BIXOLON

User's Manual

SMP685

Thermal Printer Mechanism

Rev. E

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REVISION SHEET

Revisions		Design section			Revision	
REV.	Date	WRT	CHK	APL	Page	Description
A	08.10.20	J.K.KIM	J.S.LEE	J.T.KIM	-	
B	09.09.28	J.K.KIM	J.S.LEE	J.T.KIM	-	Spec revision
C	12.09.19	J.K.KIM	J.K.KIM	J.G.KIM		Spec revision
D	13.05.15	M.W.LEE	J.S.LEE	J.T.KIM		Spec revision(685CB)
E	20.06.24	M.H.YU	J.S.LEE	J.S.LEE	ALL	Modified Contents & Spec revision

■ Table of Contents

■ Precautions

Read this manual carefully and be familiar with the contents when you design printers or terminals using the printer mechanism (SMP685).

BIXOLON is not responsible for any damage or loss occurring through improper handling of printer mechanism, or use of the product in a way that is not described in this manual, or other components of your company configuring the system.

The printer mechanism has been designed and manufactured for the purpose of mounting on general purpose electronic equipment.
Additional design and performance verification will be required in order to use this product where high responsibility is required such as danger of bodily injury or life or property loss. Please contact sales representatives of BIXOLON in this case.

Intellectual property infringement has not been fully investigated for the sample circuits included in this document. Check the intellectual properties thoroughly on the circuit before using it.

BIXOLON makes continuous improvements for the purpose of functional and performance improvement.
The specifications of the product and contents of this manual are subject to change without prior notice for this reason. Check the latest user's manual when you purchase the printer mechanism.

※ Safety Precautions

Take precautions with the following items when you design terminals or other products using the printer mechanism. Include the required precautions in the user's manual so that users can use the products such as terminals safely.

a) Precautions to prevent overheating of thermal head

When heating device of the thermal head is activated continuously due to malfunction, it may cause fire due to overheating of the thermal head. Design the system to prevent malfunction of the thermal head in case of abnormal conditions.

b) Precautions on temperature increase of the thermal head

The temperature of the thermal head and peripheral devices may increase significantly. Design the system to prevent burn injuries that could occur when user touches the thermal head. Attach a warning label so that users can use the device safely. Give warning to users so that they clean the thermal head only after it has cooled down. Leave sufficient space between the thermal head and the external case when designing the external case for faster cooling of the thermal head.

c) Precautions on the increase of motor temperature

The temperature of the stepping motor and peripheral devices may increase significantly during and right after printing. Design the external case to prevent burn injuries to users that could be caused when they touch the motor. Attach a warning label so that users can use the device safely. Leave sufficient space between the motor and external case when designing the external case for better motor cooling.

d) Precautions for motor drive

User's hair may get caught between the platen roller and gear if they get too close. Design the system to prevent printer motor drive when the external case and platen roller block are open. Design the system to prevent contact between the external case and the platen roller and gear, and prevent the object jamming. Attach a warning label so that users can use the device safely.

※ Design Precautions

Take precautions on following items when designing products such as terminals using the printer mechanism.

a) Power on sequence should be as follows.
- Startup: Apply Vdd and then Vp
- Shutdown: Shutdown Vp and then Vdd

b) The surge voltage between Vp and GND should be less than 10V.

c) Connect 0.1 uF capacitor between Vdd and GND near to the connector in order to prevent noise.

d) The resistance of the wire connected between the power supply device (Vp and GND) and the printer mechanism (terminal connection) should be as low as possible (less than 50mΩ). Leave sufficient space between signal lines to prevent interference.

e) Shutdown Vp supply while the printer is not printing to protect the thermal head from electrolytic corrosion. Design your system to maintain the same potential for the GND signal of the thermal head and the frame ground of the printer mechanism.

f) Use C-MOS IC for signals like *CLK, nLAT, SI,* and *STB.*

g) Never use the *STB* terminal during power shutdown or when the printer is not printing.

h) Never activate the thermal head if platen roller block is open and there is no paper. Incorrect activation of thermal head may damage or reduce the lifespan of the thermal head and the platen roller.

i) The temporary pause time between the activation of the same thermal device should be at least longer than 0.5 ms. Precautions should be taken when using 1 section printing or when the thermal head activation time becomes longer. Activation of the thermal head without pause for a long time may damage the thermal head.

j) Force to feed the paper may be reduced depending on the motor pulse speed. Check the actual performance while you use the device.

k) Do not move the thermal paper backward. If the thermal paper breaks away from the thermal head of platen roller, the printer mechanism may not feed the paper or a paper jam may occur.

l) Continuous printing may cause issues in the printer mechanism due to accumulated heat in the stepping motor. If there is a need to print continuously for several minutes, stop the printing the middle and restart the printing when the step motor has cooled down sufficiently. Check the actual performance while you use the device.

m) The door rotation system of the external case that holds the platen block should be installed while pressing down the center of the platen roller block. If it is installed by pressing down one side of the platen roller block, it may cause a printing problem or paper jamming. Check the actual performance while you use the device. Provide instructions to press down the center of the platen roller block during installation.

n) Provide sufficient space when designing the external case so that user can remove the lever easily using the fingers.

o) Printing quality cannot be guaranteed if thermal paper that is not recommended is used and it may reduce the life span of the thermal head.

p) The area of sensing by the paper detection sensor changes depending on the input and output resistance. Refer to the paper detection sensor sample circuit in 7-1-3. Check the performance by using the device in actual conditions.

q) Move the paper feed motor forward in 4 ~ 8 steps when you first turn on the power after product design or reattaching the separated platen roller block. Otherwise the first line will be overlapped. Check the performance by using the device in actual conditions.

※ Precautions in Handling

Incorrect handling may damage or reduce the efficiency of the printer mechanism. Take precautions with the following.

* If papers that are not recommended are used
  - Printing quality drops due to low thermal sensitivity.
  - The thermal head may wear out more quickly because the surface of the thermal paper is coarse.
  - The thermal layer of the thermal paper may get stuck to the thermal head causing printing problems and generating noise.
  - The preservation performance is poor and the printing may be discolored.
  - Electrolytic corrosion may occur due to low quality paper.

a) If the printer mechanism is left unused for an extended period of time, printing quality may be degraded due to deformation of the platen roller. In this case, feed the thermal paper for a while so that the deformation of the platen roller is reduced. Paper feeding may become difficult if the thermal head is in contact with the roller without thermal paper because the platen roller and thermal head may get stuck. In this case, separate the platen roller and install the paper again.

b) Do not separate the platen roller block during printing.
It may damage the printer mechanism.

c) If it is difficult to install the platen roller because the reduction gear is sticking out, separate the platen roller and install the block again.

d) Never pull out the thermal paper while installing the platen roller block. It may damage the printer mechanism.

e) Do not apply the platen roller block during printing. It may case defects in printing quality.

f) Wear electrostatic prevention clothes when you handle the printer mechanism to prevent damage to the thermal head from static electricity by discharging the static charges in your body by touching metal substances. Pay extra care when handling the thermal device on the thermal and connection terminals.

g) Do not scratch or scrub the thermal head with sharp of heavy objects. It may damage the thermal head.

h) High speed printing in low temperature or very humid environment may cause condensation in the printer mechanism due to water vapor evaporated from the thermal paper and it may damage the thermal paper. Do not apply power until the moisture is completely dried.

i) Connect or disconnect the printer mechanism connection terminal (printer connection terminal) only after turning off the printer mechanism.

j) Do not apply force to FPC while connecting and disconnecting the connection terminal (printer connection terminal). It may damage FPC.

k) Provide a warning to users so that they do not change the thermal paper discharge angle and do not pull the paper during printing. It may case printing defect or paper jamming.

l) Provide a warning to users so that they do not touch the thermal head and sensor when replacing the thermal paper due to damaged thermal paper or printing defects.

m) Do not use paper rolls with glue at the tip or folded ones. If this kind of paper is used, replace it with new paper before the tip appears.

n) Never unscrew the screws that hold the parts configuring the printer mechanism. Unscrewing them may degrade the performance of the printer mechanism.

o) The printer mechanism is not waterproof and is susceptible to water damage. Do not let it get exposed to water and do not handle it with wet hands. It may damage the printer mechanism or cause a fire due to short circuit.

p) The printer mechanism is susceptible to dust. Do not use the printer mechanism in dusty places. It may damage the thermal head and paper drive system.

■ Features of SMP685 printer mechanism

This printer mechanism has the following features.

*** High Speed Printer**
- Support up to 90mm per second of printing speed.

*** High Resolution Printing**
- Smooth and accurate printing is supported using high-density printer head with a density of 8 dots/mm.

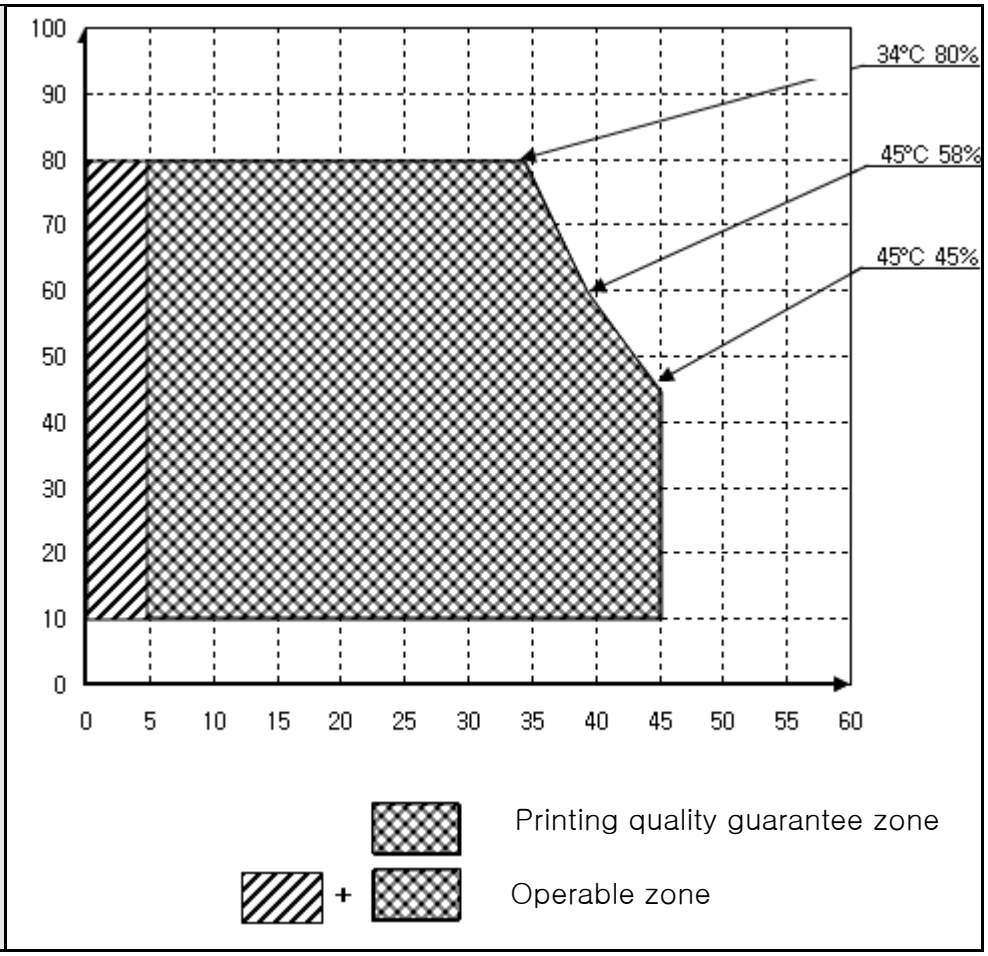
*** Small and Economic Size**
- The product is designed in compact size.

