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EPSON

Thermal Line Printer

M-T173H/T173V

Specification

STANDARD	
Rev. No.	E
Notes	

Copied Date	
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SEIKO EPSON CORPORATION

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REVISION SHEET

The table below indicates which pages in this specification have been revised.
Before reading this specification, be sure you have the correct version of each page.

Revisions		Design Section			Sheet Rev. No.					
Rev.	Document	WRT	CHK	APL	Sheet	Rev.	Sheet	Rev.	Sheet	Rev.
A	Enactment	Yamada	Takami	Murata	I	A	22	A		
B	Change	Yamada	Takami	Sato	II	A	23	D		
C	Change	Yamada	Takami	Sato	III	D	24	E		
D	Change	Yamada	Takami	Sato	IV	A	25	E		
E	Change	Kamijo	Takami	Fujikawa	V	A				
					1	A	App.1	D		
					2	A	App.2	A		
					3	A	App.3	D		
					4	A				
					5	A				
					6	A				
					7	A				
					8	A				
					9	D				
					10	C				
					11	D				
					12	A				
					13	C				
					14	A				
					15	A				
					16	A				
					17	A				
					18	C				
					19	C				
					20	D				
					21	A				

TITLE

M-T173H/T173V
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Front Part					Contents	Appendix	Total
Cover	Rev. Sheet	Scope	General Descriptions	Table of Contents			
1	3	--	3	2	25	3	37

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REVISION SHEET

REV.	SHEET	CHANGED CONTENTS
A	All	Newly enacted.
B	24	2.9.1 M-T173H overall dimensions The dimension between COVER,GEAR TRAIN,H and MOTOR: Changed “20.6” to “21.2 / (19.7).”
	25	2.9.2 M-T173V overall dimensions The dimension between COVER,GEARTRAIN,V and MOTOR: Changed “19.6” to “20.2 / (18.7).”
C	10	2.3.6 Drive method Motor drive frequency: Changed “200 to 1440 pps” to “300 to 1440 pps.” NOTE: Added 2.
	11	2.3.8 Slow-up sequence Table 2.3.2 Slow-up Sequence Changed “Speed (pps)” to “Motor drive frequency (pps).” Changed “Energizing Time (μs)” to “Motor drive cycle (μs).” Removed “Step 1, (Motor drive frequency) 205, (Motor drive cycle) 4875.”
	13	2.5.2 Print head electrical characteristics Table 2.5.1 Absolute Maximum Ratings Removed “Number of dots to be energized simultaneously.”
	18, 19	2.5.7 Energizing pulse width Added “These twice of energization must form 1 dot.” Added “Use the motor drive cycle … the minimum motor drive cycle.” NOTE: Added 2. 2.5.8 Detection of print head problems Shifted Sheet 18 to Sheet 19.
D	III	GENERAL FEATURES 4. Maintenance Changed “As maintenance is not presumed on this product, no after-sales parts are provided.” to “As maintenance is not presumed on this product, no after-sales parts are provided except the platen unit.”
	9	2.2.8 Paper insertion angle Replaced Figure 2.2.2 Paper Insertion Angle.
	11	2.3.8 Slow-up sequence Table 2.3.2 Slow-up Sequence (Motor drive cycle for Start rush-driving): Changed “5000” to “3000.” NOTE 1: Changed “5 ms” to “30 ms.” NOTE 3: Changed “5 ms” to “30 ms.”
	20	2.6 Paper-end Detector 1) Type Replaced Figure 2.6.1 Paper-end Detector.
	23	2.8 Connectors 2) Pin assignments Table 2.8.1 Pin Assignments (Pin No.1) Changed “GND (Paper-end detector)” to “LED (Cathode) (Paper-end detector).” (Pin No.2) Changed “LED(A) (Paper-end detector)” to “VDD (paper-end detector).”

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REV.	SHEET	CHANGED CONTENTS
D	24	2.9.1 M-T173H overall dimensions Replaced the diagram.
	25	2.9.2 M-T173V overall dimensions Replaced the diagram.
	App.1	Changed “Therefore, they must also be installed onto the case in this state.” to “Therefore, Epson recommends installing them in the case in this state.”
	App.3	A.12 Marks Replaced Figure 3.1.1.
E	24	2.9.1 M-T173H overall dimensions Replaced the diagram.
	25	2.9.2 M-T173V overall dimensions Replaced the diagram.

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Points That Must Be Observed To Assure Product Safety

To assure the safe operation of this product, carefully observe the specifications as well as the notes provided below.

Seiko Epson Corporation will not bear any responsibility for any damage or injuries arising from use of this product that is not in accordance with the specifications and the notes provided below.

Notes on Head Control

1. Absolute maximum voltage
   1) Printer voltage: 8.5 V or less
      (Apply to the print head, and motor)
   2) Circuit power supply voltage: 5.25 V or less
      (Apply to the head control circuit, and paper end detector.)
2. Always observe the conditions setting forth the maximum time power can be applied (and the maximum voltage that can be applied) to electronic components such as the head, motor, and detectors. If the maximum time power can be applied (or the maximum voltage that can be applied) is exceeded, the components mentioned above could overheat and start a fire or begin to smoke.
3. Always include protective circuitry governing the length of time power is applied and the amount of current that is applied when designing the drive and control circuits for the head, motor, detectors, etc. If protective circuitry is not included, misoperation of the printer control circuits could cause the components mentioned above to overheat and begin to smoke or burn.

Notes on Handling

1. Because the print head and motor can become very hot, it must not be exposed in such a way that it can be touched. Touching the print head could cause burns.
2. The case must be designed so that movable parts, such as gears, etc., are not exposed. Touching moving parts could cause a laceration or other injury.

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GENERAL FEATURES

1. Application

This preliminary specification manual applies to the M-T173H/T173V thermal line printer.

2. Features

1) Low noise
2) High-speed printing: 90 mm/s max. (at 8.5 V)
3) Compact and light mass

M-T173H: 70.1 mm (W) × 32.7 mm (D) × 15.3 mm (H), Appx.43 g
{2.76"(W) × 1.29" (D) × 0.6" × (H), Appx.0.095 lb}

M-T173V: 70.1 mm (W) × 21.8 mm (D) × 31.0 mm (H), Appx.45 g
{2.76"(W) × 0.86" (D) × 1.22" (H), Appx. 0.099 lb}

4) High quality printing: 8 dots/mm
5) Solid and durable
6) Easy paper loading

3. Designer's Guide

Also see the separately issued "M-T173H/T173V Designer's Guide" for more details.

4. Maintenance

Although maintenance is not presumed on this product, the platen unit is provided as an after-sales part.

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1. GENERAL SPECIFICATIONS

1.1 Printing Method

Thermal line dot printing

1.2 Printing Format

1.2.1 Total number of dots

384 dots/dotline

1.2.2 Example printing

(See Section 2.1.2 Example print format.)

1) Dot pitch:	Horizontal (column) direction:	0.125 mm {0.049"}
	Vertical (line) direction:	Approximately 0.125 mm {0.049"}

2) Example printing

Character structure:	12 (W) × 24 (H) dots font (including a horizontal 2-dot space)
Character size:	1.25 (W) {0.049"} × Approximately 3.0 (H) mm {0.18"}
Column pitch:	1.50 mm {0.059"}
Line pitch:	Approximately 3.75 mm {0.15"} (including 6-dotline spacing)
Number of columns:	32 (12 × 24 dots/character)

1.3 Printing Speed

Max. 90 mm/s {3.54"/s} (at 8.5 V of the printer drive voltage Vp)
(approximately 24 lps at a line pitch of 3.75 mm {0.15"})
[lps: lines per second]

NOTE: In the case of printing that uses 64 dots or less to be energized simultaneously and no head separation control.

1.4 Paper Feeding

1) Feeding method:	Friction feed
2) Minimum feed pitch:	Approximately 0.0625 mm {0.0025"}
3) Maximum feeding speed:	90 mm/s {3.54"/s} (at 8.5 V of the printer drive voltage Vp)

NOTES: 1. In the case of printing at the room temperature (25°C {77°F}) or more.
2. See Section 2.3.6 for the conditions in the motor of continuous driving.

1.5 Paper

1) Paper type: Single-ply thermal paper roll
(Heat-sensitive surface must be wrapped facing the outer side.)

2) Specified paper:

Original Paper No.	TF50KS-E2C	NIPPON PAPER INDUSTRIES CO., LTD.
	TF50KS-E2D	NIPPON PAPER INDUSTRIES CO., LTD.
	KF50	KANZAN
	P350	KSP
	PD150R	OJI PAPER CO., LTD.
	PD160R	OJI PAPER CO., LTD.

3) Shipping inspection paper (thermal paper roll):

Original Paper No.	PD150R	OJI PAPER CO., LTD.
	PD160R	OJI PAPER CO., LTD.

4) Size: 57.5 ± 0.5 (width) mm {2.26" ± 0.02"} ×Φ80 mm {Φ3.15"} or less (outside diameter)

NOTE: For details, see 2.4 Paper (Supplied by the User).

1.6 Power Supply Voltage

1) Printer drive voltage Vp: 4.5 to 8.5 V

NOTES: 1. The printer drive voltage above applies to the print head and the motor.
2. The same power source must be used for both the print head and the motor.
3. The line voltage drop which is caused by line resistance and driver's saturation is assumed to be less than 0.5 V.

2) Circuit power supply voltage V_{DD}: 2.7 to 5.25 V

NOTE: The power supply voltage applies to the print head control circuit and the paper end detector.

1.7 Print head Specifications

1) Heat element density: 8 dots/mm (0.125 mm {0.049"}/dot)

2) Total number of head elements:
384 dots/ dotline

3) Available printing width: 48 mm {1.89"}

4) Heating element typical resistance value:
176 ± 7 Ω (including heating element + wiring resistor, default value at 25°C {77°F})

1.8 Motor

1) Paper feed motor: 4-phase bipolar stepping motor

1.9 Detectors

1) Print head temperature detector:
Thermistor

2) Paper end detector: Reflecting photo detector

1.10 Connecting Method

1) Printer side: FPC output (1-mm pitch, 30-pin, terminal thickness 0.3 mm {0.012"})

2) User side (recommended): 30-pin 52807-3010 (horizontal), 52806-3010 (vertical) (Molex) or 30FMN-STK-A (horizontal), 30FMN-BTK-A (vertical) (J.S.T. Mfg. Co. Ltd.)

