Model: BT-628F
THERMAL MECHANISM

content

CHAPTER1 FEATURES

TP486F **features**

1. Use a 5V power supply or battery power supply

The voltage used to drive the thermal head is equal to the logic voltage, or is driven by a 5 V single power line.

The range of operating voltage is wide, so four to six Ni-Cd batteries or Ni-MH batteries can also be used. Two Lithium-ion batteries can be used.

2. Compact and light

The mechanism is compact and light: 70 mm in width, 33.5 mm in depth, 15 mm in height, and approximately 35 g in weight.

3. High resolution printing

A high-density print head of 8 dots/mm produces clear and precise printing.

4. Longevity

The mechanism is a maintenance-free device with a long life of 50 km print length and/or 100 million pulses.。

5. High speed printing

A maximum print speed of 200 dot lines per second (25 mm per second) at 5 V, 450 dot lines per second (56.25 mm per second) at 7.2 V, and 500 dot lines per second (62.5 mm per second) at 8.0 V is attainable.

6. Low noise

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

7. Easy paper load

Special platen design make paper load easier.

CHAPTER2 SPECIFICATION

2.1 GENERAL SPACIFICATION

Table 2-1 general specification

Item	specification
Print method	Thermal dot line printing
Dots per line	384 dots
resolution	8 dots/mm
Print width	48mm
Paper width Width x Depth x Height（mm） Maximum printing speed	57±1mm 70×33.5×15 200 dot lines/s(25mm/s)(at 5.0V) 450 dot lines/s(56.25mm/s)(at 7.2V) 500 dot lines/s(62.5mm/s)(at 8.0V)
Paper feed pitch	0.125mm
Head temperature detection	Via thermistor
Out of paper detection	Via photo interrupter
Operating voltage range Vp line(for head and motor drive) Vdd line (for head logic)	 4.2 V to 8.5 V 6 (equivalent to four through six Ni-Cd or Ni-MH batteries, or two lithium-ion batteries) 4.5 V to 5.5 V
Current consumption For driving the head (V_P) For driving the motor (V_P) For head logic (V_{dd})	Average: 1.8 A (at 5 V), 2.6 A (at 7.2 V), 2.8 A (at 8.0 V) 2 Maximum: 2.1 A (at 5 V), 3.0 A (at 7.2 V), 3.3 A (at 8.0 V) 2 Maximum 0.46 A Maximum 0.01 A
Life span (at 25℃ and rated energy) Activation pulse resistance Abrasion resistance	 100 million pulses or more (print ratio=12.5%) 4 50 km or more
Operating temperature range (℃)	0~40 (℃)
Operating humidity range(RH)	20％－80％
Storage temperature range(℃) Storage humidity range（RH）	-25-70 10%-%90

1. Maximum printing speed is attained with the following conditions:
When the driving voltage is 5 V, the character size is a 24-dot font, the line spacing is 16 dots, the temperature of the head is 40℃ or more, and the number of simultaneously activated dots is 64 dots or less
When the driving voltage is 7.2 V, the temperature of the head is 30℃ or more, and the number of simultaneously
When the driving voltage is 8.0 V, the temperature of the head is 10℃ or more, and the number of simultaneously
When the temperature is under -5℃, the motor speed is 300pps (18.75mm/sec.)
2. When the number of simultaneously activated dots is specified as 64.
3. Outside this range, prining may blot or be light.
4. When using 2-ply thermal paper, the printing pulse is 2 pulses/dot, and so 100 million pulses mean 50 million dot lines.
5. Not be used in a curled path (LTP1245K, M).
6. Under -5℃, printing at under 7.0V (Vp) will be light.
7. Continuous printing must be performed for less than 5 minutes at a temperature of over 50℃.
Outside a temperature range of -5℃ to 50℃, the printer must be driven by a fixed two division drive method.
Outside this range, automatic loading of paper cannot be performed.
At under -20℃, heat sensitizer may stick to the thermal head. If it sticks, clean the thermal head.

2.2 HEAT ELEMENT DIMENSIONS

The TP486F contains a thermal head with 384 heat elements (dot-size).

