# ***YAEN208*** *serial*

# THERMAL PRINTER MECHANISM

# TECHNICAL REFERENCE

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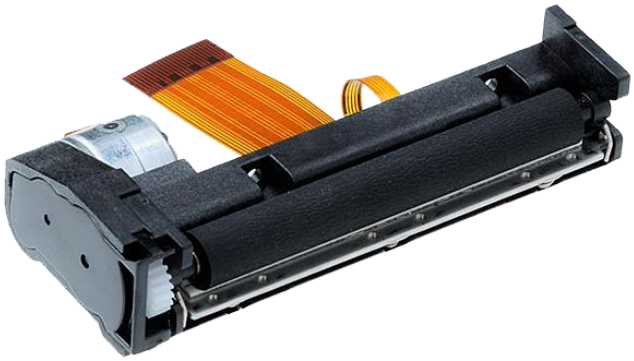
# Thermal printer mechanism

# *YAEN208*



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# REVISION RECORDS

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# Contents

# Chapter 1 Characters and operating precautions

## 1.1 Characters

### Operating voltage range

The range of TPH operating voltage is 4.2V～8.5V and the range of logic voltage is 2.7V～5.0V.

### High resolution printing

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

### Printing speed adjustable

According to driving power and sensitivity of thermal paper, set different printing speed required.The max speed is 90mm/s.

### Easy paper loading

Detachable rubber roller structure makes the paper loading easier.

### Low noise

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

## 1.2 Operation precautions

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

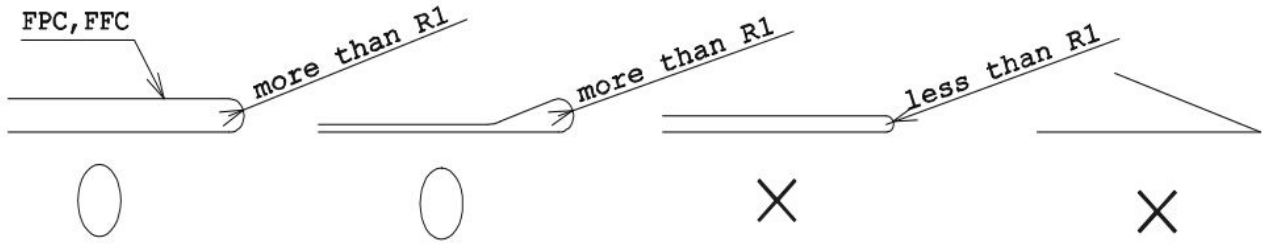
2）When attaching the platen part to the platen retainer, pay attention not to flaw or damage or smear the rubber part of the platen, the platen gear, and the bearing part (particularly, don't attach any oil or grease and foreign materials on the rubber part.)

3）Never attempt to touch the thermal printer head surface with bare 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 driver.

4）When assemble 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 sure 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, the bending should be more than R1,and do not rework (straighten or bend backward).




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）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.

9）When using this mechanism for the continuous actions, the temperature of the head (the temperature detected with the thermistor) should be equal or less than 75 Degrees.

10)Keep the paper conveyance unobstructed.

11) 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

| Item | Specifications |
|---|---|
| Print method | Thermal dot line printing |
| Dots per line | 384 dots |
| Resolution | 8 dots/mm |
| Print width | 48 mm |
| Paper width | 57.5 ± 0.5 mm |
| W*D*H(mm) | 67.3 mm * 17.8 mm * 32.0 mm |
| Paper feed pitch | 0.03125 mm |
| Weight | 30 g |
| Printing speed | 90 mm/s |
| Head temperature detection | Via thermistor |
| Out-of-paper detection | Via photo interrupter |
| Life span (at 25℃ and rated energy)<br>Activation pulse resistance<br>Abrasion resistance | 100 million pulses or more (print ratio=12.5%)<br>50km or more |
| Operating temperature range (℃) | 0～50 |
| Operating humidity (RH) | 20％～85％ |
| Storage temperature range (℃) | -20～70 |
| Storage humidity（RH） | 10%～90% |

## 2.2 Heat element dimensions

YAEN208 contains a thermal head with 384 heat elements .

