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1. GENERAL SPECIFICATIONS

1.1 Printing Method: Character wheel type serial printer

1.2 No. of Printed Columns: Maximum 19 columns
(2 symbol columns are included.)

1.3 Character Types: Symbol 13 positions + 1 space
Numeral 14 positions

1.4 Character Size: 1.6 mm (W) x 2.5 mm (H)

1.5 Character Intervals:

1) Between columns:	between numerals	2.1 mm
	between numeral and symbol	2.6 mm
	between symbols	2.3 mm
2) Between lines :	4.6 mm	

1.6 Printing Speed: (average printing speed at 6.0 VDC)

1) For 19-column printing: Typ. 0.9 lines/sec
2) For 7-column printing: Typ. 2.2 lines/sec

1.7 Paper: High quality paper of 57.5 mm width

1.8 Paper Feeding: Fast feeding can be performed at typically 8 lines/sec
Provided with a paper free mechanism

1.9 Inking Method: Ink roll method

1.10 Motor

1) Terminal voltage: +0.5
6.0 -2.0 VDC
Restarting-up voltage 4 V or less
(at 25°C)

2) Mean current: Typ. 0.25 A (6.0 VDC at 25°C,
19 columns 7 position shift printing)

1.11 Detectors: Mechanical contact point
The detectors generate the Reset signal R, Timing signal T, and Timing Sub-Signal t.

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1.12 Trigger Magnet

- 1) Terminal voltage: 6.0 ± 0.5 VDC
(Trigger magnet terminal voltage and motor terminal voltage shall meet the voltage relationship shown in 2.7.1)
- 2) DC resistance: $20 \pm 2 \Omega$ (at 25°C)

1.13 Connection Method
(on printer side): By jumper wire

1.14 Operating Temperature: 0 to 50°C

1.15 Reliability: MCBF = 700000 lines

1.16 Dimensions: 86 mm (W) x 49.5 mm (D) x 19 mm (H)

1.17 Weight: Typ. 90 g

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2. Detail Specifications

2.1 Columns Arrangement

Column number	19, 18, 17, ----- 4, 3	2, 1
Character	(0 to 9) + (-) + (,) + (.) + (#)	Symbols

(See Page 25 Character Layout)

2.2 Print Speed

Columns	Print Speed		High Speed (3P.S.)	Low Speed (16P.S.)	Mean print speed
	6 V	5 V			
7 Columns	6 V	5 V	2.78	1.59	2.18
(5 Columns + Symbol)	6 V	5 V	2.31	1.33	1.82
19 Columns	6 V	5 V	1.14	0.61	0.88
(17 Columns + Symbol)	6 V	5 V	0.95	0.51	0.73

Note P.S. : Position Shift

The above mentioned Print Speed shows one at the following conditions.

- 1) In the case Mode 1 shown in Attached figure 1 is printed continuously in accordance with Timing Chart, print speed becomes High Speed, and in the case Mode 2 is printed, print speed becomes Low Speed.

(See Attached figure 1)

- 2) Mean print speed shows arithmetic average between High Speed and Low Speed.

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2.3 Ink Roll

- 1) Color: Purple or Black
- 2) Life *1 : Purple 1000000 characters
Black 350000 characters
- 3) Parts Number: IR-40

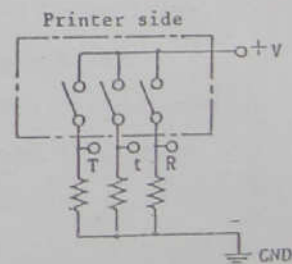
Note) *1) Life tests are conducted based on Mode 1 as described in Attached figure 1 Printing mode.

2.4 Paper

- 1) Type: High quality paper
- 2) Paper width: 57.5 ± 0.5 mm
- 3) Outer diameter: ϕ 80 mm or less
- 4) Paper thickness: 0.06 to 0.085 mm
- 5) Weight: 47 to 64 g/m²
(40 to 55 kg / 1000 sheets / 1091 mm x 788 mm)
- 6) Paper supply load: 30 g or less

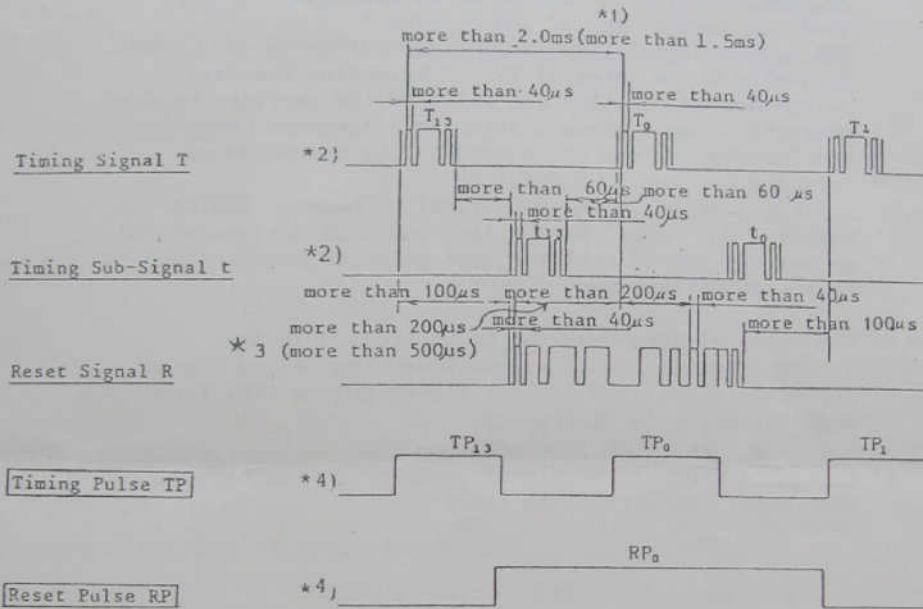
2.5 Detector

Detector comprising mechanical switches generates Timing Signal T, Timing Sub-Signal t corresponding to characters on Character Wheels, and Reset Signal R. These output signals shall be arranged to Timing Pulse on the user side, and are used as Timing Pulse.