*** High Reliability**
- 50km printing life is guaranteed.

*** Low Noise**
- Printing noise is small with thermal printing method.

1. Specifications

Printing method	Thermal Dot Line Printing
Resolution	8 dots/mm
Number of dots per line	384 dots
Simultaneously activated dots	64dots
Printing width	48mm
Printing speed	90mm/s (at 8.5V) *** Note. 1)**
Paper feed gap	0.0625mm (at 2-2Phase) *** Note. 2)**
Paper width	58 0, -1 mm
Paper diameter	Max. 80mm
Head temperature detection	Via thermistor
Out of paper detection	Via photo interrupter
Operating voltage	4.75 ~ 9.5VDC (Vp line : TPH, Step motors) 2.7 ~ 5.25VDC (Vdd line : Logic)
Power consumption	Head : 3.2A(at 64dots, 9.5V) *** Note. 3)** Motor paper feed : 0.6A (Max. current) Head Logic : 0.1A
Paper feed loading	Min. 100gf
Product life (25°C, normal energy)	Activation pulse resistance : 100million Abrasion resistance : 50km
Impact resistance	Package : Bixolon standard package Height : 75 cm Directions : 1 corner, 3edges and 6 surfaces
Recommended paper	A. TF50KS-E2D(Paper thickness : 65 μm) of Nippon paper Industries Co., Ltd B. PD 160R(75 μm) of New Oji Paper Mfg, Co., Ltd. C. P350(62 μm) of Kanzaki Specialty Paper, Inc.(USA) D. Hansol Thermo 65(65 μm) of Hansol Paper Co., Ltd.(Korea)
Size (Width x Length x Height)	67.2mm(H) x 33mm(D) x 17.4mm(H)
Weight	35.0g
Temperature range	Operating : 0°C to 45°C Storage : -20°C to 60°C (no condensation)
Humidity range	Operating : 10 to 80% RH Storage : 90% RH

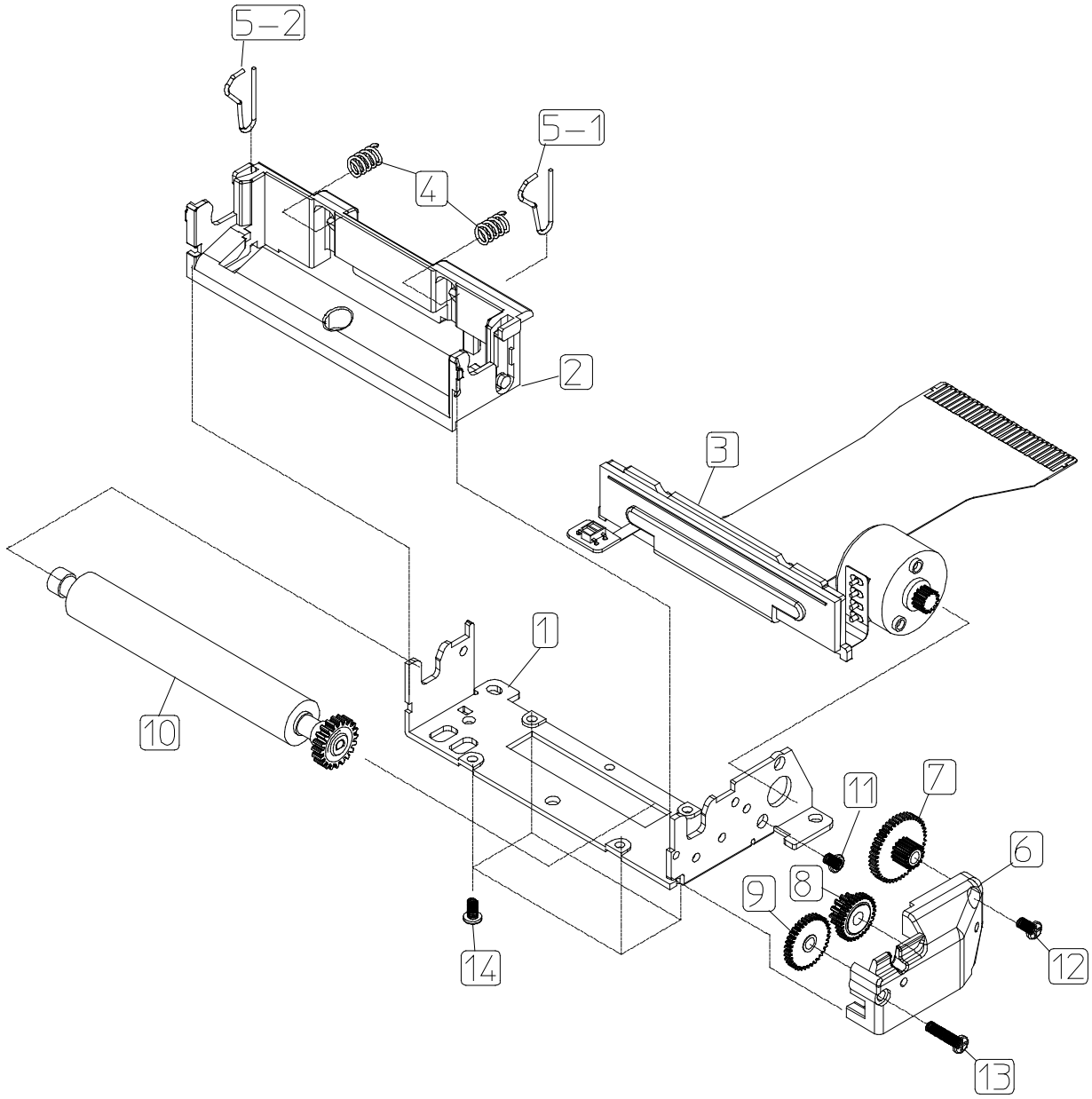
Operation conditions by temperature / humidity	

***Note. 1)** Printing speed depends on the controller processing speed and strobe pulse width.

***Note. 2)** In case of motor driving 1-2 phase, paper supply interval : 0.03125mm

***Note. 3)** Current value when all 64 dots are printed.

2. Exploded View



3. Component Names

No	Parts No	Name	Specifications	Q'ty	A/S
1	KP05-00023A	Frame lower	SECC T1.0(685CB/CJS)	1	N
	KP05-00023B		SECC T1.0(685CK)		
2	KM05-00019A	Frame upper	PC-GF10(685CB/CJS)	1	N
	KM05-00019B		PC-GF10(685CK)		
3	AE05-00033B	Ass'y TPH (AOI)	TPH(AOI)+FPC(S)+Bracket +Sensor+Motor(685CK)	1	N
	AE05-00034B	Ass'y TPH (AOI, FPC L)	TPH(AOI)+FPC(L)+Bracket +Sensor+Motor(685CJS)		
	AE05-00037B	Ass'y TPH (AOI)	TPH(AOI)+FPC(S)+Bracket +Sensor+Motor(685CB)		
	KF05-00038R	Ass'y TPH (Rohm)	TPH(Rohm)+FPC(L)+Bracket+ Sensor+Motor(685CK)		
	KF05-00037R	Ass'y TPH (Rohm, FPC L)	TPH(AOI)+FPC+Bracket +Sensor+Motor(685CJS)		
	KF05-00039R	Ass'y TPH (Rohm)	TPH(Rohm)+FPC+Bracket+ Sensor+Motor(685CB)		
4	KS05-00009C	Spring pressure	SUS304	2	N
5-1	KS05-00011B	Spring roller	SUS304(685CB/CJS)	1	N
	KS05-00010A		SUS304(685CK)		
5-2	KS05-00011C	Spring roller	SUS304(685CB/CJS)	1	N
	KS05-00010A		SUS304(685CK)		
6	KM05-00018A	Frame gear	POM(685CB/CJS)	1	N
	KM05-00018B		POM(685CK)		
7	KM05-00010A	Gear deceleration A	POM, White	1	N
8	KM05-00011A	Gear deceleration B	POM, White(685CB/CJS)	1	N
	KM05-00011B		POM, Blue(685CK)		
9	KM05-00012A	Gear deceleration C	POM, White(685CB/CJS)	1	N
	KM05-00012B		POM, Blue(685CK)		
10	AR05-00018B	Ass'y Platen roller (White Gear)	SUS303+Silicone+Washer + Bush bearing(685CB/CJS)	1	Y
	AR05-00018C	Ass'y Platen roller (Blue Gear)	SUS303+Silicone+Washer + Bush bearing(685CK)		
11	KC05-00014A	Screw- Machine	M1.7*2	1	N
12	KC05-00015A	Screw- Machine	M1.7*3	1	N

13	KC05-00007A	Screw-Tapping	M1.7*7	1	N
14	6002-001052	Screw-Tapping	M1.7*3	4	N

4. Connector Pin Arrangement

4-1 Main FPC Cable (1mm 30Pin)

Pin No.	Signal	Function
1	PS_IN	Cathode for photo interrupter
2	VSEN	Photo interrupter power
3	PS_OUT	Emitter for photo interrupter
4	NC	Non connector
5	NC	Non connector
6	Vp	Print Supply Voltage
7	Vp	Print Supply Voltage
8	DI	Data IN
9	CLK	Clock
10	GND	Ground
11	GND	Ground
12	STB6	Strobe 6
13	STB5	Strobe 5
14	STB4	Strobe 4
15	V_{DD}	Logic Voltage
16	TH1	Head Thermistor
17	TH2	Head Thermistor
18	STB3	Strobe 3
19	STB2	Strobe 2
20	STB1	Strobe 1
21	GND	Ground
22	GND	Ground
23	/LAT	Latch(Low Active)
24	DO	Data OUT
25	Vp	Print Supply Voltage
26	Vp	Print Supply Voltage
27	OUT2	Stepping Motor signal
28	OUT1	Stepping Motor signal
29	OUT3	Stepping Motor signal
30	OUT4	Stepping Motor signal

※ User recommended connector : 1mm pitch 30pin FFC/FPC CONNECTOR

5. Thermal Printer Head

Thermal head comprises a thermal device and thermal head driver that drives and controls the thermal device. Data input coming from SI terminal is “High” for printing and “Low” for not printing. The data coming from SI terminal are transmitted to the shift registers at the rising edge of the CLK signal.

