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EPSON

Serial Dot Matrix Printer

M-U110II

Preliminary Specification

STANDARD	
Rev. No.	A
Notes	

Copied Date	, ,
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SEIKO EPSON CORPORATION

MATSUMOTO MINAMI PLANT
2070 KOTOBUKI KOAKA, MATSUMOTO-SHI, NAGANO, 399-8702 JAPAN
PHONE(0263)86-5353 FAX(0263)86-9925

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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	Morozumi	--	Kumagai	I	A	20	A	44	A
					II	A	21	A		
					III	A	22	A	App. 1	A
					IV	A	23	A	App. 2	A
							24	A	App. 3	A
					1	A	25	A		
					2	A	26	A		
					3	A	27	A		
					4	A	28	A		
					5	A	29	A		
					6	A	30	A		
					7	A	31	A		
					8	A	32	A		
					9	A	33	A		
					10	A	34	A		
					11	A	35	A		
					12	A	36	A		
					13	A	37	A		
					14	A	38	A		
					15	A	39	A		
					16	A	40	A		
					17	A	41	A		
					18	A	42	A		
					19	A	43	A		

TITLE	Front Part					Contents	Appendix	Total
	Cover	Rev. Sheet	Scope	General Description	Table of Contents			
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SCOPE

The scope of this specification is restricted to the areas indicated with a filled box in the “Check” column below. (■ denotes the purpose for which this specification is to be used.)
“Studies”: At this stage, values that affect the basic design are subject to change.
“Design”: Design work may begin at this stage, after inquiring about the latest specifications.

SCOPE		
Check	Area of application	Restrictions on scope
☐	IS	
■	WS	
☐	ES	
☐		
■	Marketing	
■	User planning studies	
■	Circuit studies	
☐	Circuit design	
■	Case studies	
☐	Case design	
■	LSI studies	
☐	LSI design	
■	Software studies	
☐	Software design	
☐		
☐		
☐		
☐		

EPSON	TITLE **M-U110II** Preliminary Specification (STANDARD)

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Points You Must Observe To Assure Product Safety

In order 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 Printer Control

1. Absolute maximum voltage
   1) Printer driver voltage: 26.4 VDC.
      (Applies to the print solenoid, carriage motor, and paper feed motor.)
   2) Detector input voltage: 5.25 VDC.
      (Applies to the home position, black mark, and paper detector.)
2. When designing driver circuitry for solenoids, motors, and other electrical parts, always provide for proper energizing time limit control and include overcurrent protection.
   1) Print solenoid
      The energizing time must never exceed 380 μs under any conditions (including software runaway.)
   2) Carriage motor
      The energizing time, except for the hold current, must never exceed 1 second under any conditions (including software runaway).
   3) Paper feed motor
      The energizing time, except for the hold current, must never always exceed 1 second under any conditions (including software runaway).
   4) Detectors
      The maximum ratings for detectors must not be exceeded.

Notes on Handling

1. 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.
2. Be aware when the printer cover is open that the carriage motor, paper feed motor, and the print head give off heat.

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Outline

This printer, developed for use in ECR applications, is a serial impact dot matrix printer.

It is particularly wellsuited to the high-speed processing requirements of voucher processing, and its features, such as long ribbon life, make this printer ideal for use as a ECR printer.

With the standard model, it is possible to print with logic-seeking and feed paper in increments of 0.176 mm {1/144"}, using the stepping motor for carriage movement or paper feeding.

Further, it can be equipped with optional features, such as a paper detector, pre-print black mark detector, or validation guide.

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1. GENERAL SPECIFICATIONS

1.1 Printing Method

Serial impact dot matrix printer

1.2 Printing Direction

Bidirectional printing (logic-seeking possible)

1.3 Printing Format

1) Number of wires:	9 (dot-pitch: 0.353 mm {1/72"})
2) Number of printable dots:	Total 210 dots (420 positions) per line
3) Number of print positions:	420 positions (maximum)
For 76.2 mm-wide paper:	420 positions, 42 columns (7 × 9 + 3 position spacings)
For 57.5 mm-wide paper:	300 positions, 30 columns (7 × 9 + 3 position spacings)
For validation printing:	420 positions, 42 columns (7 × 9 + 3 position spacings)
4) Carriage movement pitch:	0.3024 mm {1/84"} per step

1.4 Printing Speed

4.4 lps maximum (lps: lines per second)
(When printing on a 76.2 mm-wide {3"-wide} paper with 42 columns of alphanumeric characters)

5.6 lps maximum (lps: lines per second)
(When printing on a 57.5 mm-wide {2.26"-wide} paper with 30 columns of alphanumeric characters)

8.9 lps maximum (lps: lines per second)
(When printing by logic-seeking with 15 columns of alphanumeric characters)

1.5 Paper Feed

1) Paper feed method:	Friction feed
2) Line spacing:	0.176 mm {1/144"} minimum
3) Feeding time:	Approximately 46.9 ms per line (when line spacing is 4.23 mm {1/6"})
4) Fast feed speed:	Approximately 33 lps (lps: lines per second) (when line spacing is 4.23 mm {1/6"})

1.6 Paper

1) Paper roll	
a) Width:	76.2 mm {3"} or 57.5 mm {2.26"}
b) Maximum diameter:	ϕ83 mm {ϕ3.25"} (Be sure to use a paper roll in which the core and the paper are not glued together)
b) Validation (1-line printing):	130 mm {5.12"} or more (W) × 60 mm {2.36"} or more (H)

1.7 Inking

Recommended ribbon cassette: Type: ERC-39 (color: purple)

Life: 3,000,000 characters

The ribbon life is based on the following conditions:

- Character font: 7 × 9 font
- Printing pattern: Average of 2 dots / 1 wire per 1 character

1.8 Power Voltage

1) Printer power voltage 24 ± 2.4 VDC

NOTES:
1. Voltage specifications apply to the print head, main unit motor, cutter motor, and solenoids.
2. The same power supply should be used for the above parts.
3. The voltage loss in the energizing circuitry (combined line loss and driver saturation voltage) must be as follows:

   Print head: 1.5 VDC maximum, Others: 1 VDC maximum
4. Voltage of print solenoids may not drop below 21.6 VDC. This also applies when all nine pins are driven simultaneously.

2) Detector input voltage 5 ± 0.25 VDC

NOTES:
- Applies to the home position detector, temperature sensing element, optional black mark, and paper detector.

1.9 Connecting Method

1) Printer side FFC, FPC connector (Type; 27FE-ST JST)

2) User side 1.25 mm pitch FFC or FPC

(Width: 35 mm {1.38"}, thickness: 0.3 mm {0.012"}, includes reinforcement plate)

1.10 Installation

The printer must be installed horizontally, but it can be tilted by as much as 20 degrees. (Refer to Section 2.11, *Overall Dimensions,* for details.)

1.11 Environmental Conditions

1) Operating temperature: 0 to 50 °C {32 to 122°F}

2) Operating humidity 10 to 90 % (non-condensing) (Refer to Figure 1.11.1)

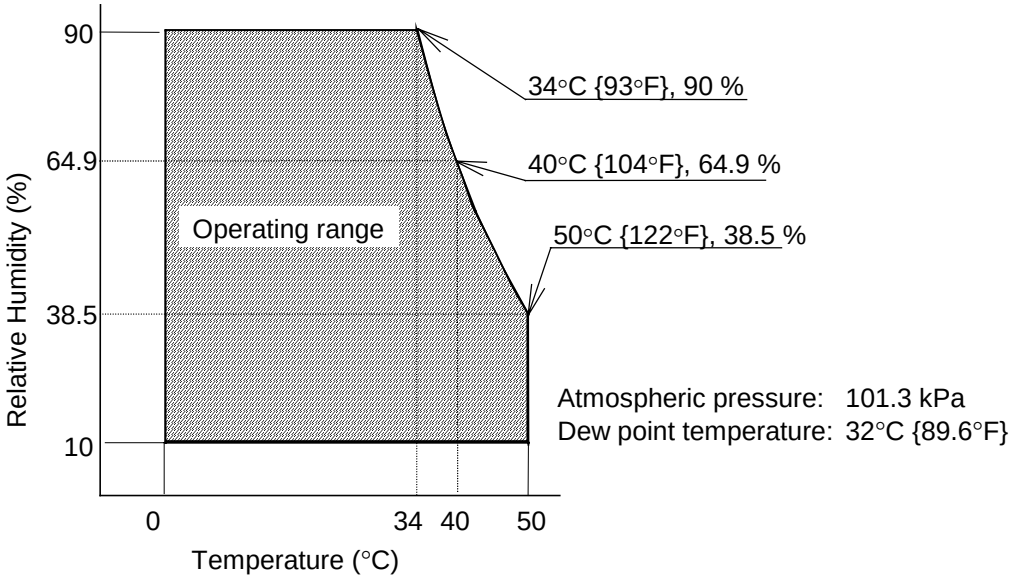


Figure 1.11.1 Environmental Conditions

1.12 Environmental Conditions for Storage (Except Paper and Ribbon Cassette)

1) Storage at high temperatures and high humidity:

	Temperature :	50 °C {122°F}
	Humidity:	90% RH
	Total time:	240 hours
2) Storage at high temperatures:	Temperature:	70 °C {158°F}
	Total time:	240 hours
3) Storage at low temperatures:	Temperature:	-25 °C {-13 °F}
	Total time:	240 hours
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 (X, Y, and Z directions)
	Center of vibration:	Any mechanism installed part
5) Impact resistance:	Impact acceleration:	980 m/s^2
	Total operation time:	6 ms
	Direction:	Once each for X, Y, and Z direction
	Impact operation point:	Any mechanism installed part
6) Long-term term storage:	Temperature:	5 to 35°C {23 to 95°F}
	Humidity:	40 to 70 % RH
	Period:	Within 18 months after the printer is produced

1.13 Reliability

1) Printer mechanism — MCBF: 9,000,000 lines
Life: 9,000,000 lines

One line is defined as one passing of the carriage set in one direction.

The end of life is defined as a breakdown of the camshaft, carriage set, or paper feed roller shaft set.
The values for MCBF and life are determined using a receipt length of 40 lines, with 25 lines of printing, as shown in the example print format.
However, EPSON-specified paper and ribbon cassette must be used.

2) Print head — 150 million characters
(using an average of 2 dots/wire per character)

1.14 Options

1) Validation guide
2) Black mark detector
3) Paper-end detector
4) Manual cutter

1.15 Dimensions

See Section 2.11, *Overall Dimensions*.

1.16 Mass

Approximately 470 g (without a ribbon cassette) {1.03 lb}

1.17 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.

1.18 Insulation Resistance

Initial Value: 10 MΩ or higher (250 VDC)

Between PCB terminals and printer frame

2. DETAILED SPECIFICATIONS

2.1 Paper

The printer paper is supplied by the user.

To assure good print quality and stable paper feeding, be sure to use only paper that fulfills the following requirements.

2.1.1 Paper roll

1) For 76 mm paper-width model

a) Normal paper

- Paper width: 76.2 ± 0.7 mm {3 ± 1/36"}
- Maximum outer diameter of roll: 83 mm {3.25"}
  (Maximum inside diameter of the paper roll core must be 10 +2/-0 mm {0.394 +0.078/-0"})
- Paper thickness: 0.06 – 0.085 mm
- Paper weight: 52.3 – 64.0 g/m^2 (JIS P8124) {14 – 17 lb}
  (45–55 kg / 1000 sheets / 788 mm – 1091 mm)

b) Pressure-sensitive paper (for one original + one copy)

- Total paper thickness: 0.14 mm maximum
  (with combination of 0.05 – 0.08 mm per one sheet)
- Recommended paper: Mitsubishi Paper Mills Co., pressure-sensitive copy paper (blue)
  Upper sheet: N40 (thickness: 0.06 mm, weight: 47.2 g/m^2 {12.6 lb})
  Lower sheet: N60 (thickness: 0.08 mm, weight: 68.0 g/m^2 {18.1 lb})

NOTE: Paper thickness that includes copy paper must be as follows:
Paper on in the print head side is thicker than paper on the platen side. (The top layer is thicker than the bottom layer.)

2) For 58 mm paper-width model

a) Normal paper

- Paper width: 57.5 ± 0.5 mm {2.26 ± 0.019"}
- Maximum outer diameter of roll: 83 mm {3.25"}
  (Maximum inside diameter of the paper roll core must be 10 +2/-0 mm {0.394 +0.078/-0"})
- Paper thickness: 0.06 – 0.085 mm
- Paper weight: 52.3 – 64.0 g/m^2 (JIS P8124) {14 – 17 lb}
  (45–55 kg / 1000 sheets / 788 mm – 1091 mm)

b) Pressure-sensitive paper (for one original + one copy)

- Total paper thickness: 0.14 mm maximum
  (with combination of 0.05 – 0.08 mm per one sheet)
- Recommended paper: Mitsubishi Paper Mills Co., pressure-sensitive copy paper (blue)
  Upper sheet: N40 (thickness: 0.06 mm, weight: 47.2 g/m^2 {12.6 lb})
  Lower sheet: N60 (thickness: 0.08 mm, weight: 68.0 g/m^2 {18.1 lb})

NOTE: Paper thickness that includes copy paper must be as follows:
Paper on in the print head side is thicker than paper on the platen side. (The top layer is thicker than the bottom layer.)

2.1.2 Validation (for one original + one copy)

130 mm {5.12"} or more (W) × 60 mm {2.36"} or more (H)

- Paper thickness: 0.085 – 0.10 mm
  (The thickness of the upper sheet of validation paper must not be thicker than the lower sheet of the validation paper.)
- Total paper thickness: 0.23 mm {0.0098"} or less
  (including the roll paper)
- Number of paper sheets (plies):
  Maximum 3 (including the roll paper)

2.1.3 Recommended paper (for evaluation)

Oji paper mfg. Co., Ltd.: Register paper

NOTES: 1. Conditions on inside end of roll paper (with or without a core)

① No fold is allowed. The paper must be wound so that the paper edge goes along the internal circumference. (Refer to Figure 2.1.1)

② No folding back is allowed.

③ The inside end must not be glued to the core (when a core exists).

④ The upper and lower layers of paper must not be glued to each other.

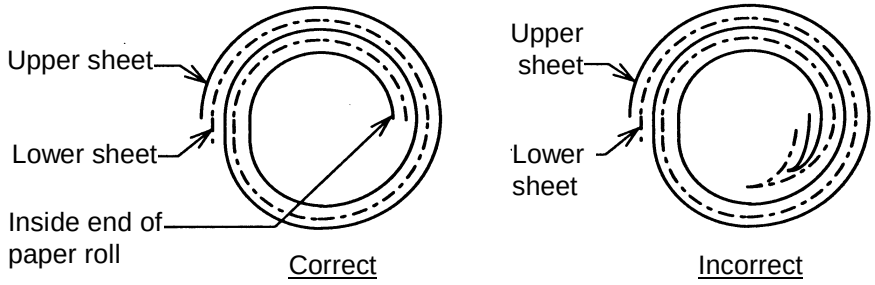


Figure 2.1.1

NOTES: 2. Roll paper sag

When pressure-sensitive roll paper is used, the difference in diameter between the upper and lower sheets generates slack in the upper sheet. (See Figure 2.1.2)
The shape of the case around the roll paper holder should be designed so that it allows some slack in the upper sheet.
Besides this, when a paper take-up device is employed, be careful of its position to prevent the upper sheet slack from being taken up by the device.

