THERMAL PRINTER MECHANISM

TMP900 Series

SPECIFICATION MANUAL

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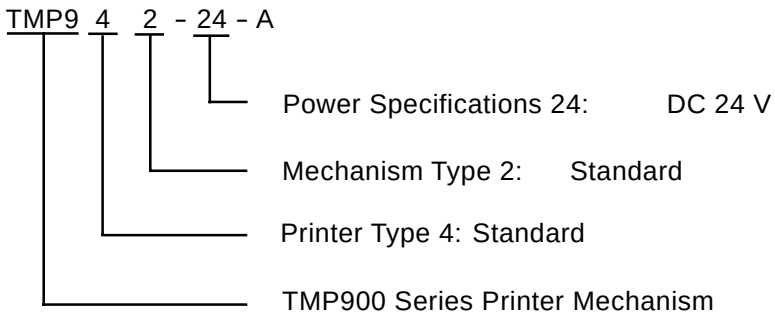
CHAPTER 1 GENERAL DESCRIPTION

The TMP900 series is a thermal printer mechanism capable of high speed printing that employs a thermal line dot printing system.

Model Name Display Directions



CHAPTER 2 BASIC SPECIFICATIONS

2-1) Printing Method

Thermal Line Dot Printing System

2-2) Dot Configuration

832 Dots/Dot Line

2-3) Number of Printing Dots

832 Dots

2-4) Number of Dots Simultaneously Energized

Maximum of 320 Dots

2-5) Print Density

Horizontal Direction: 8 Dots/mm

Vertical Direction: 8 Dots/mm

2-6) Printing Speed

HS Mode: Maximum of 150 mm/sec

LQ Mode: Maximum of 110 mm/sec

HQ Mode: Maximum of 60 mm/sec

Two Color Print Mode: Maximum of 60 mm/sec

Note 1) Printing speed varies according to the processing speed of the controller and the printing pulse width, etc.

2-7) Print Width

Maximum 104 mm

2-8) Recording Paper Width

79.5 ±0.5 mm to 111.5 ±0.5 mm

Note 1) Printing quality can deteriorate according to the type and thickness of the recording paper. Refer to the section relating to recording paper specifications to use the type appropriate for the mechanism's drive conditions.

2-9) Paper Feed

Paper feed method: Friction method

Paper feed pitch: 0.125 mm

Paper feed speed: Maximum of 150 mm/sec

2-10) Detector Functions

Head temperature detector:	Thermistor
Paper out detector:	Reflective photo-interrupter
Platen position detector:	Micro-switch
Cutter home position detector:	Micro-switch

Note 1) A reflective photo-interrupter is used for the paper out detector, so it can be used as a black mark detector.
However, in such cases, there are restrictions in black mark pitches.

2-11) Power Voltage

Drive power voltage: 24 V DC ±10 (See Note 1 below)

Circuit input voltage: 5 V DC ±5 (See Note 2 below)
3.3 V DC ±5 (See Note 3 below)

Note 1) Applies to the thermal head, paper feed motor and cutter motor drive.

Note 2) Applies to the thermal head control and paper feed motor control.

Note 3) Applies to paper out detector, platen position detector and cutter home position detector.

Note 4) To use a single 5 V power source for the circuit input voltage, contact Star Micronics.

2-12) Thermal Head

Heating element density:	8 dots/mm (0.125 mm/dot)
Total number of heating elements:	832 dots
Valid printing width:	104 mm
Average resistance value:	800 Ω ±3% (initial value)
Strobe count:	6

2-13) Motors

Paper feed motor:	4 Phase bipolar stepping motor
Cutter motor:	DC brush motor

2-14) Auto-cutter

Full-cut tolerance for recording paper thickness:
65 μm ≦ recording paper thickness ≦ 150 μm

Partial-cut tolerance for recording paper thickness:
65 μm ≦ recording paper thickness ≦ 100 μm

Partial-cut partial paper position:
Center in width direction of recording paper

Note 1) Partial-cuts are performed by a forward and reverse rotation of the cutter motor. Also, consider that the operating time for the cutter motor must be controlled, when designing.

Note 2) Auto-cutter life specifications differs with full cut and partial cut operations.

2-15) External Dimensions

162.5 mm (W) x 94.0 mm (D) x 50.0 mm (H)

Note 1) The values above do not include accessory parts incorporated into the mechanism when a presenter module is mounted.

2-16) Weight

748 g ±10g

Note 1) The values above do not include accessory parts incorporated into the mechanism when a presenter module is mounted.

2-17) Operating Environment

A: Temperature: 0 to 50°C
However, printing is guaranteed at 5 to 50°C

B: Humidity: 10 to 80% RH
However, there must be no condensation.
Assumes 80% RH at 34°C.

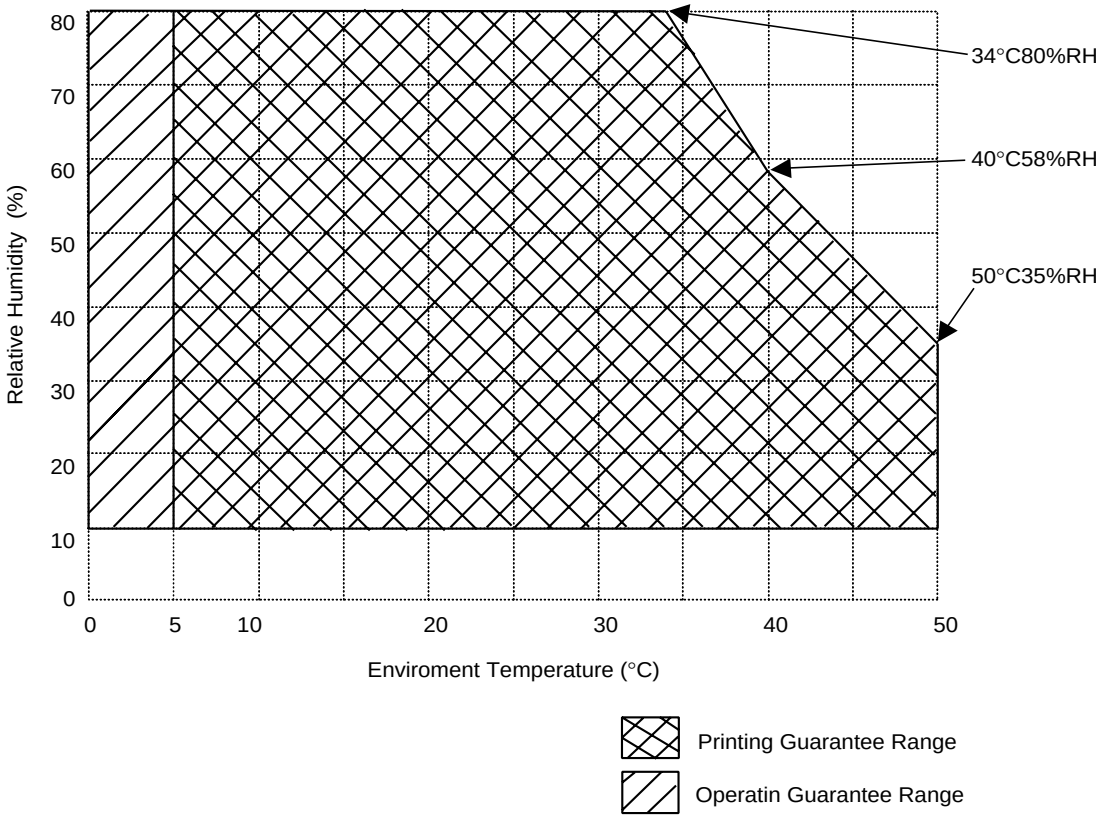


Fig. 2.17.1 Guaranteed Humidity and Temperature Ranges

2-18) Storage Environment (Excluding Roll Paper)

A: Temperature: -20 to 60°C

B: Humidity: 10 to 90% RH
However, there must be no condensation.

Note 1) The combination of 40°C and 90% RH (no condensation) is considered the worst values regarding high temperatures and humidity.

2-19) Reliability Specifications

Mechanism: (excluding thermal head and auto-cutter)

Life: 15 million lines

MCBF: 37 million lines

Note 1) Life is not guaranteed when not using our recommended paper. Always use the recommended paper.

Thermal Head:

Life: Durability: 100 km

Durability to Pulses: 100 million pulses

Note 1) This assumes repeating a printing sequence below a printing rate of 12.5% based on Star's evaluation standards. Energy supplied to the thermal head is the standard energy supply described in section 3-4-8.

Note 2) Life of the head is prescribed to be when 2 adjacent dots fail. However, failure caused by the adherence of foreign matter or human error is excluded.

Note 3) Repetitive printing of exceedingly high printing rates will cause a notable decrease in the life of the thermal head. Be careful in designing the print format.

Note 4) Life is not guaranteed when not using our recommended paper. Always use the recommended paper.

Auto-cutter:

Life: Cutting counts should be met for the following paper thicknesses.

Full Cuts:

Paper Thickness	Life
65 μm to 100 μm	1 Million Cuts
100 μm to 150 μm	300 Thousand Cuts

Partial Cuts:

Paper Thickness	Life
65 μm to 100 μm	300 Thousand Cuts

Note 1) Life is not guaranteed when not using our recommended paper. Always use the recommended paper.

2-20) Options

The TMP900 series can used the following options.

Presenter module with recovery function: PR900

CHAPTER 3 DETAILED SPECIFICATIONS

3-1) Print Configuration

The thermal head comprises 832 dot heating elements. The following shows the maximum printing range on the maximum paper width.

The mechanism can handle paper widths of 79.5 ±0.5 to 111.5 ±0.5 mm. However, it is recommended that a print layout is set that allows plenty of print margin on the left and right sides. Also, the standard position of printing to the paper width is center of the paper width.

Left and right margins in the printing region are recommended to be a minimum of 3.75 mm.

Note 1) When using the thermal head with a separate drive, there are cases in which dots are offset in the paper feed direction along the boundary of the separate head heating elements. Consider the offset of dots when setting the print layout.

Note 2) When using a paper width that is less than the maximum print width of the head (104 mm), consider the recording paper feeding state so that the print region does not leave both edges of the recording paper.

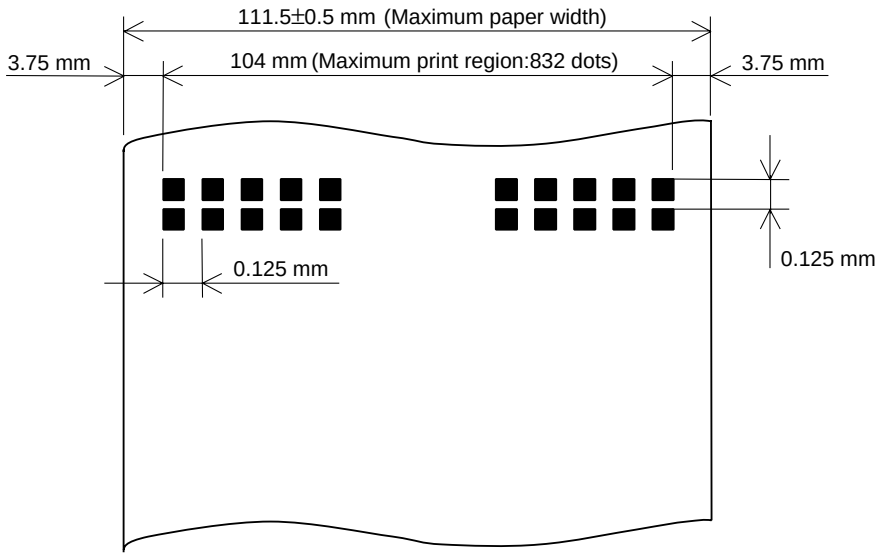


Fig. 3.1.1 Printing Region

3-2) Paper Feed Characteristics

3-2-1) Paper Feed System

Friction Method

3-2-2) Paper Feed Pitch

0.125 mm (Paper feed amount at one motor step)

3-2-3) Paper Feed Speed

HS Mode:	Maximum of 150 mm/sec
LQ Mode:	Maximum of 110 mm/sec
HQ Mode:	Maximum of 60 mm/sec
Two Color Print Mode:	Maximum of 60 mm/sec

3-2-4) Paper Feed Direction

Both forward and reverse feeds are possible. (However, only margin adjustments for top of the printing position is possible with reverse feeds.)

Note 1) The reverse feed for paper can be used only with the margin adjustments for top of the printing position on the recording paper.
Never print to the recording paper while reverse feeding paper.

Note 2) Reverse feeding of recording paper nipped between the thermal head and platen is prohibited.

Note 3) Do not directly touch the paper to the thermal head and platen and feed in the reverse direction.