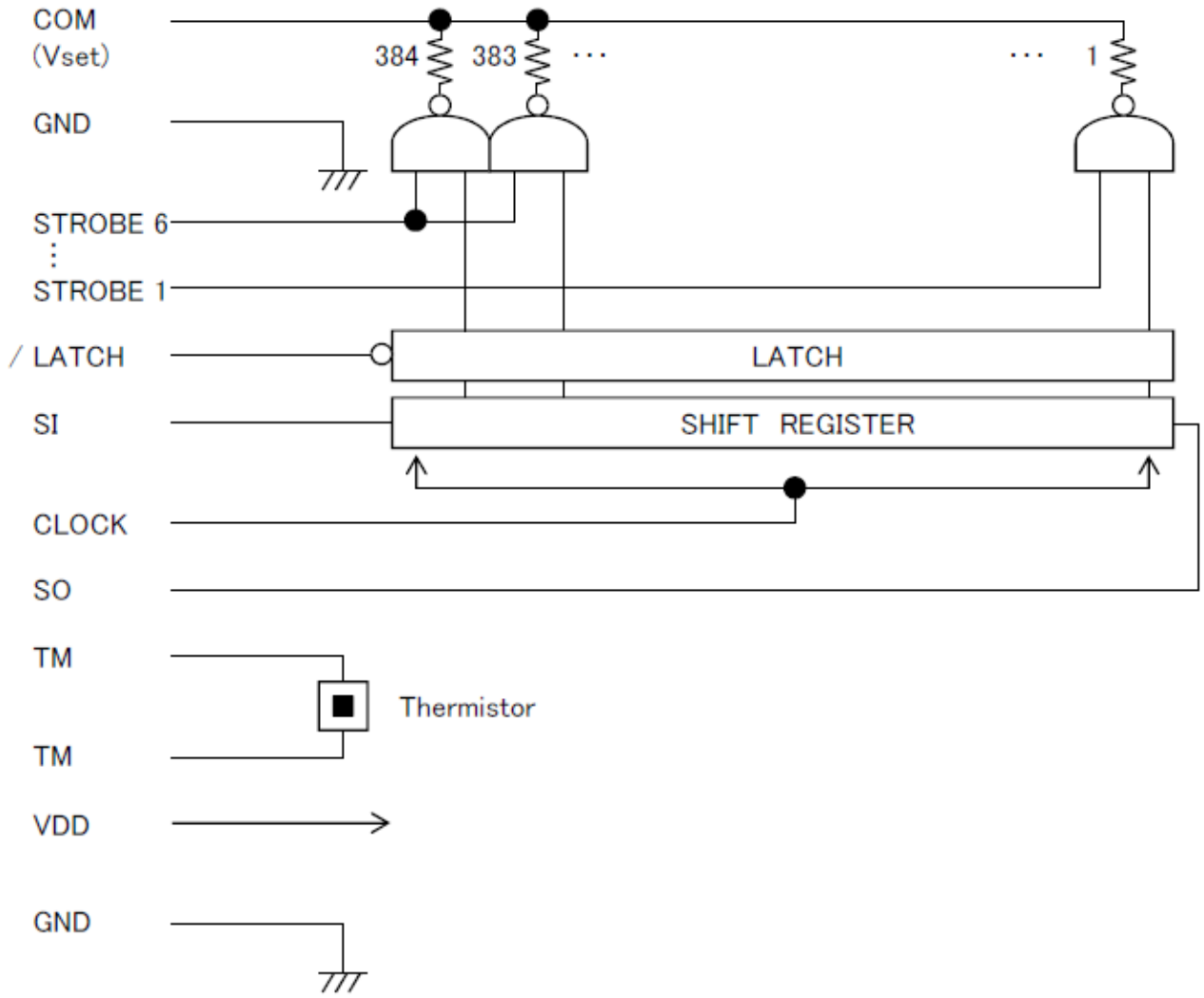
After transmitting one line data, nLAT signal becomes “Low” and data are transferred to the latch registers. STB signal becomes “High” depending on the stored printing data and thermal device is activated.

Division printing of 6block with 64 dots each is supported.
Division printing can reduce the peak current.

5-1 Specifications

Printing width	48mm
Total number of dots	384 dots / Line (2heaters/dot)
Dot density	8 dots/mm
Dot pitch	0.125mm
Average resistance	R_{ave} 176 Ω ± 4%
Thermister specifications	30kΩ (B=3950K)

5-2 Head Block Diagram

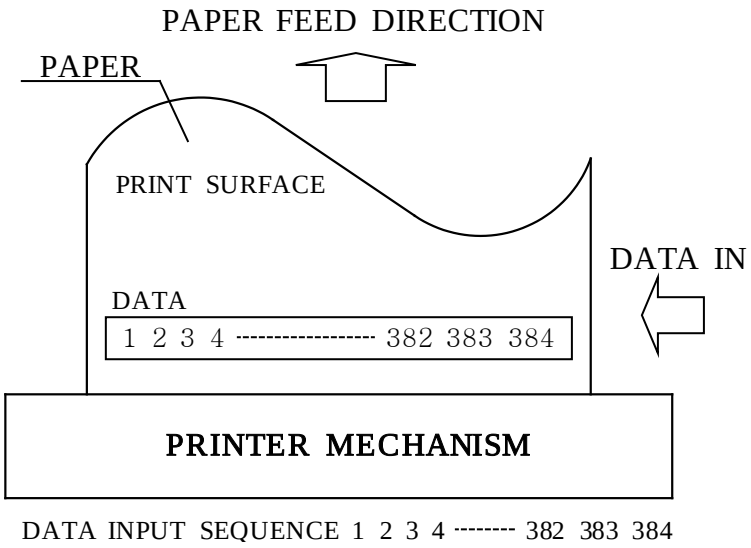


COM: TPH Supply voltage (Vset)
STB: STROBE (High active)
nLAT: /LATCH (Low active)
CLK: CLOCK
SI: Data input
SO: Data output
TM: Thermistor
VDD: TPH Logic voltage
GND: Ground

※ Relationship between STB terminal and activated thermal device

Block No.	STB number	Heating element number	Dots / STB
1	STB1	1 ~ 64	64
2	STB2	65 ~ 128	64
3	STB3	129 ~ 192	64
4	STB4	193 ~ 256	64
5	STB5	257 ~ 320	64
6	STB6	321 ~ 384	64

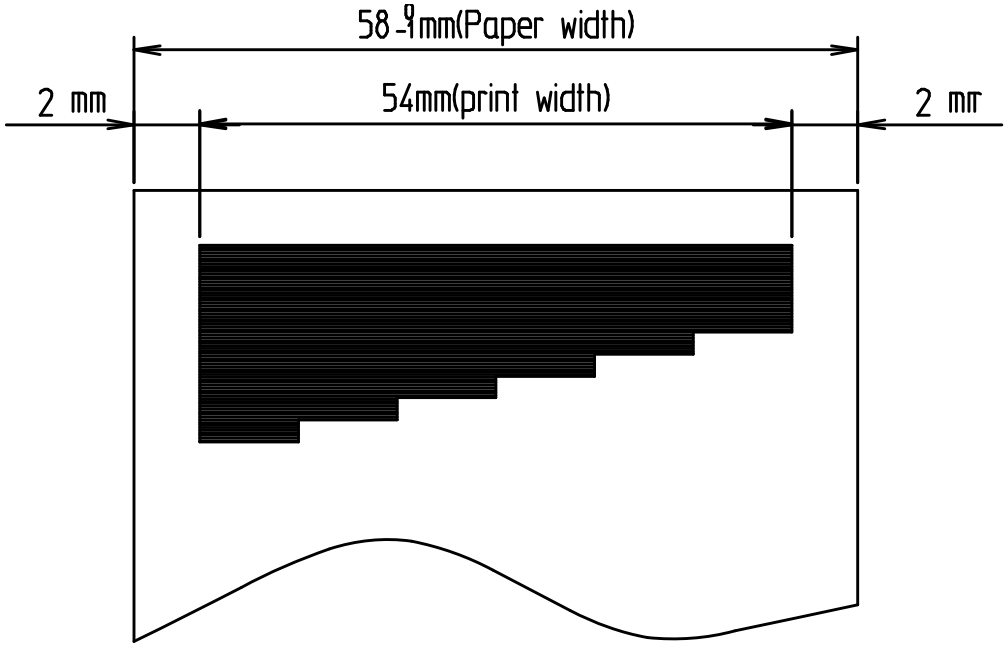
5-3 Printing position of transmitted data



