# Specification for DP330 Mini Dot Printer

**Revision:** 1.30 (issued on 2009.05.11)

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**CITIZEN SYSTEMS JAPAN CO., LTD.**
Must observe to assure product safety

In order to assure the safe operation of the product, carefully observe the specifications as well as the notes described below. Citizen Watch Company Limited will not bear any responsibility for any damage or injuries arising from use of the product that is not in accordance with the specifications and the notes described below.

< Notes on printer operation >

1. Absolute maximum voltage
   1) Printer driver voltage: less than 26.4 V DC
       - Applied to the print head solenoid, carriage motor, and paper feed motor.
   2) Detect or input voltage: less that 5.25 V DC
       - Applied to the home position sensor, black mark detector, and paper detector

2. When designing a driver circuit for electrical components of the printer such as print head solenoids, motors, detectors, follow the notes provided below.
   1) Print head solenoid
      The energizing time must never exceed 360 micro-second under any conditions including uncontrolled software program state.
   2) Carriage motor
      The energizing time, except for the hold current, must never exceed 2 second under any condition conditions including uncontrolled software program state.
   3) Paper feed motor
      The energizing time, except for the hold current, must never exceed 2 second under any condition conditions including uncontrolled software program state.
   4) Detectors
      Any operation value must never exceed the specified maximum rating.

< Notes on printer handling >

1. Cover any movable parts such as gears not to touch said parts by hand for safety.
   (If movable parts are exposed, it may suffer injury to hand.)
2. Design a desirable opening of the case for the carriage motor, paper feed motor and print head to be heating off.
## REVISION-UP LIST

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<td>Updated (Purple ribbon cassette abolition, Temperature error in writing correction, Head energizing time related addition, Flow chart error in writing correction for carriage operation)</td>
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TABLE OF CONTENTS

1. INTRODUCTION ........................................................................................................... 7

2. GENERAL SPECIFICATIONS ................................................................................. 8-10
   2.1 Printing Method ........................................................................................................ 8
   2.2 Printing Direction ...................................................................................................... 8
   2.3 Printing Format ......................................................................................................... 8
   2.4 Printing Speed .......................................................................................................... 8
   2.5 Paper Feed ............................................................................................................... 8
   2.6 Paper ......................................................................................................................... 8
   2.7 Inking ....................................................................................................................... 8
   2.8 Power Voltage .......................................................................................................... 9
   2.9 Connecting Method .................................................................................................... 9
   2.10 Printer Installation angle ....................................................................................... 9
   2.11 Environmental Conditions ..................................................................................... 9
   2.12 Environmental Conditions For Storage ............................................................... 10
   2.13 Reliability ............................................................................................................... 10
   2.14 Options .................................................................................................................... 10
   2.15 Outer Diameter ...................................................................................................... 10
   2.16 Weight .................................................................................................................... 10
   2.17 TSCA ..................................................................................................................... 10
   2.18 Insulation Resistance ............................................................................................ 10

3. DETAILED SPECIFICATIONS .............................................................................. 11-39
   3.1 Paper ......................................................................................................................... 11
   3.2 Print Format .............................................................................................................. 13
   3.3 Print Solenoid .......................................................................................................... 14
   3.4 Home Position Detector ......................................................................................... 20
   3.5 Carriage Motor ........................................................................................................ 23
   3.6 Paper end detector ................................................................................................... 26
   3.7 Paper Feed Motor .................................................................................................... 28
   3.8 Validation Printer ..................................................................................................... 30
   3.9 Ribbon Cassette ...................................................................................................... 31
   3.10 Connector ............................................................................................................... 32
   3.11 Options ................................................................................................................... 33
   3.12 Timing Chart .......................................................................................................... 37
4. REMARKS  ------------------------------------------------------------- 38
  4.1 Detection of Abnormal Conditions  -------------------------------- 38
  4.2 Handling Ribbon Cartridge  ---------------------------------------- 38
  4.3 Re-winder  -------------------------------------------------------- 38
  4.4 Appearance of Stamping Plate  ------------------------------------- 38
  4.5 Precaution for Printer Setting up  -------------------------------- 38
  4.6 Printer Usage Precaution  ----------------------------------------- 38
  4.7 Prohibitive Matters  ---------------------------------------------- 38

5. OUTER DIMENSION  ----------------------------------------------------- 39~40

6. PACKING  ------------------------------------------------------------- 41

7. PRINT QUALITY STANDARD  --------------------------------------------- 42~43

NOTE: Information in this document is subject to change without notice due to technical design improvement. It is recommended to contact us to obtain updated specification for your application.
1. INTRODUCTION

The DP330 printer has the printing mechanism which is characterized by logical seek printing, mounting the small size dot matrix print head which assures high speed printing, high reliability and low price. The printer is driven by two stepping motors and is capable of the right / leftward scanning of the print head, paper feeding and changeover of the two color ribbons (red/black).

