Thermal Printing Mechanism

Porti-M100V

Operator's Manual

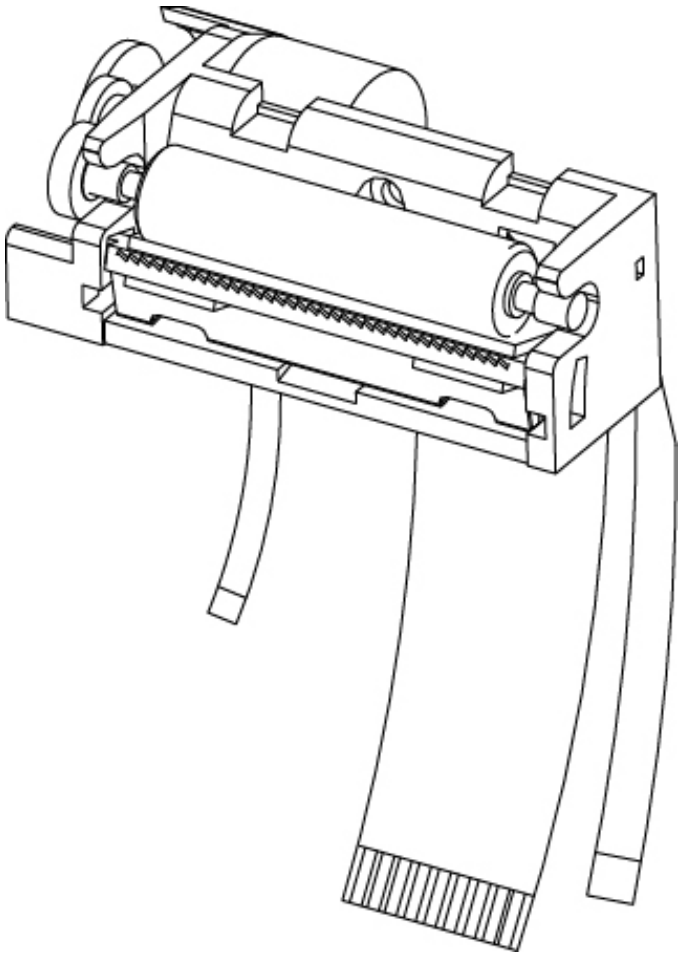

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Figure A.1 EXPLODED DIAGRAM OF Porti-M100V 25

GENERAL SPECIFICATION

Item	Specification
Printing Method	Direct thermal line printing
Printing width	24.0 mm
Head Configuration (dots/line)	192
Dot Pitch	0.125 mm
Printing Speed	50 mm/s (MAX)
Paper Width	37 ± 0.5 mm
Paper feed method	Friction feed
Head temperature sensor	Thermistor
Paper detection	Reflecting photosensor
Heater resistance	130 Ω ±4%
Number of strobes	3
External dimensions (W x D x H)	47 x 30 x 16.9 mm
Life/Reliability	100Km
Recommended paper	TSP-F50US or equivalent
Input Power	5VDC / 2.5A

DESCRIPTION OF THE MECHANISM

This is the main characteristic of the Porti-M100V. Thermal printing mechanism is definitely, reliability, the quality and long lasting performance. It is the suitable product for industrial environments such as weight, control, safety systems, as well as medical and portable applications.

MAIN FEATURES

- **High speed up 50mm/sec**
- **High resolution 8dots/mm**
- **Paper detection photo-sensor**
- **Life 100 km Printed paper**

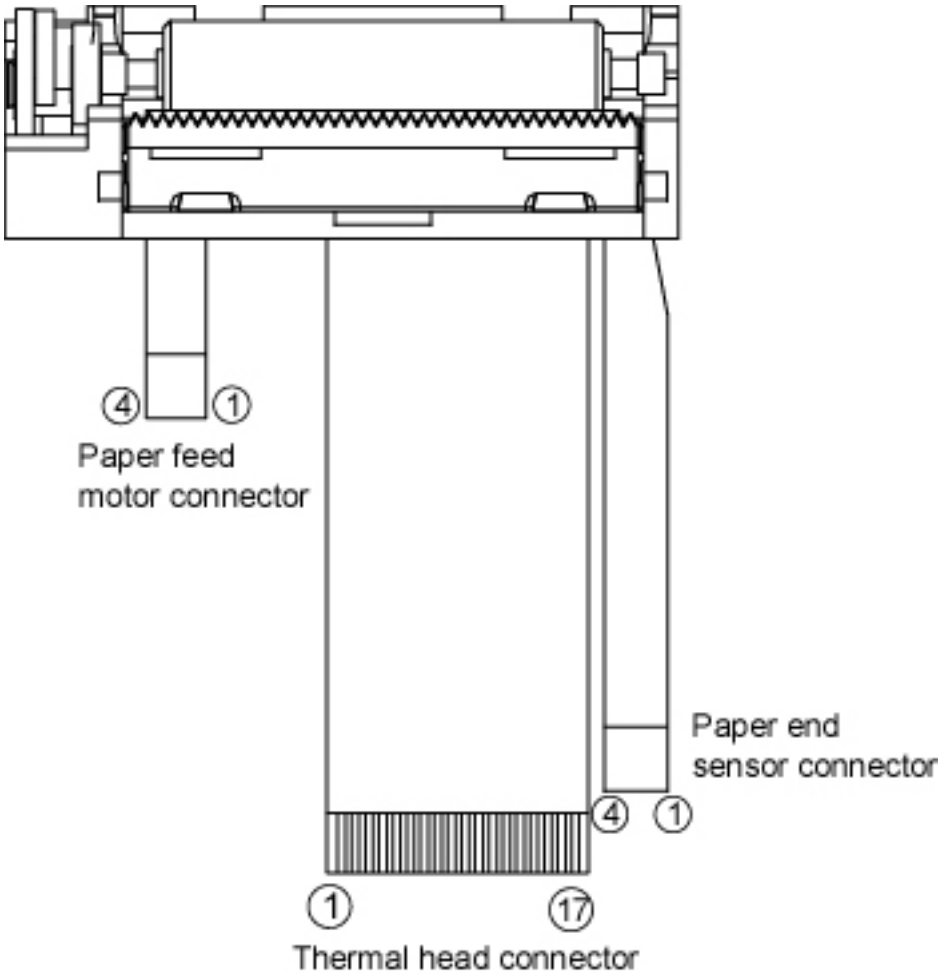
1. CONNECTIONS

The Porti-M100V has 3 interface connectors, print head connector and paper feed motor connector, paper end sensor. In the table below are described the connector specifications and functions:

(Table 1)

No.	Connector	Pin No.	Type
1	Thermal head connector	17	Connector for FPC (pitch 1mm) such as Molex connector series 52808-1790.
2	Paper feed motor connector	4	Connector for FPC (pitch 1mm) such as Molex connector series 52808-0490.
3	Paper end sensor connector	4	

(Figure 1)



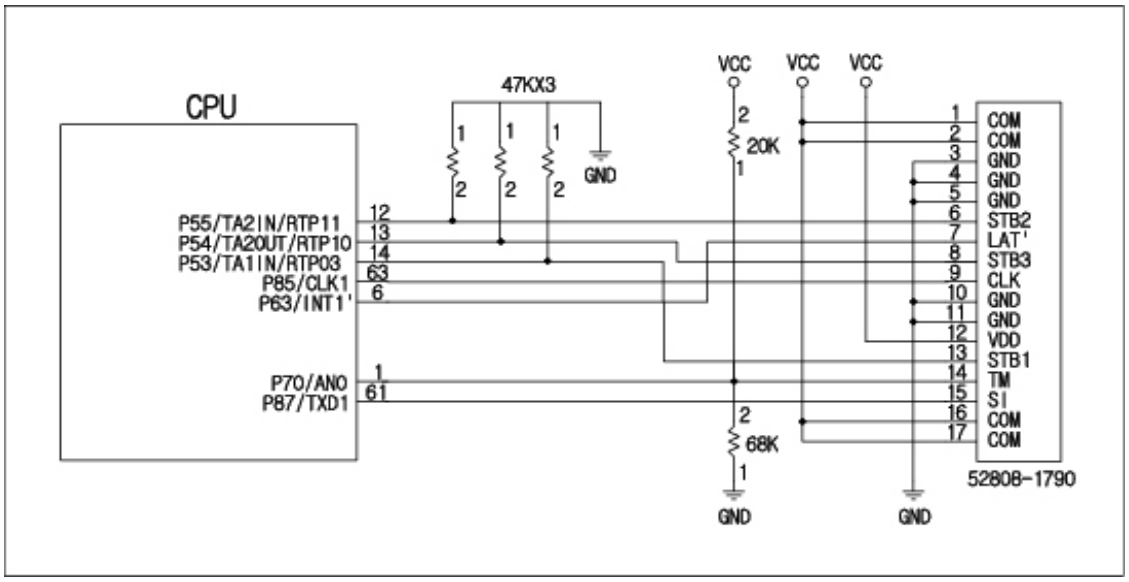
1.1 Thermal print head

1.1.1 Thermal head connector's pin assignments

(TABLE 1.1)

PIN No.	SIGNAL
1	COM
2	COM
3	GND
4	GND
5	GND
6	STB2
7	/LAT
8	STB3
9	CLK
10	GND
11	GND
12	VDD
13	STB1
14	TM
15	SI
16	COM
17	COM

1.1.2 Thermal head block diagram



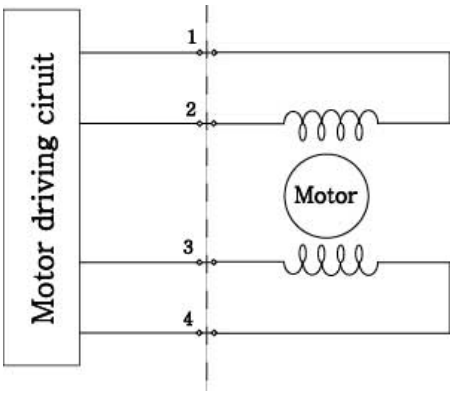
1.2 Paper Feed Motor Connector

1.2.1 Paper feed motor connector's pin assignments

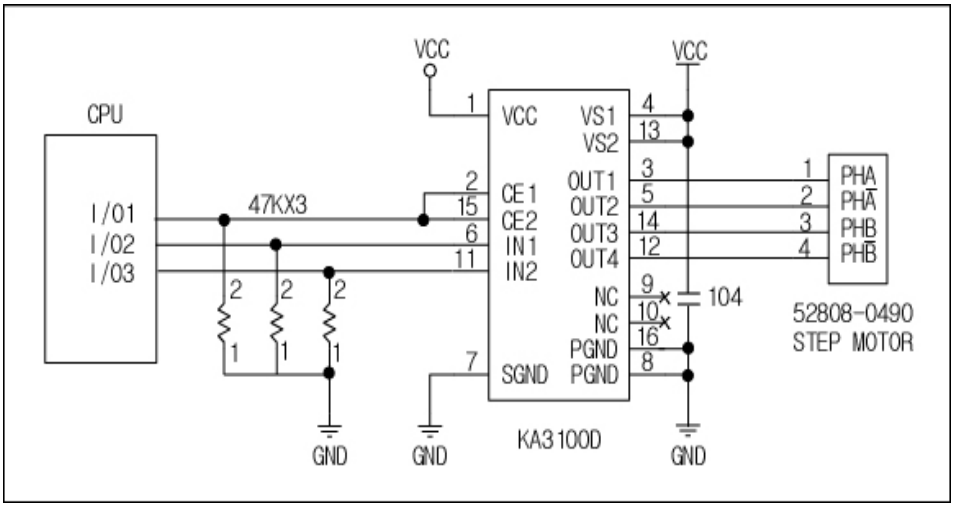
Pin No.	Signal Phase
1	Phase A
2	Phase $\overline{A}$
3	Phase B
4	Phase $\overline{B}$

(Table 1.2)

1.2.2 Paper feed motor block diagram



(Figure 1.2)