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- 1) Rating
- a) Voltage 2.5 to 17 VDC
 - b) Current 0.01 to 1 mA
 - c) Maximum switching capacity 5mW. (Resistance load)
- 2) Pulse wave form, Phase



- a) Timing pulse TP
The Timing signal T and Timing Sub-Signal t are used for conversion into the non-chattering waveform TP.
- b) Reset pulse RP
The Reset signal R and TP_1 of Timing pulse TP can be used for conversion into the non-chattering waveform RP.

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Notes

- *1) The interval of 1.5 ms or more corresponds only to the Timing pulse interval (TP_{n+1} to TP_{n+3}) after the printing and the carriage shift following driving Trigger magnet.
- *2) During printing and shift of the carriage having character wheels thereon after selecting character, Timing Signal T "makes" and "breaks." Timing Sub-Signal t may make during interval of 4 times of Timing Pulse interval TW1 of selecting the first column during printing and shift of the carriage having character wheels thereon after selecting any character, and "breaks" in the other area in the operation of printing and shift of carriage. In this case if Timing Sub-Signal t "makes", Timing Signal T may "make" by the last point of 4 times of TW1 or may not "make" till the last point of printing and shift of the carriage.
- *3) The value of more than $500\mu s$ is applied to the interval between Reset signal R and the Timing signal T_0 , after counting 8 or more timing pulses (TP) from when the motor is started-up.
- *4) denotes the signal to be generated by the user side. Hereafter the same.

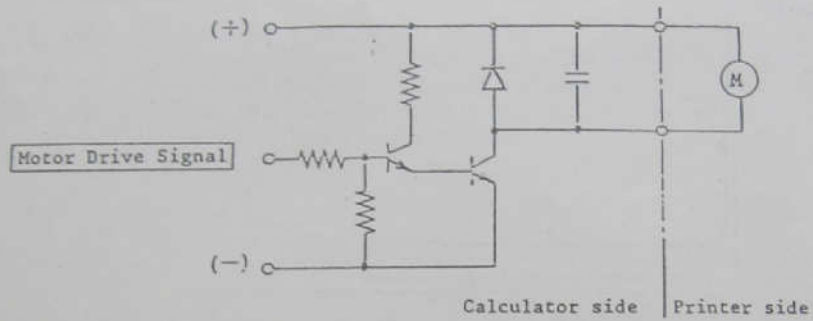
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2.6 Motor

1) Driving

Motor shall be controlled by switching on-off Motor Drive Signal.

Circuit Example



2) Terminal Voltage $6.0 \pm_{-0.5}^{+0.5}$ VDC

3) Current

a) Peak Current at Motor Starting

Typ. 1.8 A (6.0VDC, 25°C)

(Worst Case less than 3.5A)

b) Mean Current

Typ. 0.25 A

(6.0VDC, 25°C, at printing on Mode 3 in Attached figure 1)

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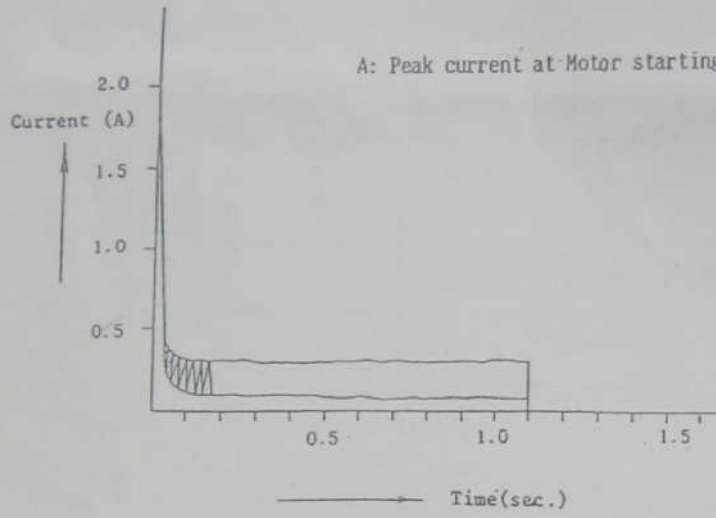
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c) Current Wave Form

(6.0VDC, 25°C, at printing on Mode 3 in
Attached figure 1)



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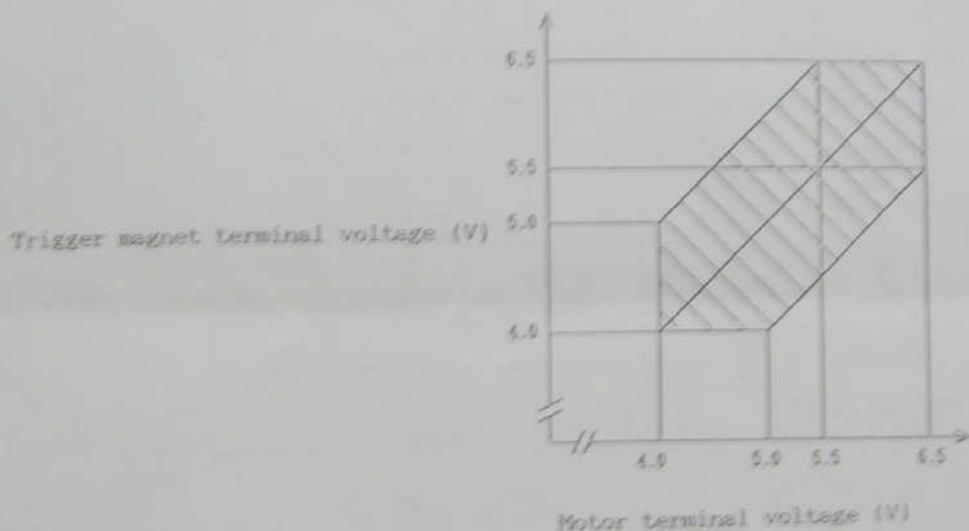
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2.7 Trigger Magnet