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![Diagram of DP330 printer components]

**DP330 - * F **

- **Black mark Detector**
  - A: Detector position, Right A
  - B: Detector position, Right B
  - C: Detector position, Right C
  - J: Detector position, Left A
  - K: Detector position, Left B
  - L: Detector position, Left C
  - N: No Detector

- **Main PCB**
  - N: Without Volume
  - V: With Volume

- **Paper Feed System**
  - F: Friction system (fixed)

- **Ribbon Casette**
  - B: Black Ribbon
  - D: Red/Black Ribbon

- **Paper width**
  - 3: 76 mm
2. GENERAL SPECIFICATIONS

2.1 Printing Method
Serial Impact Dot Matrix

2.2 Printing Direction
Bi-directional printing (logical seeking available)

2.3 Printing Format
(1) Number of wires: 9 (dot-pitch: 0.353 mm (1/72 inch))
(2) Number of Dots: Total 210 dots (420 positions *) / line * including half dot
(3) Printing position: 420 positions (Maximum)
   DP330 (76.2 mm paper): 420 positions, 42 columns (7(W) X 9 (H) + 3 half-dot space(W))
   Validation printing: 420 positions, 42 columns (7(W) X 9 (H) + 3 half-dot space(W))
(4) Carriage movement pitch: 0.318 mm (1/80 inches) / step

2.4 Printing Speed
4.3 line / sec at 42 columns (DP330, Print width: 76.2 mm)
8.2 line / sec at 15 columns (Using logical seeking)

2.5 Paper Feed
(1) Paper feed method: Friction feed
(2) Paper feed pitch: 0.176 mm (1/144 inches) minimum
(3) Paper feed time: Approximately 56.7 msec / line
   (When paper feed pitch is 4.23 mm (1/6 inch))
(4) Quick paper feed speed: 34 line / sec (at 6 line / inch)
(5) Paper feed motor:
   Voltage: 24 ± 2.4 V DC
   Coil resistance: 20 ohm ± 1.4 ohm (at 25 °C)

2.6 Paper
(1) Roll Paper
   Width: 76.2 mm (3 inches) ± 0.5mm
   Maximum diameter: 83 mm dia. (3.25 inches dia.) or less
   Note: No glue on the paper core.
   Validation Paper (One line printing)
   Width: greater than 130 mm (5.12 inches)
   Height: greater than 60 mm (2.36 inches)

2.7 Inking
(1) Original Ribbon Cassette
   Single color (Spec. M): Black : NH37703
   2 colors (Spec. D): Red / Black : NH37702

(2) Life
   Single color (Spec. M): Black : 1,000,000 characters
   2 colors (Spec. D): Red / Black (each): 400,000 characters

   Conditions of the ribbon life
   Character font: 7 X 9 font
   Printing pattern: 2dots / 1 wire / 1 character
2.8 Power voltage
(1) Printer power voltage: 24 ± 2.4 V DC
   Note:
   1. Voltage specification apply to the print head, carriage motor and paper feed motor
   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: Less than 1.5 V DC
      Others: Less than 1.0 V DC
   4. The above voltage should be applied, when all nine pins are driven simultaneously.

(2) Detect input voltage: 5 ± 0.25 V DC
   Note:
   Applies to the home position detector, paper end detector, print head temperature sensing element, optional black mark detector.

2.9 Connecting Method
(1) Printer side               FFC or FPC connector (Type; 27FE-ST)
(2) User side                  1.25 mm pitch FFC or FPC
                                 (Width; 35 mm (1.38 inches), thickness; 0.3 mm (0.012 inches), including reinforcement plate)

2.10 Printer Installation Angle
   The printer must be installed horizontally, but it can be tiled by as much as ± 20 degrees.

2.11 Environmental Conditions
(1) Operating temperature      0 - 50 °C (32 - 122 °F)
(2) Operating humidity         10 - 90 % RH (without condensation)

Humidity 90 (%)
50
10

0 35 50 (°C) Temperature
2.12 Environmental Conditions For Storage (Excluding paper and ribbon cassette)

(1) Storage at high temperature and high humidity:
   - Temperature: 50 °C (122 °F)
   - Humidity: 90%RH
   - Storage time: 240 hours

(2) Storage at high temperature:
   - Temperature: 70 °C (158°F)
   - Storage time: 240 hours

(3) Storage at low temperature:
   - Temperature: -25 °C (-13 °F)
   - Storage time: 240 hours

(4) Vibration resistance:
   - Frequency: 10 – 150 – 10 Hz
   - Sweep: 20 minutes for coming and returning
   - Directions, time: One hour for X, Y and Z directions
   - Acceleration: 19.6 m/s²
   - Center of vibration: Any mechanism-installed part

(5) Impact resistance:
   - Impact acceleration: 980 m/s²
   - Directions, time: Once for X, Y and Z directions
   - Operation time: 6 ms
   - Impact operation point: Any mechanism installed part

(6) Long-term storage:
   - Temperature: 5 - 35 °C (41- 95 °F)
   - Humidity: 40 - 70 %RH
   - Period: Within 18 months after the printer is produced

2.13 Reliability

(1) Printer mechanism
   - MCBF: 10 million lines
   - Life: 10 million lines
   - Note: One line is defined as one passing of the carriage set in one direction.
   - The end of life is defined as a broke down 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. The above life is guaranteed under the print condition using recommended paper and ribbon cassette.