3-2-5) Paper Holding Force

Minimum of 2N (Minimum of 204 gf)

3-3) Paper Feed Motor Characteristics

3-3-1) Paper Feed Motor Type

4 Phase PM Type Bipolar Stepping Motor

3-3-2) Drive Method

Bipolar Constant Current Drive

3-3-3) Excitation Method

2-2 Phase Excitation

3-3-4) Coil Resistance

6.5 Ω/Phase ±10% (25°C)

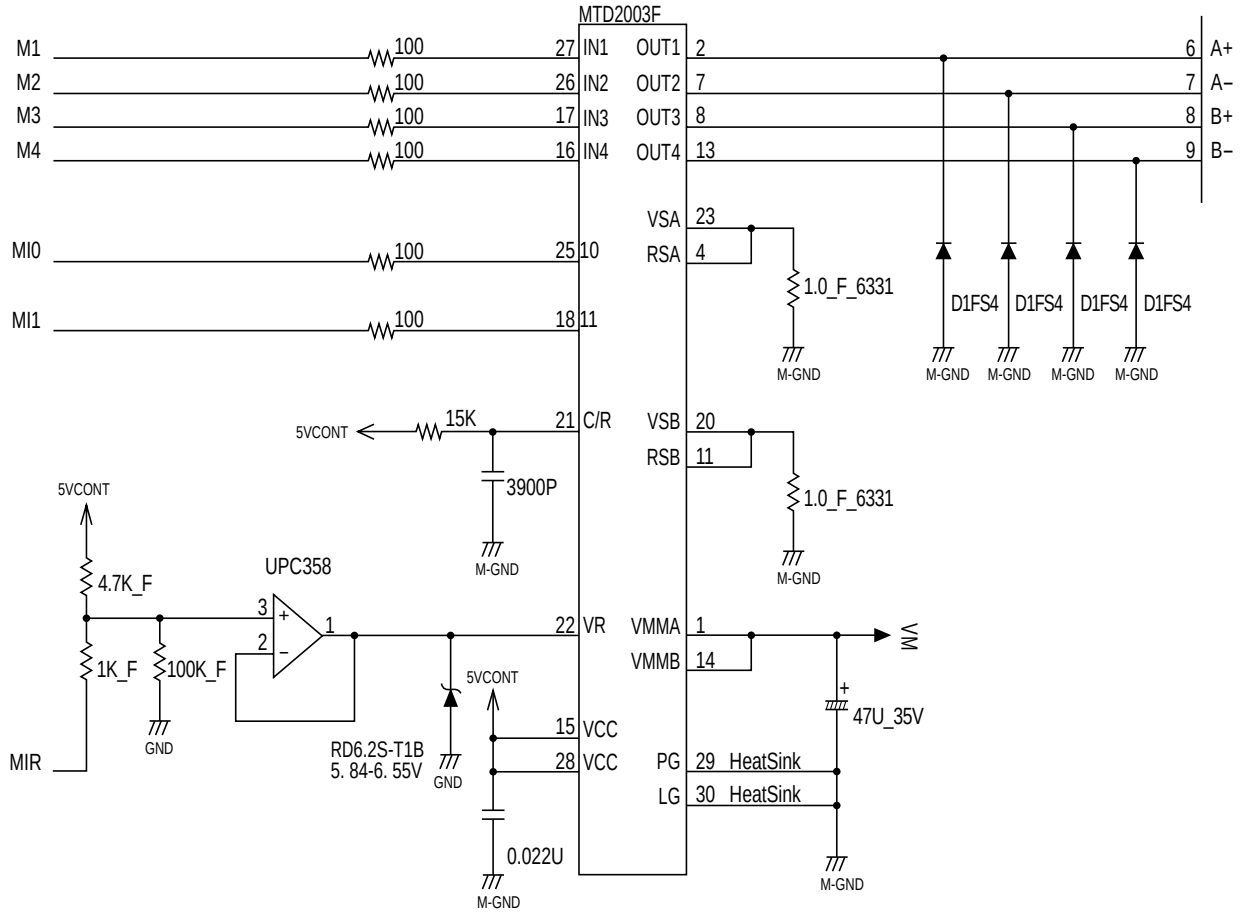
3-3-5) Drive Voltage

24 VDC ± 10%

3-3-6) Set Current

Approximately 0.485 A/Phase

3-3-7) Drive Circuit Example



Note 1) When using circuits other than the drive circuit example, there is the possibility that the standards of the motor are not ensured.

3-3-8) Excitation Sequence

Rotating Direction (Counterclockwise direction rotation when looking from the motor output shaft.)

Step / Pin No.	1	2	3	4
6 (A Phase)	H	H	L	L
7 (/A Phase)	L	L	H	H
8 (B Phase)	L	H	H	L
9 (/B Phase)	H	L	L	H

The motor transports the recording paper in the forward direction when excited in the steps of the table above. One motor step feeds the recording paper 0.125 mm.

3-3-9) Motor Drive Synch and Startup Method

The motor uses a bipolar rated current control. The rated current control set current is 0.485A/phase. The control circuit and software for motor drive and stopping should be designed with the timing chart in Fig. 3.3.9 in mind.

Note 1) When feeding paper, drive the motor below 1200 pps.

Note 2) Set the motor drive frequency to meet the usage conditions for printing (voltage, temperature, number of energized dots, etc.).

Note 3) To prevent heating of the motor, set so that it is not energized when it is not feeding paper (including printing).

Note 4) When continuously running the motor for long periods of time, check for motor heating.

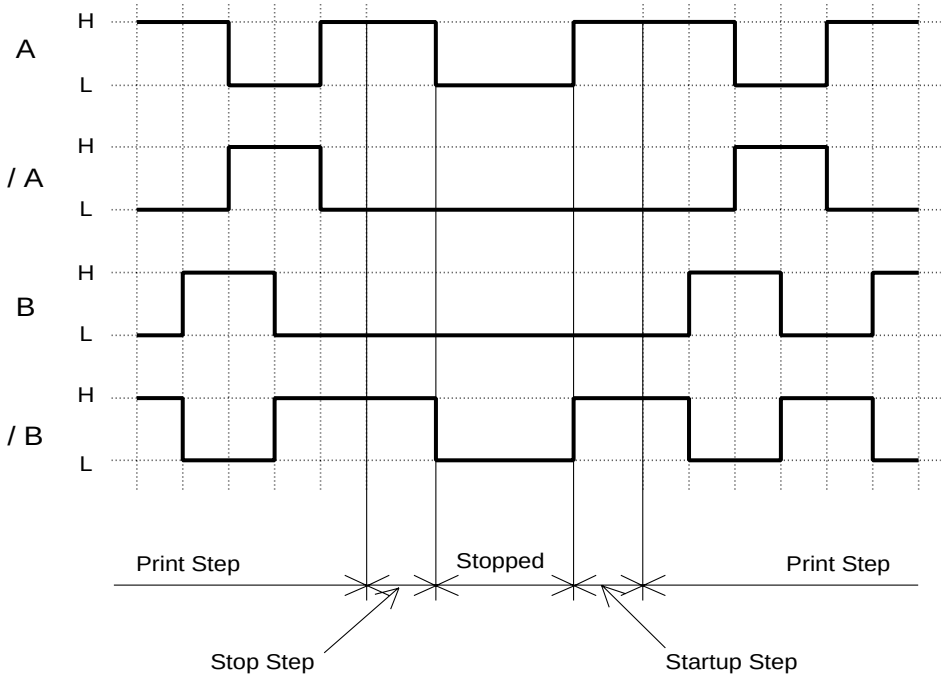


Fig. 3.3.9 Motor Startup and Stopping Timing

Stop Step:
To stop the motor, energize with the same phase as the final phase of the print step for 30 ms.

Stop Step:
When stopped, do not energize the stepping motor to prevent it from getting hot. Recording paper does not slip because of the stepping motor holding torque when not being energized.

Startup Step:
To restart while in a stop step, shift immediately to the print step sequence.
To start from a stopped state (non-energized state), shift to the print step sequence after energizing the same phase as the stop step for 30 ms.
The acceleration step for the motor drive cycle and starting up when in each of the print modes, should be designed in reference to the following startup methods.

(1) HS Mode (Print Speed Maximum 150 mm/sec)

To use the printer in the HS mode, it is required to control the acceleration of the motor to ensure paper feed force when starting up. Table 3.3.9.1 shows the acceleration speed table. Drive the motor while sequentially accelerating to the motor constant drive cycle.

Note 1) It is possible to print while the motor is accelerating, but there are cases in which printing will be distorted or disfigured due to the vibration of the motor while it is accelerating in speed. For this reason, it is recommended that printing be started after completing the acceleration step.

Table 3.3.9.1 HS Mode Acceleration Step

Step Count	Motor Drive Speed (pps)	Motor Drive Cycle (ms)	Energizing Type
1	250	4.000	2-2 Phase Excitation
2	260	3.846	2-2 Phase Excitation
3	275	3.636	2-2 Phase Excitation
4	309	3.236	2-2 Phase Excitation
5	342	2.924	2-2 Phase Excitation
6	389	2.571	2-2 Phase Excitation
7	435	2.299	2-2 Phase Excitation
8	477	2.096	2-2 Phase Excitation
9	515	1.942	2-2 Phase Excitation
10	551	1.815	2-2 Phase Excitation
11	584	1.712	2-2 Phase Excitation
12	616	1.623	2-2 Phase Excitation
13	646	1.548	2-2 Phase Excitation
14	674	1.484	2-2 Phase Excitation
15	702	1.425	2-2 Phase Excitation
16	728	1.374	2-2 Phase Excitation
17	754	1.326	2-2 Phase Excitation
18	779	1.284	2-2 Phase Excitation
19	803	1.245	2-2 Phase Excitation
20	826	1.211	2-2 Phase Excitation
21	849	1.178	2-2 Phase Excitation
22	871	1.148	2-2 Phase Excitation
23	892	1.121	2-2 Phase Excitation
24	913	1.095	2-2 Phase Excitation
25	934	1.071	2-2 Phase Excitation
26	954	1.048	2-2 Phase Excitation
27	973	1.028	2-2 Phase Excitation
28	993	1.007	2-2 Phase Excitation
29	1012	0.988	2-2 Phase Excitation
30	1030	0.971	2-2 Phase Excitation
31	1048	0.954	2-2 Phase Excitation
32	1066	0.938	2-2 Phase Excitation
33	1084	0.923	2-2 Phase Excitation
34	1101	0.908	2-2 Phase Excitation
35	1118	0.894	2-2 Phase Excitation
36	1135	0.881	2-2 Phase Excitation
37	1152	0.868	2-2 Phase Excitation
38	1168	0.856	2-2 Phase Excitation
39	1184	0.845	2-2 Phase Excitation
40	1200	0.833	2-2 Phase Excitation

(2) LQ Mode (Printing speed: Max. 110 mm/sec)

To use the LQ mode, drive the motor while sequentially accelerating to the motor constant drive cycle according to the acceleration speed table shown in Table 3.3.9.2.

Table 3.3.9.2 LQ Mode Acceleration Step

Step Count	Motor Drive Speed (pps)	Motor Drive Cycle (ms)	Energizing Type
1	250	4.000	2-2 Phase Excitation
2	260	3.846	2-2 Phase Excitation
3	275	3.636	2-2 Phase Excitation
4	309	3.236	2-2 Phase Excitation
5	342	2.924	2-2 Phase Excitation
6	389	2.571	2-2 Phase Excitation
7	435	2.299	2-2 Phase Excitation
8	477	2.096	2-2 Phase Excitation
9	515	1.942	2-2 Phase Excitation
10	551	1.815	2-2 Phase Excitation
11	584	1.712	2-2 Phase Excitation
12	616	1.623	2-2 Phase Excitation
13	646	1.548	2-2 Phase Excitation
14	674	1.484	2-2 Phase Excitation
15	702	1.425	2-2 Phase Excitation
16	728	1.374	2-2 Phase Excitation
17	754	1.326	2-2 Phase Excitation
18	779	1.284	2-2 Phase Excitation
19	803	1.245	2-2 Phase Excitation
20	826	1.211	2-2 Phase Excitation
21	849	1.178	2-2 Phase Excitation
22	871	1.148	2-2 Phase Excitation
23	880	1.136	2-2 Phase Excitation

(3) HQ Mode (Printing speed: Max. 60 mm/sec)

To use the HQ mode, drive the motor while sequentially accelerating to the motor constant drive cycle according to the acceleration speed table shown in Table 3.3.9.3.

Table 3.3.9.3 HQ Mode Acceleration Step

Step Count	Motor Drive Speed (pps)	Motor Drive Cycle (ms)	Energizing Type
1	250	4.000	2-2 Phase Excitation
2	260	3.846	2-2 Phase Excitation
3	275	3.636	2-2 Phase Excitation
4	309	3.236	2-2 Phase Excitation
5	342	2.924	2-2 Phase Excitation
6	389	2.571	2-2 Phase Excitation
7	435	2.299	2-2 Phase Excitation
8	477	2.096	2-2 Phase Excitation
9	480	2,083	2-2 Phase Excitation

(4) Semi-auto Loading Mode

To use the Semi-auto Loading mode, drive the motor with the motor drive cycle described in Table 3.3.9.4.

Table 3.3.9.4 Semi-auto Loading Mode Motor Drive Cycle

Step Count	Motor Drive Speed (pps)	Motor Drive Cycle (ms)	Energizing Type
1	250	4.000	2-2 Phase Excitation

(5) Two Color Printing Mode (Printing speed: Max. 60 mm/sec)

To use the Two Color Printing mode, drive the motor while sequentially accelerating to the motor constant drive cycle according to the acceleration speed table shown in Table 3.3.9.5.

