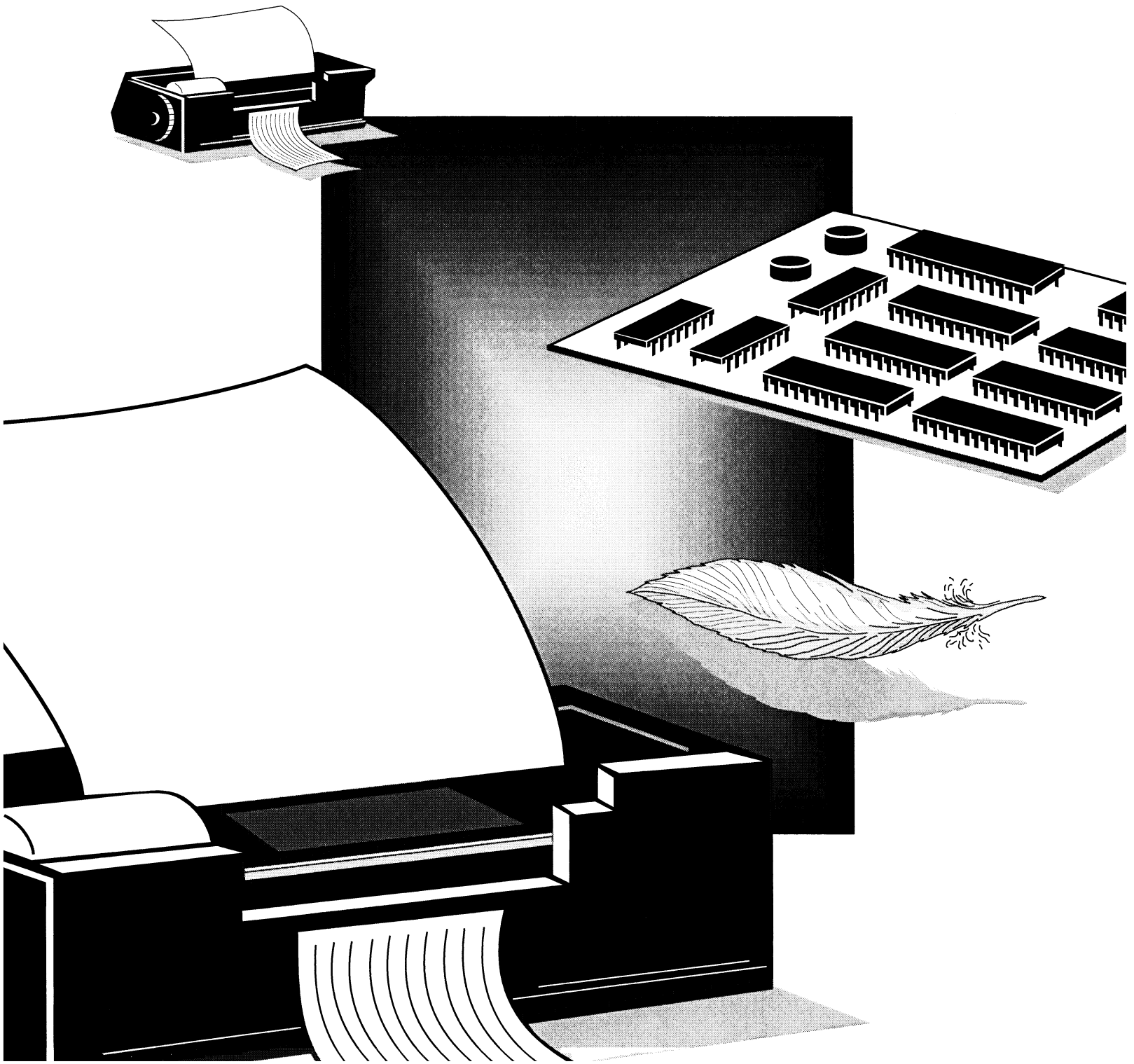
SII
Seiko Instruments

STP211 SERIES

Technical Reference



STP211 SERIES PRINTER MECHANISM TECHNICAL REFERENCE

Document Number 39019-2343-03

First Edition October 1994
Second Edition July 1995
Third Edition February 1996

PREFACE

This reference manual contains the technical information of the STP211 series thermal printer mechanism. It is recommended that the user thoroughly read this manual to become familiar with the equipment prior to use.

This reference manual is applicable to the follwing products.

- STP-211A-144
- STP-211B-192
- STP-211J-192

When the specifications of each product differ, each specification is discribed prespectively and when the specifications of each product is the same, the specification is described as a common specification of all products.

SII has not investigated the intellectual property rights of the sample circuits included in this manual. Fully investigate the industrial proprietary rights of the sample circuits described in this manual before using.

TABLE OF CONTENTS

CHAPTER 3 DRIVE METHOD (STP211J-192)

CHAPTER 4 CONNECTION SPECIFICATIONS

CHAPTER 5 ASSEMBLY DIAGRAM AND PART NAMES

CHAPTER 6 ATTACHMENT LAYOUT AND DESIGN

CHAPTER 7 REMOVAL AND REPLACEMENT

CHAPTER 8 PRECAUTIONS

TABLES

FIGURES

CHAPTER 1

SPECIFICATIONS

1.1 GENERAL SPECIFICATIONS

1.1.1 Print Method

Table 1-1 Print Method

Item	Specification
Method	Thermal serial dot printing
Printing timing	Step motor synchronization
Home position detection	Mechanical switch

1.1.2 Mechanical Specifications

Table 1-2 Mechanical Specifications

Item \ Type	STP211A-144	STP211B-192	STP211J-192
Dots/Line (H × W)	8 × 144 dots	8 × 192 dots	
Dot size (H × W)	0.30 × 0.20 mm		
Printing width	46.1 mm		
Paper feed pitch	0.35 mm		
Head feed pitch	0.32mm	0.24 mm	
Maximum Print speed*	280dps	280 dps	420 dps
Paper feed	Friction feed Paper free mechanism Capable of manual feed (Forward / Reverse)		Friction feed Paper free mechanism
Service life	5×10^5 lines (5.0 V, rated energy, normal temperature, 50 % print ratio)		
Dimensions (W × D × H)	80 × 47 × 27 mm		
Weight	Approximately 110 g		

* Print speed varies depending on the printer voltage specifications. Refer to "1.1.3 Printer Voltage and Print Speed".

1.1.3 Printer Voltage and Print Speed

Print speed varies depending on the printer voltage. Table 1-3 shows the relation ship between the printer voltage and the print speed.

Table 1-3 Printer Voltage and Print Speed

Type / Supply voltage	STP211A-144	STP211B-192	STP211J-192
4.0 to 5.5 V	240 dps	240 dps	not available
5.0 to 5.5 V	280 dps	280 dps	420 dps

1.1.4 Environmental

Table 1-4 Environmental Specifications

Item	Specification
Operation temperature range	0°C to 50°C
Storage temperature range	– 20°C to 60°C

1.1.5 Thermal Paper Specifications

Table 1-5 Thermal Paper Specifications

Item		Specification
Paper width		58 $^{+0}_{-1}$ mm
STP211A-144 STP211B-192	Recommended heat sensitive copying paper	Fuji Kagakushi Kogyo TCC12P-TRX4
	Recommended thermal paper	Japan Paper TP50KS-A
		Honshu Paper FH65BX-14N
		Mitsubishi Paper Mill F-200U7N5
STP211J-192	Recommended thermal paper	Mitsubishi Paper Mill F-200U9W3
		Nihon Paper Industries TF50KS-E2C

NOTE

Use a heat sensitive copying paper under the conditions of 0 to 40 °C ambient temperature.

1.2 PRINT CONFIGURATION

STP211A-144 print configuration and, STP211B-192 and STP211J-192 print configuration are shown in Figure 1-1 and Figure 1-2.

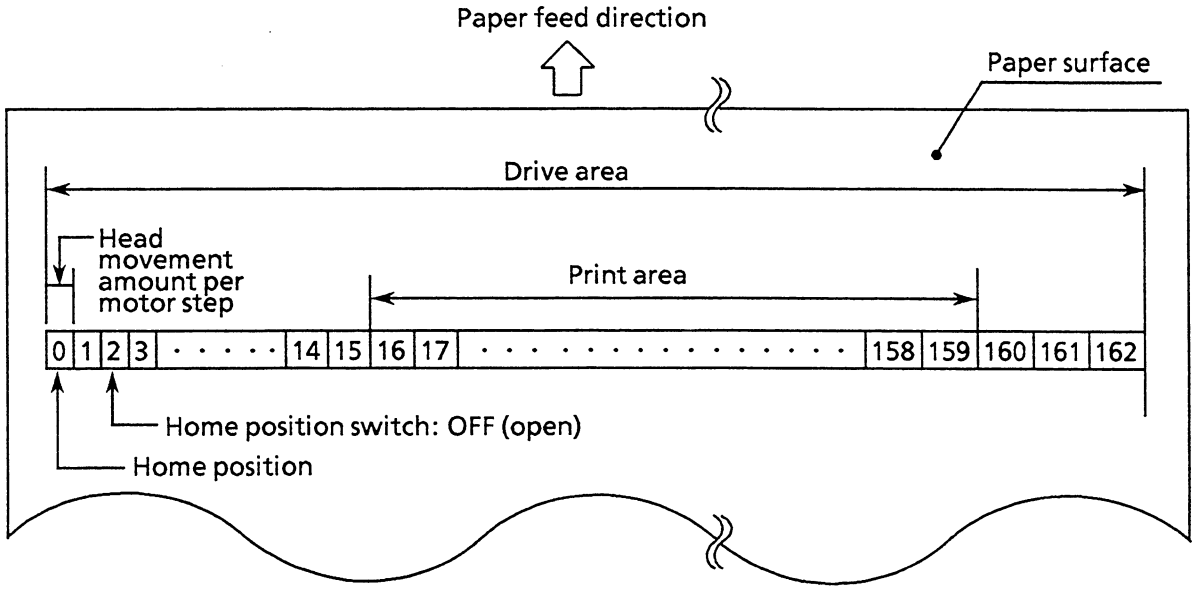
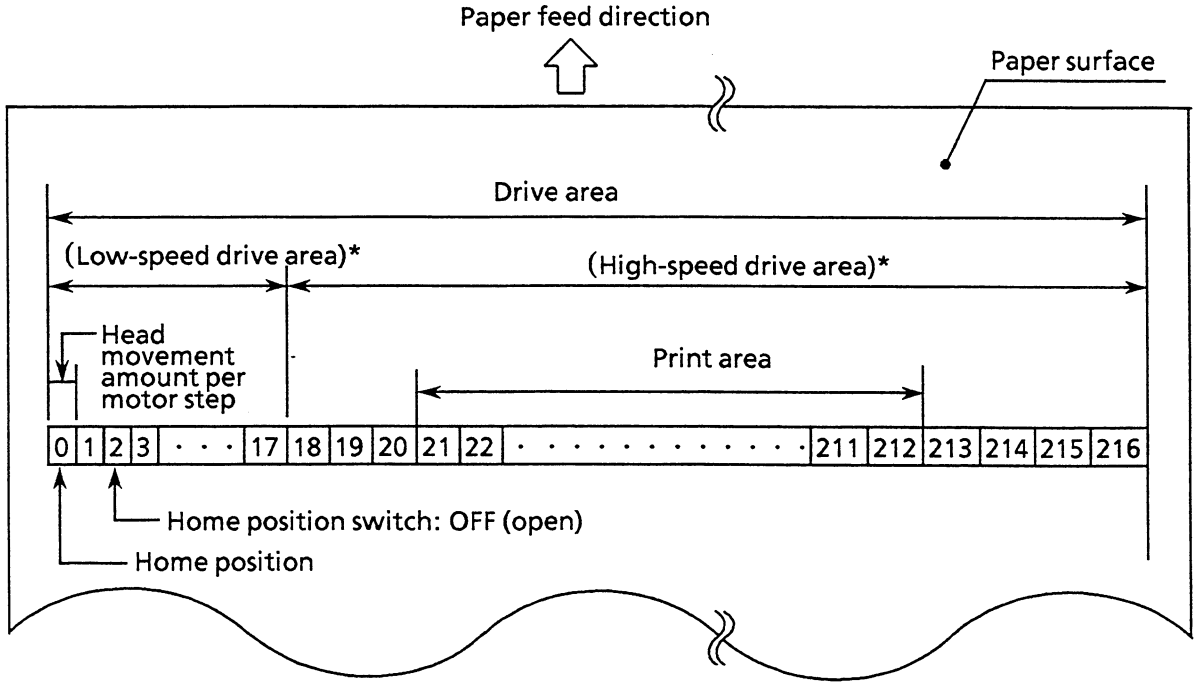


Figure 1-1 STP211A-144 Print Configuration



* The information enclosed with ( ) apply only to the STP211J-192. (Refer to "3.1.6 Head Feed Motor Drive")

Figure 1-2 STP211B-192 and STP211J-192 Print Configuration

1.3 MOTOR SPECIFICATIONS

Head feed motor and paper feed motor specifications are listed in Table 1-5.

Table 1-6 Motor Specifications

Item	Specification
Type	PM
Number of phases	4
Energizing system	2-2 phases
Winding resistance/phase	20 Ω ± 7 %
Rated voltage	4.0 to 5.5 V DC
Current consumption	600 mA/2 phases maximum

NOTE

The voltage at the FPC (Flexible Printed Circuit) terminal must be from 4.0 to 5.5 V.

1.4 THERMAL PRINT HEAD SPECIFICATIONS

1.4.1 Heating Element Dimensions

Head heating element dimensions are shown in Figure 1-3.

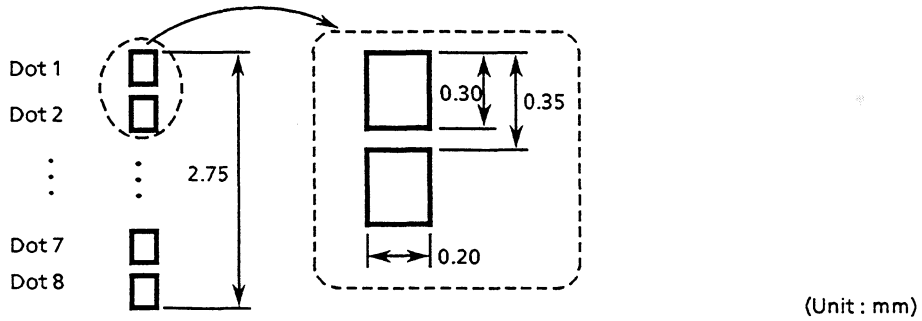


Figure 1-3 Heating Element Dimensions

1.4.2 Heating Element Resistance

Heating element resistances are ranked according to the average resistance of 8 dots at the FPC terminal.

Table 1-7 Heating Element Resistances

Rank	Resistance
A	18.0 ± 1.0 Ω
B	16.4 ± 1.0 Ω
C	14.8 ± 1.0 Ω

Heating element resistance is indicated by a symbol on the FPC.

1.4.3 Head Voltage

4.0 to 5.5 V DC (5.0 to 5.5 V DC for STP211J-192)

1.4.4 Peak Current

Maximum: 3.5 A (5.5 V DC, Heating element resistance rank: C, 8 dot synchronous drive)

NOTE

1. The voltage at the FPC (Flexible Printed Circuit) terminal must be from 4.0 to 5.5 V.
2. It is recommended that a 2200μF capacitor be inserted (for ripple smoothing) between power supply terminals in the thermal head drive circuit.

1.5 HOME POSITION SWITCH

The home position switch is a mechanical switch which detects the print head in the home position (the left side in the paper feed direction). When the print head is in the home position, the switch is OFF (open).

(1) Contact point resistance

5Ω or less (Measurement current: 50μA)

(2) Current

1.0 mA or less (5.0 V DC)

(3) Home position switch signal detection

An OFF status continuing for 450μs or more to prevent incorrect operation caused by chattering is considered to be the OFF signal.

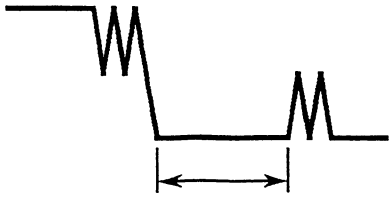


Figure 1-4 Home Position Switch Signal Detection

CHAPTER 2

NORMAL DRIVE METHOD

This chapter describes STP211A-144 and STP211B-192 normal drive method.
This drive method enables to print on the heat sensitive copying paper as well as the thermal paper.
Refer to "Chapter 3 DRIVE METHOD (STP211J-192)" for STP211J-192 drive method".