5-4 Dimension of Thermal Device

5-4-1 Heat Element Dimensions

5-4-2 Print Area

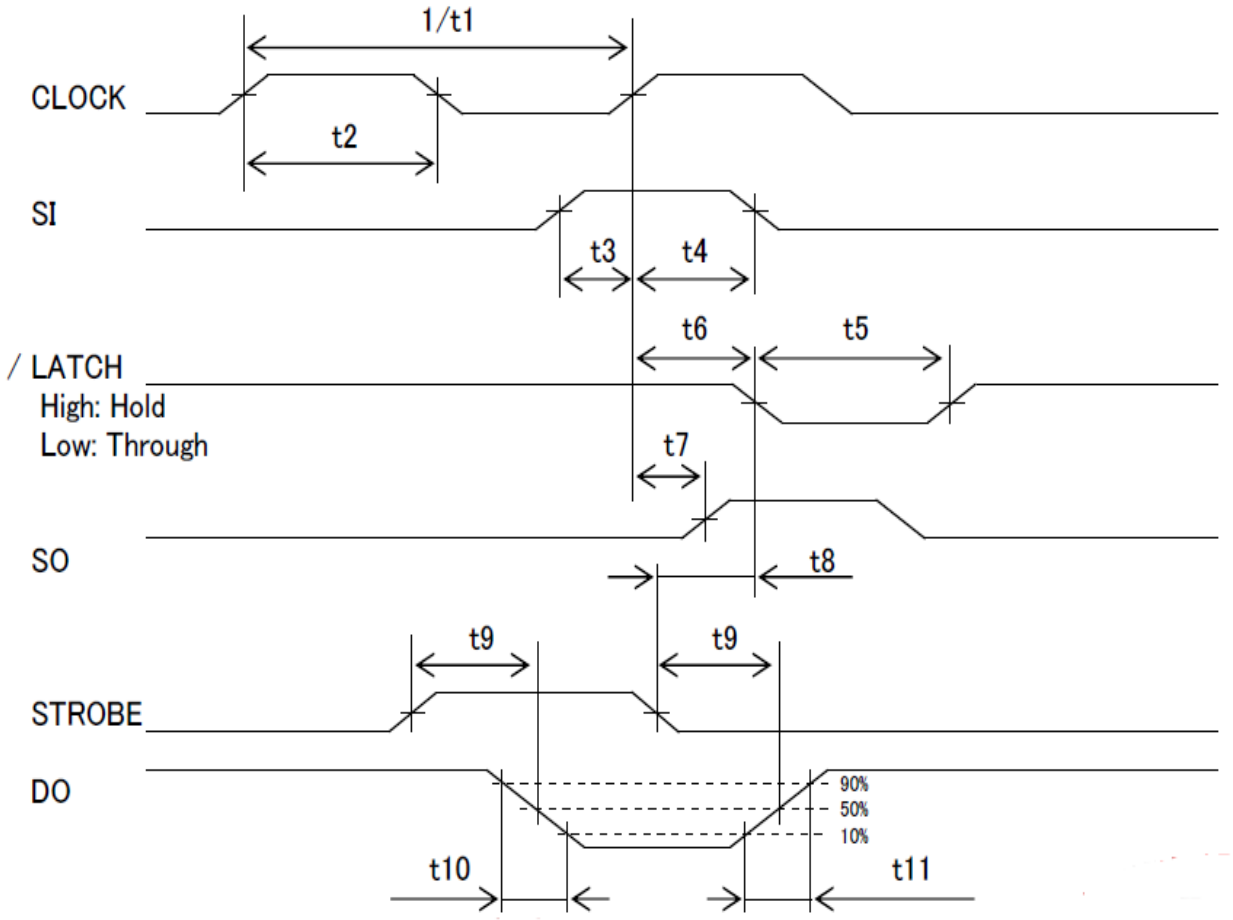


5-5 Electric Characteristics of Thermal Head

Ta = 25℃±10°C

항목	Symbol	MIN.	TYP.	MAX.	Umix	비고
공급 전압	V_{set}	4	-	8.5	V	COM
로직 전압	VDD	2.7	-	5.5	V	
논리 전류	IDD	-	-	42	mA	ALL-High
High Level 입력전압	V_{IH}	0.8xV_{DD}	-	V_{DD}	V	
Low Level 입력전압	V_{IL}	0	-	0.2 xV_{DD}		
High Level 입력전류	I_{IH}	-	-	1.0	uA	SI,CLK,nLAT
		-	-	55	uA	STB at 5V
		-	-	22	uA	STB at 3.3V
Low Level 입력전류	I_{IL}	-	-	1.0	uA	
High Level 출력전압	V_{OH}	4.1	-	-	V	at 5V
		2.3	-	-	V	at 3.3V
Low Level 출력전압	V_{OL}	-	-	0.4	V	
High Level 출력전류	I_{OH}	-	-	0.5	mA	
Low Level 출력전류	I_{OL}	-	-	0.5	mA	
DO 누설전류	I_{LEAK}	-	-	0.04	mA	ALL-LOW
CLOCK 주파수	t1	-	-	10	MHz	
CLOCK 펄스 폭	t2	45	-	-	ns	
SI-CLOCK Setup 시간	t3	30	-	-	ns	
CLOCK-SI Hold 시간	t4	30	-	-	ns	
LAT 펄스 폭	t5	100	-	-	ns	
CLOCK-LAT Setup 시간	t6	100	-	-	ns	
CLOCK-SO Delay 시간	t7	-	-	70	ns	
STB-LAT Removal 시간	t8	12.3	-	-	us	at 5V
		24.5	-	-	us	at 3.3V
STB-DO Delay 시간	t9			10	us	at 5V
		-	-	20	us	at 3.3V
DO Fall 시간	t10	-	-	4	us	at 5V
		-	-	8	us	at 3.3V
DO Rise 시간	t11	-	-	4.5	us	at 5V
		-	-	9	us	at 3.3V

5-6 Thermal Head Drive Timing Diagram



※ Caution : When sufficient driver output delay time cannot be guaranteed, V_{set} can be changed significantly. Design the circuit so that V_{set} does not exceed the peak voltage.

5-7 Maximum Ratings (Printer head ambient temperature: 25℃)

Items	Maximum rating	Condition
Supply Voltage (V_{set})	8.5V	Voltage among the connector terminals Never exceed Driver IC's high voltage limit, 10V.
Supply Energy (E_O)	0.16 mJ/dot * Note. 1))	S.L.T. = 0.63ms/line
	0.11 mJ/dot * Note. 2)	
Logic Supply Voltage (VDD)	5.5V	Include Peak Voltage
Substrate Temperature (Tsub)	70℃	Temperature detected by Thermistor
Logic Input Voltage (Vin)	0 ~ VDD	

***Note. 1)** Only on condition that neighboring 2dots are pulsed at same time.
***Note. 2)** On condition that neighboring above 3dots are pulsed at same time.

5-8 Standard Printing Conditions (Printer head ambient temperature: 25℃)

Item	Symbol	Reference		Unit	Condition	
Supply Voltage	V_{set}	7.2		V	R_{ave}=176Ω N = 64dots	
Supply Power	Po	0.24		W/dot		
Scanning Line Time	SLT	1.25	2.50	ms/line	* Note. 1)	
Supply Energy (On time)	E_O	0.19	0.29	mj/dot	5℃	
	(ton)	0.79	1.21	ms		
	E_O	0.15	0.24	mj/dot	25℃	
	(ton)	0.63	1.00	ms		
	E_O	0.12	0.19	mj/dot	40℃	
	(ton)	0.50	0.79	ms		
Supply Current	Io	2.4		A	N = 64dots	

***Note. 1)** Printing duty cycle is less than 16%.

5-9 Peak Current

Most cases in the following equation can be used to calculate the peak current of the printer head operation. Pay special attention to voltage drop of the circuit.

$$I_P = \frac{N \times V_H}{Rave}$$

Rave : Average resistance (176 Ω)
I_P : Peak current (A)
N : Number of dots running simultaneously
V_H : Head drive voltage

5-10 Head Pulse Width Control

5-10-1 Voltage pulse width
Control the pulse width depending on the head operation voltage in order to maintain consistent printing quality. The head pulse width can be obtained using the following equation.

$$T_o = E_o \times \frac{(N \times R_{COM} + Rave + R_{IC})^2}{V_H{}^2 \times Rave}$$

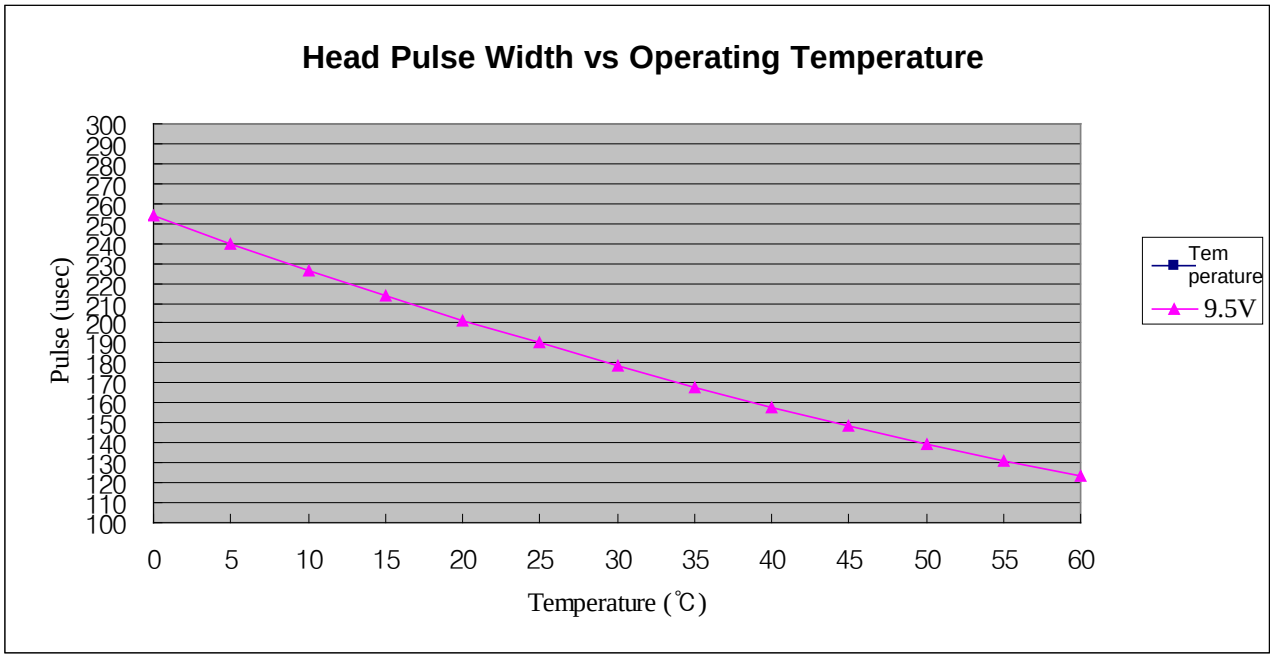
T_O : Pulse width (ms)
E_O : Supply energy (mJ/dot)
R_{COM} : Common resistance (0.05Ω)
R_{IC} : Driver saturation resistance (9Ω)