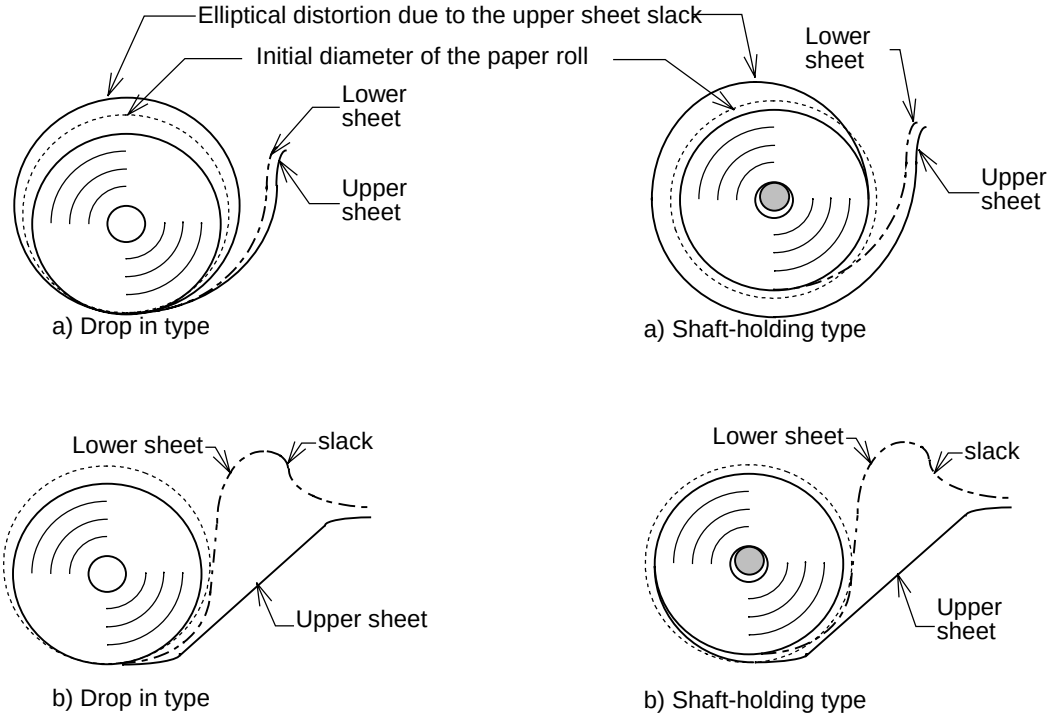


Figure 2.1.2

NOTES: 3. Direction of loading paper

If paper is loaded in a the way other than the “correct” way, cutting may not be neat, or paper may be jammed.

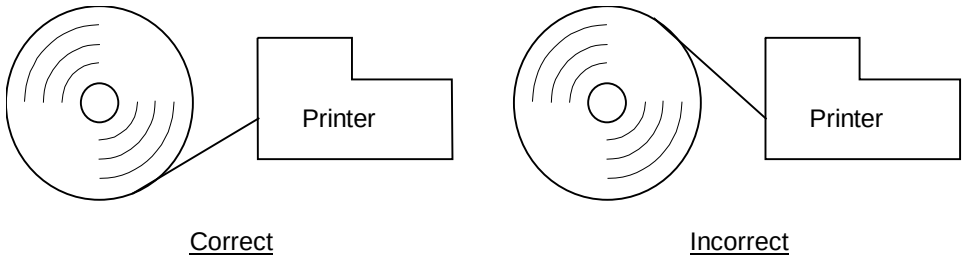


Figure 2.1.3

2.2 Font Structure and Size (Does not Include Ink Spreading)

1) 9 × 9, 3-position spacing

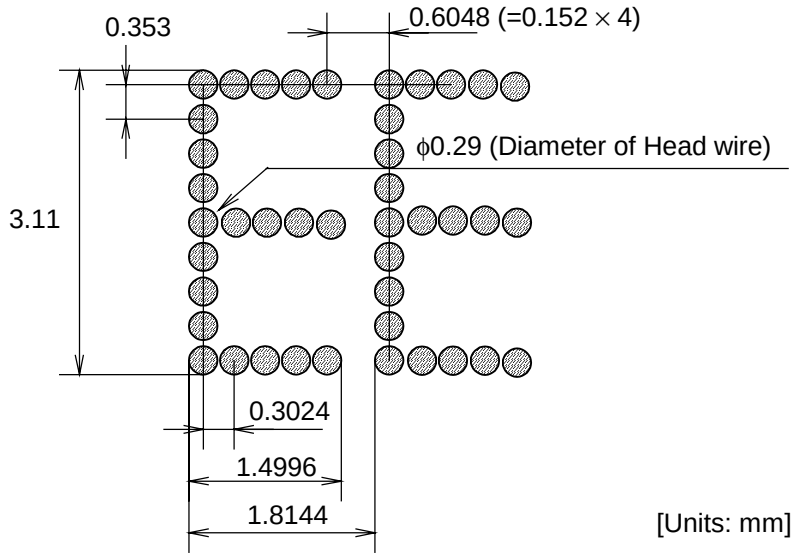


Figure 2.2.1

2) 7 × 9, 3-position spacing

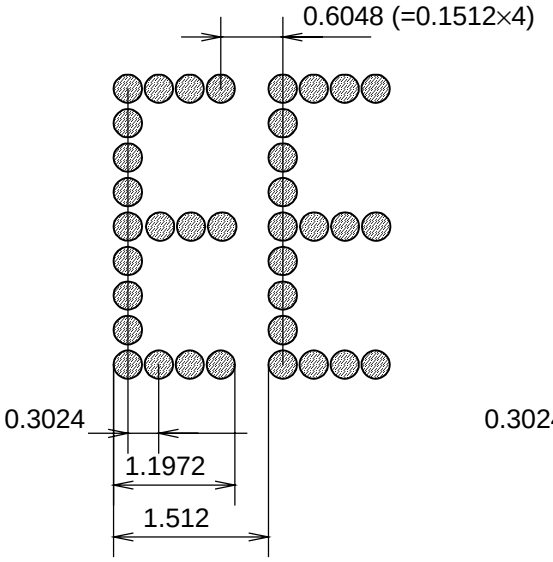


Figure 2.2.2

3) 7 × 9, 2-position spacing

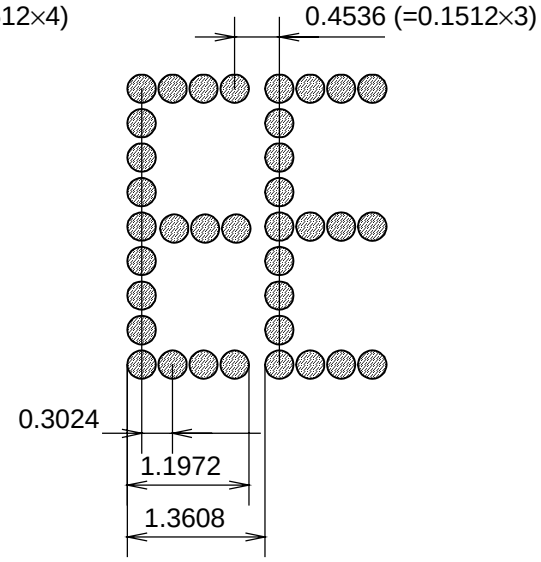


Figure 2.2.3

4) 7 × 7, 3-position spacing

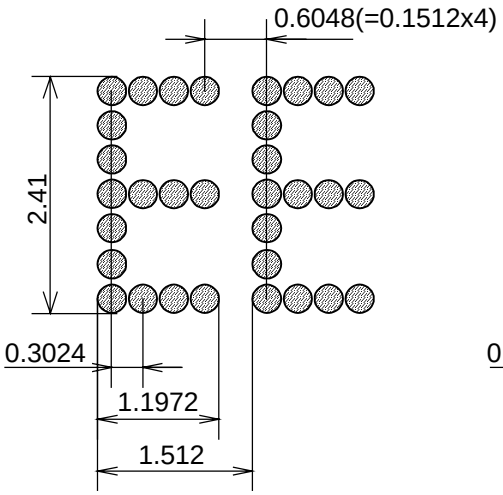


Figure 2.2.4

5) 7 × 7, 2-position spacing

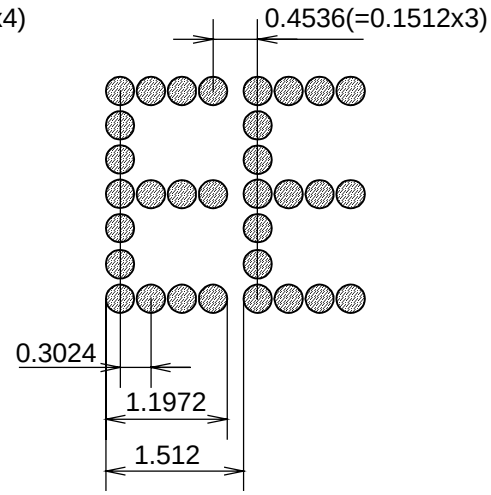
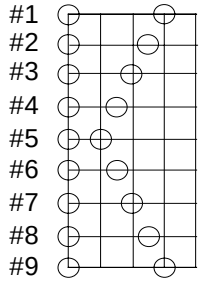


Figure 2.2.5

2.3 Print Solenoids

2.3.1 Number of print solenoids

9 Pin No.



2.3.2 Resistance

14 ± 0.5 Ω (25°C {77°F})

2.3.3 Energizing circuit

The print head energizing circuit must be designed so that the combined voltage loss when sending a current of 1.7 A to each solenoid does not exceed 1.5 V, including the collector/emitter saturation voltage and line voltage loss. When the energizing circuit is off, the current flowing through the head must become 0 A within 45 ± 15 μs.

2.3.4 Energizing width (PW)

The energizing width must be controlled so that it falls between the maximum and minimum values in Figure 2.3.1. Otherwise, the performance and life expectancy of the printer will be impaired.

If the printer is used out of the range shown in Figure 2.3.1, the users must take responsibility themselves. It is recommended to perform an endurance test or functional test in advance of this use of the printer by the user. (A functional test indicates evaluation for dot misalignment, ribbon hanging, or broken wire.)

NOTE: Energizing time should not exceed 380 µs. Otherwise a ribbon jam, head wire break, solenoid burnout, or other damage may occur.

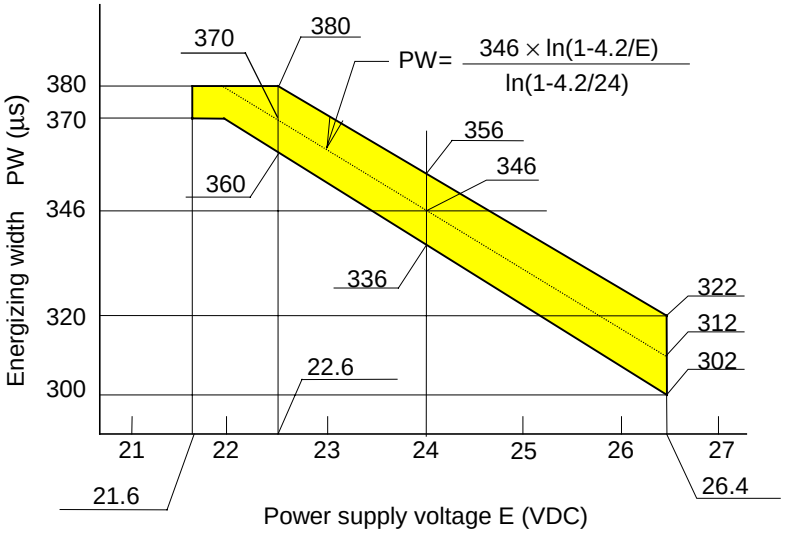


Figure 2.3.1

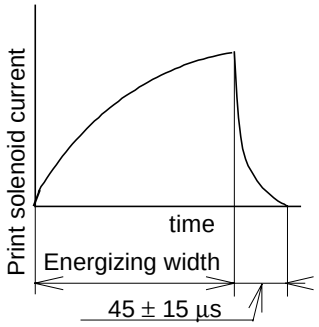


Figure 2.3.2

2.3.5 Energizing timing

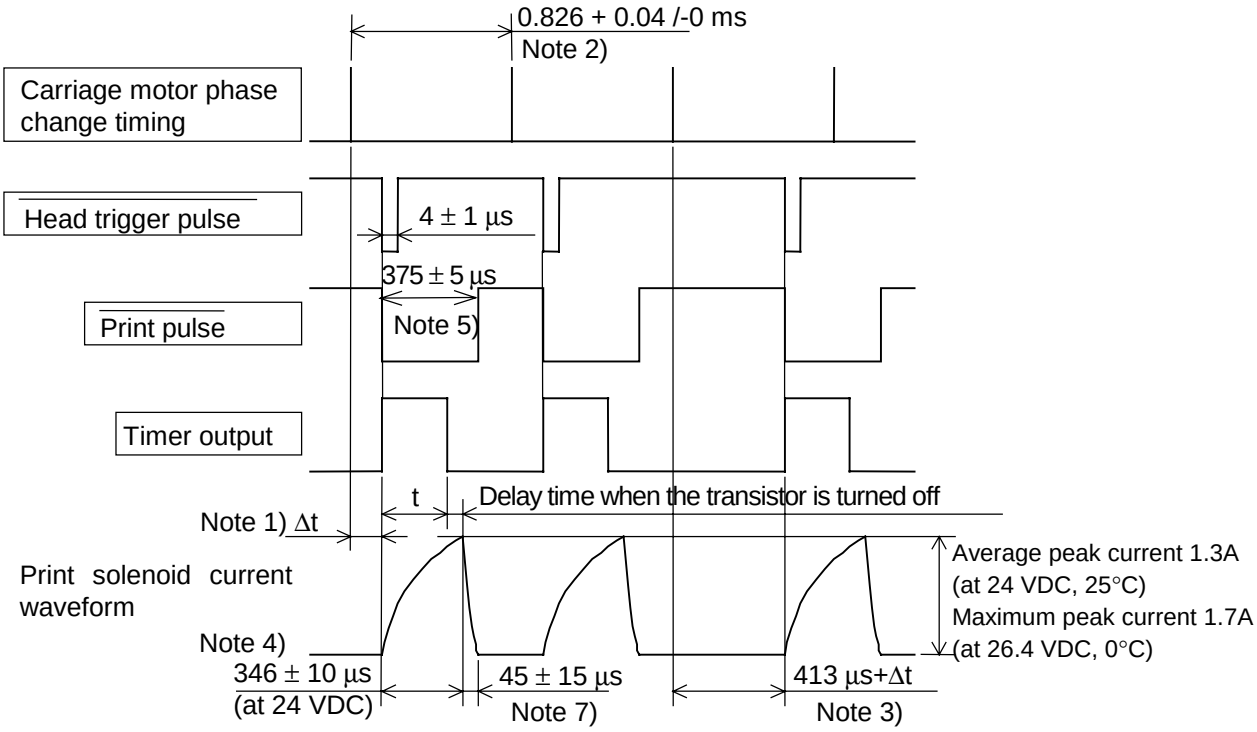


Figure 2.3.3

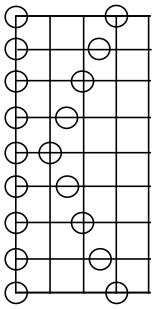
NOTES:
1. To adjust the print position for column direction in bidirectional printing, set the time lag Δt between the carriage motor's phase switching timing and the print starting timing. Compensate the print time for Δt, which corresponds to the carriage motor's misalignment caused by the carriage's gutter so that the print position can be adjusted for column direction.
   When double-height characters or graphics are printed, the upper half and the lower half would still be guttered. To avoid this, uni-directional printing is recommended (right – to – left printing).
2. The minimum cycle of the timing signal (phase signal change cycle) must be 0.826 ms.
3. The print solenoid driven timing for half-dot printing should be after a half-cycle of the timing signal cycle for the trigger pulse (minimum 413 µs + Δt).
4. t denotes the energizing period to the print solenoid based on Figure 2.3.1.
5. The driven width for the print pulse must be limited to 375 ± 5 µs.
6. The same wire must be prohibited to drive a continuous half dot.
7. The fall time of the print solenoid current waveform must be within 45 ± 15 µs.
8. ☐ denotes a signal that is provided by the user side.