Table 3.3.9.5 Two Color Printing Mode Acceleration Step

Step Count	Motor Drive Speed (pps)	Motor Drive Cycle (ms)	Energizing Type
1	250	4.000	2-2 Phase Excitation
2	260	3.846	2-2 Phase Excitation
3	275	3.636	2-2 Phase Excitation
4	309	3.236	2-2 Phase Excitation
5	342	2.924	2-2 Phase Excitation
6	389	2.571	2-2 Phase Excitation
7	435	2.299	2-2 Phase Excitation
8	477	2.096	2-2 Phase Excitation
9	480	2,083	2-2 Phase Excitation

3-4) Thermal Head

3-4-1) Configuration

(1)	Thermal element configuration	2 elements/dot
(2)	Number of thermal elements	832 Dots
(3)	Thermal element scanning density	0.125 mm/dot (8 dots/mm)
(4)	Maximum print width	104 ±0.2 mm
(5)	Average resistance value	800 Ω ±3% (initial value)
(6)	Drive power voltage	Head drive Vh 24 VDC ± 10% Driver IC Vdd 5 VDC ± 5%

3-4-2) Maximum Rating (at an Ambient Temperature of 25°C)

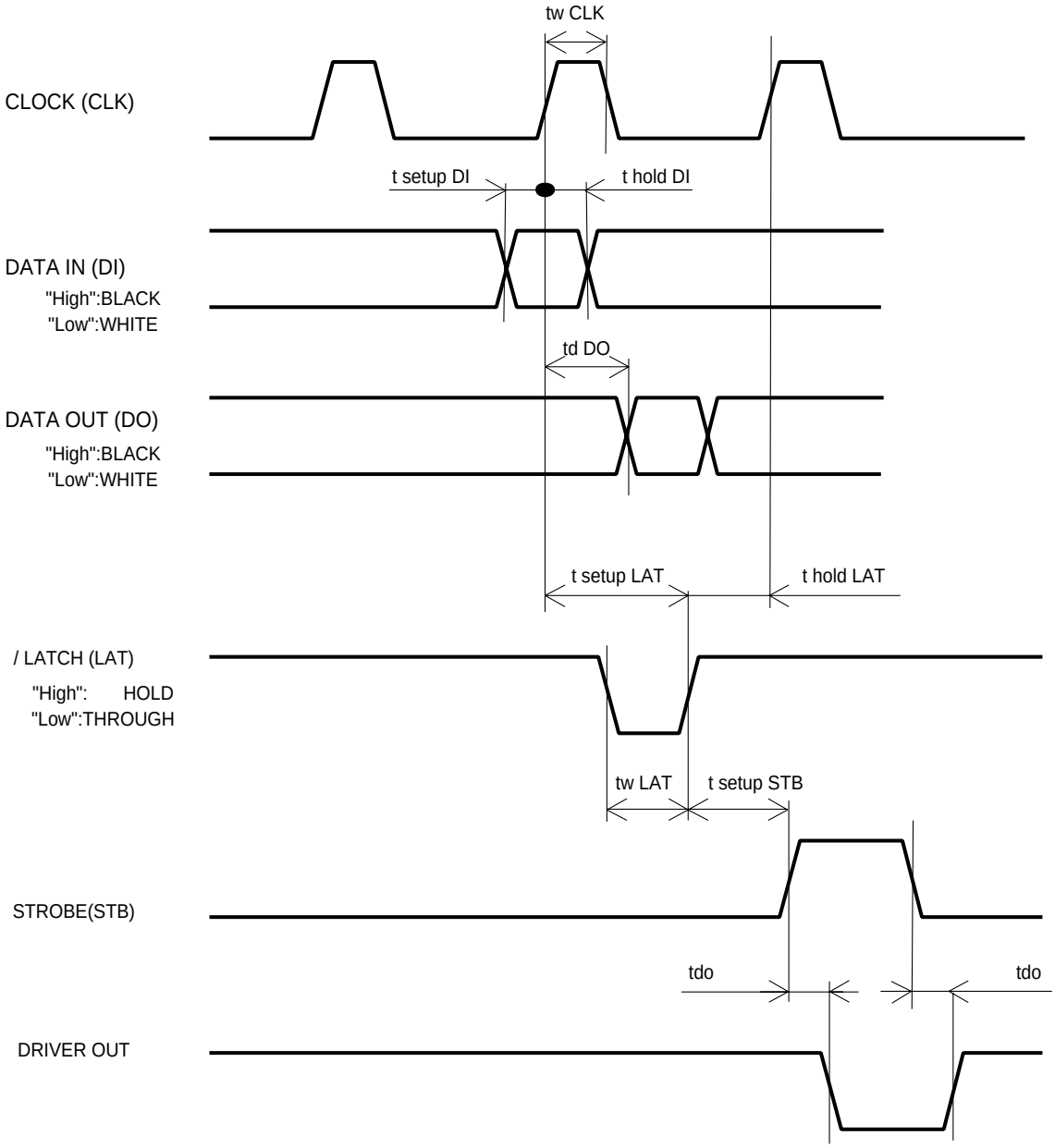
Item	Maximum Rated Value	Units	Conditions
Print Power Voltage (VH)	26.4	V	Vp < 28 V Vp: Peak voltage of Vh
PCB Temperature	65	°C	Thermistor Temperature
Logic Power Voltage (Vdd)	7	V	Including Peak Voltage
Logic Input Voltage (Vin)	-0.5 to Vdd + 0.5	V	

3-4-3) Electrical Characteristics

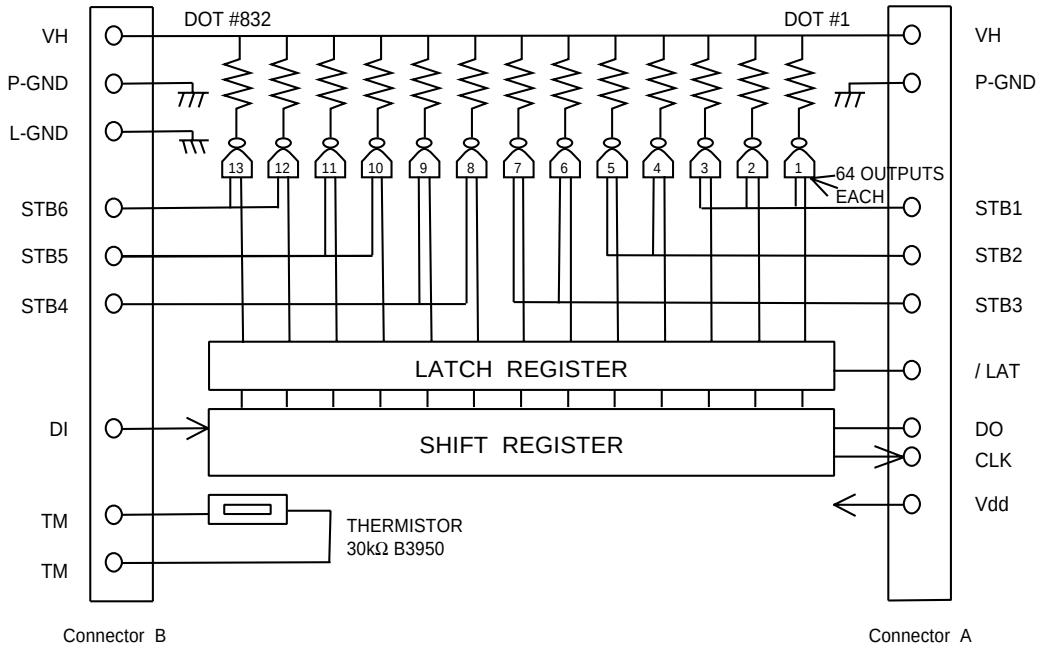
Ta = 25 ±10°C

Item		Symbols	Min.	Standard	Max.	Units	Conditions
Printing Power Voltage		VH	–	24.0	–	V	
Circuit Power Voltage		Vdd	4.75	5.00	5.25	V	
Circuit Power Current		Idd	–	–	104	mA	fDI=fCLK/2
Input Voltage	H	VIH	0.8Vdd	–	Vdd	V	STB,DI,LAT,CLK
	L	VIL	0	–	0.2Vdd	V	STB,DI,LAT,CLK
Data Input Current (DI)	H	IIH DI	–	–	0.5	µA	VIH=5V
	L	IIL DI	–	–	-0.5	µA	VIL=0V
STB Input Current (LOW-ACTIVE)	H	IIH STB	–	–	90	µA	
	L	IIL STB	–	–	-1.5	µA	
Clock Input Current (CLK)	H	IIH CLK	–	–	6.5	µA	
	L	IIL CLK	–	–	-6.5	µA	
Latch Input Current (LAT)	H	IIH LAT	–	–	6.5	µA	
	L	IIL LAT	–	–	-6.5	µA	
Data Out (DO)	H	VDOH	4.45	–	–	V	OPEN State: Vdd = 4.5 V
	L	VDOL	–	–	0.05	V	
Output Voltage		VOL	–	(1.0)	–	V	Reference Value, Driver
Clock Frequency		fCLK	–	–	8	MHz	See Timing Chart
Clock Pulse Width		tw CLK	30	–	–	ns	
Data Setup Time		tsetup DI	30	–	–	ns	
Data Hold Time		thold DI	10	–	–	ns	
Data Out Delay Time		td DO	–	–	120	ns	
Latch Pulse Width		tw LAT	100	–	–	ns	
Latch Setup Time		tsetup LAT	200	–	–	ns	
Latch Hold Time		thold LAT	50	–	–	ns	
STB Setup Time		tsetup STB	300	–	–	ns	
Output Delay Time		tdo	–	–	10	µs	

3-4-4) Timing Chart

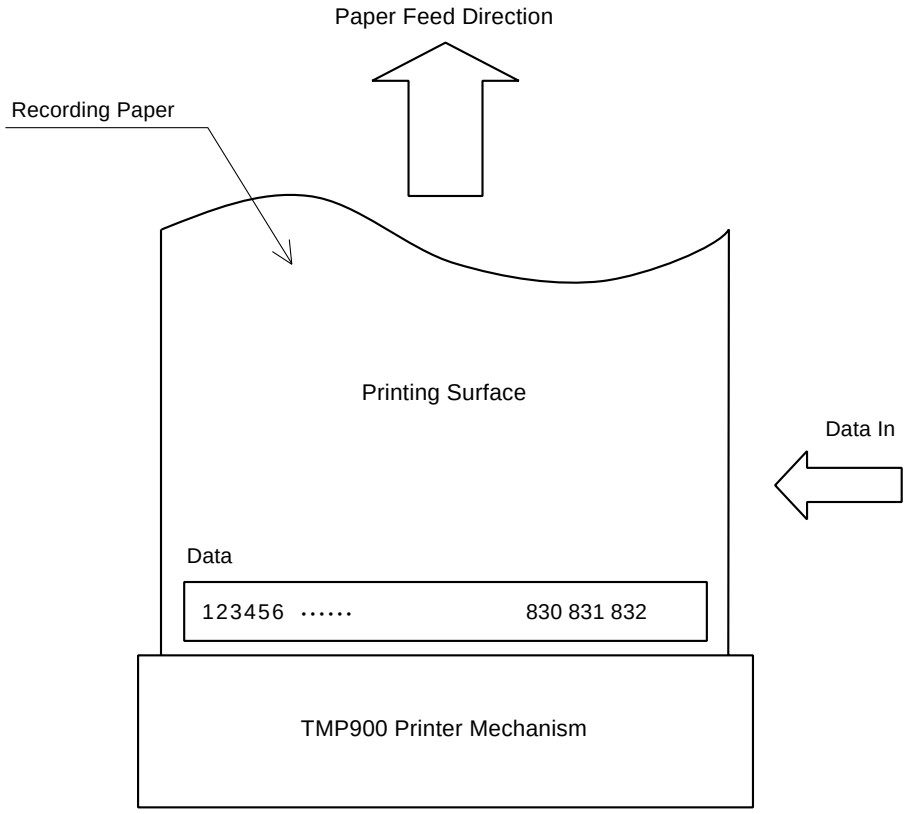


3-4-5) Equivalent Circuit



STB No.	Dot No.	dots/STB
1	1 to 192	192
2	193 to 320	128
3	321 to 448	128
4	449 to 576	128
5	577 to 704	128
6	705 to 832	128

3-4-6) Relationship Between Transfer Data Printing Position



Data Input Order 123456 ····· 830 831 832

3-4-7) Peak Current

The peak current of the thermal head substantially reaches the value calculated using the equation below, but be very careful of voltage drops in wiring circuits.

$$IP = \frac{N \times V}{Rav}$$

IP: Peak current
N: Simultaneously energized dot count
V: Print power voltage (V)
Rav: Heating element average resistance value (Ω) (800 ± 3%)

Table 3.4.7) Equation for Calculating Peak Current

Simultaneously Energized Dot Count	Peak Current (A) Calculated Value
128	4.22
192	6.34
320	10.56

Ambient temperature: 25°C
Print current voltage: 26.4 V
Resistance value: 800Ω

3-4-8) Thermal Head Energizing Pulse Control

Consider the following information when designing for the thermal head energizing time.

However, settings for the following standard energizing pulse width is with our evaluated standard paper.