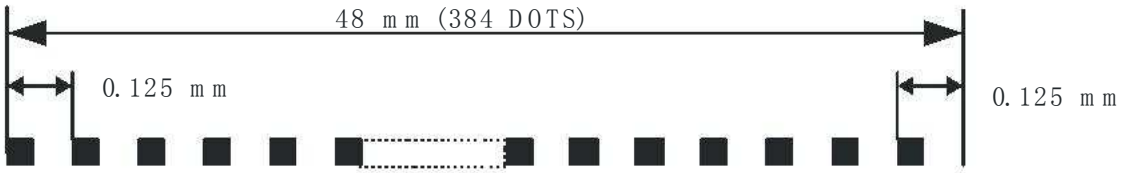


Figure 2-1 Heat Element dimensions

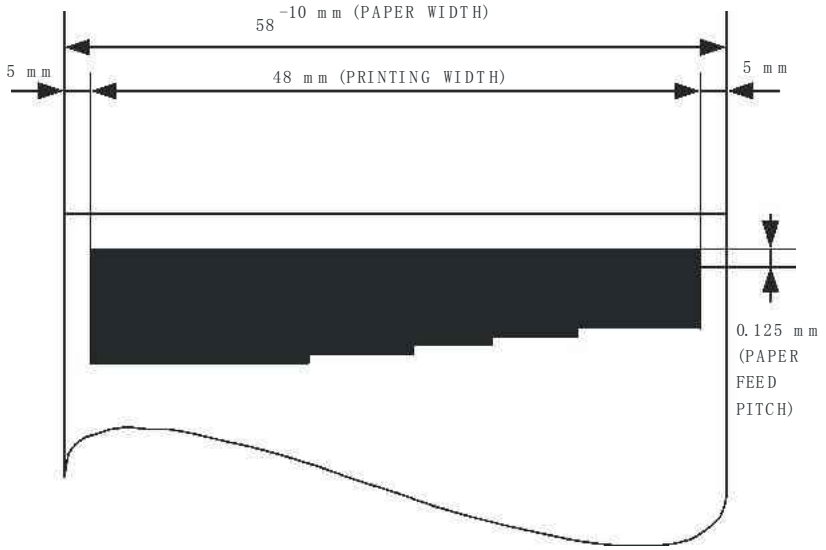


Figure 2-2 Print Area

2.3 PAPER FEED CHARACTERISTICS

Paper is fed in a forward direction when the motor shaft is rotating in the normal direction (clockwise) when seen from the motor gear side.

The motor is driven by a 2-2 phase excitation, constant current chopper method and feeds paper by 0.125 mm (equivalent to a single dot pitch) every two steps of the motor drive signal.

To prevent deterioration in printing quality due to backlash of the paper feed system, the motor should be driven 40 steps in a reverse direction then 40 steps in the normal direction during initialization or following backward feeding.

During paper feeding, the motor should be driven lower than the value obtained by equation (1).

Equation (1):

At -5°C or higher

Vp × 165 - 220 (pps) (max.1000 (pps))

At under -5°C

300 (pps)

During printing, motor drive frequency should be adjusted according to working conditions such as voltage, temperature, number of activated dots, etc. (For details, see **CHAPTER 2.5.7**)

Drive the motor at 200 pps when automatically loading paper, regardless of the voltage.

As for the motor current value, to keep the motor torque, activate the motor by only the first setting current value (i.e. one current) for the entire motor drive step time. (For details, See **CHAPTER2.4.3**)

2.4 **STEP MOTOR CHARACTERISTICS**

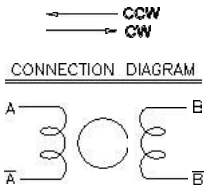
2.4.1 Step motor specifications

Table 2-2 General Motor Specifications

Item	**Specifications**
Type	PM
Number of phases	4-phase
Excitation	2-2 phase
Winding resistance per phase	14Ω±10%
Rated voltage Rated current	4.2~8.5V 0.23A/phase,0.15A/phase
Maximum current consumption	0.66A
Drive frequency	50-1000pps(according to drive voltage)

2.4.2 Excitation Sequence

Signal Name	**Sequence**			
	STEP1	STEP2	STEP3	STEP4
A	High	High	Low	Low
B	High	Low	Low	High
$\overline{B}$	Low	High	High	Low
$\overline{A}$	Low	Low	High	High



2.4.3 Driving the Step Motor

According to Chapter **3.2 DEMO Electric element motor part.**

Low speed motor driving while printing due to a division drive method, print data, and input data transfer speed may cause noise or print trouble to occur due to over torquing or overheating of the motor. To prevent these from occurring, recommend to use PWM method to drive the motor, e.g. L3967.