2.3.6 Energy consumption

Table 2.3.1

	Energy Type	Value
1	Standard average input energy *e* (24 VDC, at room temperature)	Approximately 6.9 mJ/dot (Energizing width: 346 μs)
2	Maximum input energy (26.4 VDC, at 0°C {32°F})	Approximately 11.6 mJ/dot (Energizing width: 322 μs)
3	Power calculation method	$\frac{\text{(input energy, J)} \times \text{(number of print dots)}}{\text{(print time, s)}}$
4	Average power for printing character “K” as shown below	Approximately 33.4 W (e mJ × 18 dots) / (0.413 ms × 9 timing)
5	Peak current (Worst case)	Approximately 11.7 A (At room temperature, 24 VDC, nine wires simultaneously energized) 15.3 A (0°C, 26.4 VDC, nine wires simultaneously energized)

NOTE: Voltage may not drop below 21.6 VDC; also applies when all pins are driven simultaneously.



2.3.7 Print duty cycle

To calculate the duty cycle, divide the total number of print dots in any 2-minute period by 120. Control the drive parameters so that the number of dots per second for the total of all nine wires does not exceed the values shown below. However, an average of 2 dots/wire per character must be used.

The allowable number of characters per line is calculated according to the following equation:

$N = (A \times T) / B$ (characters/line)

A: Allowable number of dots per second (dot/s)
B: Average number of dots per character (dot/s)
T: Print cycle (s/line)

Example: When an alphanumeric string with an average of 2 dots/wire per character is printed;
the print duty is calculated as 18 dots per character ($B = 9 \times 2$).

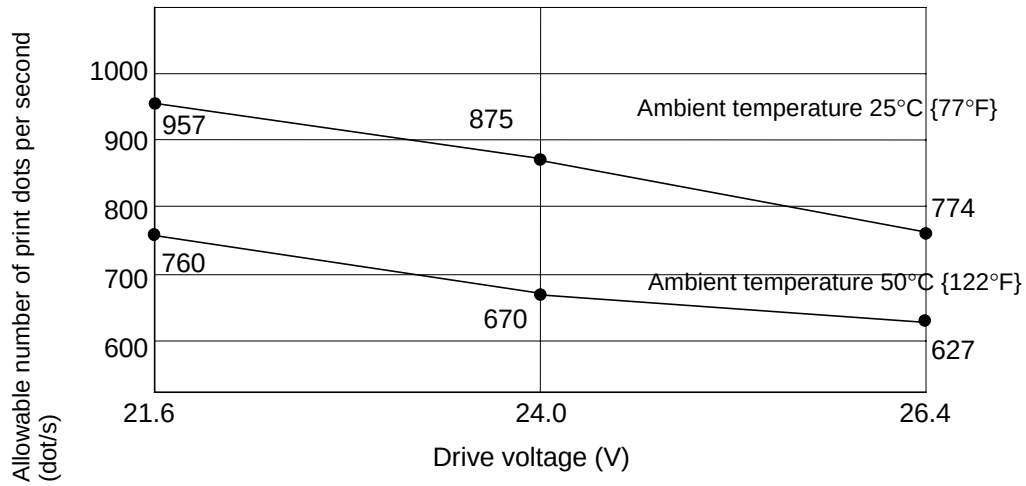


Figure 2.3.4 Print Duty

2.3.8 Temperature sensing element control

To prevent burnout, smoke emission, and fire hazard, the print solenoid incorporates a temperature -sensing element.

a) Conditions

1. Use the temperature-sensing element within the range of the print duty as shown in Figure 2.3.4 (head temperature is less than 120°C {248°F}).
2. The drive current to the print solenoid should be cut when the temperature-sensing element value becomes 17.3 kΩ (head temperature exceeds 140°C {284°F}) (25°C: 10 ± 0.1 kΩ).

b) Temperature-sensing element

LP310-1J,103F,502 (Tama Electric Co., Ltd.) or equivalent.

2.4 Home Position Detector

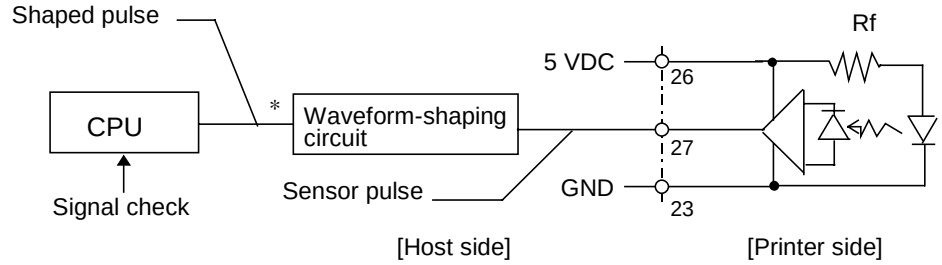
The home position detector is a type of photo interrupter that detects when the carriage comes to the home position. This detector is located at the bottom of the right side of the printer and detects the plate of the carriage. This detector also can be used for detection of abnormal operations of the carriage.

2.4.1 Detector's electrical characteristics

Open-collector output

Electrical characteristics (Ta = 25°C {77°F})			Characteristic values	Conditions
Output	Low-level output voltage	V_{OL}	Typ. 0.12 VDC, Max. 0.4 VDC	Vcc = 5 VDC, I_{OL} = 16 mA
	Low-level output current	I_{OL}	Absolute maximum ratings 16 mA	

2.4.2 Detector circuits of the printer and output pulse designations



NOTES: 1. When the photo interrupter detects light, the detector pulse becomes high.
2. In the above circuit descriptions, the terms "detector pulse" and "shaped pulse" are used for the pulse signal at the above indicated circuit points.
3. After a pulse is recognized by the CPU, it is termed a "signal."

Figure. 2.4.1

2.4.3 Waveform-shaping circuit (VAR side)

The pulse output by the printer (home position waveform as shown in Figure 2.4.1) must be processed on the VAR side by an integrating circuit with a rise time constant of 5.7 μs and a fall time constant of 4.7 μs, to obtain an output equivalent to a CMOS Schmitt gate (HC14).

The waveform output by the waveform-shaping circuit is called a shaped home-position waveform. Details of these pulses are described below.

NOTE: The shaped home-position waveform output by the above waveform-shaping circuit is inverted in relation to the detector waveform as output by the printer.

2.4.4 Output signal level

The signal level output by the shaped home-position waveform point ∗ in Figure 2.4.1 is shown in Table 2.4.1.

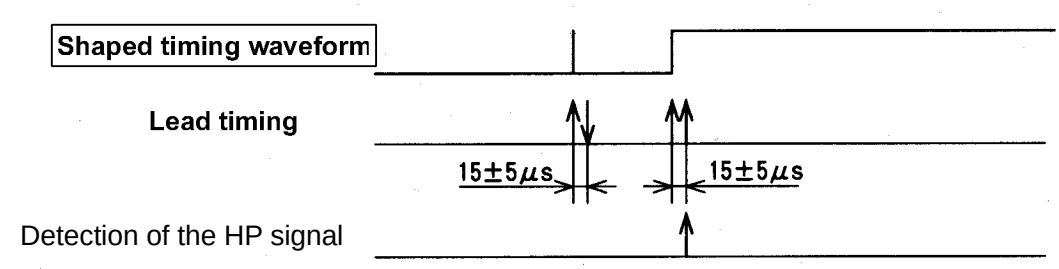
Table 2.4.1

Carriage position	Signal level
Outside home position	LOW
Inside home position	HIGH

2.4.5 Detection method of the home position signal (for noise elimination)

The home position signal for the fixed home position is defined by reading the leading or the falling edge of the shaped home-position waveform output by the waveform-shaping circuit at the timing when the phase signal of the carriage motor is changed.

During printing in the optional printable area, refer to the Designer's Guide for the M-U110II for detection of the home-position signal.



NOTE: ☐ denotes a pulse output by the user-provided waveform-shaping circuit.

Figure. 2.4.2

2.5 Carriage Drive Motor

The movement of the carriage (forward and reverse) is by controlling the carriage drive motor.

2.5.1 Type

4-phase 20-pole PM stepping motor

2.5.2 Drive method

Constant-current chopper driving with 2-phase excitation

2.5.3 Power supply terminal voltage

24 ± 2.4 VDC (includes the line voltage drop of the driving circuit)

2.5.4 Coil resistance

20 ± 1.4 Ω at 25°C {77°F} for each phase

2.5.5 Connection diagram

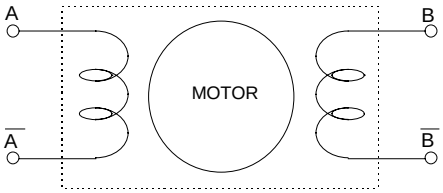


Figure 2.5.1 Carriage Drive Motor Connection Diagram

2.5.6 Current consumption:

a) Driving in acceleration/deceleration: 350 ± 25 mA (2-phase excitation)
b) Driving at constant speed: 350 ± 25 mA (2-phase excitation)
c) Hold current: 106 ± 20 mA (2-phase excitation)
d) Rush current: 350 ± 25 mA (2-phase excitation)
e) Limit to be applied: 1 second maximum for one phase, except in the hold state.

2.5.7 Maximum drive frequency

1210 pps Minimum period of pulses is 0.826 ms. (pps: pulses per second)

2.5.8 Motor drive sequence

1) Carriage movement in the direction of right to left (motor rotates counterclockwise)

Table 2.5.1 Carriage Motor Drive Sequence

Step No. \ Motor Excitation Phase No.	Phase $\overline{B}$	Phase $\overline{A}$	Phase B	Phase A
Step No. \ Motor Connector Pin No.	5	6	7	8
Step 1	H			H
Step 2			H	H
Step 3		H	H	
Step 4	H	H		

H: HIGH level
Blank: LOW level

2) Carriage movement in the direction of left to right (motor rotates clockwise)

Table 2.5.2 Carriage Motor Drive Sequence

Step No. \ Motor Excitation Phase No.	Phase $\overline{B}$	Phase $\overline{A}$	Phase B	Phase A
Step No. \ Motor Connector Pin No.	5	6	7	8
Step 1	H	H		
Step 2		H	H	
Step 3			H	H
Step 4	H			H

H: HIGH level
Blank: LOW level

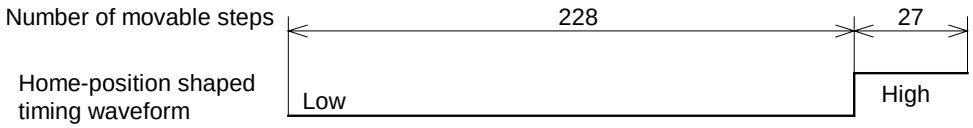
2.5.9 Minimum drive amount of the carriage motor

The ink ribbon is also fed by rotation of the carriage motor. To make sure to feed the ribbon, drive the carriage motor for at least 24 steps in the same direction as the carriage movement if the carriage is moved with printing.

However, If the carriage is moved without printing, the carriage motor can be stopped before reaching the minimum drive amount of the carriage motor.

2.5.10 Movement amount of the carriage

The movement amount of the carriage is converted for 27 steps of the carriage motor at the HIGH level and 228 steps at the LOW level after the shaped home-position waveform is changed.
The number of movable steps in the shaped home-position waveform:



NOTE: The number of movable steps (228) is the maximum range that the carriage can move at initialization. Refer to Section 3.2.4, Printing, in the printable area and the acceleration or deceleration range.

2.6 Paper Feed Motor

Paper is fed by controlling the paper feed motor.

2.6.1 Type

4-phase 20-pole PM stepping motor

2.6.2 Drive method

Constant-current chopper driving with 2-phase excitation

2.6.3 Power supply terminal voltage

24 ± 2.4 VDC (includes the line voltage drop of the driving circuit)

2.6.4 Coil resistance

20 ± 1.4 Ω at 25°C {77°F} for each phase

2.6.5 Connection diagram

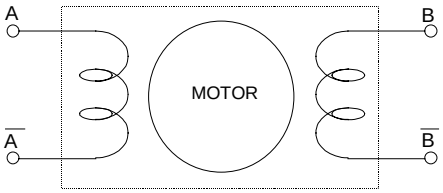


Figure 2.6.1 Carriage Drive Motor Connection Diagram

2.6.6 Current consumption:

a) Driving in acceleration/deceleration: 300 ± 21 mA (2 phase excitation)
b) Driving at constant speed: 300 ± 21 mA (2 phase excitation)
c) Hold current: 90 ± 20 mA (2 phase excitation)
d) Rush current: 300 ± 21 mA (2 phase excitation)
e) Limit to be applied 1 second maximum for one phase, except in the hold state.

2.6.7 Maximum drive frequency

800 pps Minimum period of pulses is 1.25 ms (pps: pulses per second)

2.6.8 Minimum paper feed pitch

0.176 mm {1/144"} (per step)
4.235 mm {1/6"} (per 24 steps)

2.6.9 Paper feed time

Continuous feeding (at constant speed rotation of 800 pps at maximum) (pps: pulses per second)
Approximately 30 ms / 4.235 mm {1/6"}
Approximately 33 lps (1 line = 4.235 mm {1/6"})
(lps: lines per second)

2.6.10 Motor drive sequence

a) Paper is fed in the forward direction (motor rotates counterclockwise)

Table 2.6.1 Paper Feed Motor Drive Sequence

Step No. \ Motor Excitation Phase No.	Phase $\overline{B}$	Phase $\overline{A}$	Phase B	Phase A
Motor Connector Pin No.	1	2	3	4
Step 1	H	H		
Step 2		H	H	
Step 3			H	H
Step 4	H			H

H: HIGH level
Blank: LOW level

b) Paper is fed in the reverse direction (motor rotates clockwise)

Table 2.6.2 Paper Feed Motor Drive Sequence

Step No. \ Motor Excitation Phase No.	Phase $\overline{B}$	Phase $\overline{A}$	Phase B	Phase A
Motor Connector Pin No.	1	2	3	4
Step 1	H			H
Step 2			H	H
Step 3		H	H	
Step 4	H	H		

H: HIGH level
Blank: LOW level

2.6.11 Feed switch

Before the user feeds the paper for the optional length with the FEED switch, move the carriage to the center of the print column. (For the 76.2-mm paper width model, the position to be moved is approximately 100 steps toward the center from the home position. For 57.2-mm paper width model, approximately 70 steps.)

2.6.12 Reverse paper feed

During feeding paper in the reverse direction, the paper feed motor is prohibited from being driven for 48 steps or more.
Also, to prevent backlash of the paper feed motor gears, feed the motor in the reverse direction for 6 steps more than the paper feed amount desired, and then feed the motor forward for 6 steps.

Move the carriage to the center position of the paper (refer to Section 2.6.11, Feed switch) then feed paper in the reverse direction.

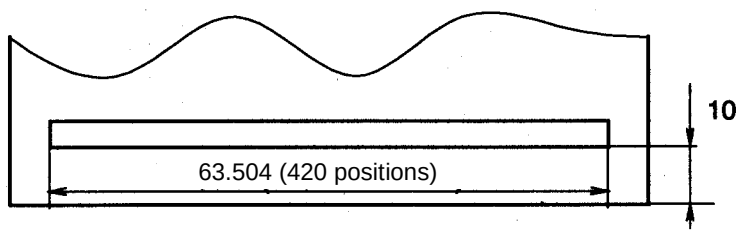
2.6.13 Paper pull-out load

The paper roll pull-out load should be 0.4 N or less when the paper supply device is provided by user.

2.7 Validation Printer

Single-line validation printing can be performed.

2.7.1 Printable area for validation printing



(Units : mm)

Figure 2.7.1

NOTE: Values for the printable area are calculated at the center of the wire dot (diameter 0.29 mm)

2.7.2 Notes on printing the validation

1) When inserting the paper, do not catch the ribbon on the paper (It is recommended to use the validation guide (option)).
2) Since there is no validation paper hold mechanism, the validation card should be inserted using the guide to prevent the paper from moving horizontally.
3) Folded, curved, or wrinkled validation cards may cause a dirty print. Give this consideration when the validation card is inserted.
4) If black mark detector C, which is available as an option, is installed, the validation cannot be printed.

2.8 Ribbon Cassette (Provided by User)

The ribbon is fed automatically when the motor turns. Use the EPSON-specified ribbon cassette. Otherwise, the function and reliability may not be guaranteed.

