YAEN201 *serial*

THERMAL PRINTER MECHANISM

TECHNICAL REFERENCE

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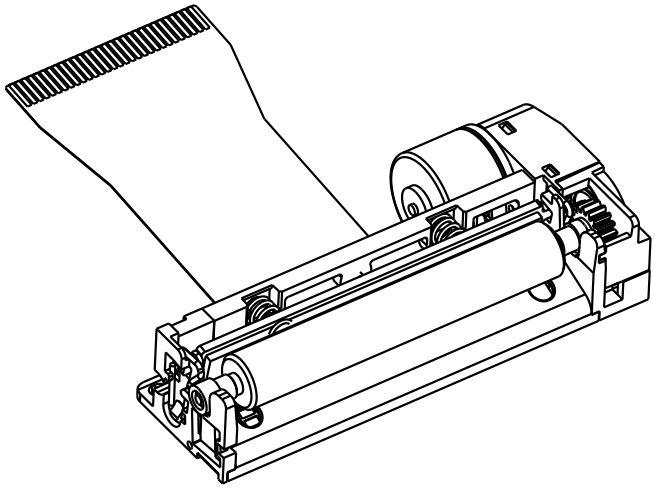
Thermal printer mechanism

TMP 201



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REVISION RECORDS

REV.	DATE	DESCRIPTION	Drawn	Checked	Approved

Contents

Chapter 1 Characters and operating precautions

1. Characters

1. Low voltage supply

The voltage used to drive the thermal printer head is equal to the logic voltage, or is driven by a 5 V single power line, the range of operating voltage is 4.2V-8.5V, so four to six NI-Cd batteries or Ni-MH batteries can also be used. Two li-ion batteries can be used.

2. Low volume Compact and light

The mechanism is compact and light, dimensions: 67.3mm (width) * 31.5mm (depth) * 18.5mm (height).

3. Printing with High resolution

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

4. High speed printing

According to driving power and sensitivity of thermal paper, setting different printing speeds are required. Max printing speed is 80 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.

2. Operation precautions

2.1 When handling this printer, for 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.

2.2 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.)

2.3 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.

2.4 When assemble the platen to the platen retainer of the casing, make sure that the orientation is correct.

2.5 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.

2.6 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.

2.7 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.

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

2.8.1Turn off the power please when it is not used
2.8.2 Do not load any wet paper please.
2.8.3 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.

2.9 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.

2.10 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.

2.11 Make sure paper load smooth please.

2.12 Use the 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	Printing Method	Thermal
	Number of Dots	384 dots/line
	Resolution	8 dots/mm (203dpi))
	Printing Speed (max)	80mm/s
	Printing Width	48mm
Paper	Paper Width	58mm
	Paper Thickness	60~100μm
	Paper Loading	Easy paper loading
Life	Printer head	More than 50km
	Pulse activation	110M pulse
Detection	Head Temperature	Thermister
	Paper End /Head Position	Photo interrupter
Operating Environment	Operating Temperature	0°C~ 50°C
	Storage Temperature	- 20°C~ 60°C
	Operating Humidity	20~ 85% RH
	Storage Humidity	10~ 90% RH
Physical Characteristics	Weight	45g
	Dimension(W*D*H)	67.3×31.5×18.5mm

2.2 Heat element dimensions

YAEN201 contains a thermal head with 384 heat elements (dot–size)

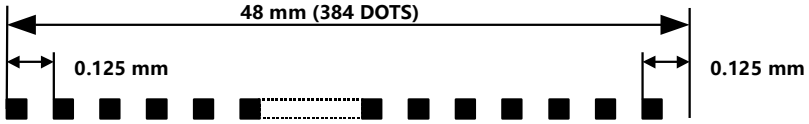


figure 2-1 Heat Element Dimensions

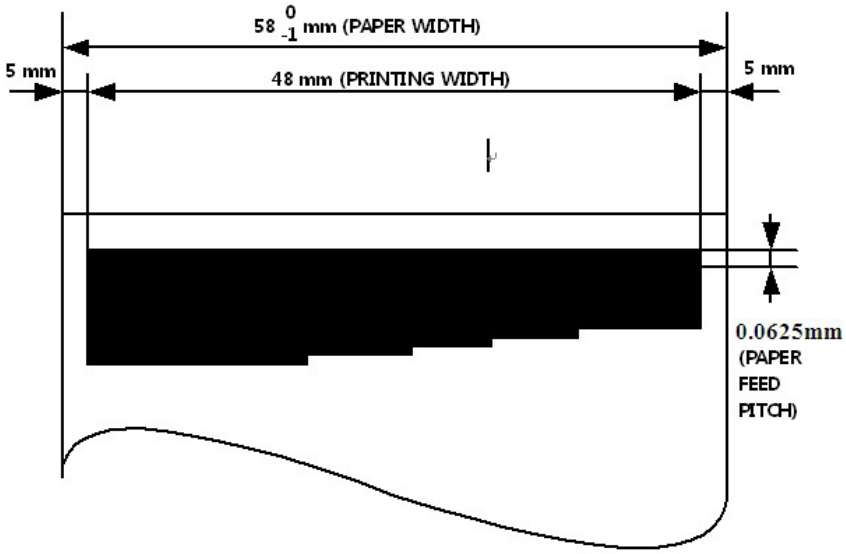


Figure 2-2 Print Area

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	10Ω±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