Driving of the trigger magnet enables the following operations: selection/printing of characters on the print wheel, carriage shift, paper feeding, and return of the carriage to its carriage stand-by status (carriage return).

1) Voltage

Coil terminal voltage 6.0 ± 0.5 VDC
 (However, the trigger magnet terminal voltage and motor terminal voltage must satisfy the voltage relationship indicated by the shaded area of the figure below.)



2) DC Resistance

$20 \pm 2 \Omega$ (at 25°C)

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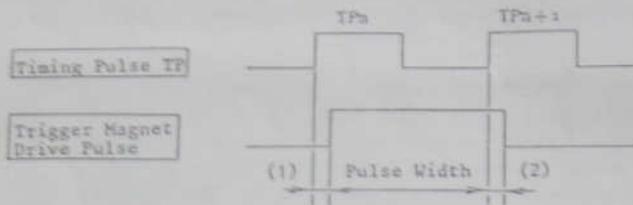
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3) Pulse Width

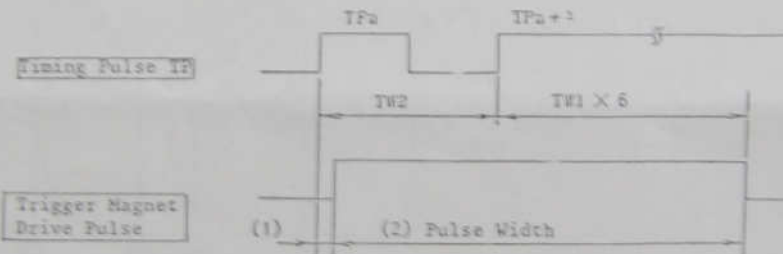
a) in selection of characters and shift of Carriage having Character Wheel thereon



(1) Applying Delay Time: less than 0.1ms

(2) Cutting off Delay Time: less than 0.1ms

b) in character selection, paper feed, Carriage return



(1) Applying Delay Time: less than 0.1ms

(2) Pulse width: $TW2 + TW1 \times 6$ tolerance $\pm TW1$

TW1: TP interval at selection of a character for the first column

TW2: TP interval at selection of a character for the last column of a line to be printed in

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Note 1) when paper feed only is carried out,

TW1-TW2

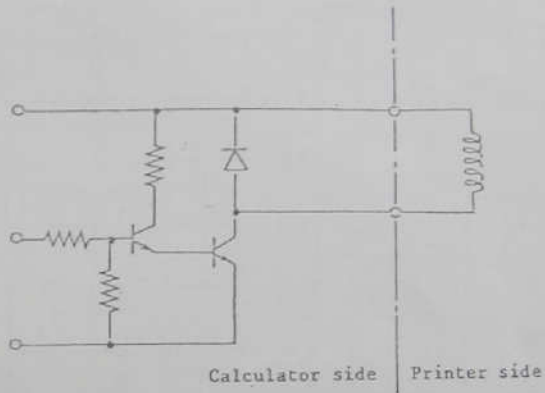
4) Drive Circuit:

Diode is used as Spark Suppressor.

Diode should be prepared by customers.

(1S2075K equivalent)

Trigger Magnet
Drive Pulse



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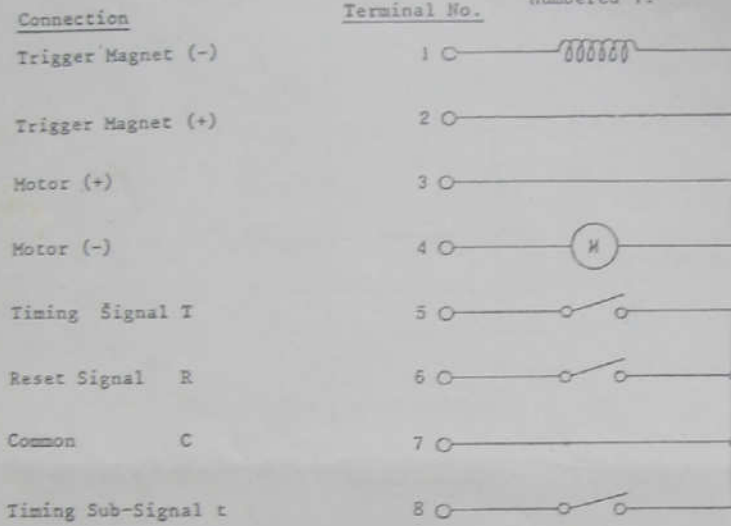
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2.8 Terminal Assignment

Note: Terminal on Detector side is numbered 1.



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2.13 Character Layout

		← Columns																				
		19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1		
Positions ↓	0																		0	G	+	
	1																			1	K	x
	2																			2	√	÷
	3																			3	P	◊
	4																			4	D	*
	5																			5	¼	S
	6																			6	M	T
	7																			7	Δ	M
	8																			8	+	⊖
	9																			9	-	=
	10																			-	-	-
	11																			⊃	R	-
	12																			•	↓	%
13																			#	A	E	

Columns 4 to 19 are identical to Column 3.

