EPSON

micro dot printer

M-190G

Specification

STANDARD	
Rev. No.	C
Notes	

Copied Date	, ,
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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	Takeuchi	--	Arai	I	C	20	C		
B	Change	Aoki	Narita	Arai	II	C	21	C		
C	Change				III	C	22	C		
					IV	C	23	C		
					V	C	24	C		
							25	C		
					1	C	26	C		
					2	C	27	C		
					3	C	28	C		
					4	C	29	C		
					5	C	30	C		
					6	C	31	C		
					7	C	32	C		
					8	C				
					9	C				
					10	C	App.1	C		
					11	C	App.2	C		
					12	C				
					13	C				
					14	C				
					15	C				
					16	C				
					17	C				
					18	C				
					19	C				

TITLE	Front Part							
M-190G Specification (STANDARD)	Cover	Rev. Sheet	Scope	General Description	Table of Contents	Contents	Appendix	Total
	1	2	--	4	1	32	2	42

Confidential

REVISION SHEET

REV.	SHEET	CHANGED CONTENTS	
B	2	1.5 Reliability NOTES: Section 2.14.1 → Section 2.14	[Correction]
	4	1.13 Factory options ERC-22(purple), ERC-09(purple) → ERC-22, ERC-09	[Change]
	28	2.13 Overall Dimensions	[Change]
C	All	All pages are revised due to add "Confidential" to the header. Units are applied for SI unit system sec → s, line/sec → lps [lps: lines per second], G → m/s^2	
	III	"Confidentiality Agreement"	[added]
	1, 3, 5, 8, 32, App.2	Ribbon cassette ERC-40	[added]

	14	2.5.1 Electrical Characteristics
		    1) Electrical Characteristics of Timing Detector Open Collector Output:
		    Typical: 0.12 V, Maximum 0.4 V → Typical: 0.3 V, Maximum 0.5 V
		    Absolute maximum rating 8 mA →
		            Absolute maximum rating 8 mA (Recommended: 2 mA)
		    Termas: Vcc = 5 V, IOL = 8 mA → Vcc = 5 V, IOL = 5 mA
		    2) Printer Timing Detector Circuit
		    Circuit of the printer side
			[changed]

	15	3) Waveform Shaping Circuit on the Designer's Side The designer needs to shape the printer timing detector signal with the integrator circuit (provided by the designer: Time constant at the leading edge $\cong$ 5.7 μs, Time constant at the trailing edge $\cong$ 4.7 μs) and …→ The designer needs to shape the printer timing detector signal with the integrator circuit (provided by the designer: Time constant at the leading edge $\cong$ 12.7 μs, Time constant at the trailing edge $\cong$ 10 μs) and …	
	31	2.13 Overall Dimensions	[changed]

TITLE	
	M-190G Specification (STANDARD)

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 voltage: 5.8 VDC or less
      (Apply to the print solenoid, motor, trigger solenoid, for fast paper feeding and detectors.)

2. 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 motor, and magnets must be observed.
   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.

   1) Motor
      The motor is DC brush motors which can be short-circuited and must there fore be protected using a fuse that is properly matched to the power supply.

   2) Print Solenoid
      Under any condition (including software runaway), the maximum power-on time may not exceed 1 second.

   3) Fast Trigger Solenoid
      Under any condition (including software runaway), the maximum power-on time may not exceed 5 seconds.

   4) All Detectors (Sensors and Switches)
      All detectors must protect the circuitry so that current never exceeds the maximum standard.

Notes on Handling

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.

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT II	SHEET I

Explanation of Voltage Terminoloty

In previous specifications for out printers, M-180, M-190, and so on, we identified a usable voltage as "terminal voltage"; however from this specification for the M-192G on, we will call a usable voltage "power supply voltage" and also provide voltage ranges, including loss of power supply, voltage when energizing, and voltage loss from driver and circuit lines.

This is because the previous term, "terminal voltage", caused confusion between voltage at the terminals and the power supply voltage.

If the voltage at the terminals is not within specifications, there is a risk that the drivers will not be driven properly.   That's why we changed it to an expression that could not be misunderstood.   Therefore, this change in terminology doesn't require a change in the power supply used for M-190 series.

Explanation of Power Supply Voltage

- M-190G power supply voltage 5 ± 0.5 V   (when a stabilized power supply is used);
                                                        $5 +0.8/-0.5$ V   (when a Ni-Cd battery is used)

    The voltage loss in each terminal, even during sending of current to print solenoids, the voltage loss in the power supply and loss from loss wiring resistance must be 0.8 V or less.   Also, the voltage loss in the driver circuitry (driver saturation voltage) must be 0.4 V or less.

Compared to this, the specification for the M-190 provides that:

- M-190 terminal voltage $4.8 +0.4/-1.5$ V (when a stabilized power supply is used);
                                                  $4.8 +0.7/-1.5$ V (when a Ni-Cd battery is used)

    These values are defined as assumed the following conditions:

- M-190 power supply voltage 5 ± 0.5 V   (when a stabilized power supply is used);
                                                          $5 +0.8/-0.5$ V   (when a Ni-Cd battery is used)

- The total for the power supply voltage loss plus the voltage loss from resistance in the wiring plus the voltage loss in the driver circuit must be within 1.2 V. (0.8 V + 0.4 V = 1.2 V)

Therefore, the lowest permissible voltage from the driver circuit when energizing is 3.3 V.
([4.5 V - 0.8 V = 3.7 V] - 0.4 V = 3.3 V.)

Also, in either printer mechanism, at the typical print speed, a motor terminal voltage is assumed to be 4.8 V.   However, this is obtained by estimating that the voltage loss in the motor terminal during continuous printing is am average of 0.2 V.

Therefore, there is no substantial terminal difference in the usable ranges of power supply and terminal voltages between M-190G and M-190.

In either mechanism, the maximum value of the voltage when a Ni-Cd battery is used is 0.3 V above the 5.5 V maximum when a stabilized power supply is used.   This maximum value allows for the high-voltage situation that occurs temporarily when the Ni-Cd battery is fully charged.   This value is not guaranteed for continuous use.

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
			NEXT III	SHEET II

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
			NEXT IV	SHEET III

General Description

The M-190G is a mechanical dot printer with a print head consisting of 8 print solenoids arranged in a horizontal line.   The print head moves horizontally to print each dot line.

The print head which moves horizontal and performs uni-directional printing as each print solenoid is energized in order.

Paper is automatically fed one pitch when the print head returns.   The desired print format is obtained by repeating this operation.

The M-190G has the following features:

1. Clear print quality from the impact dot printing system.

2. Ultra compact, light weight, and high reliability.

3. Can be driven using Ni-Cd batteries

4. Possible to copy (Original 1 sheet + 1 copy sheet)

5. Fast paper feed and paper release mechanism.

6. Graphic characters can be printed.

7. Use Ribbon Cassette for M-190

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
				NEXT V	SHEET IV

Table of Contents

	TITLE	SHEET REVISION	NO.	
EPSON	**M-190G** Specification (STANDARD)	C	NEXT 1	SHEET V

1. GENERAL SPECIFICATIONS

1.1 Print Method

Impact dot matrix printer (8 print solenoids)

1.2 Printing Speed

1) 1 line printing:	2.7 lps ± 20% (typical)	

(5 × 7 font + 3-dot line spacing)
(Motor terminal voltage at 4.8 VDC constant, 25°C{77°F}, continuous printing)

2) 1 dot line: 21.6 dot lps ± 20% (typical)
(Motor terminal voltage at 4.8 VDC constant, 25°C{77°F}, continuous printing)

[lps: lines per second]

1.3 Inking

Ribbon cassette   Possible to use ERC-22, ERC-09, ERC-40

1.4 Print Format

1) Total number of dots: Maximum 144 dots/dot line
2) Number of columns :   Maximum 24 (5 × 7 font and 1 dot column space)
(3 columns/print solenoid ×8)

1.5 Character Size

1) Dot pitch: Horizontal: 0.33 mm; Vertical: 0.37 mm {0.013"; 0.015"}
2) 5 × 7 font: 1.7 mm (W) × 2.6 mm (H) {0.067"×0.102"}

1.6 Coping Capability

1 original + 1 copy

1.7 Paper Feeding Specification

1) Feeding method: Friction method
      Paper is automatically fed every dot line.
      Possible to feed paper with a trigger solenoid for fast paper feeding.
      With paper release mechanism

2) Paper feeding pitch: When feeding automatically: 1-dot line pitch (0.37 mm {0.015"})
      During fast feeding: 3-dot line pitch (1.11 mm {0.044"})

3) Fast paper feeding speed   6.5 lps ± 20%
(Motor terminal voltage at 4.8 VDC constant, 25°C{77°F}, continuous printing)   [lps: lines per second]

NOTE: Motor terminal voltage is potential difference between + (plus) and - (minus) terminals on PCB when the motor is energized.

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
				NEXT 2	SHEET 1

1.8 Paper Specifications

    1) Paper type: Single-ply paper roll or Two-ply pressure-sensitive paper
                                        (Paper roll type or cut sheet type)

    2) Size   Width: 57.5 ± 0.5 mm {$2.26" \pm 0.02"$}

1.9 Power Supply Voltage

    1) Printer Driving Voltage   5.0 +0.8/-0.5 VDC   (Ni-Cd battery, nominal voltage 4.8V)

                                    5.0 $\pm$0.5 VDC   (when stabilized power supply is used)

      NOTES: • Can be applied to motor, print solenoid, and fast paper feed trigger solenoid

               • Use the same power supply.

               • In all printing pattern used, even during sending of current to print solenoids, the voltage drop by the power supply voltage and from wiring resistance must be 0.8 V or less.   Also, voltage loss in the driver circuitry (driver saturation voltage) must be 0.4 V or less.

    2) Detector Input Voltage   5.0 +0.8/-1.7 VDC

       NOTES: • Can be applied to reset detector, timing detector.

               • Can be used with the same printer driver power supply.

1.10 Reliability

    MCBF: 1,500,000 lines   (including print solenoid)

    Printer life: 2,250,000 lines

    NOTES: • See Section 2.14 for confirmation conditions of reliability.

            • End of life is defined as the point at which the print head, motor unit, or cam trigger set is worn out.