2.1 STEPPING MOTOR DRIVE

2.1.1 Motor Drive Circuit Example

An example of a motor drive circuit is shown in Figure 2-1.

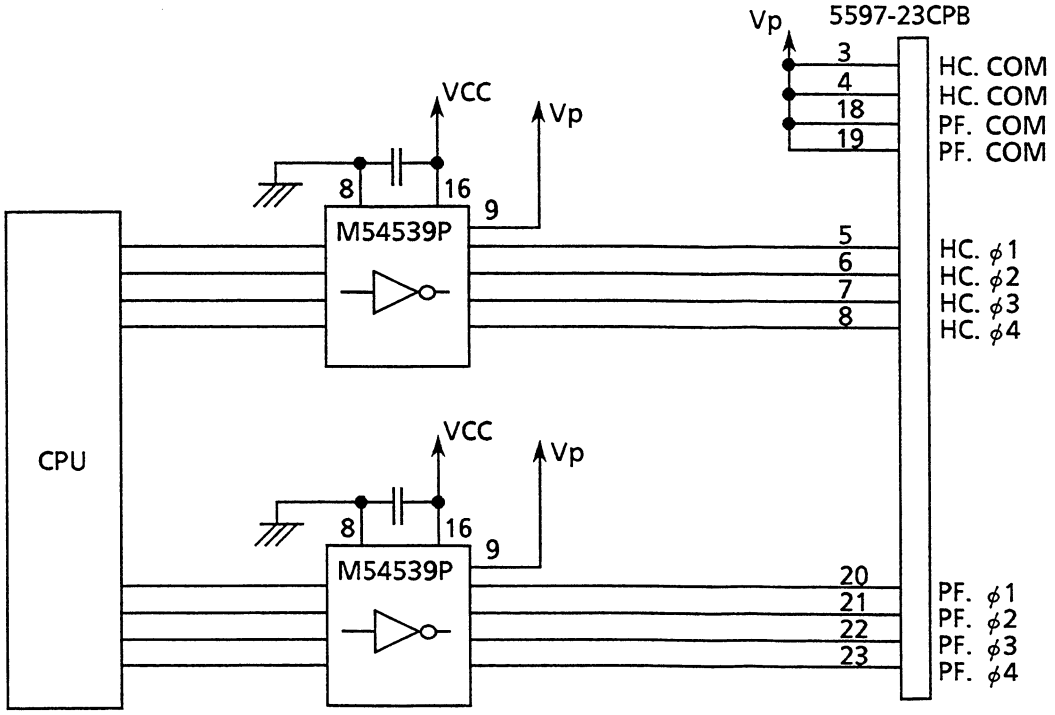


Figure 2-1 Motor Drive Circuit Example

[Recommended motor driver]

Maker	Model
Mitsubishi	M54539P

2.1.2 Excitation Sequence

(1) Head feed motor

The head feed motor uses 2-phase excitation. If the motor is excited in the order of Step 1, Step 2, Step 3, Step 4, Step 1, Step 2, and so forth, the print head moves toward the right side relative to the paper feed direction. If the motor is excited in the reverse order (Step 4, Step 3, Step 2, Step 1, Step 4, Step 3, and so forth), the print head moves toward the left side (home position).

Table 2-1 Head Feed Motor Activation Sequence

Sequence	Signal			
	HC. ϕ1 (Blue)	HC. ϕ2 (White)	HC. ϕ3 (Yellow)	HC. ϕ4 (Red)
Step 1	OFF (HIGH)	OFF (HIGH)	ON (LOW)	ON (LOW)
Step 2	OFF (HIGH)	ON (LOW)	ON (LOW)	OFF (HIGH)
Step 3	ON (LOW)	ON (LOW)	OFF (HIGH)	OFF (HIGH)
Step 4	ON (LOW)	OFF (HIGH)	OFF (HIGH)	ON (LOW)

The print head is fed one dot for each motor drive signal step.

NOTE

There is a clearance between the head feed screw and the frame. Accordingly, there is a maximum ± 1.5 dot drift when bidirectional printing is performed.

(2) Paper feed motor

The paper feed motor uses 2-phase excitation. If the motor is excited in the order of Step 1, Step 2, Step 3, Step 4, Step 1, Step 2, and so forth, the print paper is fed forward.

Table 2-2 Paper Feed Motor Activation Sequence

Sequence	Signal			
	PF. ϕ1 (Blue)	PF. ϕ2 (White)	PF. ϕ3 (Yellow)	PF. ϕ4 (Red)
Step 1	OFF (HIGH)	OFF (HIGH)	ON (LOW)	ON (LOW)
Step 2	OFF (HIGH)	ON (LOW)	ON (LOW)	OFF (HIGH)
Step 3	ON (LOW)	ON (LOW)	OFF (HIGH)	OFF (HIGH)
Step 4	ON (LOW)	OFF (HIGH)	OFF (HIGH)	ON (LOW)

The print paper is fed one dot for every four motor drive signal steps.

2.1.3 Stepping Motor Drive Speed

Stepping motor drive speed is shown in table 2-3.

Table 2-3 Stepping Motor Drive Speed

Motor	Voltage	Stepping Time	Drive Speed
Head Feed Motor	4.0 - 5.0V	4.17ms	240pps
	5.0 - 5.5V	3.57ms	280pps
Paper Feed Motor	4.0 - 5.5V	4.00ms	250pps

2.1.4 Stepping Motor Initialization

(1) Head feed motor initialization

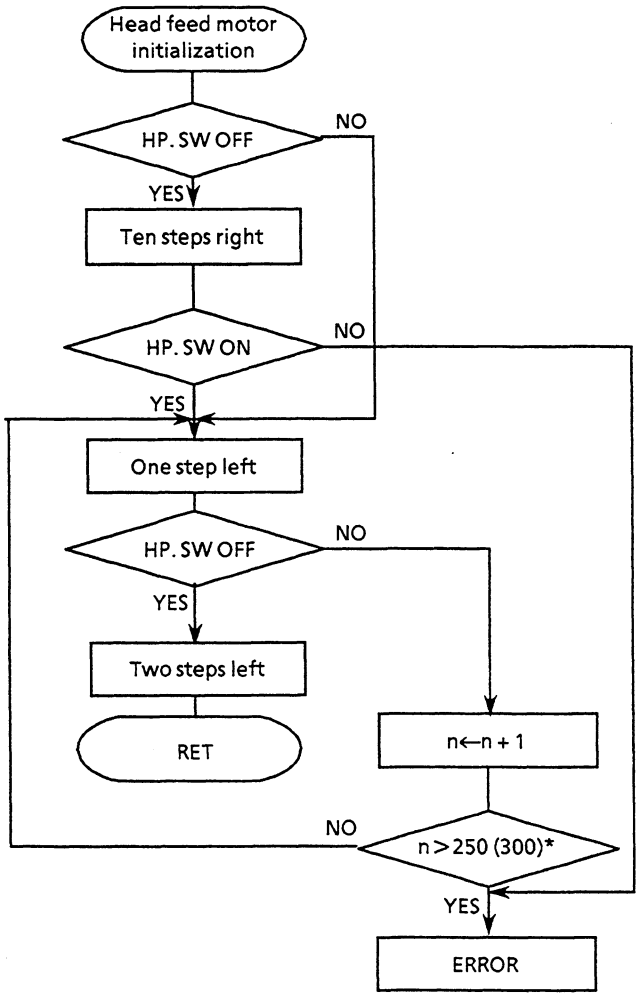
Perform the following procedure to set the home position. It is recommended that error detection also be performed.

① If the home position switch is OFF (open), move the print head ten steps to the right. If the home position switch is still OFF (open), it is judged that an error has occured.

② Observing the home position switch, move the print head to the left.

③ When the home position switch has changed to OFF (open), move the print head two more steps to the left and complete the position setting. This position becomes the home position.

④ If OFF (open) is still not detected after the print head has been moved 250 steps for STP211-144 or 300 steps for STP211-192 to the left, it is judged that an error has occured.



* The value enclosed with ( ) is applied to STP211-192.

Figure 2-2 Head Feed Motor Initialization

NOTE

The newly set home position may be slightly different from the previously set position, depending on detection timing and the accuracy of the home position switch, thus causing the print start position to be shifted slightly. Home position setting should be performed immediately following power-on. During operation, count the number of motor movement steps with the controller and determine the print start position.

(2) Paper feed motor initialization

Perform paper feed 12 steps or more. This is done to absorb backlash between the gears of the paper feed motor and the paper feed roller, and to match the logical phase output by the CPU with the actual phase of the motor.

NOTE

The print paper may shift slightly due to initialization of the paper feed motor.

2.1.5 Print Head Home Position Return

If the print head is left out of the home position for an extended period of time, the platen may become deformed, adversely affecting print quality. The head should be automatically returned to the home position in the following situations:

- When the printer is not operating for 0.5 seconds or more.
- When the printer is offline.
- When the printer is out of paper.

An example of home position return is given below. It is recommended that error detection also be performed.

① Return the print head to the calculated home position.
If the home position switch goes OFF (open) 12 or more steps before the calculated home position, or if the home position switch does not go OFF (open) before the print head has gone more than 12 steps to the left of the calculated home position, it is judged that an error has occured.

② After the home position switch goes OFF (open), the print head is moved two more steps to the left, and home return ends. At this time, the home position is not set again.

2.1.6 Head Feed Motor Drive

(1) Startup/Stopping

- Startup step
  When starting the motor when it is stopped, the same phase as the previous stopping step is output for the time of one step.

- Stopped condition
  To prevent the stepping motor from heating, it should not be excited while stopped.

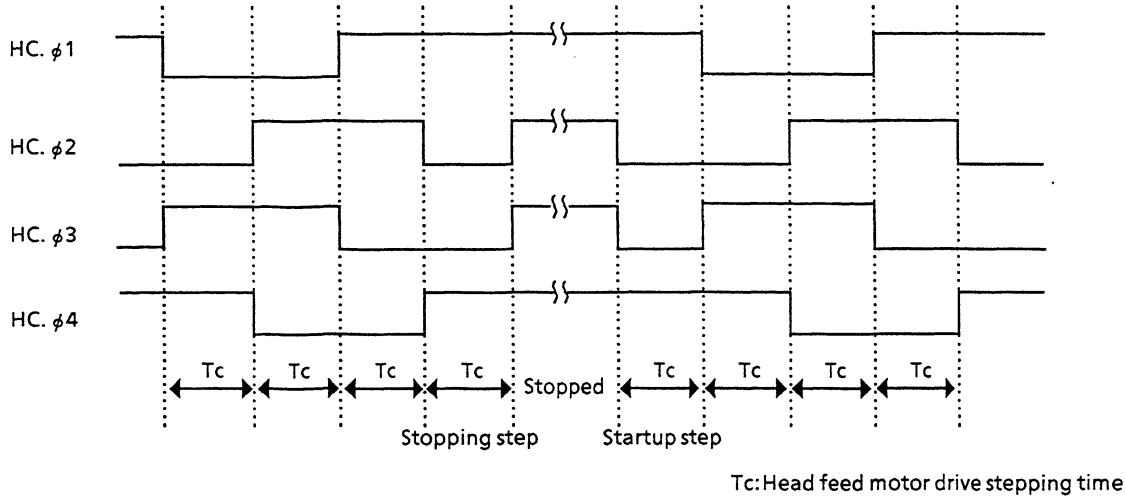


Figure 2-3 Head Feed Motor Startup/Stop Timing

(2) Reverse control

- Startup step
  The same phase as the final reverse step is excited for the time of one step. In other words, the final reverse step is output for twice the amount of time.

- Reverse step for backlash absorption
  There is a clearance in the thrust direction between the head feed screw and the frame. To absorb backlash whenever the head movement direction is changed, three reverse steps are necessary. For example, when reversing from right to left, the motor is driven three steps to the left.

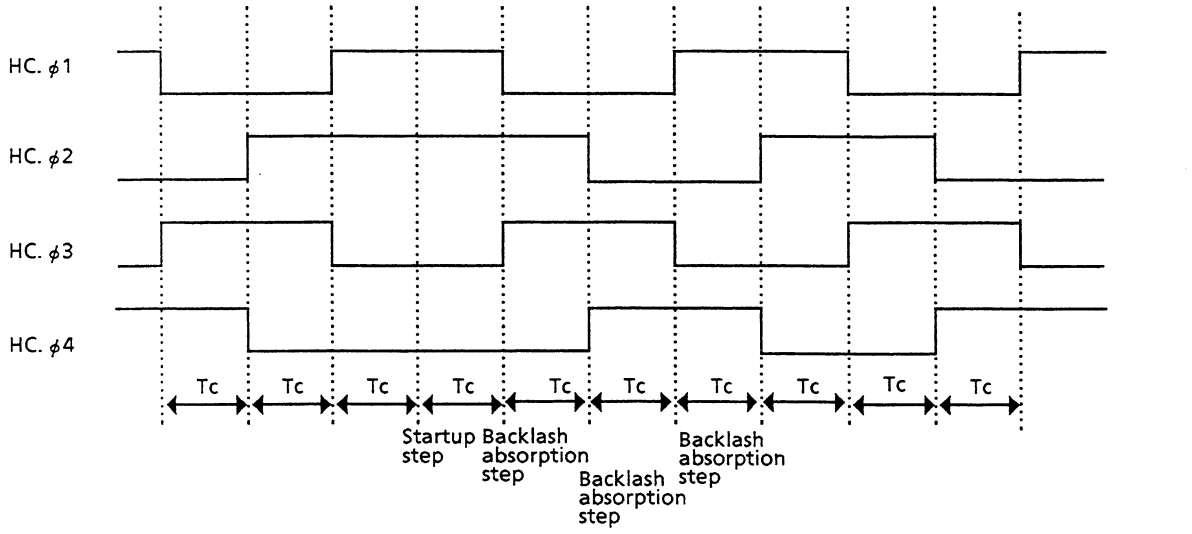


Figure 2-4 Head Feed Motor Reverse Timing

(3) Printing

- Pre-print idling
  Always conduct pre-print idling (two steps) before printing. Note that pre-print idling can be conducted in one step when printing following reverse step.

- Post-print idling
  Always conduct post-print idling after printing (two steps).

- Print step
  The print head should be driven in synchronicity with the head feed motor drive signal. One motor drive signal step should corresponds to one print pulse.

- Print area
  STP211A-144 print area is the 144 steps (dots) from the 16th step from the home position to the 159th step.
  STP211B-192 print area is the 192 steps (dots) from the 21st step from the home position to the 212nd step.