1) Type: ERC-39 (P)

2) Color: Purple (single-color)

3) Ribbon Life: 3,000,000 characters (at 25°C {77°F}, continuous printing)
- Character font: 7 × 9 font
- Printing pattern: Using an average of 2 dots/wire per character

4) External Appearance

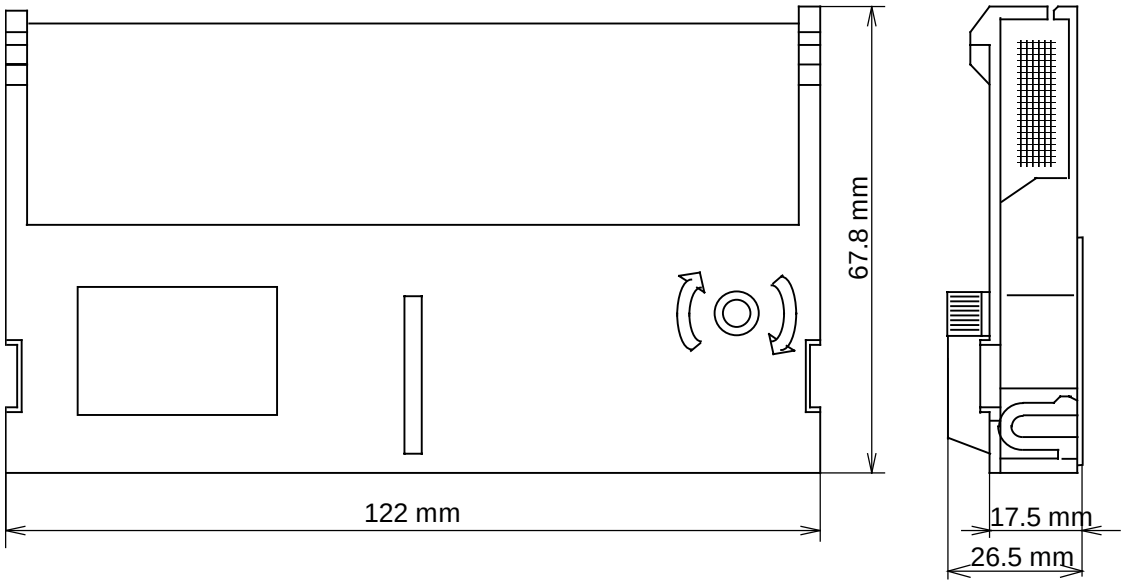


Figure 2.8.1

2.9 Connector Wiring Diagram

The connector layout as seen from the front of the printer is shown below.

a) Connector type on printer side: 27FE-ST

b) Connector type on user side: 1.25 mm {0.05"} pitch FFC or FPC

c) Terminal assignments

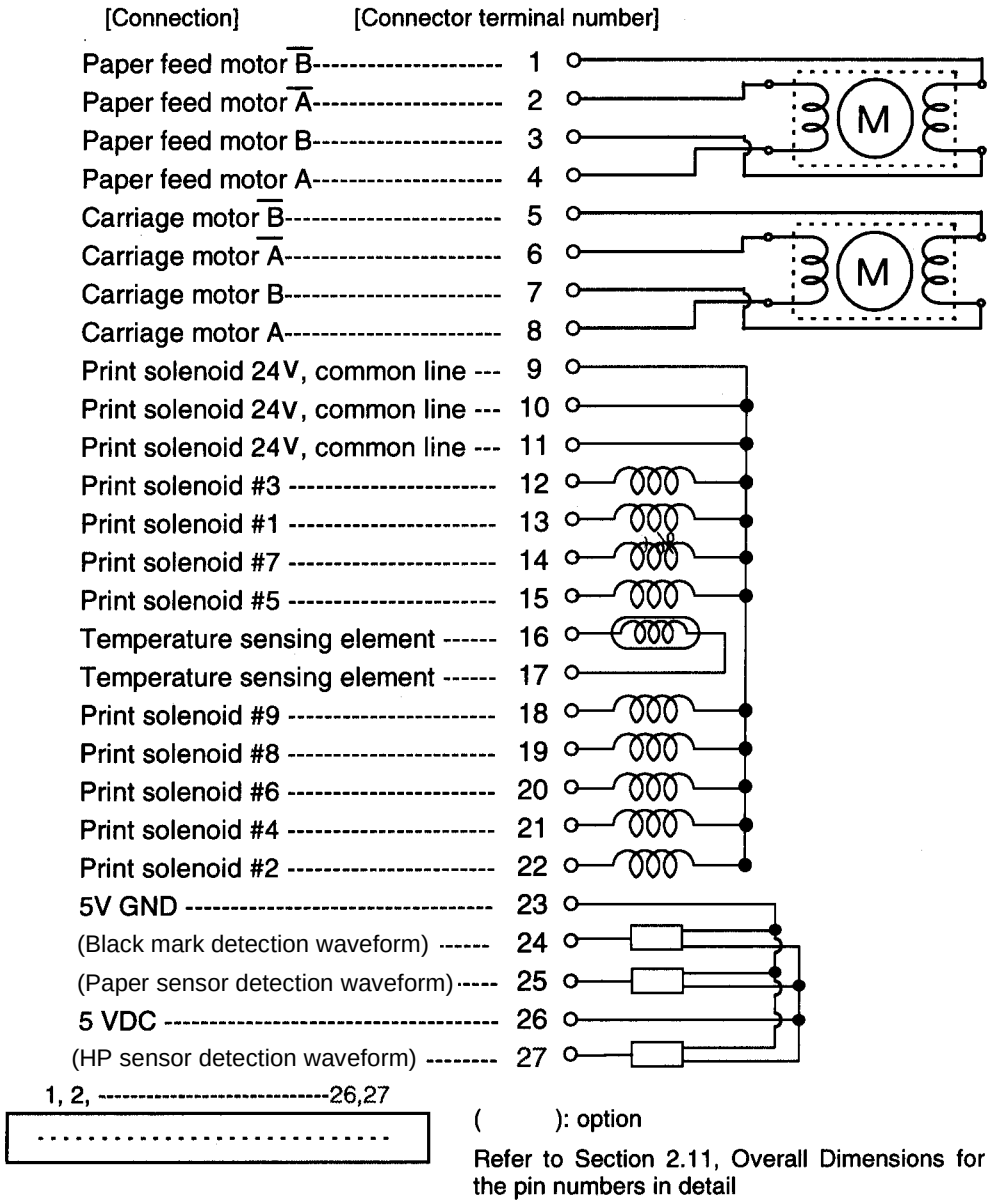


Figure 2.9.1

2.10 Options

2.10.1 Validation guide/manual cutter

The validation guide, which guides the validation when it is inserted, and the manual cutter can be installed in the printer main frame.
When using the validation, use both the validation guide and the manual cutter.
The manual cutter can be installed by itself for cutting the paper roll.

2.10.2 Black mark detector

A photo detector is installed in the paper path near the paper insertion area for detecting a black mark.

1) Type: Reflecting photodetector

2) Absolute maximum ratings: (Room temperature at 25°C {77°F})

Item		Symbol	Rating	Unit
Output characteristics	Collector current	Ic	20	mA
	Collector loss	Pc	75	mW
Total permitted loss		Ptot	100	mW

3) Ratings: (Room temperature at 25°C {77°F})

Item		Symbol	Condition	MIN	TYP	MAX	Unit
Output	Dark current	I_{CEO}	V_{CE} = 20V	–	1	100	nA

4) Pin assignments of the black mark detector:

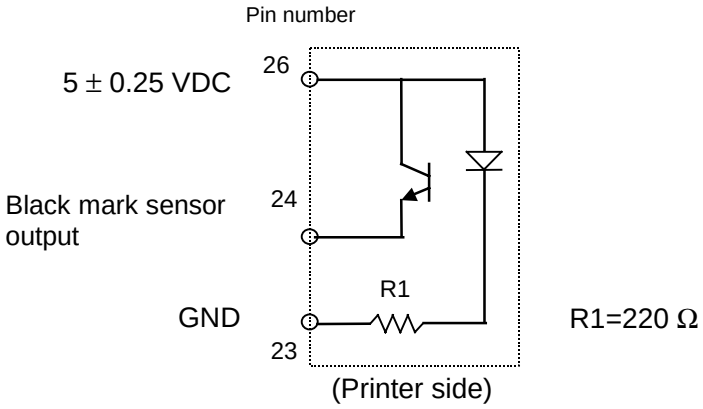


Figure 2.10.1 Black Mark Detector

5) Paper that can be used

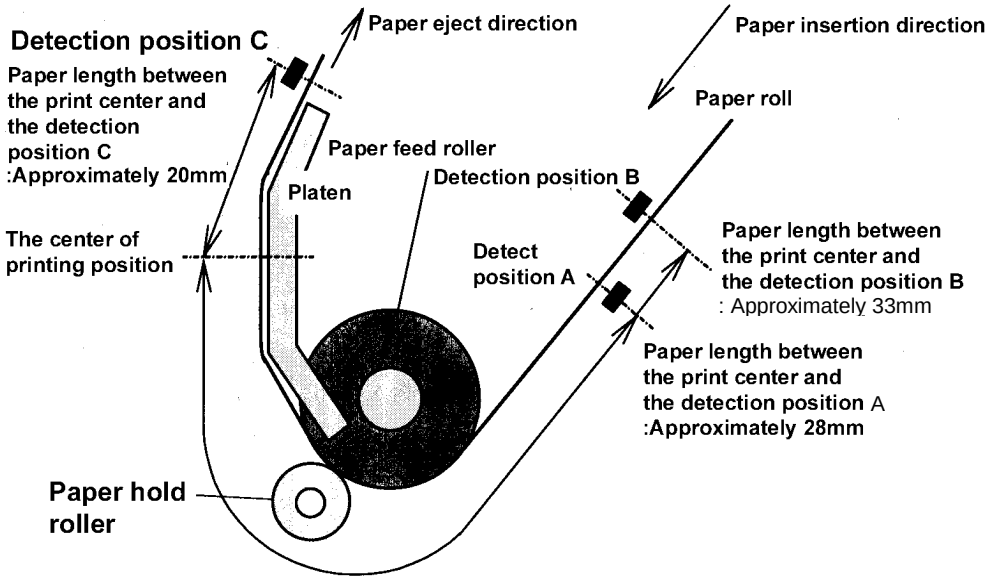
The reflecting rate of the black mark must be 10% or less, and the reflecting rate of the white be 70% or more. The reflecting rate means the value measured with Macbeth density meter (PCMII) D filter.

6) Detection position

The black mark detector must be installed in one of the following:

		Position A (face of the paper at the paper entrance)	Position B (back of the paper at the paper entrance)	Position C (face of the paper at the paper exit)
58-mm print width model	Right side	O (See note below)	O	O
	Left side	O	O	O
76-mm print width model	Right side	O (See note below)	O	O
	Left side	O	O	O

NOTE: The black mark detector cannot be used together with the paper detector.



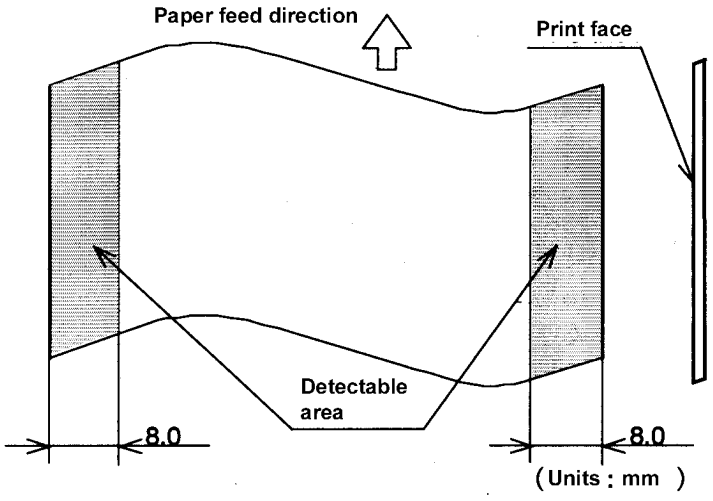


Figure 2.10.2 Black Mark Detector Detection Position

7) Black mark position

The black mark must be positioned from the top of the paper roll as follows:

Detector Position	Paper length from the top of the paper roll to the black mark
Position A (Paper exit, face of the paper)	20 mm or more
Position B (Paper exit, back of the paper)	26 mm or more
Position C (Upper paper exit, face of the paper)	0 mm or more

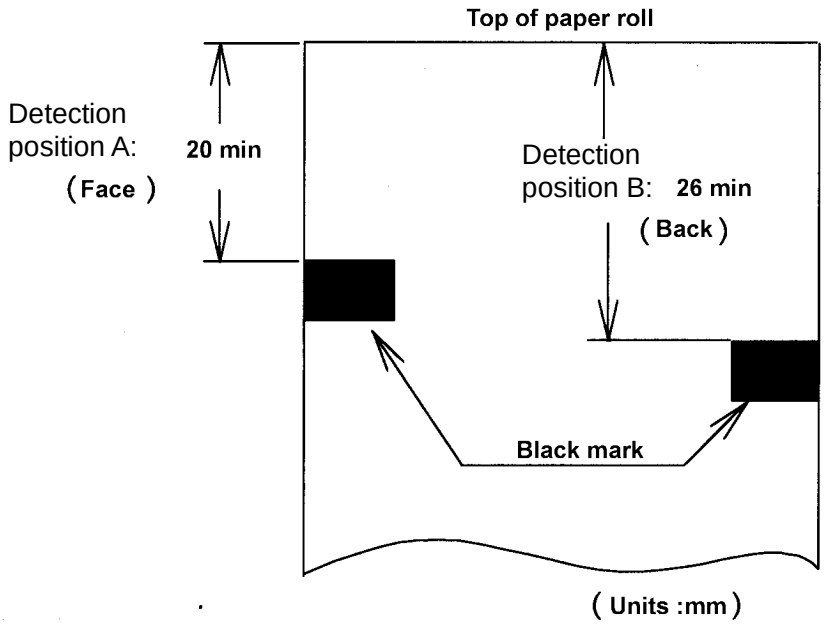


Figure 2.10.3 Black Mark Position

2.10.3 Paper Detector

A photo detector is used for detect a paper-end in the paper path near the paper entrance.

1) Type: Transparent photodetector

2) Absolute Maximum Rating

(at 25°C {77°F})

Item		Symbol	Rated value	Unit
Output characteristics	Collector current	I_C	20	mA
	Collector loss	P_C	75	mW
Total allowable loss		P_{TOT}	100	mW

3) Ratings

(at 25°C {77°F})

Item		Symbol	Condition	Specifications			Unit
				Min	Typ	Max	
Output characteristics	Dark current	I_{CE0}	V_{CE}=20V	--	1	100	nA

4) Pin assignments of the paper detector

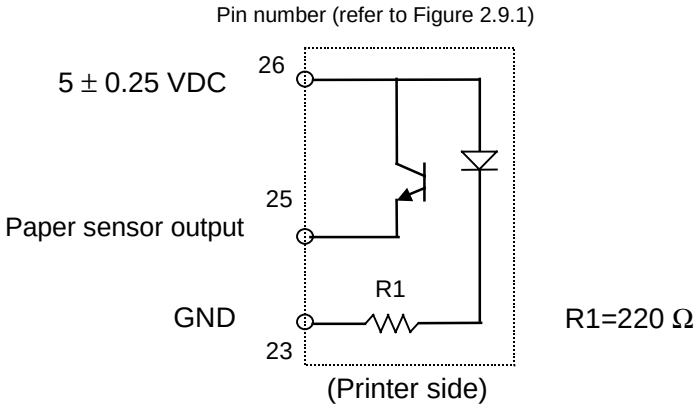
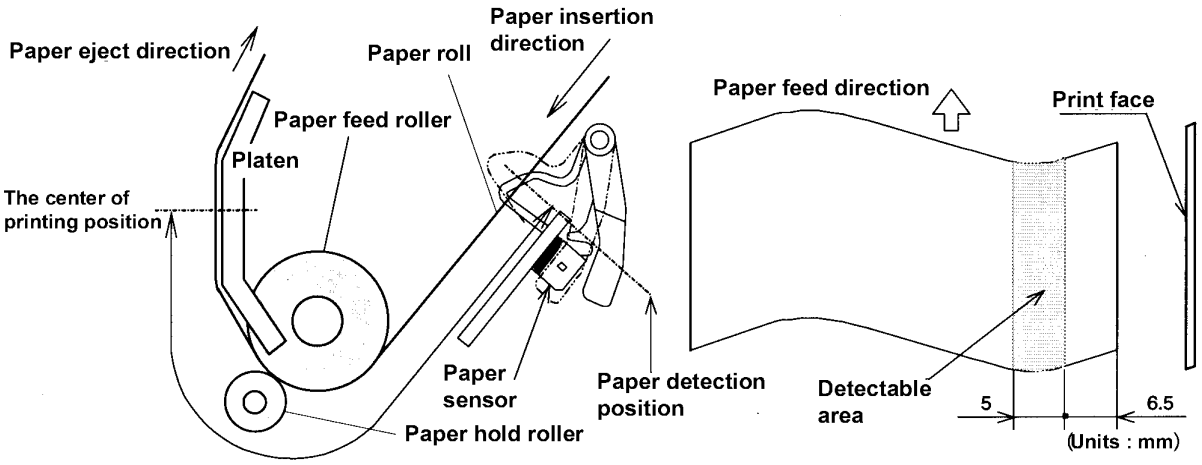


Figure 2.10.4 Paper Detector

5) Detection position



The paper length from the center of the printing position to the detection position: Approximately 35 mm {1.38"}.

