Thermal Printer Mechanism

Fujitsu FTP-638MCL101 compatible

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Character & Operation precaution

1. Character

Low voltage supply

The voltage used to drive the thermal print head is equal to the logic voltage and is driven by a 3.0V~5.0V 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.

Compact design and lightweight

The mechanism is compact and light, with dimensions 92.3mm (L)*33mm (W)*15.2mm (D).

Printing with high resolution

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

High speed printing

Max printing speed is 60 mm/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 at 60dB.

2. Operation precaution

2.1When handling this printer, be sure to take any preventive measure against static electricity such as Disposable 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, do not attach any oil or grease and foreign material on the rubber part).

2.3 Never attempt to touch the thermal head surface with bear 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 a driver.

2.4 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. Using the printer with the part is deviated may destroy the head. Never attempt to touch FPC and the probe part of the signal line of FFC (parts which are soldering-plated) and not to hit them with something hard.

2.5 Do not perform the contact bending of FPC because it may cause the disconnection. If FPC requires to be bent, the bending should be more than R1.

2.6 This printer has a structure such that the platen part is removed from the printer cabinet; therefore, applying the load on the platen part allows removal of the part from the 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. In addition, when stopping the paper feeding with the hand cutter attached on the main body side, take extra care not to let the gear get of the track. Furthermore, installing any licking system on the casing side of the main body side is recommended.

2.7 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.

2.8 When any paper is not set at the printer, be sure to separate the head and the platen. 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 trouble of the printer.

2.9 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 65 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.

2.10 Never attempt to any back feeding action of the paper.

2.11 Regarding the printing quality and lifetime; therefore, carefully confirm the property of the paper before using.

2.12 Maximum number of heaters for simultaneous is 384.

2.13 When the printer is on standby, the thermal head (VH) must be switched off. During head power supply ON/OFF sequence, strobes should be kept "disable".
If the voltage including surge exceeds maximum rating of driver IC, the TPH may burn out by latch-up. Care should be taken especially when head current changes by strobes or at the ON/OFF sequence. The voltage shall be kept within the following voltage.

VH: 0V ~ +10V
Vdd: 0V ~ +7V
Other signals: GND-0.5V ~ Vdd+0.5V

2.14 When turning the power on or off, perform the VH and Vdd in the order of 1) and 2) as follows:

At power on: 1) Vdd → 2) VH

At power OFF: 1) VH → 2) Vdd

Specifications

1 General specifications

Item	Specs
Printing method	Thermal line dot printing
Number of dots/line	576
Resolution	8
Printing width (mm)	72
Paper width (mm)	80
Feed resolution (mm)	0.0625
W * D * H (mm)	92.3*33*15.2
Weight (g)	Approx. 48
Head temperature detection	By thermistor
Paper detection	By photo interrupter
Operation voltage (V)	4.2 ~ 8.5
Logical voltage (V)	3.0 ~ 5.25
Operating temperature (℃)	0 ~ 50(no condensation)
Operating humidity (RH)	20% ~ 85%(no condensation)
Storage temperature (℃)	-25 ~ 70(no condensation)
Storage humidity (RH)	5% ~ 95%(no condensation)

2 Thermal Print head configuration

2.1 Nominal parameters

Dots of line	576 dots
Heat	0.0625mm
Heat element pitch	0.11x 0.13mm
Paper feed pitch	0.0625mm
Print width	72mm
Paper width	80mm
Average resistance	176Ω±4%
Operation Voltage	4.2V to 8.5V
Pulse activation	10^8 pulse
Abrasion resistance	50km

The life expectancy conditions: 25 ℃, 12.5% printing duty or less.

2.2 Maximum rating

Parameter	Symbol	Specification	Note
Heater energy consumption	E_{omax}	0.36mJ/dot	Speed：2.5ms/line
Head voltage	V_H	10V	Between both Connectors
Logic voltage	V_{dd}	5.25V	
Environment temperature	T_a	-30℃ to +50℃	Suggest above5 ℃
Environment humidity		10% to 90%RH	no condensation
Maximum operation temperature	T_s	Continuous:65 ℃ 30min. MAX	When 80 ℃ was detected, Printing must be stopped, until the degree is below 60 ℃
		Peak: 80 ℃ Thermistor temp.	