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Attached figure 1 Printing Mode

Mode 1 (3P.S.)	*9630,852#-741*96P+ #-741*9630,852#-7DX 0,852#-741*9630,8%÷ 1*9630,852#-741*9M0 2#-741*9630,852#-Δ* 30,852#-741*9630,+S 41*9630,852#-741*-T 52#-741*9630,852# M 630,852#-741*9630RC 741*9630,852#-741‡= 852#-741*9630,852A 9630,852#-741*963G-	Mode 4	10203040506070809G 131415161718191-K- 425262728292-2,√% 363738393-3,3*PE 748494-4,4*4#D+ 595-5,5*5#50%× -6,6*6#6061M÷ 7*7#707172Δ0 #80818283+* 91929394-S 2-3-4-5 T 4,5,6RM 5*6*7‡C #7#8A= 809G 1-K- √% PE + %× 1M÷ 72Δ0 283+*
Mode 2 (16P.S.)	86420*-86420*-864√+ 97531#,97531#,975Px -86420*-86420*-86D÷ ,97531#,97531#,97%0 *-86420*-86420*-8M* #,97531#,97531#,9ΔS 0*-86420*-86420*-+T 1#,97531#,97531#,-M 20*-86420*-86420* C 31#,97531#,97531#R= 420*-86420*-86420‡ 531#,97531#,97531A-		
Mode 3 (7P.S.)	70707070707070707Δ+ 70707070707070707Δ+ 70707070707070707Δ+ 70707070707070707Δ+ 70707070707070707Δ+ 70707070707070707Δ+ 70707070707070707Δ+ 70707070707070707Δ+		

Note) 1) P.S. : The abbreviation of "Position Shift."

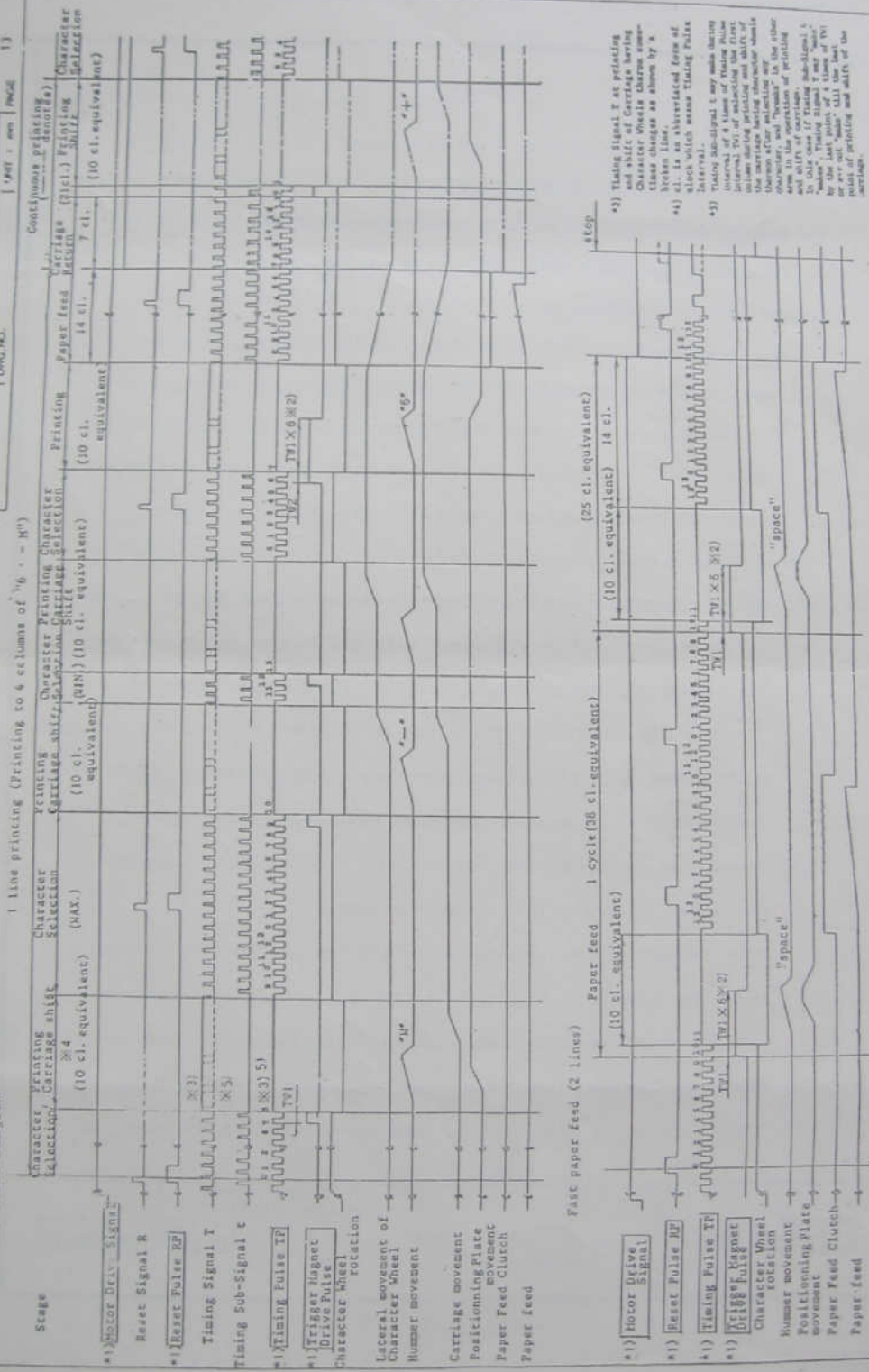
2) Set the similar pattern to the above printing mode when check test of the printer as a calculator is executed.
(Please inquire the details, if necessary.)