Figure 2.10.5 Detection Position of the Paper Detector

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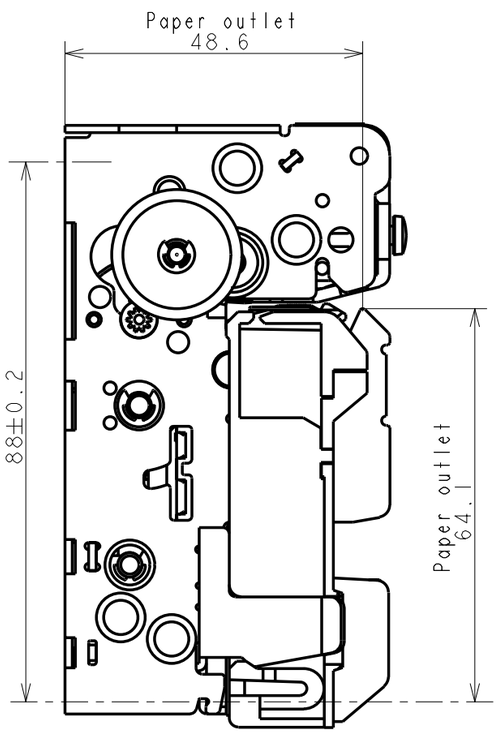
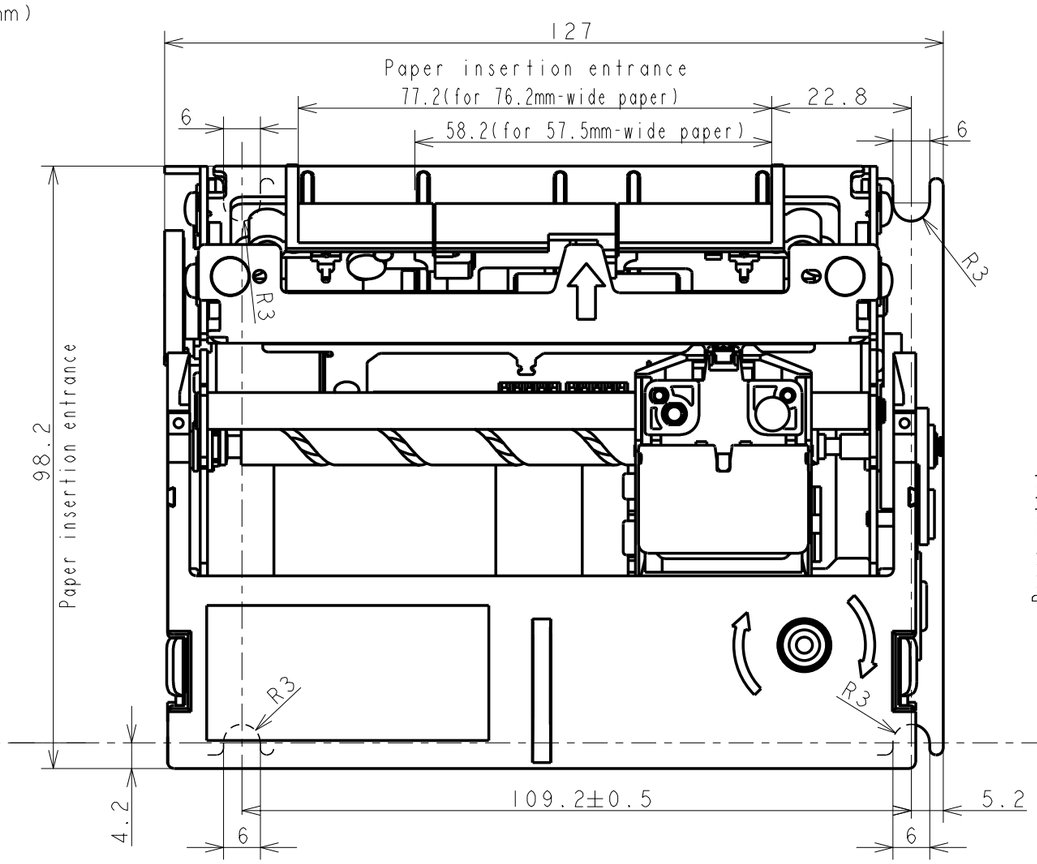
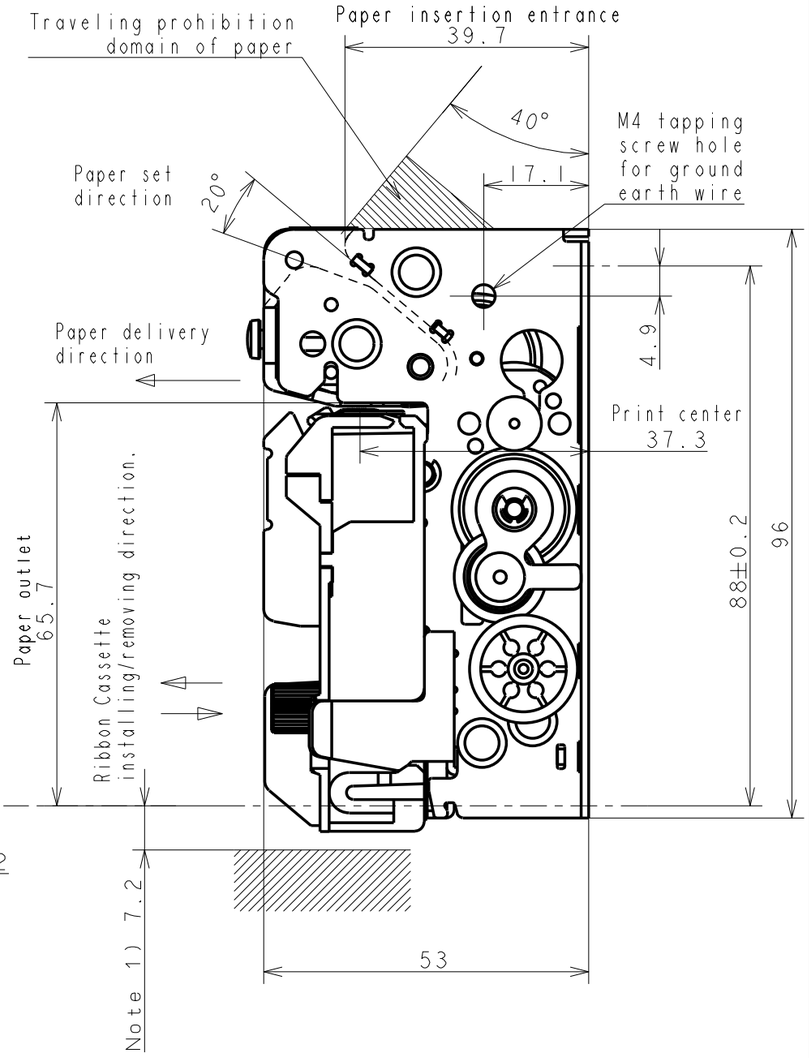
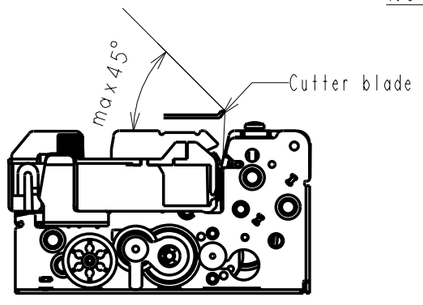
2.11 Overall dimensions

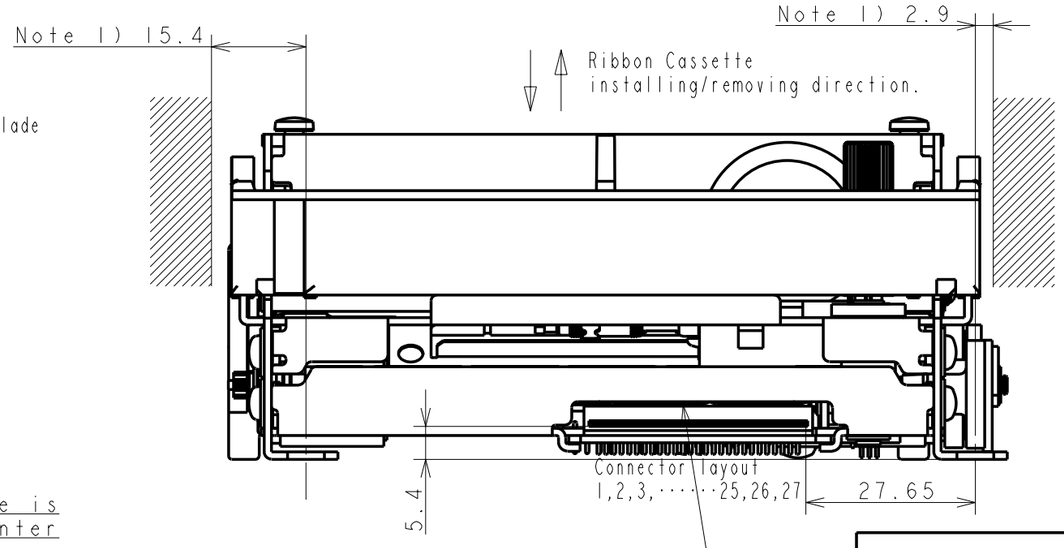
2.11.1 Standard model(Unit:mm)

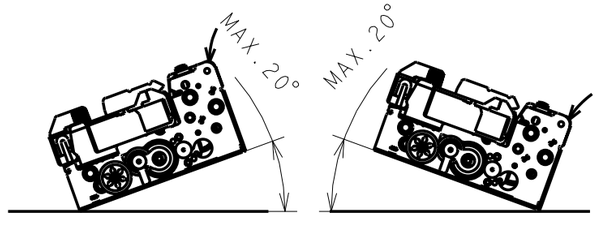












Attaches attitude

Note
1) Clearance of 2 mm or more is required between the printer side and wall so that the ribbon cassette will install/remove smoothly.

EPSON	TITLE: M-U1101 Preliminary Specification (Standard)	SHEET REVISION: A	NO. / NEXT: 30 / SHEET: 29

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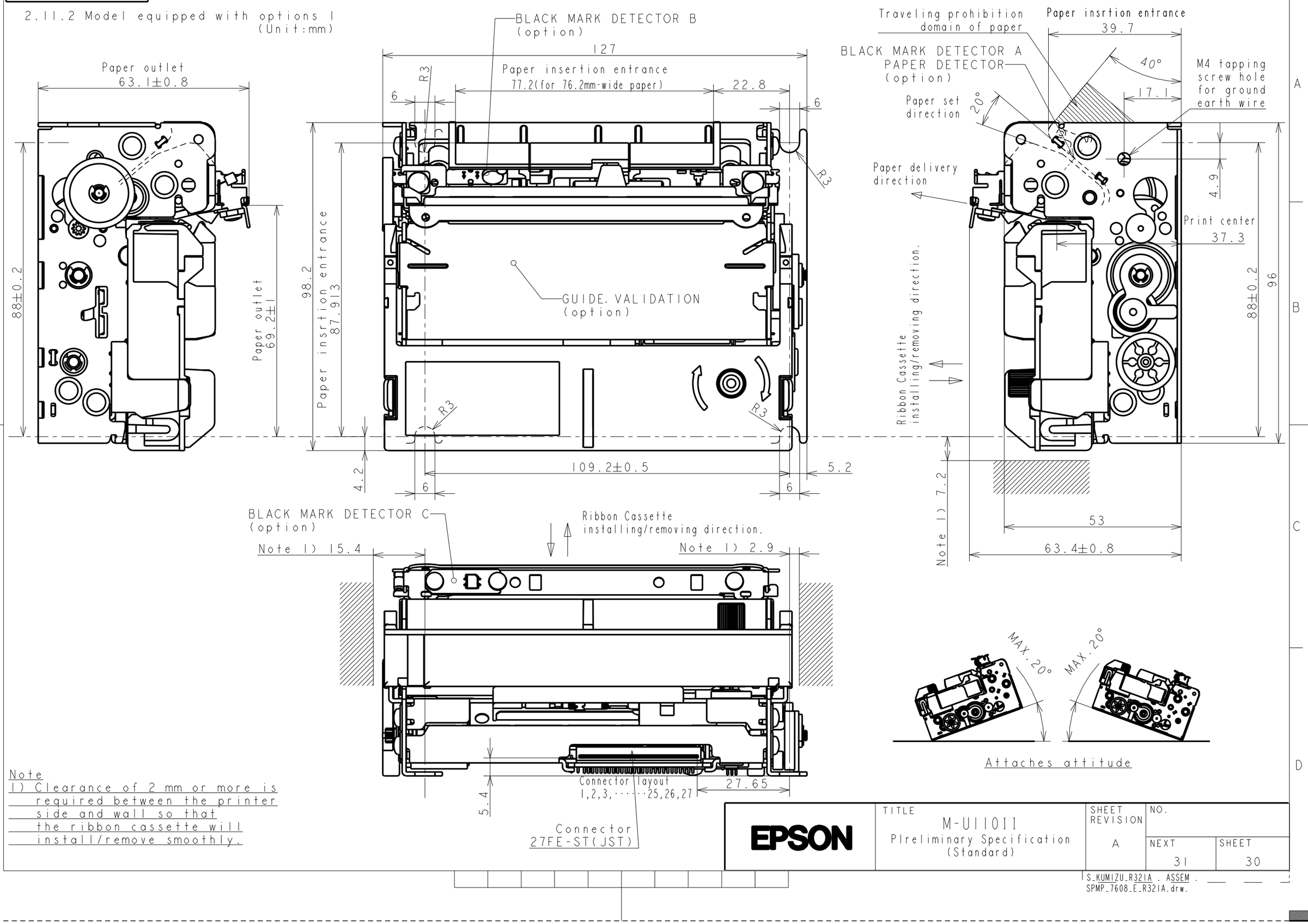
2.11.2 Model equipped with options 1
(Unit:mm)



Note
1) Clearance of 2 mm or more is required between the printer side and wall so that the ribbon cassette will install/remove smoothly.