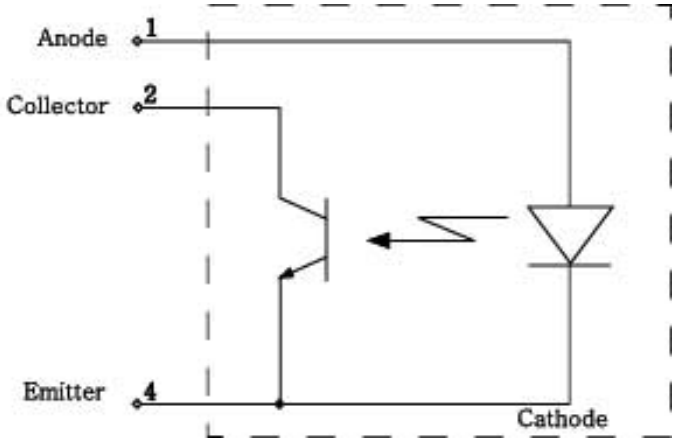
1.3 Paper end Sensor Connector

1.3.1 Paper end sensor connector's pin assignments

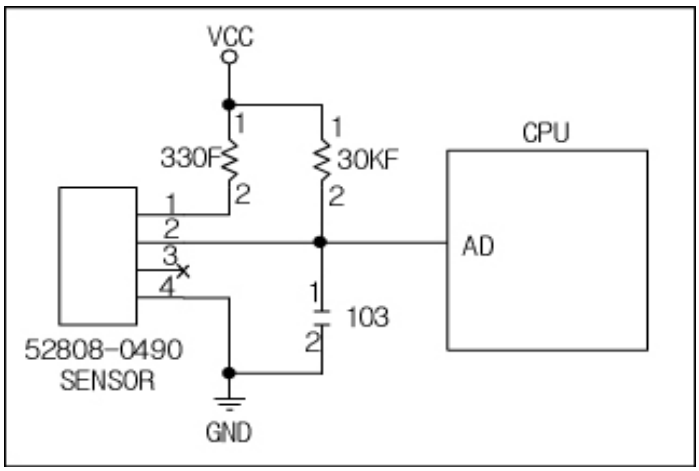
Pin No.	Signal Name
1	Vcc
2	Signal (Open collector)
3	N.C
4	GND

(Table 1.3)

1.3.2 Paper end sensor block diagram



(Figure 1.3)



2. PRINT HEAD

2.1 Outlines

Print Width	**:**	**24.0 mm**
Dot Density	**:**	**8 dots/mm**
Number of Heat Elements	**:**	**192 dots**
Average Resistance Value	**:**	**130 Ω ±4%**
External Dimension	**:**	**Fig-1**
Electrical Characteristics	**:**	**Table-1-1, Table-1-2**
Timing Chart	**:**	**Fig-2**
Pinout Diagram	**:**	**Table1.1**
Thermistor Specification	**:**	**Table-3 30kΩ(B=3950K)**
Circuit Diagram	**:**	**Fig-3**

2.2 Maximum Conditions

(Table 2.2)

Item	Symbol	Reference		Unit	Conditions
Scanning Line Time	SLT	2.5	5.0	mJ/line	T=25℃
Supply Energy	Eomax1	0.48	0.70	mJ/dot	*1
	Eomax2	0.37	0.54	mJ/dot	*2
Supply Voltage	Vsetmax	8.5		V	*3
Supply Power	Pomax	0.45		W/dot	
Supply Current	Iomax	3.8		A	64 dots is pulsed
Number of STROBE	STRmax	3		-	
Number of Heating Dots at Same Time	Ndotmax	64		dots	
Substrate Temperature	Tmax	70		℃	Temperature defected by Thermistor

***1… Only on condition that neighboring 2 dots are pulsed at same time.**

***2… On condition that neighboring above 3dots are pulsed at same time.**

***3… Voltage among the connector terminal Never exceed Driver IC's high Voltage limit, 9V.**

2.3 Standard Printing Conditions .. at 25℃

*** Mechanical Conditions**

(Table 2.3.1)

Item	Reference	Unit	Unit or Conditions
Platen Diameter	MAX. 8	mm	
Platen Hardness	40 ±5	deg	Shore A
Platen Pressure	9.8 ±4.9	N/head	
Paper Feed Pitch	8.0	Line/mm	

*** Electrical Conditions**

(Table 2.3.2)

Item	Symbol	Reference		Unit	Conditions	
Power Consumption	Vset	5.0		V	Rave = 130 Ω	
Supply Voltage	Po	0.16		W/dot	Ndot = 64 dots	
Scanning Line Time	SLT	2.5	5.0	ms/line	*4	
Supply Energy	Eo	0.23	0.37	mJ/dot	25℃	
(On Time)	(ton)	1.44	2.31	ms		
Supply Current	Io	2.2		A		

***4... Printing duty is equal or les than 33%**

2.4 Ambient Conditions

(Table 2.4)

Item	Reference	Unit	Conditions
Storage Temp	-40 ~ +80	℃	
Operation Temp	-30 ~ +70	℃	The temperature at 70℃ is defined as detecting it from Thermistor.
Humidity	10 ~ 90	%RH	Condensation should be avoided.

***5... Under the both condition of less than 0℃ and greater than 50℃, printing become to have less quality. There the condition is within the limits of working, but it is without guarantee of printing quality.**

2.5 Print Characteristics ... Under standard printing conditions.

(Table 2.5)

Item	Standard	Unit	Conditions
Minimum Optical Density	min. 1.0	-	*6
Maximum Range of MAX.-MIN	max.-min 0.3	-	*6

***6... Density is measured at the full black pattern at a distance of 10mm from full black pattern started Macbeth densitometer RD-914 or equals.**

2.6 Life... Under standard printing conditions.

The print head life specified below is defined in the case that printing area duty is 12.5%. Life means the time that the average resistance shifted 15% from the initial resistance value labeled on the print head.

It is not available, in case of exceeding uses of the following properties.

Limited Warranty of Life **(Table 2.6)**

Item	Standard	Unit	Conditions
Heat Pulse Life	$1X10^8$	Pulses	
Abrasion Life	100	km	*7, *8