2.3 Energy formula

Supply energy is defined by the following formula.

$$E_o = I_o{}^2 \overline{R} t_s = \frac{(VH - Vcom)^2 \times \overline{R} \times t_s}{(\overline{R} + R_{IC})^2}$$

include：

R_{IC}	11.7Ω
t_s	Heat time
V_H	Operation Voltage
$\overline{R}$	Average resistance

Vcom =0.3V

2.4 Standard printing conditions

Parameter		Symbol	Recommended operation conditions	Note
Heater power consumption		Eo	0. 24W/dot	$\overline{R}$ =176Ω Concurrent applied dot Number With 64 dots
Heat voltage		VH	7.2V	
Speed			2.5 ms/line	
Heater energy	5℃	Eo (ts)	0.28mJ/dot(1.18ms)	
	25℃		0.25mJ/dot(1.05ms)	
	40℃		0.22mJ/dot(0.92ms)	
Supply current		Io	36.8mA/dot	

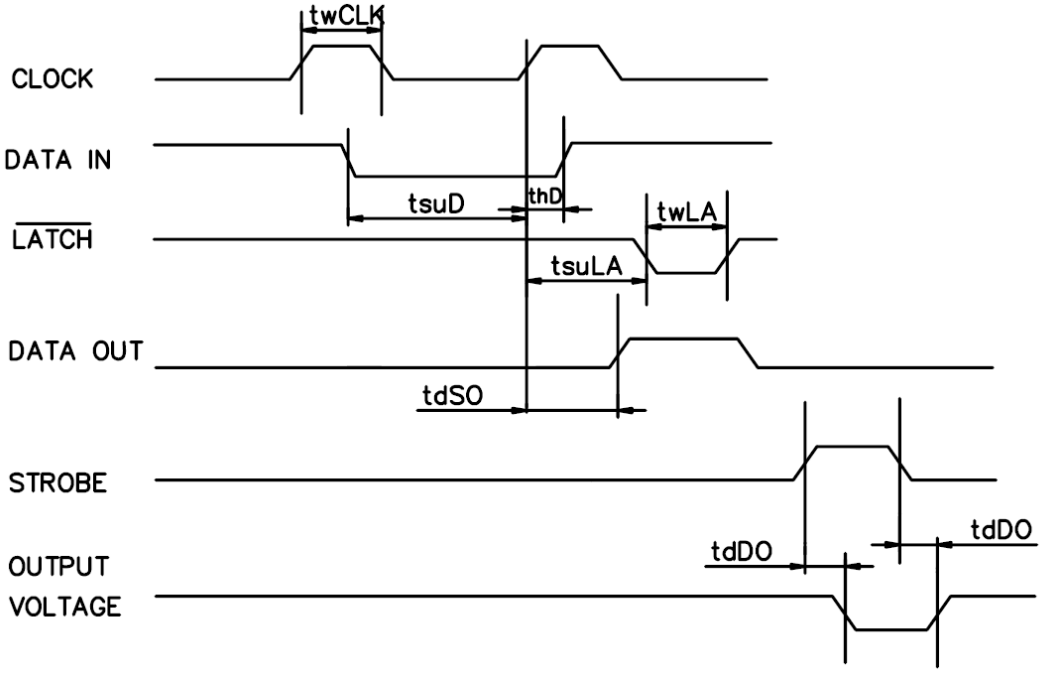
2.5 Electrical characteristics

Item	Symbol		Min	Typ.	Max	unit
Printing voltage	V_H				8.0	V
Logic voltage	V_{dd}		3.0	5.0	5.25	V
Logic current	I_{dd}	f_{CLK}=8MHz SI=1/2 f_{CLK}		31.5	90	mA
Input voltage(H)	V_{IH}	STB,DI,LAT, CLK	0.8xV_{dd}		V_{dd}	V
Input voltage(L)	V_{IL}		0		0.2xV_{dd}	V
Latch input current (H)	I_{IH}	V_{IH} =V_{dd}			4.5	μA
Heat input current (H)					110	
Clock input current (H)					4.5	
Data input current (HI)					0.5	
Latch input current (L)	I_{IL}	V_{IL}=GND	-495			μA
Heat input current (L)			-1.0			
Clock input current (L)			-4.5			
Data input current (L)			-0.5			