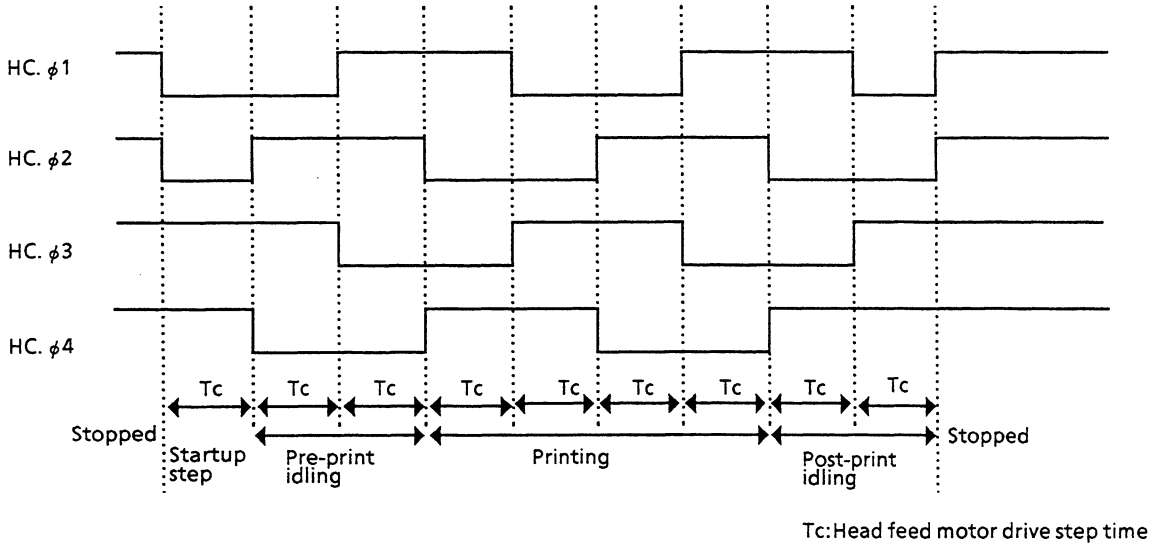


Figure 2-5 Printing

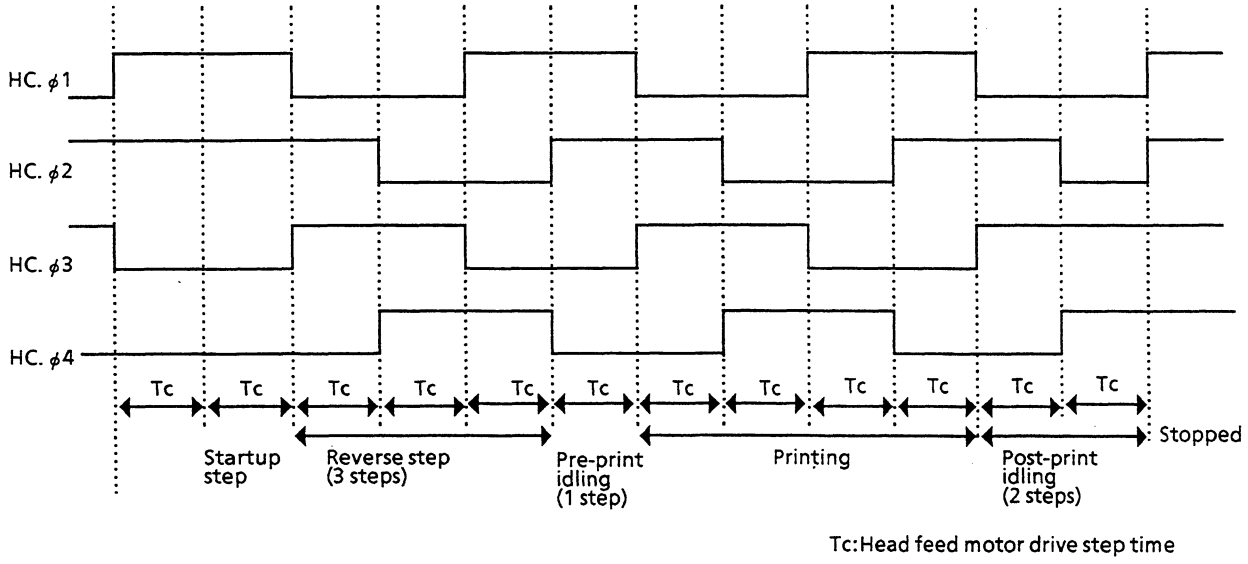


Figure 2-6 Printing (When printing following the reverse step)

2.1.7 Paper Feed Motor Drive

(1) Startup/Stopping

- Startup step
  When starting the motor when it is stopped, the same phase as the previous stopping step is output for the time of one step.

- Stopped condition
  To prevent the stepping motor from heating, it should not be excited while stopped.

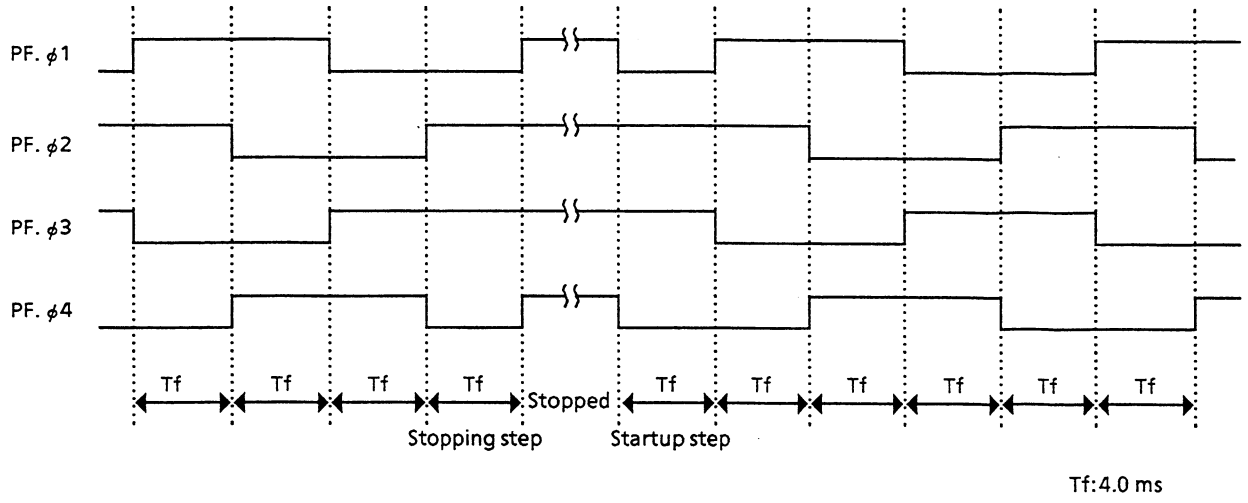


Figure 2-7 Paper Feed Motor Startup/Stop Timing

(2) Paper feed

- Paper feed can be conducted regardless of the head stop position.
- The print head should be returned to the home position before paper is inserted.
- Set a 40ms pause period after feeding each line.

2.2 PRINT PULSE WIDTH CONTROL OF THERMAL PRINT HEAD

2.2.1 Standard Print Pulse Width

The standard print pulse width (Th1) is determined using the following formula:

$$Th1 = \frac{E \times R_h}{V_h^2} \quad [ms] \quad \ldots\ldots\ldots \quad (2.1)$$

R_h: Average thermal print head resistance [Ω]
V_h: Voltage applied to thermal print head [V]
E : Energy applied to thermal print head [mJ]

- Average thermal print head resistance: R_h
  The print head resistance of the mechanism being used. The value varies according to the thermal print head rank (A, B, or C).

Table 2-4 Head resistance

Head Rank	Resistance
A	18.0Ω
B	16.4Ω
C	14.8Ω

- Voltage applied to thermal print head: V_h
  The applied head voltage at the FPC (Flexible Printed Circuit) during printing. Because the print pulse width is in inverse proportion to the square of the applied head voltage, the measurement error of Vh greatly affects print density. Sufficient care should be given.

- Energy applied to thermal print head: E
  The energy applied to the print head is decided by the temperature during printing, the sensitivity of the thermal paper used and the voltage applied to the print head.
  Tables 2-5 and 2-6 show the energy applied to the print head at normal temperature (24°C).
  Refer to "2.2.3 Head Applied Energy Correction" for how to decide the energy applied to the print head.

Table 2-5 Energy Applied to Thermal Print Head (When Both Thermal Paper and Heat Sensitive Copying Paper are used at normal temperature 24°C)

Applied energy \ Voltage applied to thermal print head	4.0V	5.0V	5.5V
Rated Energy	2.71mJ	2.42mJ	2.30mJ
Maximum Rated Energy	2.83mJ	2.52mJ	2.40mJ

Table 2-6 Energy Applied to Thermal Print Head (When Thermal Paper is used at normal temperature 24°C)

Applied energy \ Voltage applied to thermal print head	4.0V	5.0V	5.5V
Rated Energy	2.36mJ	2.10mJ	2.00mJ
Maximum Rated Energy	2.83mJ	2.52mJ	2.40mJ

2.2.2 Correction According to Activation History

The print pulse width of a dot is corrected according to the activation of that dot in Immediately preceding step. When the standard print pulse width is Th1, the print pulse width following correction according to activation history (T) is determined as follows:

Table 2-7 Correction According to Activation History

Immediately preceding step	T [ms]
Not activated	Th1
Activated	4/5 × Th1

NOTE

Avoid activating dots continuously. Set 1.5ms or more pause between pulses.

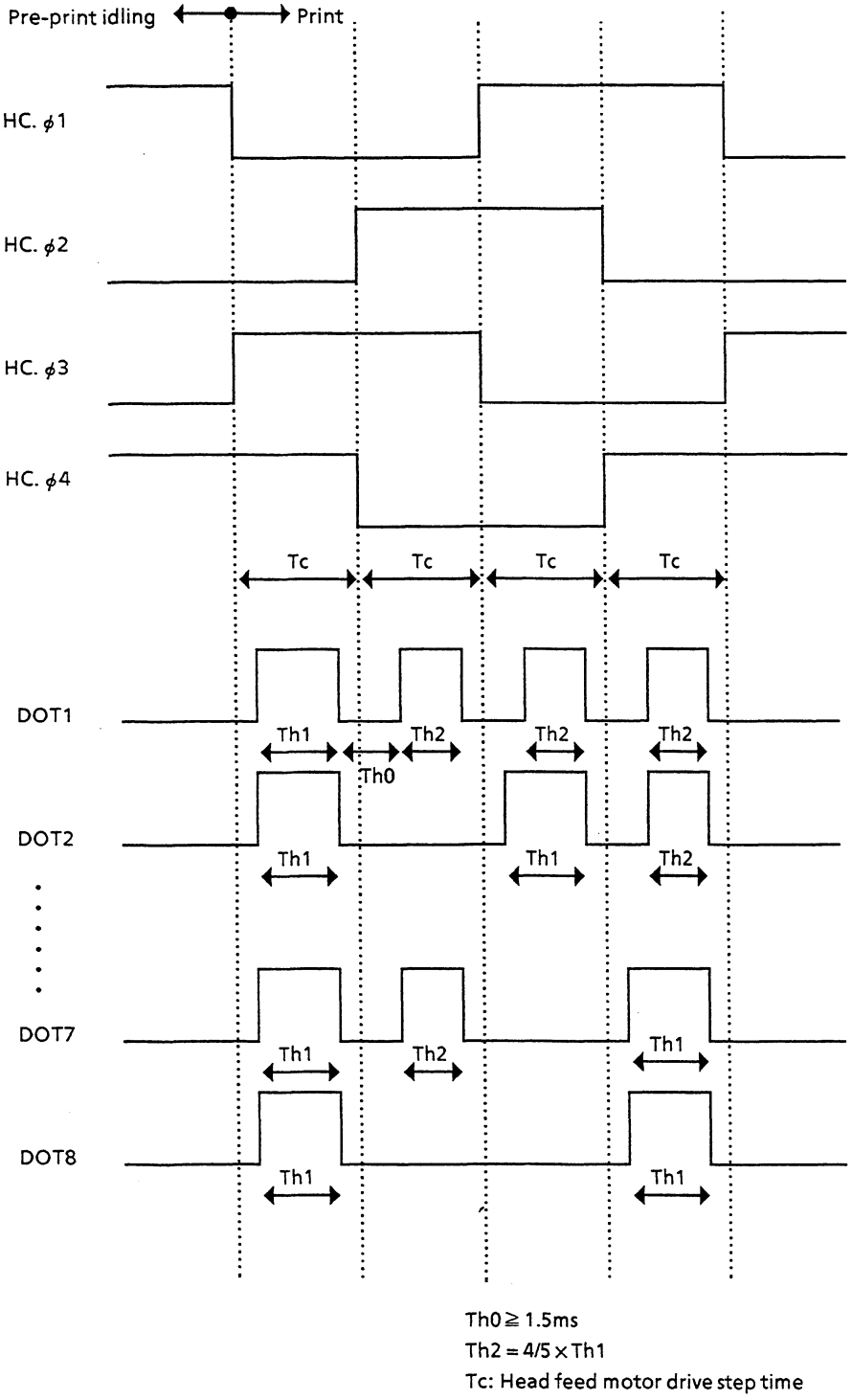


Figure 2-8 Correction According to Activation History

2.2.3 Head Applied Energy Correction

When the voltage applied to the thermal print head and operating environment temperature are changeable in use, the energy applied to the thermal print head E shown in the equation 2-1 is corrected by the following equation 2-2.

$$E = \frac{5.0 + Vh}{2 \times Vh} \times E0 \times (1 + \frac{24 - Top}{100}) \quad [mJ] \quad \ldots\ldots\ldots \quad (2\text{-}2)$$

Rh : Average thermal head resistance[Ω]
Vh : Voltage applied to the thermal print head[V]
Top : Operating environment temperature[°C]
E0 : Rated energy[mJ]

- Operating environment temperature : Top
  The environment temperature during printing . Actually the surface temperture of the thermal paper. However, because the surface temperature of the thermal paper cannot be measured directly, this operational environment temperature is substituted.

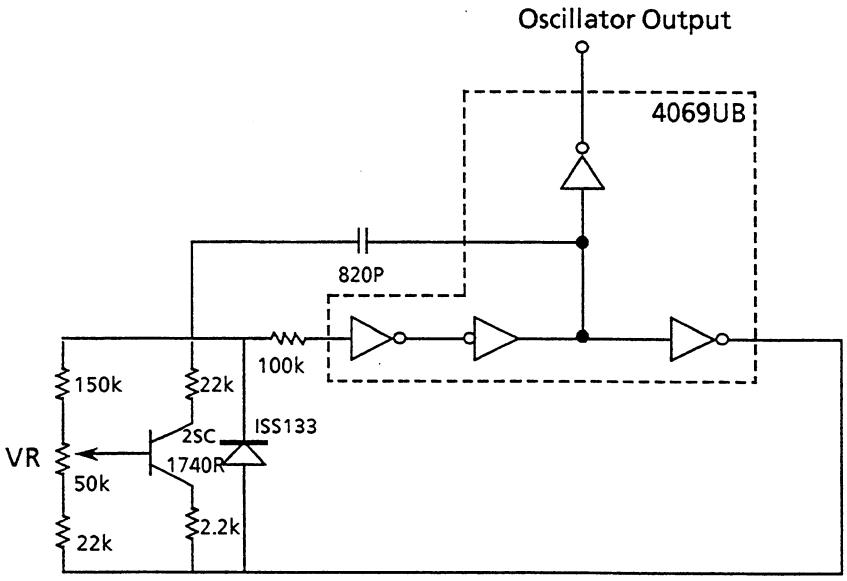
- The energy applied to the print head at normal temperature (24°C) and 5.0V of voltage applied to the print head. The rated energy should be set according to the sensitivity of the thermal paper used.

Table 2-8 Rated Energy

Paper / Applied Energy	Thermal Paper and Heat Sensitive Copying Paper	Thermal Paper
Rated Energy	2.42mJ	2.10mJ
Maximum Rated Energy	2.52mJ	2.52mJ

2.2.4 Pulse Width Control Circuit Sample

Firure 2-9 shows an example of pulse width control circuit.
This circuit enables to correct the temperature and the voltage.
The print pulse width is generated by counting the pulses output from this circuit.



- Adjusdt VR so that the 20 count period corresponds to the adaquate print pulse width at normal temperature.

Figure 2-9 Pulse Width Control Circuit Sample

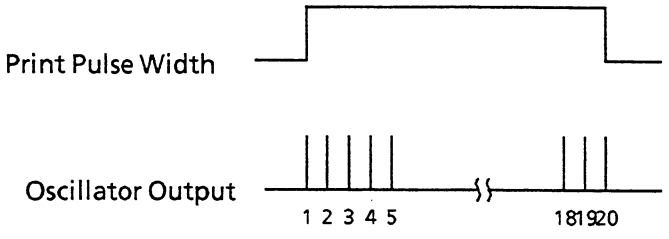


Figure 2-10 Oscillator Output and Print Pulse Width

CHAPTER 3

DRIVE METHOD (STP211J-192)

This chapter describes how to drive STP211J-192 in high speed.

3.1 STEPPING MOTOR DRIVE

3.1.1 Motor Drive Circuit Example

An example of a motor drive circuit is shown in Figure 3-1.

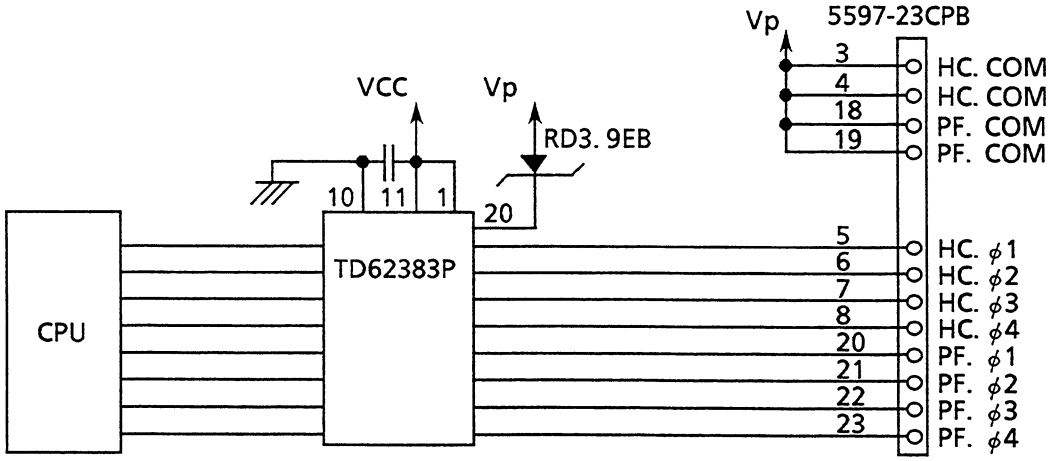


Figure 3-1 Motor Drive Circuit Example

NOTE

1. The recommended motor driver is pulled up internally.
2. If a motor driver or Zener diode other than that which is recommended is used, motor output torque may be affected, causing print density to be inconstant.