1.11 Overall Dimensions (See Section 2.9 Overall Dimensions for details.)

M-T173H: 70.1 mm (W) × 32.7 mm (D) × 15.3 mm (H)
{2.76" (W) × 1.29" (D) × 0.6" (H)}

M-T173V: 70.1 mm (W) × 21.8 mm (D) × 31.0 mm (H)
{2.76" (W) × 0.86" (D) × 1.22" (H)}

1.12 Mass

M-T173H: Approximately 43 g {0.095 lb}

M-T173V: Approximately 45 g {0.099 lb}

1.13 Environmental Conditions

1) Operating temperature: -20 to 70°C {-4 to 158°F}
(Printing quality is guaranteed within 5 to 45°C {41 to 113°F})

2) Operating humidity: 10 to 80 %RH (34°C {93°F} at 80 %, non-condensing)

NOTES: 1. Figure 1.13.1 shows the environmental conditions for operation.

2. In the range of "Print quality is guaranteed" as shown in the Figure 1.13.1, Epson guarantees the print quality. Guaranteed print area is given based on the Epson quality standard.

3. In the range of "Operating is guaranteed" as shown in the Figure 1.13.1, operation except printing quality is guaranteed.

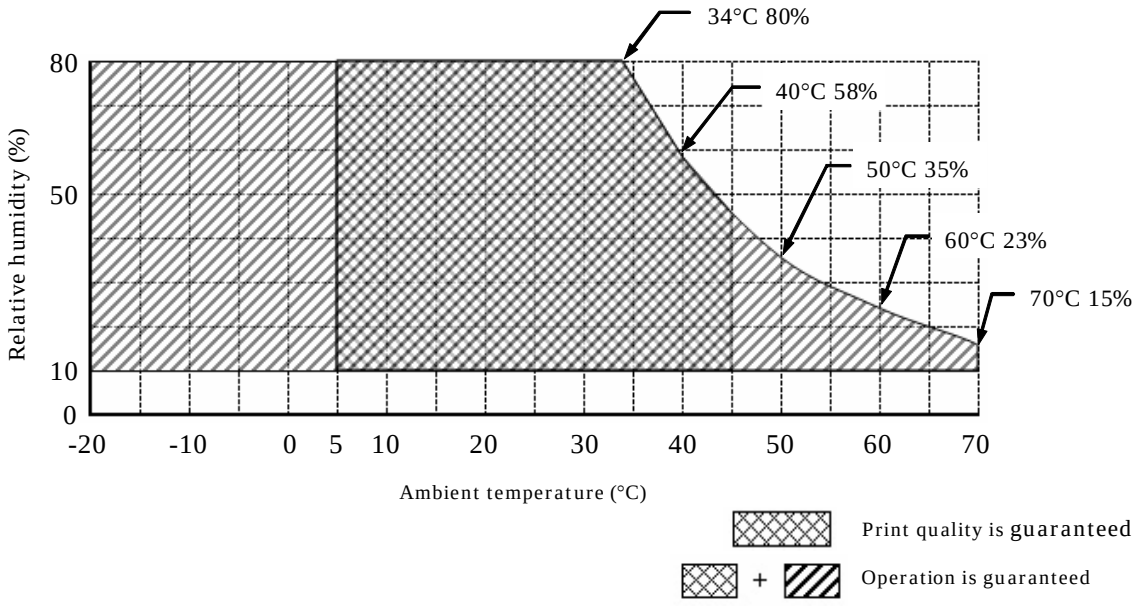

Figure 1.13.1 Environmental Conditions

1.14 Reliability

1) Printer mechanism (excluding print head)

Life:	6,000,000 lines
	End of life is defined as the point at which the printer reaches the beginning of the wear out period.
MCBF:	15,000,000 lines
	This is an average failure interval based on failures relating to wear up to the life of 6 million lines and accidental failures.

2) Print head

Life:	50 km, 100 million pulses (Printing ratio of 12.5 %)

NOTES: 1. Printer operation is estimated to follow the example print format in Section 2.1.2 where the printer intermittently repeats 50 lines of printing.

The average number of printing dots per dotline is 96 or less, and the number of printing dots per element in the average printing line is 12 or less, that is, 2 pulses are energized for 1 dot.

2. It is assumed that the recommended paper is used.

1.15 Environmental Conditions for Storage

1) Storage at high temperatures and high humidity:

Temperature:	50°C {122°F}
Humidity:	90% RH
Total time:	240 hours

Epson confirmed that no unexpected conditions will occur in operation of the mechanism at 25°C {77°F}, 60 % RH after being left for two hours past storage in the above conditions.

2) Storage at high temperatures:

Temperature:	70°C {158°F}
Total time:	240 hours

Epson confirmed that no unexpected conditions will occur in operation of the mechanism at 25°C {77°F}, 60% RH after being left for two hours past storage in the above conditions.

3) Storage at low temperatures:

Temperature:	-25°C {-13°F}
Total time:	240 hours

Epson confirmed that no unexpected conditions will occur in operation of the mechanism at 25 °C {77°F}, 60% RH after being left for two hours past storage in the above conditions.

4) Vibration resistance:

Frequency:	10 - 150 - 10 Hz
Sweep:	20 minutes for coming and returning (One hour for each direction)
Acceleration:	19.6 m/s^2 {2G} (X, Y, and Z directions)

Epson confirmed that no unexpected conditions would occur in operation of the mechanism after vibration under the above conditions.

5) Impact resistance:

Impact acceleration:	980 m/s^2 {100G}
Total operation time:	6 ms
Direction:	1 time each for X, Y, and Z directions
Impact operation point:	Any mechanism mounting portion

Epson confirmed that no unexpected conditions would occur in operation of the mechanism after impact under the above conditions.

1.16 TSCA Compliance

All the Epson-specified ink, grease, and oil materials used in this product are listed in the TSCA chemical substance inventory of the U.S. Toxic Substances Control Act.

1.17 Chemical Substance Inclusion

The chemical materials contained in this product are managed based on Seiko Epson's policy and lists of chemical substances banned in products (level 1 and 2) and controlled chemical substances set forth in Green Purchasing Standard. As for the chemical substances banned in products (level 1 and 2) and controlled chemical substances, please see the following documents that are uploaded to the Seiko Epson's homepage:

Homepage:
http://www.epson.co.jp/ecology/customer/green_cf.shtml (Japanese)
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Certification That Product Does Not Contain Banned Substances (level 1):
http://www.epson.co.jp/ecology/customer/green_p/seg_t_0102_j_20.pdf (Japanese)
http://www.epson.co.jp/ecology/customer/green_p/seg_t_0102_e_20.pdf (English)
http://www.epson.co.jp/ecology/customer/green_p/seg_t_0102_c20.pdf (Simplified Chinese)

Survey Tool for Substances to Be Eliminated From Products (level 2):
http://www.epson.co.jp/e/community/pdf/researchtool1_6_j.pdf (Japanese)
http://www.epson.co.jp/e/community/pdf/EliminationToolRev1_6.pdf (English)

SEG Green Purchasing Standard for Production Material:
http://www.epson.co.jp/e/community/pdf/gps_j.pdf (Japanese)
http://www.epson.co.jp/e/community/pdf/gps_e.pdf (English)
http://www.epson.co.jp/e/community/pdf/gps_c.pdf (Simplified Chinese)

2. DETAILED SPECIFICATIONS

2.1 Printing Specifications

2.1.1 Total number of printing dots and printable area

The print head consists of 384 dots heat elements. In the vertical direction, one dot is formed by 2 steps.

1) Printable area

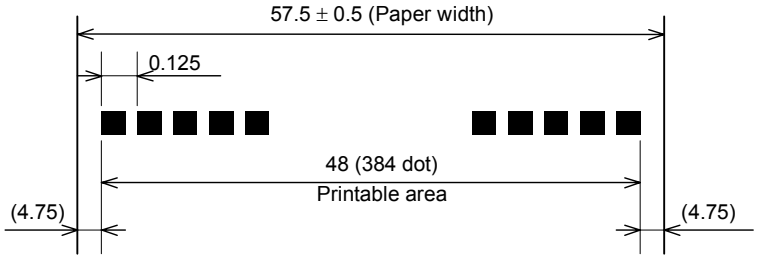


Figure 2.1.1 Printing Dots and Printable Area

NOTES: 1. When the print head elements are energized separately, the print position setting next to each other in boundary may be shifted approximately 0.0625 mm in the paper feed direction. Consider this before using such print patterns.

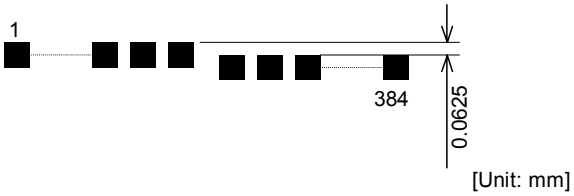


Figure 2.1.2 Shifting Print Position

2. When the print head elements are energized separately, the print dot shape may be changed by some timings of the motor operation and the head energizing pulse. Give shading in consideration especially when printing graphics.

Figure 2.1.3 Print Dot Shape

3. When a high print duty pattern is printed continuously, the head temperature increases rapidly and the print speed sometimes changes during printing. This must be taken into consideration when setting printing patterns as bit images, for example, may be printed unevenly.

2.1.2 Example print format

1) 12 × 24 font [Units: mm]