(1) Calculating energizing pulse width

To get quality print images using the thermal head, it is necessary to control the energizing pulse to the thermal head according to the conditions of use. Therefore, find each of the calculation values using the equation below to control the thermal head so that it prints with the energizing pulse width calculated when substituted in formula 1 in the equation below.

$t = ((E-Cx (T-25)) \times P) \times ((Rcom \times N + Rav + Ric + Rlead)^2 / (V^2 \times Rav))$ Formula ①

t: Energizing pulse (ms)

E: Standard supply energy (mj)

C: Temperature offset coefficient 0.002

T: Thermistor detection temperature (°C)

P: Thermal paper offset coefficient
For Mitsubishi Paper P220AG 1.0

V: Head charged voltage 24 (V)

Rav: Head average resistance value 800 (Ω)

Rcom: Head common resistance 0.1 (Ω)

Ric: Head driver ON resistance 15 (Ω)

Rlead: Head resistance resistance 10 (Ω)

N: Simultaneously charged dot count 320 (dots)

Note 1) If there is oscillation of the charged voltage in the range of the specification, it is necessary to adjust the energizing pulse width.

Note 2) Calculation of this energizing pulse is for not performing thermal head history control. To reduce thin dots at the start of printing and the phenomenon of print dot thermal retention, it is necessary to perform thermal head history control. Consult with Star regarding the detail drive conditions and methods to perform history control.

(2) Standard supply energy

The standard supply energy in each print mode is shown in Table 3.4.8.

Table 3.4.8. Standard Supply Energy in Each Print Mode

Print Mode	Standard Supply Energy (mj)
HS Mode	0.180
LQ Mode	0.220
HQ Mode	0.330
Two Color Print Mode (Black)	0.375
Two Color Print Mode (Red)	0.175

Note 1) Be careful because using the thermal head beyond the above described standard supply energy can notably shorten the life of the thermal head.

(3) Termperature offset coefficient

This is the offset value corresponding to the environment temperature in which the mechanism (thermal head) is used. Calculate the energizing pulse with the temperature offset coefficient as C = 0.002.

(4) Thermistor detection temperature

This performs temperature offset according to the thermistor detection temperature carried on the thermal head. See section 3-4-9 Thermistor Characteristics to calculate the thermistor temperature T (°C).

(5) Thermal paper offset coefficient

The thermal paper offset coefficient when using our recommended paper Mitsubishi P220-AG is 1.0. Calculate the energizing pulse with the thermal paper offset coefficient as P = 1.0.

Note 1) To use other than the recommended paper, consult with Star.

(6) Head charged voltage

The thermal head charging voltage range is 24 VDC ± 10%. It is prohibited to use the thermal head outside of this range. Also, it is recommended to use a central value of 24 VDC to charge the thermal head. Calculate based on the voltage V actually charged to the thermal head to determine the energizing pulse.

(7) Simultaneous charged dot count

The maximum number of dots simultaneously charged with this thermal head is 320 dots. Calculate the energizing pulse with the simultaneous charge dot count as N = 320.

Note 1) Be careful because using the thermal head beyond the maximum simultaneous dot count of 320 dots requires split printing so that it falls within the tolerance values. Also, there are restrictions for the mechanism's maximum print speed when using split printing, so to determine the printing format, you should thoroughly consider the print rate. Consult with Star for detailed control for split printing.

3-4-9) Thermistor Characteristics

(1) B Constant: 3950 K ±2%

(2) Resistance Value (at 25°C) R25: 30 kΩ ±5%

(3) Ambient Temperature Range: -20 to 80°C

(4) Heating Constant: Within 30 sec. (in atmosphere)

The resistance value as the temperature function can be calculated using the following equation.

RT = R25 x exp (B x {1/(T + 273) –1/ (25 + 273)})

T: Temperature (°C)

RT: T °C Resistance Value (Ω)

R25: 25°C Resistance Value (30 kΩ ±5%)

3-4-10)Precautions Regarding Use of the Thermal Head

(1) When printing continuously, control so that when the temperature of the thermistor is detected to be over 65°C, the energizing of the head is immediately stopped. Continuing to print when the temperature is over 65°C will notably shorten the life of the thermal head.

(2) In the event of a runaway CPU, there are cases in which the thermal head will continue to be energized without the software detecting an error, thereby damaging the head. For that reason, it is essential to dually use error detection by the software to protect the thermal head.

(3) Observe the following sequences (power ON/OFF) so that the thermal elements are not damaged.
At power ON: The order of Vdd, VH
At power OFF: The order of VH, Vdd

(4) Input of each of the signals (CLK, LAT, STB, DI) should be interfaced with C-MOS level (74 HCH240 or the equivalent).
Also, when turning the power ON and OFF and when not printing, the STB signal should be in a “DISABLE” state.

(5) To prevent static electrical damage of the heating elements and IC, never touch the poles of the connector pins, etc., directly with your bare hands.

(6) Do not apply any mechanical shocks (including the introduction of foreign objects) to the head PCB surface.

(7) When not printing, the thermal head VH power (including voltage charged to the capacitor) should be in an OFF state.

(8) There are cases where thermal head life is notably shortened according to the type of heat sensitive paper that is used. Always use the recommended heat sensitive paper.

(9) Because there is the possibility of mis-operation of the thermal head caused by noise, or damage to the thermal head or IC caused by surged voltages, the power line should be stabilized.

3-5) Auto-cutter

The TMP900 Series is standardly equipped with an auto-cutter that is capable of either full or partial cuts (leaving a portion of the paper uncut) using the rotation of the cutter motor and cutter home position detector.

3-5-1) Cutter Types

Separated, V-blade Guillotine Type

3-5-2) Paper Cut States

Full or Partial Cut (leaving a portion of the paper uncut)

Note 1) The portion of the paper left uncut in a partial cut is in the center of the recording paper.

3-5-3) Cutter Operation Time

Approximately 390 ms (when cutting at 25°C, 24 VDC, and 150 μm thick paper)

Note 1) The time required for the cutting operation varies according to the thickness of the recording paper being used. Design the cutter control upon checking the actual type of recording paper to be used.

3-5-4) Cutting Positions

The distance from the thermal head heating element positions (the printing position) to the auto-cutter blade positions (the cutting position) is 15 ±0.5 mm.

3-5-5) Cutter Home Position Detector

(1)	Type:	Micro Switch
(2)	Contact Point Rating:	Rated Voltage: 5 VDC Rated Current: 2 – 10 mA

3-5-6) Cutter Motor

(1)	Drive power voltage:	24 VDC ± 10%
(2)	Current Value:	Peak Current: 1.4 A (24 VDC at 25°C)

3-5-7) Auto-cutter Drive Method

The auto-cutter is operated by charging a drive power voltage to the cutter motor (+) and cutter motor (-).

Refer to the following when designing the forward and reverse movement of the cutter and the motor brake.

• Forward rotation

The auto-cutter is rotated forward by a positive charge applied to the cutter motor.

Note 1) It is prohibited to simultaneously energize to the motor forward and reverse drive circuits.

• Reverse rotation

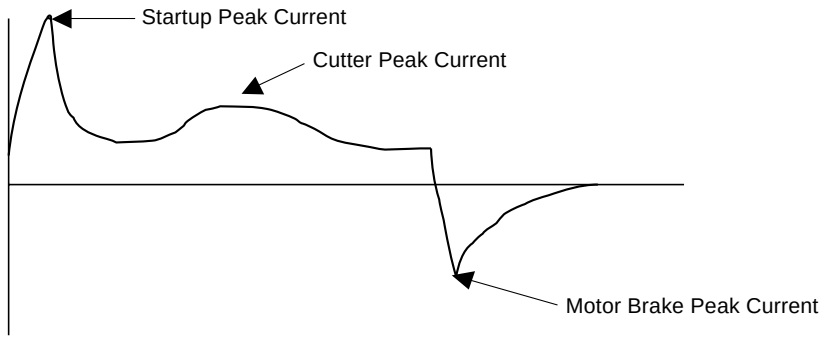
The auto-cutter is rotated in reverse by a negative charge applied to the cutter motor positive.

Note 1) It is prohibited to simultaneously energize to the motor forward and reverse drive circuits.

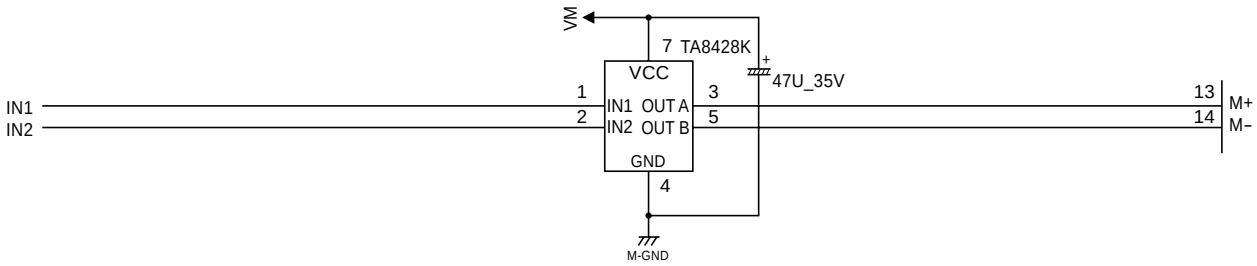
2) To rotate the motor in reverse while it is rotating forward, stop the voltage applied to the motor, wait for approximately 1 ms, then apply the voltage to the reverse rotation side.

• Motor Brake

Set the time to apply the motor brake to the time most appropriate for the conditions of use.