2.5 THERMAL PRINTHEAD CONFIGURATION

2.5.1 Outlines

Item	Specifications
Print Width	48 mm
Dots of line	384 dots
Resolution	8 dots/mm
dots Pitch	0.125 mm
Heat element pitch	0.11mm×0.1 mm
Head resistance	R=176 Ω ± 4% R=R±15%
Operation voltage range	4.2V－9.0V
Life span	$1.1X10^{8}$ pulses
Mechanism life	55Km

2.5.2 Maximum ratings

Item	Symbol	Specification	Note
Heater energy consumption	Eomax	0.26 mJ/dot	Speed 25mm/s
		0.20 mJ/dot	Speed 50mm/s
Hear voltage	VH	10 V	Between Connectors
Logic voltage	Vdd	5.5V	
Environment temperature	Ta	0 ° C ~ +50 ° C	Suggest above 5 ° C
Environment humidity		20%~80%	
Maximum operation temperature	Ts	Continuous:65°C 30min. MAX	Thermistor temp.
		Peak:80°C Thermistor temp	When 80°C was detected,Printing must be stopped, and wait until the degree is below 60°C

2.5.3 Standard printing conditions

Item	Symbol	Sepcifications		Note
Heater Power consumption	Eo	0.12W /dot	0.25W /dot	$\overline{R}$ =176
Heat voltage	VH	5.0V	7.2V	Between Connectors
Speed		25mm/s	50mm/s	
Heater Energy	5ºC	0.2mJ/dot(1.6ms)	0.17mJ/dot(0.65ms)	64 dots simultaneouslyc on
	25ºC	0.18mJ/dot(1.4ms)	0.14mJ/dot(0.54ms)	
	40ºC	0.16mJ/dot(1.28ms)	0.13mJ/dot(0.50ms)	
Supply curent	Io	26.6mA/dot	38.3mA/dot	$\overline{R}$ =176

2.5.4 Energy formula

$$Rts = \frac{(VH)^2}{(R + RIC)^2} \times ts$$

$$Eo = I^2 \times \bar{R} \times ts$$

Note：

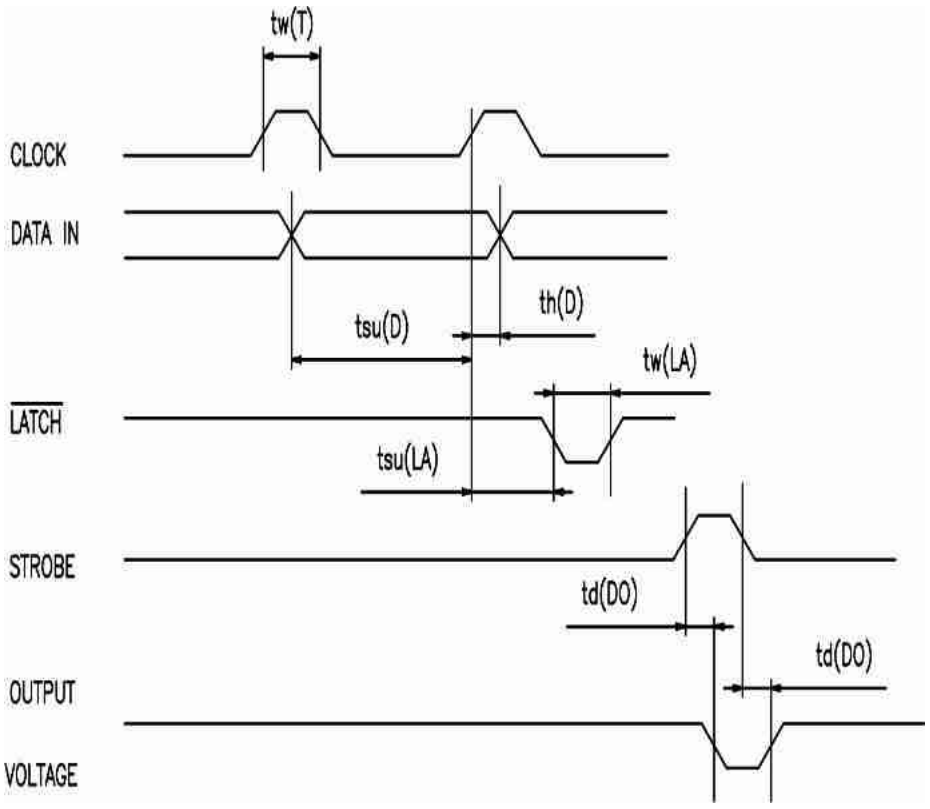
R_{IC}	12Ω(V_{dd}=5V), 15Ω(V_{dd}=3.3V)
t_s	Heat time
VH	Operation Voltage
$\bar{R}$	Average resistance