(2) Print head
   - 150 million characters
   - Note: The above life is guaranteed under the print condition of dots / 1 wire / 1 character and under the print condition using recommended paper and ribbon cassette.

2.14 Options

1. Validation guide
2. Manual cutter
3. Black mark detector

2.15 Outer Diameter

- 126.7(W) × 97.5(D) × 52.7(H)mm
- 126.7(W) × 97.5(D) × 64.1(H)mm (BM Sensor C position)

2.16 Weight

- Approx. 450 g (excluding the ribbon cassette)

2.17 TSCA Compliance

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

2.18 Insulation Resistance

- Initial value: 10 MΩ or higher (250 VDC)
- Between PCB terminals and printer frame
3. DETAILED SPECIFICATIONS

3.1 Paper

The printer paper is supplied by the user. Please use only paper that fulfills the following requirements to assure good print quality and stable paper feed.

(1) Roll paper

DP330 (paper width 76 mm)

a) Normal paper

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
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<tbody>
<tr>
<td>Paper width</td>
<td>76.2 ± 0.5 (3 ± 1/36 inches)</td>
</tr>
<tr>
<td>Outer diameter of roll</td>
<td>83 mm dia. (3.25 inches) or less</td>
</tr>
<tr>
<td>(Maximum inside diameter of the paper roll core must be)</td>
<td>10 +2/-0 mm (0.394 +0.078/-0 inches)</td>
</tr>
<tr>
<td>Paper thickness</td>
<td>0.06 – 0.085 mm</td>
</tr>
<tr>
<td>Paper weight</td>
<td>52.3 - 64.0 g/m² (JIS P8124) (14 – 17 lb)</td>
</tr>
<tr>
<td>(45 - 55 kg / 1000 sheets / 788 mm x 1091 mm)</td>
<td></td>
</tr>
<tr>
<td>Recommended paper</td>
<td>Oji resister paper</td>
</tr>
</tbody>
</table>

b) Pressure-sensitive paper (2 plat non-carbon paper (1P Original + 1P copy))

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<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Paper thickness</td>
<td>0.05 – 0.08 mm / 1P / 1P</td>
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<td>(Note: total thickness is less than 0.16 mm)</td>
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<tr>
<td>Recommended paper</td>
<td>Mitsubishi-Seishi NCR super (Blue)</td>
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(2) Validation paper

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Value</th>
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<tbody>
<tr>
<td>Greater than 130 mm (5.12&quot;) (W) x 60 mm (2.36&quot;) (H)</td>
<td></td>
</tr>
<tr>
<td>Paper thickness</td>
<td>0.085 – 0.1 mm</td>
</tr>
<tr>
<td>Total thickness of paper</td>
<td>Less than 0.25 mm (0.0098 inches) (Including roll paper)</td>
</tr>
<tr>
<td>Total number of paper</td>
<td>3 (Maximum, Including roll paper)</td>
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</table>

(3) Printable area

DP330

(Unit; mm)
(4) Note

1) Conditions on inside end of roll paper (with or without a core)
   a) No fold is allowed. The paper should be wound so that the paper edge goes along the internal circumference.
   b) No folding is allowed.
   c) The inside end should not be glued to the core. (When a core exists)
   d) The upper and lower layers of paper should not be glued to each other.

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. 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.
3.2 Print Format (Not including ink spreading)

(1) 9 X 9, 3 half-dot space

(2) 7 X 9, 3 half-dot space

(3) 7 X 9, 2 half-dot space
3.3 Print Solenoid

(1) Number of solenoids 9
(2) Power Supply Voltage 24 ± 2.4 V DC
(3) Resistance 10.9 ohm ± 0.763 ohm (at 25°C)
(4) Peak Current approximately 1.5 A/1 SOL
(5) Current-carrying Width 330 ± 5 micro sec (at 24V)
(6) Energizing circuit The print head energizing circuit should be designed so that the combined voltage loss when sending current of 1.5 A to each solenoid does not exceed 1.5 VDC, including the collector/emitter saturation voltage and line voltage loss. Elapse time of falling edge of head current waveform is 40 ± 10 micro sec.

Note: Set within the range indicated by oblique lines according to the driving voltage

T = 355 - (50/4.8 * (V - 21.6))
V = Driving voltage

(7) Exercising current to the print solenoid
Exercising the print solenoid with temporary driving conditions before printing is recommended to prevent a morning shot.
Exercising operation does not need in validation printing, paper feeding, and continuous printing while the carriage motor runs.

1) Conditions in exercising operation
   1. Current wave width 280 ± 10/-10 micro sec
   2. Number 10 times
   3. Exercising position Carriage positions to move 21 steps right or 213 steps left from the home position (Excluding the paper area)
(8) Driving Timing

Note 1) Print waiting time (�试t) which is passed from time of carriage motor phase change to time of print start must be defined in order to adjust the vertical dot alignment that is formed by the print head in either direction of the carriage movement. It is recommended that 试t variable range is ±500 μsec and minimum adjustable unit is 17 μsec. Uni-directional print is recommended for graphic or double height printing, otherwise, print dot alignment in vertical may be inaccurate. To print out more precisely in both directions of the carriage movement, it is also recommended that a thermistor which detects an atmosphere temperature is installed on a circuit board of a user side, and print waiting time (测试t) is revised according to the printing atmosphere temperature.

