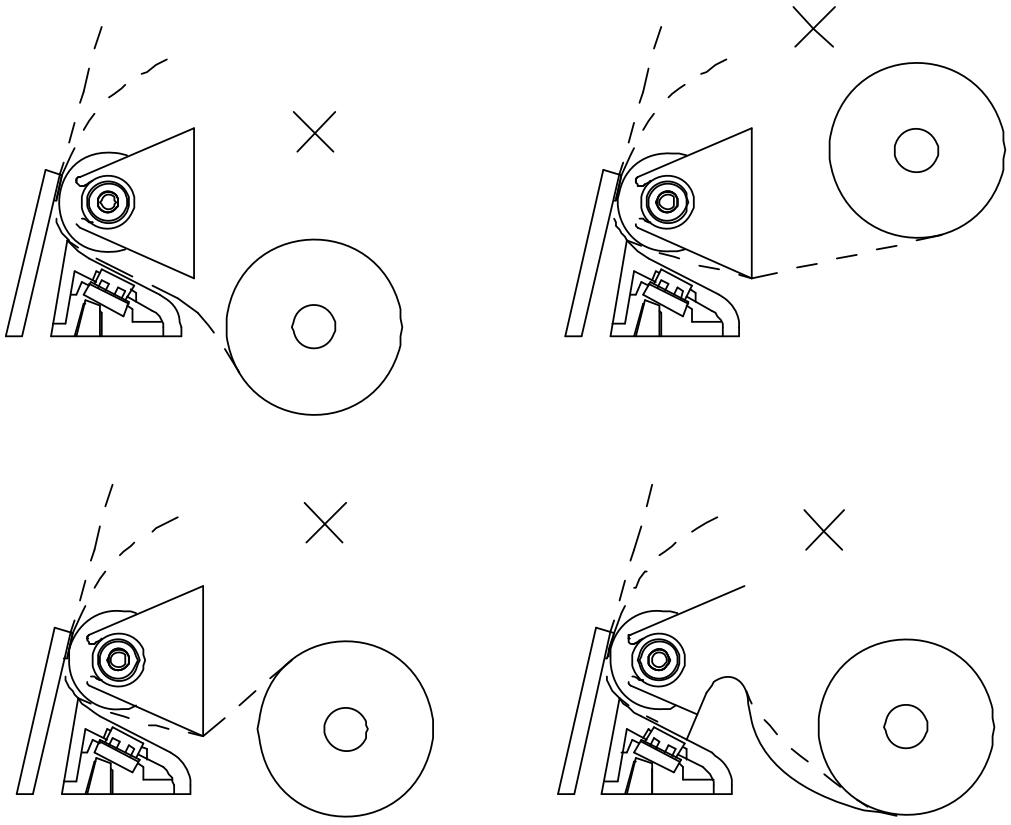
Chapter 3 Casing design guide

3.1 Thermal printer mechanism structure dimensions

3.1.1 Roll-paper mounting position