[Recommended motor driver]

Maker	Model
Toshiba	TD62383P
Sanyo	LB1247

[Recommended Zener diode]

Maker	Model
NEC	RD3.9EB

3.1.2 Excitation Sequence

(1) Head feed motor

The head feed motor uses 2-phase excitation. If the motor is excited in the order of Step 1, Step 2, Step 3, Step 4, Step 1, Step 2, and so forth, the print head moves toward the right side relative to the paper feed direction. If the motor is excited in the reverse order (Step 4, Step 3, Step 2, Step 1, Step 4, Step 3, and so forth), the print head moves toward the left side (home position).

Table 3-1 Head Feed Motor Activation Sequence

Sequence	Signal			
	HC. ϕ1 (Blue)	HC. ϕ2 (White)	HC. ϕ3 (Yellow)	HC. ϕ4 (Red)
Step 1	OFF (HIGH)	OFF (HIGH)	ON (LOW)	ON (LOW)
Step 2	OFF (HIGH)	ON (LOW)	ON (LOW)	OFF (HIGH)
Step 3	ON (LOW)	ON (LOW)	OFF (HIGH)	OFF (HIGH)
Step 4	ON (LOW)	OFF (HIGH)	OFF (HIGH)	ON (LOW)

The print head is fed one dot for each motor drive signal step.

NOTE

There is a clearance between the head feed screw and the frame. Accordingly, there is a maximum ± 1.5 dot drift when bidirectional printing is performed.

(2) Paper feed motor

The paper feed motor uses 2-phase excitation. If the motor is excited in the order of Step 1, Step 2, Step 3, Step 4, Step 1, Step 2, and so forth, the print paper is fed forward.

Table 3-2 Paper Feed Motor Activation Sequence

Sequence	Signal			
	PF. ϕ1 (Blue)	PF. ϕ2 (White)	PF. ϕ3 (Yellow)	PF. ϕ4 (Red)
Step 1	OFF (HIGH)	OFF (HIGH)	ON (LOW)	ON (LOW)
Step 2	OFF (HIGH)	ON (LOW)	ON (LOW)	OFF (HIGH)
Step 3	ON (LOW)	ON (LOW)	OFF (HIGH)	OFF (HIGH)
Step 4	ON (LOW)	OFF (HIGH)	OFF (HIGH)	ON (LOW)

The print paper is fed one dot for every four motor drive signal steps. For example, to feed the paper ten dots, the paper feed motor would be driven 40 steps.

3.1.3 Stepping Motor Drive Speed

Table 3-3 shows stepping motor drive speed.

Table 3-3 Stepping Motor Drive Speed

Motor	Voltage	Step Time	Drive Speed
Head Feed Motor	5.0 - 5.5V	2.38ms	420pps
Paper Feed Motor	5.0 - 5.5V	4.00ms	250pps

3.1.4 Stepping Motor Initialization

(1) Head feed motor initialization

Perform the following procedure to set the home position. Assume that the head feed motor drive frequency is 250pps (fixed speed drive). It is recommended that error detection also be performed.

NOTE

The printer may make a loud drive noise during head feed motor initialization.
This is not a printer mechanisum malfunction.

① If the home position switch is OFF (open), move the print head ten steps to the right. If the home position switch is still OFF (open), it is judged that an error has occured.

② Observing the home position switch, move the print head to the left.

③ When the home position switch has changed to OFF (open), move the print head two more steps to the left. This position becomes the home position.

④ If OFF (open) is still not detected after the print head has been moved 300 steps to the left, it is judged that an error has occured.

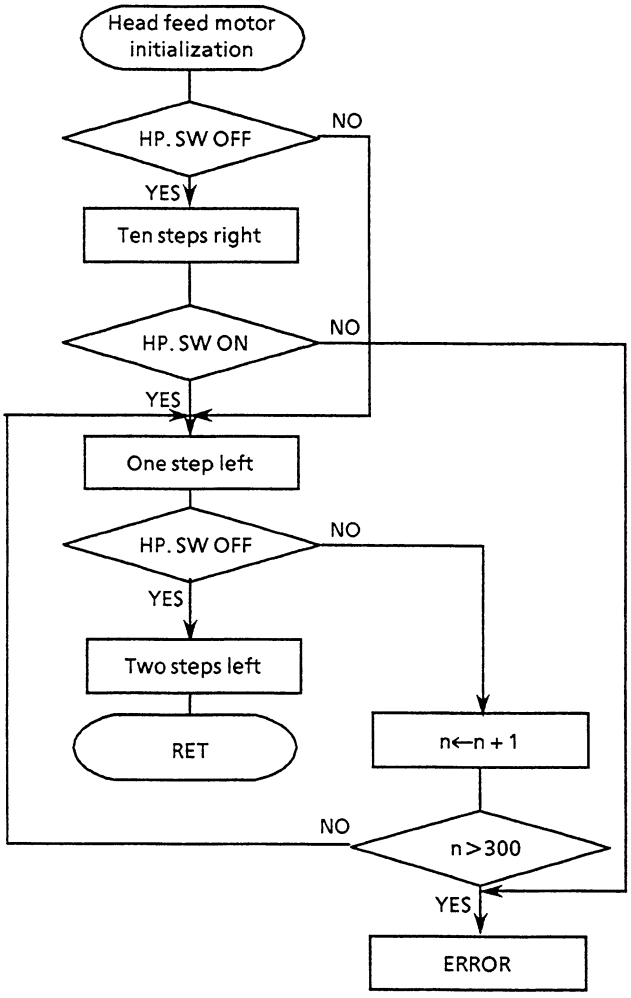


Figure 3-2 Head Feed Motor Initialization

NOTE

The newly set home position may be slightly different from the previously set position, depending on detection timing and the accuracy of the home position switch, thus causing the print start position to be shifted slightly. Home position setting should be performed immediately following power-on. During operation, count the number of motor movement steps with the controller and determine the print start position.

(2) Paper feed motor initialization

Perform paper feed 12 steps or more. This is done to absorb backlash between the gears of the paper feed motor and the paper feed roller, and to match the logical phase output by the CPU with the actual phase of the motor.

NOTE

The print paper may shift slightly due to initialization of the paper feed motor.

3.1.5 Print Head Home Position Return

If the print head is left out of the home position for an extended period of time, the platen may become deformed, adversely affecting print quality. The head should be automatically returned to the home position in the following situations:

- When the printer is not operating for 0.5 seconds or more.
- When the printer is offline.
- When the printer is out of paper.

An example of home position return is given below. It is recommended that error detection also be performed.

① Return the print head to the calculated home position.
If the home position switch goes OFF (open) 12 or more steps before the calculated home position, or if the home position switch does not go OFF (open) before the print head has gone more than 12 steps to the left of the calculated home position, it is judged that an error has occured.

② After the home position switch goes OFF (open), the print head is moved two more steps to the left, and home return ends. At this time, the home position is not set again.

3.1.6 Head Feed Motor Drive

The head feed motor drive method differs for the high-speed drive area and the low-speed drive area.
The low-speed drive area is to the 17th step to the right of the home position and the high-speed drive area is from the 18th step to the 216th step (see Figure 1-2).

(1) High-speed drive area drive
High-speed drive can be performed through acceleration and deceleration of the head feed motor.

① Acceleration/Deceleration

Table 3-4 Acceleration

	Step time (ms)	Speed (pps)
Step 1	4.00	250
Step 2	3.15	317
Step 3	2.69	372
Step 4	2.38	420

Table 3-5 Deceleration

	Step time (ms)	Speed (pps)
Step 1	2.38	420
Step 2	2.69	372
Step 3	3.15	317
Step 4	4.00	250

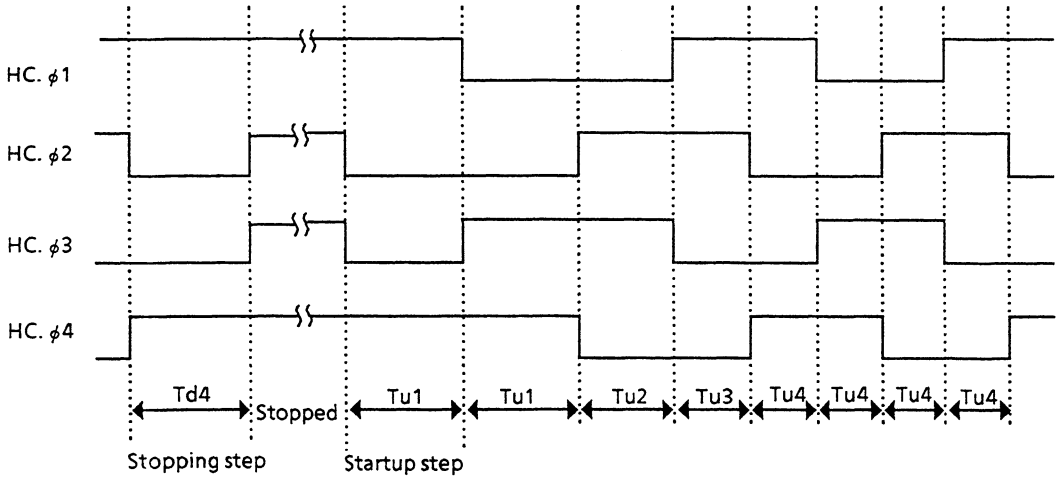
NOTE

The sound emitted by the printer may become louder during acceleration or deceleration. This is not a malfunction.

② Startup

- Startup step
  When starting the motor when it is stopped, the same phase as the previous stopping step is excited for the time of acceleration step 1.

- Acceleration control
  After the startup step is output, drive must be conducted accelerating in the order of the steps in the acceleration table, continuing through the final step. After acceleration to the final step has been completed, the motor is driven at a constant speed, equal to the speed of the final step.



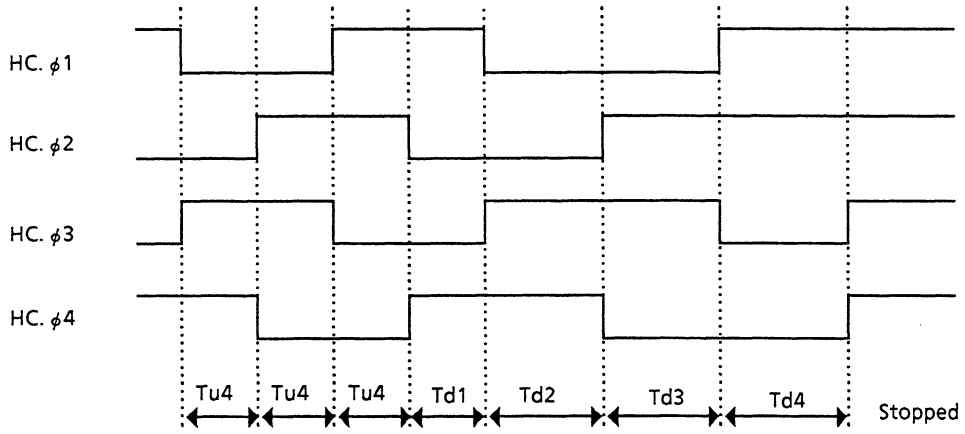
T_{u1}: Time of acceleration step 1
T_{u2}: Time of acceleration step 2
↓
T_{un}: Time of acceleration step n, etc.

Figure 3-3 Head Feed Motor Startup Timing (High-speed Drive)

③ Stopping

- Deceleration control
  To stop the motor, drive must be conducted decelerating in the order of the steps in the deceleration table, continuing through the final step.

- Stopped condition
  To prevent the stepping motor from heating, it should not be excited while stopped.



T_{d1}: Time of deceleration step 1
T_{d2}: Time of deceleration step 2
↓
T_{dn}: Time of deceleration step n, etc.

Figure 3-4 Head Feed Motor Stop Timing (High-speed Drive)

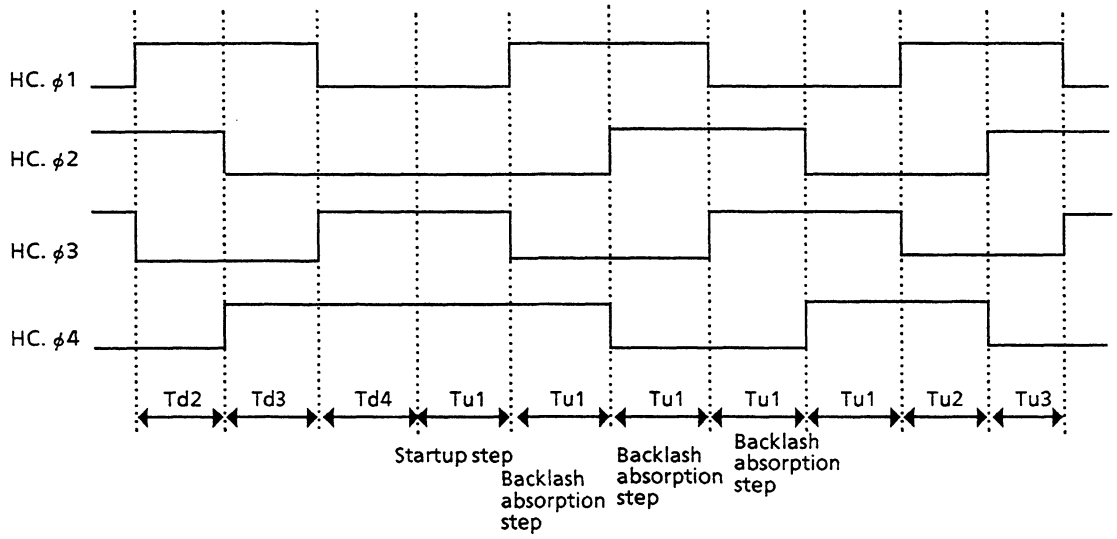
④ Reverse control

- Deceleration control
  Before reversing the motor, decelerate the motor in the order of the steps in the deceleration table, continuing through the final step.

- Startup step
  After the final deceleration step is output, the same phase as that step is excited for the time of acceleration step 1.

- Reverse step for backlash absorption
  To absorb backlash, three reverse steps are necessary. For example, when reversing from right to left, the motor is driven three steps to the left. The time for each step is the same as that for acceleration step 1.

- Acceleration control
  After backlash absorption, accelerate the motor in the order of the steps in the acceleration table, continuing through the final step.
  After acceleration to the final step has been completed, the motor is driven at a constant speed, equal to the speed of the final step.



T_{u1}: Time of acceleration step 1
T_{u2}: Time of acceleration step 2
↓
T_{un}: Time of acceleration step n, etc.
T_{d1}: Time of deceleration step 1
T_{d2}: Time of deceleration step 2
↓
T_{dn}: Time of deceleration step n, etc.