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2.9 Time Chart
1) Time Chart Diagram



Notes: *1) denotes the signal and the pulse to be generated by the customer.
*2) Trigger Magnet Drive Pulse Width for the last column of a line to be printed is gained in such a manner that 6 times of the Timing Pulse Interval TW2 is added to the Timing Pulse Interval TW2 at the selection for

*3) Timing Signal T at printing and shift of Carriage having Character Wheel Change comes these changes as shown by a clock which means Timing Pulse Interval.
*4) Timing Signal T may mean during interval of 1 character selection the Carriage having character wheel in the operation of printing and shift of Carriage. Timing Signal T may mean "Space" by the last point of the last column of printing and shift of the carriage.

2) Operation

a) Initial Setting

Initial setting is necessary to confirm that Carriage is set at the standby position (the first column) before printing or paper feed.

Initial setting ends with one-line paper feed.

b) One-line printing

- (1) First, Timing Pulse TP should be counted from the time when Motor starts by applying Motor Drive Signal. Secondly, Reset Pulse RP generated after the 8th timing pulse is defined as RP_0 . Then the first Timing Pulse TP generated after rising of Reset Pulse RP_0 is defined as Timing Pulse TP_0 .

- (2) Character selection (first column)

Trigger Magnet Drive Pulse is applied to Trigger Magnet in the interval from rising of Timing Pulse TP_n to the rising of TP_{n+1} , corresponding to a desired character. During this interval, Timing Pulse Width ($TP_n - TP_{n+1}$) shall be timed to gain TW1. After a character selection, Character Wheels stop rotating. (Timing Pulse TP_{n+1} is held,) and Carriage having Character Wheels thereon is automatically fed.

- (3) Character Selection for the next column

When character Wheels begin to rotate again, the first Timing Pulse is defined as Timing Pulse TP_{n+2} . A character selection for the next column becomes possible simultaneously with the rising of Timing Pulse TP_{n+1} rising after said Timing Pulse TP_{n+1} . Character selection is then carried out in the same way as (2).

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(4) Carriage Return and Paper Feed

In selecting a character to be printed in the last column of a line, Trigger Magnet drive pulse width should be the interval of Timing Pulse Width TW2 (TP_n to TP_{n+1}) at this time plus 6 times of Timing Pulse Width TW1, which is timed in (2), at the selection time of a character to be printed in the first column. Printing, carriage return and paper feed are carried out by applying the Trigger Magnet drive pulse of the described width. (Refer to 2.7 Trigger Magnet)

(5) Motor Stop

After the printing of a character to be printed in the last column of a line, Character Wheels begin to rotate and Timing Pulse TP is generated at the same time. Then, Timing Pulse TP shall be counted and simultaneously with the rising of the 14th Timing Pulse, Motor Drive Signal could be stopped.

Note:

- 1) The first Timing Pulse generated after printing and shift of Carriage having Character Wheels thereon (TP_{n+2}) cannot be used for Character Selection.

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c) Continuous printing.

- (1) The first line printing is carried out in the same way as one-line printing mentioned in b).
- (2) As to printing in the following lines, after the printing to the last column to be printed in the first line, Timing Pulse TP shall be counted without stopping Motor. When the 21st Timing Pulse arises, printing to the first column of the second line becomes possible. The following operation is same as (2), (3) and (4) under b) One-line printing.
- (3) By repetition of (2), continuous printing is carried out.
- (4) Motor Stop
Motor is stopped as mentioned in b)-(5).

d) One-line paper feed

- (1) First, Timing Pulse TP shall be counted from Motor starting by applying Motor Drive Signal. Secondly, Reset Pulse RP after the 8th Timing Pulse TP is defined as RP_0 . Then, the first Timing Pulse TP after rising of Reset Pulse RP_0 is defined as TP_0 .
- (2) Paper Feed
Space position corresponding to TP_{10} is selected for paper feed. At this time, the Timing Pulse Width from the leading edge of TP_{10} to that of TP_{11} shall be timed to gain TW1. The Trigger Magnet drive pulse width is the interval of TW1 plus 6 times of TW1. By applying the Trigger Magnet drive pulse of the described width, the space position on Character Wheels is selected and paper is fed. (Refer to 2.7 Trigger Magnet)