5-10-2 Pulse width calibration for temperature change
Temperature change can be processed by reading the value of thermister installed in the thermal head. It is recommended to adjust the pulse width and energy depending on the changes of the installation ambient temperature and thermal head temperature. Stop printing if the detected temperature is over 60℃. Pulse width should be calculated using the following equation

$$T_{on} = T_{25} \times \{ 1 + \frac{(25-T_X) \times C}{230} \}$$

T_{on} : Pulse width at the operating temperature
T_{25} : Pulse width at 25℃
T_X : Operating temperature
C : Thermal paper coefficients
(C=1 if Hansol 65 GSM is used)

※ Operating temperature and head pulse width (calculation example)



5-10-3 Head operation pulse width (actual measurement)

	Thermister temperature (℃)	-5	5	15	25	35	45	55
Vset=9.5V, 100mm/s	Head pulse width (usec)	318	292	266	240	215	188	163
Vset= 8.5V, 90mm/s	Head pulse width (usec)	451	413	376	339	302	265	228
Vset= 7.2V, 70mm/s	Head pulse width (usec)	698	641	582	525	468	410	353
Vset= 5.0V, 35mm/s	Head pulse width (usec)	2360	2165	1970	1776	1581	1387	1192

※ Caution : In order to increase the printing density, adjust the active pulse width to control the thermal head. If the voltage is too high or pulse width is over the specified range, the lifespan of the thermal head will be reduced significantly.

5-10-4 Thermister Specifications

- Electrical specifications of thermister

▷ Rating

1) Operating temperature : -20 ~ +80 ℃

2) Time constant : Max. 30sec (in the air)

▷ Electrical requirement

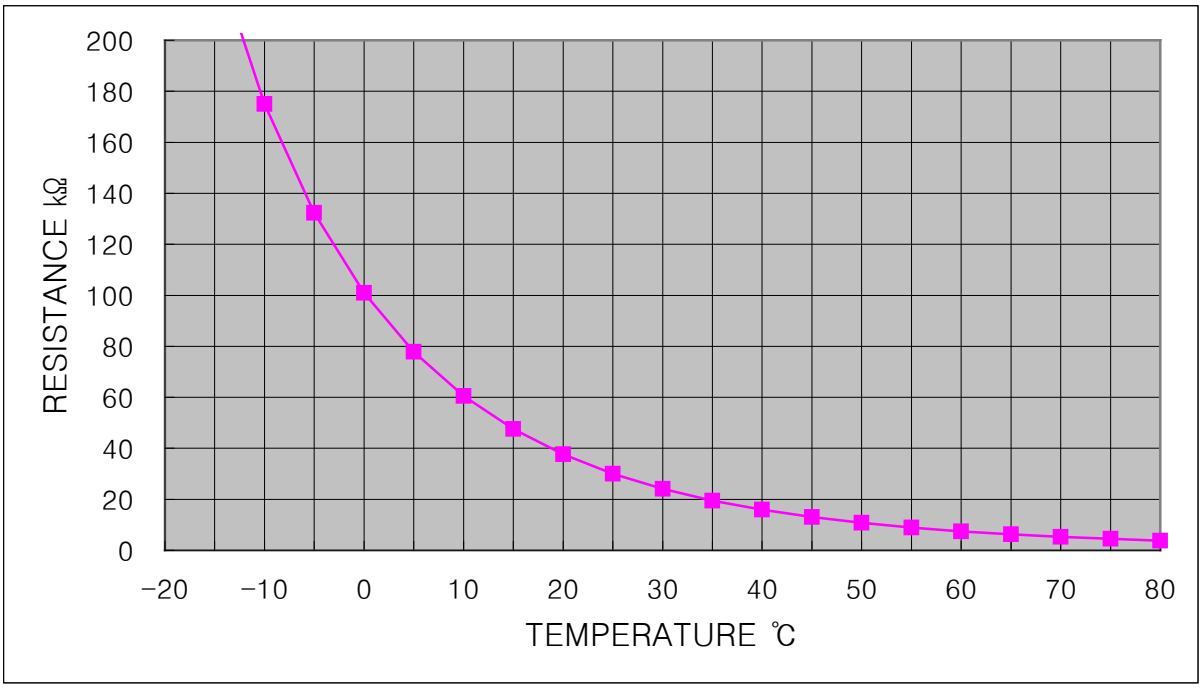
1) Resistance, R_{25} : 30 kΩ ± 5% (at 25℃)

2) B 값 : 3950 K ± 2%

$$R_X=R_{25}\times EXP\{B\times(1/T_X-1/T_{25})\}$$

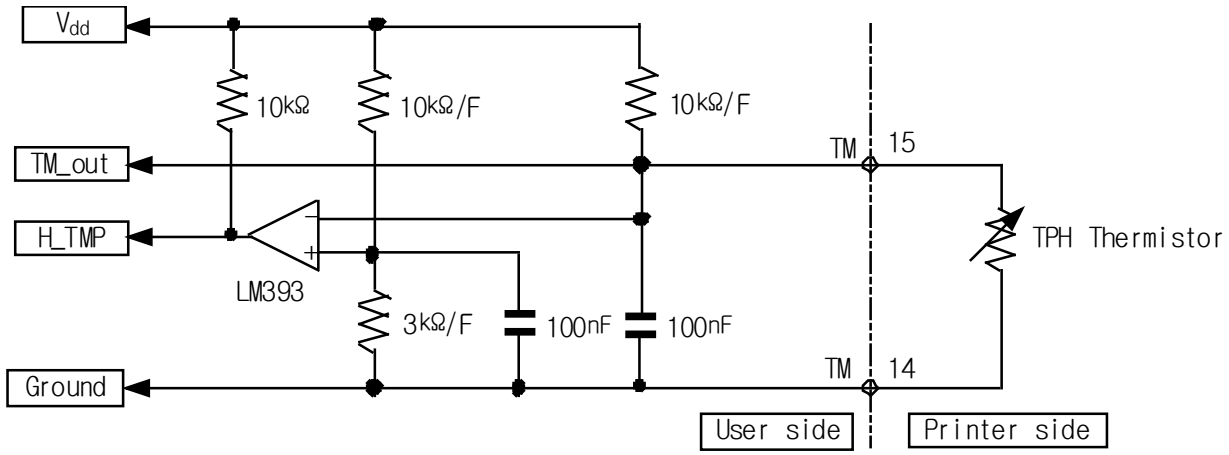
T_X(°K) = 273.15(°K) + Each temperature(℃)

T_{25}(°K) = 273.15(°K) + 25(℃) .



Temperature(℃)	R_X (kΩ)	Temperature(℃)	R_X (kΩ)
-20	316.154	30	24.111
-15	233.694	35	19.517
-10	174.734	40	15.904
-5	132.078	45	13.044
0	100.862	50	10.765
5	77.774	55	8.935
10	60.524	60	7.458
15	47.511	65	6.259
20	37.606	70	5.280
25	30.000	90	2.801

※ Recommended thermister circuit



5-10-5 Detection of abnormal temperature of the thermal head

In order to protect the thermal head and to guarantee people's safety, the abnormal temperature of the thermal head should be detected by both hardware and software.

▷ Detection of abnormal temperature by software

The design software stops the operation of the thermal device when the temperature of the thermal head detected by the thermister reaches over 60°C and resumes operation when the temperature drops below 50°C. Continuous operation of the thermal head with the temperature over 60°C will degrade the life of the thermal head significantly.

▷ Detection of abnormal temperature by hardware

Thermal head may become overheated if the software to detect the abnormal temperature does not work due to problems in control device.

Overheating of the thermal head may damage the thermal head or cause injury.

Use the hardware detection along with the software to detect abnormal temperatures in order to secure people's safety. (Damage to the thermal head may not be prevented when the hardware detects abnormal temperature if control device has a fault.)

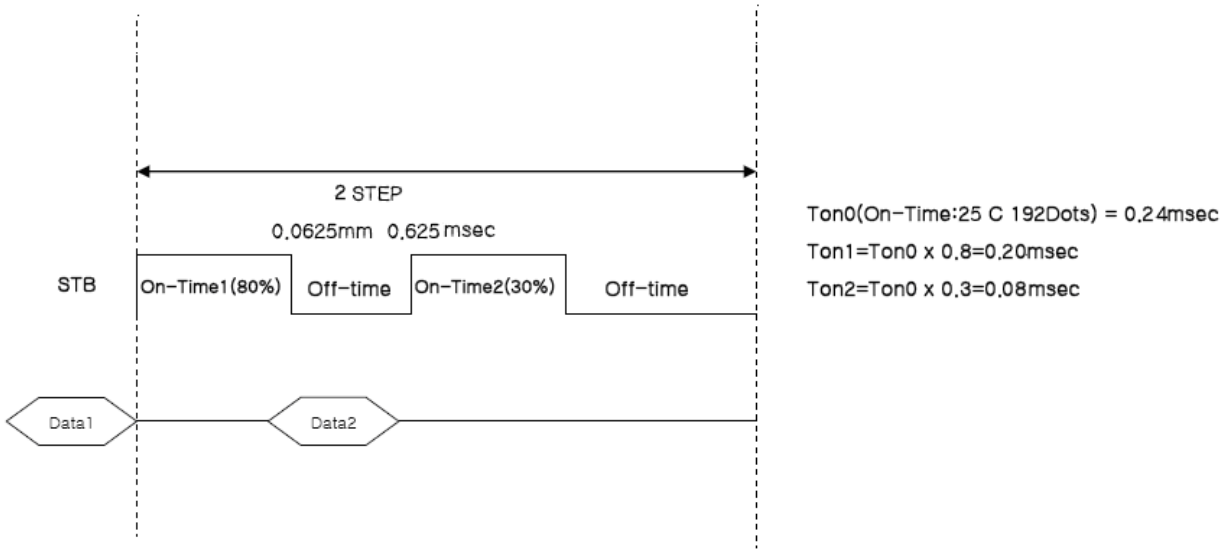
Design the hardware to detect the following abnormal conditions using comparator or similar sensor circuit. (Refer to recommended thermister circuit.)