Figure 3-5 Head Feed Motor Reverse Timing (High-speed Drive)

⑤ Printing

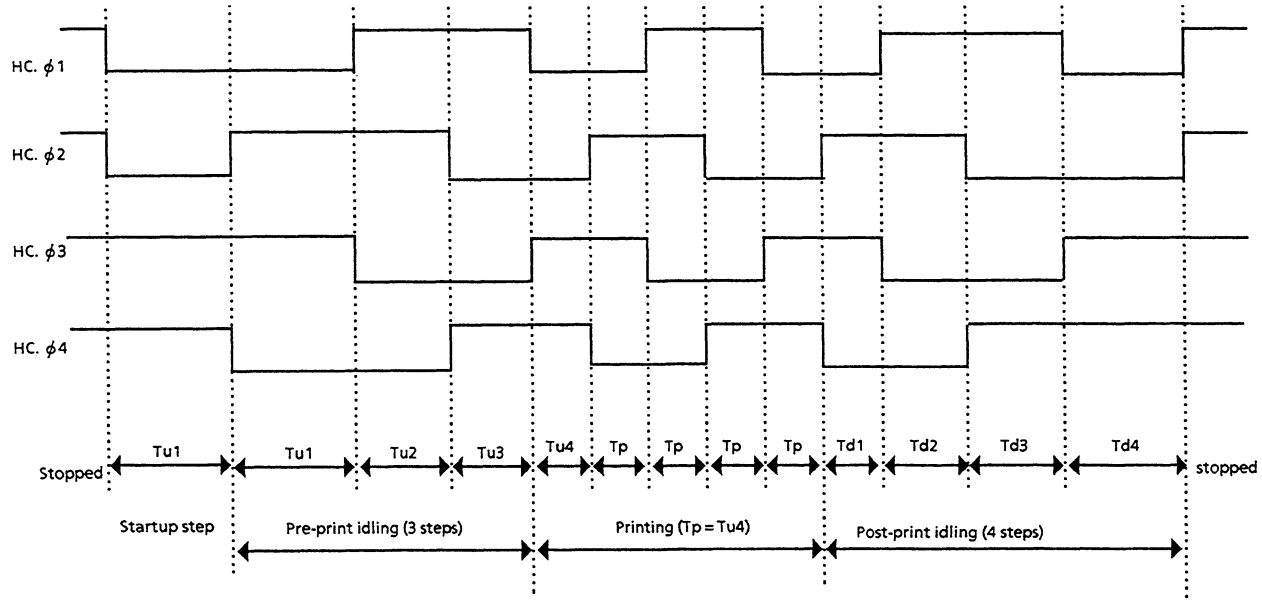
- Pre-print idling
  Always conduct pre-print idling (three steps) before printing. Acceleration can be done during pre-print idling.

- Post-print idling
  Always conduct post-print idling after printing (three or four steps). Deceleration can be done during post-print idling.

- Print step
  Printing can be conducted from acceleration step 4. The time of the final acceleration step becomes the time of the print step.

- Print area
  The print area is the 192 steps (dots) from the 21th step from the home position to the 212th step.

- The print head should be driven in synchronicity with the head feed motor drive signal. One motor drive signal step should correspond to one print pulse.



T_{u1}: Time of acceleration step 1
T_{u2}: Time of acceleration step 2
↓
T_{un}: Time of acceleration step n, etc.
T_{d1}: Time of deceleration step 1
T_{d2}: Time of deceleration step 2
↓
T_{dn}: Time of deceleration step n, etc.
T_p : Print step time

Figure 3-6 Printing

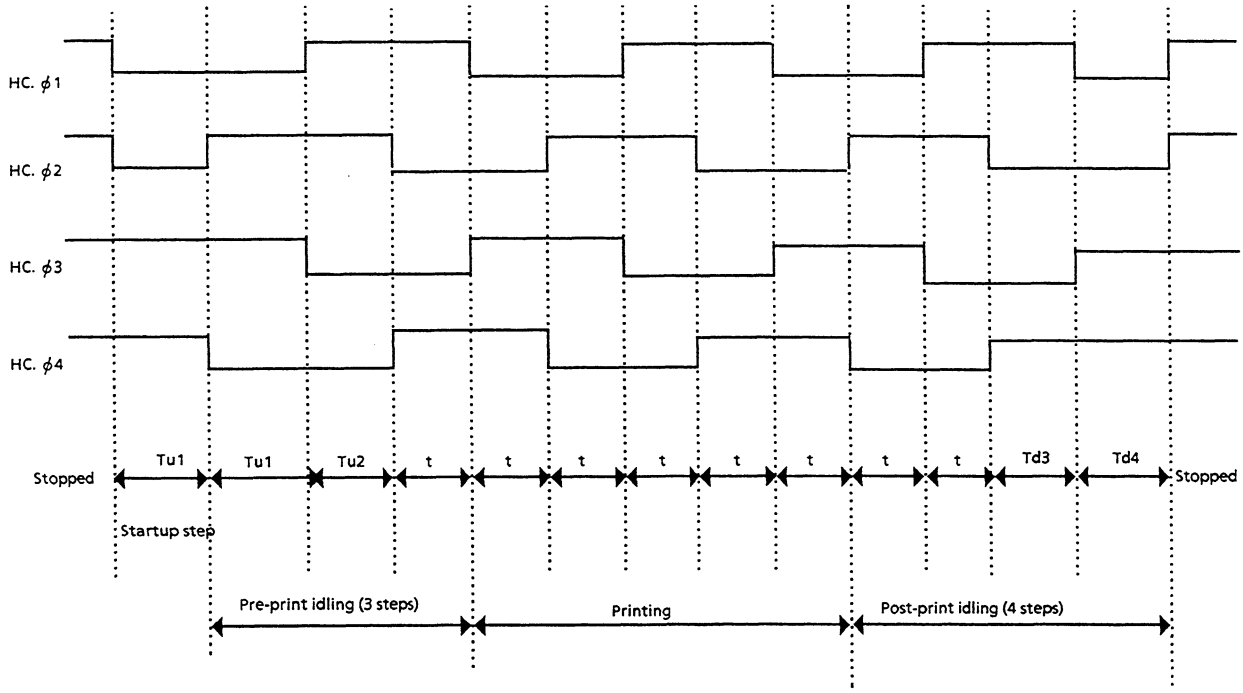
⑥ Print speed correction

During printing, if [print pulse width + processing time] exceeds the time of one head feed motor step (print step), it is necessary to change the drive frequency of the head feed motor so that the print pulse is within that step.

However, changing the drive frequency during printing may cause inconsistant print density. Before printing the line, determine the appropriate drive frequency and conduct constant speed drive at that drive frequency.

For acceleration, accelerate the motor in the order of the steps in the acceleration table, continuing to the previously determined drive frequency. After acceleration, conduct constant speed drive at that speed. For deceleration, decelerate the motor from the printing drive frequency, in the order of the steps in the deceleration table.

An example of acceleration during pre-print idling is given in Figure 1-10. In the example, the largest [print pulse width + processing time] within a line is 3.0 ms.



T_{u1}: Time of acceleration step 1
T_{u2}: Time of acceleration step 2
↓
T_{un}: Time of acceleration step n, etc.
T_{d1}: Time of deceleration step 1
T_{d2}: Time of deceleration step 2
↓
T_{dn}: Time of deceleration step n, etc.
t : Head pulse width + Processing time

Figure 3-7 Print Speed Correction

(2) Low-speed driver area drive
The head feed motor is constant-speed driven at a drive frequency of 250 pps.

NOTE

The sound emitted by the printer may become louder during low-speed stable drive. This is not a malfunction.

① Startup/Stopping

- Startup step
  When starting the motor when it is stopped, the same phase as the previous stopping step is output for the time of one step.

- Stopped condition
  To prevent the stepping motor from heating, it should not be excited while stopped.

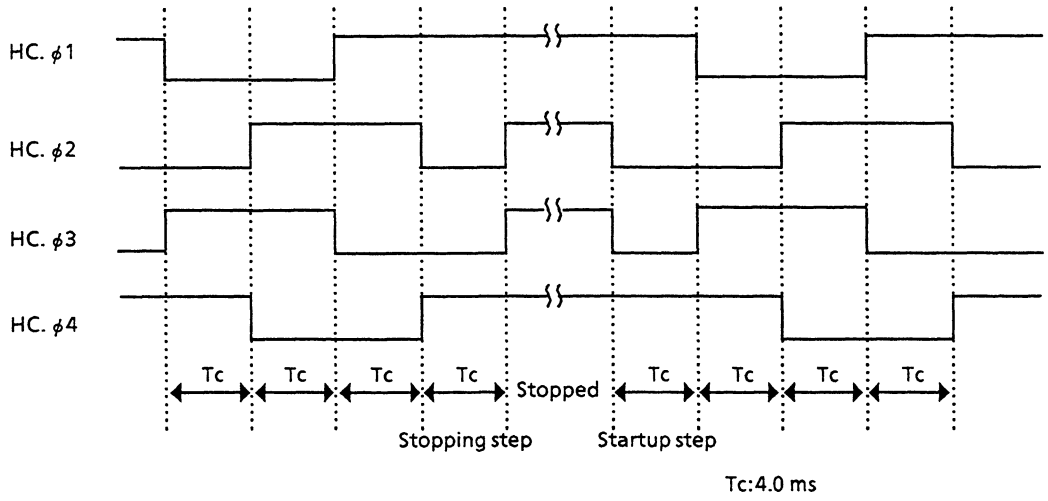


Figure 3-8 Paper Feed Motor Startup/Stop Timing (Low speed Stable Drive)

② Reverse control

- Startup step
  The same phase as the final reverse step is excited for the time of one step. In other words, the final reverse step is output for twice the amount of time.

- Reverse step for backlash absorption
  There is a clearance in the thrust direction between the head feed screw and the frame. To absorb backlash whenever the head movement direction is changed, three reverse steps are necessary. For example, when reversing from right to left, the motor is driven three steps to the left.

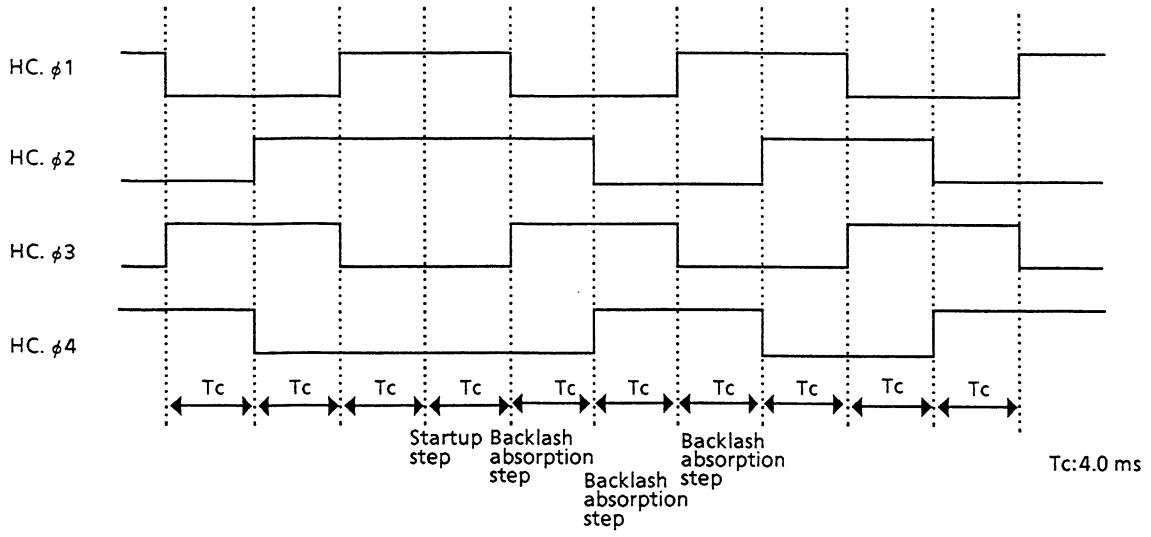


Figure 3-9 Head Feed Motor Reverse Timing (Low-Speed Stable Drive)

3.1.7 Paper Feed Motor Drive

① Startup/Stopping

- Startup step
  When starting the motor when it is stopped, the same phase as the previous stopping step is output for the time of one step.

- Stopped condition
  To prevent the stepping motor from heating, it should not be excited while stopped.

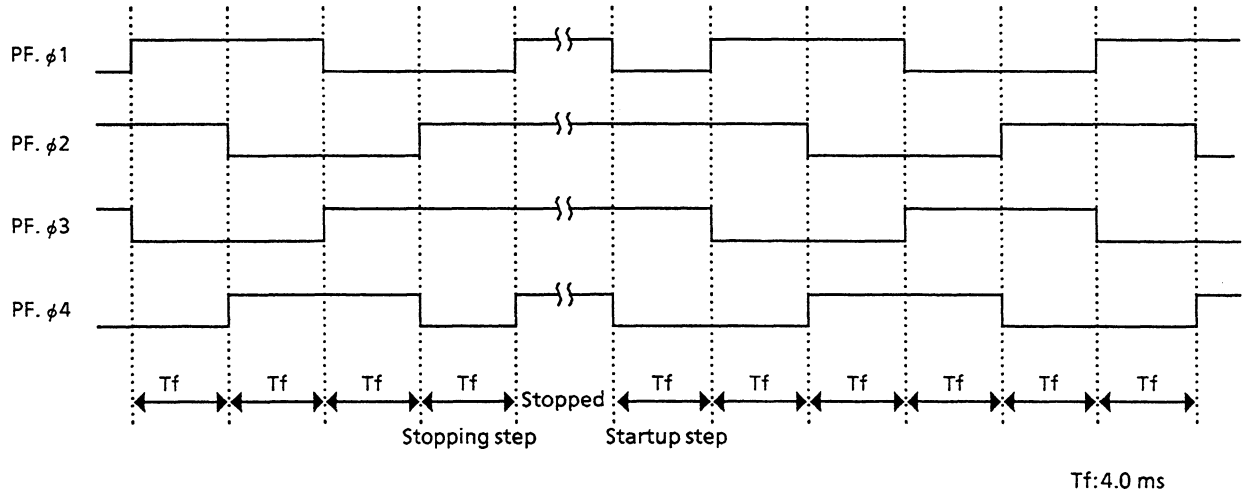


Figure 3-10 Paper Feed Motor Startup/Stop Timing

② Paper feed

- Paper feed can be conducted regardless of the head stop position.
- The print head should be returned to the home position before paper is inserted.
- Set a 40ms pause period after feeding each line.

3.2 PRINT PULSE WIDTH CONTROL OF THERMAL PRINT HEAD

3.2.1 Standard Print Pulse Width

The standard print pulse width (T_{std}) is determined using the following formula:

$$T_{std} = \frac{E_0 \times R_h}{V_h^2} \times \left\{ 1 + \frac{1.2 \times (24 - T_{op})}{100} \right\} \quad [ms] \quad \ldots\ldots\ldots \quad (3.1)$$

R_h: Average thermal print head resistance [Ω]
V_h: Voltage applied to thermal print head [V]
T_{op}: Operating environment temperature [°C]
E_0: Rated energy [mJ]

- Average thermal print head resistance: R_h
  The print head resistance of the mechanism being used. The value varies according to the thermal print head rank (A, B, or C).

Table 3-6 Head Resistance

Head Rank	Resistance
A	18.0Ω
B	16.4Ω
C	14.8Ω

- Voltage applied to thermal print head: V_h
  The applied head voltage at the FPC (Flexible Printed Circuit) during printing. Because the print pulse width is in inverse proportion to the square of the applied head voltage, the measurement error of Vh greatly affects print density. Sufficient care should be given.

- Operating environment tempertaure: T_{op}
  The environment temperature during printing. Actually the surface temperature of the thermal paper. However, because the surface temperature of the thermal paper cannot be measured directly, this operational environment temperature is substituted.

- Rated energy: E_0
  The energy applied to the print head at normal temperature (24°C).
  Use a high sensitive thermal paper (see "1.6.2 Drive Method and Recommended Thermal Paper), and set the energy as following.

Table 3-7 Rated Energy

Applied Energy \ Paper	Thermal Paper (High Sensitivity)
Rated Energy	1.6mJ
Maximum Rated Energy	2.3mJ

3.2.2 Correction According to the Number of Simultaneously Activated Dots

Due to the influence of the resistance elements of the print wiring board and the FPC (Flexible Printed Circuit) on the common electrode side of the print head, the more dots that are simultaneously activated, the lower voltage that goes to the heating elements. It is therefore necessary to correct the print head standard print pulse width (Tstd) according to the number of simultaneously activated dots. The approximate correction is made as follows:

$$T_{h1} = k \times (n - 1) \times T_{std} + T_{std} \text{ [ms]} \quad \ldots\ldots\ldots \quad (3.2)$$

k: Correction coefficient
n: Number of simultaneously activated dots
T_{std}: Thermal print head standard pulse width [ms]

- Correction coefficient: k
  Indicates the correction rate per dot. 0.02 for a print wiring board with a wiring length of about 50 mm.

3.2.3 Correction According to Activation History

The print pulse width of a dot is corrected according to the activation of that dot in the previous three steps. When the print pulse width following correction according to the number of simultaneously activated dots is Th1, the print pulse width following correction according to activation history (T) is determined as follows:

Table 3-8 Correction According to Activation History

3 steps previous	2 steps previous	Immediately preceding stèp	T [ms]
Not activated	Not activated	Not activated	T_{h1}
Activated	Not activated	Not activated	$8/9 \times T_{h1}$
Not activated	Activated	Not activated	$7/9 \times T_{h1}$
Activated	Activated	Not activated	$7/9 \times T_{h1}$
Not activated	Not activated	Activated	$5/9 \times T_{h1}$
Activated	Not activated	Activated	$5/9 \times T_{h1}$
Not activated	Activated	Activated	$5/9 \times T_{h1}$
Activated	Activated	Activated	$5/9 \times T_{h1}$

For example, if the second dot on the print head (DOT2) was activated three steps previously, not activated two steps previously, and activated in the immediately preceding step, activation time (print pulse width) would be $5/9 \times T_{h1}$.