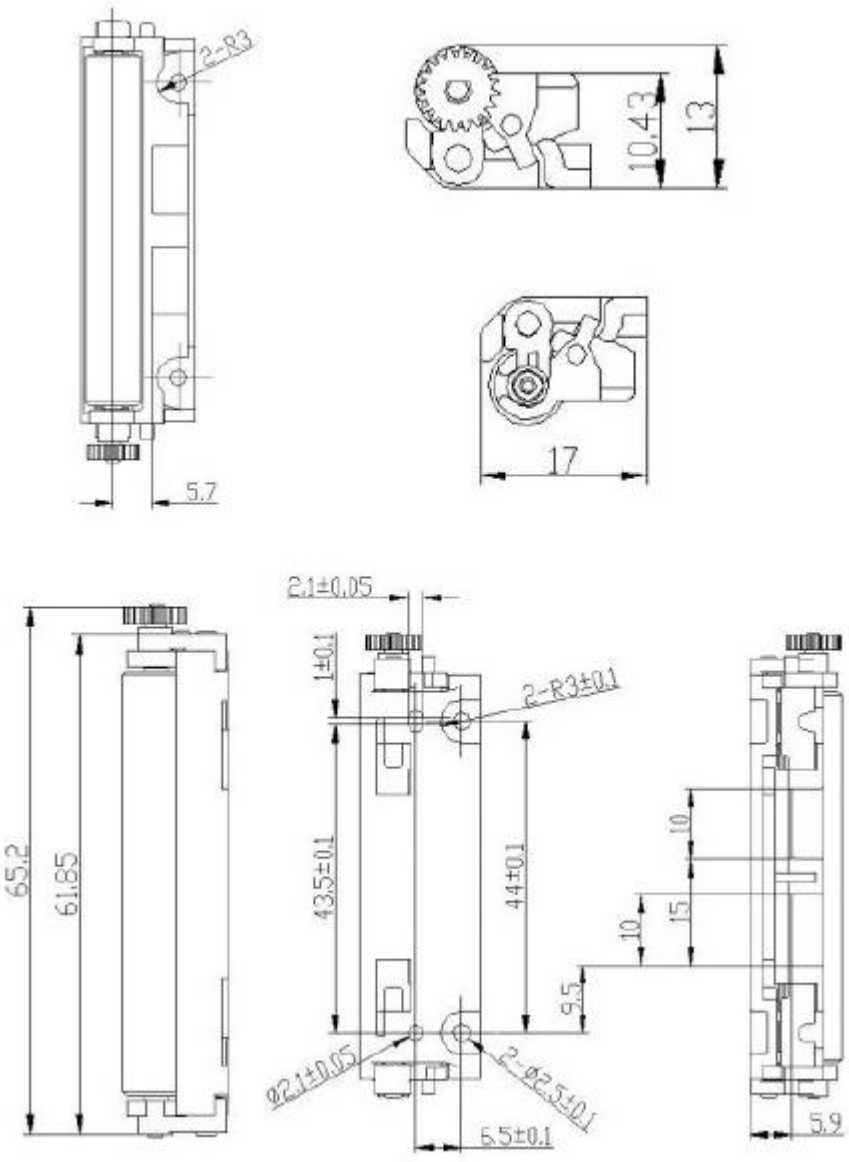


Wrong mounting

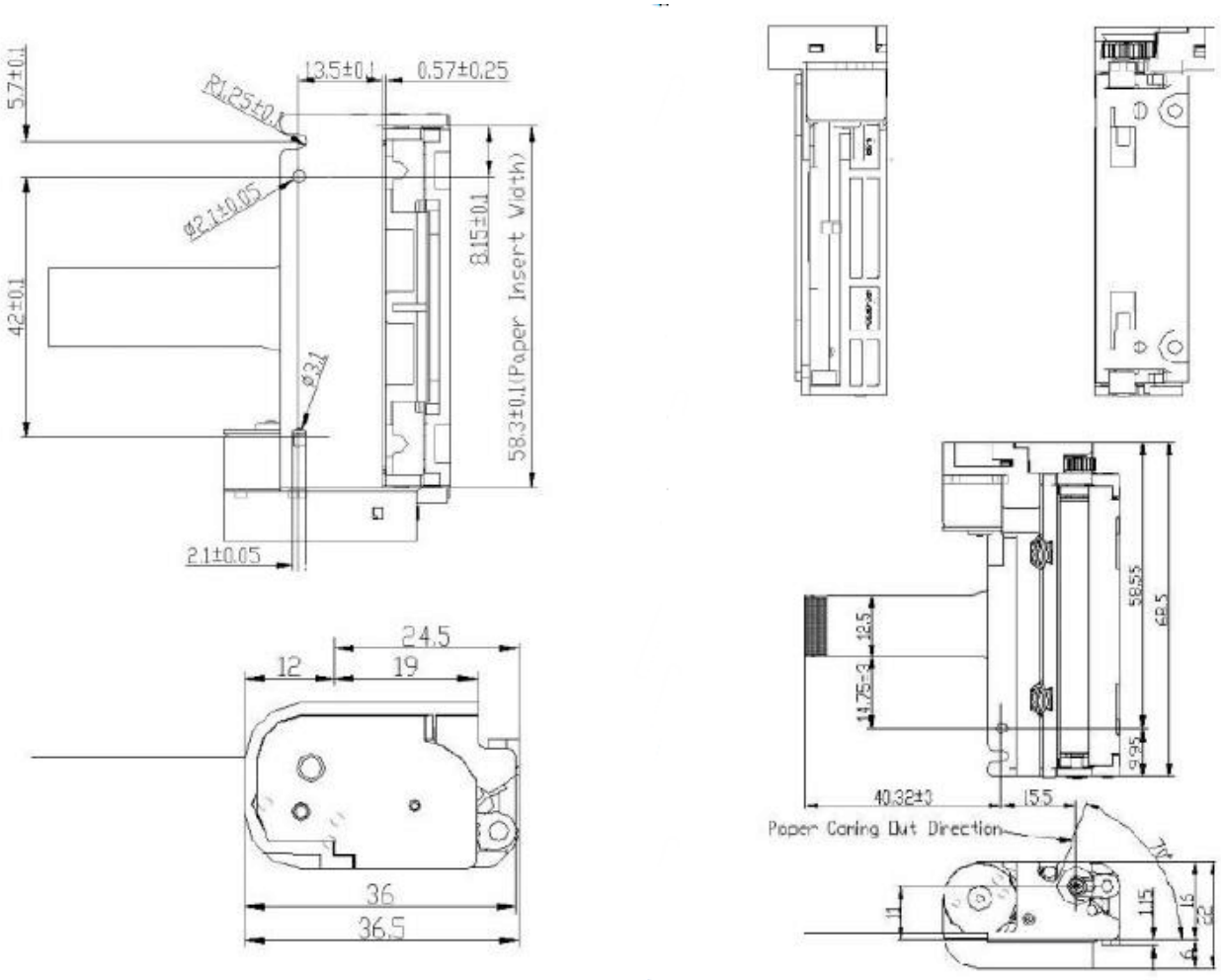


3.1.2 Platen structure dimensions.

[Unit：mm]



3.1.3 Overall dimensions



3.2 DEMO circuit figure