***7... Without defect by dust, etc.**

***8... Missing of printing dots 0.5% max. (There shall be no dot destruction until 50km.)**

2.7 Table-1-1, Table-1-2, Fig-2, Table-3, Fig-3

2.7.1 Table-1-1 Electrical Characteristics (1)

VDD=5.0V ±10%, T=25℃

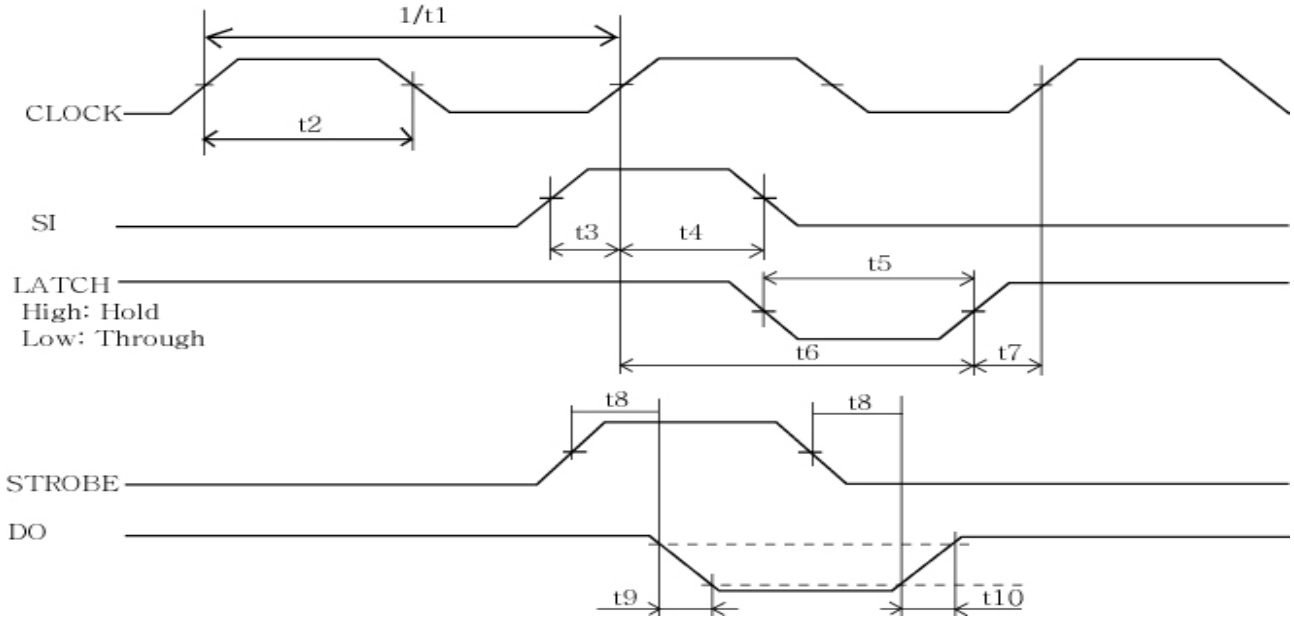
Item	Symbol	Unit			Unit	Conditions
		MIN	TYP	MAX		
Average Resistance Value	Rave	125	130	135	Ω	Standard printing conditions
Output Supply Voltage	Vset	-	-	8.5	V	
Supply Voltage	VDD	4.5	5.0	5.5	V	
Supply Current	IDD	-	-	12	mA	ALL-HIGH
High Level Input Voltage	V_{IH}	VDDX0.8	-	VDD	V	
Low Level Input Voltage	V_{IL}	0	-	VDDX0.2	V	
High Level Input Current	I_{IH}	-	-	0.5	μA	V_{IH}=VDD
Low Level Input Current	I_{IL}	-	-	0.5	μA	V_{IL}=0V
DO Leakage Current	I_{LEAK}	-	-	0.03	mA	ALL-LOW
CLOCK Frequency	t1	-	-	8	MHz	See Fig-2
CLOCK Pulse Width	t2	45	-	-	ns	
CLOCK-SI Setup Time	t3	30	-	-	ns	
CLCOK-SI Hold Time	t4	10	-	-	ns	
LATCH Pulse Width	t5	50	-	-	ns	
CLOCK-LATCH Setup Time	t6	70	-	-	ns	
CLOCK-LATCH Hold Time	t7	40	-	-	ns	
STROBE-DO Delay Time	t8	-	-	6.0	μs	
DO Fall Time	t9	-	-	6.0	μs	
DO Rise Time	t10	-	-	6.0	μs	

2.7.2 Table-1-2 Electrical Characteristics (2)

VDD=5.0V ±10%, T=25℃

Item	Symbol	Unit			Unit	Conditions
		MIN	TYP	MAX		
Average Resistance Value	Rave	125	130	135	Ω	Standard printing conditions
Output Supply Voltage	Vset	-	-	8.5	V	
Supply Voltage	VDD	2.7	-	4.5	V	
Supply Current	IDD	-	-	12	mA	ALL-HIGH
High Level Input Voltage	V_{IH}	VDDX0.8	-	VDD	V	
Low Level Input Voltage	V_{IL}	0	-	VDDX0.2	V	
High Level Input Current	I_{IH}	-	-	0.5	μA	V_{IH}=VDD
Low Level Input Current	I_{IL}	-	-	0.5	μA	V_{IL}=0V
DO Leakage Current	I_{LEAK}	-	-	0.03	mA	ALL-LOW
CLOCK Frequency	t1	-	-	5	MHz	See Fig-2
CLOCK Pulse Width	t2	64	-	-	ns	
CLOCK-SI Setup Time	t3	40	-	-	ns	
CLCOK-SI Hold Time	t4	10	-	-	ns	
LATCH Pulse Width	t5	100	-	-	ns	
CLOCK-LATCH Setup Time	t6	150	-	-	ns	
CLOCK-LATCH Hold Time	t7	40	-	-	ns	
STROBE-DO Delay Time	t8	-	-	15.0	μs	
DO Fall Time	t9	-	-	15.0	μs	
DO Rise Time	t10	-	-	15.0	μs	

2.7.3 Fig-2 Timing Chart



2.7.4 Table-3 Thermistor Specification

(1) Electrical Requirements

Item	Reference	Unit	Conditions
Resistance value(R25)	30k ±5%	Ω	at 25℃
B Value	3950 ±2%	K	

(2) Range

Item	Reference	Unit	Conditions
Operating Temperature	**-40 ~ +125**	℃	
Dissipation Constant	**1.5**	**mW/℃**	
Time Constant	**5**	**s**	
Maximum Power	**400**	**mW**	**at 25℃**

(3) Temperature Characteristics

Correlation Between Thermistor Resistance and Temperature.