"L" Output voltage of drivers	V_{DOL}	*Vdd*=3V I_{DOL}=60mA		0.7	0.9	V
Leak current of drivers	I_{LEAK}	V_{OH} = 8 V			1.0	μA/dot
"H" lever output	V_{OH}	I_{OH}=-0.5mA	2.6			V
"L" lever output	V_{OL}	I_{OH}=0.5mA			0.4	V

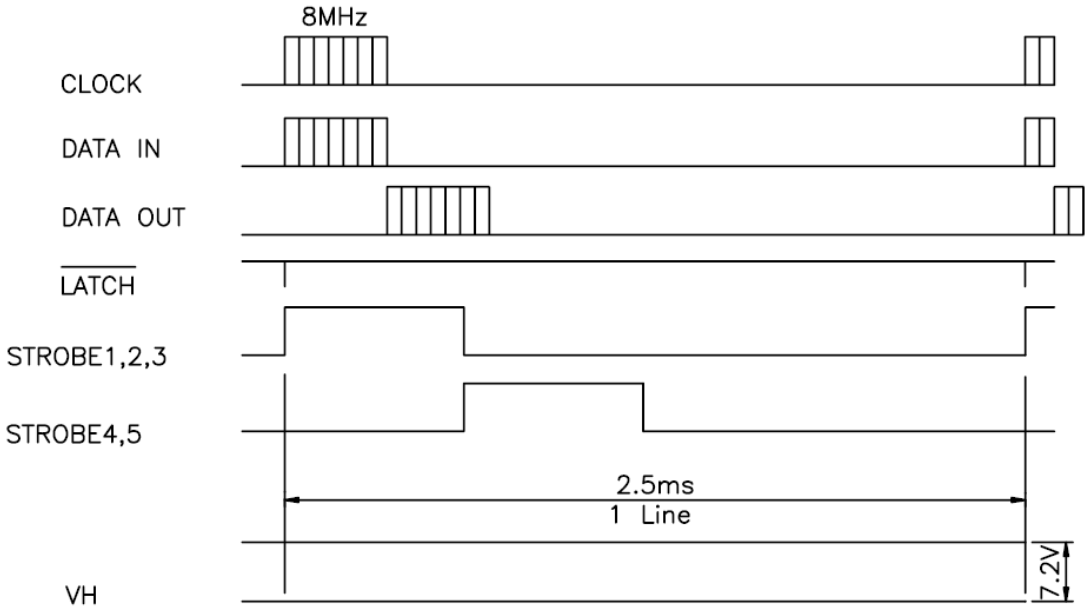
2.6 Time characteristics

Parameter	Symbol	Ratings			Unit
		Min	Typ.	Max	
Clock frequency	f_{MAX}			8.0	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
Clock to So delay time	t_d(SO)			130	ns
Strobe to driver Output delay time	t_d(DO)			26.0	μs

