Auto-cutter thermal printer mechanism

NEO-PRINTER-PT723F24401

2. Operation precautions

2.1 When handling this printer, for TPH and photo interpreter is sensitive to static electricity, please take any preventive measures against static electricity, such as disposable static wrist strap, in order to prevent damages of inner parts of the printer caused by the static electricity.

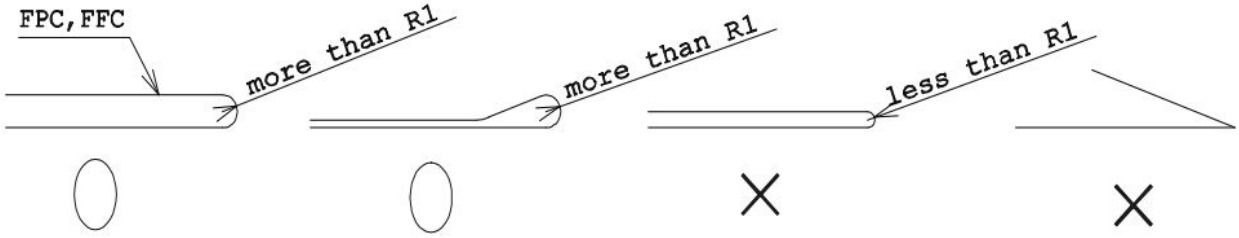
2.2 When attaching the platen part to the platen retainer, pay attention not to flaw or damage or smear the rubber part of the platen, the platen gear, and the bearing part (particularly, don't attach any oil or grease and foreign materials on the rubber part.)

2.3 Never attempt to touch the thermal printer head surface with bear hands. Attaching any oil or grease such as oils from palms on the heating element part of may be shortening the lifetime of the thermal head. In case that any oil and grease or foreign materials are attached on it. Perform the cleaning immediately. In addition, pay attention not to hit it with something hard such as driver.

2.4 When assemble the platen to the platen retainer of the casing, make sure that the orientation is correct.

2.5 The thermal head and FPC are shipped as they are connected. When installing the printer, do not pull or apply any extra force in order to avoid the connected part of the thermal head and FPC from being disconnected or deviated. When connecting FPC, please make it sure under condition that the power of control circuit is off. Plug in / out FPC to control board, should less than 10 times, meanwhile make FPC parallel to connector socket.

2.6 Do not make FPC bend because it may cause FPC disconnection or broken. If FPC requires to be bent, it will be rework if the bending more than R1.



2.7 The printer has a structure such that the platen part is removed from the printer cabinet. Therefore, if any paper ejected from this printer is pulled away with an unnecessarily strong force, it may cause the platen gear to get off the track and damage the gear. Do not attempt to pull any paper ejected from the printer.

2.8 Wet paper can be make it jammed, pay attention to the following items when using the printer:

2.8.1Turn off the power please when it is not used
2.8.2 Do not load any wet paper please.

2.8.3 Turn off the power to the head immediately when condensation occurs. Use the head only after the heads is completely dried. Depending on the environment where the printer is used (the low temperature or high humidity), condensation may be caused by water vapor generated from the used paper when performing the printing of the high printing rate. Therefore, the environment should be considerably evaluated.

2.9 To separate the head and the platen after the paper run off, If the paper is run out during the printing, stop all actions of the printer in order to prevent the printing without the paper fed. If the printing is continued without any paper fed, it may cause the troubles of the printer.

2.10 When using this printer for the continuous actions, the temperature of the head printer board (the detected temperature with the thermistor) should be equal or less than 75 degrees centigrade for the temperature protection of IC inside of the printer as well as the surface temperature of the motor should be equal or less than 90 degrees centigrade for the temperature protection of the motor coil.

2.11 Make sure paper load smooth please.

2.12 Use the high quality thermal paper, for the property of the paper have big effect on printing quality. The perforated paper may cause the damage to the thermal heads and even shorten lifetime.