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT 3	SHEET 2

1.11 Environmental Conditions

    1) Operating ambient temperature:

        a) Using with the ERC-22   -10° to 50°C {14° to 122°F}
                                      (The assured temperature for printing is 0° to 50°C {32° to 122°F}

        b) Using with the ERC-09   0° to 50°C {32° to 122°F}

        c) Using with the ERC-40   -10° to 50°C {14° to 122°F}
                                        (The assured temperature for printing is 0° to 50°C {32° to 122°F}

    2) Operating ambient humidity: 10 to 90% RH (non-condensing)
                                          See Figure 1.11.1.

Figure 1.11.1

Figure 1.11.2

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT 4	SHEET 3

3) Vibration resistance: Frequency: 10 – 150 – 10 Hz

Sweep: 20 minutes for coming and returning
(One hour for each direction)

Acceleration: Approximately 4.9 m/s^2 {0.5 G}
(X, Y, and Z directions)

Center of vibration: Any mechanism installed part

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

1.12 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} 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} 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: Approximately 19.8 m/s^2 {2 G}
(X, Y, and Z directions)

Center of vibration: Any mechanism installed part

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

5) Impact resistance: Impact acceleration: Approximately 980 m/s^2 {100 G}

Total operation time: 6 ms

Direction: 3 times each for X, Y, and Z directions

Impact operation point: Any mechanism installed part

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

NOTE: Refer to the specification for each ribbon cassette individually for the environmental conditions for storage of usable ribbon cassettes.

EPSON	TITLE		SHEET REVISION	NO.	
	M-190G Specification (STANDARD)		C	NEXT 5	SHEET 4

1.13 Connection

1) Printer side: PCB fixed to the frame (with 2.5 mm {0.098"} pitch copper pattern)
2) Circuit side: Flat cables or lead wires

1.14 Insulation Resistance

1 MΩ or more at initial (100 VDC)

1.15 Overall Dimensions

See 2.13 Overall Dimensions

1.16 Mass

Approximately 100 g {0.23 lb} except ribbon cassette

1.17 Acceptable for TSCA

All EPSON ink ribbons, grease and oil which are used for this printer
meet acceptable standard for TSCA (Toxic Substance Control Act).

1.18 Factory Options

- Manual feed knob Horizontal type Outside diameter: 20 mm {0.79"}
- Ribbon cassette ERC-22, ERC-09, ERC-40

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
				NEXT 6	SHEET 5

2. DETAILED SPECIFICATIONS

2.1 Print Specifications

2.1.1 Print area

The print head consists of 8 print solenoids (A, B, C, D, E, F, G, and H) arranged in a horizontal line.

The print head moves from the left (from the standby position) to the right, printing at 18 positions as each print solenoid is energized, so that one dot line is formed.   The total number of dots per dot line is 144 (18 positions × 8 solenoids).
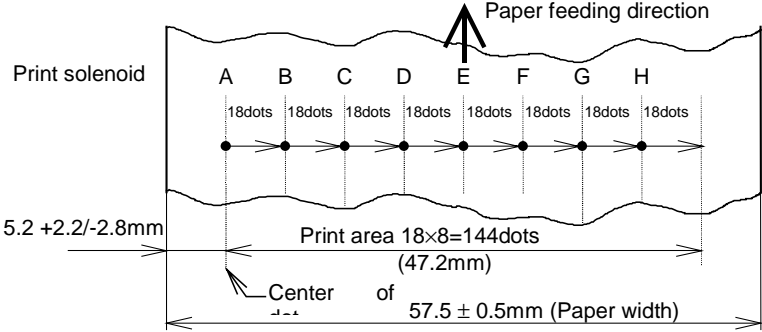
Conditions: Room temperature and normal humidity.   When paper is fed under normal conditions, the paper edge should be not fold.

Figure 2.1.1

2.1.2 Print format (5 × 7 font with 1 dot for column space and 3 dots for line space)

18 positions are divided by three.   Out of 6 dots, 5 dots are used for printing and 1 dot for column space.   By repeating this 7 times in the vertical direction (paper feed direction), a 5 × 7 font of 24 columns (3 columns × 8 solenoids) can be obtained.

Figure 2.1.2
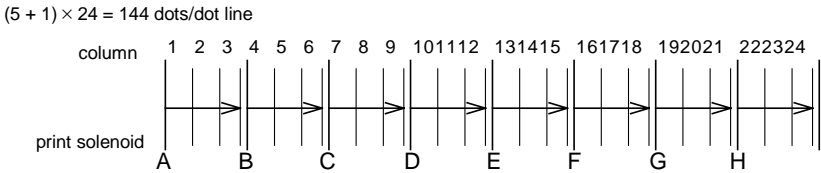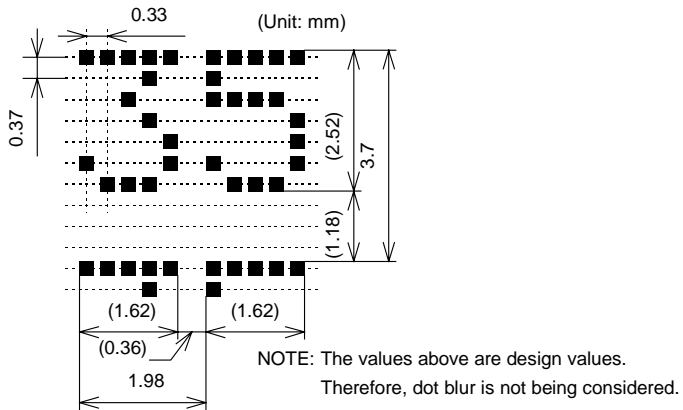

NOTE: The values above are design values.
Therefore, dot blur is not being considered.

Figure 2.1.3

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
				NEXT 7	SHEET 6

2.2 Paper Feeding

    1) When printing: Paper is automatically fed one dot line pitch (0.37 mm, 0.015") when the print head returns.

    2) Space feed

      (a) One dot line pitch feeding: Same as when printing

      (b) Fast feeding: Paper is fed three dot line pitches when the print head goes back and forth by driving the fast paper feed trigger solenoid.

    3) Paper release mechanism: Because of the way the paper release mechanism operates, paper can be pulled out (straight forward or backward) by stopping the motor quickly while satisfying the requirements given in Section 2.6.1).

               NOTE: When the motor halts without satisfying the requirements given in Section 2.6.1), the paper release mechanism won't operate.

    4) Manual feed knob (factory option):

                        Paper can be fed forward or backward by rotating the manual feed knob when the printer is halted and the paper released.

    NOTES: 1. If the paper release mechanism does not operate, paper cannot be fed backward with the manual feed knob.

              2. After the following operation, a paper feed pitch problem or paper feed not-straight feeding problem may occur.

                 ① When paper is cut.

                 ② When paper is pulled out

                 ③ When touching the manual feed knob is held or touched in a way that impedes rotation during printer operation.

                 ④ When the force of taking up paper by a take up device (provided by user) exceeds 1.0 N {approximately 100 gf}.

              3. Nothing should touch or rub against the manual feed knob during printer operation.

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.
			NEXT 8 SHEET 7

2.3 Ribbon Cassette

Three types of ribbon cassettes (ERC-22, ERC-09, ERC-40) can be used with the M-190G.

Product Number	ERC-22	ERC-09	ERC-40
Size (mm)	90.9 (W) × 24.9 (D) × 6.3 (H) (3.58" × 0.98" × 0.25")	90.9 (W) × 26.4 (D) × 7.0 (H) (3.58" × 1.04" × 0.28")	90.9 (W) × 26.9 (D) × 6.3 (H) (3.58" × 1.04" × 0.25")
Weight	Approx. 4.0 g (0.14 oz)	Approx. 3.5g (0.13 oz)	Approx. 4.0 g (0.14 oz)
Life	Purple: Approx. 1 million characters Black: Approx. 600,000 characters (Power supply voltage: 5.0 VDC, 25°C {77°F}) (Print mode is as shown in 2.14)	Purple: Approx. 250,000 characters Black: Approx. 200,000 characters	Purple: Approx. 2,000,000 characters
Color	Purple or Black		Purple

- Refer to Ribbon Cassette Specifications for more detailed specifications.
- Use only the specified ribbon cassettes.   Otherwise, the quality, life, and other characteristics are not guaranteed.
- The ribbon cassette which is bundled in the printer when it is shipped from the factory may not satisfy the life-time listed in the table above.

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	C	NO.	
					NEXT 9	SHEET 8

2.4 Paper

2.4.1 1-ply paper roll

1) Type: Normal paper

2) Size: 57.5 ± 0.5 mm (paper width) $\times$ 83 mm or less (outside diameter)
                                        $\times$ 10 mm or more (inside diameter)

NOTES: Inside end of paper roll should meet the following conditions:

      1. No fold is allowed.   The paper must be wound so that the paper edge goes along the internal circumference.   (Refer to Figure 2.4.1)

      2. No folding back is allowed.

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

Inside end of paper roll

Correct   Incorrect
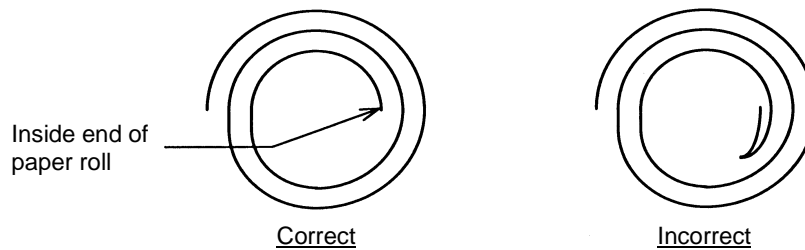
Figure 2.4.1

3) Thickness: 0.06 to 0.085 mm

4) Weight: 52.3 to 64 g/m^2 {13.9 to 17.0 lbs}
                   (45 to 55 Kg {20.41 to 24.94 lbs} / 1000 sheets
                                    / 1091$\times$788mm {42.95"$\times$31.02"})

5) Others: No gluing at either side of roll paper.