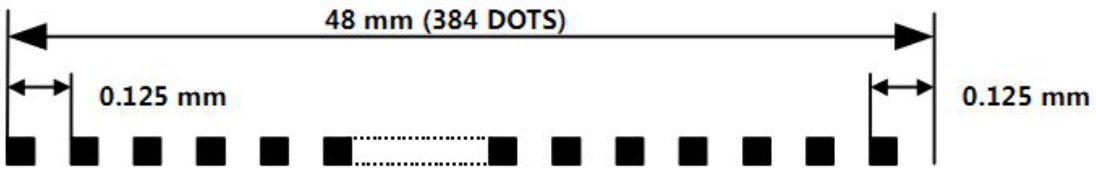



Figure 2-1 Heat Element Dimensions

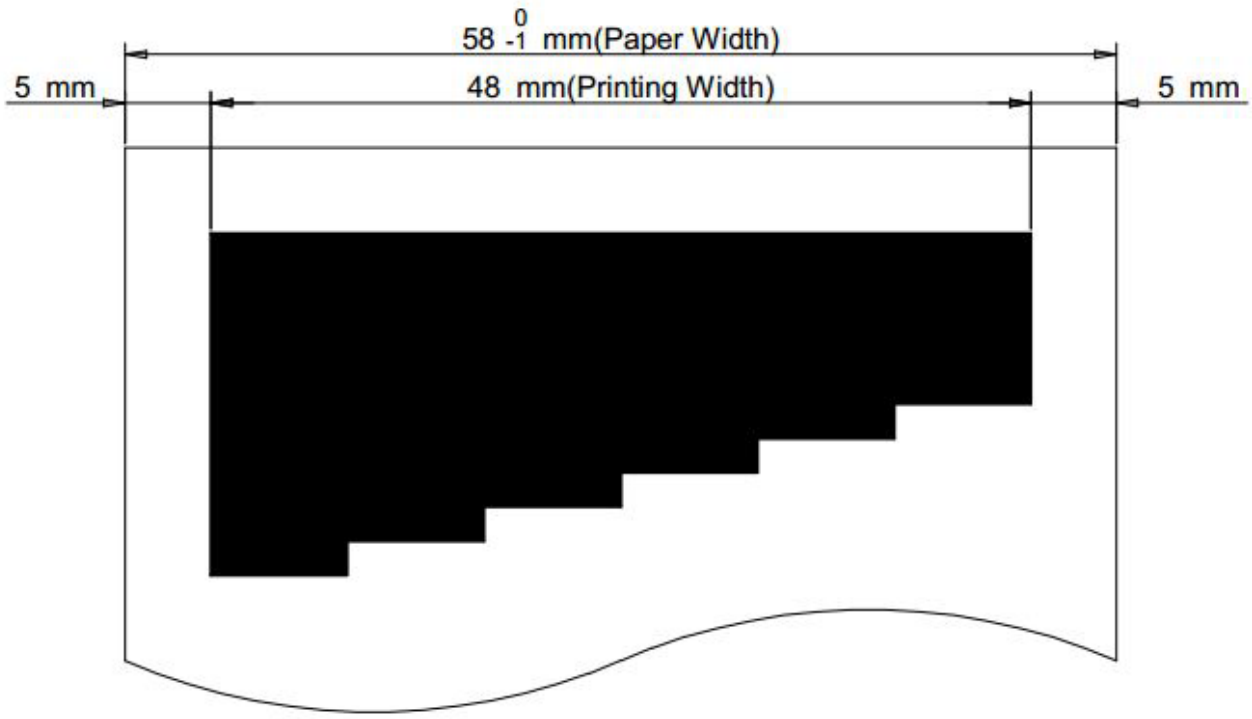



Figure 2-2 Print Area

## 2.3 Step motor characteristics

### 2.3.1 Step motor specification

| Item | Specification |
|---|---|
| Type | PM |
| Number of phases | 2-phase |
| Excitation | 1-2 phase |
| Winding resistance per phase | 14.5Ω±10％ |
| Rated voltage | 4.2~8.5V |
| Drive frequency | 183pps~3840pps |

### 2.3.2 Excitation sequence

Table 2-1 Step drive

| Signal name | Sequence | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | STEP1 | STEP2 | STEP3 | STEP4 | STEP5 | STEP6 | STEP7 | STEP8 |
| PA | High | High | Low | Low | Low | Low | Low | High |
| PNA | Low | Low | Low | High | High | High | Low | Low |
| PB | Low | Low | Low | Low | Low | High | High | High |
| PNB | Low | High | High | High | Low | Low | Low | Low |

### 2.3.3 Accelerate time table

| STEP | Time (ms) | STEP | Time (ms) | STEP | Time (ms) | STEP | Time (ms) | STEP | Time (ms) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4.250 | 35 | 1.151 | 69 | 0.800 | 103 | 0.480 | 137 | 0.338 |
| 2 | 3.760 | 36 | 1.141 | 70 | 0.790 | 104 | 0.470 | 138 | 0.336 |
| 3 | 3.459 | 37 | 1.131 | 71 | 0.780 | 105 | 0.460 | 139 | 0.333 |
| 4 | 2.762 | 38 | 1.121 | 72 | 0.770 | 106 | 0.450 | 140 | 0.331 |
| 5 | 2.314 | 39 | 1.111 | 73 | 0.760 | 107 | 0.446 | 141 | 0.329 |
| 6 | 2.028 | 40 | 1.103 | 74 | 0.750 | 108 | 0.441 | 142 | 0.327 |
| 7 | 1.928 | 41 | 1.093 | 75 | 0.740 | 109 | 0.436 | 143 | 0.325 |
| 8 | 1.828 | 42 | 1.083 | 76 | 0.730 | 110 | 0.431 | 144 | 0.323 |
| 9 | 1.728 | 43 | 1.073 | 77 | 0.720 | 111 | 0.426 | 145 | 0.321 |
| 10 | 1.675 | 44 | 1.063 | 78 | 0.710 | 112 | 0.422 | 146 | 0.319 |
| 11 | 1.635 | 45 | 1.053 | 79 | 0.700 | 113 | 0.417 | 147 | 0.317 |
| 12 | 1.595 | 46 | 1.043 | 80 | 0.694 | 114 | 0.413 | 148 | 0.315 |
| 13 | 1.565 | 47 | 1.033 | 81 | 0.690 | 115 | 0.409 | 149 | 0.313 |
| 14 | 1.543 | 48 | 1.023 | 82 | 0.680 | 116 | 0.405 | 150 | 0.311 |
| 15 | 1.523 | 49 | 1.013 | 83 | 0.670 | 117 | 0.401 | 151 | 0.309 |
| 16 | 1.503 | 50 | 0.990 | 84 | 0.660 | 118 | 0.397 | 152 | 0.308 |
| 17 | 1.486 | 51 | 0.980 | 85 | 0.650 | 119 | 0.393 | 153 | 0.306 |
| 18 | 1.466 | 52 | 0.970 | 86 | 0.640 | 120 | 0.390 | 154 | 0.304 |
| 19 | 1.426 | 53 | 0.960 | 87 | 0.630 | 121 | 0.386 | 155 | 0.303 |
| 20 | 1.406 | 54 | 0.950 | 88 | 0.625 | 122 | 0.383 | 156 | 0.301 |
| 21 | 1.384 | 55 | 0.940 | 89 | 0.620 | 123 | 0.379 | 157 | 0.297 |
| 22 | 1.364 | 56 | 0.930 | 90 | 0.610 | 124 | 0.376 | 158 | 0.293 |
| 23 | 1.344 | 57 | 0.920 | 91 | 0.600 | 125 | 0.373 | 159 | 0.290 |
| 24 | 1.322 | 58 | 0.910 | 92 | 0.590 | 126 | 0.370 | 160 | 0.286 |
| 25 | 1.302 | 59 | 0.900 | 93 | 0.580 | 127 | 0.367 | 161 | 0.283 |
| 26 | 1.282 | 60 | 0.890 | 94 | 0.570 | 128 | 0.364 | 162 | 0.279 |
| 27 | 1.262 | 61 | 0.880 | 95 | 0.560 | 129 | 0.361 | 163 | 0.276 |
| 28 | 1.242 | 62 | 0.870 | 96 | 0.550 | 130 | 0.358 | 164 | 0.273 |
| 29 | 1.222 | 63 | 0.860 | 97 | 0.540 | 131 | 0.353 | 165 | 0.270 |
| 30 | 1.202 | 64 | 0.850 | 98 | 0.530 | 132 | 0.350 | 166 | 0.267 |
| 31 | 1.191 | 65 | 0.840 | 99 | 0.520 | 133 | 0.348 | 167 | 0.264 |
| 32 | 1.181 | 66 | 0.830 | 100 | 0.510 | 134 | 0.345 | 168 | 0.261 |
| 33 | 1.171 | 67 | 0.820 | 101 | 0.500 | 135 | 0.343 | 169 | 0.260 |
| 34 | 1.161 | 68 | 0.810 | 102 | 0.490 | 136 | 0.340 | | |