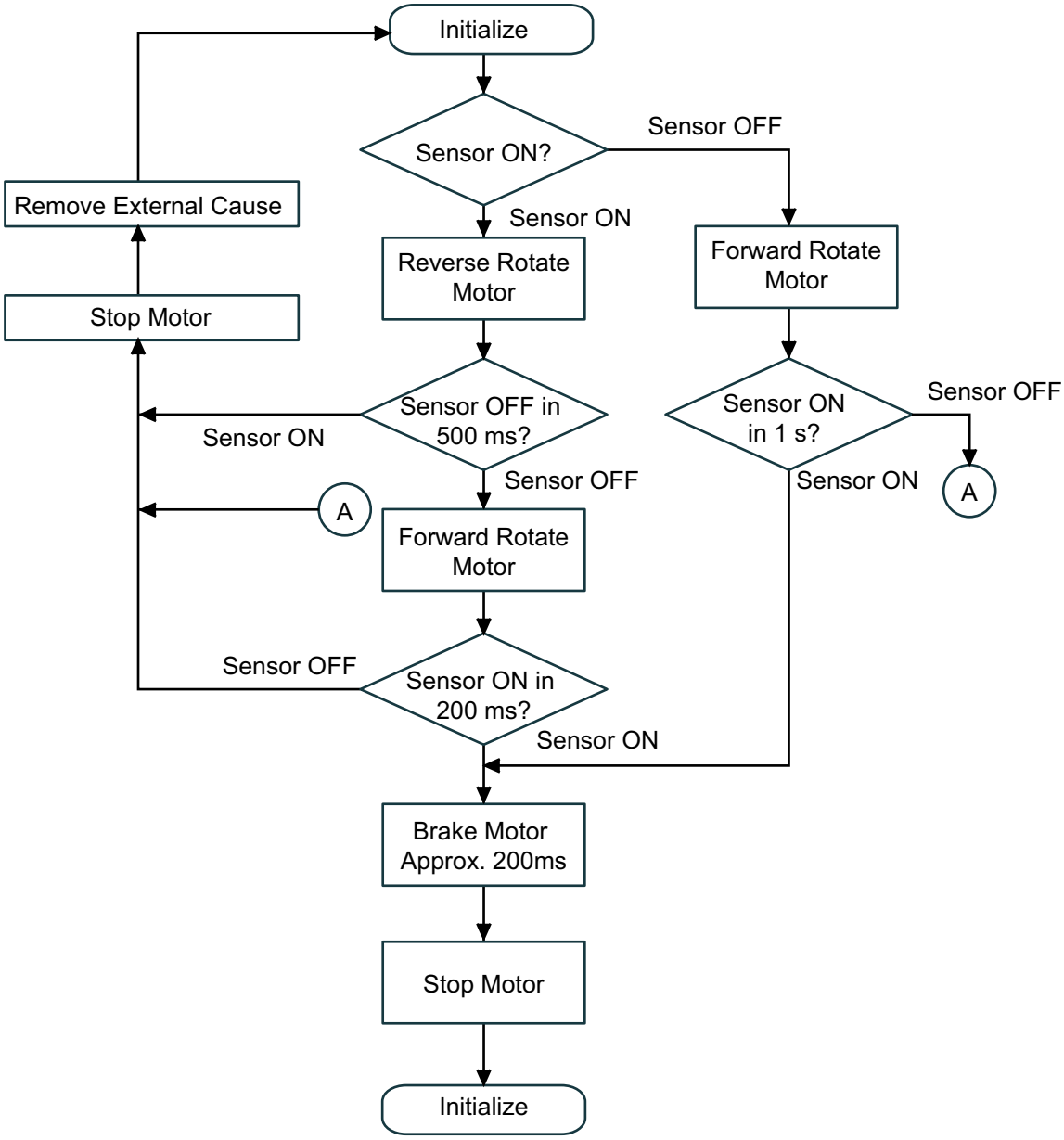


3-5-8) Drive Circuit Example

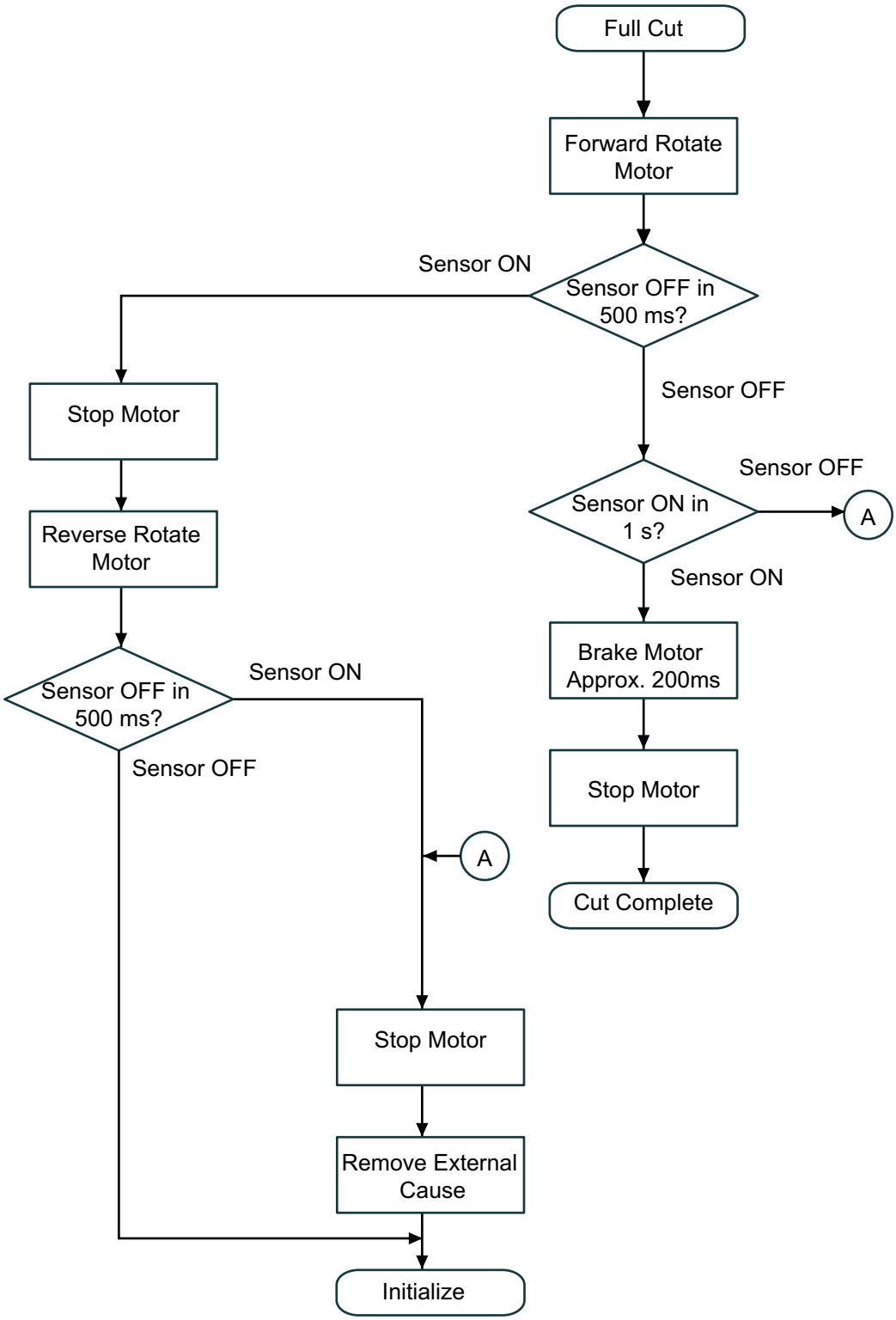


3-5-9) Flow Chart

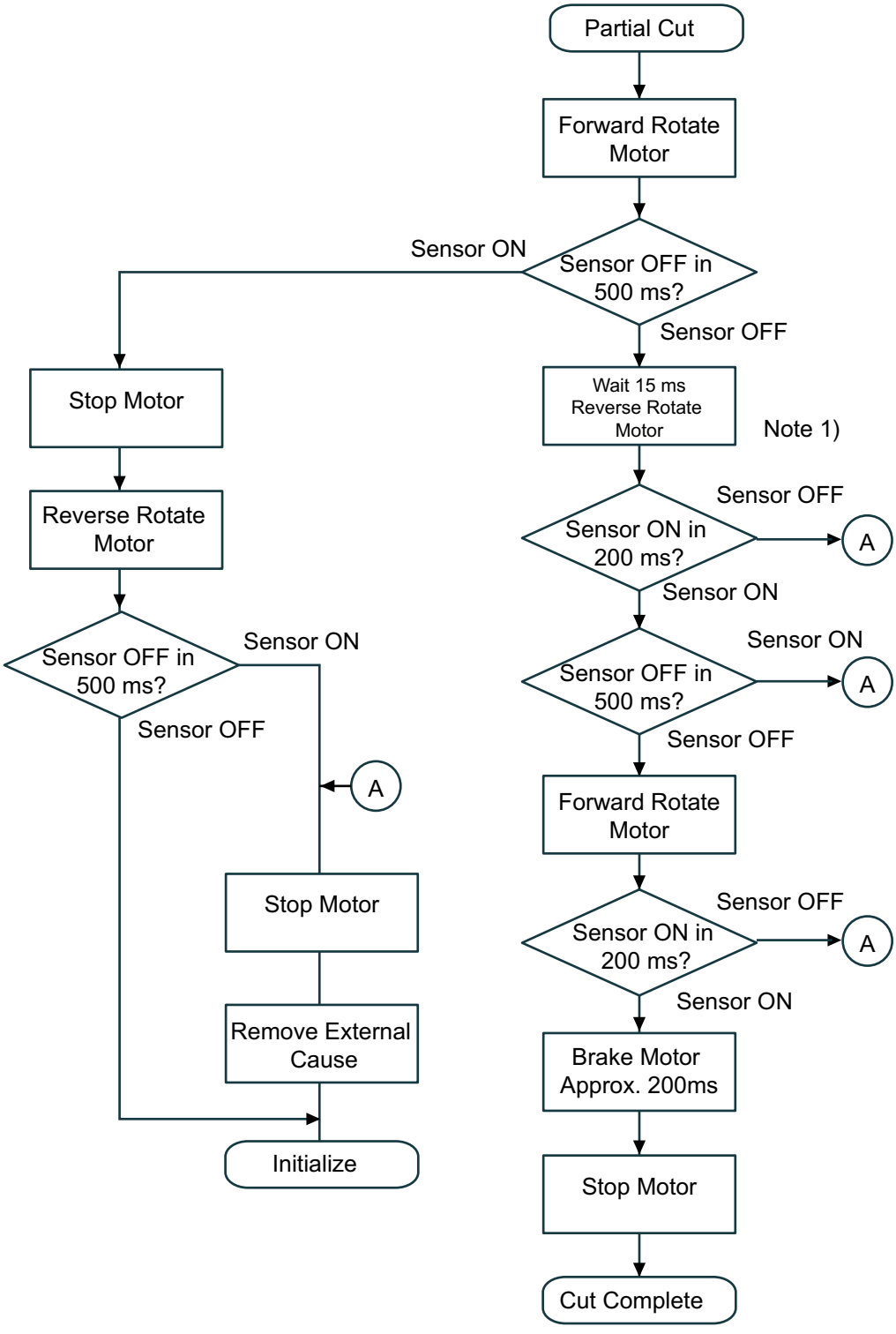
(1) Initializing (Initializing Operation)



(2) Full Cut


Full Cut
Forward Rotate Motor
Sensor ON
Sensor OFF in 500 ms?
Sensor OFF
Stop Motor
Sensor OFF
Sensor ON in 1 s?
A
Reverse Rotate Motor
Sensor ON
Brake Motor Approx. 200ms
Sensor OFF in 500 ms?
Sensor ON
Sensor OFF
Stop Motor
A
Cut Complete
Stop Motor
Remove External Cause
Initialize

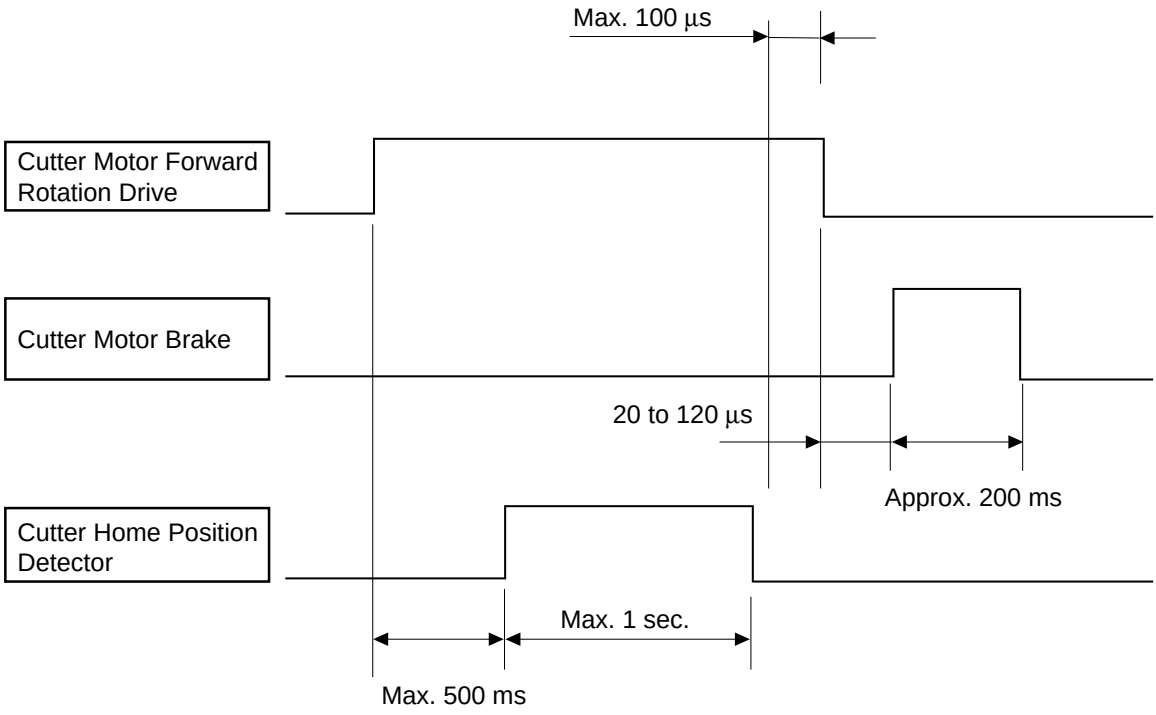
(3) Partial Cut (leaving a portion of the paper uncut)



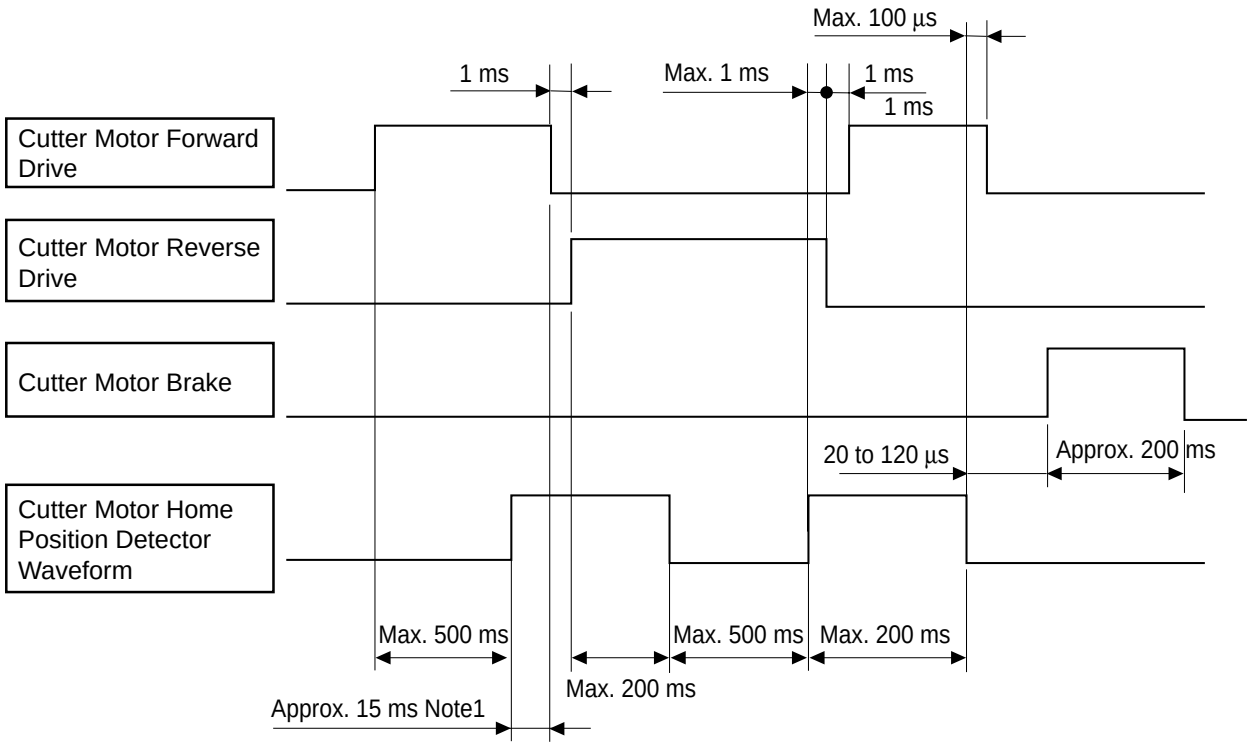
Note 1) Optimum values may vary according to the conditions of use (recording paper, environment, etc.). It is recommended to design upon confirmation on the machine.