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
			NEXT 10	SHEET 9

2.4.2 2-ply pressure - sensitive paper (Recommended paper)

1) Type: No-carbon paper (Mitsubishi Seishi)
       N40: Upper sheet(Hi) + Lower sheet (Blue color printing)

2) Thickness: Upper sheet: 0.066 mm
       Lower sheet: 0.058 mm

3) Weight: Upper sheet: 47.0 g/m^2
       Lower sheet: 47.0 g/m^2

4) Printing method: Upper sheet: Print by ink ribbon
       Lower sheet: Copy with pressure-sensitive
       (possible to print one sheet only)

5) Form for cut sheet type

    a) Size: 57.5 ± 0.5 mm (paper width) $\times$ 300 mm or less (paper length)

    b) Limitation for glued portion

      ① Glued portion: See Figure 2.4.2

      ② Notes: 1. No past can ooze outside the portion beyond the wavy line in the figure.
          2. Paper should be pasted evenly.
          3. Glued portion must not harden.
          4. Whether the printer is under operating or storage condition, glued sheets should not peel off and paste must not run out (ooze out).

    c) Filing hold position: (See Figure 2.4.2)

      ① Dimension: Paper width "W": 57.5 ± 0.5 mm
          Dimension "A":   30 mm or more

      ② A filing hole can be placed within the area filled with oblique lines in the figure.

      ③ The first line must be printed 5 mm or more below the hole and 30 mm or more below the top of the paper.

      ④ Nothing shall be printed within 15 mm from the end of the paper.

glued portion
1.5 mm or less

4^{-0}mm

4^{-0}mm

A

$\frac{A}{2}$ $\frac{A}{2}$

30 mm or less

EPSON

Center
of paper

5 mm or more

W

1.5mm

End of paper
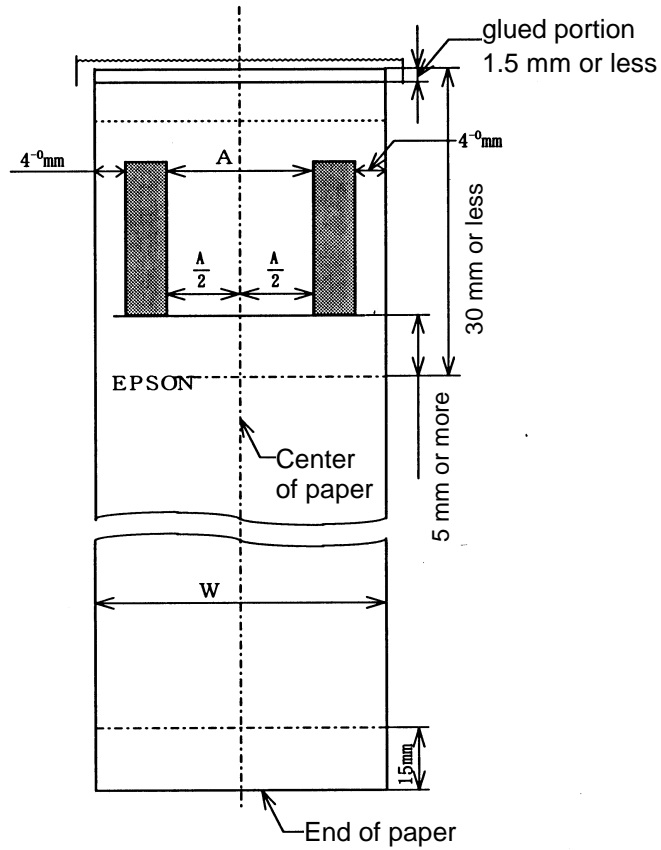
Figure 2.4.2

6) Form for paper roll type

    a) Size: 57.5 ± 0.5 mm (paper width) $\times$ 83 mm or less (outside diameter)
                                                   $\times$ 10 mm or more (inside diameter)

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 2.4.3)

    ② No folding back is allowed.

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

    ④ Upper and lower papers must not be glued to each other.

Upper paper

Lower paper

Inside end of
paper roll

Correct

Upper
paper

Lower
paper

Incorrect

Figure 2.4.3

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT 12	SHEET 11

Notes: 2. Roll paper sag

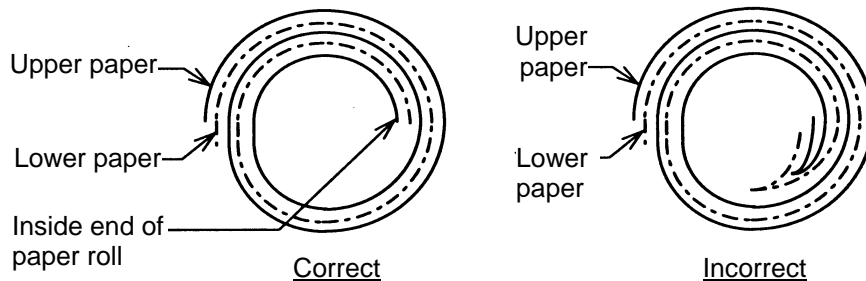When pressure sensitive roll paper is used, the difference in diameter between the upper and lower papers generates an upper paper sag and, as seen from the side, the initial circular shape of the paper roll is distorted to form an ellipse.   The diameter of the ellipse eventually becomes larger than the initial diameter of the roll. (See Figure 2.4.4)

The shape of the case around the roll paper holder should be designed so that it allows some sag of the upper paper.

Besides this, when a paper take-up device is employed, be careful of its position to prevent the upper paper sag from being taken up by the device.

a) Drop in type   b) Shaft-holding type
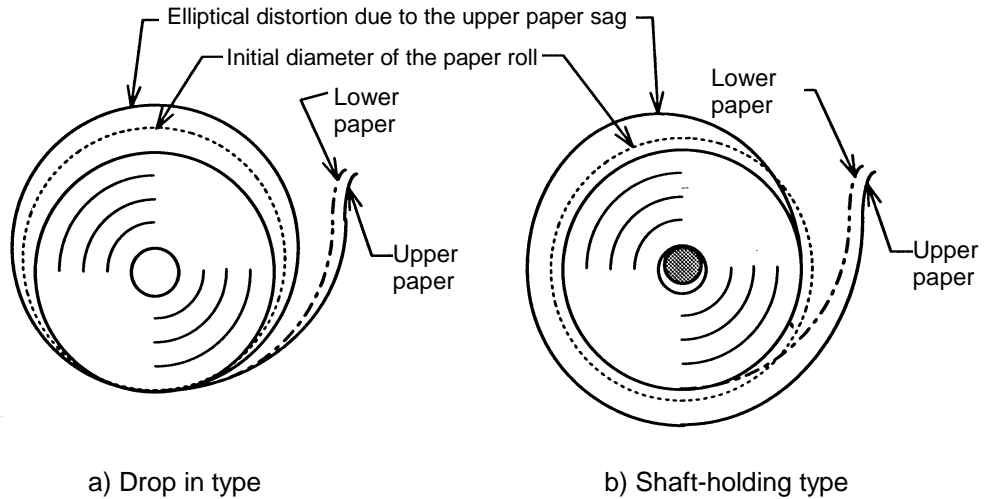
Figure 2.4.4

7) Others (common to cut sheet and roll paper):

a) Other characteristics

Impact, friction, temperature, humidity, light, and oil contamination do affect the color and life of no-carbon paper.   This means that all these factors should be taken into account when handling this type of paper.   Discuss the details with the paper manufacturers.

b) Storage

Unused paper should be stored so as to avoid impact, friction, light, and oil, and should be kept under adequate temperature and humidity conditions.

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
			NEXT 13	SHEET 12

2.4.3 Notes

1) Paper supply load: The paper supply load at the paper entrance should be 0.3 N {approximately 30 gf} or less.

2) Paper taking up　　Follow the procedure below to take up the paper after printing.

　① Paper should be took-up with a constant-torque method or equivalent.

　② The paper holding force F should be 1.0 N {approximately 100 gf} or less. (See Figure 2.4.5)

　③ The angle to take up the paper to the printer should be 45 degree or less. (See Figure 2.4.5)

F = Max. 1.0 N {approximately 100 gf}
A = Max. 45 deg

Printer

Paper entrance
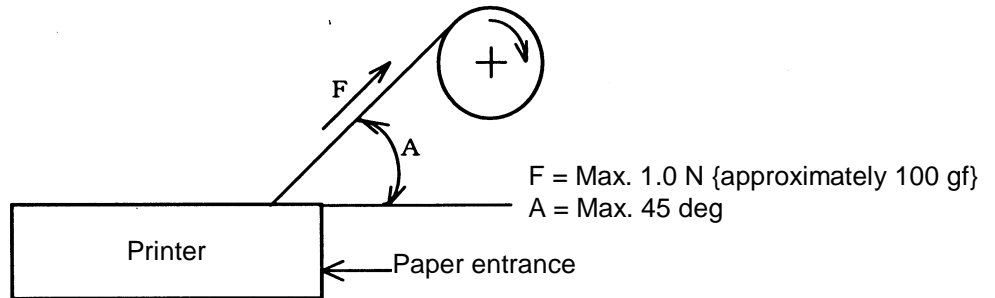
Figure 2.4.5

3) Other notes

　① Paper with folds, wrinkles, or tears should not be used.

　② Neither perforations nor holes can be positioned within the printable area.

　③ Paper should be pulled out slowly and straight-forwardly.

　④ When printing is stopped in the middle of a print job and the paper is reset after being pulled out or moved, printing position and pitch cannot be guaranteed for subsequent printing.

　⑤ When loading the 2-ply pressure sensitive paper, be sure the upper and lower paper fit correctly.

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
			NEXT 14	SHEET 13

2.5 Printer Control Signal

2.5.1 Timing Detector and Output Waveform Treatment

The timing detector is connected directly to the printer.   It generates the timing detector output waveform signal.   The output waveforms are to be wave-shaped through a waveform shaping circuit on the designer's side and constitute Timing signal T by recognizing the change in waveform level. Timing signal T is used as the pulse to control print solenoids and fast paper feed trigger solenoid.

1) Electrical Characteristics of Timing Detector Open Collector Output

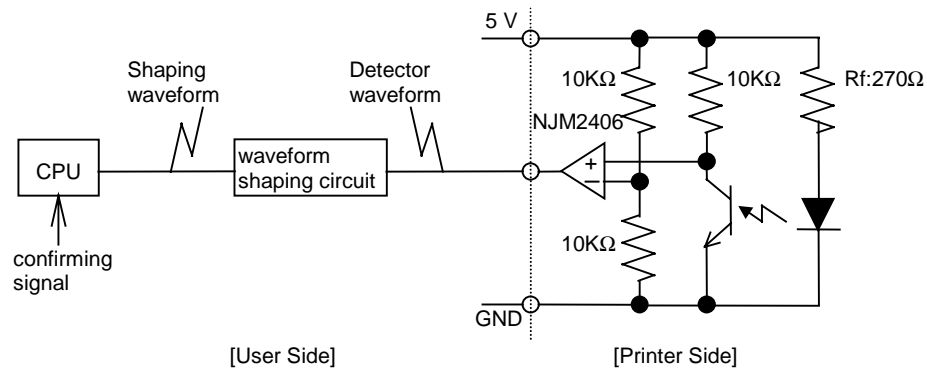| Electrical Characteristics (Ta=25°C)			Characteristic Value	Terms
Output	Low level output voltage	V_{OL}	Typical: 0.3 V Maximum: 0.5 V	Vcc = 5 V, I_{OL} = 5 mA
	Low level output current	I_O	Absolute maximum rating 8mA (Recommended: 2 mA)	

2) Printer Timing Detector Circuit, Names of Output Waveform, and the Waveform in Each Side

[User Side]   [Printer Side]

NOTES: 1. When it detects, the detector goes on.