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(3) Motor Stop

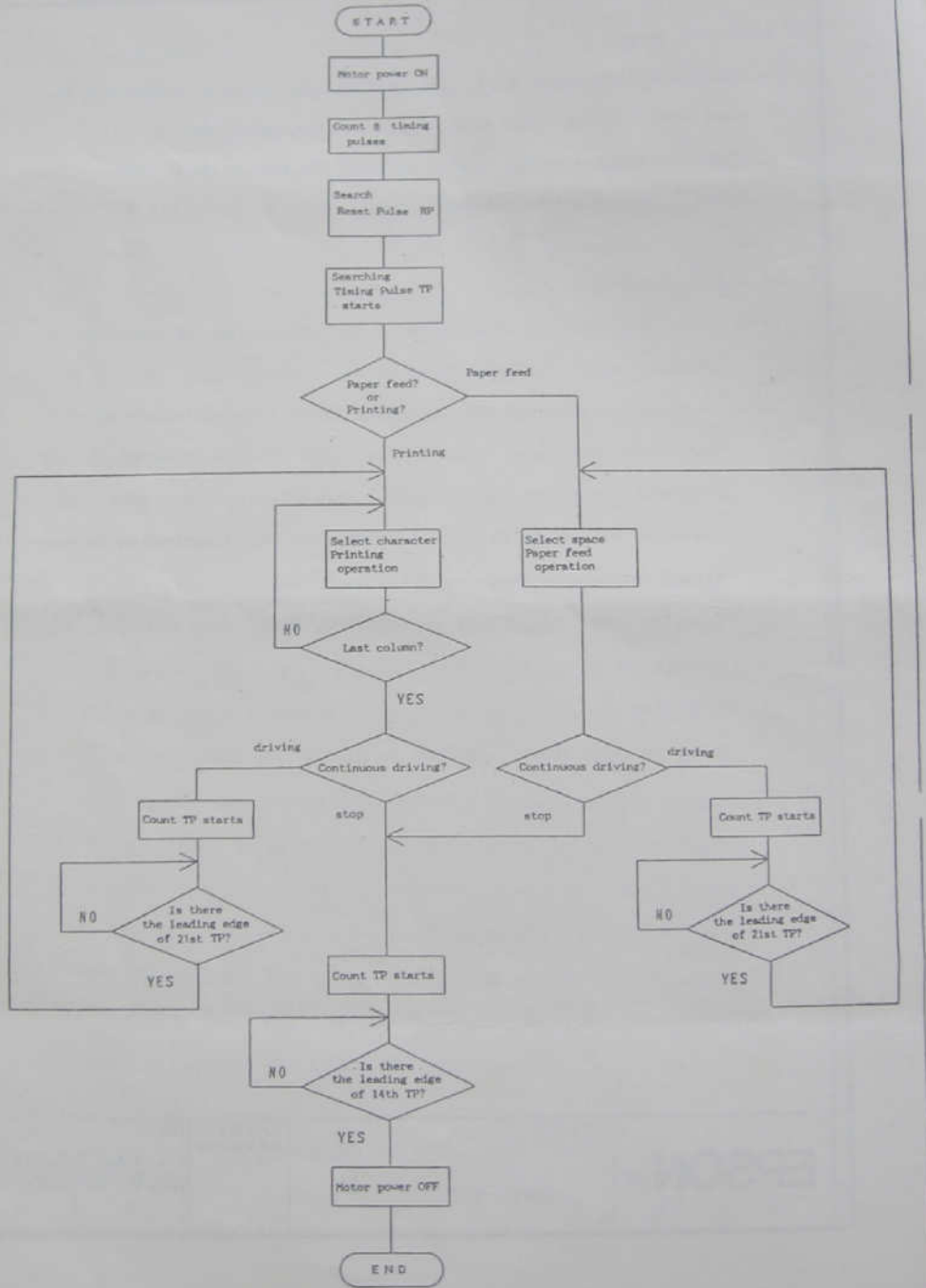
After one-line paper feed, Character Wheels begin to rotate. At the same time, Timing Pulse shall start to be counted and simultaneously with the rising of the 14th Timing Pulse, Motor Drive Signal could be stopped.

e) Fast Paper Feed

- (1) Paper feed for the first line is carried out in the same way as one-line paper feed mentioned in d).
- (2) As to paper feed for the following lines to be printed, after the first line paper feed, Timing Pulse shall be counted without stopping the Motor. With the 21st Timing Pulse, the space position (TP₁₀) can be selected. The following operation is same as one-line paper feed mentioned in d)-(2).
- (3) When the operation of (2) is repeated, fast paper feed is carried out.
- (4) Motor Stop
Motor is stopped as described in d)-(3)

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3) PLAN CHART OF PRINTING AND PAPER FEED



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2.10 Reliability

MCBF = 700000 lines

The mean cycle between accidental errors of the calculator that can be detected is 50000 lines or more.

Printing mode is mode 4 of Attached figure 1.

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2.11 Error Detection of the Printer

a) Drop of battery capacity and detection of abnormal load

- (1) When the period of timing pulse is more than 500 ms in all the area, from the motor ON to OFF, (in the case that the leading edge of timing pulse is not generated after 500 ms), printer may be considered to be in the abnormal condition.
- (2) In the first column, in the character selection, if selected timing pulse interval TW1 exceeds 20 ms, it is the abnormal condition.

Note) TW1 is the timing pulse interval (TP_n to TP_{n+1}) when the trigger magnet drive pulse for the first column is applied.

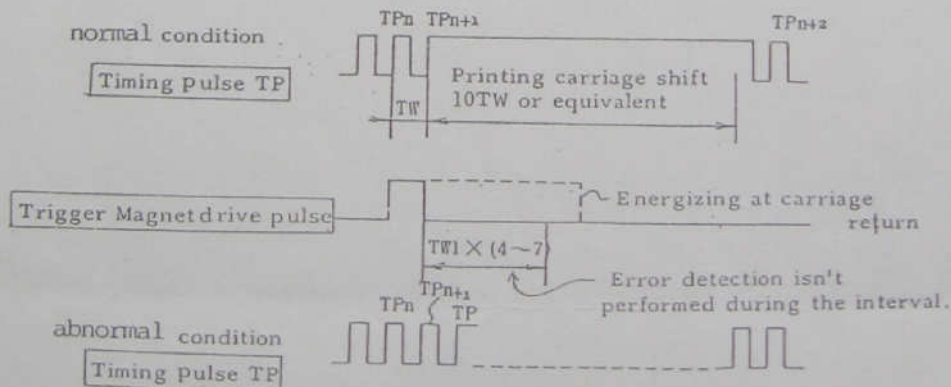
b) Detection the abnormal signal of detector

- (1) During 1 line printing or paper feed, timing pulse TP should be counted, and if there is no reset pulse RP between timing pulse TP_{1j} and TP_0 and/or if there is no reset pulse between TP_0 and TP_1 , it is the abnormal condition.
(Refer to 2.5 2) Figure of waveform and phase about reset signal R.)

c) Detection of abnormal type select mechanism

- (1) After trigger magnet drive pulse is applied to trigger magnet in the interval from the leading edge of timing pulse TP_n corresponding to a selected character, to the leading edge of timing pulse TP_{n+1} (same as trigger magnet drive pulse at the time of carriage returning), the timing pulse within 6 times of TW1 from the rising edge of TP_{n+1} should be ignored.