Note 2) Phase change timing cycle is minimum 833 μsec.

Note 3) Half dot print is defined as the half of head trigger signal pulse (min. 416.5 + 试t)

Note 4) Continuous full and half dot print performed by the same wire is prohibited.

Note 5) Elapse time of falling edge of head current waveform is 40 ± 10 μsec.

Note 6) The above specification of drive timing except for the head current waveform should be designed by a user of this printer.

Note 7) To adjust the print waiting time (测试t) whenever a user of this printer like is recommended.
(9) Energy consumption

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<th>Value</th>
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<tr>
<td>1</td>
<td>Standard average input energy (24 VDC at room temperature)</td>
<td>Approximately 6.8mJ / 1 dot (Current carrying width: 330 μs)</td>
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<td>2</td>
<td>Maximum input energy (26.4 VDC at 0 °C (32 °F))</td>
<td>Approximately 8.8mJ / 1 dot (Current carrying width: 310 μs)</td>
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<td>3</td>
<td>Power calculation method</td>
<td>(Input energy) X (Number of printing dots)</td>
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<tr>
<td></td>
<td></td>
<td>(Printing time)</td>
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<tr>
<td>4</td>
<td>Average power for printing character “K” as shown below</td>
<td>Approximately 25.4 W</td>
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<tr>
<td></td>
<td></td>
<td>(6.8mJ X 14 dots)/(0.4165 X 9 timing)</td>
</tr>
<tr>
<td>5</td>
<td>Peak current</td>
<td>Approximately 10.0 A</td>
</tr>
<tr>
<td></td>
<td>(Worst case)</td>
<td>(24VDC at room temperature, when nine wires are driven at the same time)</td>
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<tr>
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<td></td>
<td>Approximately 13.5 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0 °C, 26.4VDC, when nine wires are driven at the same time)</td>
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Note: Voltage should not drop below 21.6 VDC even if when nine wires are driven at the same time.

(10) Printing Duty

Calculate the number of the dots from the printing, and set it up in less than allowable duty line which shows total dot / one-second in the figure.

Allowable characters (cha/line)
= see upper (A) / Average No. of dots at 1 character (B) / printing speed (*LPS)
  (dot / sec)    (dot / cha)    (line / sec)
(11) Temperature sensing element control (thermistor)

The print head temperature detect thermistor is built in the print head to prevent burnout, smoke emission and fire hazard.

1) Use conditions

Use the temperature-sensing element within the range of the print duty as shown. (Head temperature is less than 120 °C (248 °F))
The values of the temperature-sensing element should be checked between unprinted areas after one line print is completed. When the thermistor value becomes over 16.43 k ohm (inside print head temperature: 140 °C (284 °F)), the head coil current is adjusted to the specified duty value.
Thermistor resistance is 10 ± 0.1 k ohms at 25 °C.

2) Thermistor

LP73 2B 103J5000 （KOA）or equivalent
(12) Example of revision value of print waiting time and thermistor circuit

To print out more precisely in both directions of the carriage movement, it is recommended that print waiting time should be adjusted at each atmosphere temperature based on the following graph.

![Graph showing the relation between atmosphere temperature and revision value of print waiting time.]

**Thermistor circuit example**

![Diagram of the thermistor circuit example.](attachment:thermistor_circuit_example.png)
(12) Example Drive Circuit

User side

Print solenoid 1

Print solenoid 5

Print solenoid 9

+24V

Printer side

STA401A

Print solenoid 1

Print solenoid 5

Print solenoid 9

+24V

User side
3.4 Home Position Detector (HP)

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 also can be used for detection of abnormal operations of the carriage. This consists of the shield plate and the photo coupler. The output signal wave is rectified as HP signal.

(1) Electrical characteristics of detector

1) Type of photo interrupter       EE-SX398 (OMRON)
2) Input Voltage                  5 ± 0.25 VDC

<table>
<thead>
<tr>
<th>Electric characteristic (Ta=25°C)</th>
<th>Characteristic</th>
<th>Conditions</th>
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<tbody>
<tr>
<td>Output</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low level output voltage</td>
<td>V&lt;sub&gt;cl&lt;/sub&gt;</td>
<td>TYP. 0.12 VDC</td>
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<tr>
<td></td>
<td></td>
<td>Max 0.4 VDC</td>
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<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;CC&lt;/sub&gt;=5 VDC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I&lt;sub&gt;OL&lt;/sub&gt;=16 mA</td>
</tr>
<tr>
<td>Low level output current</td>
<td>I&lt;sub&gt;cl&lt;/sub&gt;</td>
<td>Absolute max. rating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 mA</td>
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(2) Example of HP Waveform Shaping Circuit

Note 1. The pulse-detecting wave should become high when light is applied.
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. A pulse is termed a “signal” after the CPU recognizes it.

(3) Waveform-shaping circuit (User side)

The pulse output by the printer (detector pulse) must be processed on the user side by an integrating circuit with a rise time constant of 5.7 micro sec. and a fall time constant of 4.7 micro sec.

The waveform output by the waveform-shaping circuit is called a shaped home-position waveform.