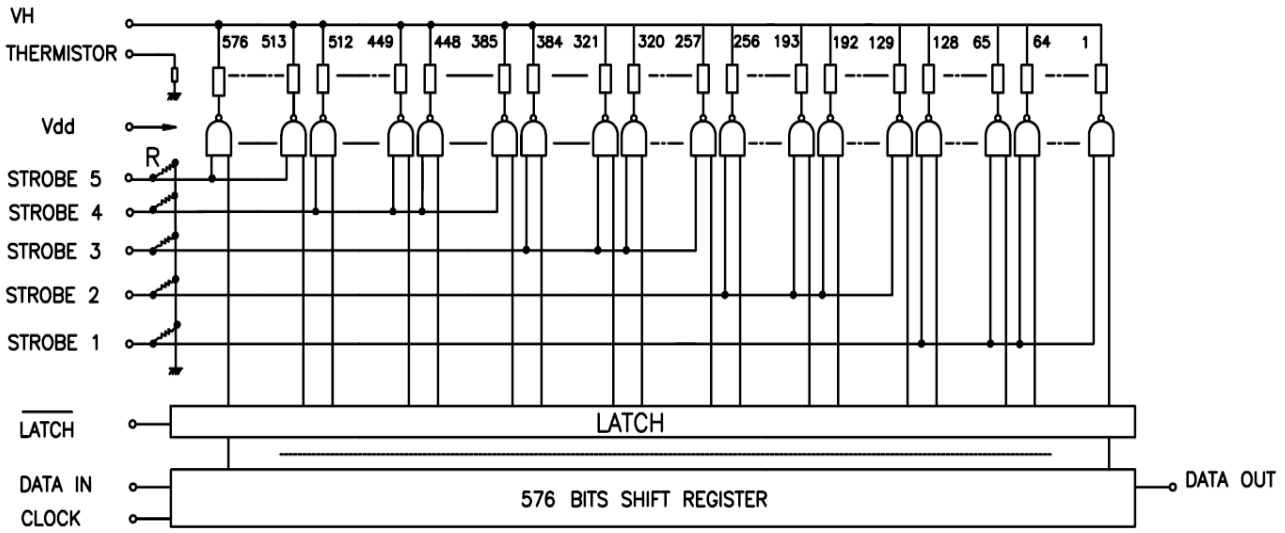


2.7 Thermal Print Head Timing Chart

The following is suggested. It needs that the system can provide enough current.



2.8 Schematic diagram



2.9 Thermistor

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

Note:

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

Temp. (℃)	Res. (KΩ)	Temp. (℃)	Res. (KΩ)	Temp. (℃)	Res. (KΩ)	Temp. (℃)	Res. (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 Stepping motor

The paper will be feed 0.0625 mm depends on the each single step.

3.1 Stepping motor phase

Drive the motor with the 2-2 phase excitation of the bipolar. The reference excitation method is described below.

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

3.2 Stepping motor configuration

Item	Spec.	Cond.
Working voltage	4.2 to 8.5V	
Feed resolution	0.0625mm	
Coil resistance	10Ω±7％	At 20℃
Coil current	0.357A	
Life	3000h	

3.3 Driving the bipolar transistor

3.3.1 Drive the motor by the fixed current control for the output torque stabilization to the applied voltage change. This reference excitation current is 440mA. Applying any excessive electric current will cause the abnormal generation and the excessive torque, which will end in mechanical damages.
Therefore, do not apply any electric current that exceeds the requirement.

3.3.2 Determine the motor driving requirements after confirming effects of load variations caused by temperature, the humidity, and types of paper. If the motor is driven by any excessive torque, the gears may be damaged when the paper is locked; therefore, attention should be paid.

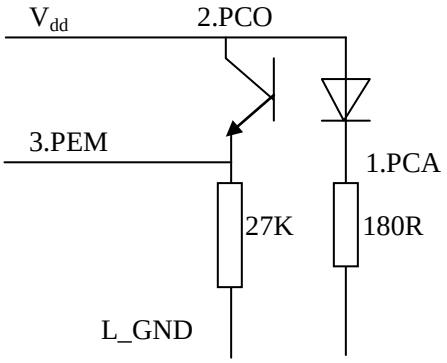
3.3.3 In the low-speed drive (the low driving frequency), abnormal noises and the torque reduction may occur due to resonance of the motor. In the low-speed drive, be sure to perform sufficient evaluation and confirmation.

3.3.4 At the start of the high-speed printing and the start of the printing after turning off the motor excitation, perform the speedup control.

4 Out of paper detection

The printer has a built-in paper detector (reflection type photo interrupter) to detect if paper is present or not. In addition, it can be used as the paper-positioning tool by seeking the mark.
An external circuit should be designed so that it detects output from the paper detector and does not activate the thermal head and motor when there is no paper. Not doing so may cause damage to the thermal head or platen roller, or significantly shorten the life of the head.