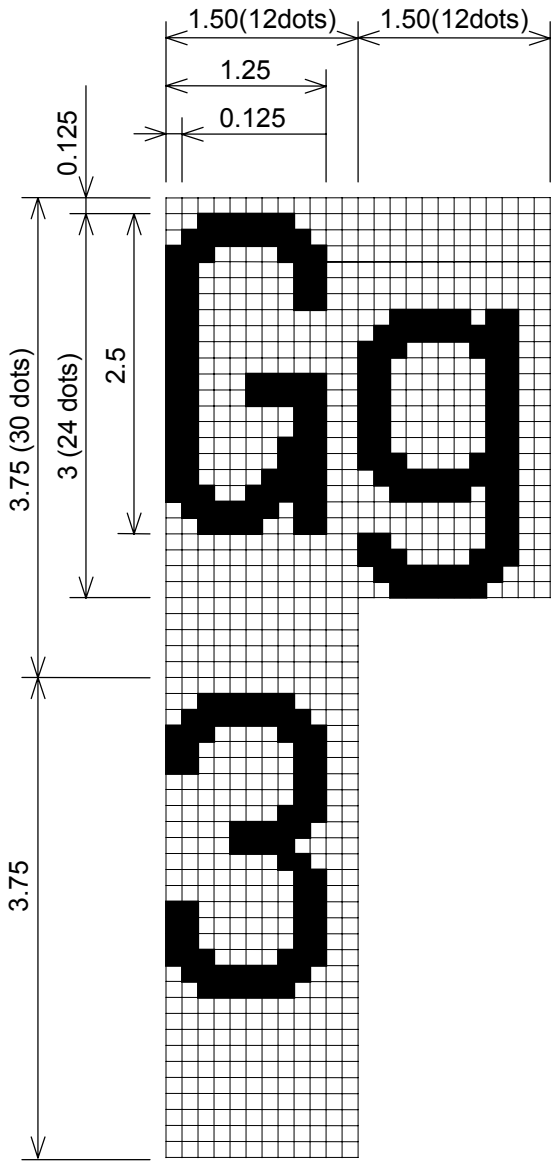


Figure 2.1.4 12 × 24 font Example Print Format

2) Example print design

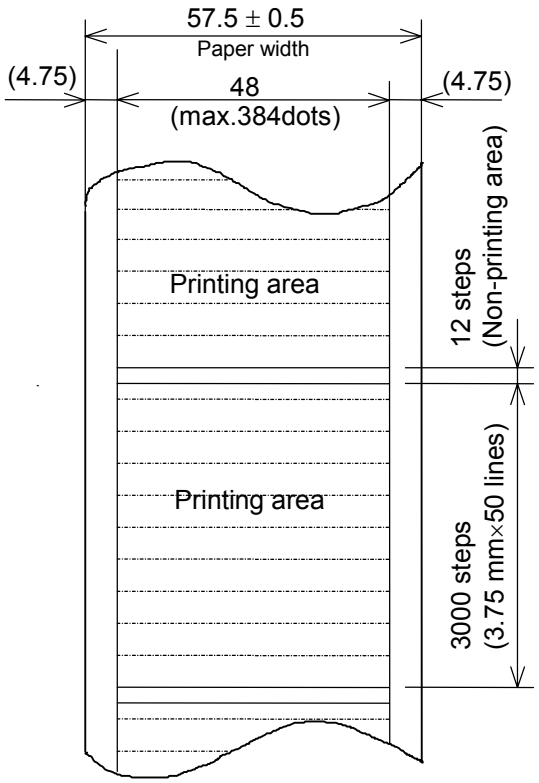


Figure 2.1.5 Example Print Design

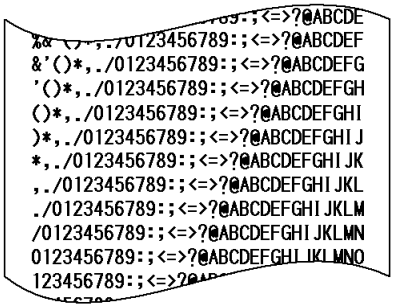


Figure 2.1.6 Example Endurance Print Test Pattern

NOTES: 1. Characters should be printed using two horizontally consecutive dots.

2. To prevent adhesion of the paper to the heat element, do not stop the motor at the same phase in which print energizing is finished.

   (Epson recommends allowing extra 3 steps of motor rotation for paper feed after the printer finishes printing.)

2.2 Paper Feeding

2.2.1 Paper feed method

Friction feed

2.2.2 Minimum paper feed pitch

Approximately 0.0625 mm {0.0025"}/1 step (equivalent to 0.5 dots)

2.2.3 Feeding speed

90 mm/s {3.54"/s} (at 8.5 V of the printer drive voltage Vp)

NOTE: See Section 2.3.6 for the conditions in the continuous motor driving.

2.2.4 Control method

Stepping motor
(See Section 2.3 Paper Feed Motor.)

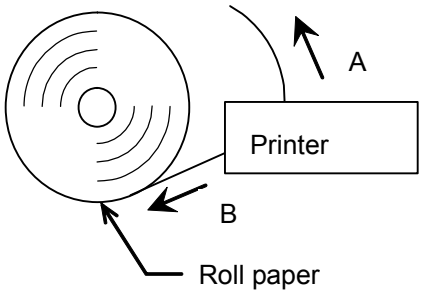
NOTES:
1. To prevent irregular paper feed pitch caused by backlash on the paper feed drive system after the power is turned on, the platen unit is opened/closed to replace the roll paper, and the paper is cut manually, feed the motor by 20 steps and rotate the motor CCW viewed from the motor gear side before starting printing.
2. When feeding paper, calculate the maximum motor drive matched to the motor drive voltage according to the following formula.

   When Vp > 5.5 V
   Vp x 160 + 80 (pps) (max.: 1440 pps)

   When Vp ≤ 5.5 V
   Vp x 210 - 195 (pps)

2.2.5 Paper feed direction

Motor rotation direction: Forward (direction of arrow A)
(Counterclockwise rotation as seen from the motor gear side)



(View from the opposite side from the motor gear)

Figure 2.2.1 Paper Feed Direction

NOTE: The paper must not be fed backward (Motor rotation direction: Backward (direction of arrow B; clockwise as seen from the motor gear side)) as this may cause a paper jam.

2.2.6 Paper roll supply load

0.49 N {50 gf} or less (at the paper slot)

2.2.7 Paper holding force

0.78 N {80 gf} or more (in vertical direction at the paper exit)

2.2.8 Paper insertion angle

Within 22 to 60° down from the horizontal face

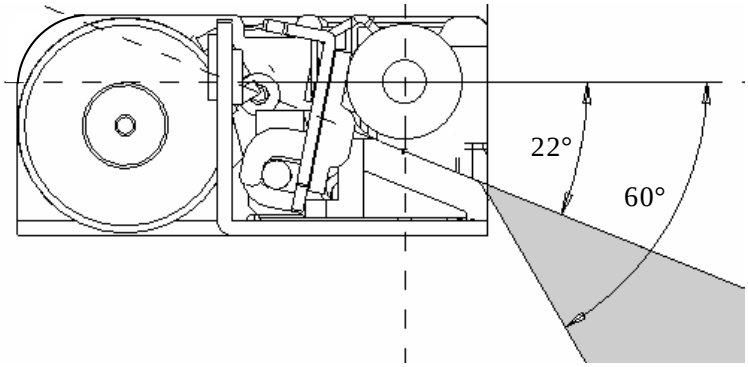


Figure 2.2.2 Paper Insertion Angle

2.3 Paper Feed Motor

2.3.1 Type

4-phase, 20-step PM stepping motor

2.3.2 Power supply voltage

4.5 to 8.5 V

2.3.3 Coil resistance

14 ± 1.4 Ω (25°C {77°F}, per single phase)

2.3.4 Connection diagram

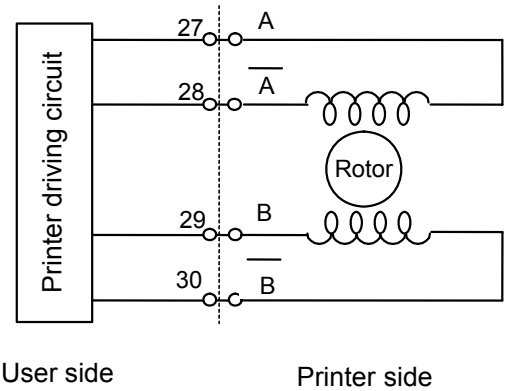


Figure 2.3.1 Motor Connection Diagram

2.3.5 Current consumption (per motor)

Max. 600 mA

2.3.6 Drive method

Constant current chopping drive: 2-2 phase excitation
Constant current control: 300 mA/phase
Motor drive frequency: 300 to 1440 pps (pps: pulse per second)

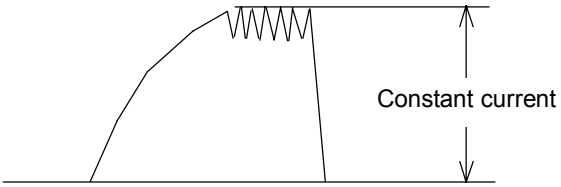


Figure 2.3.2 Current Waveform

NOTES: 1. To prevent damage to the motor coil due to overheating, continuous energization of the same phase must not exceed 100 ms.
2. Driving at 300 pps or less may cause motor vibration that may lead to possible malfunction of the motor.

2.3.7 Motor drive sequence

Rotation direction (Counterclockwise rotation as seen from the motor gear side)

Table 2.3.1 Motor Drive Sequence

Step \ Motor Phase	Phase $\overline{A}$	Phase B	Phase A	Phase $\overline{B}$
1	OFF	ON	ON	OFF
2	OFF	OFF	ON	ON
3	ON	OFF	OFF	ON
4	ON	ON	OFF	OFF

NOTE: Paper is fed approximately 0.0625 mm {0.0025"} by 1 step driving.

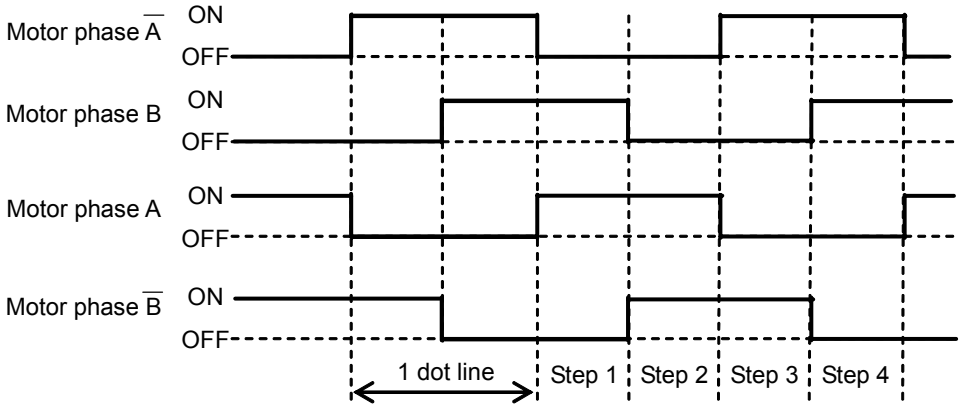


Figure 2.3.3 Motor Drive

2.3.8 Slow-up sequence

Table 2.3.2 shows the example slow-up sequence.

Table 2.3.2 Slow-up Sequence

Step	Motor drive frequency (pps)	Motor drive cycle (μs)
Start rush-driving	-	30000
1	332	3013
2	430	2327
3	512	1953
4	584	1712
5	649	1541
6	708	1412
7	763	1310
8	815	1227
9	864	1158
10	910	1099
11	954	1048
12	996	1004
13	1037	964
14	1076	929
15	1114	898
16	1150	869
17	1186	843
18	1220	819
19	1254	798
20	1287	777
21	1318	758
22	1350	741
23	1380	725
24	1410	709
25	1440	694

(Units: ms, Precision: ± 0.05 ms in the deceleration and acceleration range, however, +0.05/–0 ms in the constant speed range)

NOTES: 1. When the motor restarts after holding, drive one step to the last phase in use when the motor would stop with 30 ms, then the motor stops and starts slow-up control.

2. When restarting the motor during stop-rush driving, stop stop-rush driving, and start slow-up control.

3. When stopping the motor, drive one step to the last phase in use when the motor would stop with 30 ms. (Do not stop the motor at the last phase in which the last printing energization has performed.)