3-5-10)Timing Chart

(1) Full Cut



(2) Partial Cut (leaving a portion of the paper uncut)



Note 1) Optimum values may vary according to the conditions of use (recording paper, environment, etc.). It is recommended to design upon confirmation on the machine.

3-5-11) How to Release a Motor Lockup

When the auto-cutter gets locked because of trouble, such as jammed paper, use the following procedures to release the cutter.

(1) Turn OFF the power to the auto-cutter DC motor.

(2) Reverse the power to the auto-cutter DC motor to return the cutter blade.S

(3) When the auto-cutter blade has returned to its home position, stop energizing the auto-cutter DC motor. and remove the cause.

(4) If the auto-cutter blade will not return to its home position, stop energizing the auto-cutter DC motor immediately and rotate the emergency knob in the direction of the arrow on the auto-cutter unit case to remove the cause after returning the auto-cutter blade to its home position. Rotate the emergency knob with a tweezers, screwdriver or ball-point pen to prevent any dangerous situations.

3-5-12) Amount of Paper Remaining After a Partial Cut

The amount of paper remaining in the center of a partial cut when using our recommended standard paper (Mitsubishi P220AG) is shown below.

1.5 mm + 3.5 mm - 1 mm

Note 1) The amount of paper remaining at the center of a partial cut varies according to the type of paper used, so design after confirming operations.

Note 2) Changing the energizing time to the auto-cutter DC motor makes it possible to adjust the amount of paper remaining. It is recommended to make fine adjustments to the energizing time when checking operations.

3-5-13) Precautions Regarding Use of the Auto-cutter

(1) It is prohibited to operate the cutter while feeding paper or while the platen is open. The auto-cutter employs sharp cutting blades to cut the recording paper so it is extremely dangerous to operate the cutter particularly while the platen is opened, so that should be strictly avoided.

(2) Absolutely never approach the auto-cutter blades while the cutter is operating because it is extremely dangerous.

(3) Do not disassemble carelessly. Also, when handling the auto-cutter unit, be certain that the power has been turned OFF.

(4) The cutter can become locked, depending on the thickness of the recording paper. Always use after checking the range of the specifications of the recording paper.

(5) The TMP900 Series handles all paper widths within specifications. However, the widths of paper on the same mechanism (auto-cutter) is limited to one type.

(6) It is prohibited to use the cutter while there is no paper loaded.

3-6) Paper Out Detector

The TMP900 Series of printers are equipped with a paper out detector (a reflective photo-interrupter) to detect the presence of recording paper.

When designing an external circuit, consider a configuration of the circuit that controls the output of the detector and does not energize the thermal head when there is a “paper out” state. If the thermal head is energized while a “paper out” state exists, the life of the platen and thermal head will be notably shortened.

3-6-1) Absolute Maximum Rating (Ta = 25°C)

Item		Symbols	Rated Values	Units
Input	Current	I_F	50	mA
	Reverse Voltage	V_R	6	V
	Tolerance Loss	P_D	75	mW
Output	Collector-Emitter Voltage	V_{CEO}	35	V
	Emitter-Collector Voltage	V_{ECO}	6	V
	Collector Current	I_C	20	mA
	Collector Loss	P_C	75	mW
Total Tolerance Loss		P_{tot}	100	mW
Operating Temperature		T_{opr}	-25 to +85	°C
Storage Temperature		T_{stg}	-40 to +100	°C

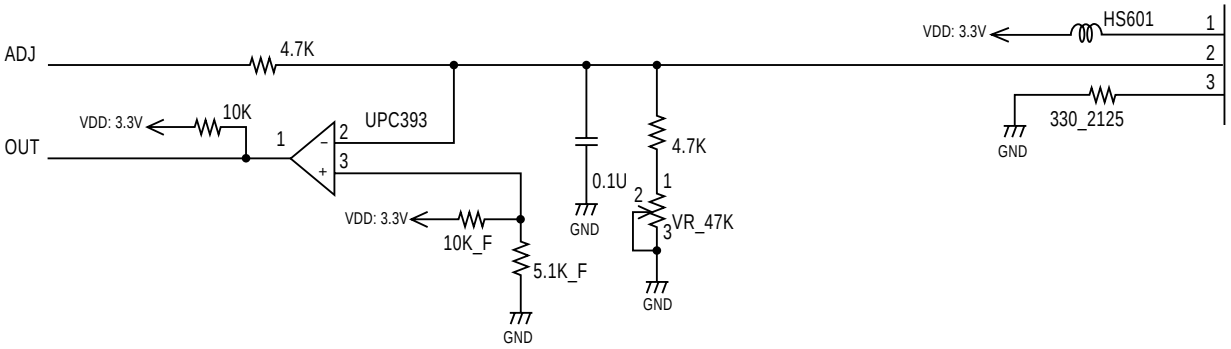
3-6-2) Electrical and Optical Characteristics (Ta = 25°C)

Item			Symbols	Conditions	Min	Typ	Max	Units
Input	Forward Voltage		V_F	I_F = 20 mA	–	1.2	1.4	V
	Reverse Current		I_R	V_R = 3 V	–	–	10	μA
Output	Dark Current		I_{CEO}	V_{CE} = 20 V	–	1	100	nA
Joining Characteristics	Optical Current		I_C	V_{CE} = 5 V I_F = 20 mA	1.0	–	3.0	mA
	Leaked Current See Note 1		I_{LEAK}	V_{CE} = 5 V I_F = 20 mA	–	–	500	nA
	Response Time See Note 2	Rise	tr	V_{CE} = 5 V I_C = 100 μA RL = 1000 Ω d = 4 mm	–	50	150	μS
		Fall	tf		–	50	150	μS

Note 1) No reflective objects

Note 2) d indicates the thickness of the mirror.

3-6-3) External Circuit Example



3-7) Platen Position Detector

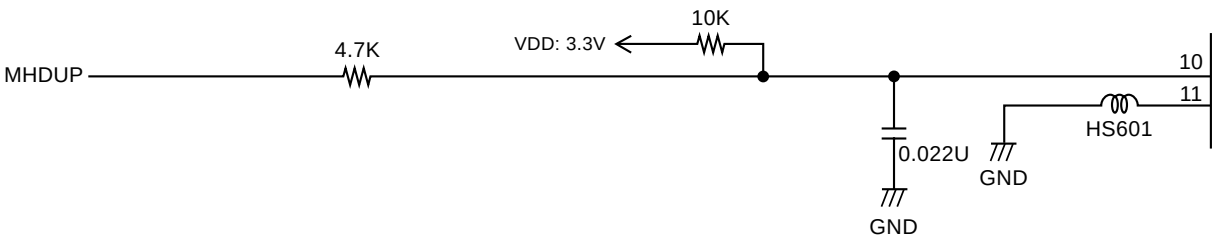
The TMP900 Series of printers are equipped with a platen position detector to detect the whether the platen is open or closed. This detector is set to detect when the platen is open and closed, using a micro-switch.

When designing an external circuit, consider a configuration of the circuit that controls the output of the detector and does not energize the thermal head when there is a “platen open” state. If the thermal head is energized while a “platen open” state exists, the life of the platen and thermal head will be notably shortened. Also, it is extremely dangerous to operate the cutter while the printer is in a “platen open” state.

3-7-1) General Standards

(1) Type:	Micro Switch
(2) Rating:	DC 5 V 0.1 mA
(3) Maximum Rating:	DC 16 V 0.1 A (Resistance Load)
(4) Ambient Temperature Range:	-10 to 70°C

3-7-2) External Circuit Example



3-8) Connector

There are three types of connectors for the TMP900 Series printers. See Table 3.8 for details of each.

Table 3.8

Connector No.	Function and Model Number	Number of Pins	Recommended Other Party Connectors
1 (A)	Thermal head control pin Made by JST PHR-16	16	Made by JST Top type: B16-PH-K-S Side type: S16-PH-K-S
2 (B)	Thermal head control pin Made by JST PHR-15	15	Made by JST Top type: B15-PH-K-S Side type: S15-PH-K-S
3	Motors (for feeding and cutting) and sensor control pin Made by JST PHR-14	14	Made by JST Top type: B14-PH-K-S Side type: S14-PH-K-S

3-8-1) Thermal Head Control Pins (Connector 1)

Pin Numbers	Signal Name	I/O	Function
1	VH	-	Printing power voltage
2	VH	-	Printing power voltage
3	VH	-	Printing power voltage
4	VH	-	Printing power voltage
5	DO	Output	Print data output (Serial output) See Note 1
6	/LAT	Input	Print data latch
7	CLK	Input	Synch signal for print data transfer
8	Vdd	-	Circuit Power Voltage
9	STB1	Input	Strobe 1
10	STB 2	Input	Strobe 2
11	STB3	Input	Strobe 3
12	P-GND	-	Power ground
13	P-GND	-	Power ground
14	P-GND	-	Power ground
15	P-GND	-	Power ground
16	(N. C.)		

Note 1) When DO is unused, it should be N. C.

3-8-2) Thermal Head Control Pins (Connector 2)

Pin Numbers	Signal Name	I/O	Function
1	VH	-	Printing power voltage
2	VH	-	Printing power voltage
3	VH	-	Printing power voltage
4	VH	-	Printing power voltage
5	DI	Input	Print data input (Serial Input)
6	STB6	Input	Strobe 6
7	STB5	Input	Strobe 5
8	STB4	Input	Strobe 4
9	TM	Output	Thermistor
10	TM	Output	Thermistor
11	L-GND	-	Logic ground
12	P-GND	-	Power ground
13	P-GND	-	Power ground
14	P-GND	-	Power ground
15	P-GND	-	Power ground

3-8-3) Motor and Sensor Control Pins (Connector 3)

Pin Numbers	Signal Name	Function
1		Paper out detector anode/collector
2		Paper out detector emitter
3		Paper out detector cathode
4		——
5		——
6	A	Motor drive signal
7	/A	Motor drive signal
8	B	Motor drive signal
9	/B	Motor drive signal
10		Platen Position Detector Signal
11	S-GND	Logic ground
12		Cutter home position detector signal
13		Cutter motor (+)
14		Cutter motor (-)

3-9) Heat Sensitive Recording Paper

3-9-1) Type:

Single roll heat sensitive paper

3-9-2) Paper Width

79.5 ±0.5 to 111.5 ±0.5 mm

3-9-3) External Dimensions

Roll Diameter: Maximum 254mm (10 inches)

Width (Rolled Dimensions): 80 $^{+0.5}_{-1}$ to 112 $^{+0.5}_{-1}$ mm

Note 1) Maximum value for roll diameter is the tolerance when using a shock absorbing mechanism (damper roll).

Note 2) When using rolls with comparatively large external diameters, the load when feeding paper adds a shock to the mechanism. For that reason, to alleviate the shock, it is necessary to use a shock absorbing mechanism. Consider this when designing. For small diameter rolls, it is also recommended to use a shock absorbing mechanism.

3-9-4) Paper Thickness

65 to 150 μm

3-9-5) Shaft Core Diameter (mm)/Outer Diameter (mm)

Tolerance values cary for roll paper shaft cores (paper cores) according to the thickness of the paper used. See the following table to determine the roll paper shaft core diameter to use.

Paper Thickness is 65 to 100 μm:	Shaft core inner diameter: Max. 25.4 ±1 mm Shaft core outer diameter: Max. 31.4 ±1 mm
Paper Thickness is 100 to 150 μm:	Shaft core inner diameter: Max. 50.8 ±1 mm Shaft core outer diameter: Max. 56.8 ±1 mm

Note1) Paper jams may occur if outside of the aforementioned specification range.