Note 1. 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.
(4) Output signal level by the shaped HP waveform point

<table>
<thead>
<tr>
<th>Carriage position</th>
<th>Output signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>In home position</td>
<td>High</td>
</tr>
<tr>
<td>Out of home position</td>
<td>Low</td>
</tr>
</tbody>
</table>

(6) Relation of HP and Carriage movement

**HP Wave form**

- 226 steps (2 colors, spec. D) Note: including 13 steps for color change
- 213 steps (Single color, spec. M)

**Left side of carriage**

**Right side of carriage**

(6) Detector Signal judgment

Read the detector signal when the signal level changed (falling or rising). After 15 ± 5 micro sec from detected edge, the detector signal should be read again.

Each signal judgment is only considered to be possible when the results of both cases match. If the two results do not match, repeat the procedure above.

**Detected Signal**

**Reading timing**
(6) Example of HP and Carriage Movement

Since the head carriage position cannot be determined in the first place, initialization must be performed at power on. According to the following flow chart, stop the motor.

**Acceleration / Deceleration table at initialization**

<table>
<thead>
<tr>
<th>Units: micro sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>Acceleration</td>
</tr>
<tr>
<td>Deceleration</td>
</tr>
</tbody>
</table>

Initialization

HP detection

HP High

Yes

Move carriage to left direction at Acceleration for 10 steps Constant speed for 50 steps Deceleration for 10 steps

No

Move carriage motor to right direction Acceleration for 10 steps Constant speed for 230 steps

HP High

Yes

No

Home Position Error

HP High

Yes

No

Move carriage to right direction Constant speed for 11 steps Deceleration for 10 steps

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

(1) Specification
a) Type 4-phase 20-pole PM type stepping motor
b) Control method Constant current chopper driving with 2-phase excitation
c) Coil resistance $17.5 \pm 1.75 \Omega$ (at $25^\circ C$, 1 phase)
   Note: Stepping motor does the movement of carriage and a roll paper feed.
(2) Power supply voltage 24 ± 2.4 V DC
(3) Current consumption
   (a) Driving in accelerating and decelerating 350 mA
   (b) Driving at constant speed 350 mA
   (c) Low excitement time (hold time) 106 mA
   (d) High excitement time 350 mA
   Note: Don't supply current to the same phase continuously for more than one second except for hold time.
(4) Maximum drive frequency 1200 pps (pulses per second)
   Note: Minimum period of pulses is 0.833 msec.
(5) Circuit

(6) Drive sequence
   Movement in the direction of right to left
   
<table>
<thead>
<tr>
<th>Step</th>
<th>Phase</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B phase</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>A phase</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>B phase</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>A phase</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>

   Movement in the direction of left to right
   
<table>
<thead>
<tr>
<th>Step</th>
<th>Phase</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B phase</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>A phase</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>B phase</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>A phase</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>
(7) Carriage motor slow up/down control

It should control open loop, and the control of carriage motor does switching in accordance with the switching time-table

a) Slow up

<table>
<thead>
<tr>
<th>Step</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching time (ms ± 0.05)</td>
<td>2.80</td>
<td>1.76</td>
<td>1.51</td>
<td>1.32</td>
<td>1.17</td>
<td>1.07</td>
<td>0.99</td>
<td>0.94</td>
<td>0.91</td>
<td>0.86</td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
</tr>
<tr>
<td>Pulse (PPS)</td>
<td>455</td>
<td>568</td>
<td>662</td>
<td>758</td>
<td>855</td>
<td>935</td>
<td>1010</td>
<td>1064</td>
<td>1099</td>
<td>1163</td>
<td>1200</td>
<td>1200</td>
<td>1200</td>
</tr>
</tbody>
</table>

b) Slow down

<table>
<thead>
<tr>
<th>Step</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching time (ms ± 0.05)</td>
<td>0.83</td>
<td>0.88</td>
<td>0.93</td>
<td>1.02</td>
<td>1.09</td>
<td>1.21</td>
<td>1.31</td>
<td>1.45</td>
<td>1.61</td>
<td>1.83</td>
<td>2.13</td>
<td>2.49</td>
<td>3.20</td>
</tr>
<tr>
<td>Pulse (PPS)</td>
<td>1200</td>
<td>1136</td>
<td>1078</td>
<td>978</td>
<td>914</td>
<td>825</td>
<td>765</td>
<td>690</td>
<td>619</td>
<td>547</td>
<td>468</td>
<td>402</td>
<td>313</td>
</tr>
</tbody>
</table>

(8) Minimum drive amount of the carriage motor

The carriage should move from left at least 72 steps to right to feed ribbon before the printing is started, because the ribbon feed is performed while the carriage is moved. The carriage motor can be stopped before reaching the minimum drive amount of the carriage motor, when the carriage is moved without printing

(9) Constant speed

When moving less than 24 steps, perform phase switching at a Low speed of 357.1PPS (2.8msec)

(10) Step number

1) Single color (spec. M)

Area

<table>
<thead>
<tr>
<th>Step number</th>
<th>HP waveform</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>210</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Low</td>
</tr>
</tbody>
</table>

2) 2 colors (spec. D)

Area

<table>
<thead>
<tr>
<th>Step number</th>
<th>HP waveform</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>210</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Low</td>
</tr>
</tbody>
</table>
(11) Detecting uncontrolled carriage motor operation
This carriage motor uses open loop control technology, so that uncontrolled motor condition cannot be detected immediately. Thus, it is necessary to detect home position always. When detecting uncontrolled condition with the motor, the motor should stop immediately, and the printer will be initialized after a cause is cured. It is recommended that the printer should be specified to check the home position one time per 10 lines or one receipt, if the carriage does not pass the home position because of print position.