4. Do not drive motor while it is holding.

2.4 Paper (Supplied by the User)

2.4.1 Paper type

1) Specified thermal paper roll:

Original Paper No.	TF50KS-E2D	NIPPON PAPER INDUSTRIES CO.,LTD.
	TF50KS-E2C	NIPPON PAPER INDUSTRIES CO.,LTD.
	KF50	KANZAN
	P350	KSP
	PD150R	OJI PAPER CO., LTD.
	PD160R	OJI PAPER CO., LTD.

NOTES: 1. Use the specified paper. Otherwise, the proper print quality cannot be obtained, print head reliability may decrease, or there may be damage to the print head.

2. If the paper feeding stops when paper other than the specified paper is used with a high print ratio, paper may be sticking to the print head so that the paper cannot be fed. To prevent the paper-sticking problem, feed for three steps without printing after a high ratio of printing.

2.4.2 Form

1) Paper width: 57.5 ± 0.5 mm {2.26" ± 0.02"}

2.4.3 Required specification for paper roll

1) Paper roll diameter: Maximum Φ80 mm {Φ3.15"}

2) Paper surface direction: Roll paper with the print face (colored surface) outside must be used.

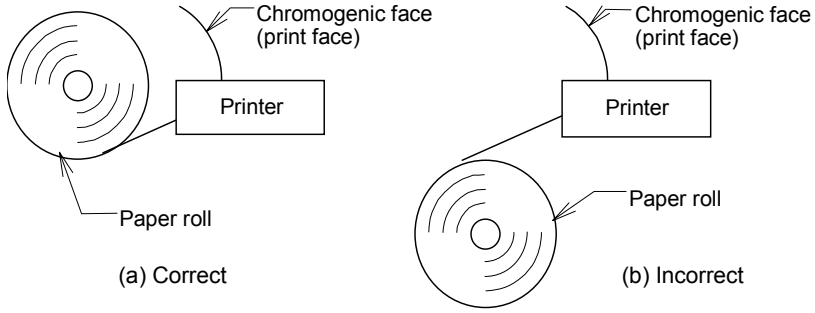


Figure 2.4.1 Paper Surface Direction

3) Paper end termination: The end of the paper roll should not be pasted to the paper spool or folded back.

4) Surface treatments

Paper-end mark: When printing a paper-end mark on the chromogenic face (print face), never use the paper printed with ink that affects printing quality or that may damage the print head.

Coating and pre-printing paper: To use the coated paper or preprinted paper on the print face, make sure to specify the types of coat and ink or set the head energizing pulse width that is capable of preventing the following problems:

- Deterioration of print quality
- Paper sticking to the print head when the printer is left in a high-temperature, high-humidity location
- Printing noise may become high, because the level of sticking of the paper to the print head.

NOTE: The paper roll supply load must not exceed the specified value.

2.5 Print head

2.5.1 Structure

1) Total number of heat elements: 384 dots

2) Heat element density: 8 dots/mm (0.125 mm/dot) {203.2 dpi, 0.0049"/dot}
[dpi: dots per 25.4 mm {1"}]

3) Heat element typical resistance value:
176 ± 7 Ω
(including heat element + wiring resistor, default value at 25°C {77°F})

2.5.2 Print head electrical characteristics

1) Absolute maximum ratings

Table 2.5.1 Absolute Maximum Ratings

Item	Symbol	Terms	Rated value	Units
Circuit power supply voltage	V_{DD}		7.0	V
Input voltage	V_{IN}		-0.5 to V_{DD} + 0.5	V
Power supply voltage	V_H		8.5	V

2) Allowable operating range (T = 25°C {77°F}, V_{DD} = 5.0 V)

Table 2.5.2 Allowable Operating Ranges

Item	Symbol		Conditions	Standard Value			Units
				MIN	TYP	MAX	
Circuit power supply voltage	V_{DD}			2.7	-	5.25	V
Clock frequency	t1	f CLK	V_{DD}=3 to 5.25V	-	-	8	MHz
			V_{DD}=2.7 to 3V	-	-	5	MHz
Clock pulse width	t2	tw CLK	V_{DD}=3 to 5.25V	30	-	-	ns
			V_{DD}=2.7 to 3V	50	-	-	ns
Setup time (DI→CLK)	t3	t setup DI	V_{DD}=3 to 5.25V	30	-	-	ns
			V_{DD}=2.7 to 3V	70	-	-	ns
Hold time (CLK→DI)	t4	t hold DI	V_{DD}=3 to 5.25V	30	-	-	ns
			V_{DD}=2.7 to 3V	40	-	-	ns
Setup time (CLK→$\overline{LAT}$)	t6	t setup LAT		100	-	-	ns
Latch pulse width	t5	tw LAT		100	-	-	ns
Setup time ($\overline{LAT}$→STB)	t7	t setup STB		300	-	-	ns
Latch hold time	t8	t hold LAT	V_{DD}=3 to 5.25V	50	-	-	ns
			V_{DD}=2.7 to 3V	50	-	-	ns
Latch delay time (STB→$\overline{LAT}$)	t9	t delay LAT	V_{DD}=3 to 5.25V	30	-	-	µs
			V_{DD}=2.7 to 3V	36	-	-	µs
Output delay time	t10	tdo	V_{DD}=3 to 5.25V	-	-	30	µs
			V_{DD}=2.7 to 3V	-	-	36	µs
Data out delay time (DI to DO)	t11	td DO	V_{DD}=3 to 5.25V	-	-	90	ns
			V_{DD}=2.7 to 3V	-	-	130	ns

See 2.5.5 Timing chart.

NOTES: 1. If the latch delay time (t9) larger than the standard value is not be secured, dot position misalignment results. Be sure to secure the latch delay time larger than the standard value.

2. If V_{DD} is less than 3.0 V, print density may become low. Be sure that V_{DD} is 3 V or larger.

3) Electrical characteristics (T = 25°C {77°F}, V_{DD} = 5.0 V)

Table 2.5.3 Electric Characteristics

Item	Symbol	Terminals	Conditions	Standard Value			Units
				MIN	TYP	MAX	
HIGH input voltage	V_{IH}	CLK, DI, LAT, STB		0.8V_{DD}	-	V_{DD}	V
LOW input voltage	V_{IL}	CLK, DI, LAT, STB		0	-	0.2V_{DD}	V
HIGH input current	I_{IH1}	STB	V_{IH}=5V	-	-	55	µA
	I_{IH2}	CLK, LAT		-	-	1	µA
	I_{IH3}	DI		-	-	0.5	µA
LOW input current	I_{IL1}	STB	V_{IL}=0V	-	-	-0.5	µA
	I_{IL2}	CLK, LAT		-	-	-1	µA
	I_{IL3}	DI		-	-	-0.5	µA
HIGH output voltage	V_{DOH}	DO		4	-	--	V
LOW output voltage	V_{DOL}	DO		-	-	0.5	V
Current consumption	I_{DD}	V_{DD}	$f_{DI}=f_{CLK}/2$	-		36	mA

Electrical characteristics values are the same also when VDD = 3.3 V.

2.5.3 Data transfer direction

The print data that is transferred from terminal DI is printed as shown in Figure 2.5.1.