## 2.4 Thermal head specifications

### 2.4.1 General characteristics

| Item | Specification | Note |
|---|---|---|
| Print width | 48mm | |
| Number of heater elements | 384 dots | |
| Heater resolution | 8 dots/mm | 203dpi |
| Heater elements pitch | 0.125 mm | |
| Heater resistance | 176Ω±4% | |
| Number of data inputs | 1 serial input | Data In |
| Heating voltage | 4.2V~8.5V | |

### 2.4.2 Maximum parameter

| Parameter | Symbol | Specification | Note |
|---|---|---|---|
| Heating energy consumption | Eo max | 0.26mJ/dot | 1.25ms/line |
| Heating voltage | $V_H$ | 7.2V | |
| Logic voltage | VDD | 5 V | Including crest voltage |
| Environmental temperature | Ta | -30 ℃ ～ +50 ℃ | Suggestion is above 5℃ |
| Environmental humidity | | 10～90%RH | Non-condensing |
| Maximum operating temperature | Ts | Continuous:65° C 30min. MAX.<br>Peak80° C Thermistor temp. | When up to 80° C 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

| Parameters | | Symbol | Recommended parameters | Note |
|---|---|---|---|---|
| Heating power | | Eo | 0.27W/dot | $R_{ave}$ =180 Ω<br>Vdd=5V<br>64dots heating t the same time |
| Heater voltage | | VH | 7.2V | |
| Suggestion Speed | | | 1.25ms/line | |
| Heating Energy | 5℃ | Eo (ts) | T.B.D | |
| | 25℃ | | T.B.D | |
| | 45℃ | | T.B.D | |
| Current | | Io | 2.5A | |

### 2.4.4 Electrical characteristics

1) Limited parameter

| Item | Symbol | Text condition | Rated value | Unit |
|---|---|---|---|---|
| Supply voltage | VDD | Surge | 0～7 | V |
| | VH | Surge | 0～10 | V |
| Logic input voltage | $V_{IN}$ | | 0～VDD+0.5 | V |
| Drive supply current | $I_{DOL}$ | | 70 | mA |

2) Recommended parameter

| Item | Symbol | Text condition | Reference | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Supply voltage | VDD | | 2.7 | 5.0 | 5.5 | V |
| | VH | | - | - | 8.5 | V |
| Logic input voltage | $V_{IH}$ | | 0.8*VDD | - | VDD | V |
| | $\overline{V_{IL}}$ | | 0 | - | 0.2*VDD | V |
| Clock frequency | $f_{clk}$ | Duty 50% | - | - | 10 | MHz |