2. Waveforms in each side of the circuit are hereinafter referred to as "detector waveform" and "shaping waveform."

3. Recognized points in acknowledged work of CPU are hereinafter referred to as "signals."

4. It is desirable to connect capacitors (0.1μF or more) between +5V, and GND near the printer connection part on the designer's side in order to stabilize detector input voltage.

Figure 2.5.1

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION C	NO. NEXT 15	SHEET 14

3) Waveform Shaping Circuit on the Designer's Side

The designer needs to shape the printer timing detector signal with the integrator circuit (provided by the designer: Time constant at the leading edge $\cong$ 12.7 μs, Time constant at the trailing edge $\cong$ 10 μs) and to connect the signal to the input terminal of the schmitt trigger logic IC (74HC14 or equivalent). The output of this logic is the shaped, timing waveforms.

The following explanation is for the shaped, timing waveforms which are output from this waveform shaping circuit.

NOTE: The shaped reset waveforms output by the above waveform-shaping circuit are inverted in relation to the sensor waveforms output by the printer (See Figure 2-5-2-(1))

4) About the Power Supply

It is desirable to turn the sensor power supply ON/OFF at the same time the motor is on.

(This stops the LED from flickering and helps to cut down power consumption waste in standby.

EPSON	TITLE		SHEET REVISION	NO.	
	M-190G Specification (STANDARD)		C	NEXT 16	SHEET 15

2.5.2 Timing Signal T

1) Shaped timing waveforms

The shaped timing waveforms as output by the waveform-shaping circuits, which the designer must create, are shown in Figure 2.5.2.

Timing sensor waveforms
(printer connector No.18)

Shaped timing waveforms

0.48ms. typical   (power supply voltage 5.0V, 25°C {77°F})

min. 0.2ms
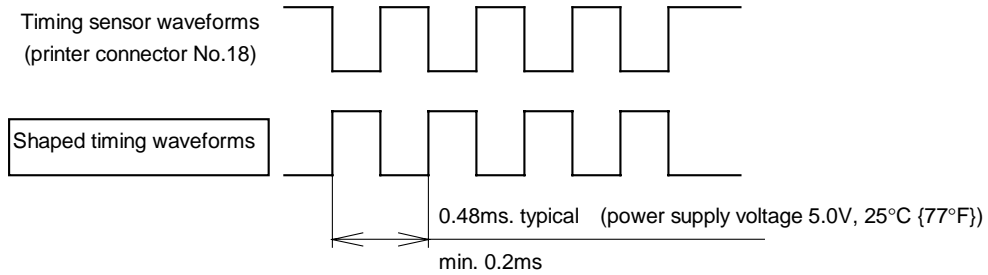
NOTE: ☐ denotes a waveform output by the designer's waveform-shaping circuit.

Figure 2.5.2

2) Confirmation of Timing signal T (noise elimination)

Timing signal T is defined by the leading edge of the shaped timing waveforms output by the waveform shaping circuit.   When an edge has been detected, the shaped timing waveforms should be read again after 15 ± 5 μs.   If both results are equal, Timing signal T is established.   If the results are not equal, the pulse should be treated as noise and disregarded.

Shaped timing waveform

Read timing

15 ± 5 μs 15 ± 5 μs

Confirmation of timing signal T

Timing signal Tn   Timing signal Tn+1
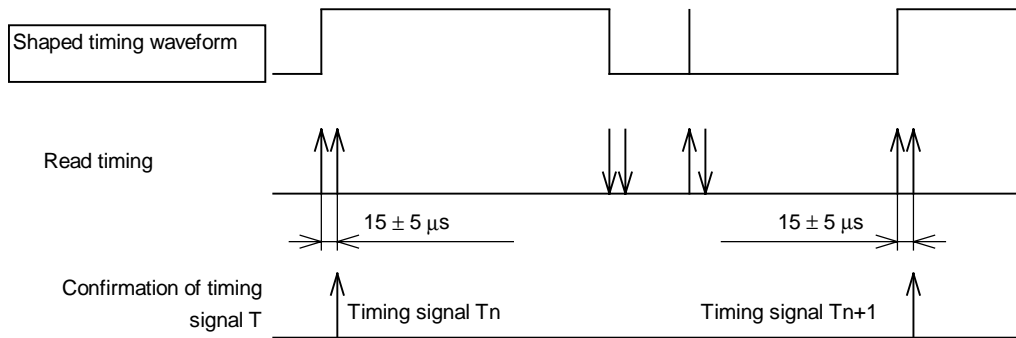
NOTE: ☐ denotes a waveform output by the designer's waveform shaping circuit.

Figure 2.5.3

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT 17	SHEET 16

2.5.3 Reset Detector and Output Waveform Treatment

The printer mechanism has a built-in reset detector that outputs a waveform once for each dot line.

To obtain Reset signal R, the designer needs to shape the waveform which is output from the reset detector of the printer and to recognize the change of the waveform level.

Reset signal R is used to reset the counting of Timing signal T for each character or graphics.

NOTE: For example, in printing a printing cycle of one character line (of. 5×7 font) or a printing cycle of a bit image, Reset signal R is used only when the first Timing signal T in dot line 1 is confirmed. Resetting of the counting of Timing signal T is not performed until one character line or each printing cycle of a bit image is completed.

1) Electric Characteristics of Reset Detectors (Ta = 25°C{77°F})

Item		Symbol	Terms	Mix. value	standard value	Max. value	Unit
Input	forward voltage	V_F	I_F=20mA	--	1.2	1.4	V
Output	dark current	I_{CEO}	V_{CE}=20V	--	--	0.1	µA
Transfer characteristic	photo-electric current	I_C	I_F=5mA, V_{CE}=5V	100	--	400	µA
	saturation voltage between the collector and the emitter.	V_{CE}(sat)	I_F=10mA, I_C=40µs	--	--	0.4	V

2) Printer Reset Detector Circuit and Names of Output Waveforms and Waveform on Each Side
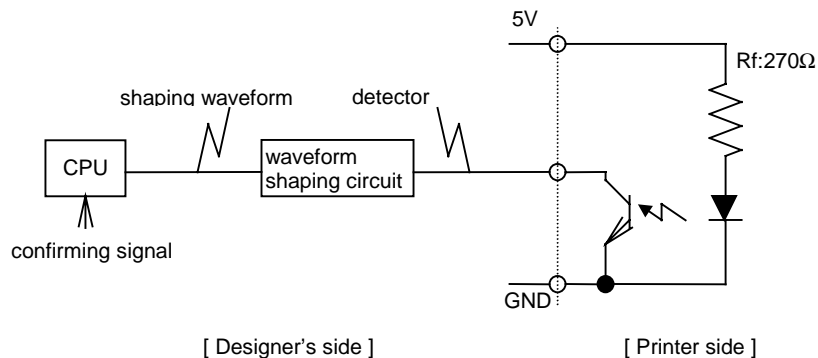
[Designer's side]   [Printer side]

NOTES: 1. When it detects, the detector goes on.

2. Waveforms in each side of the circuit are hereinafter referred to as "detector waveform" and "shaping waveform".

3. Confirmed points in acknowledged work of CPU are hereinafter referred to as "signals".

4. It is desirable to connect capacitors (0.1 µF or more) between +5 V and GND near the printer connection part on the designer's side in order to stabilize detector input voltage.

Figure 2.5.4

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.
			NEXT 18 / SHEET 17

3) Waveform shaping circuit on the designer's side

The designer needs to pull-up the waveform output + terminal of the reset detector at 51 k$\Omega \pm$ 5%.

The designer is also required to install a capacitor (0.001 µF) between GND and the waveform output terminal and to connect the signal to the input terminal of the schmitt trigger logic IC (74HC14 or equivalent). The output of this logic is the shaped, reset waveforms.
The following explanation is for the shaped, reset waveforms which are output from this waveform shaping circuit.

NOTE: The shaped reset waveforms output by the above waveform-shaping circuit are inverted in relation to the sensor waveforms output by the printer (See Figure 2.5.5).

4) About the power supply

It is desirable to turn the sensor power supply ON/OFF at the same time the motor is on.

(This stops the LED from flickering and helps to cut down power consumption waste in standby.

2.5.4 Reset Signal R

1) Shaped reset waveforms, as output by the user-provided waveform-shaping circuit, are shown in Figure 2.5.5.

Reset sensor waveforms
(printer connector pin No.4.)   Low   High   Low

Shaped reset waveforms   High   Low   High
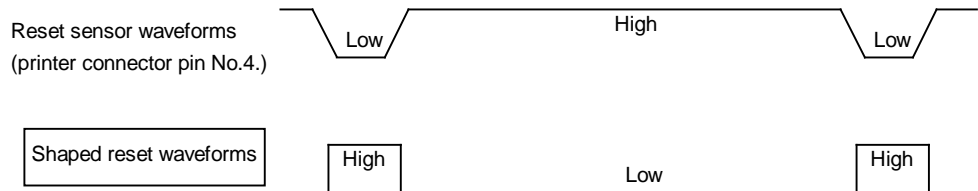
NOTES: 1. ☐ denotes a waveform output by the user-provided waveform shaping circuit.