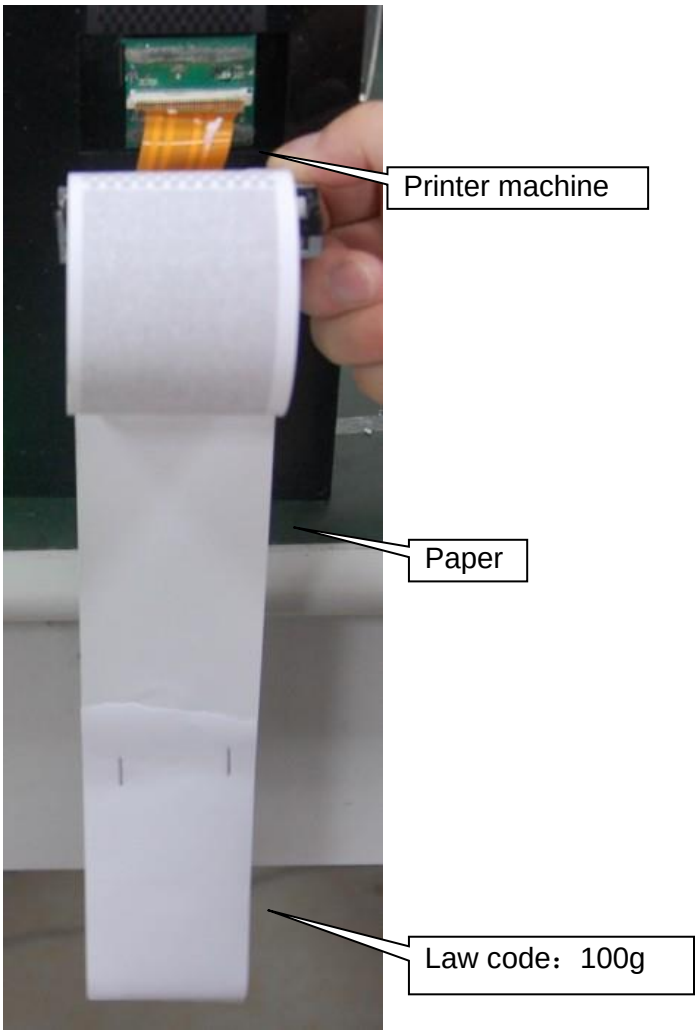
2.3.3 Step motor driving

There are two step motors driving: 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	Note
Print width	48 mm	

Number of heater elements	384 dots	
Heater resolution	8 dots/mm	
Heater pitch	0.125 mm	
Printed dot dimension	0.11mm×0.13 mm	
Heater resistance	$\overline{R}$ =176 Ω ±3%	
Number of data inputs	1 serial input	Data In
Logic signals	6 STROBE and 1 LATCH	
Logic power supply	5.0 V × 60 mA	At 8 MHz
Heater print voltage	8.5V	
Specification for Thermistor	R_{25}=30K Ω ±5%,B=3,950K±3%	See 2.4.8

2.4.2 Maximum parameter

Parameter	Symbol	Specification		Note
Heater energy consumption	Eo max	2.5 ms/line	1.25 ms/line	Ta=25℃
		0.26 mJ/dot	0.20 mJ/dot	
Head voltage	VH max	10 V		Between Connectors
Logic voltage	VDD max	5.5V		
Number of heating dots simultaneously ON	Ndot max	192 dots		
Operating temperature	Ta	-5 ℃ ～ +50 ℃		
Storage temperature		-40 ℃ ～ +80 ℃		Non-operating
Operating humidity		10～90%RH		Non-condensing
Storage humidity		5～90 %RH		

2.4.3 Characteristics recommended

Item		Symbol	Recommended conditions		Note
Print Speed			2.5 ms/line	1.25 ms/line	
Heater power consumption		Po	0.238W/dot	0.336W/dot	$\overline{R}$ =176Ω
Heat voltage		VH	7.2V	8.5V	Between Connectors
Heater energy consumption	5℃	Eo (ts)	0.20mJ/dot(0.77ms)	0.17mJ/dot(0.47ms)	$\overline{R}$ =176Ω See 2.4.7
	25 ℃		0.18mJ/dot(0.70ms)	0.14mJ/dot(0.39ms)	
	40 ℃		0.16mJ/dot(0.62ms)	0.13mJ/dot(0.36ms)	
Supply current		Io	36.8mA/dot	43.7mA/dot	