Chapter 2 Specifications

2.1 General specifications

Item	Specifications
	PT723F24401
Print method	Thermal dot line printing
Dots per line	576 dots
Resolution	8 dots/mm
Print width	72 mm
Paper width	80mm
W x D x H（mm）	102.5×42.4×22.3
Weight	116g
Maximum printing speed	120 mm/s
Paper feed pitch	0.0625mm
Head temperature detection	Via thermistor
Out-of-paper detection	Via photo interrupter
Head-up detection	yes（Mechanical switch）
Life span (at 25℃ and rated energy) Activation pulse resistance Abrasion resistance	 110 million pulses or more (print ratio=12.5%) 150 km or more
Operating temperature range (℃)	0～50
Operating humidity (RH)	20％～85％
Storage temperature range (℃)	-20～＋60
Storage humidity（RH）	5%～90%

2.2 Heat element dimensions

PT723F24401 contains a thermal head with 576 heat elements (dot–size)

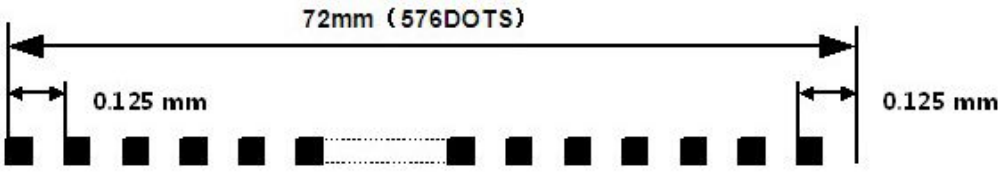


figure 2-1 Heat Element Dimensions

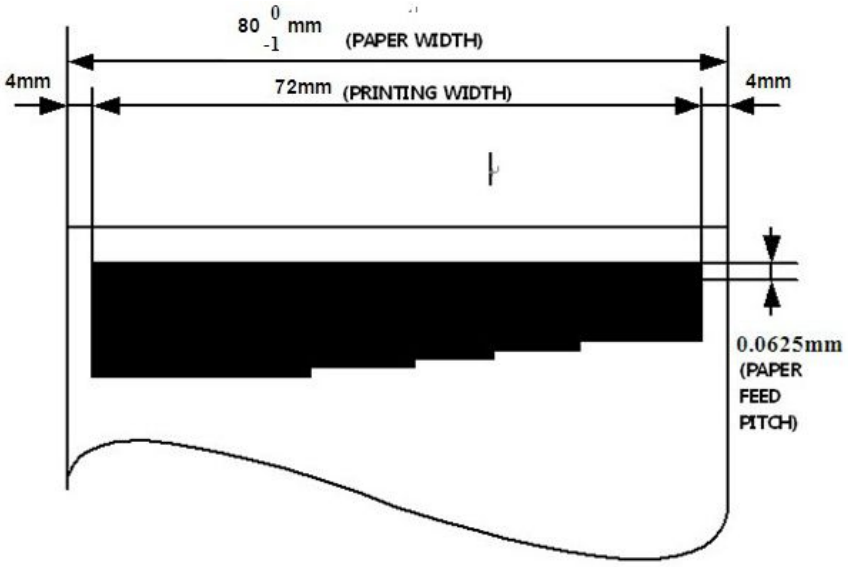
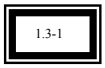


Figure 2-2 Print Area

2.3 Step motor characteristics

2.3.1 Paper conveyance motor



（1）General specification

Item	Specification
Type	PM
Number of phases	2-phase
Excitation	2-2 phase
Drive current	320mA～420mA
Winding resistance per phase	10Ω±7%
Rated voltage	24V
Drive frequency	50-2000pps(Depends driving voltage)

（2）Excitation sequence

Signal name	Sequence			
	STEP1	STEP2	STEP3	STEP4
A	high	high	low	low
$\overline{A}$	low	low	high	high
B	low	high	high	low
$\overline{B}$	high	low	low	high

2.3.2 The drive motor for cutters

（1）General specification

Item	Specification
Type	PM
Number of phases	2-phase
Excitation	2-2 phase
Winding resistance per phase	12Ω±7%
Drive voltage	5V±10%
Drive frequency	50-2000pps(Depends driving voltage)

（2）Excitation sequence

Signal name	Sequence			
	STEP1	STEP2	STEP3	STEP4
$\overline{A}$	high	high	low	low
A	low	low	high	high
B	low	high	high	low
$\overline{B}$	high	low	low	high

2.3.3 Step motor driving

There are two step motor driving: Constant current driving and constant voltage driving
The advantages and disadvantages of constant current driving and constant voltage driving:

	Constant current driving	constant voltage driving
advantages	1.Overall drive current is relatively small, motor heat is small. 2.Drive noise is small. 3.Power-saving.	1.Motor driving force is relatively large 2.Circuit is simple and cheap
disadvantages	1.Motor driving force is relatively small 2.Complex circuit, slightly higher cost	1.Drive current is large, motor heat is large 2.High noise 3.Current consuming

There are two common methods to drive the step motor: 2-2 phase drive (Full Step), 1-2 phase drive (Half Step).