2. The number of timing sensor waveforms between reset sensor waveforms varies.

Figure 2.5.5

EPSON	TITLE		SHEET REVISION	NO.	
	M-190G Specification (STANDARD)		C	NEXT 19	SHEET 18

2) Confirmation of Reset signal R (noise elimination)

Reset signal R is defined by the leading edge of the shaped timing waveforms output by the waveform shaping circuit.   When an edge has been detected, the shaped timing waveforms should be read again after 15 ± 5 μs.   If both results are equal, Reset signal R is established.   If the results are not equal, the pulse should be treated as noise and disregarded.
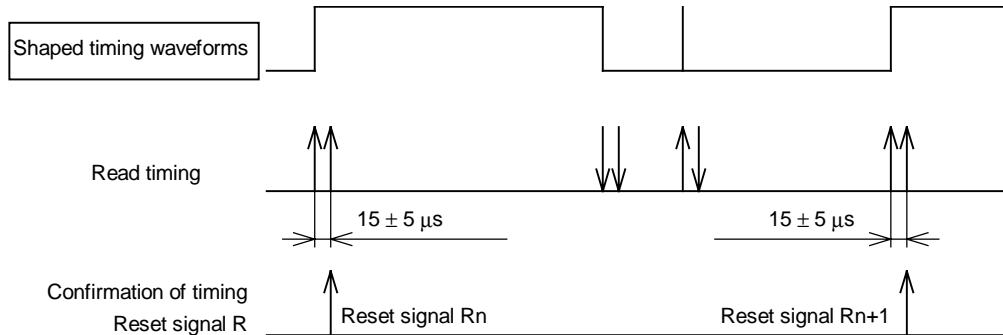
NOTE: ☐ denotes a shaped waveform output by the designer's waveform-shaping circuit.

Figure 2.5.6

2.5.5 Relationship Between Timing Signal T and Reset Signal R

The printer controller makes Timing signal T confirmable within 100 μs and the next Timing signal T confirmed T1 after confirming Reset signal R.
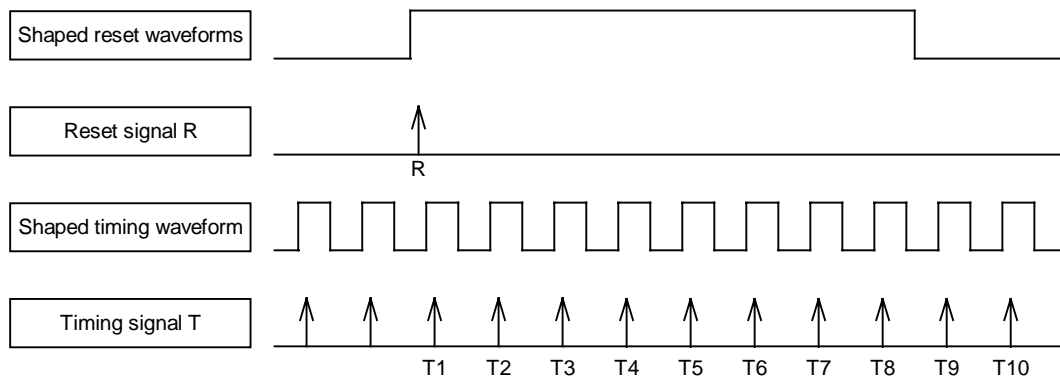
NOTES: 1. ☐ user-supplied signals and waveforms.

2. The Timing signal T point fluctuates in relation to the Reset signals R.   This causes a shift in print position.

Figure 2.5.7

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT 20	SHEET 19

2.6 Motor

1) Driving and braking: Energize the motor driving signal to start a stopped motor.
Shut off the motor drive signal within 0.1 ms after the confirmation of Reset signal Rn (Rn is R10 for the 5×7 font and 3-dot line spacing), Short circuit the motor terminals with a transistor by energizing the motor braking signal (100 ms or more), to quickly stop the motor. If the motor is not stopped quickly, the paper release mechanism will not work.

NOTES: 1. The transistor for motor driving/braking should be supplied on the designer's side.

2. Use a low-saturation transistor for motor driving/braking.

2) Stopping due to an abnormality:

Refer to Sections 2.9 and 2.10

3) Current:

(a) Peak current: 1.5 A typical (Power supply voltage: 5 VDC at 25°C {77°F}, when the motor is started up)

2.2 A maximum (Power supply voltage: 5.8 VDC at -10°C {14°F}, when the motor is started up)

(b) Mean current: 0.35 A, typical (Power supply voltage: 5 VDC at 25°C {77°F} as measured with 0 meter, not including when started up.)

(c) Current waveform: Refer to the Figure below. (Power supply voltage:5 VDC, 25°C {77°F})
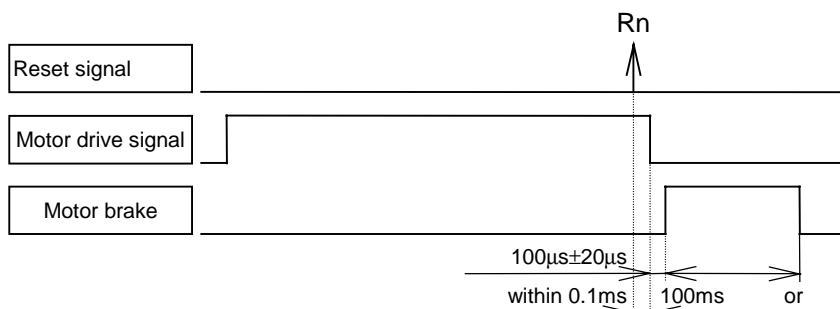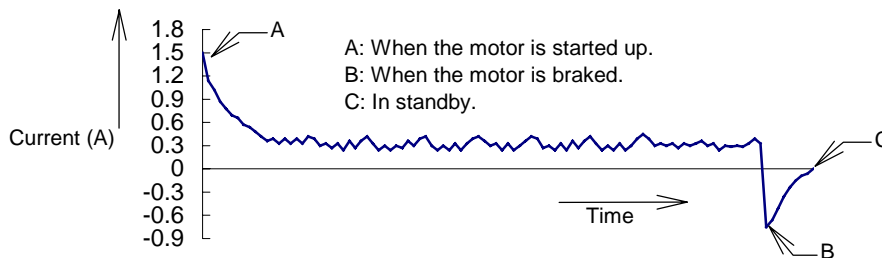
Figure 2.6.1

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.

| | | | NEXT 21 | SHEET 20 |

2.7 Print Solenoids

Dot printing is performed by energizing the print solenoids.

1) Number of print solenoids: 8

2) DC resistance: 1.3 $\Omega \pm 10\%$ (25°C {77°F})

3) Peak current: 2.5 A/solenoid, typical (Power supply voltage: 5.0 VDC at 25°C {77°F})
3.4 A/solenoid, maximum(Power supply voltage: 5.8 VDC at -10°C {14°F})

4) Driver Circuity

① To ensure an appropriate printing density, use a low-saturation transistor for driving the print solenoids.
(The print head driver must be designed so that the combined voltage loss when sending a current to each solenoid does not exceed 0.4 V, including the collector/emitter saturation voltage loss.)

② It is desirable to connect capacitors, (1500 μF or more) between Common terminals for print solenoids and GND near the printer connection part on the designer's side in order to secure printing density.

③ A Zener diode is provided by a circuit created by the designer as a surge protector.
The zener diode should have the capacity to protect the maximum rating between the collector and the emitter of the printing solenoid drive transistor.

④ Print solenoid drive pulse P should not shut off due to noise.

⑤ Up to 3 print solenoids may sometimes be energized at the same time.   Therefore, when using transistor arrays, it is better not to connect A, D and G to the same array.   (The same holds for B, E and H, and C and F.)

⑥ When the driver is OFF, the current flowing through print solenoids must become 0 A within 40 μs.

5) Drive timing and pulse width: From the leading edge of Timing signal Tn to the leading edge of Timing signal Tn+1 (see following Figure).

6) Power consumption: 3.5 mJ/dot typical (Power supply voltage: 5.0 VDC, 25°C {77°F})
8.4 mJ/dot maximum (Power supply voltage: 5.8 VDC, -10°C {14°F})

7) Spacing of energizing: When energizing, from the confirmation of the Timing signal Tn, the next energizing should be performed after the confirmation of Tn + 3.

8) Number of solenoids energized at the same time:
Maximum 3

9) Continuous energizing: To protect solenoids from heat, one print solenoid can be energized continuously up to 400 dot lines ($6 \times 3 \times 400 = 7200$ dots).   Also, the non-energized time should always be twice as long as the continuous energized time.

10) Solenoid protection for abnormal conditions:
Refer to Section 2.9 and 2.10.

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
				NEXT 22	SHEET 21

Figure 2.7.1
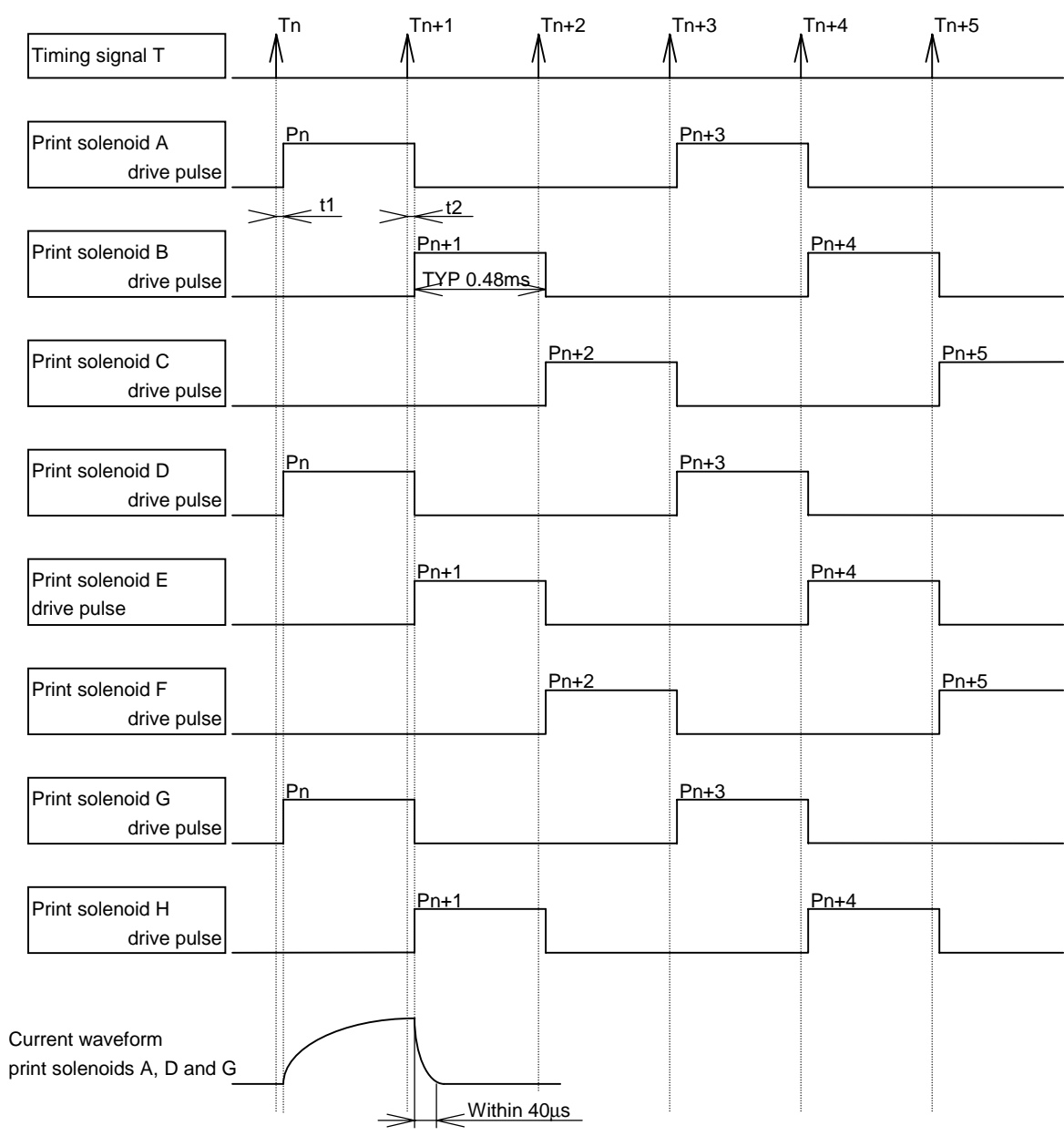
NOTES: 1. Signals in ☐ should be provided by the designer.