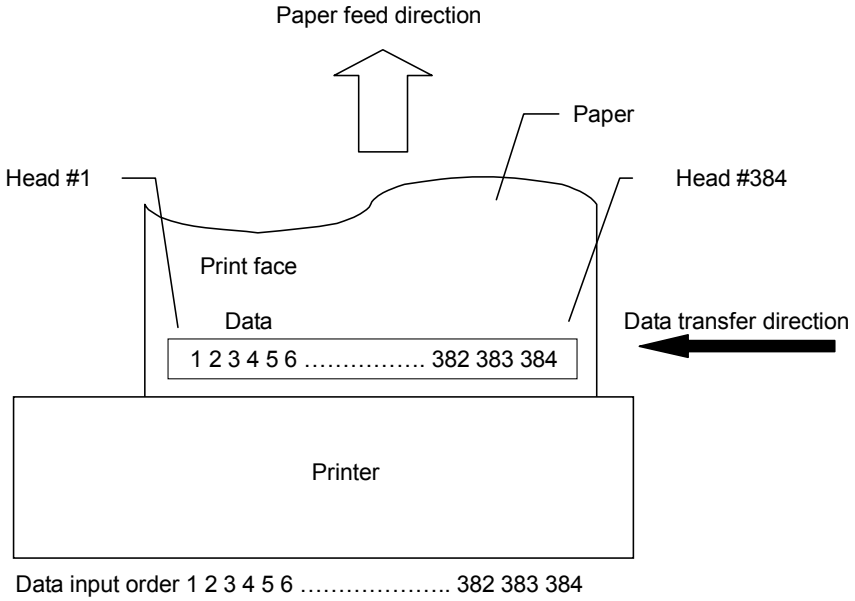


Figure 2.5.1 Relationship between Transferred Data and Print Position

2.5.4 Print head block diagram

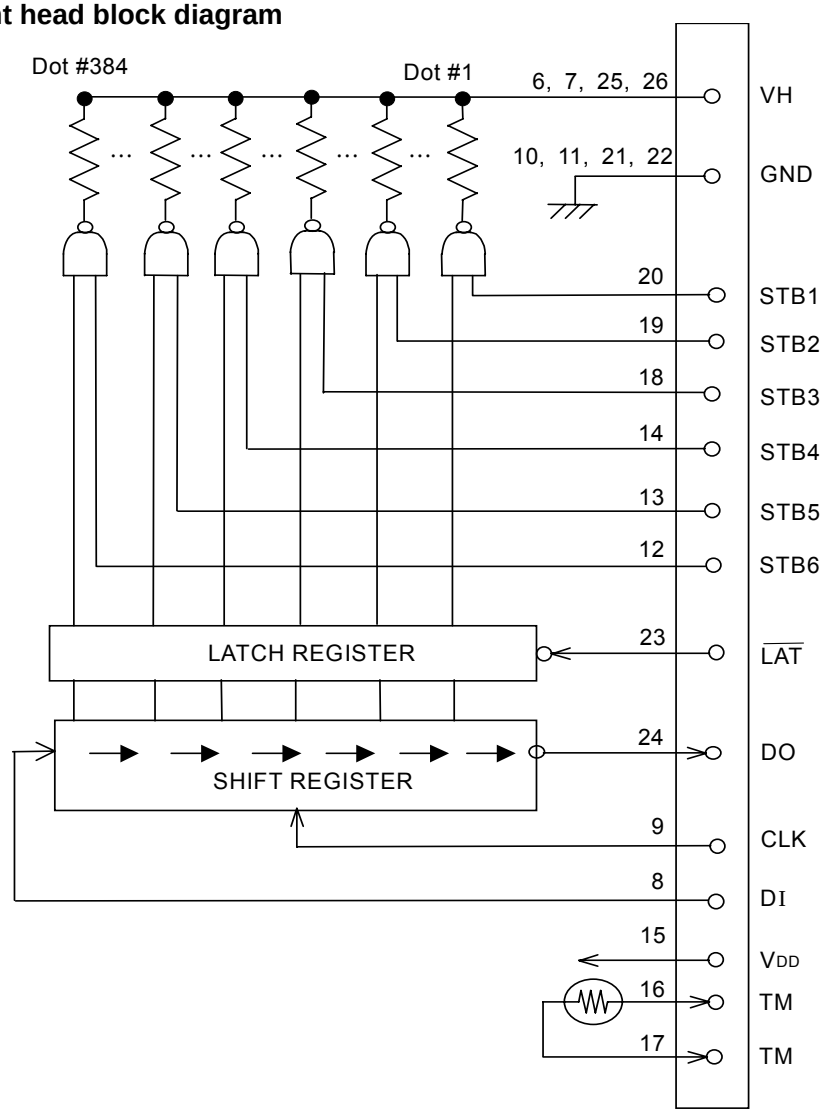


Figure 2.5.2 Print head Block Diagram

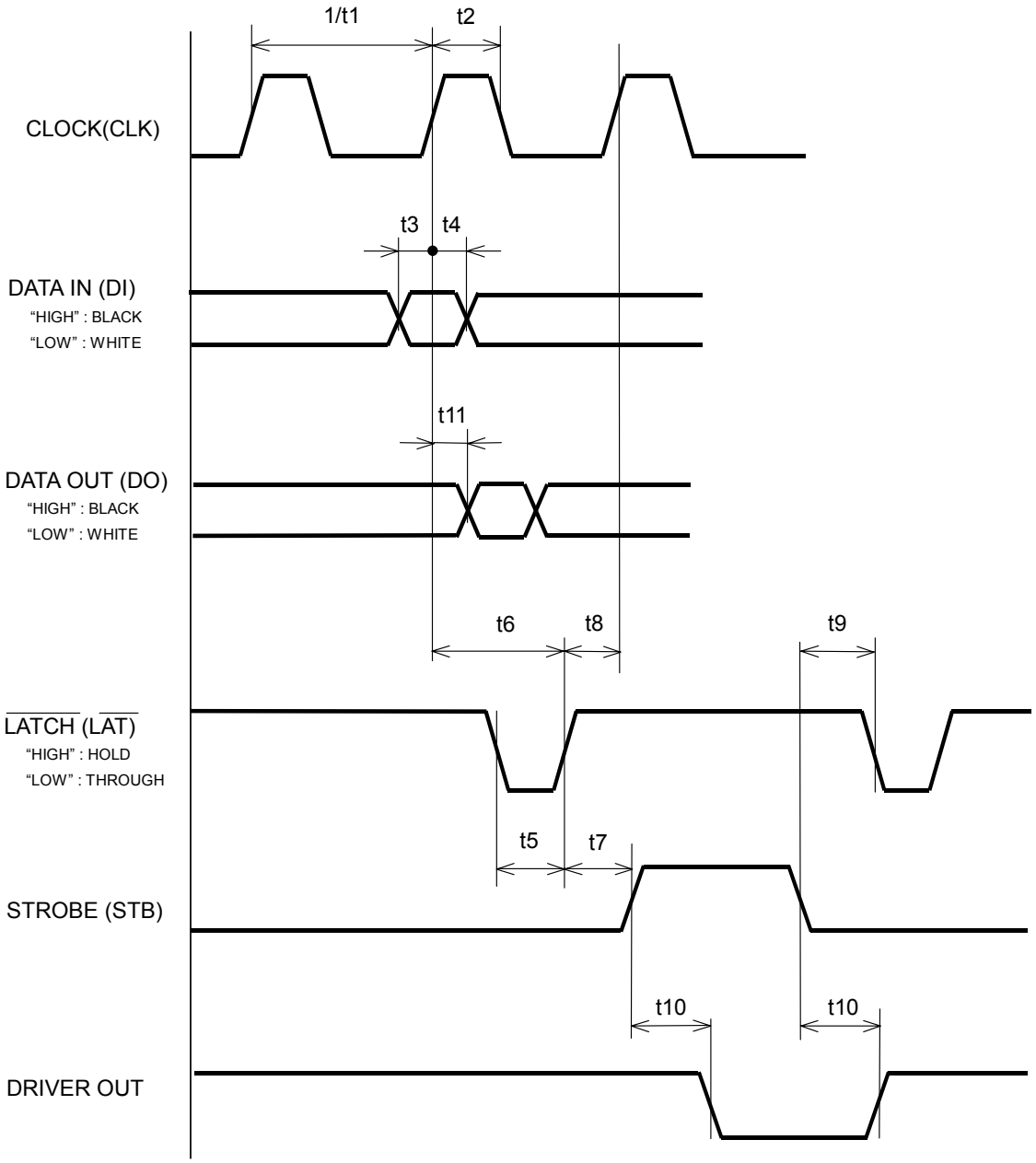
1) Print head strobe processing

Table 2.5.4 Print head Strobe Processing

STB No.	Dot No.	Dots/STB
1	1 to 64	64
2	65 to 128	64
3	129 to 192	64
4	193 to 256	64
5	257 to 320	64
6	321 to 384	64

NOTE: The problem of shading during printing can be caused by voltage fluctuation or some print patterns.

2.5.5 Timing chart



NOTE: For the details about each signal, see Table 2.5.2 Allowable Operating Ranges.

Figure 2.5.3 Timing Chart

2.5.6 Current consumption (Reference: when applying the head energizing pulse width in 2.5.7)

1) Peak current:

Approximately 3.0 A (VH = 8.5 V, 25°C, an instant while energizing 64 dots)

The following formula is used to obtain the peak current for energizing the print head:

$$\text{Peak current} = \frac{V_H \text{ max}}{(R \text{ min} + R \text{ ic})/N + R \text{ com}} \quad \text{..... Formula 2.5.1}$$

Condition:			
	V_H max:	Head connector terminal voltage max.	8.5 V
	R min:	Head resistance value minimum	169 Ω
	R com:	Common resistance value	0.05 Ω
	R ic:	Driver-on resistance value	9 Ω
	N:	Number of dots to be energized simultaneously	64 dots

2) Mean current:

Approximately 1.0 A (V_H = 7.5 V, 25°C)

The following formula is used to obtain the head drive current:

$$\text{Mean current} = \frac{V_H \text{ typ}}{(R \text{ typ} + R \text{ ic})/N + R \text{ com}} \times \frac{\text{Energizing pulse width}}{\text{Cycle}} \quad \text{..... Formula 2.5.2}$$

Condition:			
	V_H typ:	Head connector thermal voltage typical	7.5 V
	R typ:	Head resistance value typical	176 Ω (including wiring resistance)
	R com:	Common resistance value	0.05 Ω
	R ic:	Driver-on resistance value	9 Ω
	N:	Number of dots to be energized simultaneously	48 dots (Printing ratio of 12.5%)
	Energizing pulse width:		0.393 ms
	Cycle:		0.777 ms

NOTES:
1. If all dots are energized at the same time, a high current will flow; therefore, the user should use power supplies with current capacity adequate for the corresponding print duty.
2. When designing lines and bit images, take the printing ratio and print duty into account.
3. Printing quality may be poor if the printing ratio or print duty is high.
4. Definitions of printing ratio and print duty:
   - Printing ratio: the number of printing dots (energizing pulses) per dotline
   - Print duty: the number of printing dots (energizing pulses) per heat element on paper feed amount (two steps, including non-printing area)

2.5.7 Energizing pulse width

To calculate the pulse width, use a compensation coefficient in formula 2.5.3 according to the use conditions. Calculate each value shown in formula 2.5.4-1 to 2.5.6-2, and then apply the pulse width according to the PLS value calculated by assigning a value to formula 2.5.3.

These twice of energization must form 1 dot.

Energizing pulse width PLS (µs)
PLS = Pt × Qv × Qs × Qc × Qd {Allowable = 5 %} …..formula 2.5.3

- Pt is defined as follows, depending on the temperature detected by the thermistor:
  When -20 ≤ T ≤ 34: Pt = –12 × T + 945 …..formula 2.5.4-1
  When 34 < T ≤ 80: Pt = –7.45 × T + 790 …..formula 2.5.4-2
  T: temperature detected by the thermistor (°C)
- Qv is defined as follows, depending on the print head voltage:
  Qv = (0.1 × VH × VH – 3 × VH + 66)/(VH × VH) ..…formula 2.5.5
  VH: Print head voltage (V)
- Qs is defined as follows, depending on the cycle time of energizing the motor:
  When 697 ≤ SLT < 3500 (µs): Qs = 1.35 × LOG (SLT/1000) + 0.845.…formula 2.5.6-1
  When 3500 ≤ SLT < 10000 (µs): Qs = 2.53 × LOG (SLT/1000) + 0.2.…formula 2.5.6-2
  SLT: Cycle time of energizing the motor (µs)

  Use the motor drive cycle shown in Table 2.3.2 Slow-up Sequence in order from step 1. Calculate the minimum motor drive cycle from the maximum motor driving frequency calculated in 2.2.4 Control method, and set the motor drive cycle to more than the minimum.
- Qc is defined as follows, depending on the number of the heat elements in each strobe energized simultaneously:
  When 1 ≤ n ≤ 16: Qc = 0.92
  When 17 ≤ n ≤ 32: Qc = 0.96
  When 33 ≤ n ≤ 48: Qc = 1.00
  When 49 ≤ n ≤ 64: Qc = 1.05
  When 65 ≤ n ≤ 80: Qc = 1.10
  When 81 ≤ n ≤ 96: Qc = 1.15
  When 97 ≤ n ≤ 112: Qc = 1.20
  When 113 ≤ n ≤ 384: Qc = 1.26
  n: amount of the dots that are simultaneously energized with each strobe signal
- Qd is defined in the range of 1.0 to 1.2, depending on the thermal paper type and printing conditions:

NOTE: 1. If the SLT is completed before turning off the head energizing, do not change the phase of the motor before turning off the head energizing.
2. Keep motor drive frequency in 2.3.6 in mind because the motor drive frequency depends on the head energization time.

2.5.8 Detection of print head problems

To protect and ensure the safety of the print head, the temperature of the print head must be detected using both the hardware and software described below.

1) Software-based detection of temperature

Select the behavior after detection of high print head temperature using the thermistor (TH) from the two options below to protect the print head. If energizing of the print head is continued with the temperature exceeding 80°C {176°F}, the print head life may be shortened greatly.

(1) When the thermistor (TH) on the print head detects a temperature of 80°C {176°F} or more (thermistor resistance value RTH ≤ 3.80 kΩ), energizing of the print head is stopped until the temperature falls below 60°C {140°F} (RTH ≥ 7.45 kΩ).