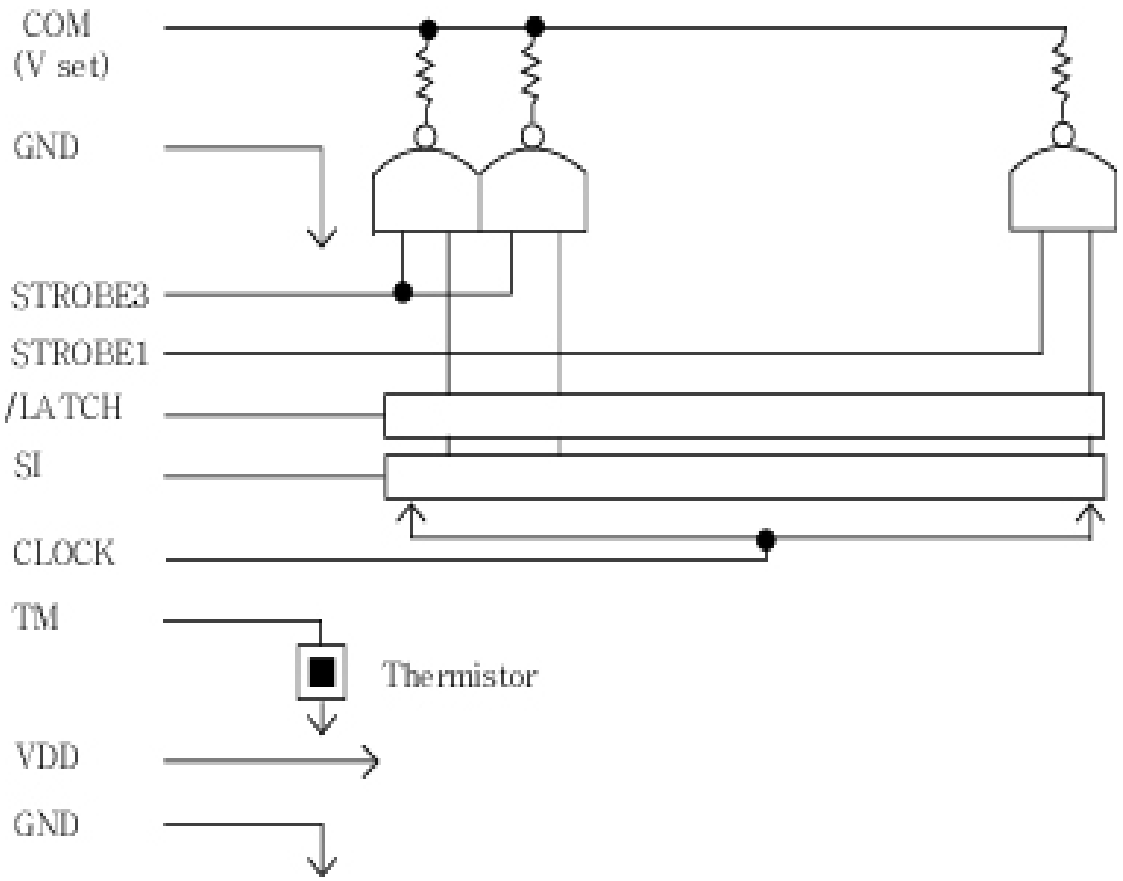
RX = R25 X EXP (B X (1 / TX - 1 / T25)) TX (˚ K) = 273.15(˚ K) + Each Temperature(℃)

T25(˚ K) = 273.15(˚ K) + 25(℃)

Temperature Characteristics

Temp (℃)	Resistance Value(kΩ)	Temp (℃)	Resistance Value(kΩ)	Temp (℃)	Resistance Value(kΩ)	Temp (℃)	Resistance Value(kΩ)
-40	**1205.579**	**10**	**60.524**	**60**	**7.458**	**110**	**1.587**
-35	**844.731**	**15**	**47.511**	**65**	**6.259**	**115**	**1.390**
-30	**600.612**	**20**	**37.606**	**70**	**5.280**	**120**	**1.221**
-25	**432.951**	**25**	**30.000**	**75**	**4.475**	**125**	**1.077**
-20	**316.154**	**30**	**24.111**	**80**	**3.811**	**130**	**0.952**
-15	**233.694**	**35**	**19.517**	**85**	**3.260**	**135**	**0.844**
-10	**174.737**	**40**	**15.904**	**90**	**2.801**	**140**	**0.751**
-5	**132.078**	**45**	**13.044**	**95**	**2.416**	**145**	**0.670**
0	**100.862**	**50**	**10.765**	**100**	**2.093**	**150**	**0.599**
5	**77.774**	**55**	**8.935**	**105**	**1.819**		

2.7.5 Fig-3 Circuit Diagram



STROBE No.	Dot No.	Number of dots
1	1 ~ 64	64
2	65 ~ 128	64
3	129 ~ 192	64

2.8 Operation Precautions

(1) When continuous printing is performed, the supply energy should be adjusted so that the head temperature monitored through the thermistor will remain below the maximum temperature 70℃ shown in Table-3.

(2) Power on and off sequence must be in the following order to prevent the dot element damage;

■Turn on - Apply the logic supply voltage (V_{dd}) first and the print head supply voltage (Vset) next.

■Turn off - Switch off the print head supply voltage(Vset) first and turn off the logic supply voltage (VDD) next.

(3) At the time of power on/off, strobe(STROBE) shall be on "Non-active Condition".

(4) Heat elements and IC's shall be anti-electrostatic in order to prevent the electrostatic destruction. Do not touch the FFC terminal by naked hands.

(5) Mechanical stress or shock (including foreign particle rolling) to the surface of head substrate should be avoided to prevent damage.

(6) When the print head operation is finished, print supply voltage. (including the charged voltage with capacitor) should be reduced to the ground level and remained until next print head operation.

(7) Platen roller should be composed of non-conductive materials.

(8) Condensation should be avoided. If condensation occurred, do not switch on the print head power until condensation disappeared.

(9) FFC terminal are easy to bent, please pay attention to that when the connector is plugged in or out.

At the connecting area between FFC and substrate, FFC must be handled except strongly force, like a shock, due to protect against damage.

(10) Print quality would be degraded if paper or ink residue were stuck on the heat element area. For such a case, please use applicator with alcohol to clean up. Do not use the sandpaper destroying the heat elements.

(11) If printing sound, for example sticking sound, occurred, please review and adjust the paper feed mechanism and the electrical pulse program to eliminate the sound.

(12) The change of print head flatness (warp) is minimized with temperature change in the free body of one unit. Please pay attention to the warp created by fixing the print head to the printer unit with screws or clamp.

(13) Please pay attention that the paper used does not include bad factor to affect the print head life.

It is recommended that a thermal paper has the following ION concentration.

.Na^+ION 500ppm MAX .CI^-ION 300ppm MAX .K^+ION 150ppm MAX

(14) Special care should be taken to prevent rubbing thermal paper on hard cover and FFC cover by paper guide, etc...

(15) Please take care, do not repeat bend after connecting FFC.

(16) In case of installing capacitor for noise reduction, it is recommended that capacitance is 0.1㎌/16V between GND and VDD line.

(17) Installing electrolytic capacitor with high capacitance is recommended for stability on COM line.

But the capacitance is depended on current limitation of protection circuit, in case of lithium ion battery.

(18) Please take care, all GND pins should be connected to Mother Board's signal GND for electrical stability.