2.5.5 Electrical characteristics

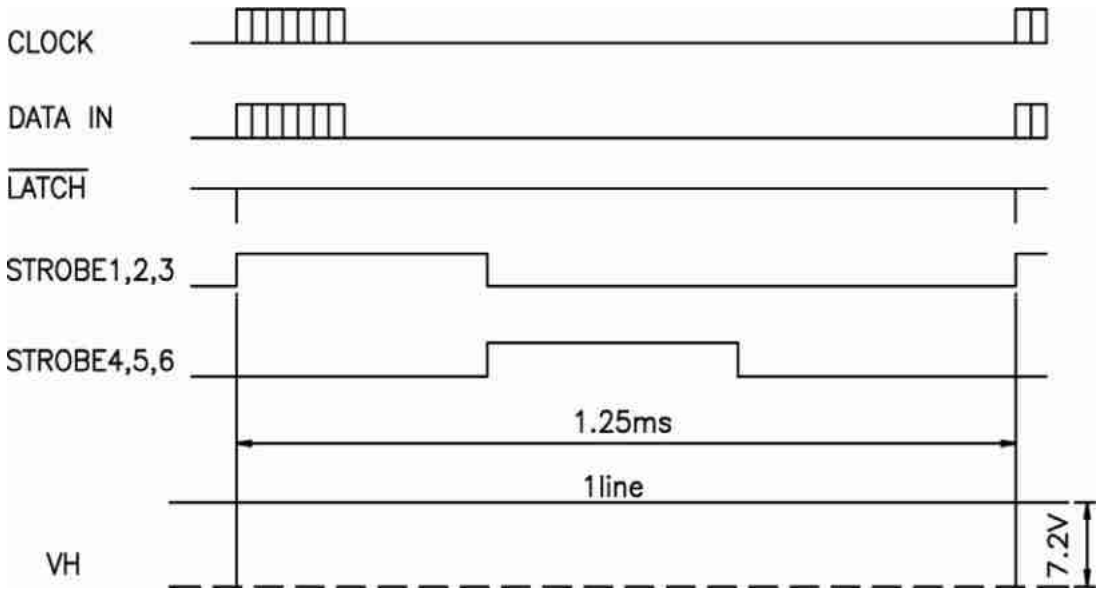
Item	Symbol	Min	Typ	Max	Unit
Print voltage	V_H	4.2	5.0	9.0	V
Logic voltage	V_{dd}	3.0	5.0	7	V
Logic current	I_{dd}			30	mA
Input voltage(HI)	V_{IH}	0.8 V_{dd}		V_{dd}	V
Input voltage(LO)	V_{IL}	0		0.3 V_{dd}	V
Latch input current(HI)	I_{IH}			3.0	μA
Heat input current(HI)				55	
Clock input current(HI)				3.0	
Data input current(HI)				0.5	
Latch input current(LO)	I_{IL}	-3.0			μA
Heat input current(LO)		-0.5			
Clock input current(LO)		-3.0			
Data input current(LO)		-0.5			
Output voltage(HI)	V_{OH}	0.9 V_{dd}			V
Output voltage(LO)	V_{OL}			0.2	V

2.5.6 Time characteristics

patameter	Symbol	Ratings			Unit
		Min	Typ.	Max	
Clock frequency	f_{max}			5.0	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
Strobe to driver Output delay time	t_d(DO)			26.0	μs



2.5.7 Timing chart



2.5.8 Pin Assignment

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

2.5.9 Thermistor resistance

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

Note:

R_{25}	30KΩ±5％
B	3950±3％
T	Degree（℃）
Range	-20℃－80℃

Thermistor value table

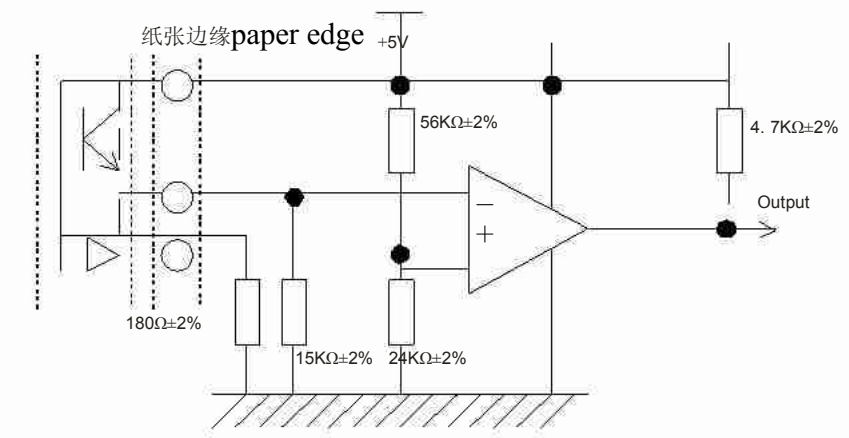
Temp.(ºC)	Resistance®		
	Min(KΩ)	Typ.(KΩ)	Max.(KΩ)
-40.0	717	843	989
-35.0	535	623	723
-30.0	405	466	535
-25.0	308	352	400
-20.0	238	269	303
-15.0	185	208	232
-10.0	145	161	178
-5.0	113	124	137
0.0	88.7	96.8	105
5.0	69.9	75.7	81.7
10.0	55.4	59.5	63.8
15.0	44.1	47.1	50.1
20.0	35.4	37.5	39.6
25.0	28.5	30.0	31.5
30.0	22.8	24.2	25.5
35.0	18.3	19.6	20.8
40.0	14.9	15.9	17.1
45.0	12.1	13.1	14.1
50.0	9.92	10.8	11.7
55.0	8.16	8.91	9.7
60.0	6.76	7.41	8.12
65.0	5.62	6.2	6.83
70.0	4.7	5.21	5.77
75.0	3.95	4.4	4.9
80.0	3.34	3.74	4.18

Handling precautions:

1. To protect the thermal head and to ensure personal and printer safety, thermal head temperature must be controlled in the recommend value.
2. When turning the power on or off, always DISABLE (put in Low state) the DST terminals. To prevent the thermal head from being damaged by static electricity:
3. when thermistorl resistant connected，abnormal thermal head Temperatures must be detected by both hardware and software。
4. Do not input a pulse over than 2V and 20 nsec to each signal terminal of the thermal head.
5. When turning the power on or off, always DISABLE (put in Low state) the DST terminals. Use C-MOS IC chips (74HC240 or equivalent) for CLK, LATCH, DAT and DST signals of the thermal head.
6. As a noise countermeasure, make the wire less then 100mm between Vh and GND, connect the 47μ F ceramic capacitor noted below between Vh and GND pinsnear the thermal head control connector. Add 0.1 μ F capacitor between Vdd and GND.
7. At power ON:1) Vdd 2) Vh, At shut down 1) Vh 2) Vdd
8 It may become the source of a corroded thermal head.If condensed, power off the Vp until dried。

2.6 Photo interruptor

TP486F has a built-in head-up detector to detect whether the head is up or down and a paper detector to detect whether paper is present or exhausted
The signal is high when the thermal head is in the up position. Otherwise it is low.
The signal is high when paper is exhausted. Otherwise it is low.
Photo interruptor sample driving Circuit as the following，Vdd can be select 3.3V or 5V。
When the hear is up or paper is exhausted，power must be turned off；when paper is exhausted，use a low speed to load the paper。



Absolute Maximum Ratings (Ta=25℃)

Parameter		Symbol	Ratings	Unit
Input	Power Dissipation at(or below) 25℃ Free Air Temperature	Pd	75	mW
		V_R	5	V
	Forward Current	I_F	50	mA
	Peak Forward Current Pulse width ≦ 100 μ s, Duty cycle=1%	I_{FP}	1	A
Output	Collector Power Dissipation	P_C	75	mW
	Collector Current	I_C	50	mA
	Collector-Emitter Voltage	B V_{CEO}	30	V
	Emitter-Collector Voltage	B V_{ECO}	5	V
Operating Temperature		Topr	-25~+85	℃
Storage Temperature		Tstg	-40~+85	℃
Lead Soldering Temperature (1/16 inch from body for 5 seconds)		Tsol	260	℃