For full step driving, the drive IC charges the two windings in step motor to the predetermined current in sequence. Each plus will drive the motor to rotate with a typical step angle. These methods result in a simple drive circuit and software, but also bigger noise in low speed.

Half step drive is more complicate than full step drive,, such as charging on A phase, rotor teeth stop on stator poles, drive receive next pulse, for example, charging B phase and keep A phase in a charging situation, rotor teeth will move half step angle, stop in the middle of two nearby whole step. This can make the case without changing the motor, stepper motor angular resolution doubling. In this drive way, two phases may need to be energized, with the motor driving IC, control each step of each phase in the ratio of the current state; it can make the motor run quieter. But it also improves the complexity of control software to some extent.

Timing table of paper conveyance motor driving

STEP	Time(ms)	STEP	Time(ms)	STEP	Time(ms)
1	1.32	9	0.79	17	0.46
2	1.20	10	0.75	18	0.42
3	1.10	11	0.71	19	0.38
4	1.03	12	0.67	20	0.35
5	0.97	13	0.63	21	0.32
6	0.92	14	0.58	22	0.30
7	0.88	15	0.54	23	0.27
8	0.83	16	0.50	24	0.24

Timing table of the drive motor for cutters

STEP	Time(ms)	STEP	Time(ms)
1	1.00	8	0.71
2	0.96	9	0.67
3	0.92	10	0.63
4	0.88	11	0.58
5	0.83	12	0.54
6	0.79	13	0.50
7	0.75	——	——

2.4 Thermal head specifications

2.4.1 General characteristics

Item	Specification	Note
Print width	72mm	
Number of heater elements	576 dots	
Heater resolution	8 dots/mm	
Heater pitch	0.125 mm	
Heater resistance	$\overline{R}$ =1500 Ω ±3%	
Number of data inputs	1 serial input	Data In
Logic signals	4 STROBE and 1 LATCH	
Logic power supply	3.3 V × 80 mA	At 20 MHz
Heater print voltage	24 V	
Specification for Thermistor	R_{25}=30KΩ±5%,B=3,950K±3%	See 2.4.8

2.4.2 Maximum parameter

Parameter	Symbol	Specification		Note
Heater energy consumption	Eo max	0.83 ms/line	1.25 ms/line	Ta=25℃
		0.22 mJ/dot	0.32 mJ/dot	
Head voltage	VH max	28 V		Between Connectors
Logic voltage	VDD max	5.5V		
Number of heating dots simultaneously ON	Ndot max	288 dots		
Operating temperature	Ta	-5 ℃ ～ +50 ℃		
Storage temperature		-40 ℃ ～ +80 ℃		Non-operating
Operating humidity		10～90%RH		Non-condensing
Storage humidity		5～90 %RH		

2.4.3 Characteristics recommended

Item		Symbol	Recommended conditions		Note
Print Speed			0.83 ms/line	1.25 ms/line	
Heater power consumption		Po	0.36W/dot		$\overline{R}$ =1500Ω
Heat voltage		VH	24V		Between Connectors
Heater energy consumption	5℃	Eo (ts)	0.16mJ/dot(0.44ms)	0.18mJ/dot(0.50ms)	$\overline{R}$ =1500Ω See 2.4.7
	25℃		0.14mJ/dot(0.39ms)	0.16mJ/dot(0.44ms)	
	40℃		0.12mJ/dot(0.33ms)	0.14mJ/dot(0.39ms)	
Supply current		Io	15.4mA/dot		