NOTE

Avoid consecutive activation. Allow an interval of at least 1.0 ms between pulses.

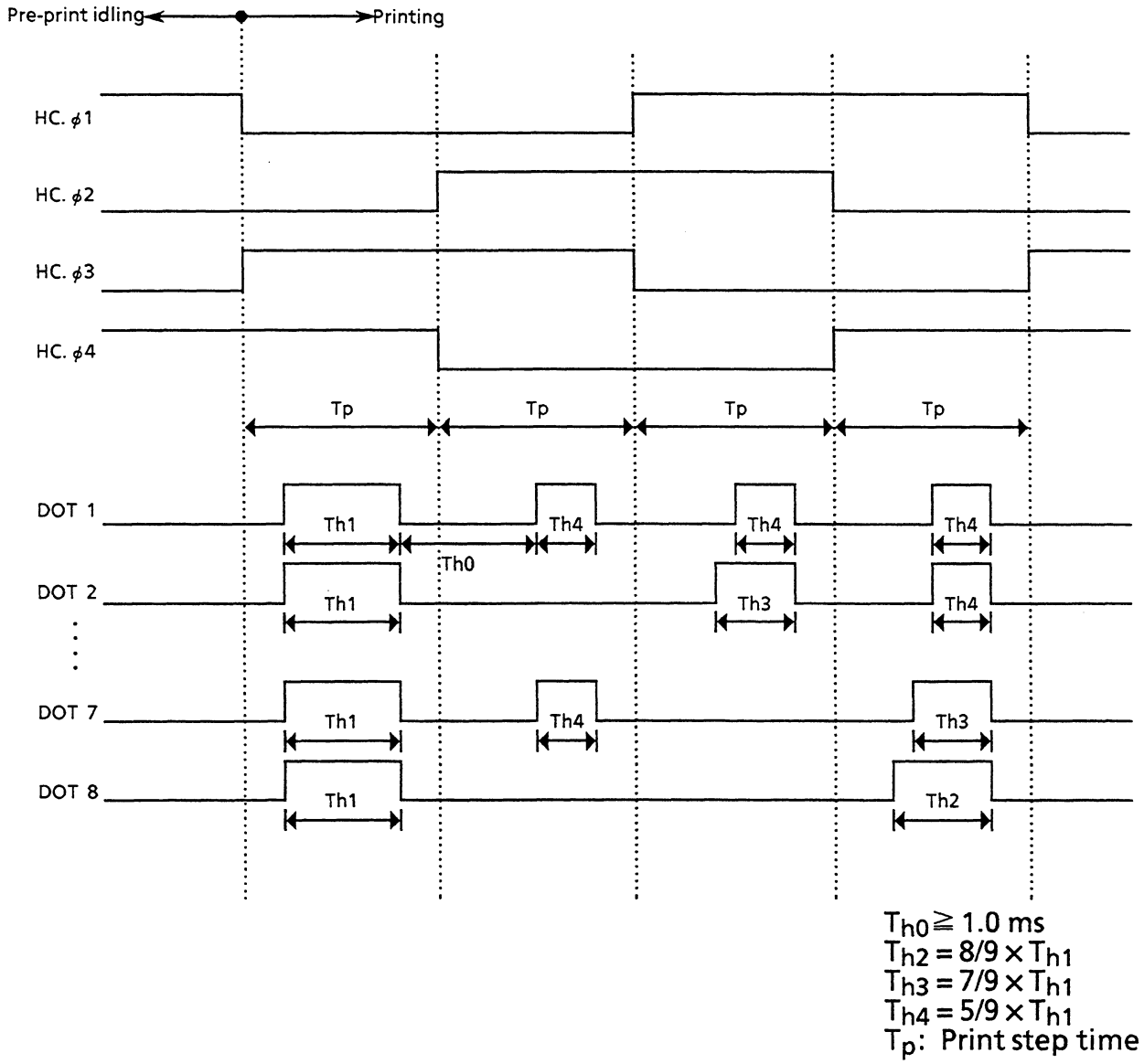


Figure 3-11 Correction According to Activation History

CHAPTER 4

CONNECTION SPECIFICATIONS

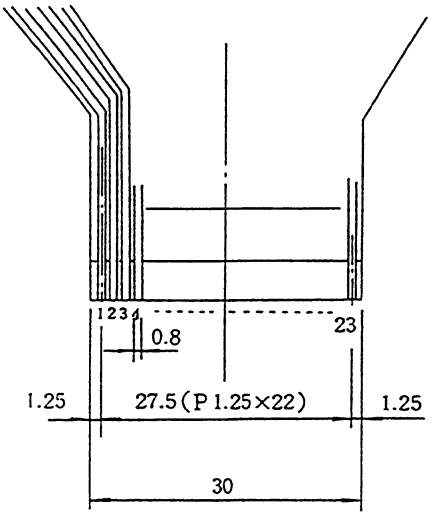
The pins of the FPC (Flexible Printed Circuit) are defined in Table 4-1. Pin arrangement is shown in Figure 4-1.

Table 4-1 FPC Pin Definition

Pin No.	Pin Name (color)	Function Name
1	——	Home position switch
2	——	Home position switch
3	HC.COM (Green)	Head feed motor COMMON
4	HC.COM (Green)	Head feed motor COMMON
5	HC.ϕ1 (Blue)	Head feed motor ϕ1
6	HC.ϕ2 (White)	Head feed motor ϕ2
7	HC.ϕ3 (Yellow)	Head feed motor ϕ3
8	HC.ϕ4 (Red)	Head feed motor ϕ4
9	——	Head DOT 1
10	——	Head DOT 2
11	——	Head DOT 3
12	——	Head DOT 4
13	——	Head DOT 5
14	——	Head DOT 6
15	——	Head DOT 7
16	——	Head DOT 8
17	——	Head COMMON
18	PF.COM (Green)	Paper feed motor COMMON
19	PF.COM (Green)	Paper feed motor COMMON
20	PF.ϕ1 (Blue)	Paper feed motor ϕ1
21	PF.ϕ2 (White)	Paper feed motor ϕ2
22	PF.ϕ3 (Yellow)	Paper feed motor ϕ3
23	PF.ϕ4 (Red)	Paper feed motor ϕ4

[Recommended Connector]

Maker	Part Number
Molex-Japan Co., Ltd.	5597-23APB (angle type) 5597-23CPB (straight type)



UNIT : mm

Figure 4-1 FPC Pin Arrangement

CHAPTER 5

ASSEMBLY DIAGRAM AND PART NAMES

5.1 ASSEMBLY DIAGRAM

The assembly diagrams of STP211A-144 and STP211B-192, and STP211J-192 are shown in Figure 5-1 and Figure 5-2.

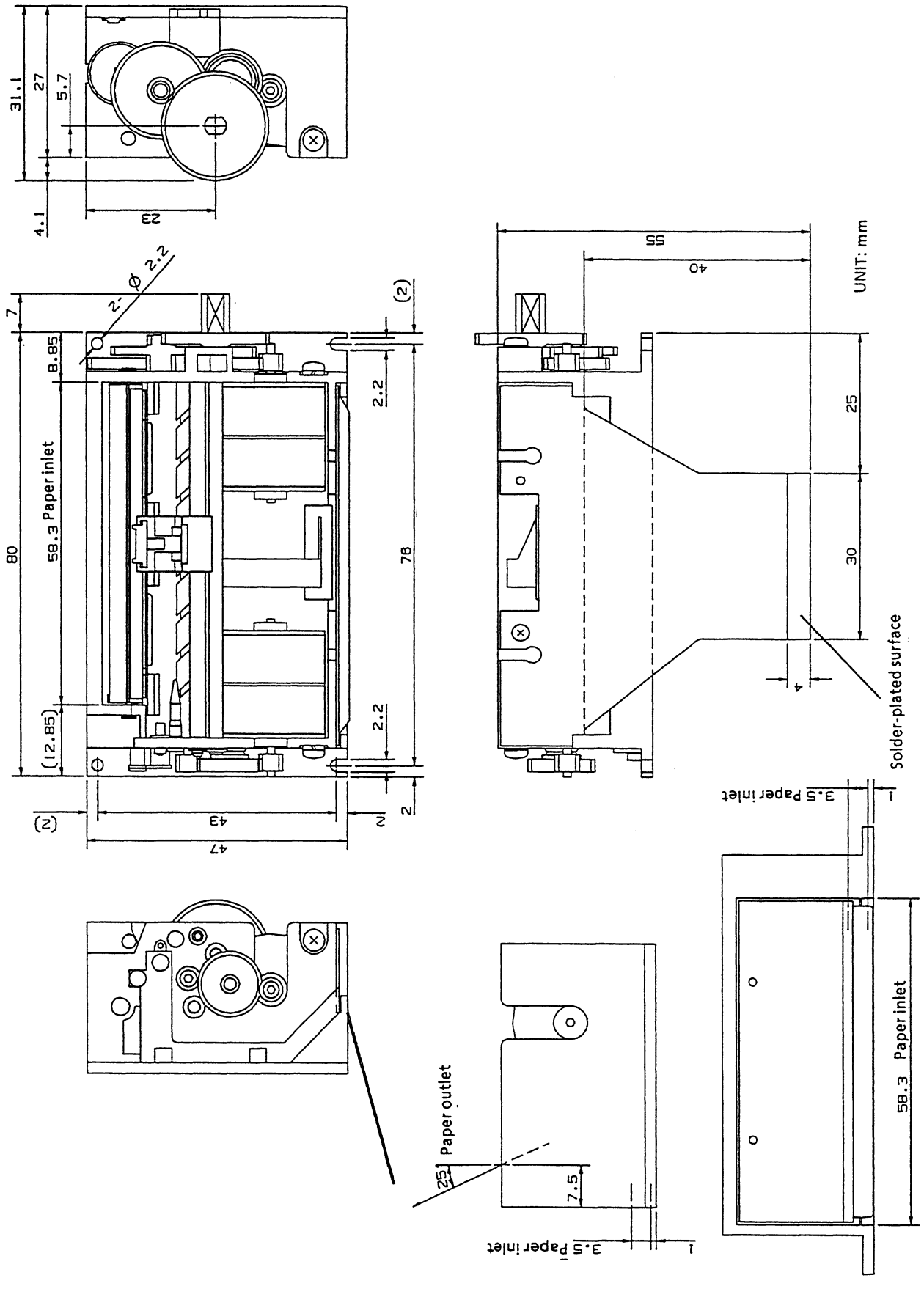


Figure 5-1 Assembly Diagram (STP211A-144 and STP211B-192)

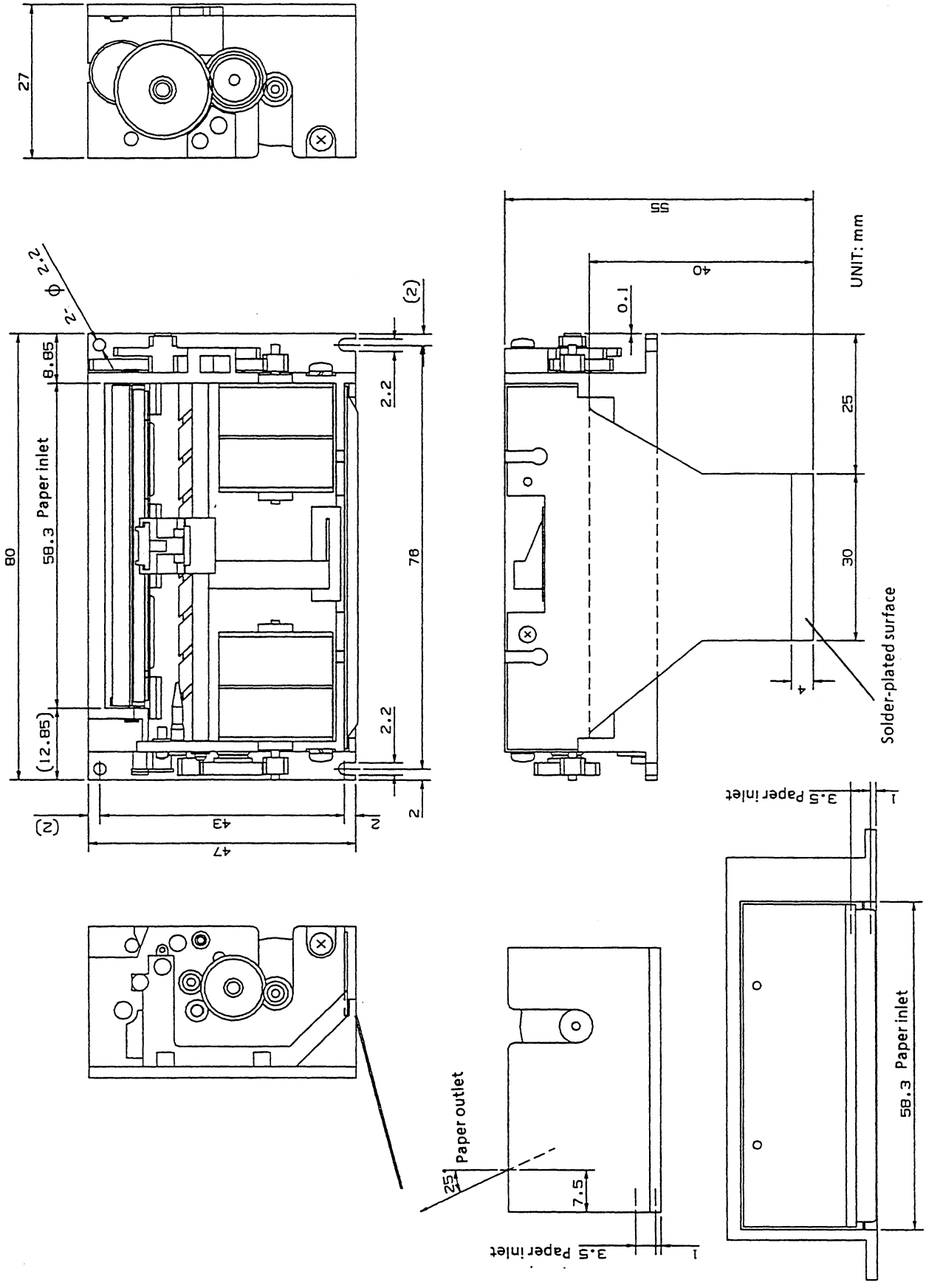


Figure 5-2 Assembly Diagram (STP211J-192)

5.2 PART NAMES

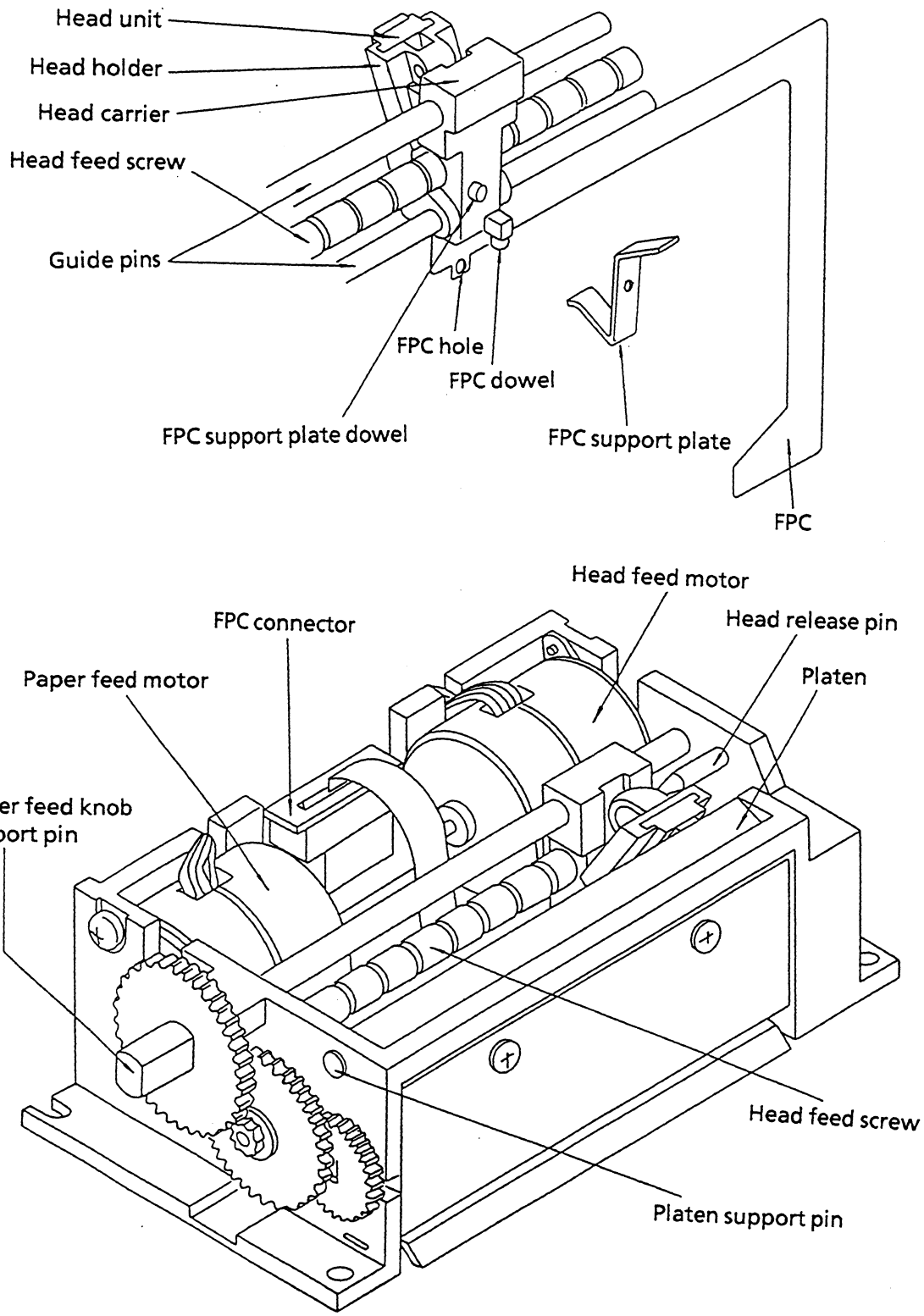


Figure 5-3 Part Names

CHAPTER 6

ATTACHMENT LAYOUT AND DESIGN

6.1 SECURING THE PRINTER

- Insert an L-shaped dowel or pin into the U-shaped hole (width: 2.2 mm) in the printer then secure the printer through the two holes (diameter: 2.2 mm) using screws.
- It is recommended that a damper (made of rubber, etc.) be inserted between the printer and the cabinet to prevent resonance.