(19) Resistance of interface wire should be used it less than 0.44Ω/m and the length should be less than 0.5m.

3. PAPER FEED MOTOR

The paper feed pitch for stepping motor is 2 steps for one dotline (1dotline = 0.125mm).

3.1 Ratings

(Table 3.1)

No.	Item	Specification			Remark
1	Number of phase	2			
2	Step angle	18 °	deg		
3	Voltage	5	VDC		
4	Excitation	2-phase Bipolar			
5	Direction of rotation	Both-Way (CW / CCW)			
6	Rated current	300mA / phase at 800pps			(5V DC)

3.2 Electrical characteristics

- **With a terminal voltage of 5VDC otherwise specified.**
- **Under 2-phase excitation.**

(Table 3.2)

No.	Item	Specification	Remark
1	Winding resistance	12Ω ± 10% / phase	Equivalent at 25℃
2	Pull - out Torque	Min 13 gf · cm	f= 800 pps 5V
3	Holding Torque	Min 40 gf · cm	
4	Max. starting rate	1030 pps MIN.	No Load
5	Insulation resistance	100MΩ MIN	DC500V between winding and case
7	Dielectric strength	5mA (AC 600V 0.5SEC)	between winding and case
8	Temperature rise winding	90 deg. MAX	Motor 7.2VDC , 598PPS
9	Flux leakage	10 Gauss MAX.	At distance of 20mm from motor surface
10	Noise	No touch sound and noise	5[VDC], 800pps

3.3 Mechanical properties

(Table 3.3)

No	Item	Performance
1	Rotor Inertia	0.07 g · ㎠ (ref) : Calculated value
2	Construction and dimension	Refer to the Outside- Drawing
3	Appearance	Any scratches press burrs or stains on the surface of the motor, the lead screw will not be allowed
4	Weight	9g Approximate
5	Output shaft material	SUS 420J2
6	Noise	No unusual sound

3.4 Excitation (2 phase, Full step)

(Table 3.4)

PIN No.	STEP 1	2	3	4
1	+	-	-	+
2	-	+	+	-
3	-	-	+	+
4	+	+	-	-

Switching sequence for cw rotation

3.5 Environmental properties

① Operation temperature / humidity range

Temperature : 0 ~ 80℃

Humidity : 20 ~ 80% (No condensing)

② Storage temperature / humidity range

Temperature : -40 ~ 80℃

Humidity : 8 ~ 90% (No condensing)

4. PAPER END SENSOR

A photo-sensor is used to detect the existence of the thermal paper in the path near the thermal head.

4.1 Maximum rating

(Table 4.1)

ITEM		Symbol	Rating	Unit
INPUT	Power dissipation	P_D	75	mW
	Reverse voltage	V_R	5	V
	Forward current	I_F	50	mA
	Pulse forward current	I_{FP}	1	A
OUTPUT	Collector power dissipation	P_C	50	mW
	Collector current	I_C	20	mA
	C-E voltage	V_{CEO}	30	V
	E-C voltage	V_{ECO}	3	V
Operating temp		Topr.	-25 ~ +85	°C
Storage temp		Tstg	-30 ~ +100	°C
Soldering temp		Tsol	240	°C

4.2 Electron-optical characteristics

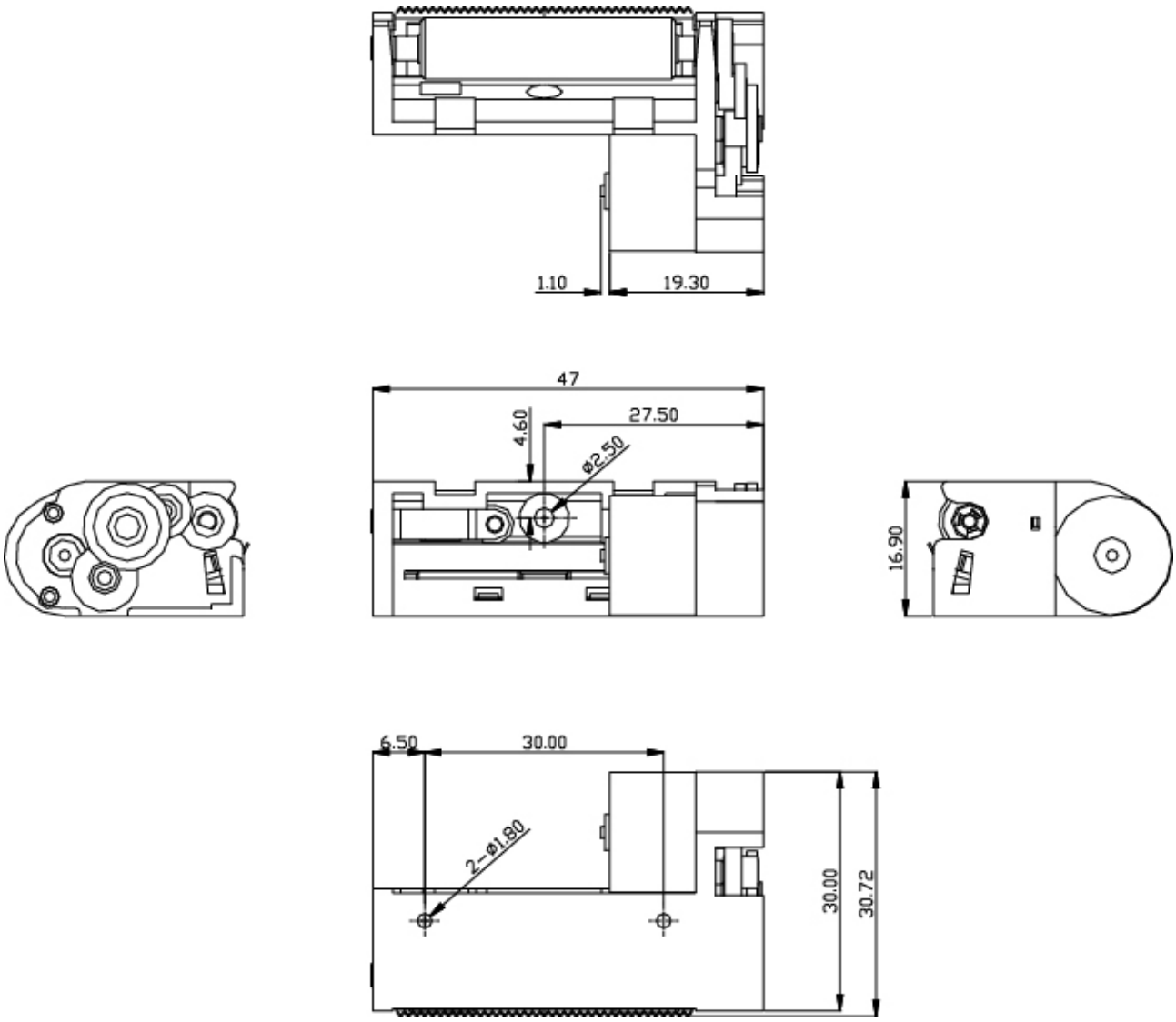
(Table 4.2)