2. t1 = t2 ≤ 100 μs

3. For printing, print solenoids A, D and G are energized with drive pulse Pn which has the pulse width of Timing signal Tn to Tn+1.   Next, print solenoids B, E and H are energized with drive pulse Pn+1 which has a pulse width equal to Timing signal Tn+1 to Tn+2.   In the same way, print solenoids C and F are energized with drive pulse Pn+2, and then print solenoids A, D and G are energized with drive pulse Pn+3.   The 8 solenoids should be driven in the order (A, D, G) - (B, E, H) - (C, F).

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
				NEXT 23	SHEET 22

2.8 Fast Paper Feed Trigger Solenoid

Paper is fed at high-speed (three pitches when the print head returns) by energizing the fast paper feed trigger solenoid.

1) DC resistance: 20 $\Omega \pm 10\%$ (25°C {77°F})

2) Drive timing and drive pulse width:

After recognizing the Reset signal R, the first Timing signal T is taken to be Tf1.   During the period from the confirmation of Tf1 to that of Tf7, the fast paper feed is performed.
The same paper feed operation can be performed in the 5 $\times$ 7 font (line spacing: 3 dots) printing mode by driving the fast paper feed trigger solenoid during the period from the confirmation of T673 to the confirmation of T679.
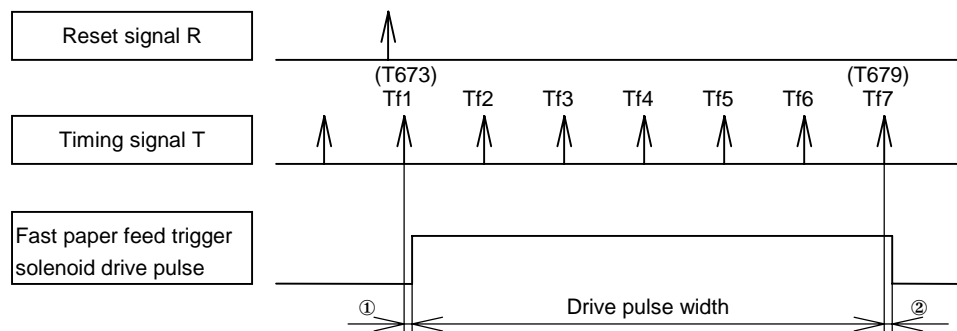
NOTES: 1. Signals in ⬚ should be provided by the designer.

2. Numbers in ( ) denote timing pulses when fast paper feed is performed in 5 $\times$ 7 font with 3-dot line spacing mode.

3. Delay in starting drive pulse in ①: 100 μs or less

4. Delay in stopping drive pulse in ②: 100 μs or less

Figure 2.8.1

3) Drive circuit:

① A diode is used as a current suppressor and it should be prepared by the designer.

② The fast paper feed trigger solenoid should not be disturbed or stopped by noise.

③ Use a low-saturation transistor to drive the fast paper feed trigger solenoid.
(Use the same transistor as the printing solenoid driver.)

4) Protection of fast paper feed trigger solenoid against abnormalities:
Refer to Sections 2.9 and 2.10.

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT 24	SHEET 23

2.9 Detection of Abnormal Printer Conditions

1) Detection of abnormal conditions:

In the following cases, the printer is considered to be in an abnormal condition and abnormal condition handling should be done:

a) When the period for Timing signal T is more than 2.8 ms
For a period of 100 ms after energizing the motor drive signal or after disturbing the motor drive signal, the monitoring of Timing signal T should be suspended.

b) More than 120 Timing signal T are confirmed after energizing the motor drive signals.

2) Handling abnormal conditions:

Whenever an abnormal condition is detected, the motor, print solenoid, and fast paper feed trigger solenoid drive signals should be shut off within 1ms.

3) Procedure after abnormal conditions:

Check whether or not a paper jam has occurred or if a foreign object has fallen into the printer.   If a paper jam or foreign object is present, remove it and restart the printer.

2.10 Maximum Allowable Continuous Energizing Time

The continuous energizing time (including the abnormal conditions in Section 2.9) should never exceed the time shown below.

Print solenoid: 1 second
Fast paper feed trigger solenoid: 5 seconds

EPSON	TITLE	SHEET REVISION	NO.	
	M-190G Specification (STANDARD)	C	NEXT 25	SHEET 24

2.11 Terminal Assignment

Connection	Terminal No.
Fast paper feed trigger solenoid	1
Fast paper feed trigger solenoid	2
Reset detector GND	3
Reset detector Waveform	4
Reset detector +5V	5
Motor (+)	6
Motor (-)	7
Print solenoid (B)	8
Print solenoid (C)	9
Print solenoid (D)	10
Print solenoid (E)	11
Print solenoid (F)	12
Print solenoid (G)	13
Print solenoid (H)	14
Common for print solenoids	15
Common for print solenoids	16
Print solenoid (A)	17
Timing detector Waveform	18
Timing detector GND	19
Timing detector +5V	20

NOTE: Terminals are numbered 1,2,... 20 from the left side of the edge-connector pattern on the board.

1,2 · · · · · · · · · · · · · · · · · · 19,20
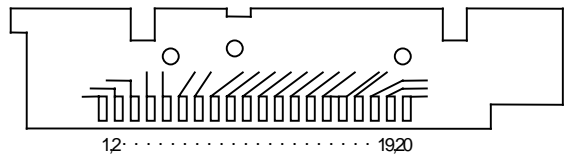
Figure 2.11.1

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT 26	SHEET 25

2.12 Timing Chart

2.12.1 Timing Chart diagram (5×7 font)

1) For 3-dot line spacing:
(a) Continuous printing

One print cycle

Motor drive signal

Reset signal R
R1　(R2)　(R7)　(R8)　R1　(R2)　(R3)　(R4)

Timing signal T
T1 T7　T60 T80T89T97T103　T156　T636　T673T679　T733　T1 T7

Printable area
T48 or more　Dot line 1　Dot line 2　Dot line 7　【Tf1】　【Tf61】　Dot line 1　Dot line 2　Dot line 3　Dot line 4

Fast paper feed trigger Solenoid drive pulse

Paper feed operation

Motor stopping range

(b) Intermittent printing

Motor drive signal

Reset signal R
R1　(R2)　(R7)　(R8)　(R9)　R10　R1　(R2)

Paper feed operation

One print cycle
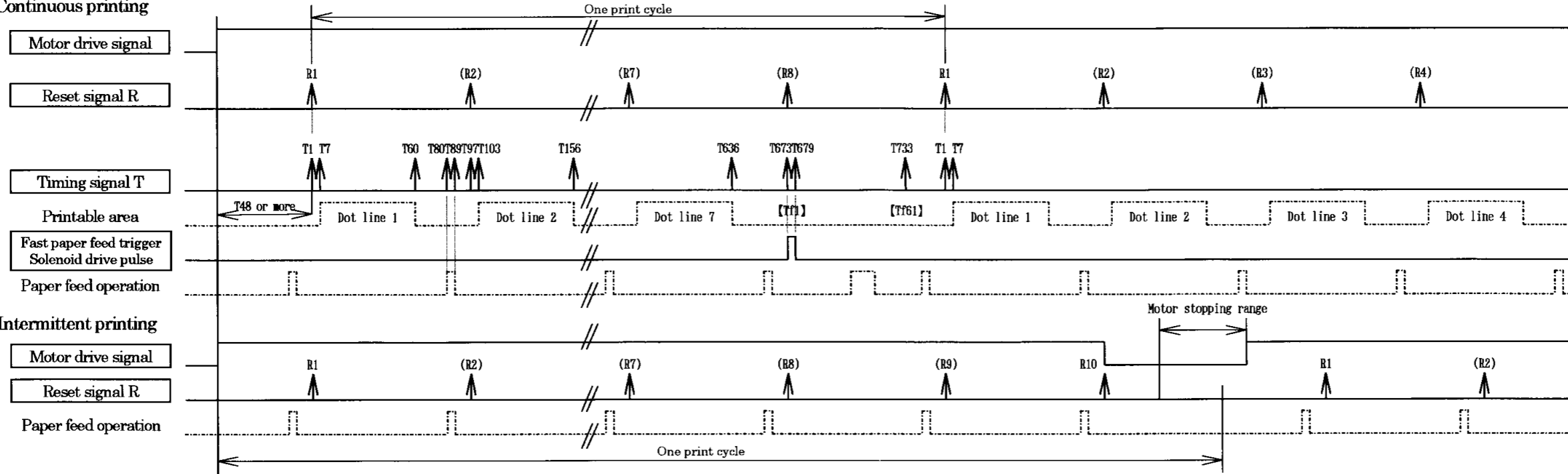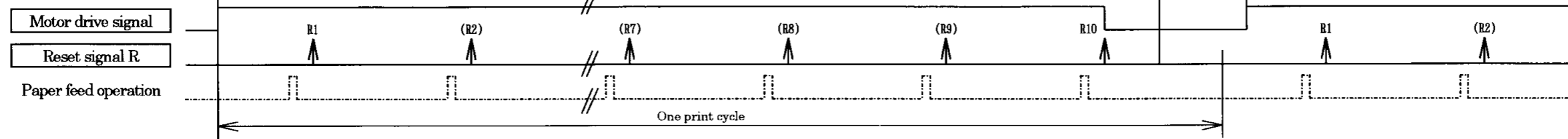
2) When printing again after setting 4-line spacing
(a) Continuous printing