(2) When the thermistor (TH) on the print head detects a temperature of 75°C {167°F} or more (thermistor resistance value RTH ≤ 4.46 kΩ), energizing of the print head is stopped within 10 seconds until the temperature falls below 70°C {158°F} (RTH ≥ 5.27 kΩ).

2) Hardware-based detection of problems

When a runaway occurs on the CPU, temperature detection by the software sometimes does not function, resulting in overhearing of the print head.
Overheating not only causes the print head to malfunction but also might cause a burn hazard due to direct contact by the user.
Be sure to also use hardware-based detection of problems to ensure safety.

(When the CPU has run away, the print head is sometimes damaged even if problems are detected by hardware-based detection.)

The hardware must detect the following by detection circuits, such as a window comparator circuit:

(1) Overheating of the print head (approximately 90°C or more (RTH ≤ 2.79 kΩ))

(2) Thermistor connection problems (probable causes: opening or short-circuiting of the thermistor)

When a problem occurs, immediately turn off energizing of the print head and set the printer to standby.
Before re-energizing the print head, make sure that the problem has been restored.

2.5.9 Notes on using the print head

1) To avoid damage to the heat elements, follow the sequence shown below.
Power supply on: Turn on the circuit power supply voltage (VDD), and then turn on the head terminal voltage (VH).
Power supply off: Turn off the head terminal voltage (VH), and then turn off the circuit power voltage (VDD).
If VH cannot be discharged to GND level when turning VDD on or off, VDD should be turned on or off only when VH is 1 V or less.

2) When the power is turned on or off, the strobe (STB) signal must be LOW.

3) Do not energize the print head (perform printing operation) when the printer is out of paper.

4) To prevent malfunction of the print head due to noise and to prevent damage to the print head IC due to surge voltage, an aluminum electrolytic capacitor should be installed between VH and GND, near the print head.
A laminated ceramic capacitor also should be installed between VDD and GND to stabilize the power line.

5) To prevent damage of the print head by electrolytic corrosion, after printing is finished and the motor stops, turn off the head terminal voltage VH. If a capacitor retains charge voltage, it must be discharged to GND level. Also, the device that turns the power supply for VH off should have as low a loss voltage loss as possible.

6) C-MOS IC or equivalent must be used for input of each CLK, LAT, STB, and DI signal.

7) The power line must be as thick and as short as possible.

8) If the thermistor detection temperature reaches 70°C {158°F}, finish printing less than 60 steps. To use the printer again, wait until the temperature drops to 60°C {140°F} or less.

9) Provide a protection circuit so that the print head will never be energized continuously due to CPU runaway or any other malfunctions.

10) The print head temperature must be detected by the thermistor at least once in 30 dot lines to set the head energizing pulse width. (Detection of the temperature for every dot line is recommended.)

11) The printing density may become irregular due to voltage fluctuation, print patterns, or paper characteristics. In this case, the basic energizing pulse width PLS can be adjusted. However, to prevent the print head from a state of being continuously energized, set an off time (not being energized) that is either 200 μs or 10% of energizing cycle. Give print quality consideration, too.

2.5.10 Maximum energizing pulse width

Specify the maximum value of the calculation value obtained by the formula in 2.5.7, Energizing pulse width as the maximum energizing pulse width. If energizing exceeding this maximum value is performed, the print head life may be shortened significantly.

2.6 Paper-end Detector

A photo sensor (paper-end detector) is mounted to detect the presence of paper in the path near the print head.

1) Type Reflecting photo detector CNB1302 (Panasonic) equivalent

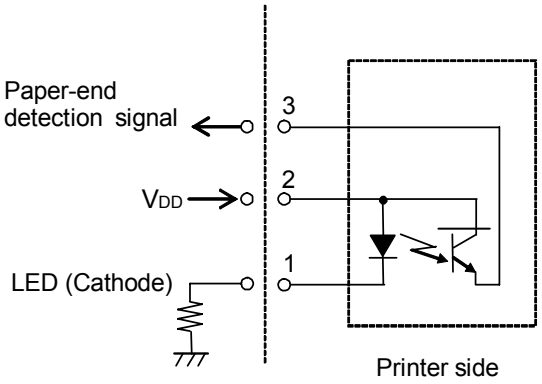


Figure 2.6.1 Paper-end Detector

2) Absolute maximum rating (at 25°C {77°F})

Table 2.6.1 Absolute Maximum Ratings

Item		Symbol	Rated Value	Unit
Input characteristics (LED)	Forward current	IF	50	mA
	Reverse voltage	V_R	3	V
	Allowable loss	P_D	75	mW
Output characteristics (photo transistor)	Collector-emitter voltage	V_{CEO}	30	V
	Emitter-collector voltage	V_{ECO}	5	V
	Collector current	I_C	20	mA
	Collector loss	P_C	50	mW

3) Electric characteristics (at 25°C {77°F})

Table 2.6.2 Electrical Characteristics

Item		Symbol	Conditions	MIN	TYP	MAX	Unit
LED (input)	Forward voltage	V_F	I_F = 50 mA	–	1.3	1.5	V
	Reverse current	I_R	V_R = 3 V	–	0.01	10	μA
	Capacity between terminals	Ct	V_R = 0 V, f = 1 MHz	–	30	–	PF
Photo transistor output characteristics	Braking current between collector and emitter	I_{CEO}	V_{CE} = 10 V	–	–	200	nA
Transfer characteristics	Collector current	I_C	V_{CC} = 5 V, I_F = 10 mA, R_L = 100Q, d = 1 mm	180		440	μA
	Dark current	I_D	V_{CC} = 5 V, I_F = 10 mA, R_L = 100Q	–	–	200	nA
	Saturation voltage between collector and emitter	V_{CE}	I_F = 20 mA, I_C = 0.1 mA	–	–	0.4	V
	Rise time	tr	V_{CC} = 5 V, I_C = 0.1 mA, R_L=100 Ω	–	20	–	μs
	Fall time	tf		–	20	–	μs

NOTE: To prevent deterioration over time of the paper-end detector due to constant energization, stop supplying power to the detector when it is not used.
If the detector deteriorates, it can no longer detect paper correctly because of low output.

4) Detection method

To detect whether paper is ended during printing, the detection signal is sampled at every dot line. If there are two or more consecutive samples that are LOW, they indicate a paper end.

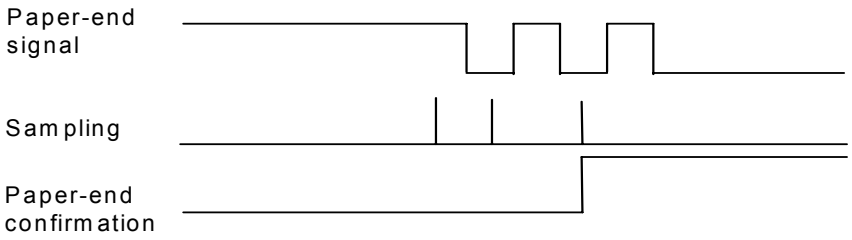


Figure 2.6.2

NOTES: 1. When a paper end is judged, printing operation (energization to the print head and motor) must not be performed.
However, if a paper end is detected during printing, be sure to stop the printing operation within 15 dot lines (for 30 steps of the motor) from the detection point.
(That is, printing of 15 dot lines is possible.)

2. To prevent malfunction of the paper-end detector due to stray light, design the case so that stray light does not directly strike the paper-end detector.

2.7 Head Temperature Detector

1) Electrical characteristics

Constant B: 3,950 K ± 79

Resistance value R(25): 30 ± 1.5 kΩ (T = 25°C {77°F})

2) Temperature characteristics

$R_T = R(25) \times \mathrm{Exp}\ [\ B \times \{1/(T + 273) - 1/(25 + 273)\}]$

T: Temperature (°C)

R_T: Resistance value (kΩ) at T°C

R(25): Resistance (30 ± 1.5 kΩ) at 25°C {77°F}

Operation temperature: -20 to 80°C {-4 to 176°F}

3) Connection method

Pin assignments are shown in Figure 2.7.1

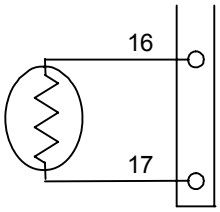


Figure 2.7.1 Head Temperature Detector Pin Assignments

2.8 Connectors

1) Connector

Printer side: 1-mm pitch, 30-pin FPC (upper connection side, terminal thickness 0.3 mm {0.012"})

User side: (to be provided by the user)
Recommended connector:

30pin: 52807-3010 (horizontal), 52806-3010 (vertical) (Molex) or
30FMN-STK-A (horizontal), 30FMN-BTK-A (vertical) (J.S.T. Mfg. Co. Ltd.)