1) Overheating of the thermal head (over 90°C)
2) Incorrect connection of thermister (thermister could be open or shorted.)

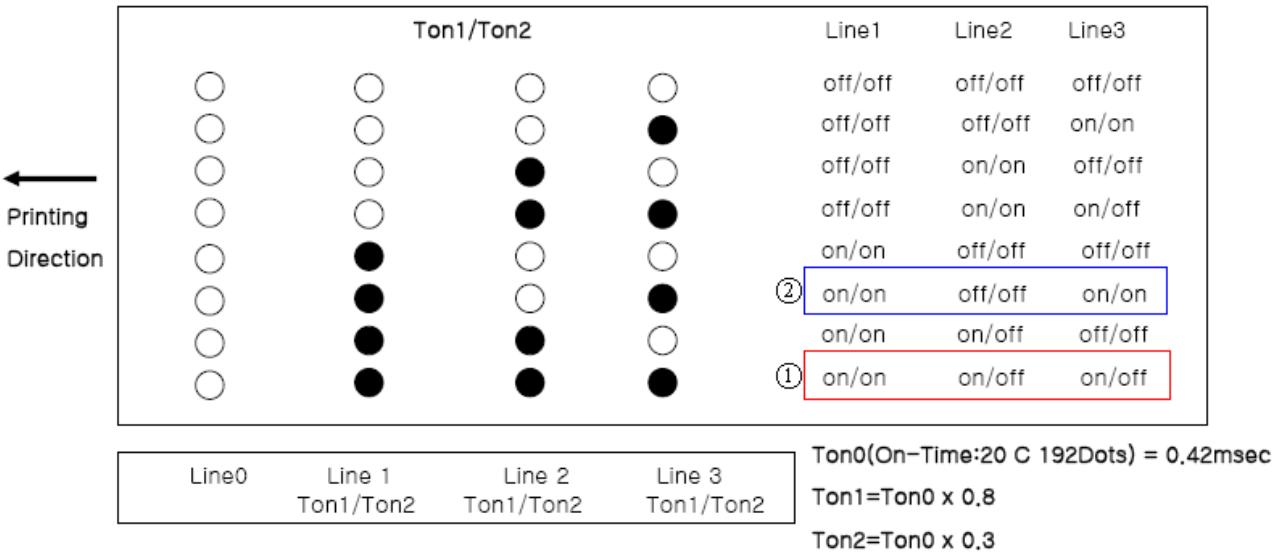
Shutdown the supply voltage (V_H) of the thermal head when conditions (1) or (2) are detected.

And activate the error mode to use the printer after taking proper measures.

5-10-6 Head History Control



One dot will be printed by THP per two motor steps. The minimum off-time should be guaranteed since the heating element of TPH should be cooled down sufficiently in order to achieve good printing quality.



In case of the red box (①),both T-On 1 and T-On 2 should be in ON state since the previous dot was not printed in the Line 1, and only T-On 1 should be in ON state in case of Line2/Line3 since the previous dot was not printed in this case.

In case of blue box (①), both of T-On 1 and T-On 2 should be in ON state because the previous dot was not printer in Line1/Line3.

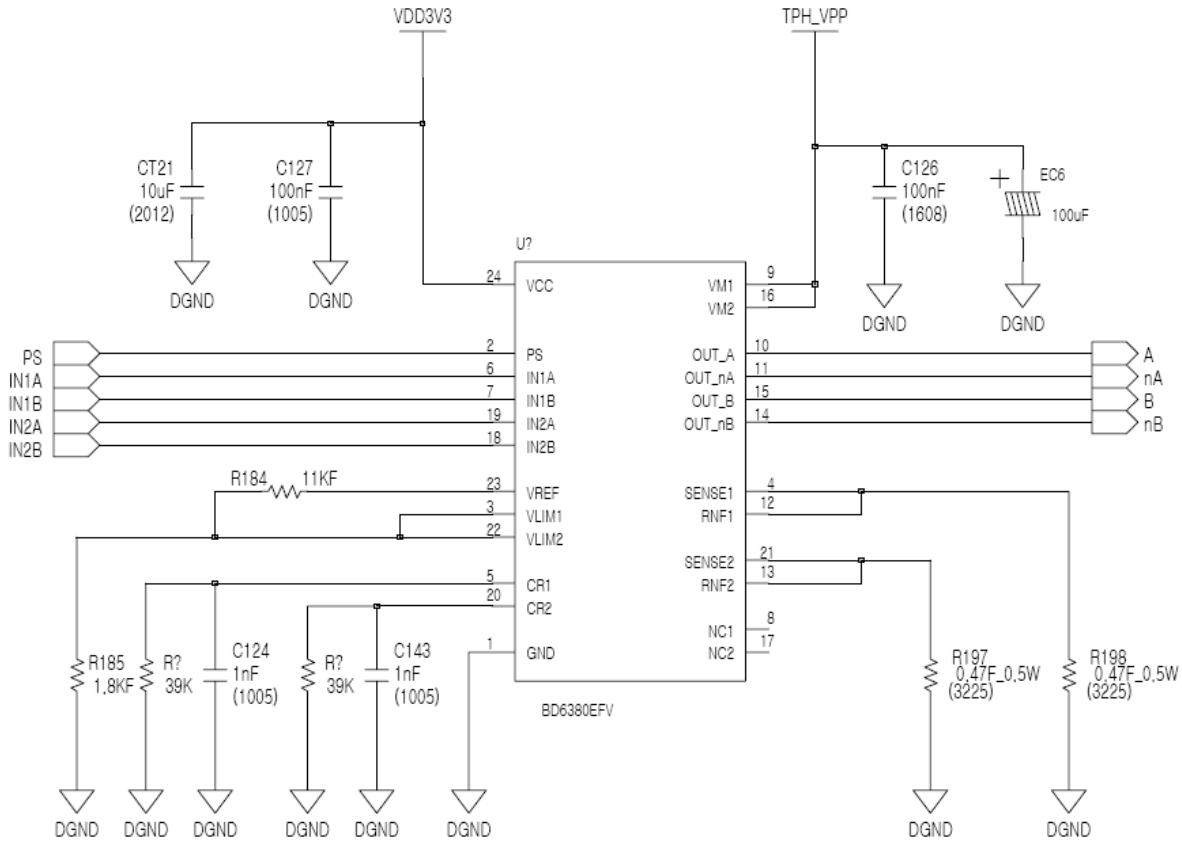
6. Stepping Motor (Paper Feeding)

6-1 Specifications

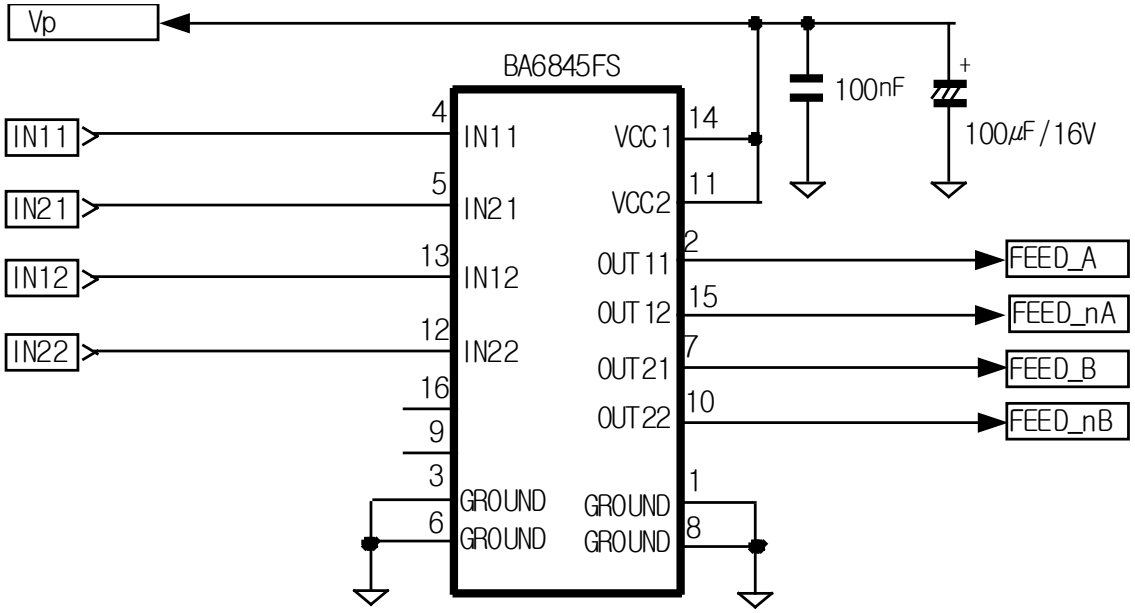
Items	Specifications
Type	PM type stepping motor
Drive Method	Bi-polar chopper
Excitation Method	2-2 Phase
Terminal Voltage	Vp : DC 4.75V ~ DC 8.5V
Wire Resistance	12 Ω/Phase ±5%
Motor Control Current	0.33A/Phase
Motor Drive Pulse	1440 pps Max.

6-2 Example drive circuit

- Constant drive circuit (Vpp=8.5V)



- Constant voltage drive circuit (Vp=7.2V or 8.5V)



IN11 / 21	IN12 / 22	OUT11 / 21	OUT12 / 22	Mode
L	H	H	L	Forward
H	H	L	H	Reverse
L	L	OPEN	OPEN	Stop
H	L	OPEN	OPEN	Stop

Maximum drive time should be limited in order to prevent overheating of the motor. Overheating of the motor and motor drive IC should be prevented during 2-2 phase drive. During 1-2 phase drive, care should be taken to prevent out-of-phase while feeding paper. Motor temperature increases depending on the operating conditions. Maintain the temperature of the motor external case below 85℃. Check the performance by using the device in actual conditions.