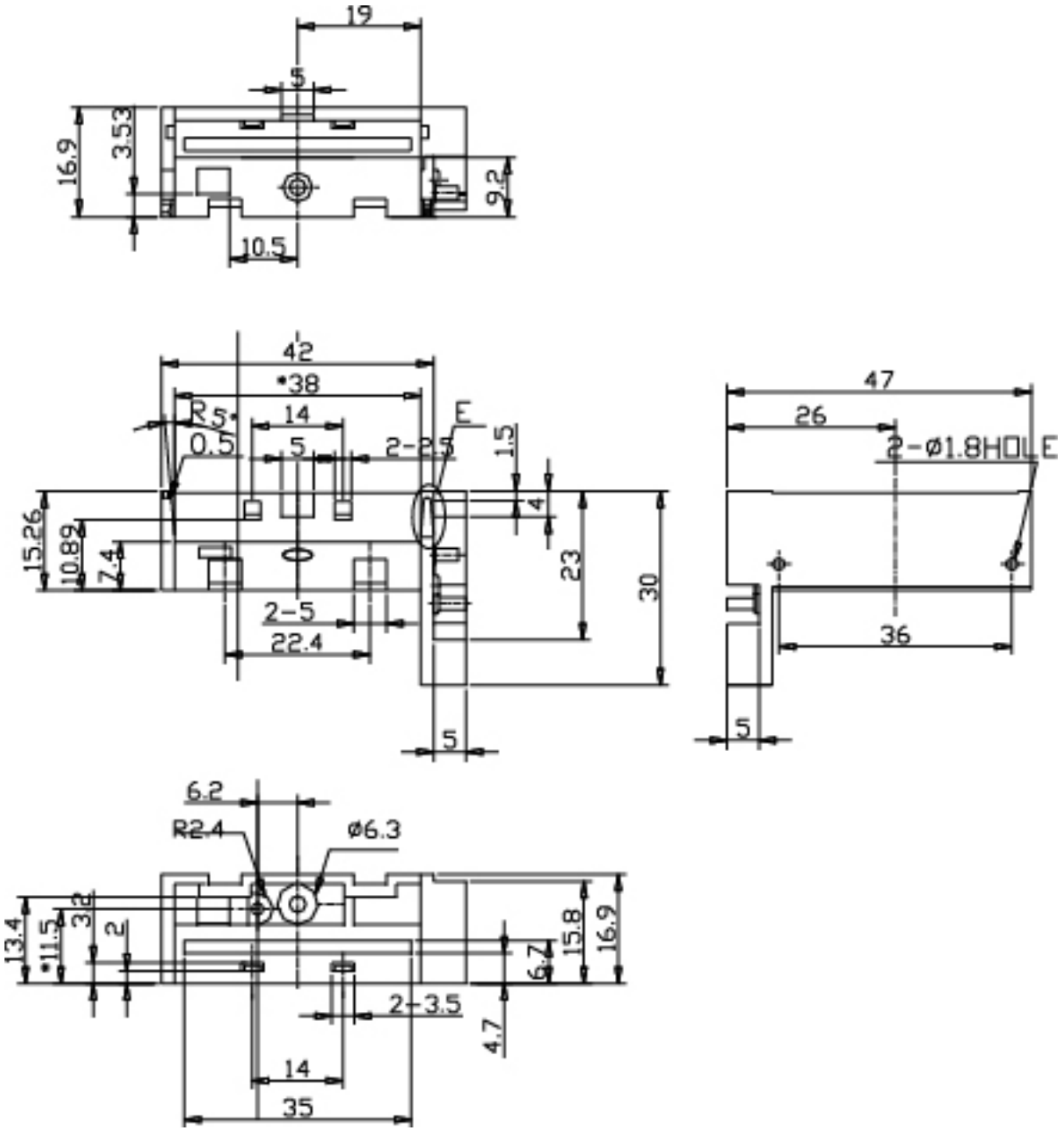
ITEM		Symbol	Conditions	Min	Typ	Max	Unit
INPUT	Forward voltage	V_F	I_F=10mA			1.3	V
	Reverse current	I_R	V_R=5V			10	μA
	Peak wavelength	λ_P			940		nm
OUTPUT	Collector dark current	I_{CEO}	V_{CE}=10V			0.2	μA
Light current		I_L	V_{CE}=5V, I_F=10mA	90			μA
Leakage current		I_{CEOD}	V_{EC}=5V, I_F=10mA			0.2	μA
Switching speeds	Rise time	tr	V_{CC}=2V I_C=100μA R_L=1KΩ		30		μsec.
	Fall time	tf			25		μsec.

5. DIMENSIONS

The figure 5.1 illustrates the overall dimensions for the Porti-M100V thermal printing mechanism.

(Dimension in mm) **(Figure 5.1)**




19
5
16.9
3.53
9.2
10.5
42
38
R5
0.5
14
5
2-2.5
E
1.5
4
15.26
10.89
7.4
23
30
2-5
22.4
5
47
26
2-ø1.8HOLE
36
5
6.2
R2.4
ø6.3
13.4
11.5
3.2
2
15.8
16.9
6.7
2-3.5
4.7
14
35