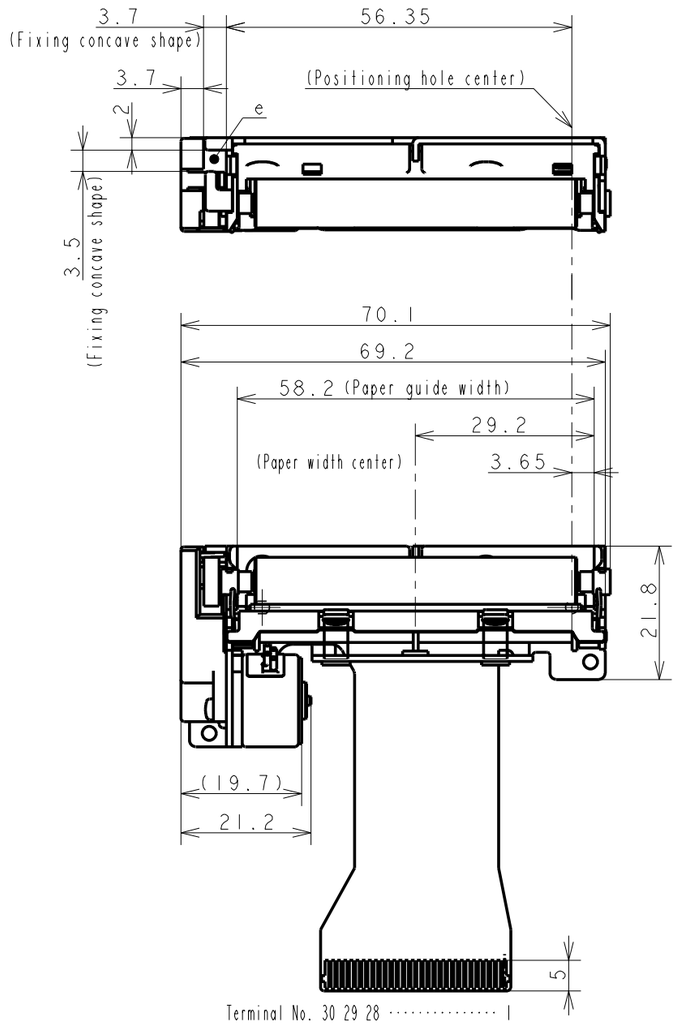
2) Pin assignments

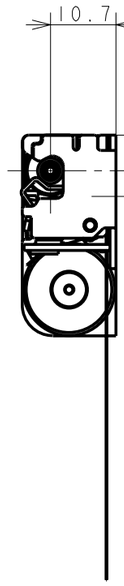
Table 2.8.1 Pin Assignments

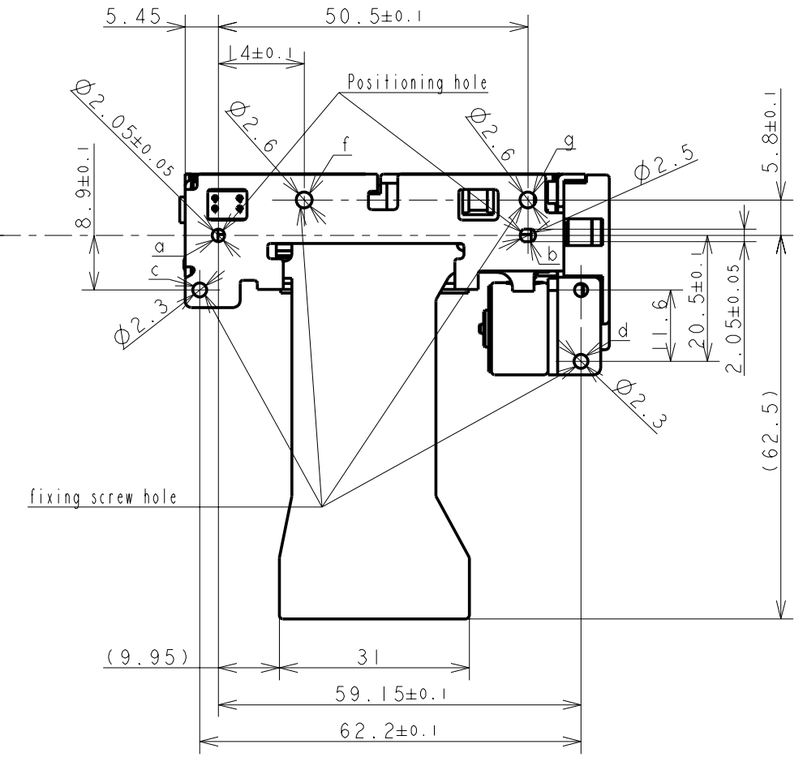
Pin No.	Signal Name
1	LED (Cathode) (Paper-end detector)
2	VDD (Paper-end detector)
3	Paper-end signal
4	NC
5	NC
6	VH
7	VH
8	DI
9	CLK
10	GND
11	GND
12	STB6
13	STB5
14	STB4
15	VDD
16	TM
17	TM
18	STB3
19	STB2
20	STB1
21	GND
22	GND
23	$\overline{\text{LAT}}$
24	DO
25	VH
26	VH
27	Motor A phase
28	Motor $\overline{\text{A}}$ phase
29	Motor B phase
30	Motor $\overline{\text{B}}$ phase

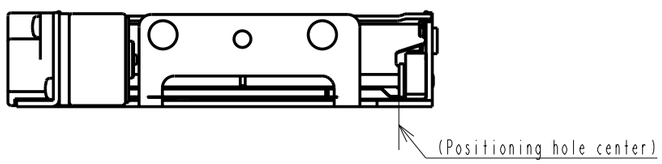
2.9 Overall Dimensions

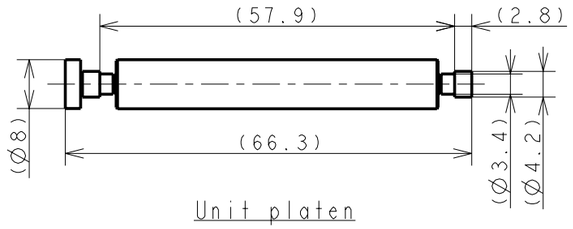
2.9.1 M-T173H (Unit:mm)



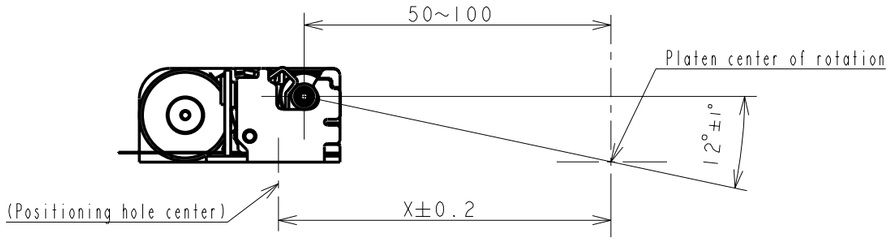


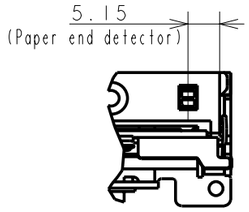






Unit platen





Note

1. To Prevent incorrect paper feeding and paper jams, the paper holder must be designed so that the center of the paper printer guide width matches the center of paper roll. The holder must be able to guide paper that is 57.5 ± 0.5 mm wide.
2. The case must be designed to prevent the paper from rewinding around the paper roll.
3. Design the paper exit area on the printer case so that paper can be fed smoothly.
4. When mounting the printer, select either of the methods below to fasten the printer, and use the positioning holes(a, and b) for positioning.
   1) 2 fixing screw holes(c, and d) and a fixing concave shape(e)
   2) 2 fixing screw holes(c, and d) and one of the 2 fixing screw holes(f, and g)
   No part of the printer except the mounting-foot locations should touch the case.
5. The shapes of parts shown in the figures may differ slightly from the actual parts.
6. The connector must be assigned so that side-to-side force is not always applied to the FPC after the printer is installed.
7. Because this printer uses a plated steel plate, rust may occur at the edges.

Confidential

EPSON	TITLE: M-T173H/T173V Specification (STANDARD)	SHEET REVISION: E	NO.
		NEXT: 25	SHEET: 24

Pro/ENGINEER

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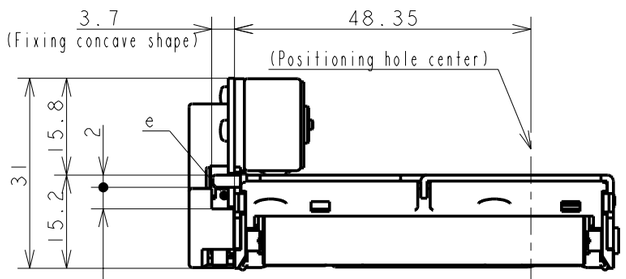
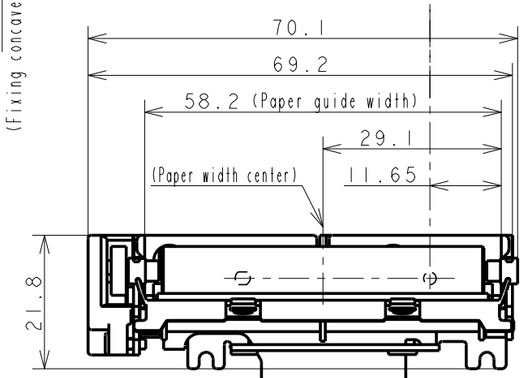
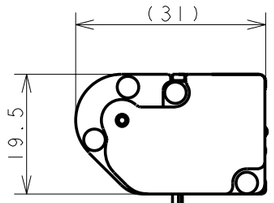
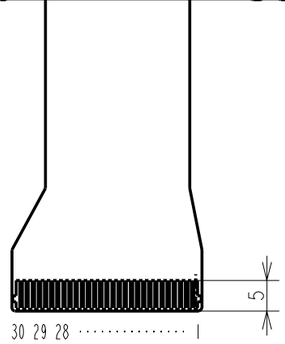
2.9.2 M-T173V (Unit:mm)