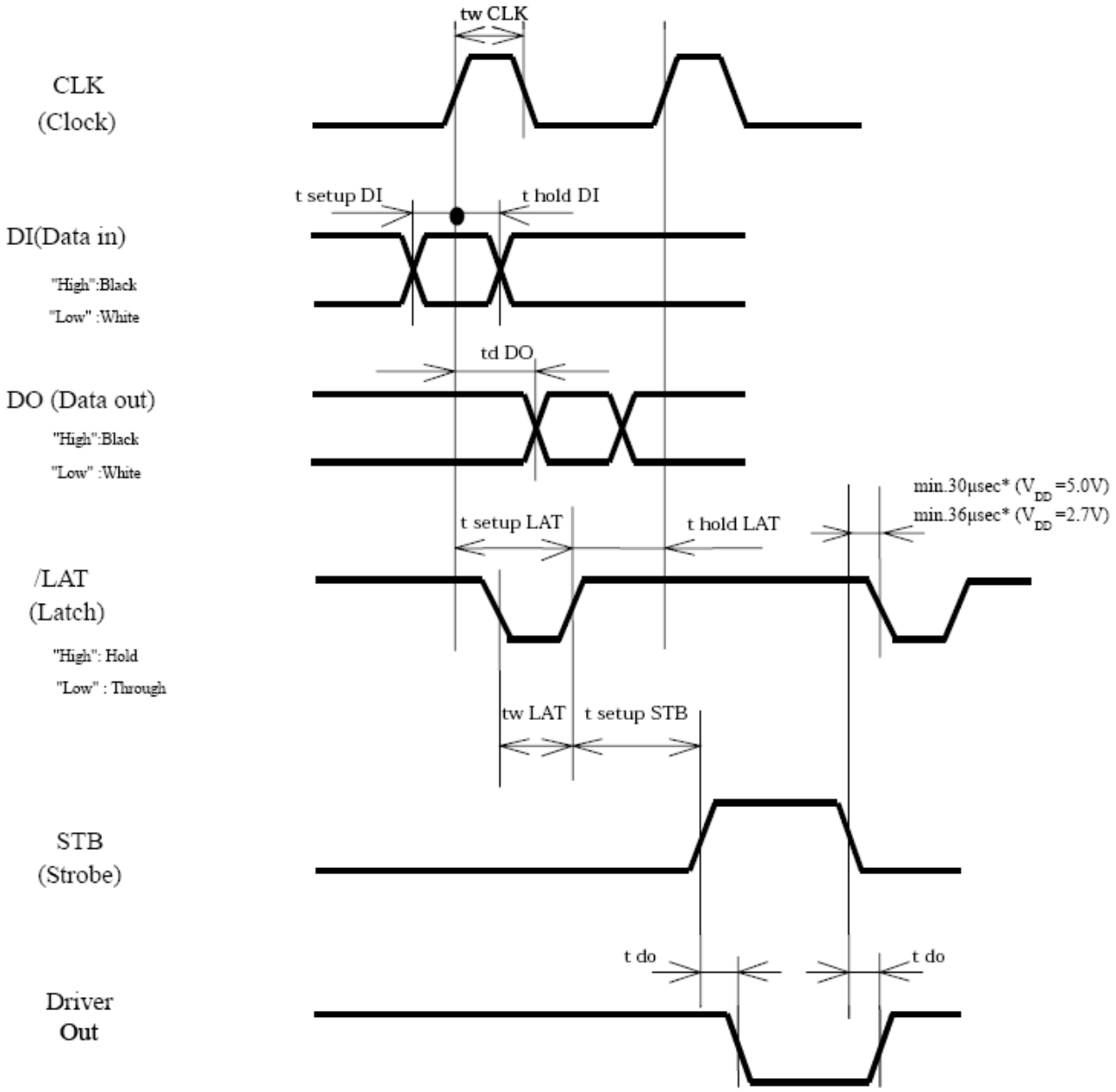
3) Electrical characteristics

| Item | | Symbol | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Logic input current | $\overline{LATCH}$ | $I_{IH}$ | $V_{IH}$= $V_{DD}$ | - | | 3.0 | μA |
| | STROBE | | | - | - | 330 | |
| | CLOCK | | | - | - | 3.0 | |
| | DATAIN | | | - | - | 0.5 | |
| | $\overline{LATCH}$ | $I_{IL}$ | $V_{IL}$=GND | -330 | - | - | μA |
| | STROBE | | | -3.0 | - | - | |
| | CLOCK | | | -3.0 | - | - | |
| | DATAIN | | | -0.5 | - | - | |
| Drive output voltage(Low) | | $V_{DOL}$ | $V_{DD}$=3V $I_{DOL}$=60mA | - | 0.7 | 0.9 | V |
| Drive Leak current | | $I_{LEAK}$ | $V_{OH}$=8V | - | - | 1.0 | μA/dot |
| Logic supply current | | $I_{dd}$ | $f_{CLK}$=8MHz DI=1/2$f_{CLK}$ | - | 21 | 60 | mA |
| Logic supply current (Non-Operation) | | Is | DATA IN/CLOCK = GND Other logic signal open | - | - | 150 | μA |

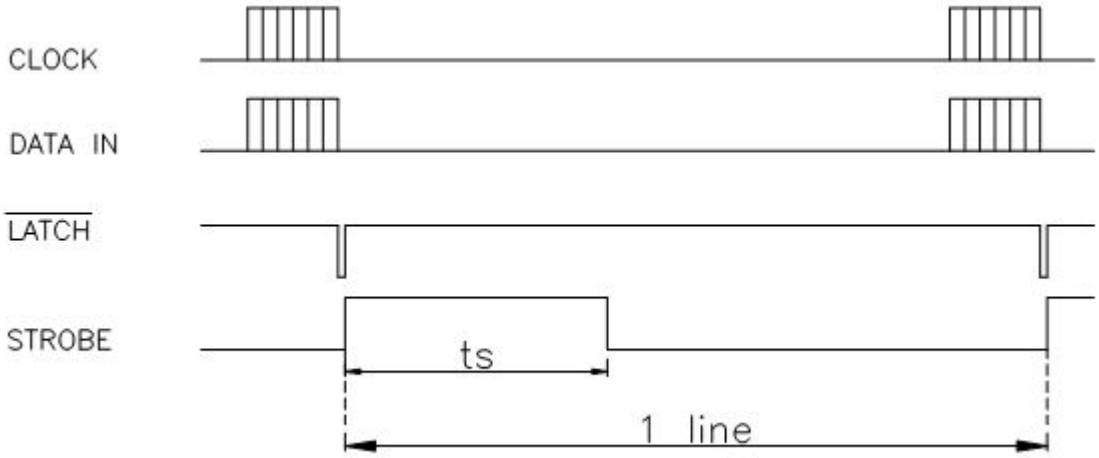
Note：STROBE includes pull-down resistance of 50KΩ ±50% per IC

## 2.4.5 Timing characteristics

| Parameter | Symbol | Ratings | | | |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | unit. |
| Clock frequency | $f_{CLK}$ | - | - | 10 | MHz |
| Clock pulse width | $t_w$(T) | 40 | - | - | 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) | - | - | 50 | ns |
| Strobe to driver Output delay time | $t_d$(DO)r | - | - | 13.0 | μs |
| | $t_d$(DO)f | - | - | 13.0 | μs |


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* ($V_{DD}$=5.0V)
min.36µsec* ($V_{DD}$=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

### 2.4.6 Timing chart




*: While printing, data transmission is possible.