(＊1) tw=100 μsec. , T=10 msec. (＊2) t=5 Sec

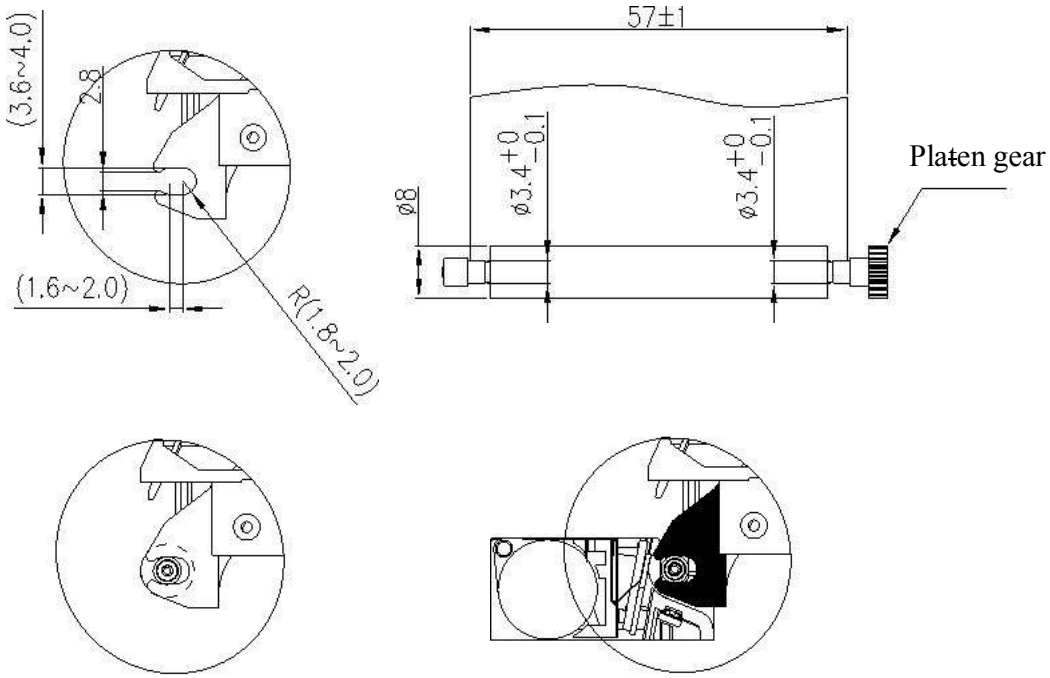
Electro-Optical Characteristics (Ta=25℃)

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
	Peak avelength	λp		940		nm	
	View Angle	2θ1/2		110		Deg	I =20mA
Outpu	Dark Current	I_{CEO}			100	nA	V_{CE}=10V
	C-E Saturation Voltage	V_{CE} (sat)			0.4	V	I_C=2mA I_B=0.1mA
Light Current		I_C(ON)	0.1			mA	V_{CE}=5V I_F=20mA
Leakage Current		I_{CEOD}			1	μA	
Speed	Rise time	t_r		20		μsec	V_{CC}=2V I_C=100 μA R_L =1K
	Fall time	t_f		20		μsec	