2.4.4 Electrical characteristics

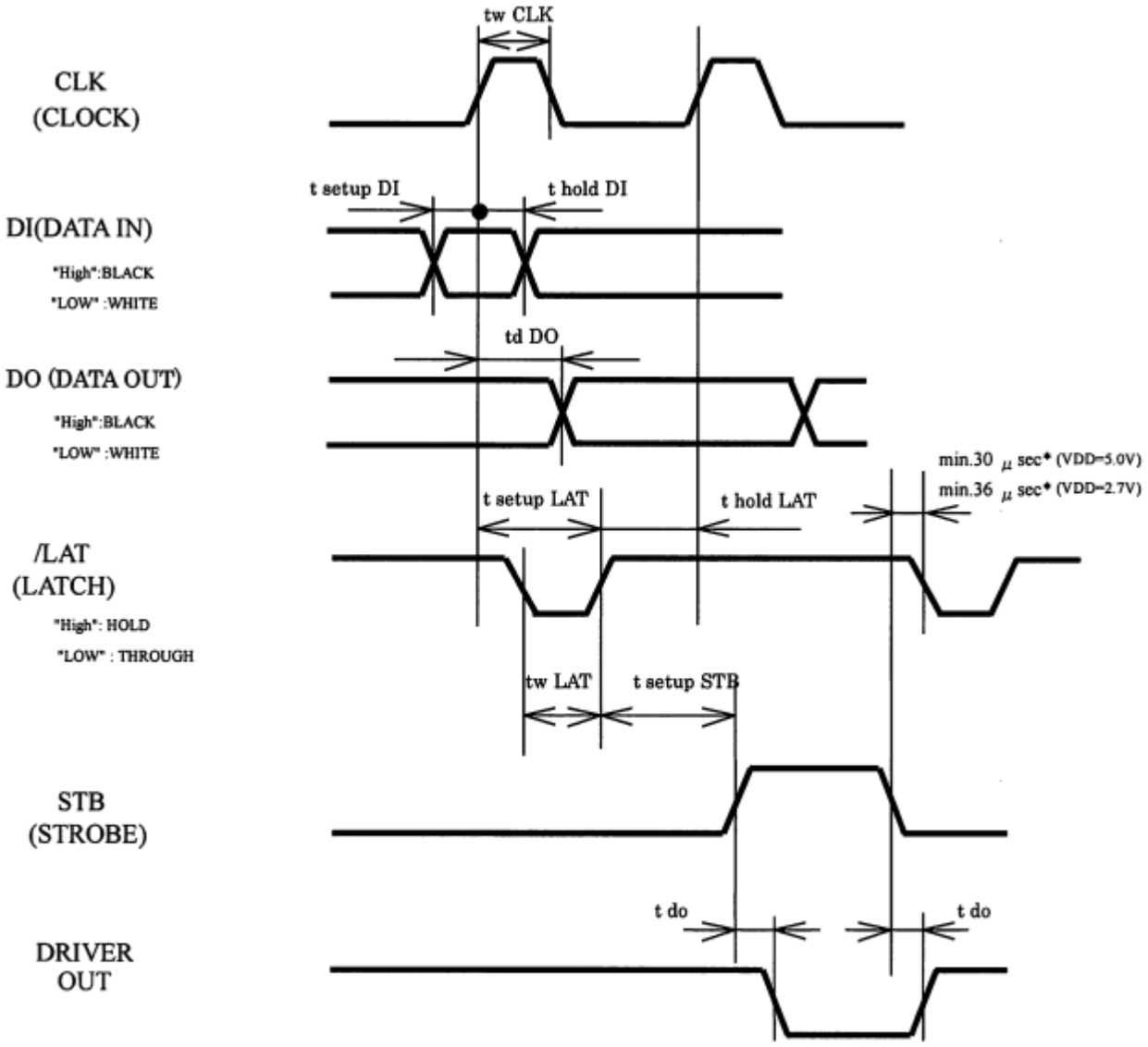
Parameter		Symbol	Test conditions	Min.	Typ.	Max.	Unit
Supply voltage		VH		——	——	8.5	V
		VDD		2.7	5.0	5.25	V
Input voltage for logic		V_{IH}		0.8 VDD		VDD	V
		V_{IL}				0.2 VDD	V
Clock frequency		f_{CLK}	Duty50%			10	MH_Z
Input current	LATCH	I_{IH}	V_{IH}=VDD			3.0	μA
	STROBE					55	
	CLOCK					3.0	
	DATAIN					0.5	
	LATCH	I_{IL}	V_{IL}=GND	-330			μA
	STROBE			-0.5			
	CLOCK			-3.0			
	DATAIN			-0.5			
Output voltage of drivers (Heater supply voltage)		V_{OL}	VDD=3V I_{OL}=60mA		0.7	0.9	V
Leak current of drivers		I_{LEAK}	V_{OH}=8V			1.0	μA/dot
Logic supply current		I_{dd}	f_{CLK}=8MHz DI=1/2f_{CLK}		21	60	mA
Logic supply current (Non-Operation)		Is	DATA IN/CLOCK = GND Other logic signal open			25	μA

Note： Each STROBE includes pull-down resistance of 300KΩ±50%.

2.4.5 Timing characteristics

Parameter	Symbol	Ratings			
		Min.	Typ.	Max.	unit.
Clock frequency	f_{CLK}			10	MHZ
Clock pulse width	t_w(T)	50			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	t_{su}(STB)	100			ns
Strobe to Latch setup time	t_h(STB)	100			ns
Clock to Data out delay time	t_d(SO)			70	ns
Strobe to driver Output delay time	t_d(DO)r			13.0	μs
	t_d(DO)f			13.0	μs

2.4.6 Timing chart



*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).