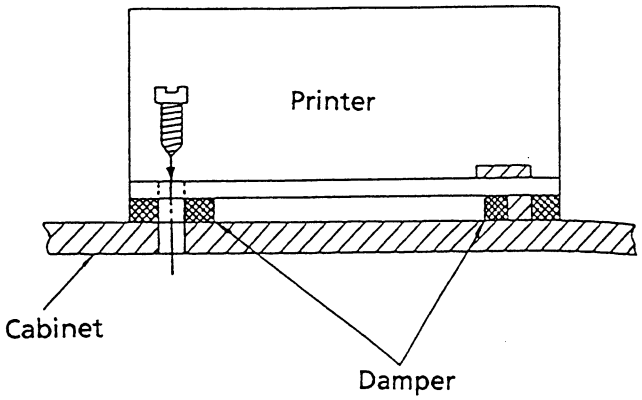


Figure 6-1 Securing the Printer

6.2 PAPER CUTTER ATTACHMENT

- Design the layout so that the tip of the cutter is located on line with paper ejection, as shown in Figure 6-2.
- Design should be such that paper from the roll will not be caught and pulled back into the printer. See Figure 3-1 Assembly Diagram for details concerning dimensions.
- Design the paper cutter so that paper can be cut with a force of 80g or less.

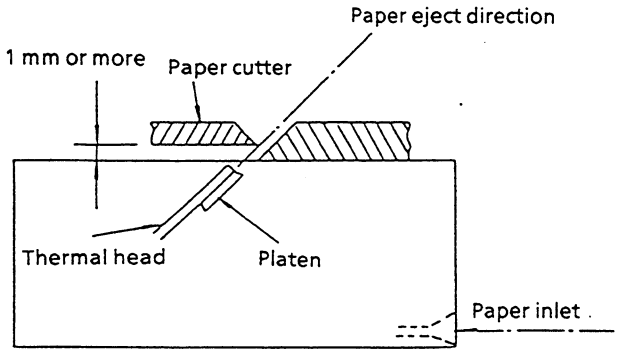


Figure 6-2 Paper Cutter Mounting

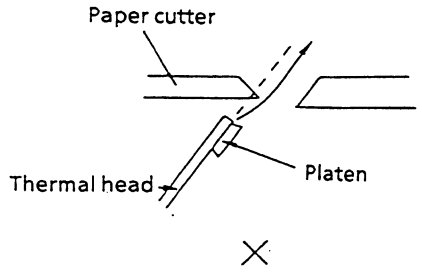


Figure 6-3 Incorrect Paper Cutter Mounting 1

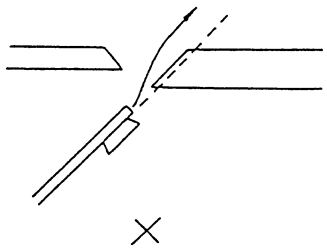


Figure 6-4 Incorrect Paper Cutter Mounting 2

- A layout such as that shown in Figure 6-3 may cause poor contact between the platen and the thermal print head, adversely affecting print quality.
- A layout such as that shown in Figure 6-4 may damage the surface of the paper. This layout is also undesirable because it applies excessive force on the thermal head when cutting the paper.

6.3 THERMAL PAPER ROLL HOLDER ATTACHMENT

6.3.1 When Using a Roll Having a Core

Take into consideration the following items when determining the layout of the thermal paper roll holder.

- Paper must not shift to the left or right in relation to the paper inlet slot. The play between the holder and the thermal paper roll must be 2 mm or less in the thrust direction. Be sure that the holder does not come in contact with the end surfaces of the paper roll.
- The axis of the holder must be parallel with the paper inlet of the printer, as shown in Figure 6-5.

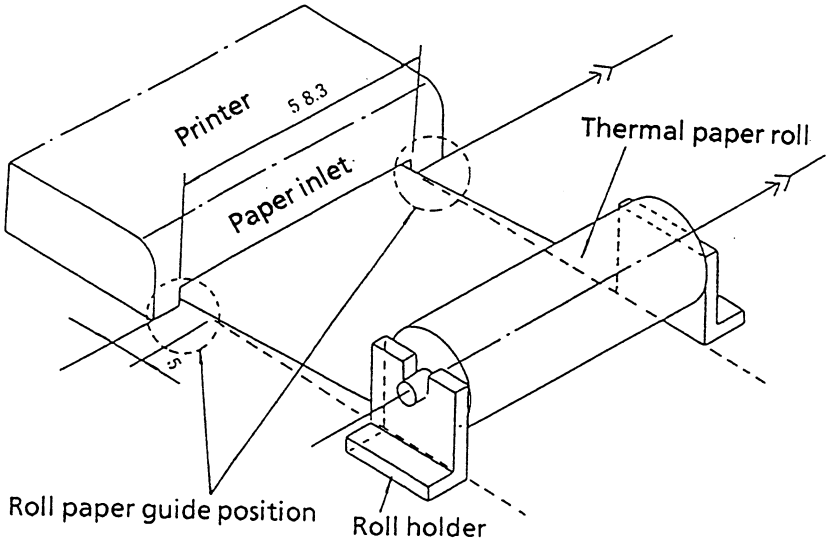


Figure 6-5 Thermal Paper Roll Holder Attachment Position (With Core)

- The paper supply load to the printer must be 50g or less.
- It is recommended that paper guides (width: 58.3 mm, length: at least 5 mm) be provided at the paper inlet.

Examples of improper design are given in Figure 6-6.

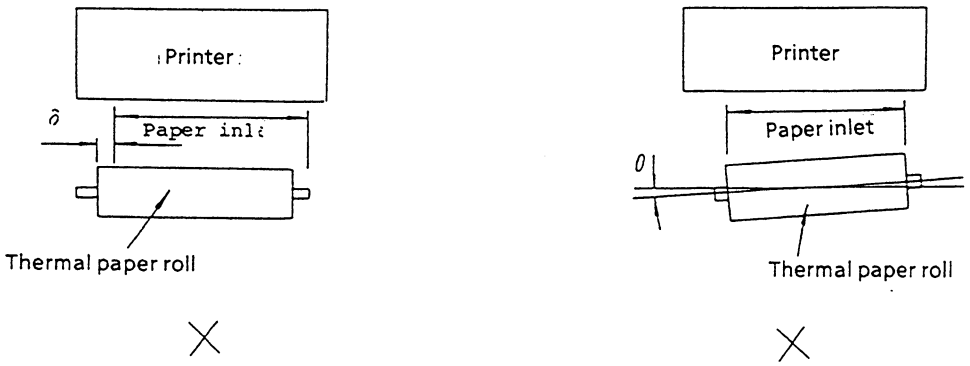


Figure 6-6 Incorrect Thermal Paper Roll Holder Attachment

6.3.2 When Using a Coreless Roll

- When using a coreless roll, be sure that the layout will prevent the roll from moving back and forth or side to side.

(Example)

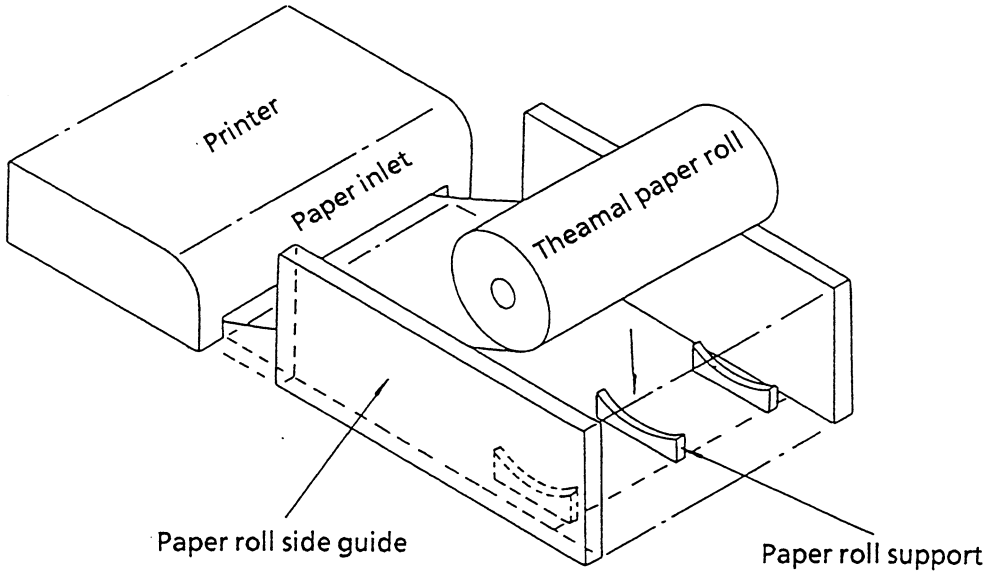


Figure 6-7 Thermal Paper Roll Holder Attachment Position (Without Core)

6.4 PAPER FEED KNOB

- The paper feed knob support pin (see the cross-sectional diagram in Figure 6-8) protrudes by 7 mm from the surface of the printer. Design the knob so that it will fit on the pin.
- The outer circumference of the knob should be 20 mm or more. Be sure that no force is applied to the support pin except in the direction of rotation.

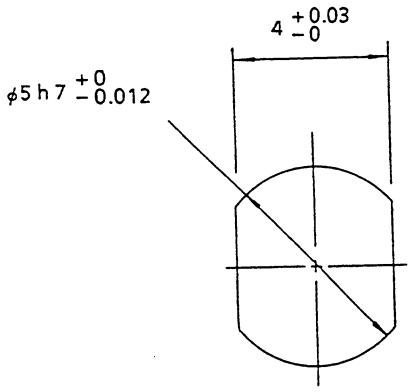


Figure 6-8 Paper Feed Knob Support Pin (Cross Section)

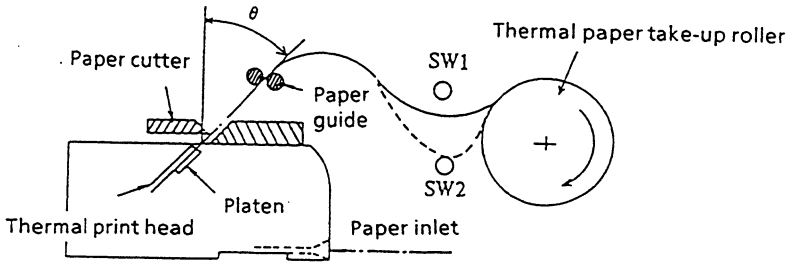
NOTE

The STP211J-192 is not equipped with the paper feed knob support pin.

6.5 THERMAL PAPER TAKE-UP DEVICE

Take into consideration the following items when designing the thermal paper take-up device.

- After printing, the paper must be taken up without being pulled taut (see Figure 6-9).



Take-up roller operates when SW2 is ON.

Take-up roller stops when SW1 is ON.

Figure 6-9 Thermal Paper Take-up Device

- Even when paper guides have been attached as shown in Figure 6-10, if the thermal paper is pulled taut, correct contact between the thermal head and the thermal paper can not be obtained and printing will be adversely affected.

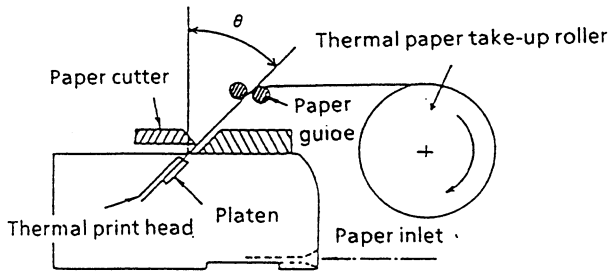


Figure 6-10 Incorrect Thermal Paper Take-up Device Design

6.6 OTHER

- Be sure that the cabinet does not interfere with the printer's drive mechanisms (thermal print head, gears, etc.).
- Keep the parts free from dust and debris.

CHAPTER 7

REMOVAL AND REPLACEMENT

7.1 REPLACING THE THERMAL PRINT HEAD UNIT

7.1.1 Removing the Thermal Print Head Unit

① Rotate the head feed deceleration gears and move the head carrier to the center of the printer.

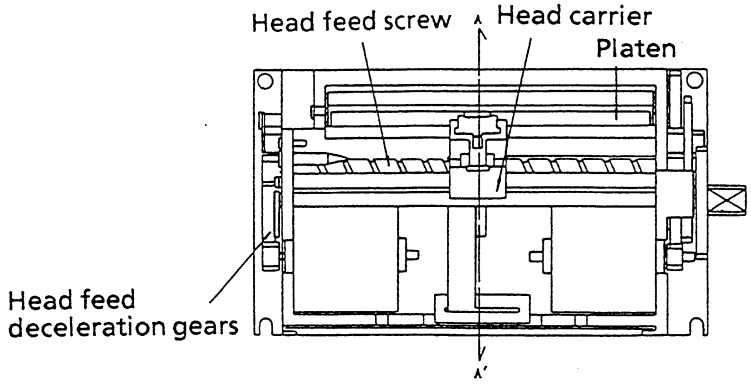


Figure 7-1 Thermal Print Head Unit Replacement Position

② Remove the FPC support plate from the head carrier.
Using a hooked pin or plate, remove the FPC support plate from the dowel on the head carrier frame.

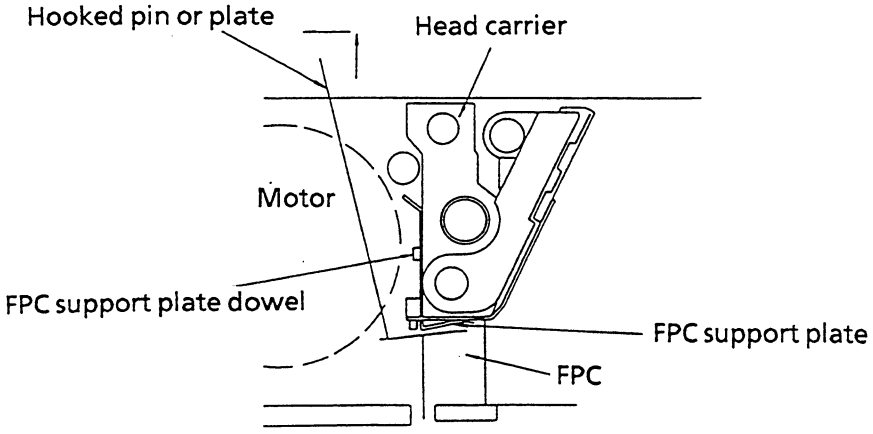


Figure 7-2 Removing the FPC Support Plate (Cross Section of Figure 7-1 AA')

③ Disconnect the FPC from the connector.