2.4.4 Electrical characteristics

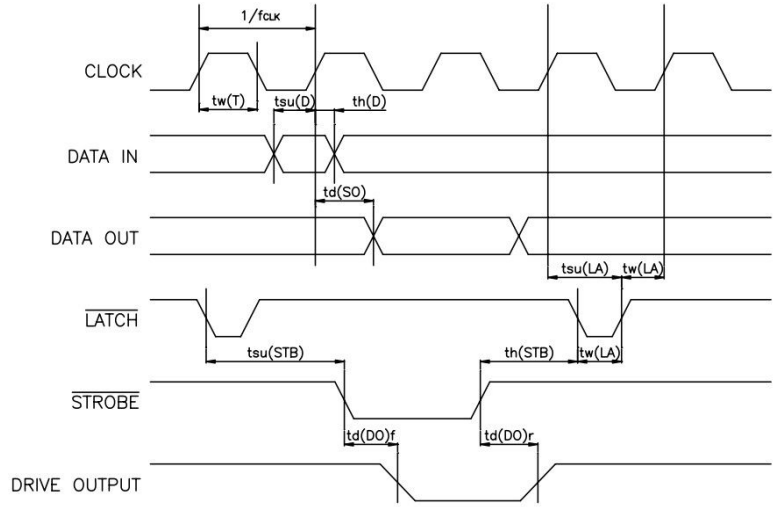
Parameter		Symbol	Test conditions	Min.	Typ.	Max.	Unit
Supply voltage		VH		——	——	24	V
		VDD		3.0	3.3	5.5	V
Input voltage for logic		V_{IH}		0.8 VDD		VDD	V
		V_{IL}				0.2 VDD	V
Clock frequency		f_{CLK}	Duty50%			30	MHz
Input current	LATCH	I_{IH}	V_{IH}= VDD			8.0	μA
	STROBE					2.0	
	CLOCK					8.0	
	DATAIN					1.0	
	LATCH	I_{IL}	V_{IL}=GND	-480			μA
	STROBE			-120			
	CLOCK			-8.0			
	DATAIN			-1.0			
Output voltage of drivers (Heater supply voltage)		V_{OL}	VDD=3.3V I_{OL}=40mA		0.96	1.92	V
Leak current of drivers		I_{LEAK}	V_{OH}=24V			5.0	μA/dot
Logic supply current		I_{dd}	f_{CLK}=20MHz DI=1/2f_{CLK}			80	mA

Note： Each STROBE includes pull-down resistance of 300KΩ±50%.

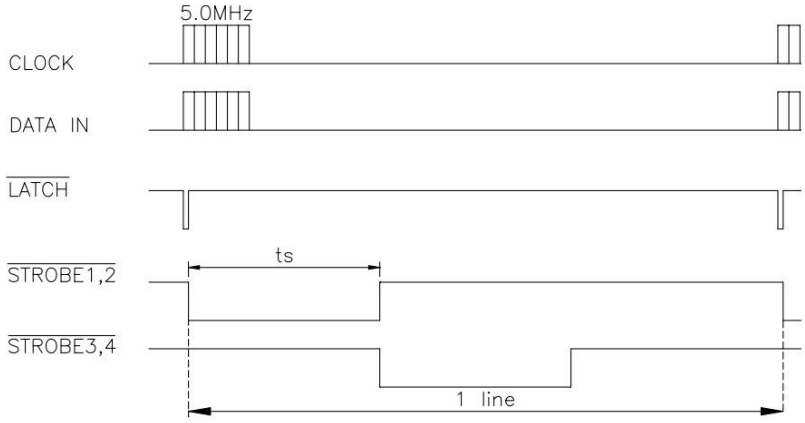
2.4.5 Timing characteristics

Parameter	Symbol	Ratings			
		Min.	Typ.	Max.	unit.
Clock frequency	f_{CLK}			30	MHZ
Clock pulse width	t_w(T)	14			ns
Data setup time	t_{su}(D)	8			ns
Data hold time	t_h(D)	8			ns
Latch setup time	t_{su}(LA)	20			ns
Latch pulse width	t_w(LA)	100			ns

Latch to Strobe setup time	t_{su}(STB)	100			ns
Strobe to Latch setup time	t_h(STB)	100			ns
Clock to Data out delay time	t_d(SO)			28	ns
Strobe to driver Output delay time	t_d(DO)r			60	μs
	t_d(DO)f			15	μs



2.4.6 Timing chart



2.4.7 Equation

Calculate the printing energy using this equation：

$$E_O = I_o^2 \overline{R} t_s = \frac{(VH - V_{com})^2 \cdot \overline{R} \cdot t_s}{(\overline{R} + R_{ic})^2}$$