2.4.7 Equation:

Calculate the printing energy using this equation：

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

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

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)

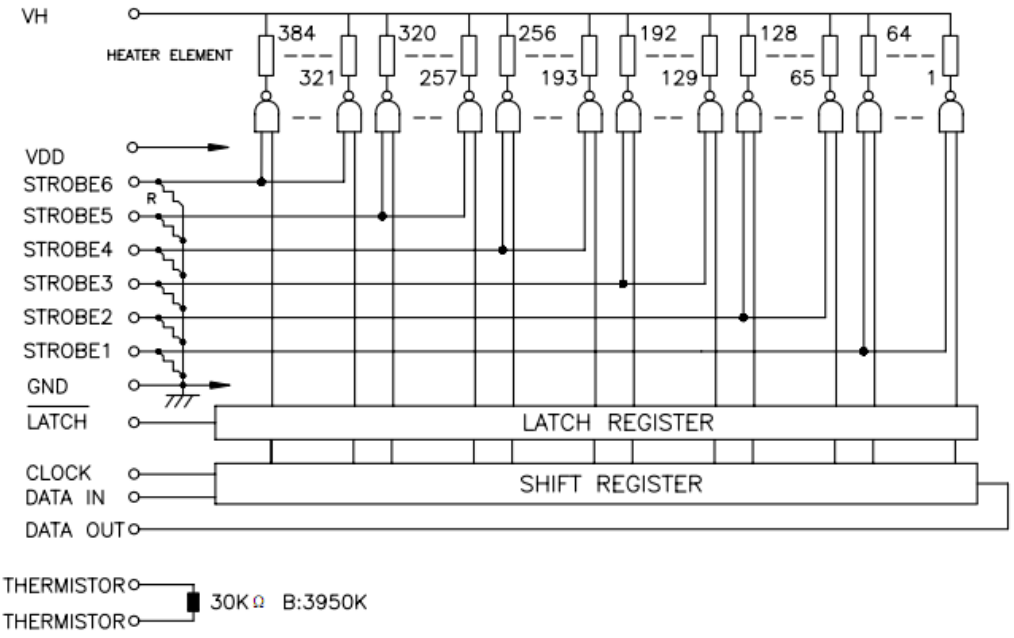
*3 R_{res}: Heater resistance, R_{lead}: Lead resistance

2.4.8 Thermistor resistance

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 ~ 64	64
2	65 ~ 128	64
3	129 ~ 192	64
4	193 ~ 256	64
5	257 ~ 320	64
6	321 ~ 384	64

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:

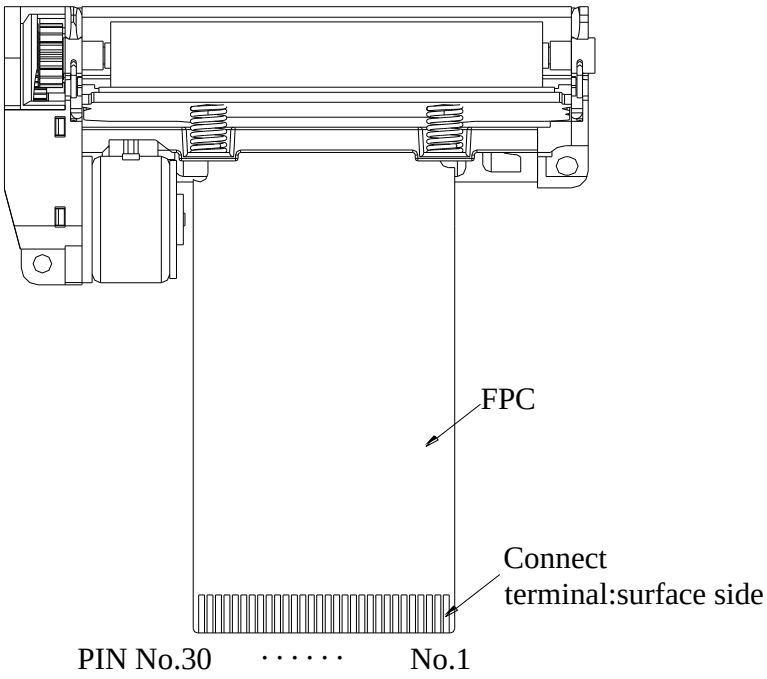
1. When the power on, the order should be VDD-VH.
2. When the power is on or stand by, make sure that the STROBE signal is in invalid state.
3. Make sure if program is abnormal (such as system halted), VH voltage should be shut off automatically.
4. During the printing, Detecting thermistor temperature, 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.