Allowable set $6 \pm \frac{1}{2} TW1$



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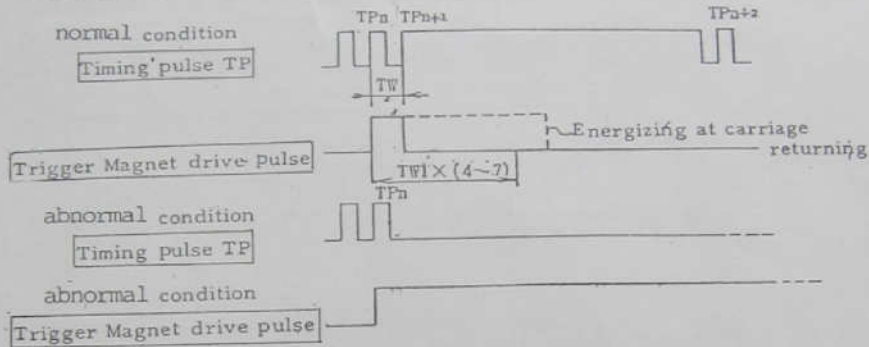
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- (2) In case applying trigger magnet drive pulse from the leading edge of timing pulse TP_n corresponding to selected type wheel character, and the following timing pulse TP_{n+1} is not generated within the time of 6 times of $TW1$, it is the abnormal condition.

Allowable set $6 \pm \frac{1}{2} TW1$

Note) Error detection of the first column must be performed as described in a) item (2).



Note 1) When measures described above is used, printer operation can not be guaranteed for a period from over standard to detection of abnormal condition.

Note 2) In case the motor and trigger magnet of printer are energized continuously by drop of power supply voltage and drop of battery capacity so that damage by a fire or breakdown might occur in printer, adequate protective mechanism should be set up by the user.

Example measures against abnormal condition

items	measures for printer	measures in display
a)-1 a)-2 c)-2	Stop energize the motor and trigger magnet immediately.	Give warning sign
b)-1	Stop energize the motor and trigger magnet immediately or stop printing and return the carriage to the standby condition.	Give warning sign

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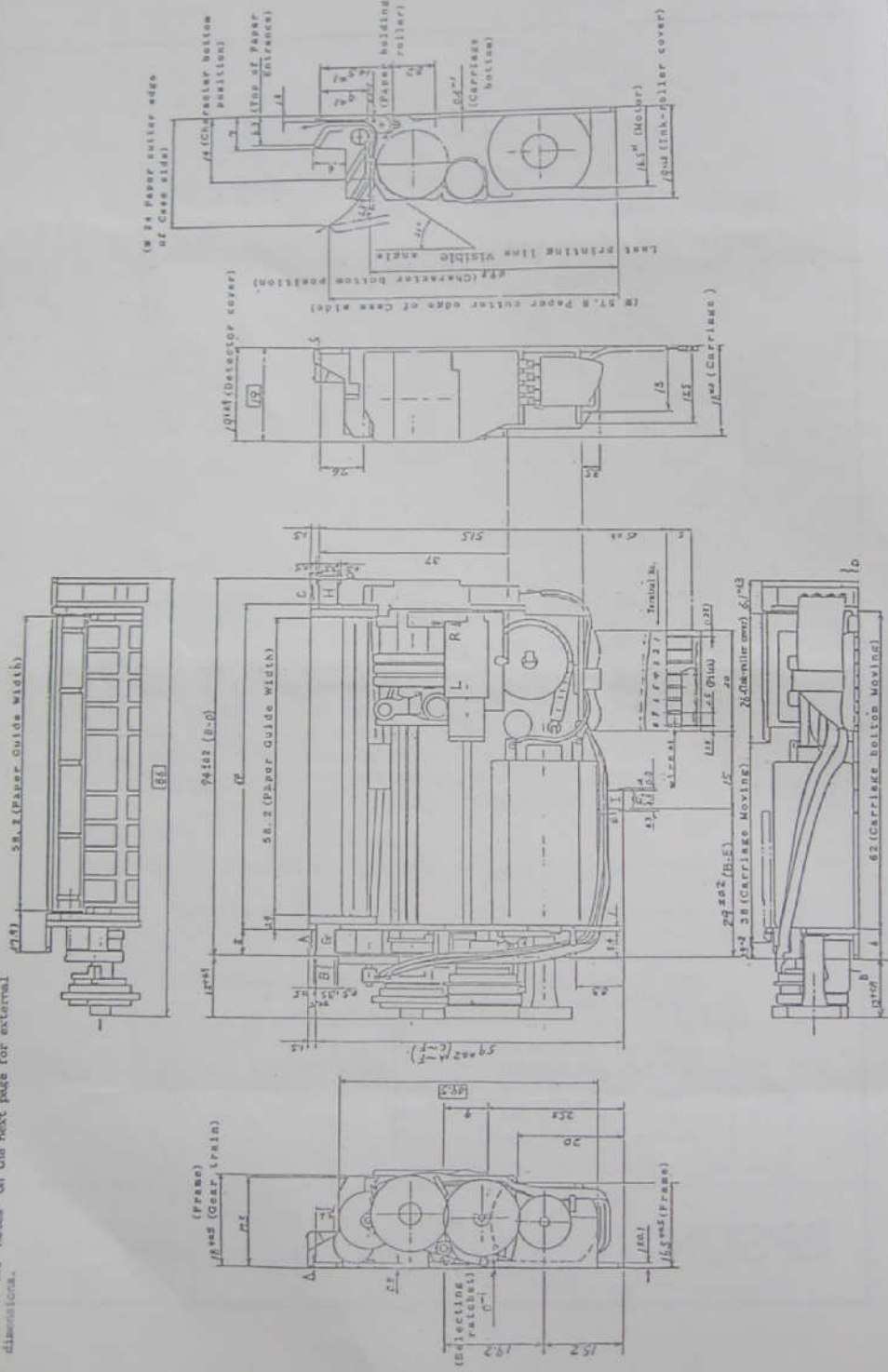
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2.12 External Dimensions