Printing　40-dot line spacing　printing

7-dot line printing　3-dot line spacing　39-dot line spacing (3-dot line spacing × 13)　1-dot line spacing

Motor drive signal　ON

Reset signal R
(R7)　(R8)　R1　R2　R3　R13　R14　R1

Printable area
Dot line 7　Dot line 1

Fast paper feed trigger Solenoid drive pulse

Paper feed operation

(b) Intermittent printing

Motor drive signal　ON

Motor stopping range

Reset signal R
(R7)　(R8)　R1　R2　R3　R13　R14　R1

Paper feed operation

3) Expanded scale

Reset signal R
R1　R2

Timing signal T
T1　T7　T60　T80　T89　T97　T103

Print solenoid A,D and G drive pulse P
T48 or more　P7 P10　P55 P58　P103

Print solenoid B,E and H drive pulse P
P8 P11　P56 P59　P104

Print solenoid C and F drive pulse P
P9 P12　P57 P60　P105

Paper feed operation

NOTES: 1. ( ) are not necessary under normal conditions.
2. Numeric values in [ ] denote the timing pulse when reset pulse R8 is used.
3. Signals in ▭ should be provided by the designer.

EPSON	TITLE	M-190G Specification (STANDARD)	SHEET REVISION C	No.
				NEXT 27	SHEET 26

2.12.2 Timing Signal T as corresponds to the print solenoid driver for each dot (5×7 font)

Print solenoid	A			B			C		
Column	1	2	3	4	5	6	7	8	9
Print solenoid	D			E			F		
Column	1 0	1 1	1 2	1 3	1 4	1 5	1 6	1 7	1 8
Print solenoid	G			H					
Column	1 9	2 0	2 1	2 2	2 3	2 4			

Dot line 1: T7, T10, T13, T16, T19, T25, T37, T43, T55 — T8, T11, T14, T17, T20, T26, T38, T44, T56 — T9, T12, T15, T18, T21, T27, T39, T45, T57

Dot line 2: T103, T151 — T104, T152 — T105, T153

Dot line 3: T199, T247 — T200, T248 — T201, T249

Dot line 4: T295, T343 — T296, T344 — T297, T345

Dot line 5: T391, T439 — T392, T440 — T393, T441

Dot line 6: T487, T535 — T488, T536 — T489, T537

Dot line 7: T583, T631 — T584, T632 — T585, T633

	TITLE	M-190G Specification (STANDARD)	SHEET REVISION	No.	
EPSON			C	NEXT 28	SHEET 27

2.12.3 Initialization

The printer paper can be released by initializing as follows during power-on.

① Count the number of timing pulses after starting up the motor. Check whether or not Reset signal R is generated during the period from the confirmation of Timing signal 47 to the confirmation of Timing signal 48. Then follow a) or b) below.

    a) After the reset shaping, waveform is low in the whole range between Timing signal 47 and Timing signal 48
The first Reset signal R is taken to be R1 and the first timing pulse T after recognizing R1 is T1.

    b) In case except a)
Start counting the timing pulses from the next one. Reset signal R after the number of timing pulses reaches 48 is R1, and the first Timing signal after recognizing R1 is T1.

② Continue counting Timing signal T. The first Reset signal confirmed after T61 is R2, and the motor is stopped quickly at the same time Reset signal R2 is confirmed.

2.12.4 Description of operation (5 × 7 font)

1) In case of 3-dot line spacing:

  (A) Continuous printing

① Same as Step ① of 2.12.3.

② Continue counting Timing signal T. The left-most upper dot of the 1st, 10th, and 19th columns is printed by applying drive pulse P7 of T7 to T8 to print solenoids A, D, and G.

③ The left-most upper dot of the 4th, 13th, and 22nd columns is printed by applying drive pulse P8 of T8 to T9 to print solenoids B, E, and H.

④ The left-most upper dot of the 7th and 16th columns is printed by applying drive pulse P9 of T9 to T10 to print solenoids C and F.

⑤ The above procedure is repeated, and when drive pulse P57 of T57 to T58 is applied to print solenoids C and F, the right-most upper dot of the 9th and 18th columns is printed.

⑥ One dot of character space is obtained for the right-most column (3, 12, 21), (6, 15, 24), (9, 18) of each print solenoid. Paper is automatically fed one dot when the print head returns during the time from T61 to T96, and this completes the printing of one dot line.

⑦ Afterward, counting of timing pulses is continued (T97, T98, ...), and printing is carried out up to dot line 7. The right-most lower dot of the 9th and 18th columns is printed by applying drive pulse P633 (from T633 to T634) to print solenoids C and F. This completes the printing of 1 line with the 5 × 7 font.

⑧ Continue to count the timing pulses, and drive the fast paper feed trigger solenoid for the period from the confirmation of timing pulse T673 to the confirmation of T679. Fast paper feed is performed (3 pitches while the print head moves back and forth), and thus 3-dot line spacing is obtained.

⑨ Printing of the next line is started with R1, which is the next reset signal R generated after timing pulse T733 in dot line 8, and with T1 which is the next timing signal T generated after recognizing R1.

    ∗ From ⑧ on, the fast paper feed trigger solenoid can be energized using reset pulse R as a reference. (Refer to ⑧' and ⑨' for more details.)

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION	NO.	
			C	NEXT 29	SHEET 28

⑧' The reset pulse generated after timing pulse T637 of dot line 7 is detected. After this detection, the first timing pulse is Tf1, and fast paper feed is performed by driving the fast feed trigger solenoid during the period from the confirmation of Tf1 to that of Tf7.

⑨' The timing pulses used for driving the fast feed trigger solenoid are counted continuously, and the reset signal R after Tf61 is taken as R1 and the timing signal T generated after recognizing R1 is taken as T1, after which printing is started.

(b) Intermittent printing

① Same as steps ① to ⑦ of 2.12.4 1) (a).

② In dot lines 8 and 9, the fast feed trigger solenoid is not driven, and the paper is fed automatically. The reset pulse confirmed after timing pulse T829 is R10, and the motor is stopped quickly after this reset pulse is confirmed.

③ Repeat Steps ① and ②.

2) When printing again after setting n-line spacing:

(a) Continuous printing

① Same as Steps ① to ⑧ of 2.12.4 1) (a).

② Printing of the next line started with the next reset pulse (R1) confirmed after timing pulse T733 (or Tf61) in dot line 8. The paper is fed at fast-speed (in the same manner as 2.12.4 1), (a) Step ⑧) m times until Rm. (m is obtained from formula 1.)

③ The fast paper feed trigger solenoid is not energized, and paper is fed automatically until R(m+a+1) while counting reset pulses.

④ Printing of the next line is started with R(m+a+1) as R1.
$n/3 = m$, remainder a - - (formula 1)
where   n: number of space dot lines
        m, a: integer values

(Example)

To feed paper for 40 dot lines (4 lines, the 5×7 font, and 3-dot line spacing)

$n = 40 \rightarrow m = 13 \Rightarrow$ Rm = R13 " Fast paper feed 13 times
            a = 1   R(m+a+1) = R15 = The following line, R1.

(b) Intermittent printing

① Same as Steps ① to ⑧ of 2.12.4 1) (a).

② Printing of the next column is started with the next reset pulse as R1 that is generated after timing pulse T733 (or Tf61) in dot line 8. The paper is fed at fast-speed (in the same manner as 2.12.4 1) (a), Step ⑧) m times until Rm. (m is obtained from formula 2 below.)

③ The fast paper feed trigger solenoid is not energized, and paper is fed automatically until R(m+a+1) is confirmed while counting reset pulses. After R(m+a+1) is generated, the motor is stopped quickly.

④ Start printing in the same manner as Steps ① to ⑦ of 2.12.4 1) (a).
$(n-1)/3 = m$, remainder a - - (formula 2)
where   n: number of space dot lines
        m, a: integer values

(Example)

To feed paper for 40 dot lines (4 lines, the 5×7 font, and 3-dot line spacing)

$n = 40 \rightarrow m = 13 \Rightarrow$ Rm = R13 " Fast paper feed 13 times
            a = 0   R(m+a+1) = R14 = The motor is stopped quickly at the same time R14
                                            is confirmed.

EPSON	TITLE		SHEET REVISION	NO.	
	M-190G Specification (STANDARD)		C	NEXT 30	SHEET 29

2.12.5 Bit image printing

When bit image printing is activated, T1 is confirmed according to the procedure described in 2.12.3 ①, after which printing is carried out while counting timing pulses until the bit image printing is finished.

- For the continuous energizing time for the print solenoid, refer to Section 2.7.9 to protect solenoids from heat.).

2.12.6 How to confirm any Reset Signal Rn

1) After confirming reset pulse R1, the next reset pulse Rn which is generated after timing pulse T (96 $\times$ (n-2) + 61) is taken as Rn.

2.12.7 Notes

1) Periods when the print solenoid must not be energized:

   a) From motor start-up to the reset pulse R1 (from motor start-up to steady driving)

   b) From T61 + 96n to T96 + 96n (while print head returns)
   (n = 0 or more: integer values)

   c) From the moment when the fast paper feed trigger solenoid is energized to the next reset pulse.

2) The print solenoid drive pulses should not be activated or stopped by noise.

3) The fast paper feed trigger solenoid drive pulse should not be activated or stopped by noise.

4) The fast paper feed trigger solenoid should not be energized by the reset pulse which turns off the motor drive signal.

5) The reset detector is sometimes on and sometimes not in standby.