### 2.4.7 Equation

Calculate the printing energy using this equation：

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

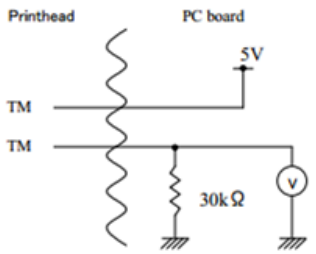
| | |
|---|---|
| $R_{IC}$ | 9 Ω |
| $t_s$ | Heating time |
| VH | Heating voltage |
| $R_{ave}$ | Average resistance value |
| N | Heating dots at the same time 64dots |
| $R_{com}$ | Common electrical resistance 0.08 Ω |
| $R_{lead}$ | Connecting line resistance |

## 2.4.8 Thermistor resistance

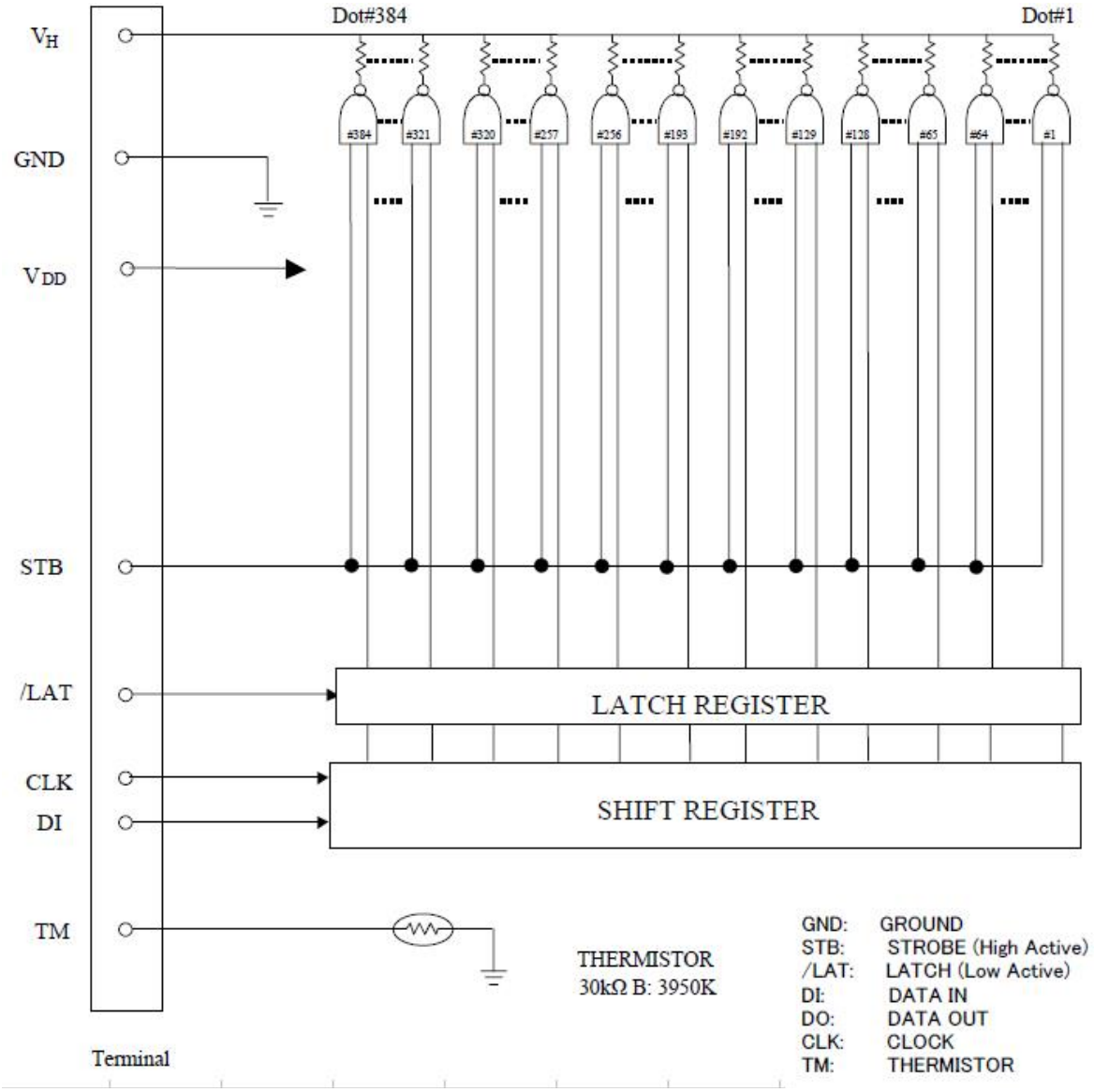
$R_{25} = 30\text{K}\Omega \pm 5\%$, B $_{CONST}$= 3950kelvin±3%, $R = R_{25}e^{B(1/T-1/T_{25})}$

| 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 | 59.9 | 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 |

Recommended Circuit



### 2.4.9 Structure figure




| 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 |

## 2.4.10 Operating precautions

In order to prevent the printer head heater element overheating or burned up, when we designing products, pay attention to the points as follows:

**In hardware terms:**

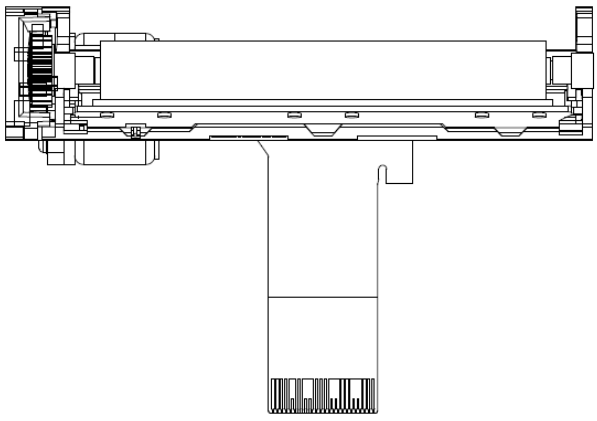
1) When the power on, the order should be VDD→VH.
2) When the power is on or stand by, make sure that the STROBE signal is in invalid state.
3) Make sure if program is abnormal (such as system halted), VH voltage should be shut off automatically.
4) During the printing, Detecting thermistor temperature,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

**In firmware terms:**

1) STROBE time should not be too long.
2) In the following two cases, do not start:
   ① when paper jammed; ② When the paper is out.
3) When the power is on or each printing task completed, it is recommended to send blank data to the mechanism, so it can prevent the printer head from damaged if there are some hardware failure on the control board.
4) Over-temperature protection:The printer stops working when heating temperature is greater than 75℃,and start working again when the temperature down to 60℃.

## 2.5 Pin assignment

| Pin No. | Signal Name | Function |
|---|---|---|
| **1** | PS | Optical coupling signal output |
| **2** | GPS | Optical coupling grounding |
| **3** | VPS | Optical coupling power |
| **4** | VP | Printing power supply |
| **5** | VP | Printing power supply |
| **6** | VP | Printing power supply |
| **7** | DI | Printing data in |
| **8** | CLK | Printing clock inpit |
| **9** | GND | Ground power supply for thermal head |
| **10** | GND | Ground power supply for thermal head |
| **11** | GND | Thermally sensitive resistor input terminal |
| **12** | VDD | Logic power |
| **13** | DST | Heating allowed control pin |
| **14** | TH | Thermistor |
| **15** | GND | Ground power supply for thermal head |
| **16** | GND | Ground power supply for thermal head |
| **17** | GND | Asynchronous clock for communication |
| **18** | LAT | Data Latching control |
| **19** | VP | Printing power |
| **20** | VP | Printing power |
| **21** | PA | Step motor wending 1 Pin1 |
| **22** | /PA | Step motor wending 1 Pin2 |
| **23** | PB | Step motor wending 2 Pin1 |
| **24** | /PB | Step motor wending 2 Pin2 |

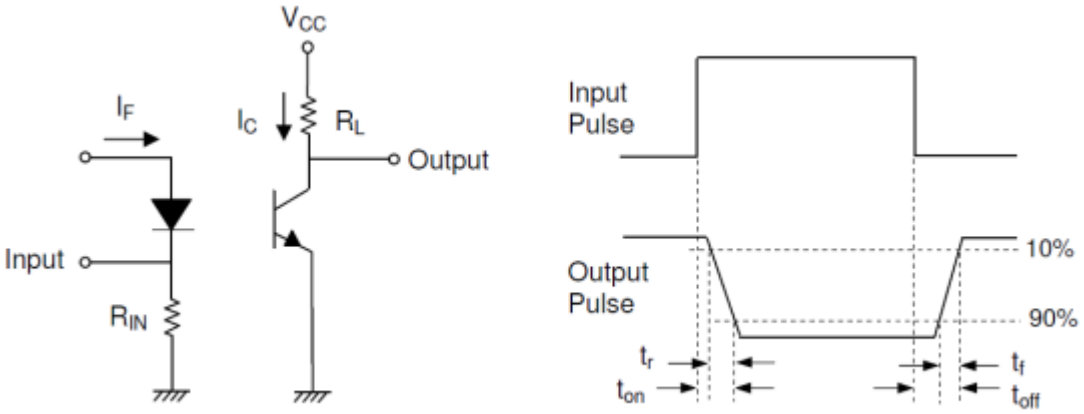


## 2.6 Opto interrupter specification

TMP201 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.

Circuitry of the opto interrupter please refer to the following picture, logic voltage can be 3.3V, also can be 5V.

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.