* Refer to the "Notes" on the next page for external dimensions.



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Notes:

1. The dimensions marked with (⊗) denote the reference dimension of paper cutter top edge.
2. The center of paper holder in the calculator case side should be set to that of width direction at printer paper entrance in order to guide paper 57.5 ± 0.5 mm in width from the entrance.
3. The clearance between the paper holder of the calculator case side and roll paper toward the thrust direction must be 2 mm or less, and the paper holder must not press the both edge of paper.
4. As the roll paper is set up toward vertical direction at the paper exit portion (near paper cutter setting position), printing noise increases by resonance of roll paper during printing. And as roll paper is set toward horizontal direction, the paper feed load increases, and it might cause the trouble of paper feed.
5. Consideration must be given in the calculator case design to prevent rolling in the paper again.
6. It is desirable that the area of the opening of the case, such as paper entrance portion or paper cut portion (paper exit), is small as possible to make the noise small.
7. About mounting to the case, the front and back, left and right, upper and lower positions of the printer are located and mounted at 3 mounting-foot-portions (G, H, I) of printer bottom (frame). And the portions except for mounting-foot-portions shall not touch the case. Especially, the case to fix the mounting-foot in the paper entrance side and gear train portions (G) shall not touch the gear.
It is desirable to make small space in the mounting-foot-portions with the case mounted in order to make it difficult to convey the printer vibration to the case. (Screwing hard is not good in the view of making the noise small.)
8. The dimensions marked with denote the external dimensions of the specifications.
9. Care must be taken because the ink roll cover which is projected beyond the height of the printer (19 mm) slides toward the column direction.
10. The gear train side must be protected with the upper case. (for safety and not to let in the paper dust or foreign things.)
11. The printer uses plated steel plate. The cut surfaces are not processed.

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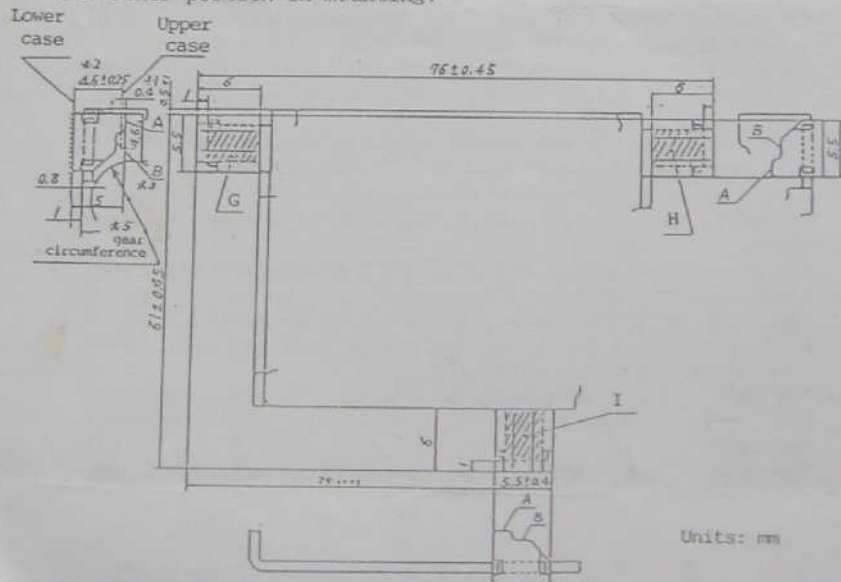
Notes: Mounting the printer

a) In case not using mounting rubber

The printer is mounted and located at the mounting-foot-portion (G, H, I marked with  as shown below.). It is desirable to make small space in the mounting-foot-portion with the case mounted in order to make it difficult to convey the printer vibration to the case.

b) Mounting example when using mounting rubber (Mounting rubber is optional.)

- ※1 A surface of mounting rubber is compressed by the upper case.
- ※2 The space between the upper case and the lower case must be 4.6 ± 0.25 mm in mounted condition.
- ※3 B surface is the stopped position when it gets impact to the up direction. So, the upper case must be large enough to cover the area over B surface.
- 4 About the mounting direction, the mounting rubber must be attached as shown below. Especially in the paper entrance side, the front and back of the rubber on the gear side are opposite to those of on the detector side. (The shapes are not symmetrical.)
- ※5 Design so that the case does not touch the gear circumference.
- 6 In mounting, use the 3 mounting rubbers. Please inquire when use other portion in mounting.



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