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
			NEXT 31	SHEET 30

2.13 Overall Dimensions — Confidential
When ERC-22 is mounted

(Character bottom position) during 3-dot line spacing

⊚19 12.4

⊚10°

Paper

(NOTE4) Manual feed knob

⊚10

36.4

★90.9⁺⁰·⁶/₋⁰·³

★14.9   Ribbon cassette(NOTE3)   ★13.7

4.9 (Paper entrance width)

1.5

Bottom of frame

★13.6 ★1.2

EJECT   PUSH

★15.3

0.5-0.5

46.85

49.2±0.5

36.4

Paper exit

Paper

19

24.9⁺⁰·⁶/₋⁰·³

47.2⁺¹·²/₋⁰·⁹

Paper cutter (NOTE2)

Ribbon feed roller

★16.4⁺⁰·¹/₋⁰·⁶

76.3⁺¹ (NOTE7)

16.4   (Frame edge)

16.4⁺⁰·² (Cover edge)

Bottom of frame

1 (Frame thickness)

3

15.8⁺⁰·⁸

1.5

1.6 (Pattern width)

2.5 (Pitch)

9.8   47.5(2.5×19)

16⁺¹   74.5⁺⁰·⁶

※13.8±0.1   ※62.6±0.15   ※9±0.1

3.2   3.2

4.3

※2.6   ※2.6

※R1.3   ※R1.3

#1   #2

(Cover edge)
(Pattern side)

3.2

※44.5±0.1   ※41.7±0.1

#3

FPC

7.5

#4

※Ø2.6±0.1

58.4   12.3   ※Ø2.6±0.1

(Inside width of paper guide)

Ribbon cassette upper surface

Lower limit of ribbon cassette bottom at removal

15.5±1.5

5

PUSH

Lower limit of ribbon cassette bottom at removal

Max5.2

Mounting hole(#3)

Ribbon cassette removal(as seen from the direction of arrow "A")

Paper entrance width

Printer

Figure B

Paper entrance width
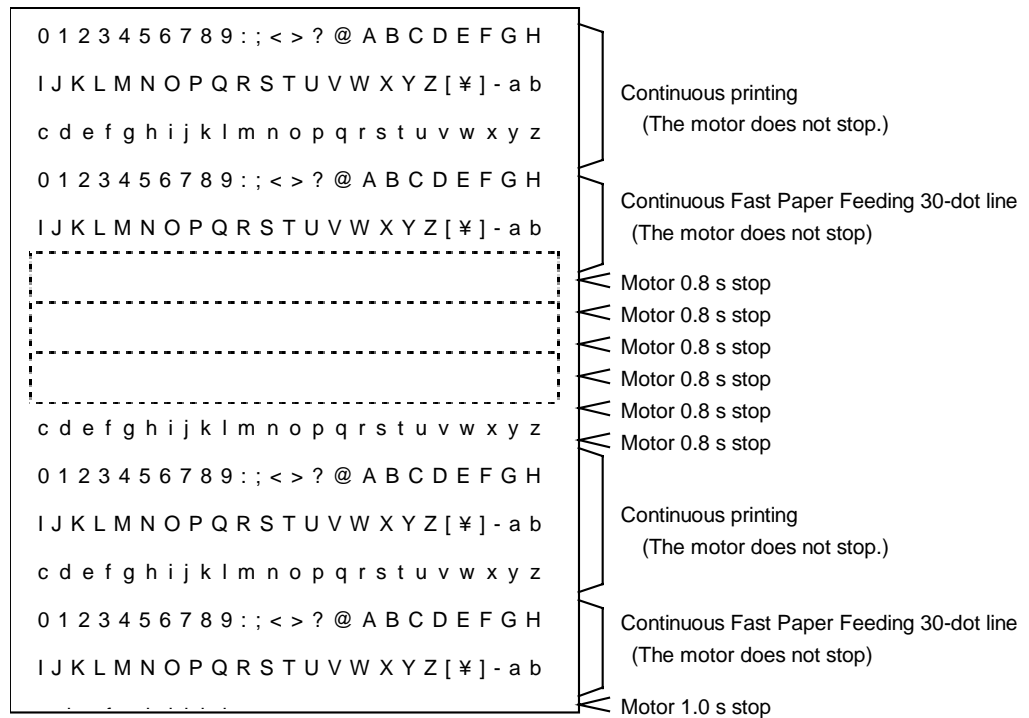
Printer

Figure C bad example

NOTES:
1. Figures marked with ※ indicate mounting holes.
2. Figures marked "⊚" indicate the reference position for adjusting the paper cutter.
3. Figures marked "★" describe the ribbon cassette(ERC-22).
4. When the manual feed knob is mounted, figure marked"---"indicate the knob.
5. Insert any three screws into mounting holes #1 to #4,and tighten them.
   Take in consideration that the printer frame may be deformed and functional problems may occur if all four screws are tightened.
6. When the manual feed knob is mounted,the printer is mounted by mounting hole #1 to #3 since mounting hole #4 is not available.
7. The area filled with oblique lines is where the FPC moves back and forth.The case should be designed so that the FPC does not touch the case.
8. The manual feed knob rotates while the printer is operating.Therefore,the knob should be adjusted so as not to rub against the case or project outside the case.The knob should be protected.
9. When loading roll paper,use normal curl(see Figure B),not reverse curl(see Figure C).
10. Set the paper holder so that the center of the paper guide inside width is aligned with the center of the roll paper,and so that paper that is 57.5±0.5mm wide can be guided.
11. Clearance between the paper holder on the case side and the roll paper width must be 2.0mm or less, and should be sufficient so as to prevent the holder from pressing or rubbing against both sides of the paper roll.
12. Paper supply load at Paper Entrance position should be 0.3N(approximately 30gf) or less.
13. When designing the case,the paper cutter position and roll-in protection should de considered.
14. Because the plated steel plate is used in this unit,the cut edges may get rusty.

	TITLE	SHEET REVISION	NO.	
EPSON	M-190G Specification (STANDARD)	C	NEXT 32	SHEET 31

s-rk45-spmp-9002-e

2.14 Life / MCBF Confirmation Conditions

EPSON confirmed the reliability for the printer and the ribbon cassettes (ERC-22, ERC-09, ERC-40) under the following conditions.

1) Environmental Temperature: Approximately 25°C {77°F}

2) Printer drive voltage: Power supply voltage   5.0 VDC

3) Paper: Oji Paper Mfg. Co.,Ltd.
45 kg / 1000 sheets / 1091 mm × 788 mm for registers
(20.41 lbs / 1000 sheets / 42.96" × 31.02")

4) Ribbon cassette: ERC-22, ERC-09 or ERC-40

5) Printing Mode: Repeats the following pattern

```
0 1 2 3 4 5 6 7 8 9 : ; < > ? @ A B C D E F G H
I J K L M N O P Q R S T U V W X Y Z [ ¥ ] - a b      Continuous printing
c d e f g h i j k l m n o p q r s t u v w x y z         (The motor does not stop.)
0 1 2 3 4 5 6 7 8 9 : ; < > ? @ A B C D E F G H
I J K L M N O P Q R S T U V W X Y Z [ ¥ ] - a b      Continuous Fast Paper Feeding 30-dot line
                                                         (The motor does not stop)
                                                       Motor 0.8 s stop
                                                       Motor 0.8 s stop
                                                       Motor 0.8 s stop
                                                       Motor 0.8 s stop
                                                       Motor 0.8 s stop
c d e f g h i j k l m n o p q r s t u v w x y z       Motor 0.8 s stop
0 1 2 3 4 5 6 7 8 9 : ; < > ? @ A B C D E F G H
I J K L M N O P Q R S T U V W X Y Z [ ¥ ] - a b      Continuous printing
c d e f g h i j k l m n o p q r s t u v w x y z         (The motor does not stop.)
0 1 2 3 4 5 6 7 8 9 : ; < > ? @ A B C D E F G H
I J K L M N O P Q R S T U V W X Y Z [ ¥ ] - a b      Continuous Fast Paper Feeding 30-dot line
                                                         (The motor does not stop)
                                                       Motor 1.0 s stop
```

NOTES: • Except under the above-mentioned conditions, the reliability mentioned in Section 1.10 and 2.3 may not be secured.

• The number of printed lines counted for the MCBF and the life, described in Section 1.10 do not include the number of continuous fast paper feeding lines shown above.

Figure 2.14.1

EPSON	TITLE **M-190G** Specification (STANDARD)	SHEET REVISION C	NO.
			NEXT App.1 / SHEET 32

APPENDIX

A.1 Note on the printer external appearance

Because plated steel plate is used in this unit, the cut edges may get rusty.

A.2 Basic concept for reliablity

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 Notes on using the printer

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) Remove the paper roll when not using the M-190G for a long period.   If the printer is left unused with a paper roll for a long period, the paper may become dirty or discolored.

A.4 Note on handiling the printer

Static discharge can destroy the sensors.   Do not touch the terminal pins on the PCB.   It is recommended to take the following countermeasures to protect the PCB connector from static:

- Use a grounding wristband.
- Use an antistatic mat.
- Use static dischargers.
- Use an antistatic bag for transport. etc.

A.5 Prohibited Actions

1) Printing (driving the print head) without paper inserted and printing outside of the specified print area described in Section 2.12.7 1).

2) Using the printer when condensation has occurred.   Do not power the printer until all condensation has evaporated.

3) Do not pull the paper toward the reverse direction of the feeding the paper when the paper free mechanism does not work (stopping due to irregular operation etc.)

EPSON	TITLE	**M-190G** Specification (STANDARD)	SHEET REVISION C	NO.	
				NEXT App.2	SHEET App.1

A.6 Notes on inserting the paper

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 2-ply pressure sensitive paper, make sure that the layers are aligned properly.

A.7 Notes on handling the ribbon cassette

1) Use the specified ribbon cassettes (ERC-22, ERC-09 or ERC-40).

2) It is desirable to mount the ribbon cassette after removing the paper.

3) Before mounting the cassette, the ribbon should be tightened by rotating the ribbon feed roller in the direction shown by the arrow.   Then place the ribbon feed roller side of the cassette forward the printer frame; then press down the portion marked PUSH side of the cassette.   See 2.13 overall Dimensions for ribbon cassette installing.   After installing the ribbon cassette, check whether the ribbon cassette is installed correctly.
With the ribbon cassette, do not force the ribbon feeding roller.   If you do so, the printer frame may be deformed.

4) To remove the ribbon cassette, push the portion marked PUSH with your finger.

5) When the printer with the ribbon cassette installed is transported, the ribbon cassette may moved be out of the proper position.   To avoid this, reinstall the ribbon cassette following the description in 2) and 3).