6. DISASSEMBLEY AND ASSEMBLY

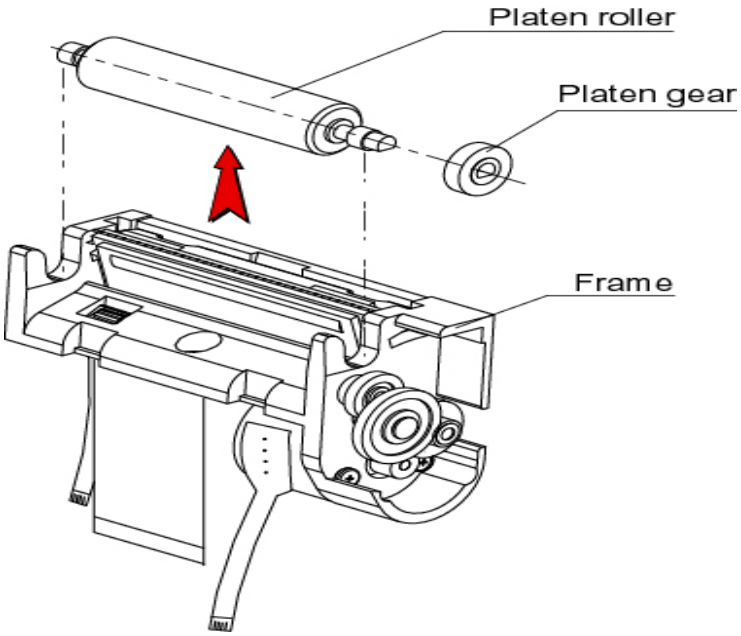
6.1 Assembly

For assembly, follow the disassembly procedures described in Section 6.2, "Disassembly", in reverse sequence.

6.2 Disassembly

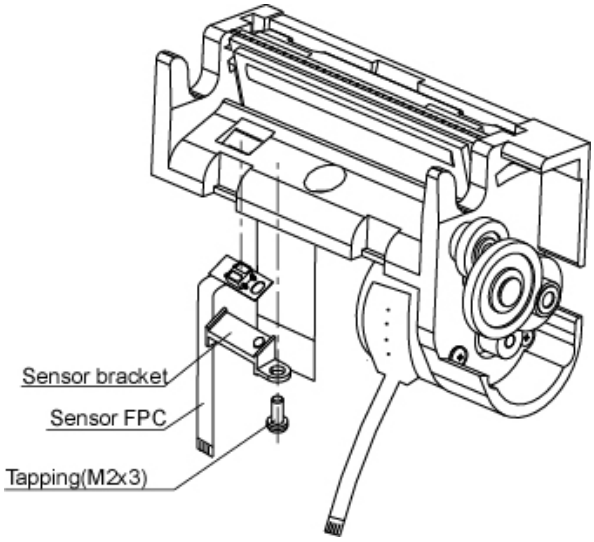
Disassembly of printer components beyond the examples shown in Figure A.1,"Exploded View of Porti-M100V"may result in damage to the printer and its functions.

6.2.1 Remove the Platen



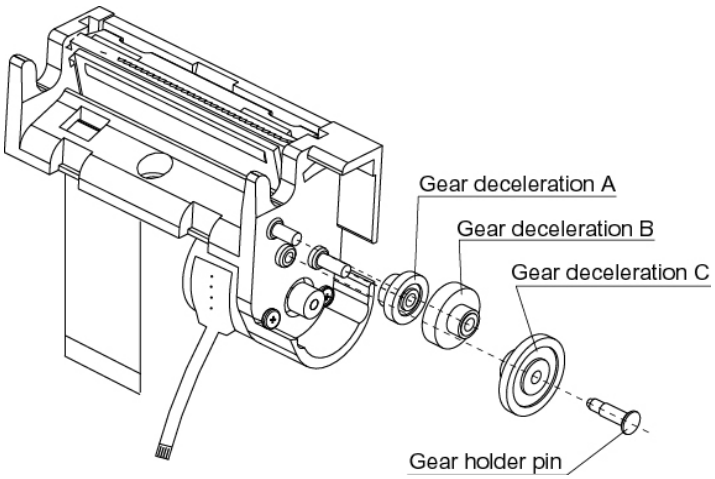
① **Remove the PLATEN-ROLLER from the FRAME as shown and pull out the PLATEN-GEAR**

6.2.2 Remove the Sensor



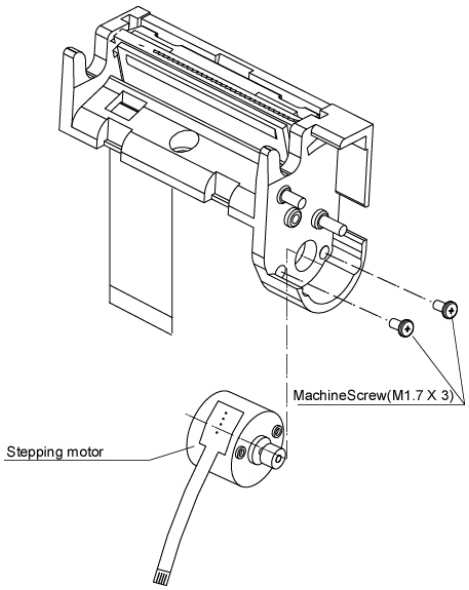
① **Using a screwdriver, remove the Tapping(M2x3) and detach the SENSOR BRACKET and the SENSOR ass'y.**

6.2.3 Remove the Gear



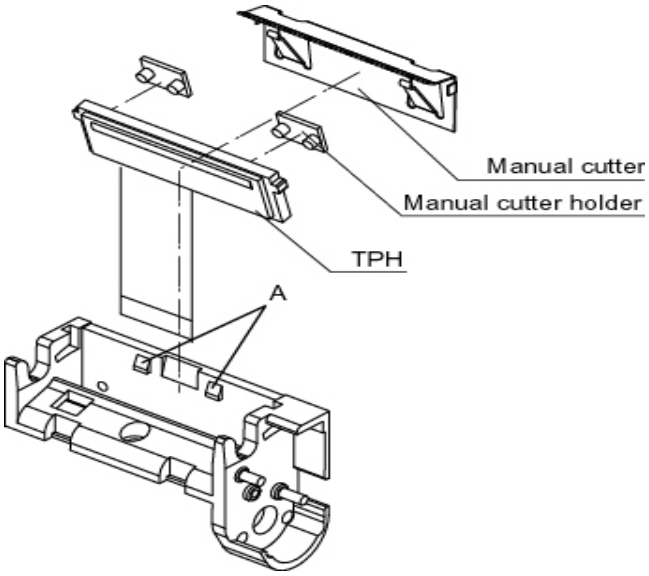
① **Detach the GEAR HOLDER PIN and remove the GEAR (A,B,C).**

6.2.4 Remove the Stepping Motor



① **Using a screwdriver, remove the Machine(M1.7x3) and detach the STEPPING MOTOR.**

6.2.5 Remove the TPH



① **Unhook the parts "A" and detach the MANUAL-CUTTER from the FRAME.**

② **Detach the MANUAL CUTTER HOLDERs and from the TPH ass'y.**

Figure A.1 EXPLODED DIAGRAM OF Porti-M100V