2.5 Pin assignment

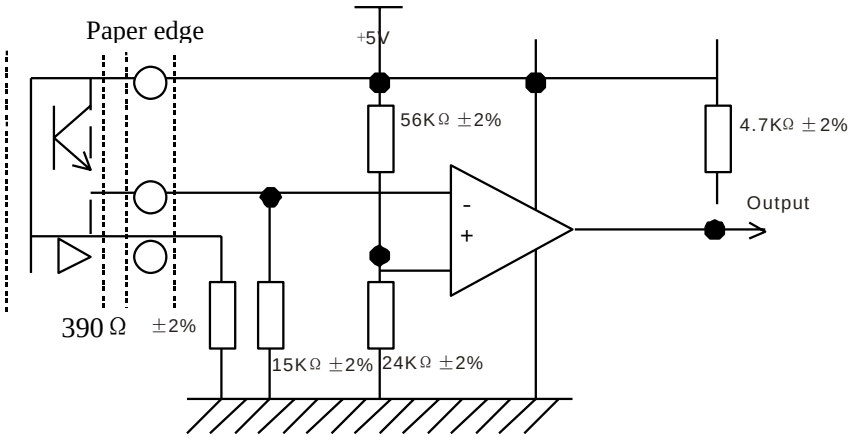
No.	Signal name	Description
1	PHK	Cathode for photo interruptor
2	VSEN	Paper sensot power
3	PHE	Emittor for photo interruptor
4	N.C(101)SW1(103)	Platen release switch
5	N.C(101)SW2(103)	Platen release switch
6	VH	Head drive power
7	VH	Head drive power
8	DI	Data in
9	CLK	Aynchronous clock for communication
10	GND	Ground power supply for thermal head
11	GND	Ground power supply for thermal head
12	STB6	Thermal head energizing control signal
13	STB5	Thermal head energizing control signal
14	STB4	Thermal head energizing control signal
15	VDD	Logic power
16	TM	Thermally sensitive resistor input terminal 1
17	TM	Thermally sensitive resistor input terminal 2
18	STB3	Thermal head energizing control signal
19	STB2	Thermal head energizing control signal
20	STB1	Thermal head energizing control signal
21	GND	Ground power supply for thermal head
22	GND	Ground power supply for thermal head
23	/LAT	Data latch
24	DO	Data out
25	VH	Power supply for thermal head
26	VH	Power supply for thermal head
27	MT/A	Stepping motor excitation signal
28	MT/$\overline{A}$	Stepping motor excitation signal
29	MT/B	Stepping motor excitation signal
30	MT/$\overline{B}$	Stepping motor excitation signal



2.6 Photo interpreter specification

YAEN201 has one opto sensor, it performs dual functions - door open and end of paper detection. The opto sensor is designed in a way that as soon as the door is opened, the distance between the paper and the sensor increases, and this causes the end of paper sensor is to trigger. Arrange the circuitry so that no energy is applied to the head when there is no paper. If the head is energized when there is no paper and the head is in the down position, then both roller and head may be strongly damaged.

One possible interface as following:



Electro-Optical Characteristics (Ta=25℃)

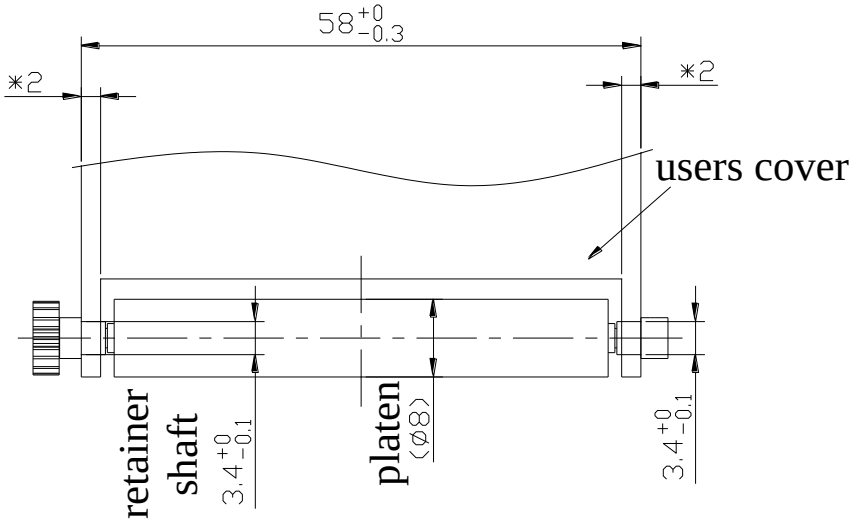
Parameter		Symbol	Min	Typ.	Max.	Unit	Conditions
Input	Forward oltage	V_F	---	1.2	1.6	V	I_F=20mA
	Reverse Current	I_R	---	---	10	μA	V_R=5V
Output	Collector-Emitter Voltage	BV_{CEO}	30	---	----	V	I_C=0.5mA
	Emitter-Collector Voltage	BV_{ECO}	5	---	---	V	I_E=0.1mA
	Dark Current	I_{CEO}	---		100	nA	V_{CE}=10V
	C-E Saturation Voltage	$VCE_{(SAT)}$	---	---	0.4	V	I_C=2mA E_e=1mW/cm^2
Transfer Characteristics	Light Current	IC(ON)	180	---	440	μA	V_{CE}=5V I_F=10mA
	Leakage Current	ICEOD	---	---	1		
	Rise time	tr	---	20	---	μsec	V_{CE}=2V I_C=100μA R_L=1KΩ
	Fall time	tf	---	20	---	μsec	