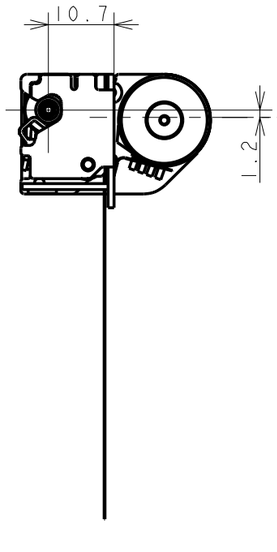


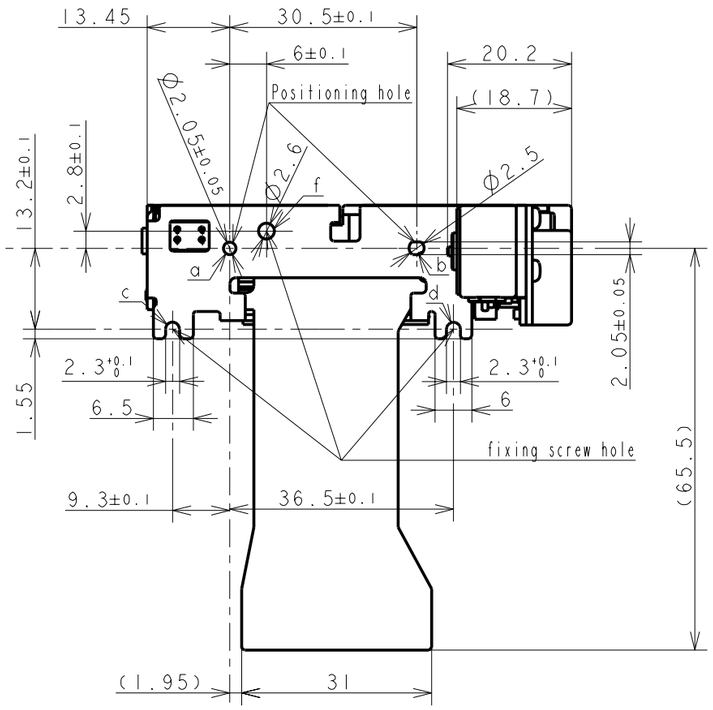


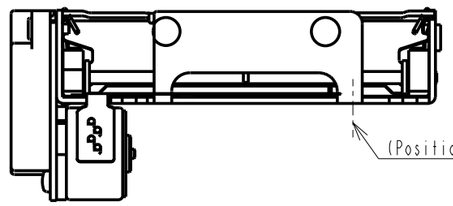


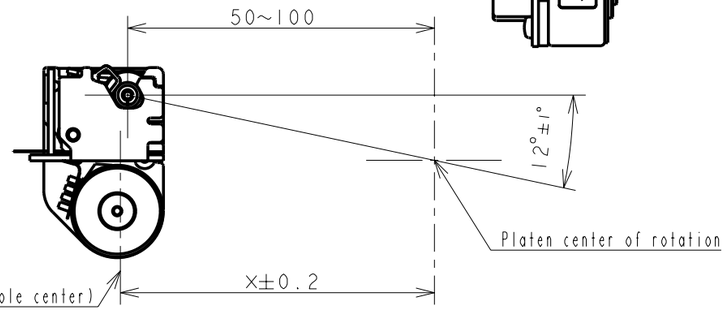
Note

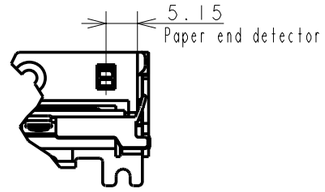
1. To Prevent incorrect paper feeding and paper jams, the paper holder must be designed so that the center of the paper printer guide width matches the center of paper roll. The holder must be able to guide paper that is 57.5 ± 0.5 mm wide.
2. The case must be designed to prevent the paper from rewinding around the paper roll.
3. Design the paper exit area on the printer case so that paper can be fed smoothly.
4. When mounting the printer, select either of the methods below to fasten the printer, and use the positioning holes(a, and b) for positioning.
   1) 2 fixing screw holes(c, and d) and a fixing concave shape(e)
   2) 3 fixing screw holes(c, d, and f)
   No part of the printer except the mounting-foot locations should touch the case.
5. The shapes of parts shown in the figures may differ slightly from the actual parts.
6. The connector must be assigned so that side-to-side force is not always applied to the FPC after the printer is installed.
7. Because this printer uses a plated steel plate, rust may occur at the edges.

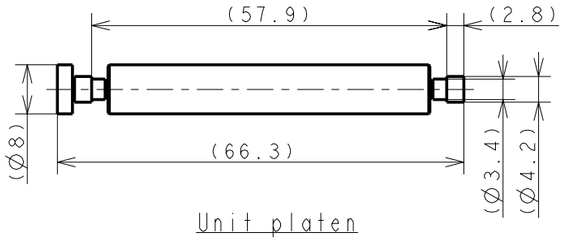












Unit platen

EPSON	TITLE: M-T173H/T173V Specification (STANDARD)	SHEET REVISION: E	NO.
		NEXT: App.1	SHEET: 25

000-TOP_V_C1370 . ASSEM . 33
SP_9001E_C1370.drw. 10

APPENDIX: NOTES ON HANDLING THE PRINTER

A.1 Initial installation

1) To prevent electrostatic damage to the heat elements, ICs and paper-end detector of the print head, handle the printer only after taking proper countermeasures against the static electricity in the environment and on your body.

A.2 Notes on using the printer

1) Because the printer uses a line thermal print head, avoid operating it in dusty environments so not to shorten the life of the print head.
2) Use the specified heat-sensitive paper.
   Otherwise, the proper print quality cannot be obtained, print head reliability may decrease, or there may be damage to the print head.
3) Store thermal paper away from heat and light.
   It will gradually discolor if it is exposed to heat, high humidity, or direct sunlight.
4) Perform regular maintenance according to 3.1.7 Maintenance methods to maintain top printer performance.
5) Turn the printer power off when the printer is not used.
6) Never energize the print head when the printer is out of paper, because this may shorten the life of the print head.
   Also, never drive the motor when the printer is out of paper as this will apply a load on the gears and may shorten its life.
7) Foreign objects adhering or paper dust accumulating on the paper-end detector may cause the detector to malfunction. So, remove foreign objects or paper dust with a soft brush, cotton wool bud or other utensil.
8) When the platen block is removed, the gears of the platen unit expose the gears on the printer side. So, take care not to damage the gears or allow foreign objects to enter the platen unit.

A.3 Notes on handling the printer

1) Do not touch the heat elements of the print head with a screwdriver, or tweezers, or directly with your fingers. These components are fragile and may break.
2) The print head and paper-end detector may be damaged due to electrostatic discharge.
   To avoid electrostatic discharge to the connection part of the print head, take the following measures:
   - Ground your body.
   - Use a conductive mat.
   - Use electrostatic discharge equipment.
   - Use an antistatic vinyl envelope when the printer is transported.
3) The printer main unit and platen unit are packaged as a combination before shipment from the factory. Therefore, Epson recommends installing them in the case in this state.
4) Do not handle the printer with holding the FPC only. Doing so may break the FPC. However, when disconnecting the printer FPC from the connector to the driving circuit, be sure to hold the part of the FPC close to the connector and pull it out.

A.4 Warnings

1) Avoid condensation because the M-T183 uses a thermal print head. If it does occur, do not turn on the power until the condensation has disappeared.
2) Make sure that there are no foreign objects on the thermal paper and the platen.
3) Never pull the paper out in either the forward or reverse direction when the platen is closed.

4) Do not glue the end of the roll paper to the paper core; doing so places excessive load to the gears in the paper feed mechanism because the paper does not separate from the paper core.

A.5 How to load the paper

Steps

1) Lift the platen unit.
2) Load a roll paper into the paper supply unit.
3) Pull the leading edge of the paper out and insert it into the paper guide and the print head unit. If the paper is not set straight, paper may not be fed correctly or paper feed pitch may become irregular.
4) Close the platen unit.

A.6 Notes on paper removal

Steps

1) Lift the platen unit.
2) Pull the paper out straight in the proper paper feeding direction.

A.7 When printing in low temperatures

When printing first starts, the print may be faded because the thermal head is cool.

A.8 When printing in high temperatures

Poor print quality (such as blurred print) may result.

A.9 Maintenance

1) Cleaning of the print head

   Paper dust, paper clips, and thermal chemicals on the heat elements of the print head may reduce print quality. If this occurs, clean the print head as follows:

   Steps

   (1) Open the platen unit, and release the platen from the print head.

   (2) Wipe the heat elements of the print head lightly with a cotton swab soaked in alcohol solvent (ethanol, or IPA).
   Using other solvents may damage the print head.

   After the alcohol evaporates completely, return the platen unit to its original position and return the print head to its regular position.

   Do not touch the print head or the motor surface just after printing, as these areas are very hot. Do not touch the print head or IC protection part with a screwdriver or tweezers or directly with your fingers.

2) Handling paper jams

   Steps

   (1) Open the platen unit, and release the platen and the print head.

   (2) Remove the jammed paper straight from the paper exit.

3) Cleaning of paper-end detector

   Any adhesion of foreign materials or deposition of paper dust onto the paper-end detection causes contamination of the light-receptive or light-emitting sections. This may deteriorate the function of the paper-end detector. If this occurs, clean the paper-end detector as follows:
   Do not touch the surface of the paper-end detector with a screwdriver or tweezers or directly with your fingers.

Steps

(1) Open the platen unit, and release the platen and the print head.

(2) Wipe the surface of the paper-end detector lightly with a cotton swab soaked in alcohol solvent (ethanol, or IPA).
Using other solvents may damage the paper-end detector.

After the alcohol evaporates completely, return the platen unit to its original position and return the print head to its regular position.

A.10 When not using the printer for an extended period of time

1) When transporting or storing the printer for an extended period of time, clean the print head as described in A.9 1), and close the platen unit. If the printer does not feed the paper after a long period of storage, open the platen unit, and pull up the print head once from the platen to allow paper feed.

2) If the printer is left unused with a paper roll in it for a long period of time, discoloration of the thermal paper, loss of heat sensitivity, or sticking of the paper to the platen may occur.
In these cases, replace the thermal paper with a new roll.

Because this printer uses plated steel parts, exposed edges may be subject to rust.

A.11 External appearance of pressed parts

Because this printer uses plated steel, the cutting edges may be subject to rust.

A.12 Marks

The model name, model code and date of manufacture of the product are stamped on the FPC.

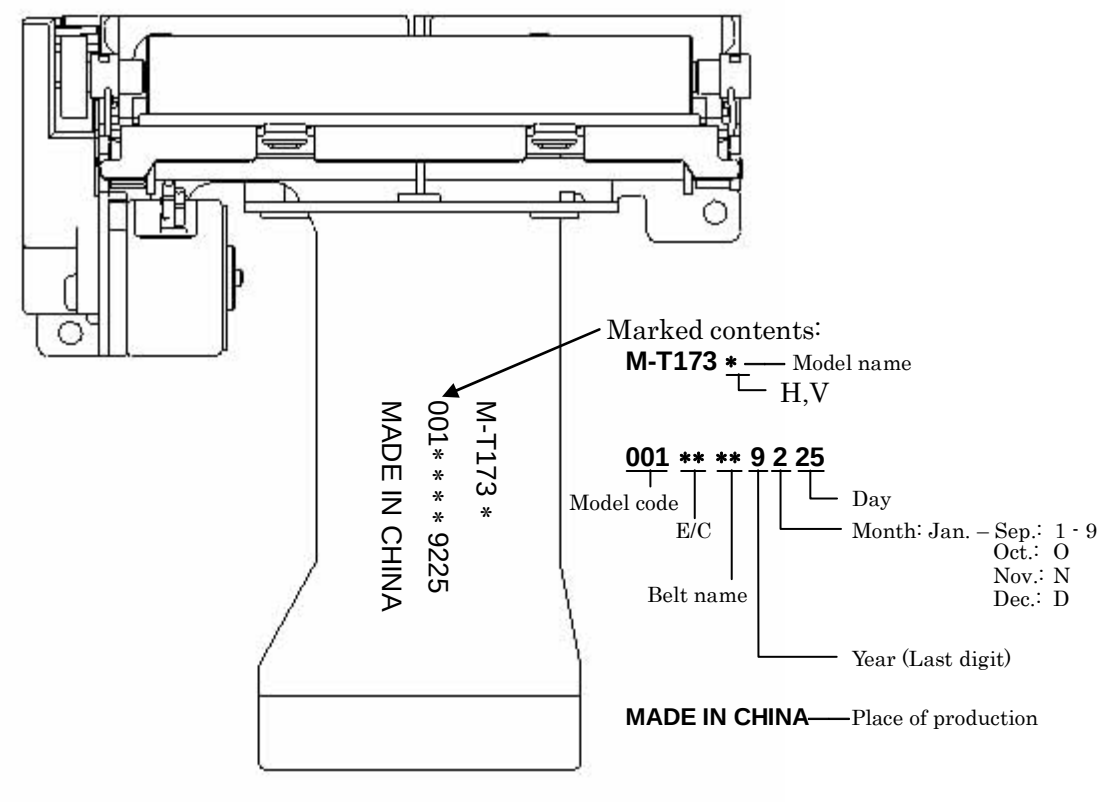


Figure 3.1.1