3-9-6) Recommended Heat Sensitive Paper

Manufacturer	Manufacturer Name	Quality Characteristics and Use	Paper Thickness (μm)
Mitsubishi Paper Mills Limited	P220AG	Normal Type	65
	HP220A	Long-storage type	65
	HP220AB-1	Long-storage type	75
	P220AB	Normal type for cards/tickets	85
	P220AC-1	Normal type for cards/tickets	95
	P220AC	Normal type for cards/tickets	105
	P220AD	Normal type for cards/tickets	130
	P220AE-1	Normal type for cards/tickets	150
	PB670	2 color type (red/black)	75
	PB770	2 color type (blue/black)	75
Oji Paper Co., Ltd.	PD150R	Normal Type	75
	PD160R	Long-storage type	65/75
	PD750R	2 color type (red/black)	75
	PD700R	2 color type (blue/black)	75
KSP	P-320RB	2 color type (red/black)	65
	P-320BB	2 color type (blue/black)	65
Nippon Paper Industries Co., Ltd.	TF50KS-E2C	Normal Type	65

3-9-7) Head Adjustment Lever Position According to Recording Paper Used

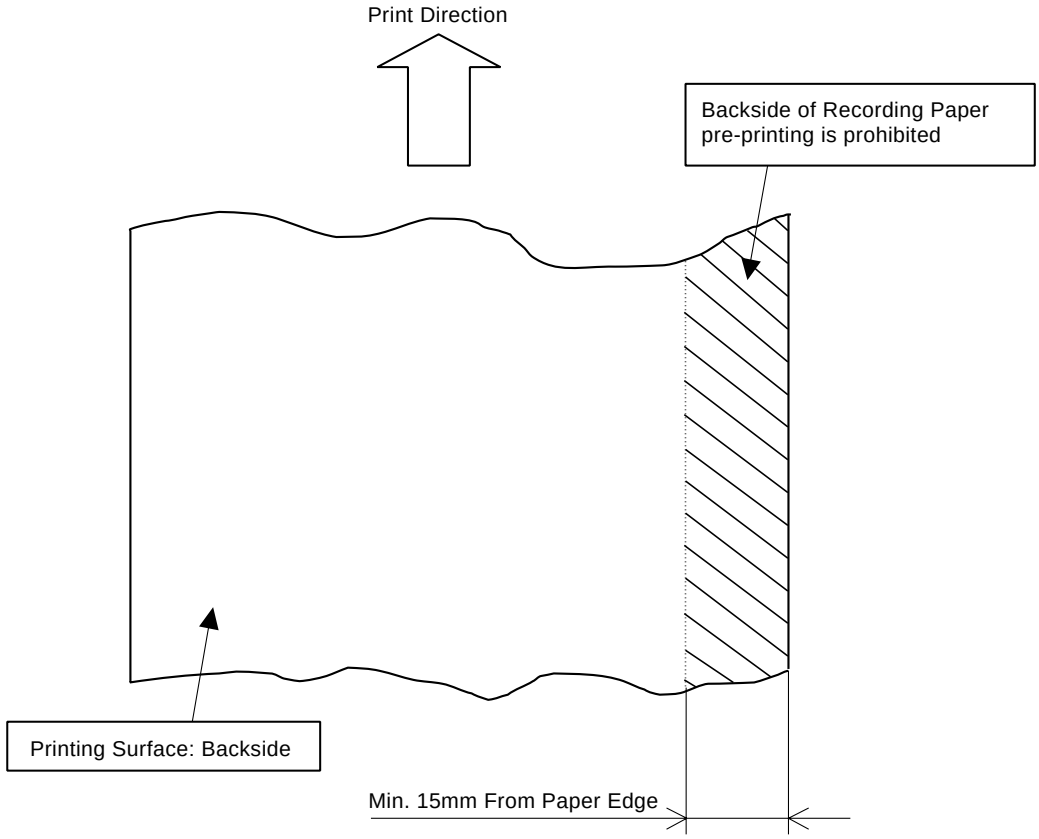
The TMP900 Series or printers require that the head position be adjusted according to the thickness of the paper to be used to ensure high quality printing. The adjustment of the head position is performed by changing the position of the head adjustment lever.

See the table below to set to the optimum lever position.

65 μm ≦ paper thickness < 100 μm	Normal position
100 μm ≦ paper thickness ≦ 150 μm	Thick paper position

3-9-8) Pre-printing on the Backside of Recording Paper

When pre-printing to the backside of recording paper, it should meet the following specifications.

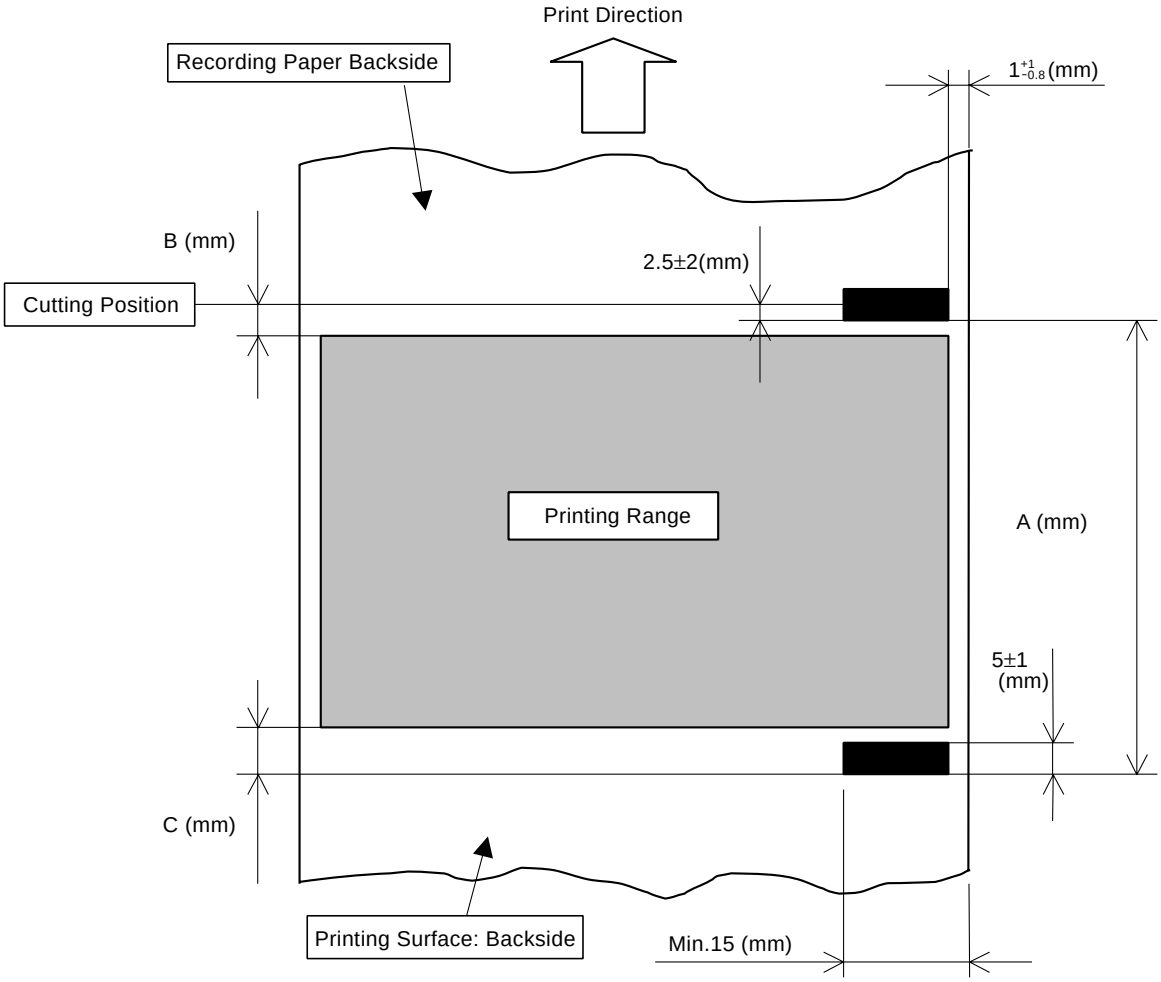


3-9-9) Others

- Coloring Side: Roll Outer Side
- Trailing Edge Processing: Do not glue to fasten to roll paper and shaft core. The trailing edge should not be folded.

3-10) Black Mark Specifications

The following describes the recommended black mark specifications for printers that use the paper out detector as the black mark detector.



3-10-1) Black Mark Pitch (Dimensions A)

Black mark pitch can be set to a dimension of A = 45 to 300 mm.

Note 1) Black mark pitch is recommended to be set to the above range, but to set to use pitches that are smaller than the aforementioned range, consult with Star.

3-10-2) Black Mark Dimensions

See the following drawings for the dimensions of black marks to be printed.

3-10-3) PCS Value

The PCS value of black mark must be 0.90 or more.

Note 1) The PCS value of black marks can cause page skipping problems or improper page length detection if they do not meet the aforementioned specifications. For that reason, always ensure that the PCS value is met.

3-10-4)Top margin (Dimension B)

Set the printing range, leaving plenty of top margin from the cutting position.

If not reverse feeding the recording paper, it is recommended that the top margin be a total of 20 mm including the distance of 15 mm from the thermal head heating elements to the cutting position and the amount of the acceleration step paper feed amount (in HS mode 40 steps = 5 mm) caused by the paper feed motor acceleration control after cutting the paper.

If you want a smaller top margin setting, reverse feed the recording paper. However, in such cases, it is recommended that the top margin be set to more than the paper feed motor acceleration step (more than 5 mm) after cutting the paper.

Note 1) If the top margin is not sufficiently taken, problems, such as the page being skipped, can occur. So, you must set for plenty of top margin.

Note 2) The setting of the printing range should not exceed the black mark pitch.

3-10-5)Bottom margin (Dimension C)

Set the printing range leaving plenty of bottom margin from the trailing edge of the printing range to the black mark.

It is necessary to consider the printing precision of the black mark, the printing TOF accuracy (±2 mm of the standard printing position), the setup ambient temperature of the printer mechanism, the variation in the forming accuracy of the parts and part wear-out to set the bottom margin. It is recommended that the following bottom margin be secured to set the printing range.

Bottom Margin (Dimension C) ≧ 3 mm + (Dimension A x 3%)

Note 1) If the bottom margin is not sufficiently taken, problems, such as the page being skipped, can occur. So, you must set for plenty of bottom margin.

Note 2) The setting of the printing range should not exceed the black mark pitch.

3-10-6)Setting Example of the Printing Range

The following shows a printing range setting example when not reverse feeding recording paper.

• When Black Mark Pitch (Dimension A) is 100 mm:

The top margin is set to 20 mm.

The bottom margin is set to 3 mm + (100 mm x 0.03) = 6 mm.

According to the above, it is necessary to set the printing range to less than 100 mm – 20 mm – 6 mm = 74 mm.

Note 1) If you have any questions regarding how to set the printing range for the black mark, consult with Star Micronics.

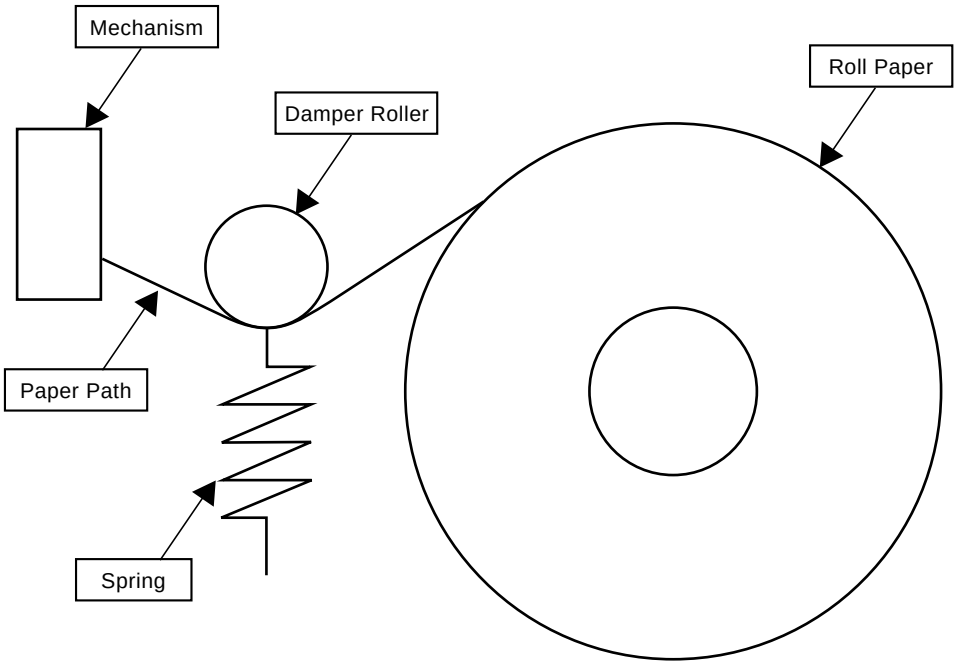
3-11) Roll Paper Supply Conditions

If the roll paper supply conditions are poor, there can be inconsistencies in the paper feed pitch or notable differences in the length of the print. For that reason, use the optimum roll paper supply conditions to maintain quality printing.

Particularly, if using large diameter roll paper, and are printing at high speed (HS mode), always arrange a shock absorbing mechanism (damper roller).

Note 1) If the roll paper supply conditions are poor, not only will print quality be mal-effected, but the normal drive of the paper feed motor will also affected.

3-11-1) Example Shock Absorber Mechanism



CHAPTER 4 DESIGNING THE OUTER COVER

4-1) Printer External Appearance and Dimensions

The accompanying Fig. 4.1A and Fig. 4.1 B show the external appearance of the printer mechanism and the dimensions.

Refer to them to design the printer outer cover.