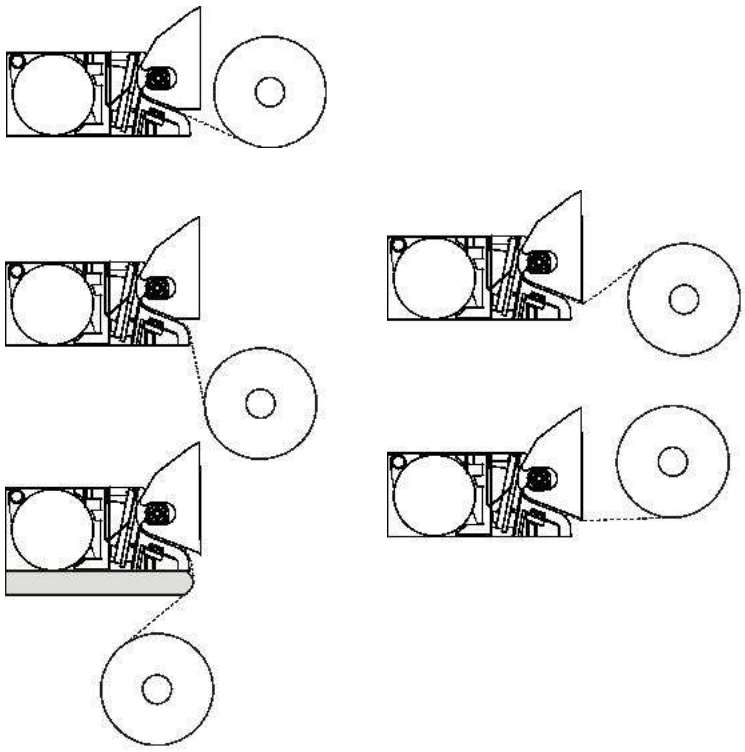
CHAPTER 3 HOUSING DESING GUID

3.1 Appearance and Dimensions

3.1.1 Structure and dimensions for easy paper load.

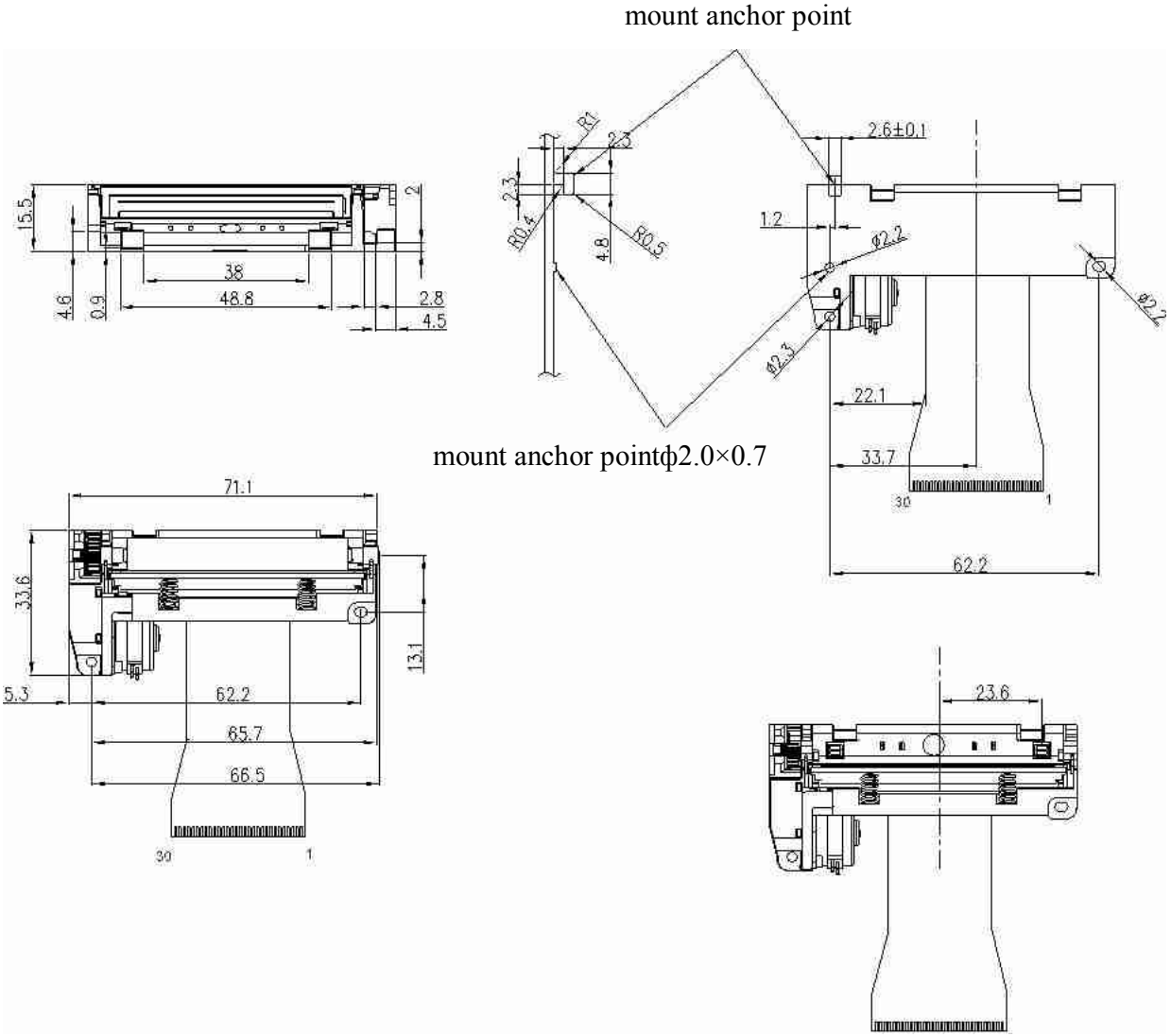


3.1.2 Mount roll paper position