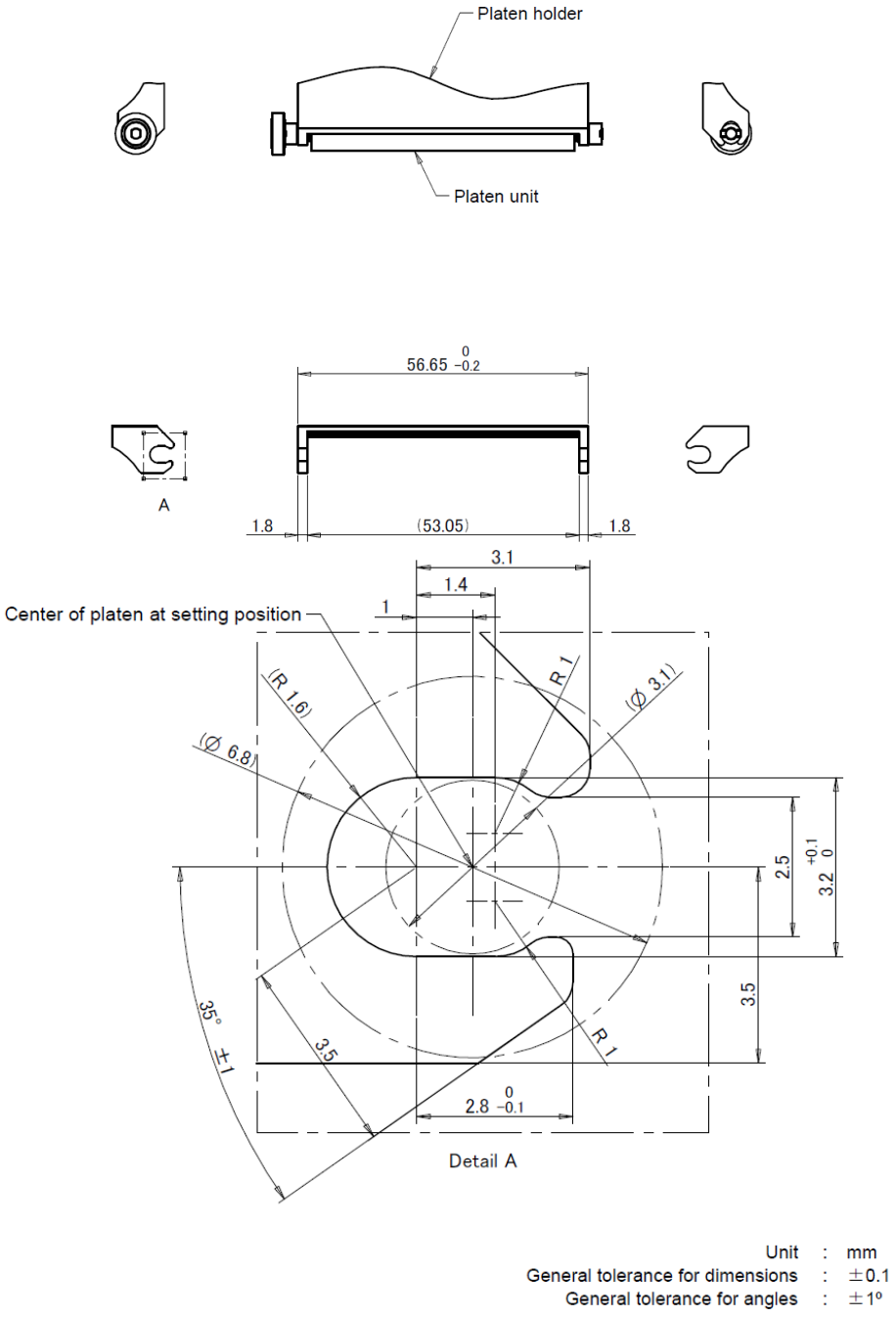



Electro-Optical Characteristics( Ta=25℃)

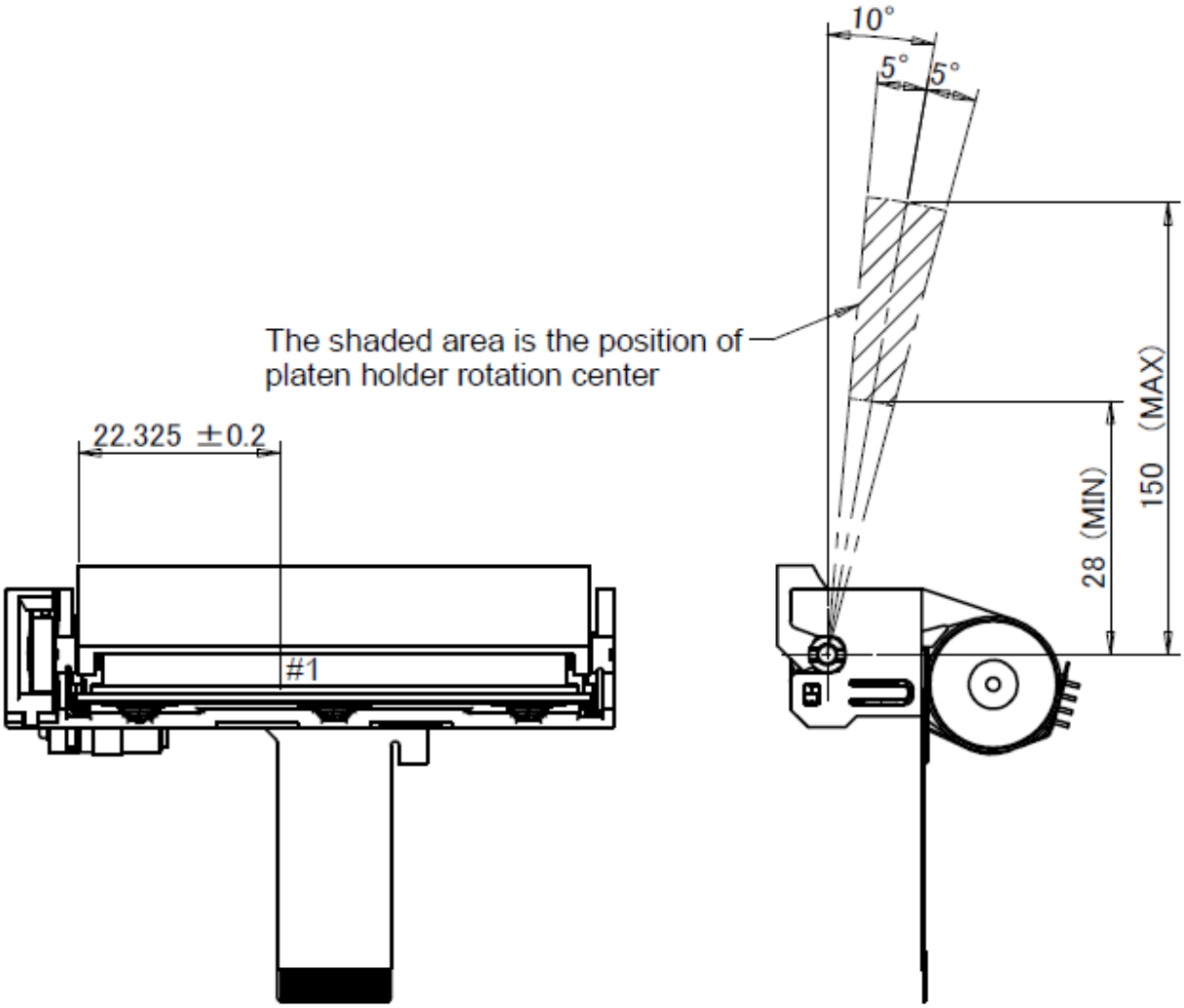
| Parameter | | Symbol | Min | Typ. | Max. | Unit | Conditions |
|---|---|---|---|---|---|---|---|
| Input | Forward oltage | $V_F$ | --- | 1.25 | 1.5 | V | $I_F$=4mA |
| | Reverse Current | $I_R$ | --- | --- | 10 | μA | $V_R$=6V |
| | Peak Wavelength | λ | --- | 940 | --- | nm | $I_F$=20mA |
| Output | Collector Dark Current | $I_{CEO}$ | --- | --- | 0.1 | nA | $V_{CE}$=10V |
| Transfer Characteristics | Collector-Emitter Voltage | $V_{CE(SAT)}$ | 60 | --- | 130 | μA | VCE=2V, IF=4mA |
| | Dark Current | $I_{CEOD}$ | --- | --- | 1 | μA | --- |
| | Rise time | tr | --- | --- | 15 | μs | $V_{CE}$=2V $I_C$=0.1mA $R_L$=1000Ω |
| | Fall time | tf | --- | --- | 15 | μs | |