1) Holding the actuator between your thumb and forefinger, raise the actuator with your forefinger until it stops.
2) Pull the FPC off the connector.

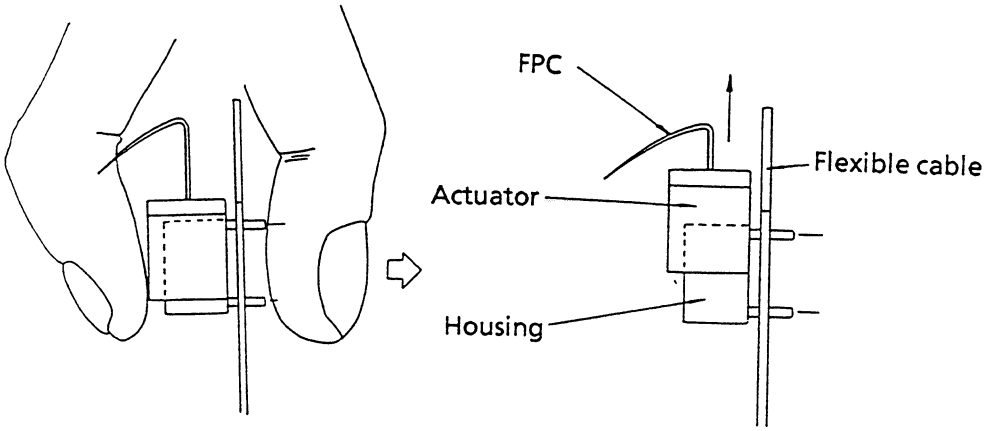


Figure 7-3 Removing the FPC from the Connector

④ Pull the FPC out through the frame slit.

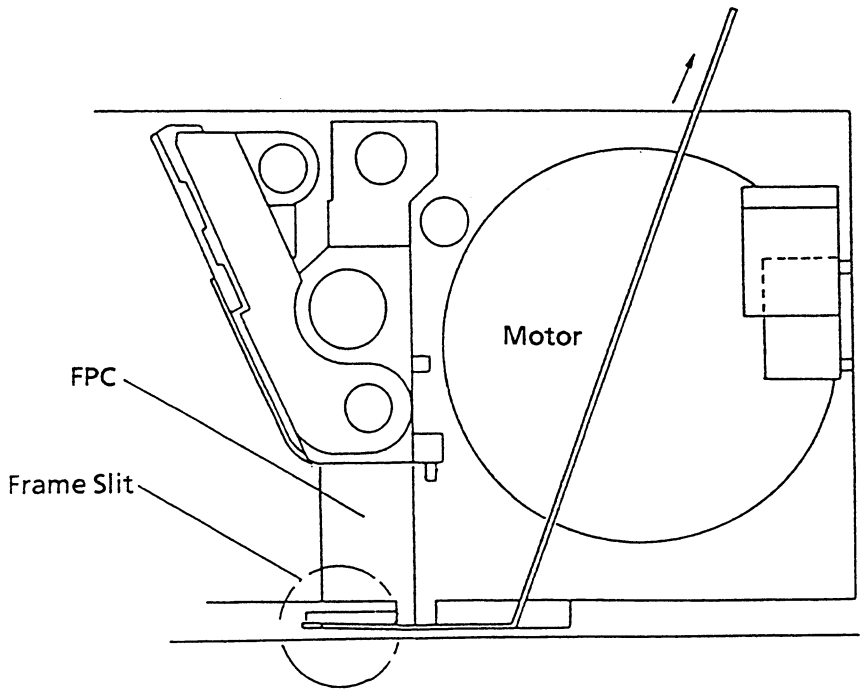


Figure 7-4 Removing the FPC Through the Frame Slit

⑤ Remove the thermal print head unit from the head holder.
Insert the tip of a screwdriver into the groove in the head holder and raise the thermal print head unit until it comes free from the head holder.
Tilt the head holder toward the head carrier, then, grasping the thermal print head unit with you fingers, pull it up and out of the printer.

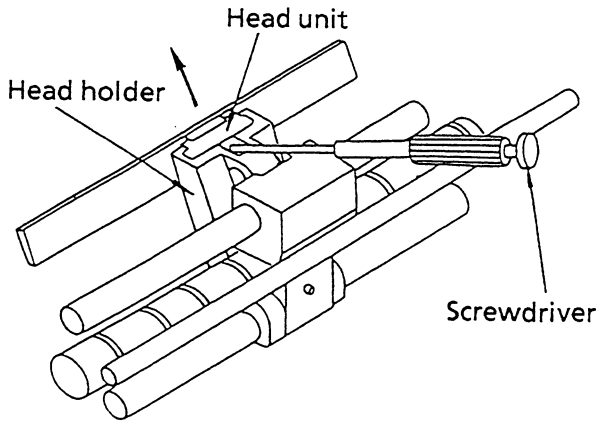


Figure 7-5 Removing the Thermal Print Head Unit

7.1.2 Attaching the Thermal Print Head Unit

① Rotate the head feed deceleration gears and move the head carrier to the left side of the printer (refer to Figure 7-1 Thermal Print Head Replacement Position).
② With the solder-plated surface of the FPC terminal face-down, pass the FPC under the guide pins from the platen side.

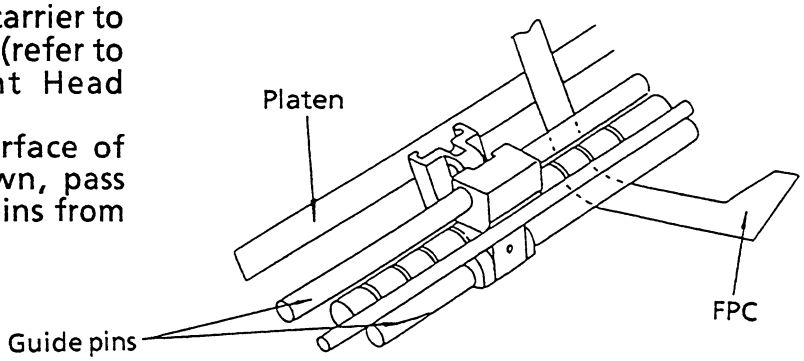


Figure 7-6 Passing the FPC Under the Guide Pins

③ Insert the corner of the FPC (indicated in Figure 7-7 by diagonal lines) underneath the frame slit.

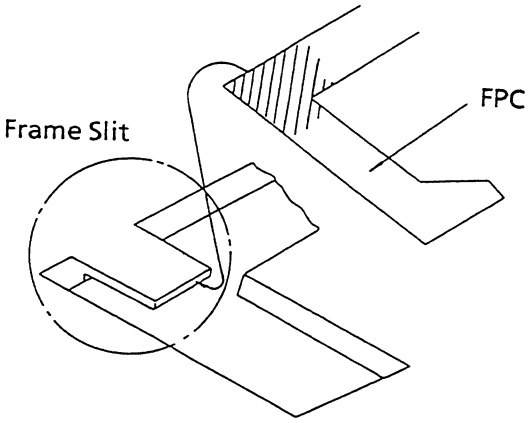


Figure 7-7 Inserting the FPC into the frame slit

④ Rotate the head feed deceleration gears and move the head carrier to the center of the printer (refer to Figure 7-1 Thermal Print Head Unit Replacement Position).

⑤ Insert the thermal print head unit along the head holder guides until it clicks into position.
If the FPC is caught on the head feed screw or between the guide pin and does not become parallel between the guide pin and the groove in the frame, use tweezers to push the FPC into a parallel position.

⑥ Remove the platen.
Remove the platen support pins from both sides.
Insert the tip of a screwdriver into the stepped portion of ⓐ indicated in Figure 5-9, then raise and remove the pins.

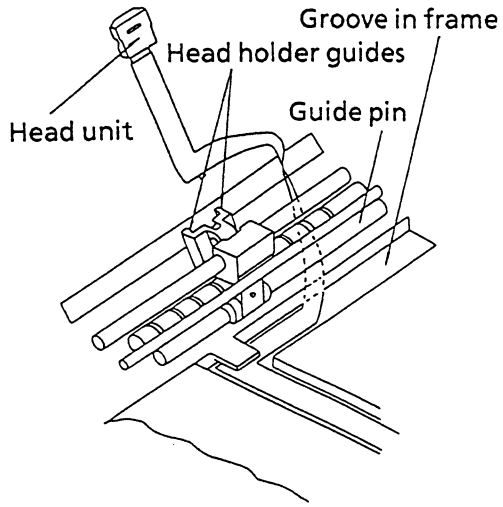


Figure 7-8 Attaching the Thermal Print Head Unit

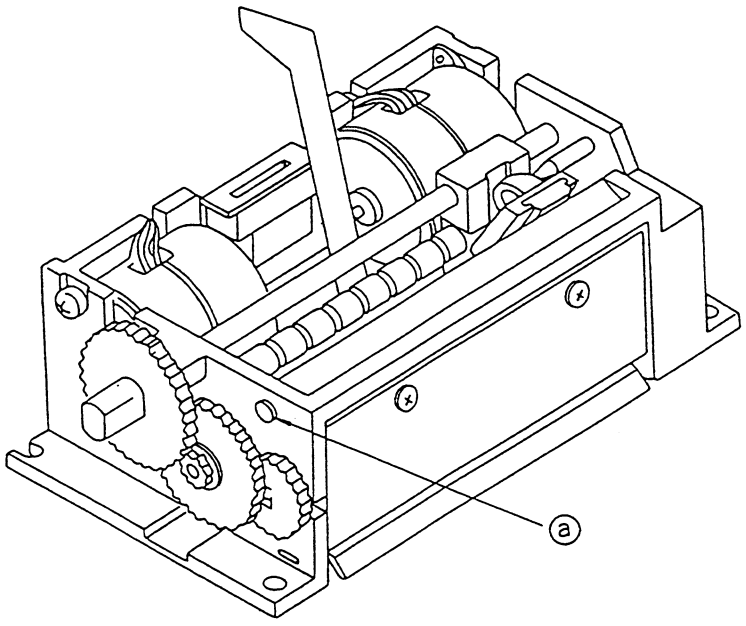


Figure 7-9 Removing the Platen Support Pin

Raise the thermal print head away from the platen then remove the platen.
Be careful not to touch the heating element when raising the print head.
Always hold the head holder when raising the print head.

⑦ With the printer standing with the paper inlet down, hook the FPC support plate onto the FPC support plate dowel on the head carrier.

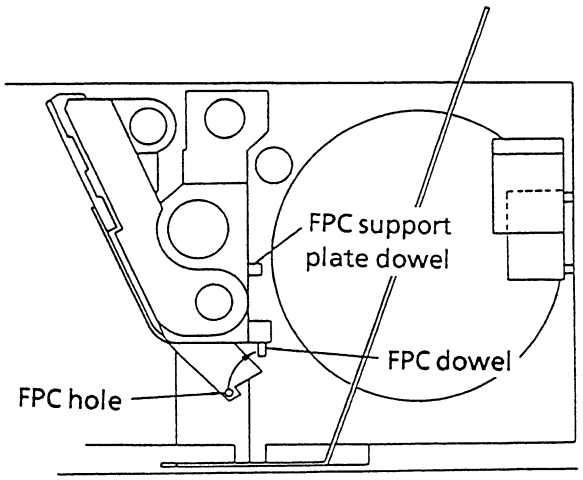
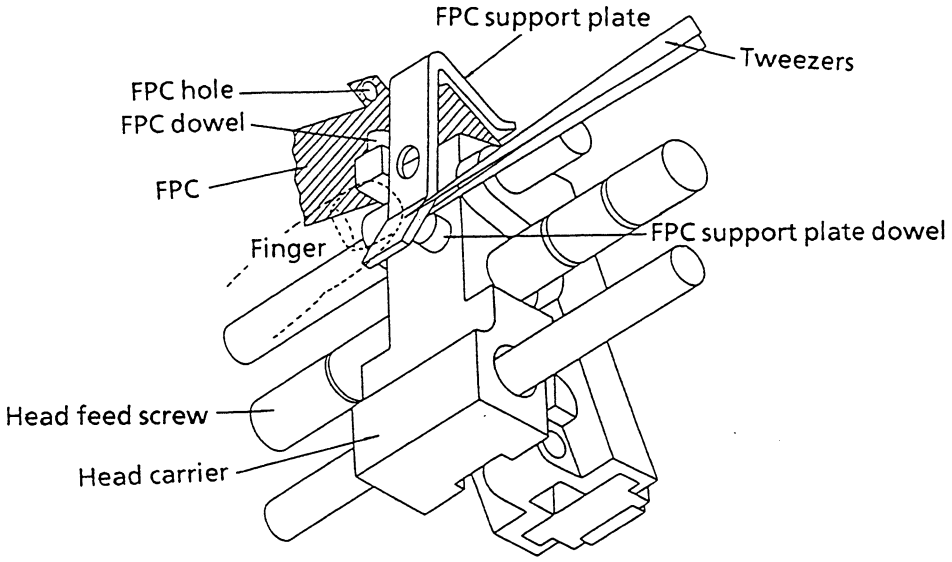


Figure 7-10 Hooking the FPC onto the Dowel



1) Grasp the FPC support plate with tweezers.
2) Insert the FPC between the FPC support plate and the head carrier.
3) Holding the FPC support plate with the tweezers, position the plate next to the FPC support plate dowel on the head carrier.
4) Holding the support plate in that position, place your finger onto the support plate.
5) Release the tweezers and press the support plate onto the dowel so that the dowel goes into the hole in the support plate.

Figure 7-11 Hooking the FPC Support Plate onto the Dowel

⑧ If the dowel does not go into the hole in the FPC, use tweezers to move the FPC so that the dowel goes into the hole.

⑨ Mount the platen.
Raising the thermal print head, insert the platen with the small chamfered side up. Insert the platen support pins into the holes in the frame and into the platen.

⑩ Place the FPC along the groove in the frame.

⑪ Connect the FPC to the connector. The procedure is the reverse of that for Figure 5-3 Removing the FPC from the Connector.

CHAPTER 8

PRECAUTIONS

Be sure to follow the precautions and instructions given in this chapter when using the STP211-144 or the STP211-192.

- The thermal print head may be damaged if excessive energy is applied. Apply only the specified pulse.
- Thermal head lifetime and clear, distinct printing cannot be guaranteed if paper other than the recommended thermal paper is used.
- Do not execute printing when paper has not been properly loaded.
- Do not hold the paper feed knob while the printer is operating. Holding the knob during operation may cause malfunction.
- When inserting the thermal paper, take care the followings.

① Load paper with the print head in the home position.
② Cut the end of the paper at a right angle as shown in Figure 8-1, gently insert the paper straight into the paper inlet.
③ Insert the paper straight into the printer until it does not go any further, then rotate the paper feed knob while inserting paper in the paper feed direction.
④ If the paper is not inserted straight it may weave back and forth as it is being fed. Continue feeding the paper until it comes out straight.
⑤ When the paper is wound onto the roller a slight noise may be omitted. This is normal and is not a malfunction.

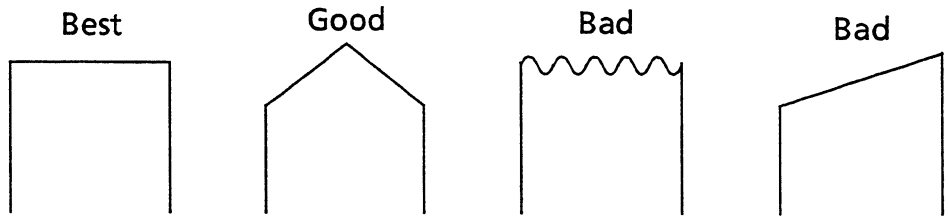


Figure 8-1 End of Paper

- Pull the paper straight up by hand in the direction in which the paper is normally fed.
- To prevent corrosion of the thermal print head, be sure that the thermal paper is not grounded.

SII
Seiko Instruments

Seiko Instruments USA
Micro Printer Division
2990 West Lomita Blvd.
Torrance, CA 90505
Phone: 310-517-7778
Facimile: 310-517-8154

(Specifications subject to change without notice.)

BPC# 1279911