Chapter 3 Casing design guide

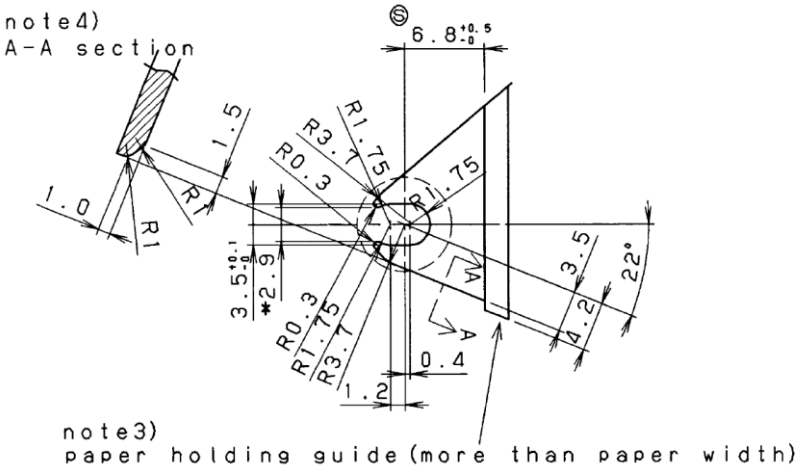
3.1 Thermal printer mechanism structure dimensions

3.1.1 Easy paper loading dimensions

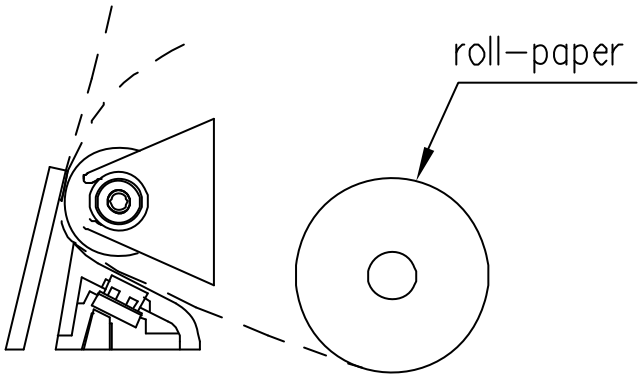
[Unit：mm]



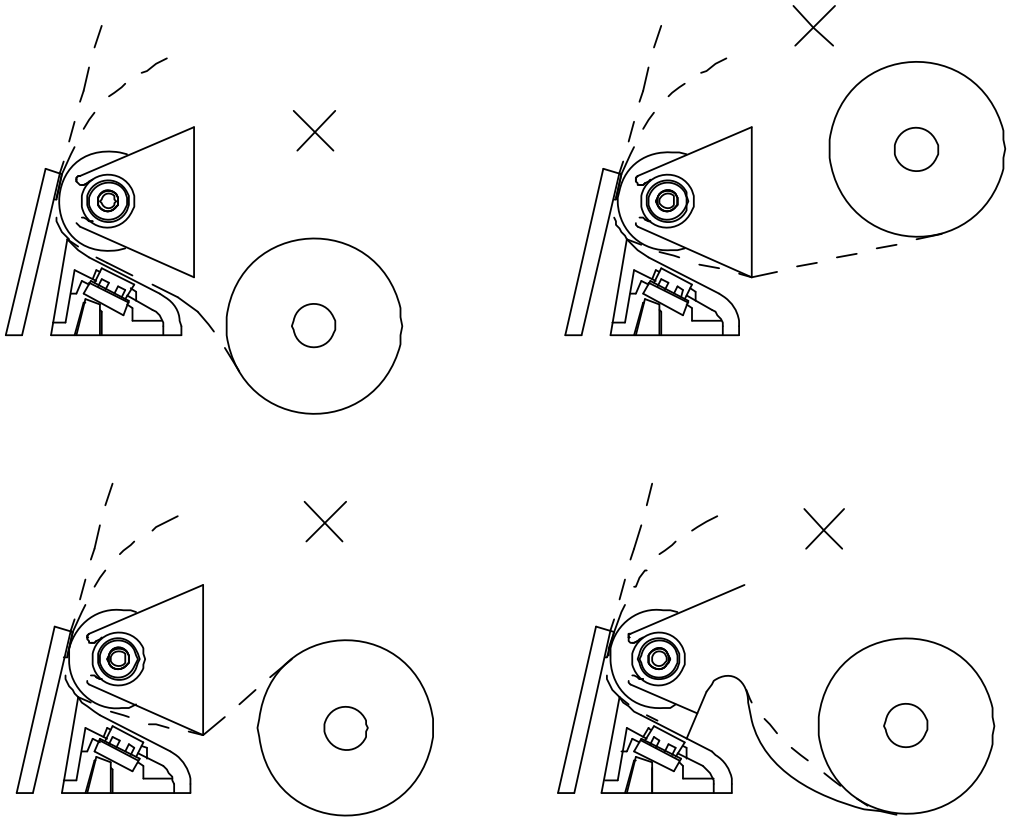
1)*Dimension is recommended dimension,
2)Ⓢ is the central of printer mechanism,
3)There is a paper guide setting needed to assure the stable of output opto interrupter signal,
4) There must be guide angles in both side of the easy paper loading structure (see following).