EPSON	TITLE: M-U1101 Preliminary Specification (Standard)	SHEET REVISION: A	NO.
		NEXT: 31	SHEET: 30

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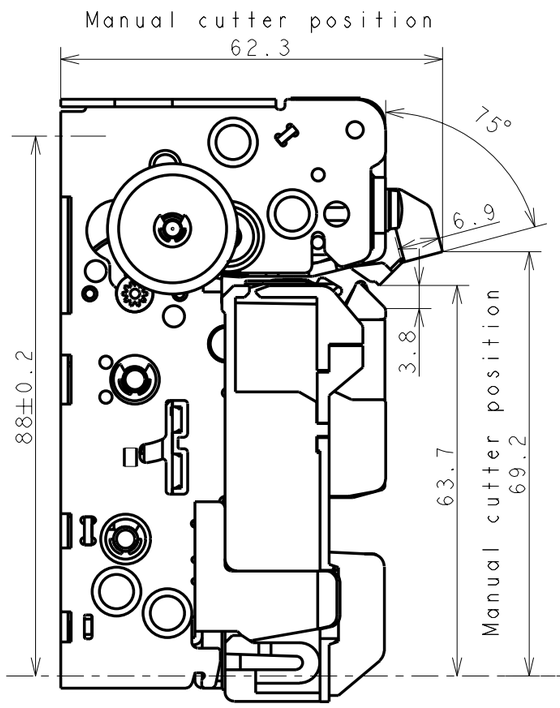
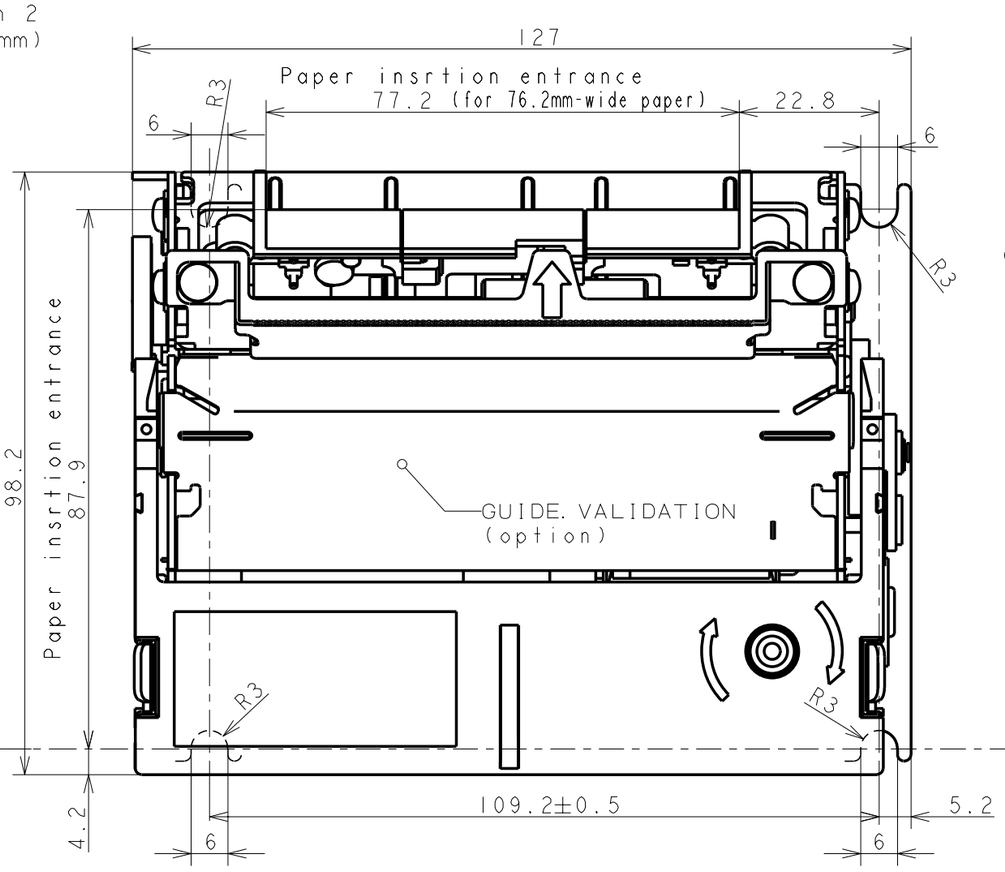
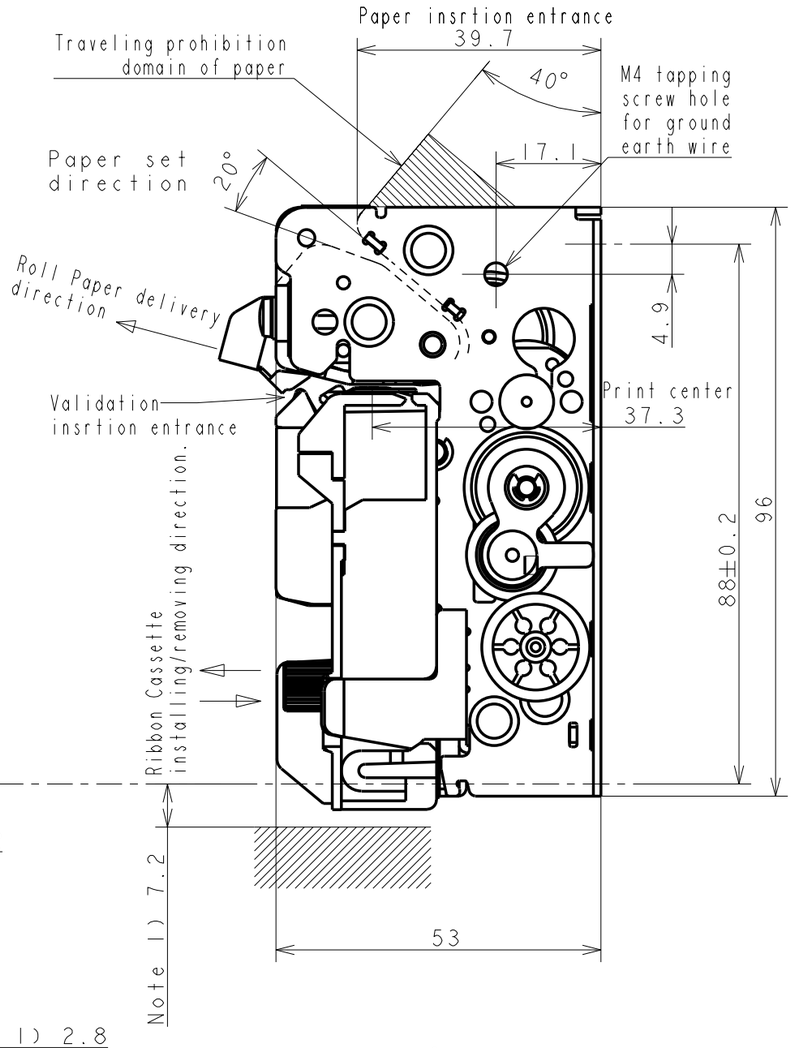
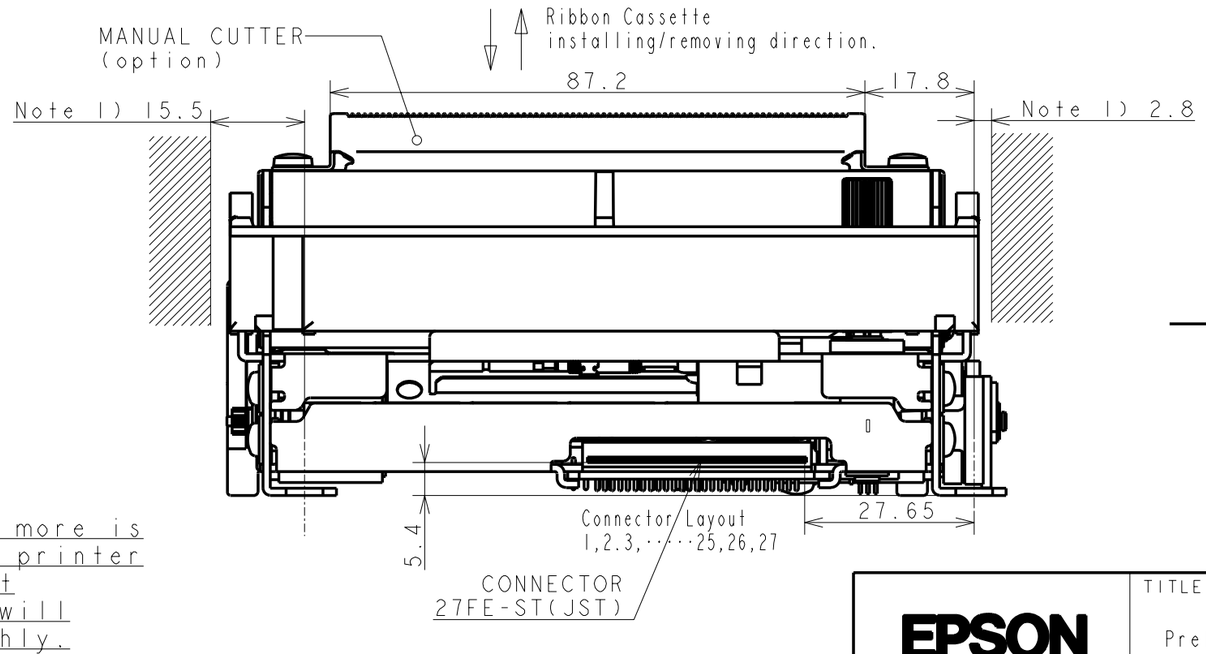
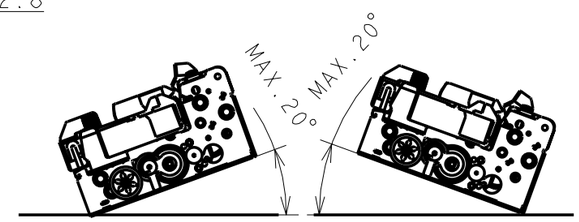
2.11.3 Model equipped with option 2
(Unit:mm)











Attaches attitude

Note
1) Clearance of 2 mm or more is required between the printer side and wall so that the ribbon cassette will install/remove smoothly.

EPSON	TITLE M-U11011 Preliminary Specification (Standard)	SHEET REVISION A	NO. NEXT 32 SHEET 31

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SPMP_7602_E_R321A.drw.

3. USAGE EXAMPLES

This section describes some usage examples that meet the specifications of this printer.

3.1 Initialization

3.1.1 Carriage motor

In some cases, to match the carriage motor's fixed phase with the phase for control, or to check the position of the carriage, move the carriage motor to its home position, according to Figure 3.1.1.

However, for acceleration or deceleration control, unless otherwise noted, follow the instructions described in Table 3.2.1 and 3.2.2.

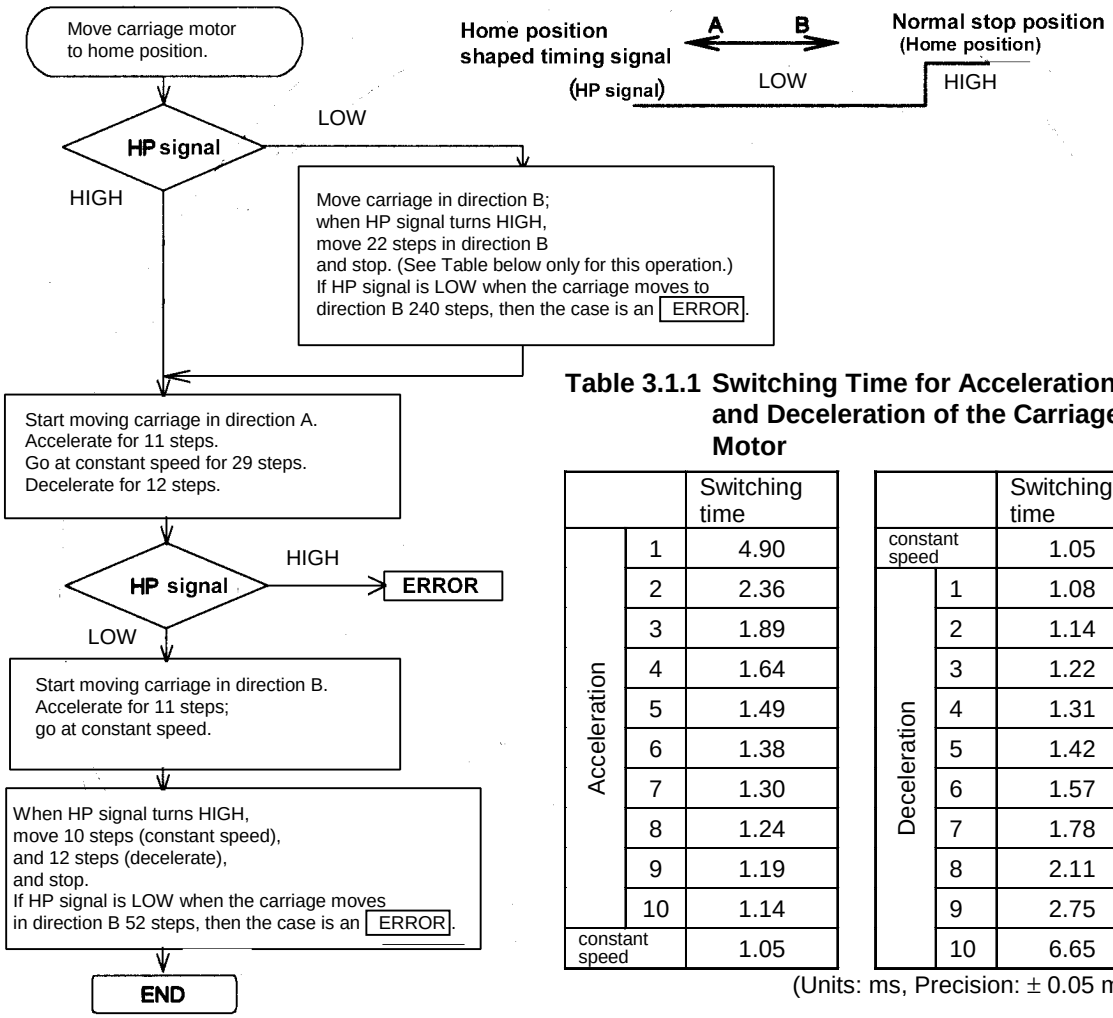


Table 3.1.1 Switching Time for Acceleration and Deceleration of the Carriage Motor

		Switching time
Acceleration	1	4.90
	2	2.36
	3	1.89
	4	1.64
	5	1.49
	6	1.38
	7	1.30
	8	1.24
	9	1.19
	10	1.14
constant speed		1.05

		Switching time
constant speed		1.05
Deceleration	1	1.08
	2	1.14
	3	1.22
	4	1.31
	5	1.42
	6	1.57
	7	1.78
	8	2.11
	9	2.75
	10	6.65

(Units: ms, Precision: ± 0.05 ms)

NOTES: 1) If an error is detected, stop driving the carriage motor and remove the error cause; then initialize the printer again.

2) HP signal = Home Position signal

Figure 3.1.1 Flowchart for Initialization

3.1.2 Paper feed motor

Perform when power is supplied to match the motor's fixed phase with the phase for control. At a constant speed of 7.0 ± 0.05 ms, send four steps in the positive direction after four steps of back feed.

3.2 Timing Chart and Control Method

3.2.1 Relationship of the control between the carriage motor and the paper feed motor

1) Figure 3.2.1 shows an example of the control of the carriage motor and the paper feed motor.

(When the ratio of the simultaneous operations of the carriage motor and the paper feed motor is high.)