6-3 Drive Sequence (Motor runs in a counterclockwise direction)

	INPUT				OUT			
	IN1A	IN1B	IN2A	IN2B	A	nA	B	nB
1	H	L	L	L	H	L	Open	Open
2	H	L	L	H	H	L	L	H
3	L	L	L	H	Open	Open	L	H
4	L	H	L	H	L	H	L	H
5	L	H	L	L	L	H	Open	Open
6	L	H	H	L	L	H	H	L
7	L	L	H	L	Open	Open	H	L
8	H	L	H	L	H	L	H	L

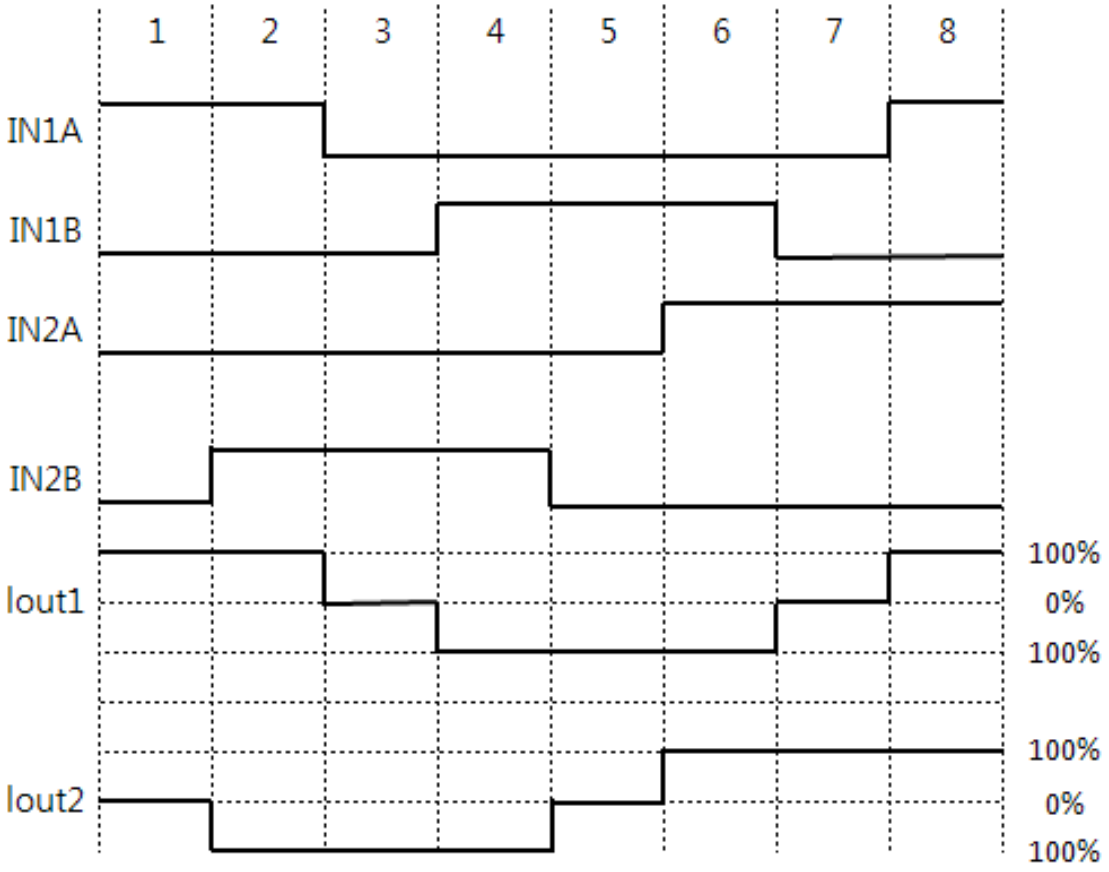
PS	State
L	Standby state(RESET)
H	ACTIVE

※ H: High /L: Low

※ Precautions when designing motor control circuit and software

In order to stop the motor, excite the motor for one step period using the same phase as the final phase of the printing step.

6-4 Motor timing diagram



6-5 Drive frequency acceleration (acceleration control)

Acceleration control is required in order to maintain power when driving the motor.

Drive the motor in accordance with the acceleration step in the Table.

The method of accelerating the motor is as follows
- Output the step signal start time
- Output the first step during the first step acceleration time
- Output the second step during the second step acceleration time
- Output the nth step during the nth step acceleration time
- The motor will run at a constant speed after it is accelerated to the motor drive speed

The printer can still print while the motor accelerates.

The maximum printing speed may depend on the drive method of the thermal head. The acceleration step should be set as follows.

※ Acceleration Step(at 2-2Phase)

Number of Steps	Speed (pps)	Step Time (㎲)
Start	200	5000
1	211	4728
2	342	2922
3	447	2234
4	528	1894
5	602	1660
6	669	1494
7	730	1369
8	787	1270
9	840	1190
10	890	1123
11	938	1066
12	984	1016
13	1027	973
14	1069	935
15	1110	901
16	1148	871
17	1187	842
18	1224	817
19	1259	794
20	1290	775
21	1328	753
22	1360	735
23	1392	718
24	1422	703
25	1432	698
26	1440	694

7. Sensor

7-1 Paper detection sensor and black mark detection sensor

7-1-1 Absolute Maximum Ratings

(Ta = 25℃)

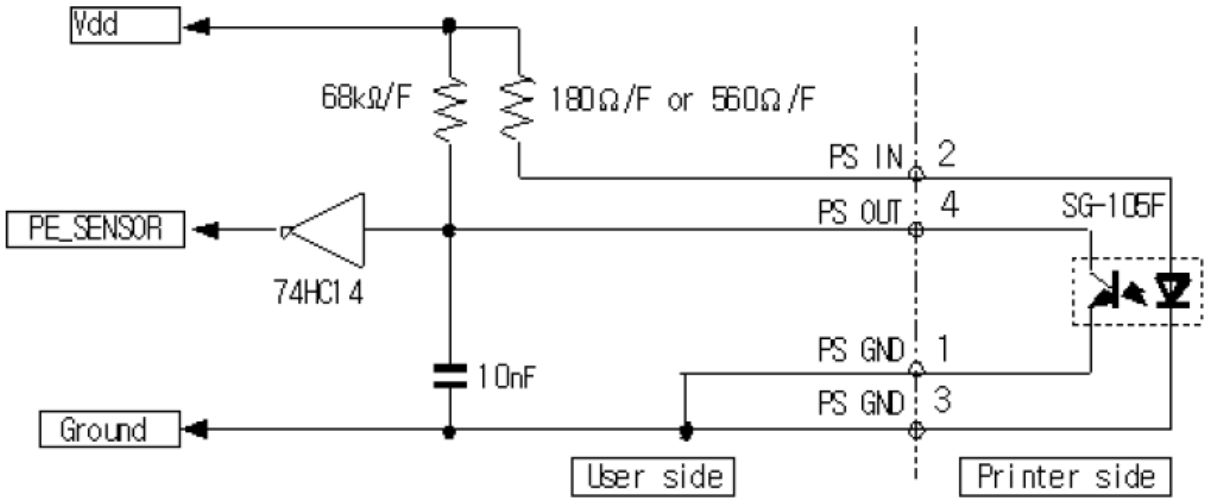
Parameter		Symbol	Rating	Unit
Input	Forward current	IF	50	mA
	Reverse current	VR	5	V
	Power consumption	PD	75	mW
Output	Collector-Emitter voltage	VCEO	30	V
	Emitter-Collector voltage	VECO	3	V
	Collector current	Ic	20	mA
	Collector power consumption	Pc	50	mW
Operating temperature		TOPR	-20~+85	℃
Storage temperature		TSTG	-30~+100	℃

7-1-2 Electrical Characteristics

(Ta = 25°C)

Parameter		Symbol	MIN.	TYP.	MAX.	Unit	Conditions
Input	Forward voltage	VF	--	--	1.3	V	IF=10mA
	Reverse current	IR			10	μA	VR =5V
Output	Collector current	IC	180	--	440	μA	VCE=5V IF=10 d=1mm
	Leakage current	ICECO	--	--	0.2	μA	VCE=5V IF=10mA
	Fall time / rise time	tf/tr	--	25/30	--	μs	Vcc=2V Ic=0.1mA RL=1kΩ

7-1-3 External circuit for paper detection sensor sampling



Paper detection	Paper detection sensor (PS OUT) signal level
When there is paper	Low
When there is no paper	High

※ Caution : Check the actual performance of paper detection when you use the device as there will be a difference in detected voltage depending on the Vdd input voltage or sensor input/out resistance.

Adjust the sensor input/out resistance to reduce the sensitivity to environments such as oil pollution, lifespan and external lighting and the difference may occur depending on the set conditions. Check performance by using the device in actual conditions.

8. How to handle the Printer Mechanism

8-1 Installation of the thermal paper

- Place the thermal paper correctly between the paper guide device of the printer mechanism and extend the tip of the thermal paper to the upper side by 2 inches (around 5cm) or more.
- Install the thermal paper correctly and depress the platen roller block for installation.

8-2 Removing thermal paper

Move the platen roller block upside and remove the thermal paper.

8-3 Procedure to resolve thermal paper jamming

- Separate the platen roller block from the printer mechanism and move it up.
- Remove the jammed paper and paper residue.

8-4 Precautions during installation/removal of the thermal paper

- Automatic loading may not work if the thermal head has been in contact with the platen roller for a long time without thermal paper as they may get stuck. In this case, separate the platen roller block and install it again and try again.
- Feed thermal paper at the wrong angle may cause problems in printing. Keep feeding the paper until the paper is feeding at the right angle, or remove and reinstall the platen roller block.
- Use of excessive force to remove the thermal paper may cause problems to the printer mechanism. Do not apply excessive force.
- Thermal paper may lose elasticity in high humidity environment and may cause problems in printing. Check the performance sufficiently in high humidity environment.

8-5 Cleaning thermal head

Thermal head should be cleaned as foreign substances on the thermal head surface may cause problems in printing after long hours of use.

As the temperature of thermal head and peripheral devices may be very high right after printing, wait until the temperature goes down sufficiently before cleaning.

The sequence of cleaning is as follows.