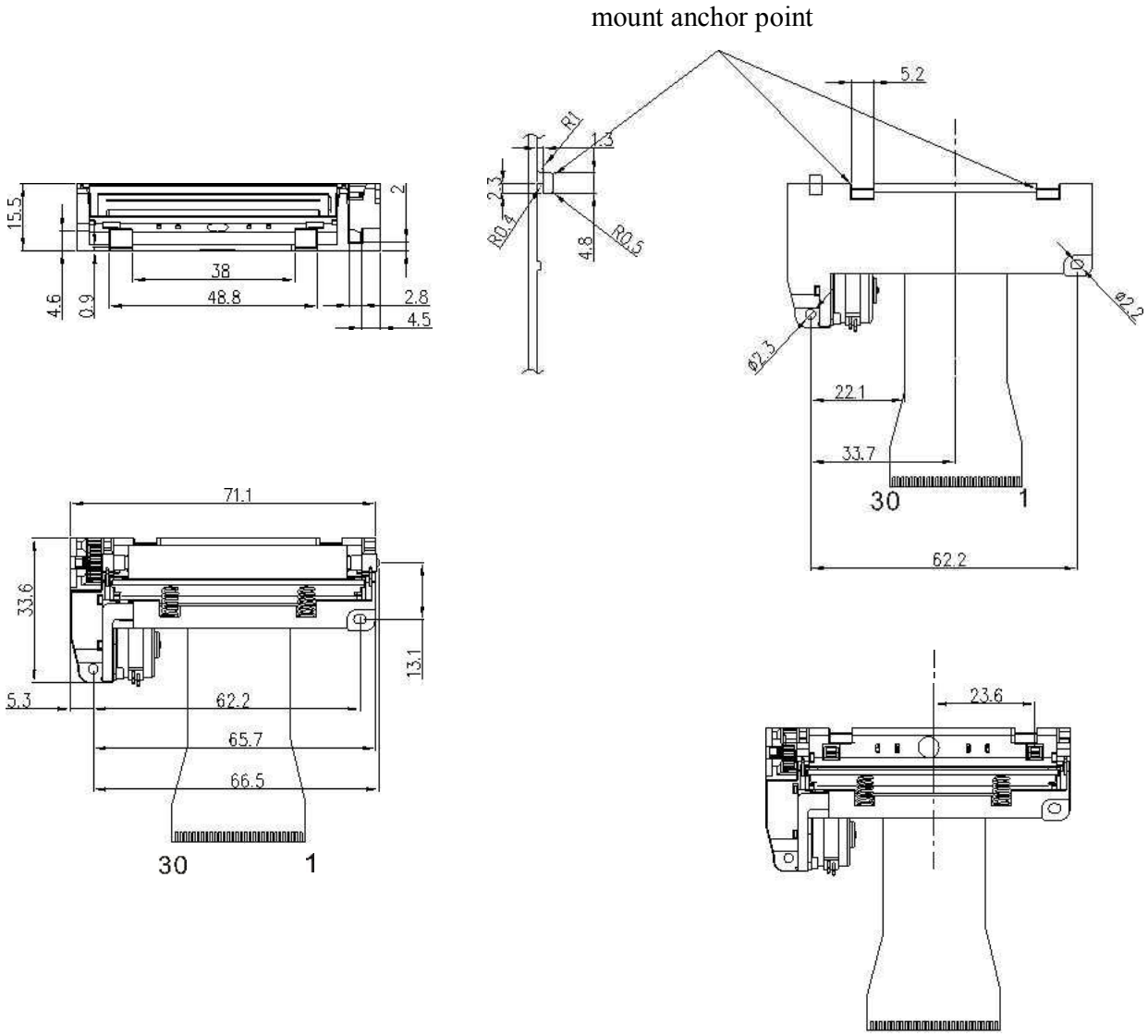


3.1.3 Mount dimensions

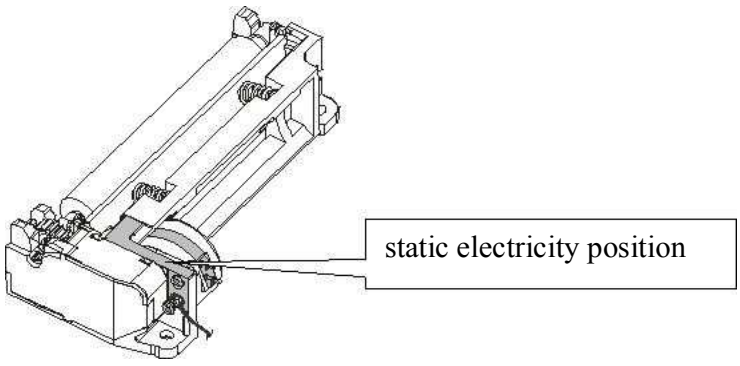
TP486F has two mount dimensions
Mount dimensions 1.



Mount dimensions 2



3.1.4 Positions for static board



3.2 DEMO Electronic element