3.1.2 Roll-paper mounting position

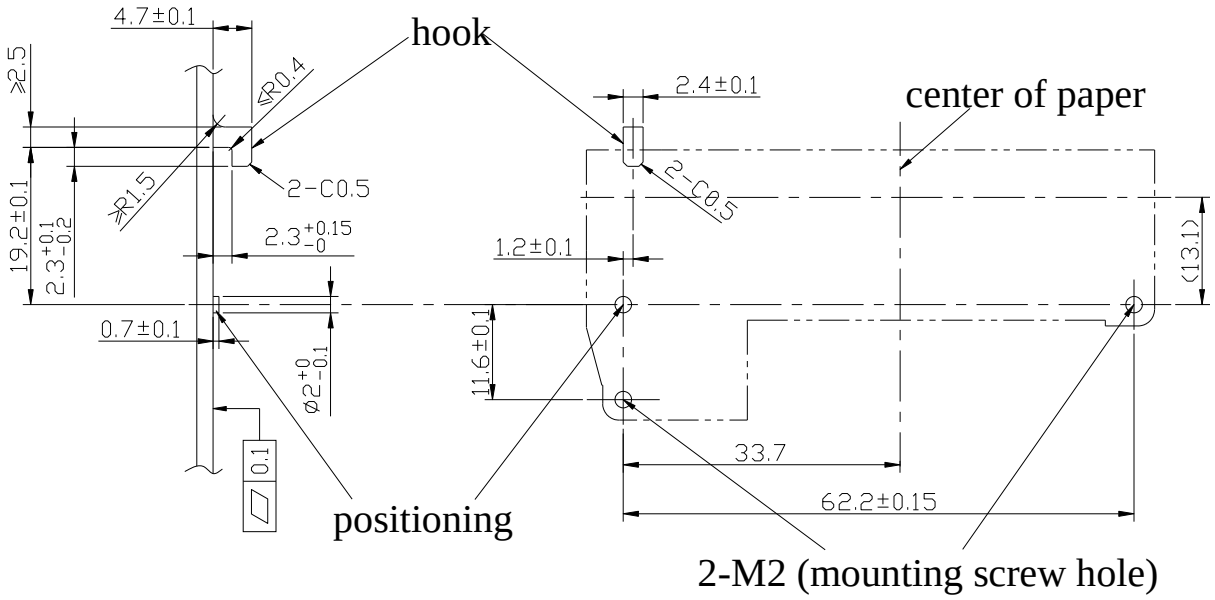


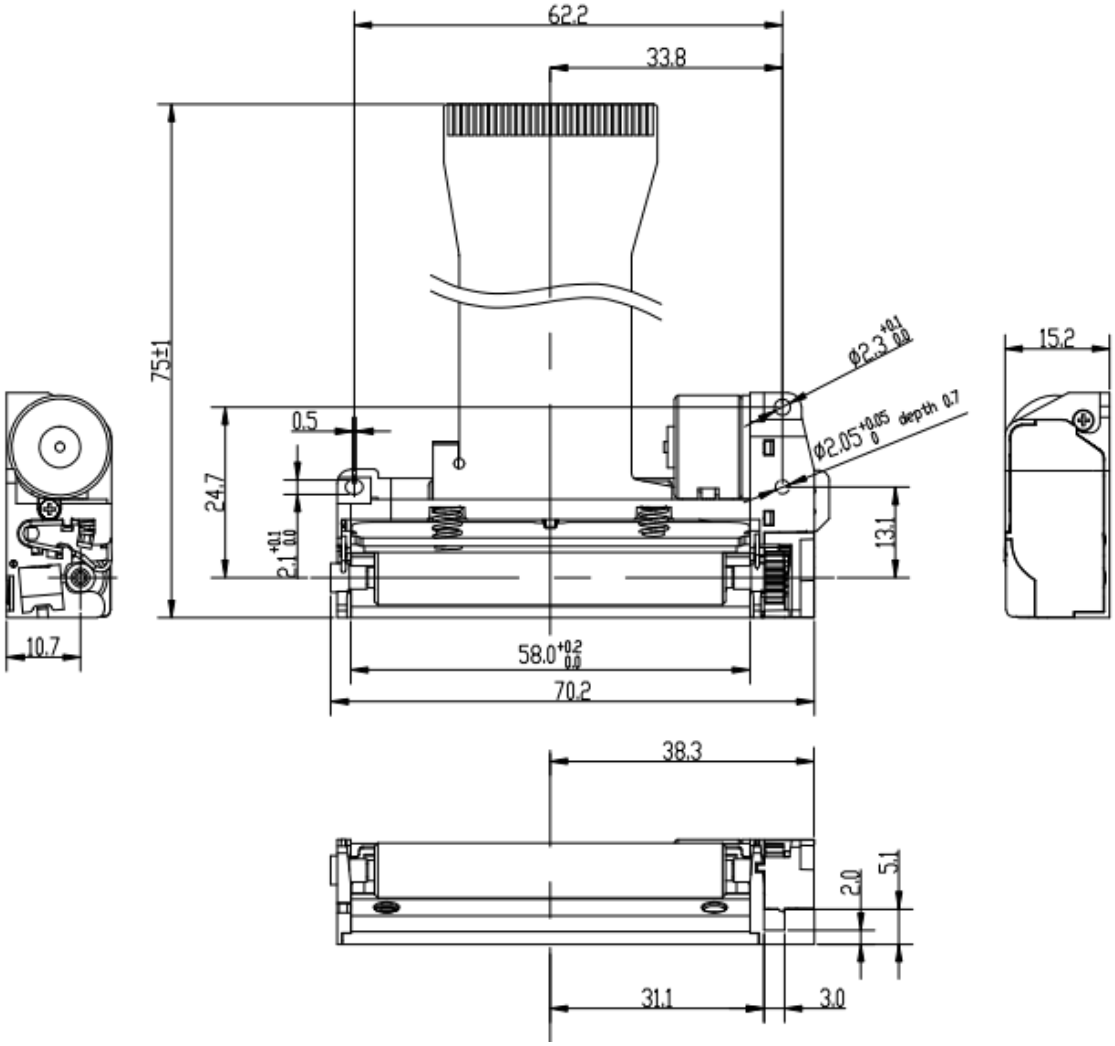
Wrong mounting



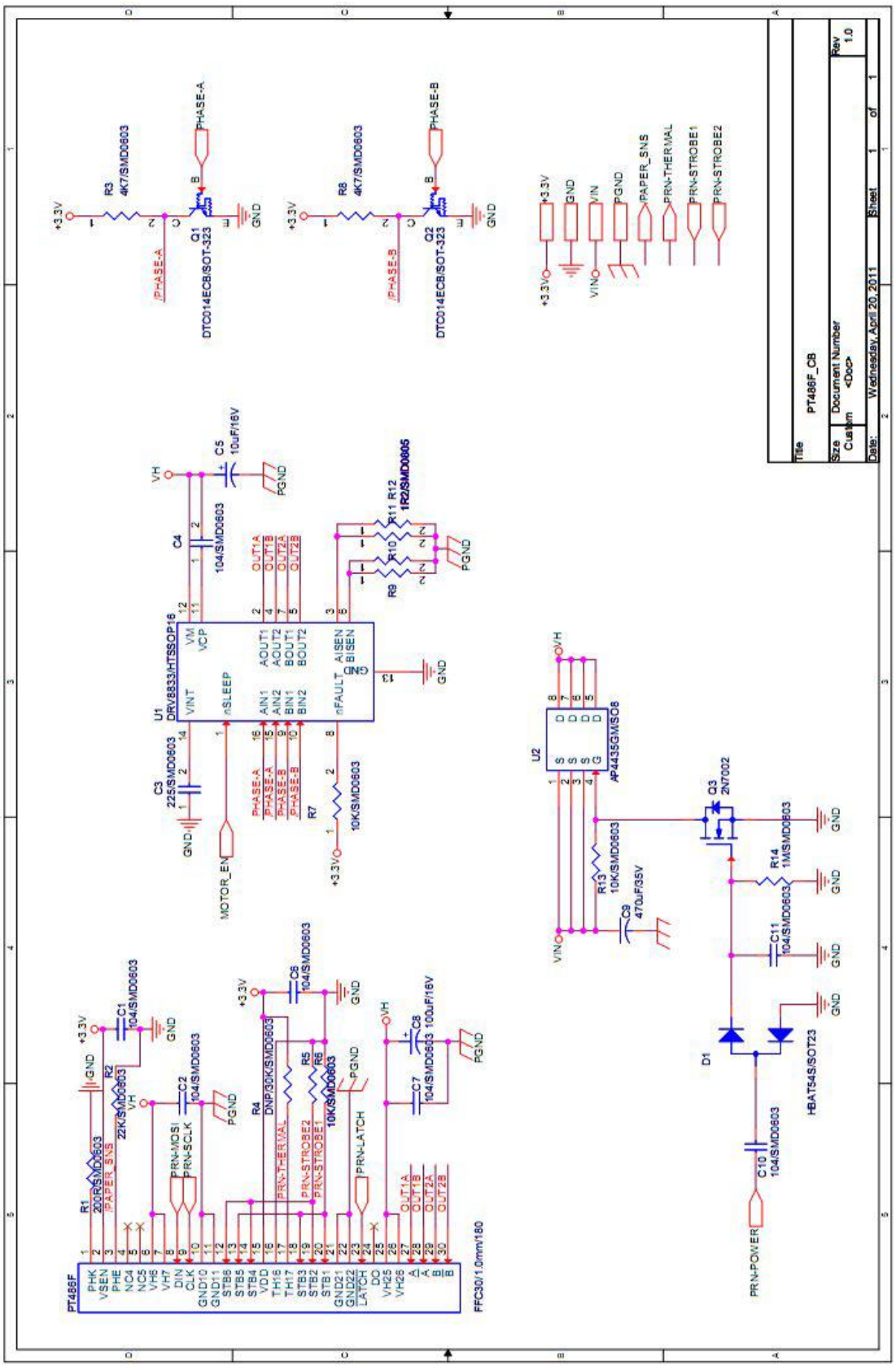
3.1.3 Overall dimensions

[Unit：mm]





3.2 DEMO circuit figure


PT486F_CB
Wednesday, April 20, 2011
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PHASE-B
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HBAT54S/SOT23
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PRN-POWER
PRN-MOSI
PRN-SCLK
PRN-LATCH
PRN-THERMAL
PRN-STROBE1
PRN-STROBE2
PAPER_SNS
MOTOR_EN