Sample External Circuit



General Specifications

Item		Symbol	Condition	Value			Unit
Input	Forward voltage	V_F	I_F=20mA	1.0	1.2	1.5	V
	Reserve current	I_R	V_R=5V			10	μA
Output	Collector-emitter breakdown voltage	BV_{CEO}	I_C=0.5mA	30			V
	Emitter-collector breakdown voltage	BV_{ECO}	I_E=0.1mA	5			V
	Dark current	I_{CEO}	V_{CE}=10V			100	nA
Coupling	Collector-emitter saturation voltage	$V_{CE(SAT)}$	I_C=2mA E_e=1mW/cm^2			0.4	V
	Detect distance	d					mm
	Leak current	I_{LEAK}	I_F=10mA V_{CE}=5V			50	μA
	Rise/Fall Time	t_r/t_f	V_{CE}=5V I_C=1mA R_L=1000Ω			15/15	μs

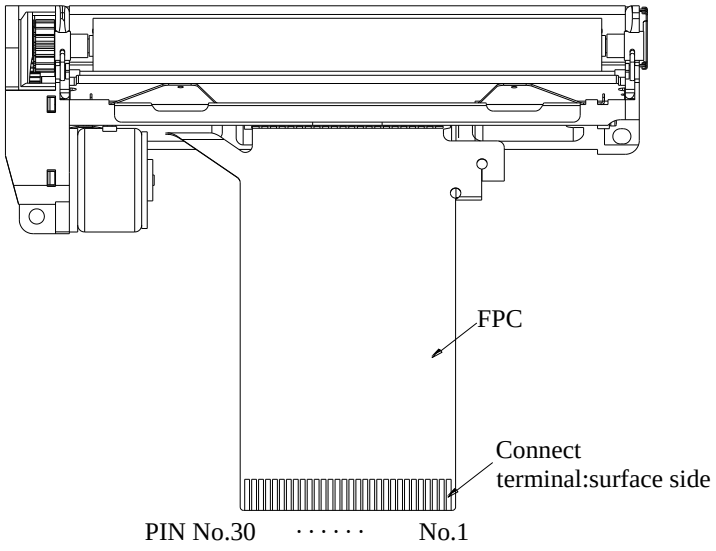
5 Platen release switch specifications

This printer is built in a sliding switch for detecting whether the platen is released.

Item	Specifications
Rated voltage	DC5V
Rated current	1mA
Contact resistance	Equal or less than 1Ω