4.4 lps maximum (lps: lines per second)
(When printing on 76.2 mm-wide paper with 42 columns of alphanumeric characters)

5.6 lps maximum (lps: lines per second)
(When printing on 57.5 mm-wide paper with 30 columns of alphanumeric characters)

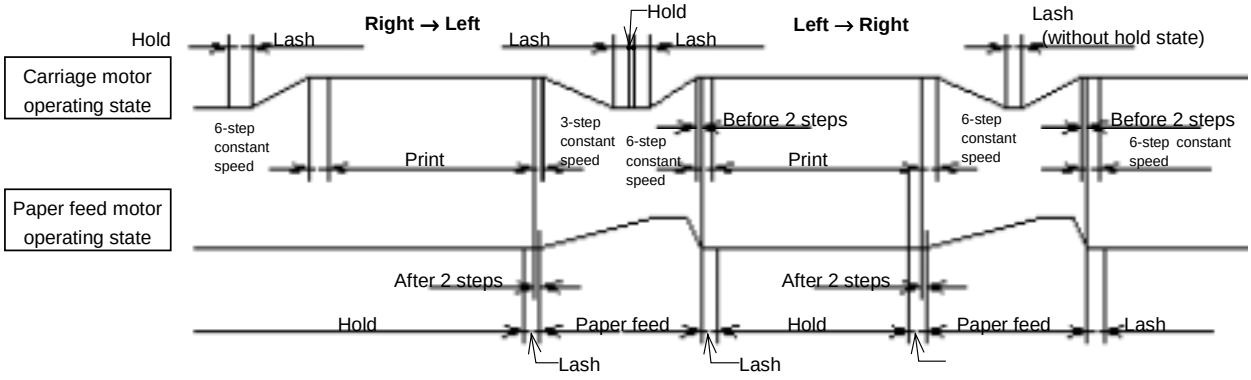


Figure 3.2.1

REMARKS: 1. Lash is a drive pulse used to stabilize a drive phase when stopping the motor.
When printing continuously, do not hold if the carriage movement reverses at the right end.

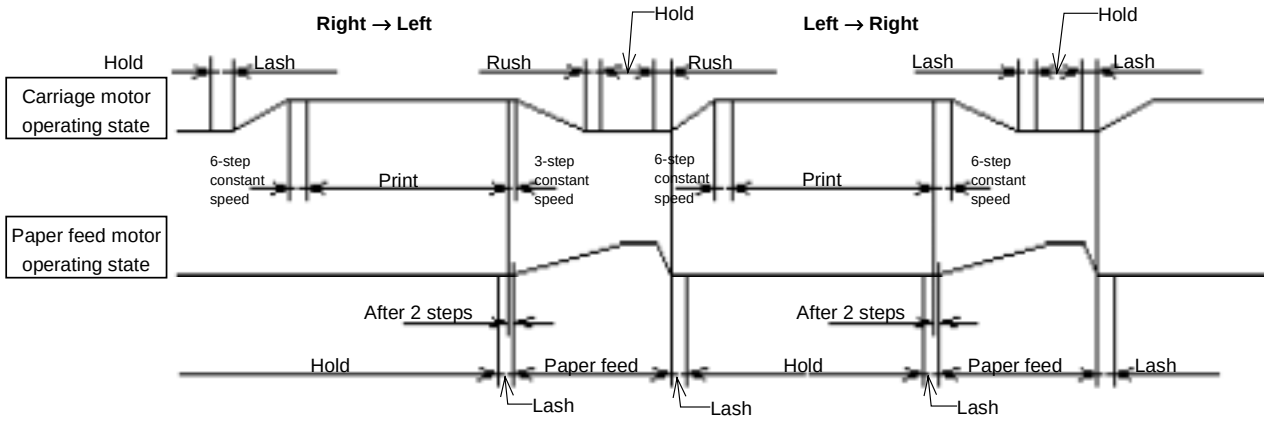
2. Hold is a drive pulse current state where its phase is same as that of Lash.

2) Figure 3.2.2 shows an example of the control of the carriage motor and the paper feed motor (equivalent to the M-U110).

(When the ratio of the simultaneous operations of the carriage motor and the paper feed motor is low.)

4.1 lps maximum (lps: lines per second)
(When printing on 76.2 mm-wide paper with 42 columns of alphanumeric characters)

5.2 lps maximum (lps: lines per second)
(When printing on 57.5 mm-wide paper with 30 columns of alphanumeric characters)



REMARKS: 1. Lash is a drive pulse used to stabilize a drive phase when stopping the motor.
2. Hold is a drive pulse current state where its phase is same as that of Lash.

Figure 3.2.2

3.2.2 Carriage motor

1) Timing chart

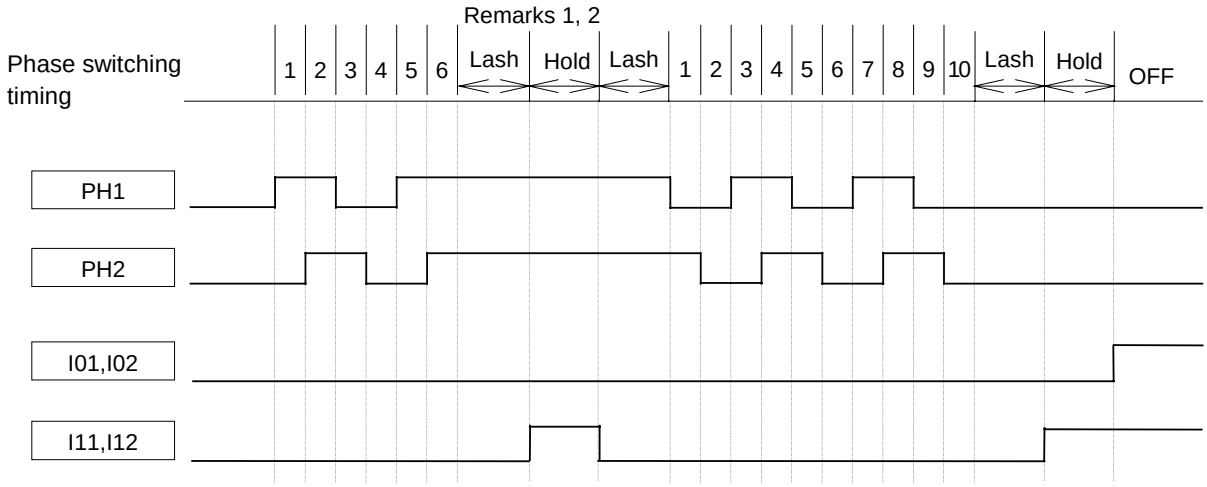


Figure 3.2.3 Carriage Drive Timing Chart

REMARKS: 1. Lash is a drive pulse used to stabilize a drive phase when stopping the motor.
2. Hold is a drive pulse current state, where its phase is same as that of Lash.

NOTES: 1. The Lash drive pulse takes 5 ms +0.5 ms/ -0 ms, or the time required for 6 steps of drive pulse at constant speed printing.
2. When stopping the motor, perform Lash at the same phase as the final phase, and switch to the Hold mode.
3. When starting the motor, return to the same phase condition as the final phase. Also, perform Lash, and after Lash, switch to the first phase.
4. [ ] represents signals supplied by the VAR who uses this mechanism.

2) Control method

Because the carriage motor makes use of a stepping motor, it is possible to stop the motor at any position (column), or change the printing direction. To control the carriage motor, use the open loop method to perform phase switching according to the set time.

a) Acceleration

For acceleration, follow the acceleration time data in Table 3.2.1 and 3.2.2 and switch phases accordingly.

b) Deceleration

For deceleration, follow the deceleration time data in Table 3.2.1 and 3.2.2 and switch phases accordingly.

c) Constant speed

When moving less than 24 steps, perform phase switching at a low speed of 204.1 pps (4.9 ± 0.05 ms) (pps: pulses per second).

Table 3.2.1 Acceleration and Deceleration Time Data
(Direction of the carriage movement: right to left: A)

			Switching time
Constant speed	While printing		0.826
	1	Non-printing	0.826
	2		0.826
	3		0.826
Deceleration	4	1	0.826
	5	2	0.826
	6	3	0.860
	7	4	0.920
	8	5	1.000
	9	6	1.090
	10	7	1.200
	11	8	1.350
	12	9	1.560
	13	10	1.890
	14	11	2.530
	15	12	6.000

			Switching time
Acceleration	1	1	4.900
	2	2	2.200
	3	3	1.690
	4	4	1.420
	5	5	1.250
	6	6	1.130
	7	7	1.040
	8	8	0.970
	9	9	0.910
	10	10	0.860
	11	11	0.860
Constant speed	12	Non-printing	0.826
	13		0.826
	14		0.826
	15		0.826
	16		0.826
	17		0.826
	While printing		0.826

(Units: ms, Precision: ± 0.05 ms)

Table 3.2.2 Acceleration and Deceleration Time Data
(Direction of the carriage movement: left to right: B)

			Switching time
Acceleration	1	1	4.900
	2	2	1.920
	3	3	1.470
	4	4	1.240
	5	5	1.090
	6	6	0.990
	7	7	0.910
	8	8	0.850
Constant speed	9	Non-printing	0.826
	10		0.826
	11		0.826
	12		0.826
	13		0.826
	14		0.826
	While printing		0.826

			Switching time
Constant speed	While printing		0.826
	1	Non-printing	0.826
	2		0.826
	3		0.826
	4		0.826
	5		0.826
	6		0.826
Deceleration	7	1	0.826
	8	2	0.826
	9	3	0.860
	10	4	0.920
	11	5	1.000
	12	6	1.090
	13	7	1.200
	14	8	1.350
	15	9	1.560
	16	10	1.890
	17	11	2.530
	18	12	6.000

(Units: ms, Precision: ± 0.05 ms)

3.2.3 Paper feed motor

1) Paper feed timing chart

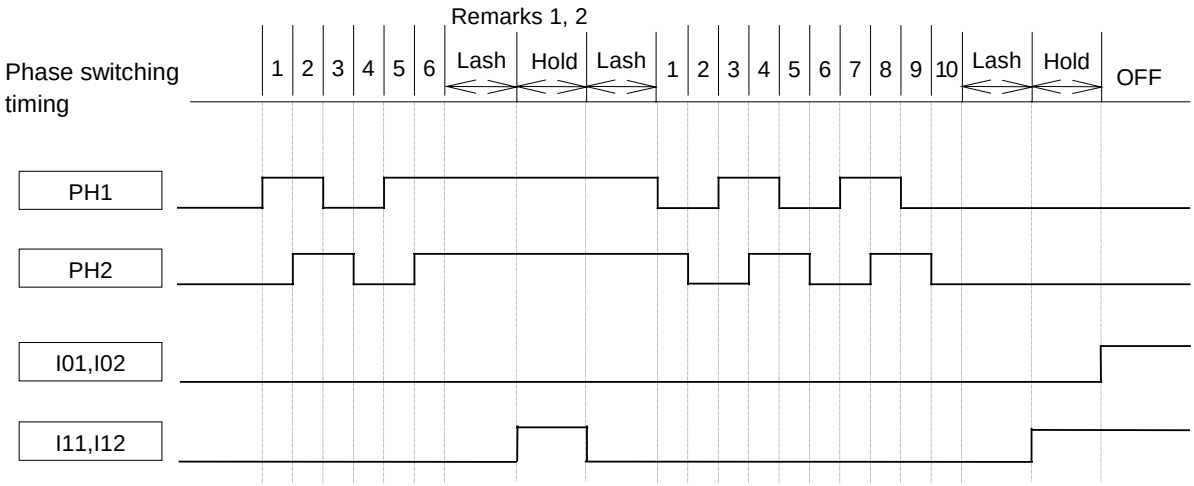


Figure 3.2.4 Paper Feed Timing Chart

REMARKS: 1. Lash is a drive pulse used to stabilize a drive phase when stopping the motor.
2. Hold is a drive pulse current state, where its phase is same as that of Lash.

NOTES: 1. The Lash drive pulse takes 5 ms +0.5 ms/ -0 ms or the drive pulse time for 6 steps when the carriage motor moves at constant speed.
2. When stopping the motor, perform Lash at the same phase as the final phase, and switch to the Hold mode.
3. When starting the motor, return to the same phase condition as the final phase. Also, perform Lash, and after Lash, switch to the first phase.
4. [ ] represents signals supplied by the VAR who uses this mechanism.

2) Control method

Use the open loop method to perform phase switching according to the time set in Table 3.2.3. However, when the paper feed amount is less than 16 steps, do not perform acceleration or deceleration; instead, drive at constant speed of 142.8 pps (7.0 ms) (pps: pulses per second).

Table 3.2.3 Acceleration/deceleration Time Data

		Standard mode
Acceleration	1	7.00
	2	3.88
	3	2.98
	4	2.51
	5	2.21
	6	2.00
	7	1.84
	8	1.71
	9	1.61
	10	1.52
	11	1.45
	12	1.38
	13	1.33
	14	1.28
Constant speed		1.25

		Standard mode
Constant speed		1.25
Deceleration	1	1.67
	2	2.50

(Unit: ms, Precision: ± 0.05 ms)

NOTES: To prevent paper feed pitch problems caused by backlash of the paper feed mechanism, after performing any of the following tasks, be sure to feed paper by 4.23 mm {1/6"} before printing.

- Turning on power supply
- Cutting paper when issuing receipt
- Moving without controlling paper, such as pulling paper out in normal/reverse direction of paper feed, loading paper, etc.

3) Paper feed with FEED switch

If continuous feeding is too fast, even when the printer is operated following the table (Table 3.2.3, Acceleration/deceleration Time Data), drive the motor with the maximum drive frequency, or operate with the drive frequency including a rest time to make operation intermittent and a resulting motion of 4.23 mm {1/6"}.

3.2.4 Printing

1) Print timing

Figure 3.2.5 shows the print timing (the carriage motor's phase switching timing) in bidirectional printing (left to/from right) for all printing area (420 positions). The print solenoid must be energized after switching the phase of the carriage motor for the 12th timing from the home position, according to Table 3.2.1 and 3.2.2.

In the case of printing for n steps, including logic seeking:

a) Right to left (when moving in direction A):

The carriage must be moved for acceleration range (11 steps) + constant speed range (6 steps) + printing range (n steps) + constant speed range (3 steps) + deceleration range (12 steps, that is total (32 + n) steps.

b) Left to right (when moving in direction B):

The carriage must be moved for acceleration range (8 steps) + constant speed range (6 steps) + printing range (n steps) + constant speed range (6 steps) + deceleration range (12 steps, that is total (32 + n) steps.

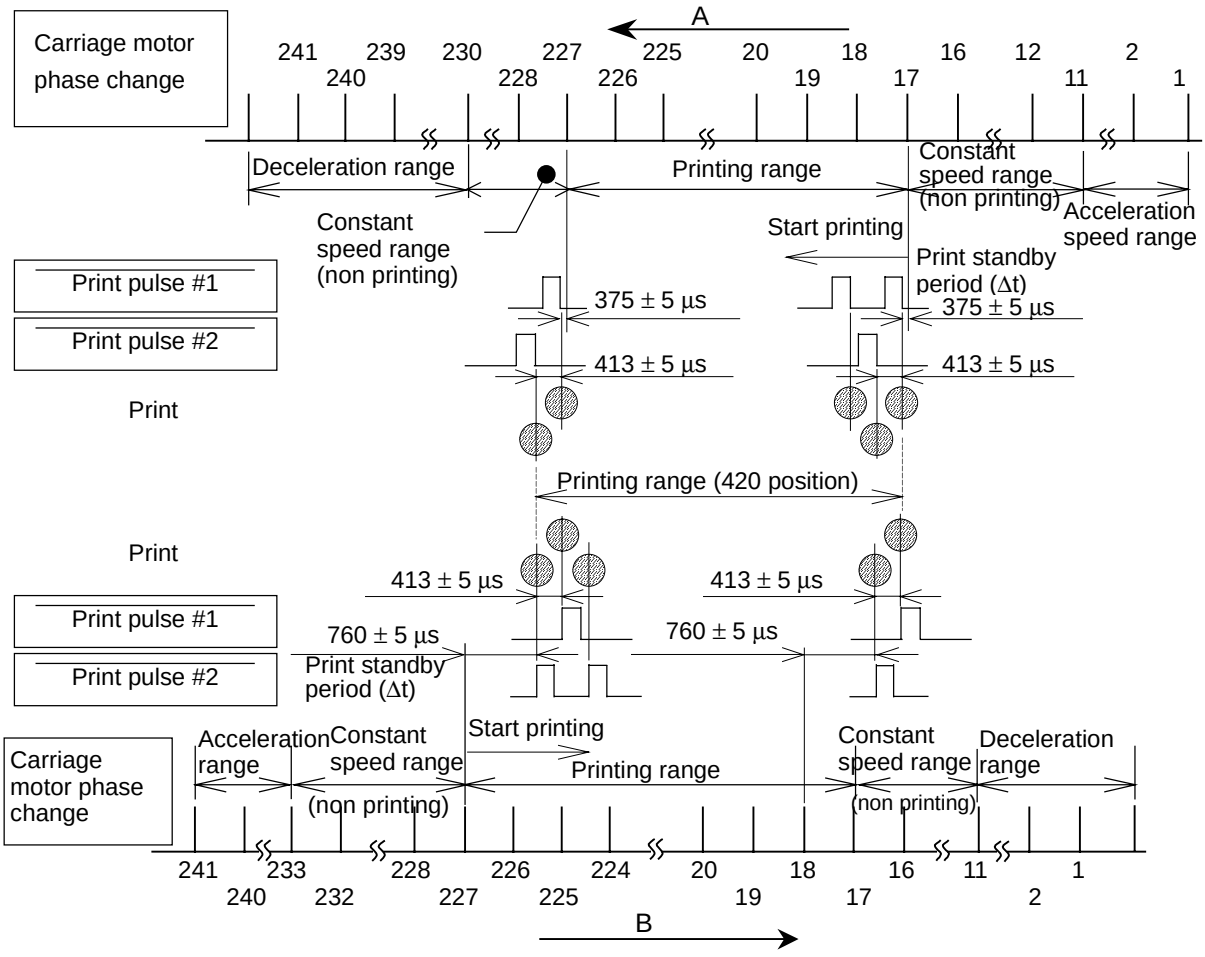


Figure 3.2.5

NOTES: 1. [ ] represents signals supplied by the VAR who uses this mechanism.