# Chapter 3 Casing design guide

## 3.1 Platen structure dimensions



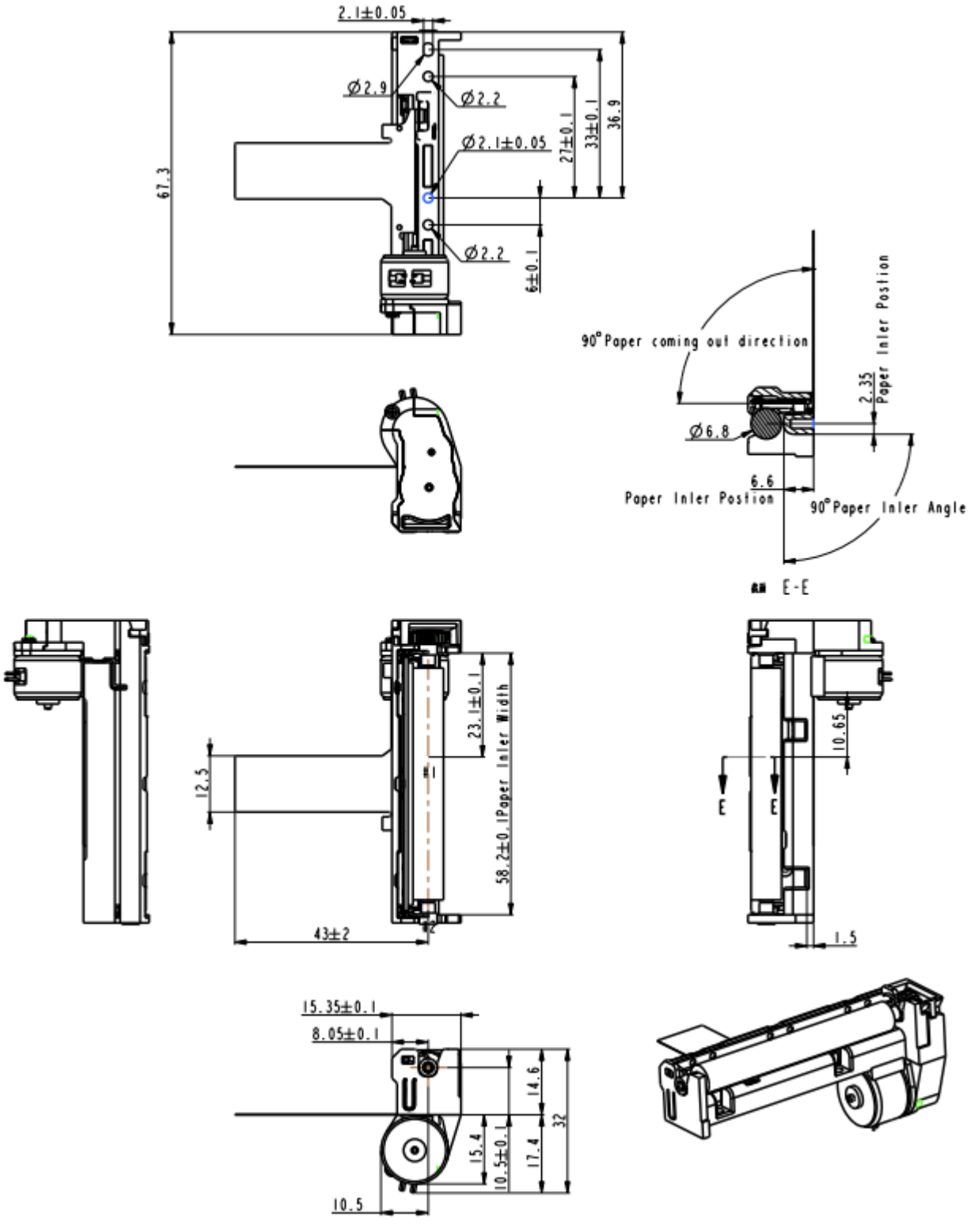

Unit : mm
General tolerance for dimensions : ±0.1
General tolerance for angles : ±1°




Unit : mm
General tolerance for dimensions : ±0.1
General tolerance for angles : ±1°

## 3.2 Mechanism structure dimensions

General tolerance of dimensions: ±0.5mm



## 3.3 DEMO circuit figure