- Turn off the printer.
- Pull up and open the platen roller block by depressing.
- Soak soft swab in alcohol and clean the polluted part of the thermal head.
- Wait until alcohol has completely dried, and install and use the platen roller block.

9. Precautions in Designing External Case

- As the amount of thermal paper installed in a roll becomes smaller, it is more likely to cause curling, causing printing failure or paper jamming. Check the performance by using thermal papers with high curling effects.

- Secure enough space in the adjacent areas except the parts that are connected directly to the printer mechanism during external case design so that they are affected by external force. Loading by external force may cause printing failure or paper jamming.

- Prevent accumulation of paper dust or residues in the control panel or power supply device in the case design, which could happen when thermal paper is used over a long time.

- The ambient temperature may increase significantly when thermal printer is used. Design the system in such a way that the heat can be discharged easily to outside and prevent burn injuries to users. Attach a warning label so that users can use the device safely.

10. Frame Ground

It is recommended to connect the printer main body and the platen roller block to the frame ground (FG) of the external case to prevent damage by static electricity.
Check performance by using the device in actual operating conditions.

10-1 How to connect to the frame ground

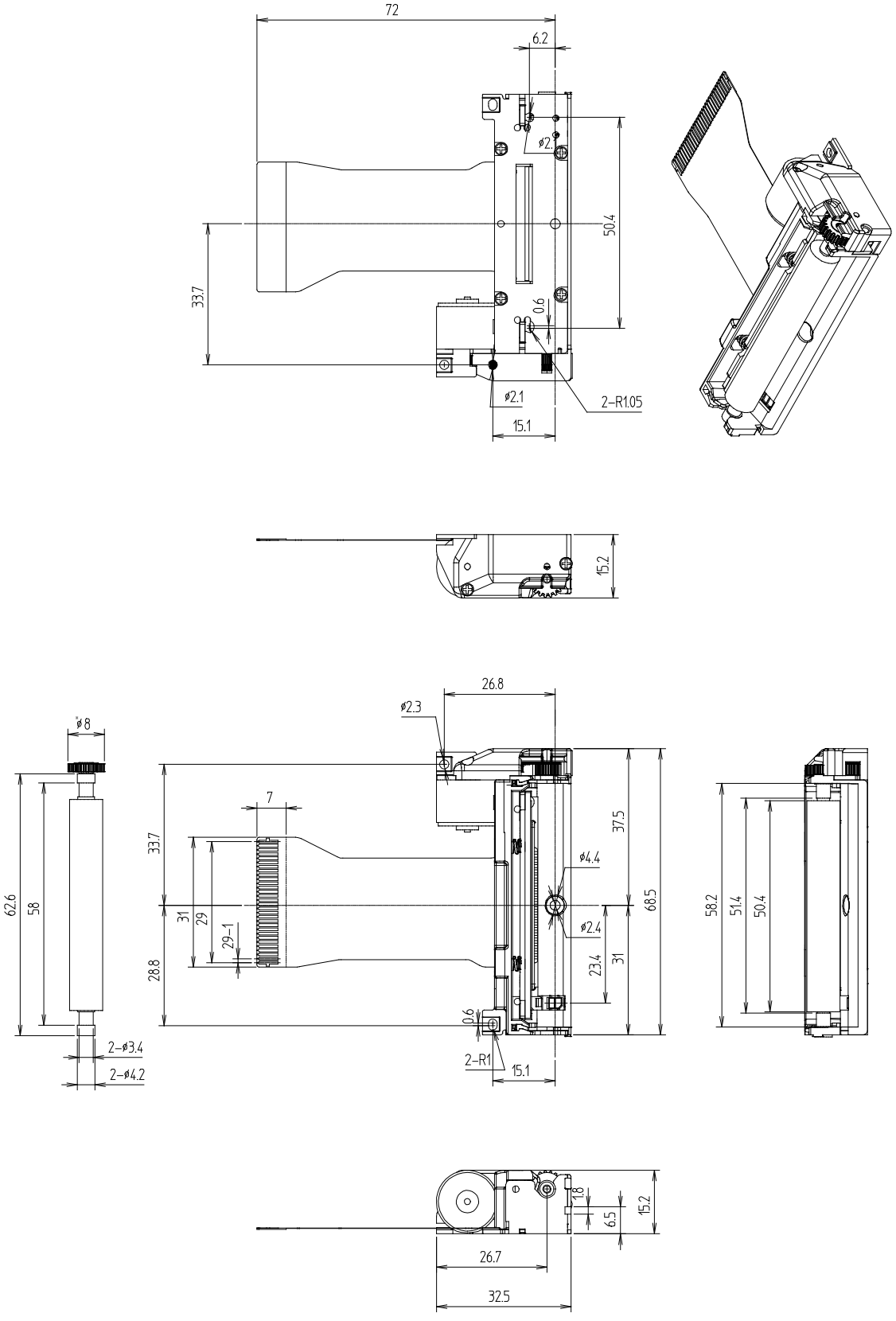
- Connect the frame ground (FG: Terminal No. 30) of the FPC Cable (30pin) to the frame ground (FG) of the external case.
- Keep the distance between the frame ground of the FPC Cable (30pin) and FG of the external case as short as possible.
- Electric potentials of all FG should be same.
- Connect GND terminal (SG) to FG directly or connect around 1MΩ resistance between GND (SG) and FG depending on operating conditions.

11. Precautions when fixing the platen roller block

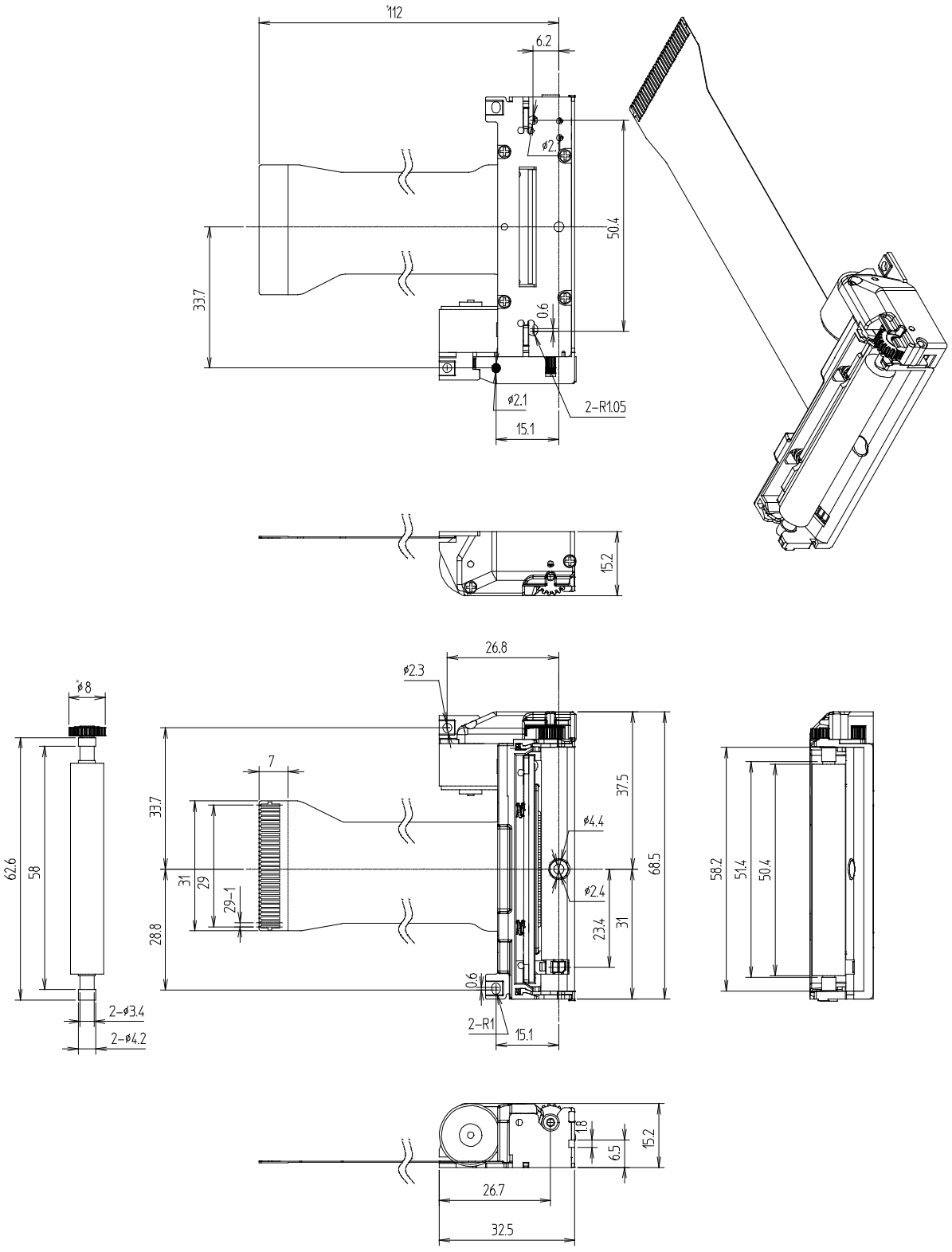
- The external case that fixes the platen roller block should have sufficient strength in design to prevent deformation or wobbling by impact, twist or external force, and the rotation axis that fixes the external case should be designed to prevent fluctuation in a left and right direction. Otherwise it may cause paper jamming or printing quality degradation due to incomplete closing of external case. Conduct sufficient verification by using the device in actual operating environment.
- Provide sufficient strength to the door rotation system as a certain level of force will be applied to the external case while installing or removing the platen roller block. Use shaft-type material to design the rotation axis of the door rotation system so that platen roller block is installed safely.
- When thermal paper is newly installed, it should be installed by depressing the center of the external case in the door rotation system. Installing the paper by depressing only one side of the external case may cause problems in the installation of the platen roller block, causing paper detection failure or printing failure. Provide information to users so that they always install the paper by depressing the center of the external case.

12. Exterior and Dimension

(SMP685)



(SMP685CJS)


112
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32.5

Product Approval

Product Name	**SMP685**
Manufacturer	**BIXOLON**
Product Specifications	**SMP685 User's Manual Rev. E**
Company Name	
Approval Date	
Approved By	
Signature	