1) Uncontrolled state for single color (spec. M)

<table>
<thead>
<tr>
<th>Carriage moving direction</th>
<th>Carriage motor phase change</th>
<th>Uncontrolled state/ HP signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>From right to left</td>
<td>From 1 to 19</td>
<td>LOW</td>
</tr>
<tr>
<td></td>
<td>From 27</td>
<td>HIGH</td>
</tr>
<tr>
<td>From left to right</td>
<td>From 1 to 17</td>
<td>LOW</td>
</tr>
<tr>
<td></td>
<td>From 25</td>
<td>HIGH</td>
</tr>
</tbody>
</table>

2) Uncontrolled state for 2 colors (spec. D)

<table>
<thead>
<tr>
<th>Carriage moving direction</th>
<th>Carriage motor phase change</th>
<th>Uncontrolled state/ HP signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>From right to left</td>
<td>From 1 to 40</td>
<td>LOW</td>
</tr>
<tr>
<td></td>
<td>From 38</td>
<td>HIGH</td>
</tr>
<tr>
<td>From left to right</td>
<td>From 1 to 38</td>
<td>LOW</td>
</tr>
<tr>
<td></td>
<td>From 46</td>
<td>HIGH</td>
</tr>
</tbody>
</table>

Note: Uncontrolled state of the motor should be detected when the carriage has moved. The number in the table shows the number of carriage motor phase change, which is counted from the carriage start position when most left column is printed.

(12) Centering control
When the print operation is not performed after elapsing certain period (1.5 – 2.0 sec.) at the end of the print, the carriage must be moved to the center area (100 steps from the HP position to the center area) to make the ribbon cassette change or paper feed smoothly.

(13) Carriage position
When moving the carriage position intentionally to the place that is out of the specified area by hand, let the carriage to move back the printable area.
3.6 Paper end detector

A transparent photo-interrupter is installed for detect a paper-end in the paper path near the paper entrance.

(1) Type: Photo interrupter

GP1S094HCZ (SHARP)

(2) Input Voltage: 5 ± 0.25 VDC

(3) Electrical characteristics (Ta=25°C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Typ</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Forward Current</td>
<td>$V_F$</td>
<td>1.20</td>
<td>V</td>
</tr>
<tr>
<td>Output Dark Current</td>
<td>$I_{ceo}$</td>
<td>0.1</td>
<td>μA</td>
</tr>
<tr>
<td>Collector Output Current</td>
<td>$I_c$</td>
<td>220 ± 180</td>
<td>μA</td>
</tr>
</tbody>
</table>

(4) Recommended circuit

![Recommended circuit diagram](image-url)
(5) Detector position

- Platen
- Approx. 27.15
- Paper length
- Paper entrance direction
- Unit; mm
- Friction roller
- Approx. 26.15
  (Paper length)
- Platen
- Approx. 27.15
  (Paper length)
- Paper exit direction
- Print Center
- : Paper end detector Position
3.7 Paper Feed Motor
Paper is fed by controlling the paper feed motor.

(1) Specification
   a) Type 4 phases 20 pole PM type stepping motor
   b) Control method Constant current chopper driving with 2-phase excitation
   c) Power supply voltage 20 ± 1.4 ohm (25 °C, 1 phase)
(2) Coil resistance 24 ± 2.4 V DC
(3) Current consumption
   a) Driving in accelerating and deceleration 300 ± 21 mA (2 phase excitation)
   b) Driving at constant speed 300 ± 21 mA (2 phase excitation)
   c) Low excitement time (hold time) 90 ± 20 mA (2 phase excitation)
   d) High excitement time 300 ± 21 mA (2 phase excitation)
   Note: Don’t supply current to the same phase continuously for more than one second except for hold time.
(4) Maximum drive frequency 826 pps (pulses per second)
   Note: Minimum period of pulses is 1.21 msec.
(5) Circuit

(7) Drive sequence
1) Forward direction H: High level L: Low level

<table>
<thead>
<tr>
<th>Step Phase</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>B phase</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>A phase</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>B phase</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>A phase</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
</tbody>
</table>

2) Reverse direction H: High level L: Low level

<table>
<thead>
<tr>
<th>Step Phase</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>B phase</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>A phase</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>B phase</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>A phase</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>
(7) Acceleration and deceleration control of paper feed motor

It should control open loop, and the control of carriage motor does switching in accordance with the switching time-table.