Note 1) If the positional relationship of the printer mechanism and the paper feed roll holder mounting is poor, recording paper can skew, the ends of the paper become creased or the paper to jam. For that reason, design so that center of the printer mechanism paper guide in the width direction and the center of the paper feed roll holder in the paper width direction match.

Note 2) Set the insertion angle of the recording paper to the printer mechanism to be within the standard range.

Note 3) Design so that paper transport is unobstructed at the recording paper discharge outlet.

Note 4) Determine the layout of the cables from the printer mechanism so that no unnecessary loads are applied to them. Also, ensure that cable insulating covering is not damaged by the edges of the printer mechanism or the case.

Note 5) Plated steel is used so rusting can occur on edges.

Note 6) Design for gaps between the case and the printer mechanism for areas other than where attached.

4-2) Fastening the Printer

The printer mechanism can be fastened using screws from the front or the back sides of the printer. Either can be selected.

Note 1) Depending on the state of the surface to which the printer mechanism is fastened, the printer mechanism can become deformed making it difficult to attain quality prints. Avoid fastening to surfaces that have bumps or that are uneven.

4-2-1) Fastening from the Printer Front

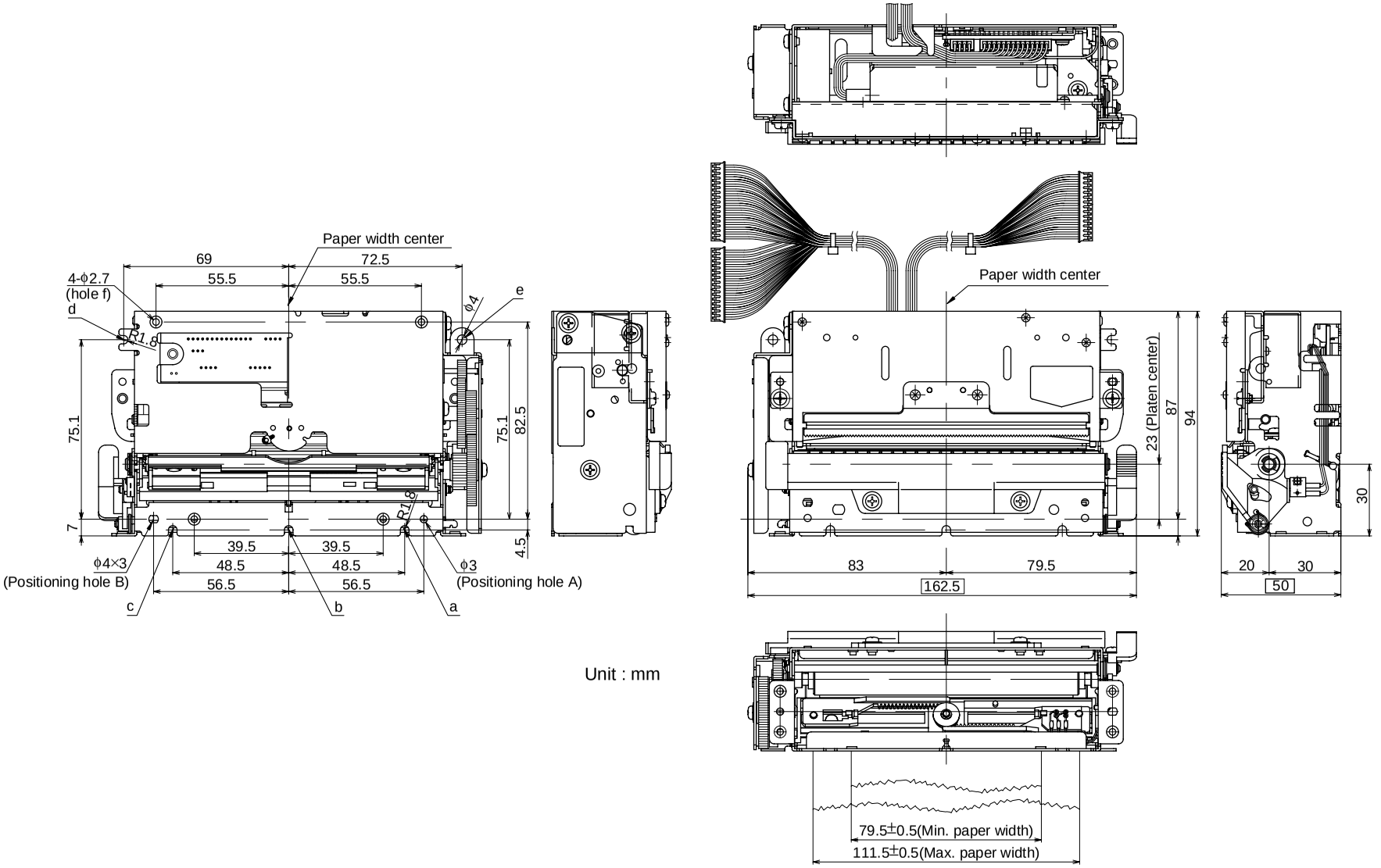
Use the U-shaped grooves of a, b, c and d and the hole e shown in the accompanying Fig. 4.1A to fasten the printer mechanism. Also, A and B are for positioning the printer mechanism.

4-2-2) Fastening from the Printer Back

Use the four holes f shown in the accompanying Fig. 4.1A to fasten the printer mechanism. Also, A and B are for positioning the printer mechanism.

Use self-tapping screws to fasten the printer mechanism. Control the tightening torque to avoid damaging the threads of the screws when tightening.

Note 1) If you are unsure of which self-tapping screws to select, contact your supplier.



Unit : mm

Fig. 4.1A External View

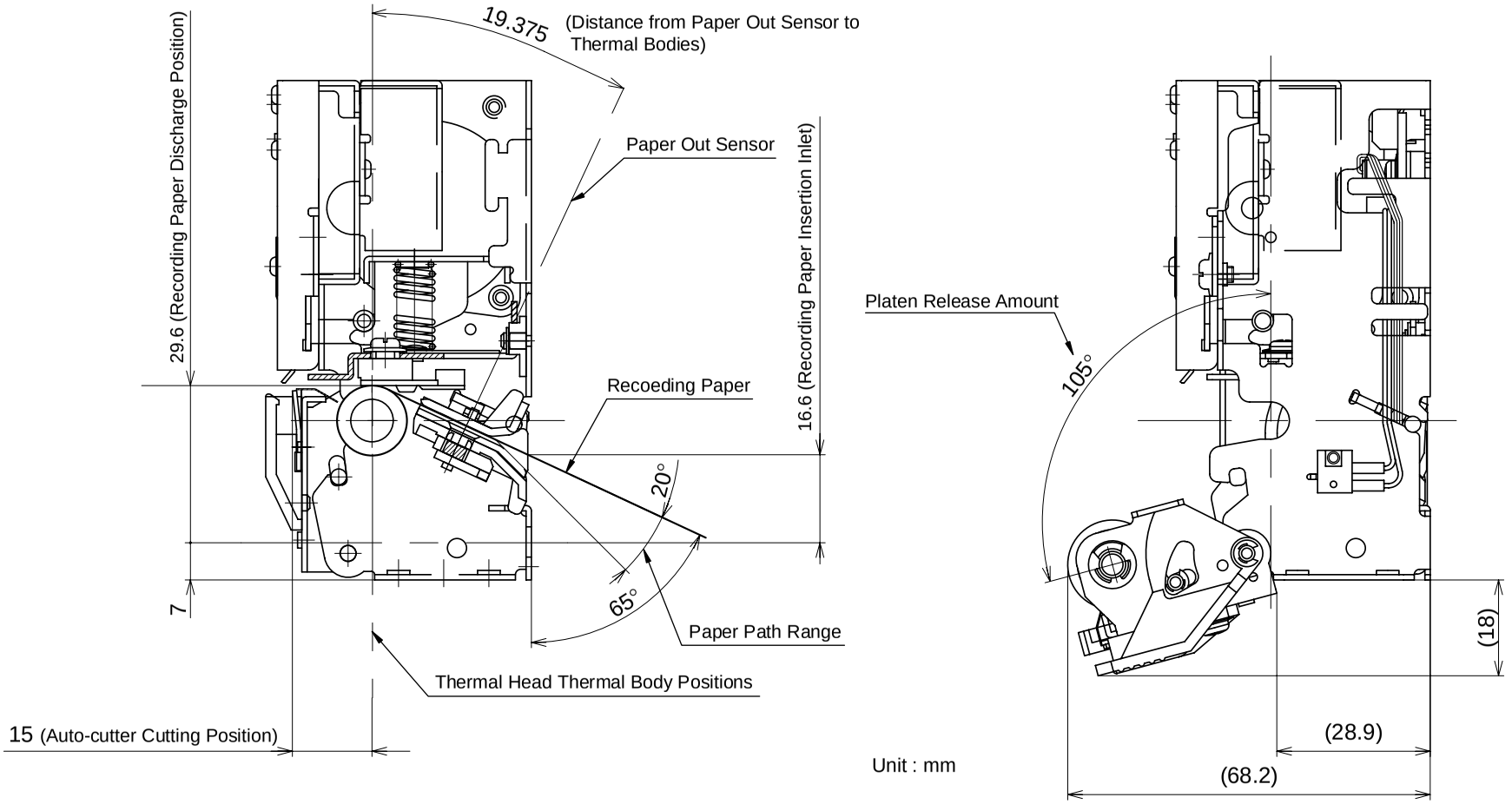


Fig. 4.1B External View

CHAPTER 5 HANDLING THE PRINTER

5-1) Precautions Regarding Designs

1. See “3-4-10) Precautions Regarding Use of the Thermal Head” for details regarding the thermal head.
2. To avoid damaging the heating elements that is generated by the ions on the recording paper and noise, design so that the VH charge is applied to the power circuit only when printing.
3. Absolutely never energize the head when there is no recording paper, or when the platen is released.

5-2) Precautions for Handling

1. To prevent static electric damage to the thermal head’s heating elements and the IC, handle the printer only after preparing for anti-static and grounding yourself.
2. Handle the thermal head carefully because applying mechanical stress or shocks to it (including wear out by micro-granules), it is possible to damage the PCB surface of the heating elements.
3. Print quality and thermal head life cannot be guaranteed if you use recording paper other than what has been recommended.
4. To prevent static electric damage to the thermal head’s heating elements and the IC, handle the printer only after preparing for anti-static and grounding yourself.
5. Be careful not to allow condensation to form. If condensation does form, absolutely do no turn ON the power until it has evaporated.
6. Absolutely never directly touch the thermal head heating elements, the driver IC unit or the pins with your hands or a screwdriver.
7. Avoid leaving the printer without paper.
8. Be careful not to allow foreign objects to adhere to the recording paper and the platen.
9. Do not pull on the paper without opening the platen.
10. When closing the platen from an open state, check that it has been correctly locked by the locking mechanism before operating the printer.
11. Do not apply excessive force to the cable connectors. Limit the number of times to attach and detach the connectors to 10 times.
12. There are cases of discoloring of the recording paper, degradation of the coloring layer or the recording paper and platen could fuse together if the printer is left unused for extended periods. So, when using the printer after having been unused for extended periods, it is recommended to install new recording paper.
13. The platen rubber may deform making printing thinner in some places, if the printer is left unused for extended periods.
14. Initial print may be thin when using the printer in a cold environment because the thermal head is cold.

15. When using the printer in a high temperature environment, the print may run or characters may be distorted.
16. Avoid sudden changes of the environment even if the ambient temperature and humidity are within standard.
17. Do not store or use the printer in locations that are dusty, oily or exposed to metallic dust.

5-3) Precautions Concerning Safety

1. During or after printing, the area near the thermal head and the surface of the motor are extremely hot. Do not touch directly with your hands.
2. Burning of the thermal head has the dangerous possibility of causing overheating or smoke.
3. For that reason, see “3-4-10) Precautions Regarding Use of the Thermal Head” for details on dual use of the software and hardware for error detection of the control system.
4. Do not touch the gears or rotating parts while the printer mechanism is operating.
5. Be very careful because there is the possibility of injury by handling the edges of the printer mechanism (particularly the metal parts).
6. Be careful to never directly touch the paper tear bar (manual cutter) or the auto-cutter blades with your hands because the blades are extremely dangerous.

5-4) Performing Maintenance

5-4-1) Cleaning the Thermal Head and Platen

To ensure long-term and stable printing, periodically clean the thermal head and the platen. It is recommended that you clean every 500,000 lines. The thermal head and platen can be cleaned by opening the platen unit with the release lever.

- To clean the thermal head heating elements, wipe with a cotton swab dampened with an alcohol based cleaner (such as ethanol or methanol). Also, do not apply excessive force when doing so. Wipe the heating elements gently. After cleaning, check that the alcohol has completely evaporated before closing the platen unit.
- To clean the platen, use a soft, dry cotton swab and rotate the platen to clean it. Completely remove all paper dust from the platen rubber. If it is not completely cleaned, paper can become jammed.

5-4-2) Handling Recording Paper Jams

If recording paper should become jammed, open the platen unit and remove the jammed paper.
Do not forcefully pull on jammed recording paper with opening the platen unit because this can damage the drive system parts.

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