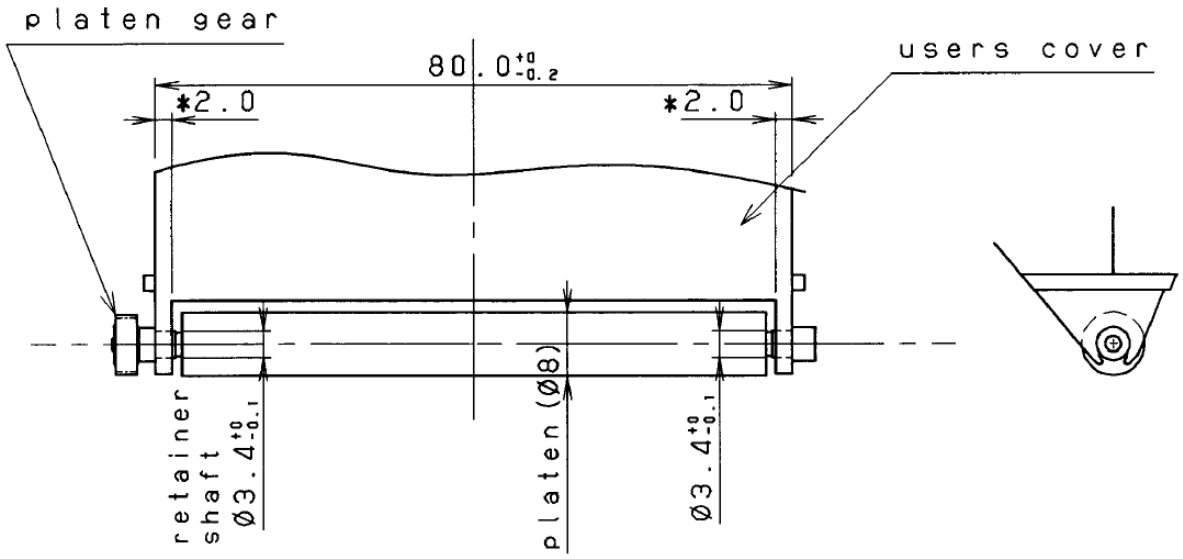
6 Pin assignment

No.	Symbol	Signal name
1	PCA	Cathode for photo interrupter
2	PCO	Paper sensor power
3	PEM	Emitter for photo interrupter
4～5	NC	No connect
6～7	VH	Head drive power
8	DI	Data in
9	CLK	Clock
10～11	P_GND	Head ground
12	STB5	Strobe 5
13	STB4	Strobe 4
14	STB3	Strobe 3
15	Vdd	Logic power
16	TM	Thermistor
17	STB2	Strobe 2
18	STB1	Strobe 1
19	NC	No connect
20	NC	No connect
21～22	P_GND	Head ground
23	\LAT	Data latch
24	DO	Data out
25～26	VH	Head drive power
27	PA	Excitation signal A
28	\PA	Excitation signal \A
29	PB	Excitation signal B
30	\PB	Excitation signal \B



7 Mechanism design

7.1 The figure of the retainer dimension



Notes:

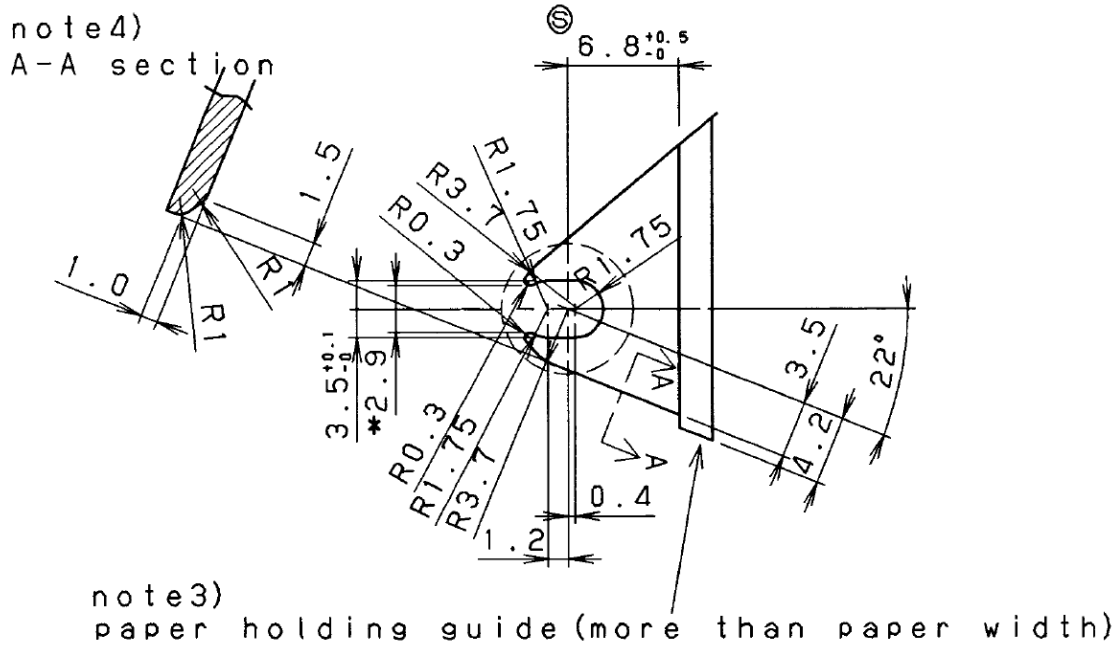
1.* the dimension is a recommended one.

2. Ⓢ shows the center line of the platen set in the main body of the printer.