1) Acceleration

<table>
<thead>
<tr>
<th>Step</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching time (ms ± 0.05)</td>
<td>2.80</td>
<td>2.37</td>
<td>2.05</td>
<td>1.77</td>
<td>1.57</td>
<td>1.46</td>
<td>1.38</td>
<td>1.30</td>
<td>1.26</td>
<td>1.22</td>
</tr>
<tr>
<td>Pulse (PPS)</td>
<td>357</td>
<td>422</td>
<td>488</td>
<td>565</td>
<td>637</td>
<td>689</td>
<td>725</td>
<td>769</td>
<td>794</td>
<td>820</td>
</tr>
</tbody>
</table>

2) Deceleration

<table>
<thead>
<tr>
<th>Step</th>
<th>Const.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching time (ms ± 0.05)</td>
<td>1.22</td>
<td>1.26</td>
<td>1.30</td>
<td>1.38</td>
<td>1.46</td>
<td>1.57</td>
<td>1.77</td>
<td>2.05</td>
<td>2.37</td>
<td>2.80</td>
</tr>
<tr>
<td>Pulse (PPS)</td>
<td>820</td>
<td>794</td>
<td>769</td>
<td>725</td>
<td>689</td>
<td>637</td>
<td>565</td>
<td>488</td>
<td>422</td>
<td>357</td>
</tr>
</tbody>
</table>

Note: 1) the drive stepping number is less than the table number

In case of that the drive stepping number is less than the table number, the half of drive step will start at the beginning of the accelerated table, and the rest of half will start at the end of the decelerated table.

2) Carriage centering:

The carriage must be positioned in the center of the paper - approx. 100 steps from the home position to the center, and then the paper will be fed when a user press the form feed switch to perform paper feed operation.

3) Avoiding paper slack

The paper must be fed in 1/12 - 1/6 inch (2.12 - 4.23 mm) - forward to set the gear backlash to the direction of normal gear rotation and to avoid smaller paper feed pitch caused by the unstable gear backlash at the following conditions.

* at first paper feed after the printer powered on.
* at first paper feed after paper is loaded.

4) Reverse feed direction

Reverse feed must be less than 72 steps of the motor. The smaller paper feed will be caused when the normal paper feed is performed suddenly after the reverse feed. This phenomenon is the similar to the power on condition. To avoid the smaller paper feed caused by the backlash of the gear, set the excess paper feed, +1/12 against a certain value in reverse feed, and then perform the excess paper feed in normal feed.

5) Feeding load applied

The feeding load must be less than 0.4 N if a paper feed mechanism is provided by a user.

(8) Paper feed pitch

Minimum 0.176 (1/144inch) ± 0.1 mm
3.8 Validation Printer

Single-line validation printing can be performed.

(1) Printable area

![Diagram of printable area]

Note: Values for the printable area are calculated at the center of the wire dot. (diameter 0.3 mm)

(2) Notes on the validation printing

1. The ribbon mask which is used for guiding the paper when the validation paper is loaded can be installed to the carriage. (To use the validation mask (option) is recommended.)
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. The validation can not be printed when black mark detector C (the position of paper exit), which is available as an option, is installed.
3.9 Ribbon Cassette (provided by user)

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

(1) Type
- Single color (Spec. M) ; Black (option) : NH37703
- 2 colors (Spec. D) ; Red / Black : NH37702

(2) Life
- Single color (Spec. M) ; Black (option) : 1,000,000 characters
- 2 colors (Spec. D) ; Red / Black (each): 400,000 characters

Note: Conditions of the ribbon rife
Character font; 7 * 9 font
Printing pattern; 2dots / 1 wire / 1 character

(3) Appearance
3.10 Connector

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

(1) Type
- Printer Side: MOLEX 52041-2745 (1.25mm pitch)
- User Side: FPC or FFC

(FFC 0.3 ± 0.05mm 27 terminals contact pitch 1.25mm)

(2) Connector Terminal Array

<table>
<thead>
<tr>
<th>No.</th>
<th>Connection</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Paper Feed Motor B</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Paper Feed Motor A</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Paper Feed Motor B</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Paper Feed Motor A</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Carriage Motor B</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Carriage Motor A</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Carriage Motor B</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Carriage Motor A</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Print Solenoid COM (+24V)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Print Solenoid COM (+24V)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Print Solenoid COM (+24V)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Print Solenoid #3</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Print Solenoid #1</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Print Solenoid #7</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Print Solenoid #5</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Thermistor</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Thermistor</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Print Solenoid #9</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Print Solenoid #8</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Print Solenoid #6</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Print Solenoid #4</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Print Solenoid #2</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>5V GND</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Black Mark detector</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Paper end detector</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>+5V</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>HP</td>
<td></td>
</tr>
</tbody>
</table>

(3) Recommended Applicable FPC Layout
3.11 Options

3.11.1 Validation guide
The validation guide, which guides the validation when it is inserted, can be installed in the printer main frame.