2. The carriage motor's phase switching timing consistes of the instances counted from the home position.

2) Paper feed timing

The timing chart when paper feed is started is as shown in Figure 3.2.6. Since the print operation is continued for 2 steps (even in the constant speed range of the carriage motor because of the print standby time Δt and the half dot period), acceleration of the paper feed motor should be started gradually after 2 steps.

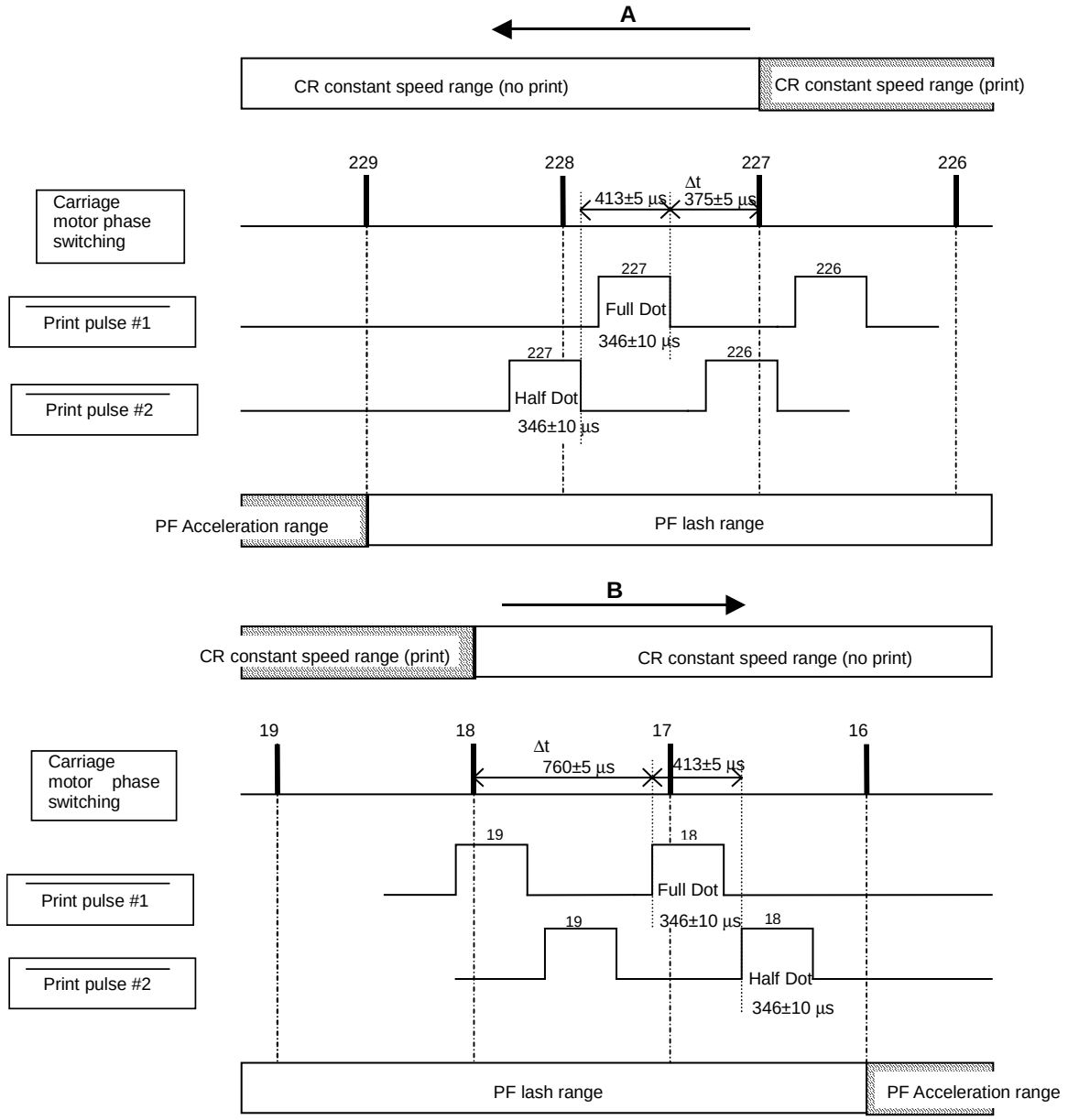


Figure 3.2.6

3.2.5 Carriage motor out-of-sync detection

Because this printer's carriage motor is driven by the open loop control method, when a problem (dropping of foreign objects, paper jam, etc.) occurs and the motor goes out of sync, this problem cannot be detected instantly. For this reason, to perform printing, a regular return to the home position (e.g, every 10 lines or at every receipt issuance) and subsequent inspection of the carriage motor are required.

In the following cases when an out-of-sync problem occurs, immediately stop the carriage motor, clear the problem, and perform re-initialization.

Table 3.2.4

Direction of carriage movement	Carriage motor's phase switching timing	HP signal (out-of-sync state)
Right → Left: A	1 to 19	LOW
	27 or more	HIGH
Left → Right: B	1 to 17	LOW
	25 or more	HIGH

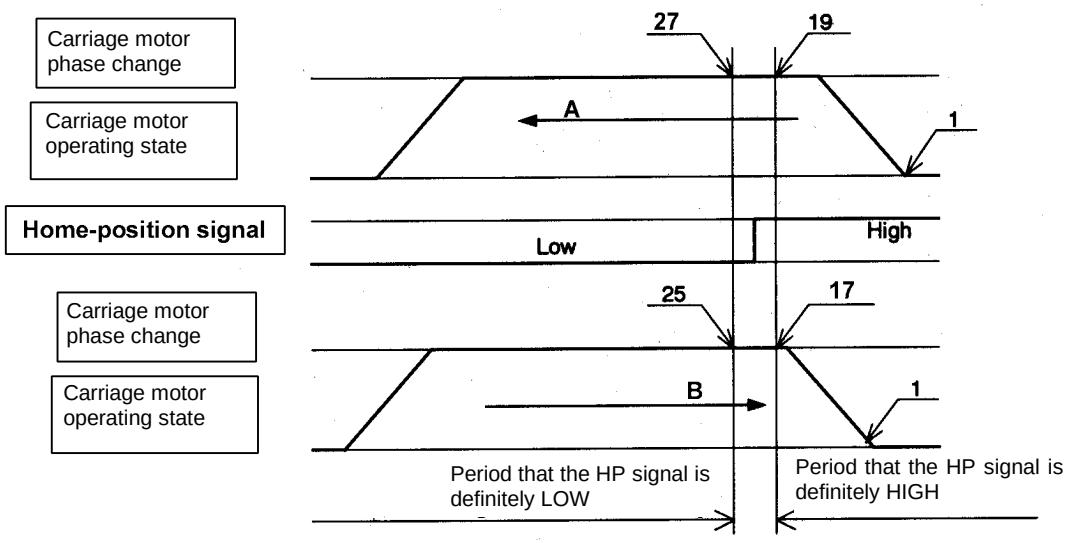


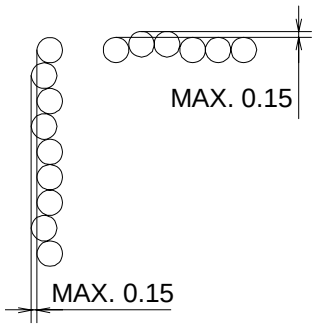
Figure 3.2.7

NOTES: 1. Out-of-sync detection can be performed only during carriage movement.
2. The carriage motor's phase switching timing is the instances counted from the home position.

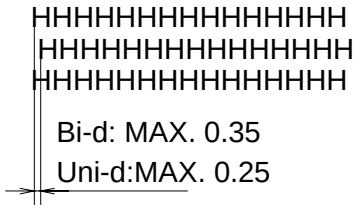
4. PRINT QUALITY (Reference)

The following print examples are the inspection specifications for the print quality at the factory.

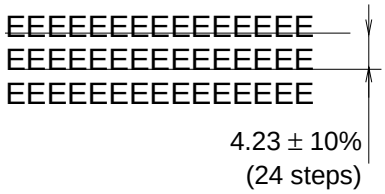
*1. Dot alignment [Units: mm]



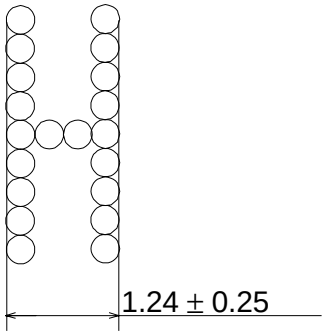
*2. LR misalignment



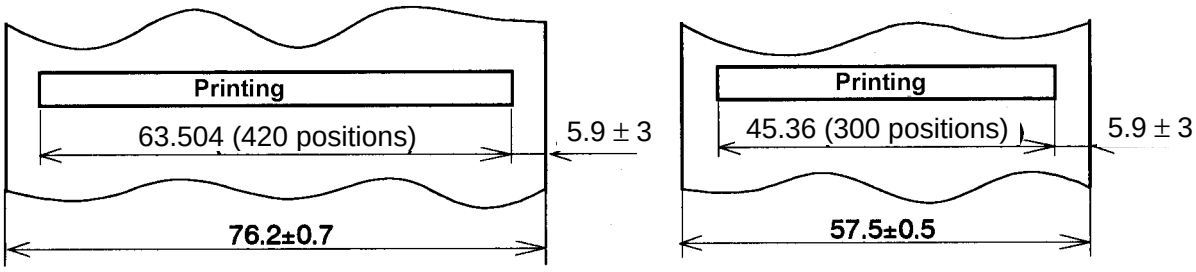
*3. Paper feeding pitch



*4. Print width (7 × 9 font)



*5. Print starting position and printable area



[Units: mm]

NOTE: Values for the printable area are calculated at the center of the wire dot (diameter 0.29 mm).

Appendix

A.1 Stamped Parts

Since this unit uses plated steel, the cutting edges may be subject to rust.

A.2 Reliability (Basic Concept)

Concept

1. The MCBF rating used in these specifications corresponds to the EPSON concept of the "reliability guarantee period."
   EPSON uses a projected number of printed lines along with exponential distribution to define the reliability guarantee period, and allows an accumulated failure rate of 30% during this period.
2. Due to product tolerances, wear-out failures may in some cases start to occur within the reliability guarantee period, but design and production generally are aimed at preventing wear-out failures during the reliability guarantee period.
3. Service life is taken to mean the average service life.

A.3 Printer Precautions

A.3.1 Printer installation precautions

1) As a precaution against noise, damping material, such as rubber, should be provided in the installation location of the printer.
2) For installation, use the two U-grooves in the front of the printer and the protrusions in the rear. The differential height of the four mounting portions must be 0.5 mm {0.02"} or less. Except for the mounting parts, the spacing must be made for the printer bottom.
3) The gap between the central positions of the printer and paper receiving section (provided by the VAR) shall be ± 0.3 mm in the direction of paper width.
4) The exposed wiring of the PCB on the underside of the printer should not come into contact with the mounting base or with any conductive parts that could cause short-circuiting. Proper insulation should be provided.

A.3.2 Printer usage precautions

1) Since the printer uses permanent magnets (in the motor) and electromagnets (solenoids), it should not be used in locations where metallic particles or high levels of dust and other contamination exist.
2) Using the ground hole on the frame (see "Overall Dimensions"), take measures against static charge.
3) Perform regular maintenance, according to the printer's technical manual.

A.3.3 Prohibited actions

Printing (driving the print head) without paper or ribbon cassette inserted, and printing outside of the specified print area.

A.3.4 Inserting the paper

Paper insertion precautions

1) Use only the specified paper.
2) Cut the paper edge along the perforation.
3) Make sure that the paper is not wrinkled or torn.
4) When using multiple-layer paper, make sure that the layers are aligned properly.

Paper removal precautions

- Remove the paper in one of the following two ways.
  1) Pull the paper out by hand in either direction.
  2) Activate paper feed so that the paper is removed in the forward direction.

  Be sure to observe the above instructions for inserting and removing printer paper. Otherwise, paper jumps and other problems may occur.

A.3.5 Printer usage method supplement

1) Printing

   Because there is a high probability that the receipt printing position is off, due to the influence of the previous receipt tear-off, carry out a 24-step feed before the start of receipt issue.

2) Temperature-sensing element

   The values of the temperature-sensing element must be checked between unprinted areas after one line print is completed.

3) Take-up

   Follow the procedure described below for paper take-up after printing. Otherwise, uneven paper feeding can cause printing problems or paper buckling.

   ① The take-up method should be a constant-torque method or equivalent method.
   ② Tension F on the paper during the initial take-up period must be less than 1.3 N.
   ③ Take-up speed S during the initial take-up period must be less than 280 mm/s {11.02"/s}.
   ④ The figure below shows the required positioning of the take-up unit in relation to the printer main unit.

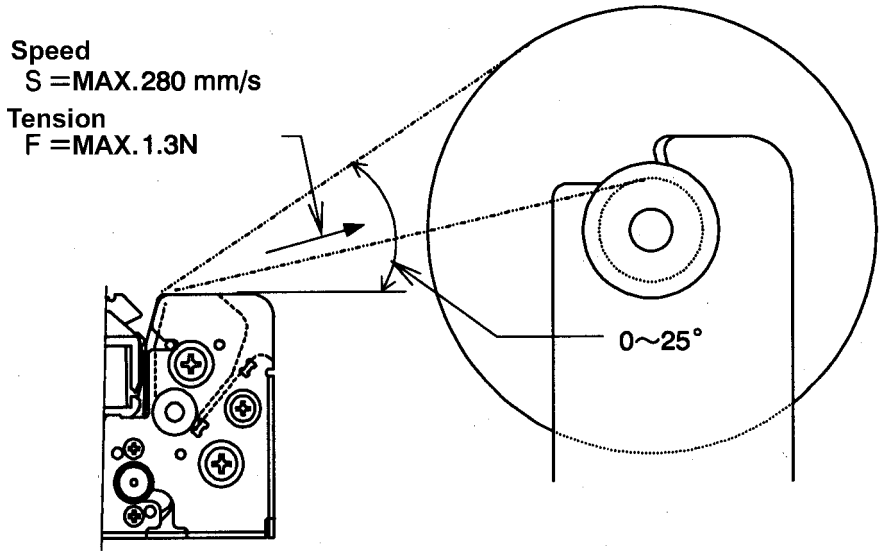


Figure A.3.1

4) Power supply

The printer will be more reliable if 5 VDC power is turned off for optional devices when they are not used.