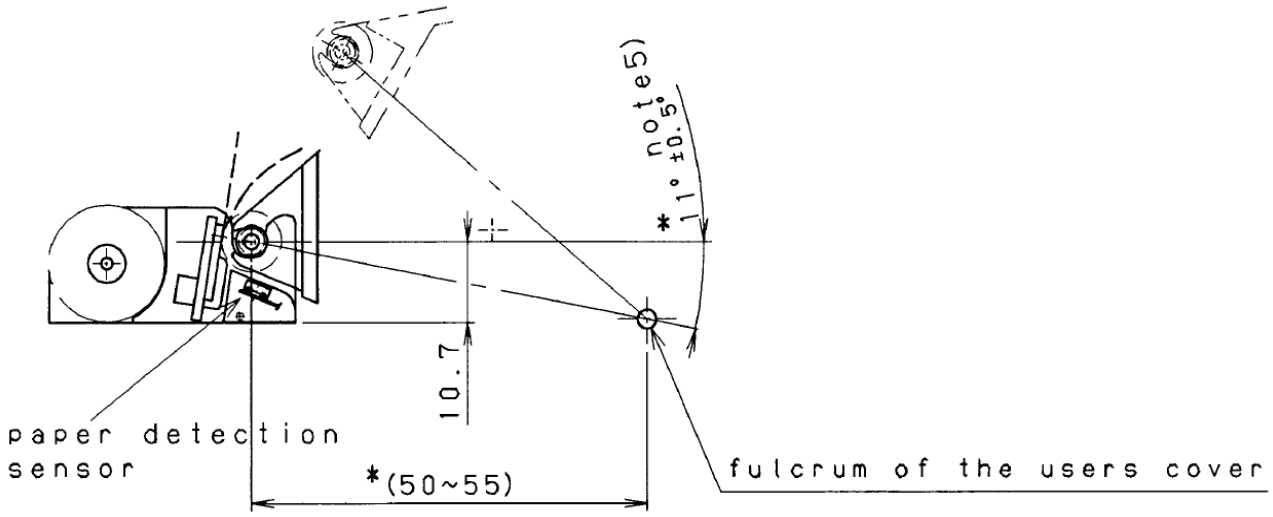
3. Install the paper holding guide to achieve the output stabilization of the paper detection sensor.

4. You are requested to chamfer both outside of the retainer as shown in A-A cross section so that the main body of the printer.

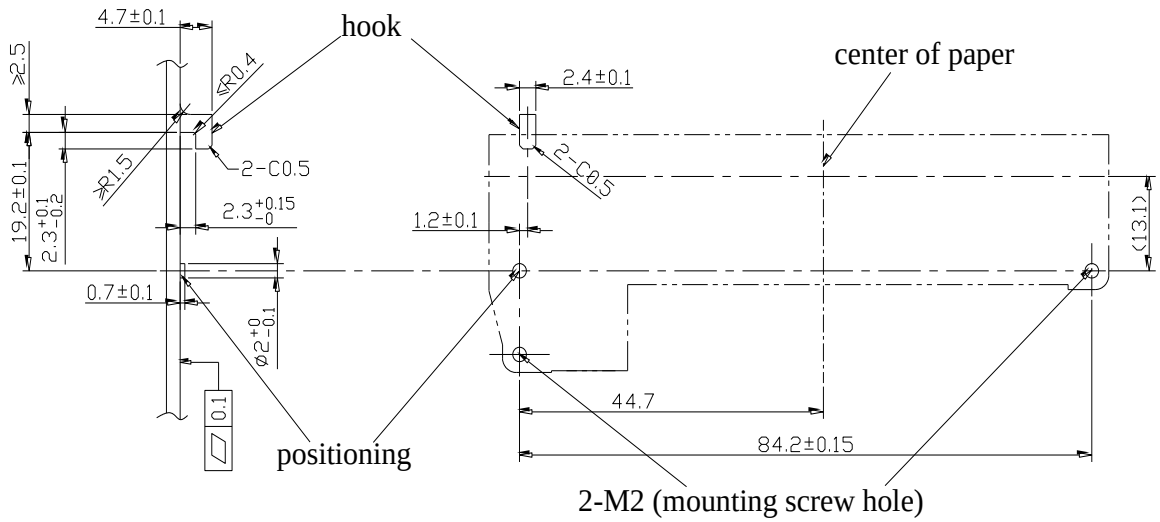
7.2 Expansions figure of the retainer (both sides are the same shape)



7.3 Fulcrum position of the user cover



7.4 Mounting position



7.5 External dimensions