3.11.2 Manual cutter
The manual cutter for cutting paper roll can be installed in the printer main frame.

3.11.3 Black mark detector

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

(1) Type       Photo interrupter  SG-105(KOSEIDENSHI)
(2) Input Voltage: 5 ± 0.25 VDC
(3) Electrical characteristics (Ta=25°C)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Typ</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Forward Current</td>
<td>$V_F$</td>
<td>1.3</td>
<td>V</td>
</tr>
<tr>
<td>Output Dark Current</td>
<td>$I_{ceo}$</td>
<td>0.2</td>
<td>μA</td>
</tr>
<tr>
<td>Collector Output Current</td>
<td>$I_c$</td>
<td>90 min</td>
<td>μA</td>
</tr>
</tbody>
</table>

(4) Recommended circuit

(a) No VOLUME

(b) With VOLUME

![Diagram](image-url)
(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
(PCM II) D filter.

(6) Detector position

The black mark detector should be installed in one of the following positions.

<table>
<thead>
<tr>
<th></th>
<th>Position A (Paper entrance, paper face side)</th>
<th>Position B (Paper entrance, paper back side)</th>
<th>Position C (Paper exit, paper face side)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP330</td>
<td>Right side: O (A)</td>
<td>O (B)</td>
<td>O (C)</td>
</tr>
<tr>
<td></td>
<td>Left side: O (J)</td>
<td>O (K)</td>
<td>O (L)</td>
</tr>
</tbody>
</table>

Notes: Symbols within parenthesis indicate detector positions.
(8) Position of Black mark

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

<table>
<thead>
<tr>
<th>Black mark detect position (distance between the sensor and the friction roller)</th>
<th>Detective position A (Surface)</th>
<th>Detective position B (Back)</th>
<th>Detective position C (Surface)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP330 Left side of paper</td>
<td>A: 18 mm or more</td>
<td>B: 17 mm or more</td>
<td>C: 0 mm or more</td>
</tr>
<tr>
<td></td>
<td>J: ↑</td>
<td>K: ↑</td>
<td>L: ↑</td>
</tr>
</tbody>
</table>
3.11.4 Color change (Spec. D)

Color change is carried at the same timing with the carriage operation moving between left and right.

(1) In the case of changing the ribbon to red:
The carriage will move 213 steps to left from the home position. The carriage will move 13 steps to left from the position (B) at 2.8 m sec. (357 PPS), constant low speed.

(2) In the case of changing the ribbon to black:
The carriage will move 21 steps to right from the home position. The carriage will move 21 steps to right from the position (A) at 2.8 m sec. (357 PPS), constant low speed.

(3) After performing the home position operation or when the printer power is turned on, perform the ribbon color change operation from red to black.

(4) Drive sequence

<table>
<thead>
<tr>
<th>Step Phase</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td>A</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>B</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>A</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
</tbody>
</table>
### 3.12 Timing Chart

(1) Major example

<table>
<thead>
<tr>
<th></th>
<th>CR</th>
<th>PF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>W</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>P</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>W</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td></td>
</tr>
</tbody>
</table>

H: Low Excitation holding (print stop)
W: High Excitation holding; 6 ms
A: Acceleration speed
B: Deceleration speed
F: Constant speed (paper feed)
P: Constant speed (printing)

(1) Motor phase changing timing chart for Carriage motor and Paper feed motor

(2) Motor phase changing timing chart for Carriage motor and Paper feed motor

<table>
<thead>
<tr>
<th>I 01 I 02 signal</th>
<th>Low</th>
<th>Low</th>
<th>High</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>I 11 I 12 signal</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

Exiting level
High Excitation
Low Excitation
OFF
4. SPECIAL REMARKS

4.1 Detection of Abnormalities
Step-out condition of the carriage motor is undetectable when it happens immediately. Abnormality detection should be carried out to check on HP signal periodically. (Refer to 3.5 (10))

4.2 Handling Ribbon Cartridge
1) Use the product designated by CITIZEN to maintain print quality and to obtain enough durability.
2) Supplementation of ink for the ribbon is prohibited.
3) The ribbon cartridge must not be supplied, being mounted on the printer at the time of shipment.

4.3 Re-winder
Paper rolling force should be less than 1.47 N (150 gr).

4.4 Appearance of stamping part
Rust may be observed on the edge of stamping plate due to using ordinal steel plate.

4.5 Printer installation precautions
1) As a precaution against noise and unstability, 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 inch) 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 short-circuiting. Proper insulation should be provided.

4.6 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, take measures against static charge.
3) When paper is set to the printer, ensure that top edge has no shrinkage, no tear, and must be cut at 90 degree against the side edge of paper. The top edge of copy paper must be no gap in any direction between two papers.
4) To remove paper, pull the paper in forward or reverse by hand, or operate paper feeding mechanism in forward.
5 Outer dimensions

STANDARD

MANUAL CUTTER
BLACK MARK SENSOR C POSITION
6. Packing

Drop test and Vibration test

(1) Drop test condition
   ① Order of drop
      1 angle → 3 corner → 6 faces total 10 times

   ② Height
      60cm

(2) Vibration test condition
   Acceleration: 1G (constant)
   Frequency: 5 - 60Hz
   Sweep: 6 minutes (1 cycle) 10 times (total 1 hour)
   Direction: X, Y, and Z
7. Print Quality Standard

1. Dot alignment

2. Horizontal and Vertical position accuracy

Bi-directional: 0.5 mm MAX.
Uni-directional: 0.25 mm MAX
3. Slant of characters

4. Horizontal print position

Forward

4.8 ± 3 mm