R_{ic} =24Ω : Driver IC "ON" resistance

t_s : Strobe pulse width

VH : Head voltage

$\overline{R}$: Heater average resistance

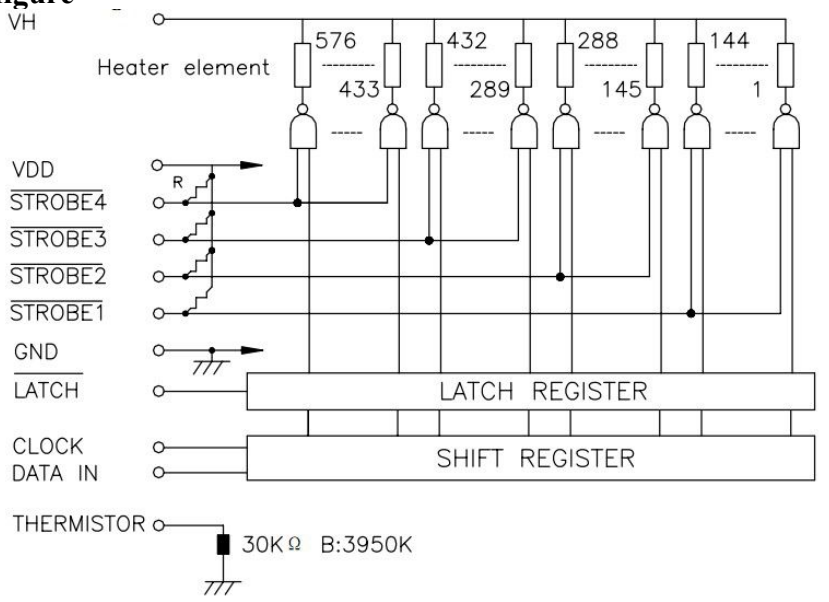
V_{com} =0.5 V

2.4.8 Thermistor resistance

R_{25} = 30kΩ ±5%, B $_{CONST}$= 3950Kelvin±3%, $R = R_{25}e^{B(1/T-1/T_{25})}$

Temperature (° C)	Thermistor Resistance (R)		
	Min.(KΩ)	Typ.(KΩ)	Max.(KΩ)
-40	717	843	989
-35	535	623	723
-30	405	466	535
-25	308	352	400
-20	238	269	303
-15	185	208	232
-10	145	161	178
-5	113	124	137
0	88.7	96.8	105
5	69.9	75.7	81.7
10	55.4	59.5	63.8
15	44.1	47.1	50.1
20	35.4	37.5	39.6
25	28.5	30	31.5
30	22.8	24.2	25.5
35	18.3	19.6	20.8
40	14.9	15.9	17.1
45	12.1	13.1	14.1
50	9.92	10.8	11.7
55	8.16	8.91	9.7
60	6.76	7.41	8.12
65	5.62	6.2	6.83
70	4.7	5.21	5.77
75	3.95	4.4	4.9
80	3.34	3.74	4.18

2.4.9 Structure figure



STROBE No.	Dot No.	Number of Dots
1	1 ~ 144	144
2	145 ~ 288	144
3	289 ~ 432	144
4	433 ~ 576	144

2.4.10 Operating precautions

In order to prevent the printer head does not appear hot spot overheating and burned up phenomenon, when we designing products, need to pay attention to several points as follows:

In hardware terms:

When the power on, the order should be VDD→VH.

When the power is on or stand by, make sure that the STROBE signal is in invalid state.

Make sure if program is abnormal (such as system halted), VH voltage should be shut off automatically.

During the printing, Detecting thermistor temperature, make sure that the thermal printer head (TPH) is not overheated.

When printing in high speed continuously,please pay attention to the temperature of TPH,in order to avoid beyond the standard value.

Don't let the head have water droplets congealing.if the head had water droplets,VH voltage should stay power off until water droplets dispear.

In firmware terms:

STROBE time should not be too long.

In the following two cases, do not start:

① when the motor is stationary; ② When the paper is out.

When the power is on or each printing task completed, it is recommended to send blank data to the mechanism, so it can prevent the printer head from damaged if there are some hardware failure on the control board.

Over-temperature protection:The printer stops working when heating temperature is greater than 75℃,and start working again when the temperature down to 60℃.

2.5 Pin assignment

2.5.1 For thermal head connector on control circuit

No.	Signal name	No.	Signal name
1	PHK	16	GND
2	VSEN	17	THERMISTOR
3	PHE	18	$\overline{\text{STROBE1}}$
4	VH	19	$\overline{\text{STROBE2}}$
5	VH	20	$\overline{LATCH}$
6	VH	21	CLOCK
7	DATA IN	22	VH
8	$\overline{\text{STROBE3}}$	23	VH
9	$\overline{\text{STROBE4}}$	24	VH
10	VDD	25	SW
11	GND	26	SW
12	GND	27	MT/A
13	GND	28	MT/$\overline{\text{A}}$
14	GND	29	MT/B
15	GND	30	MT/$\overline{\text{B}}$

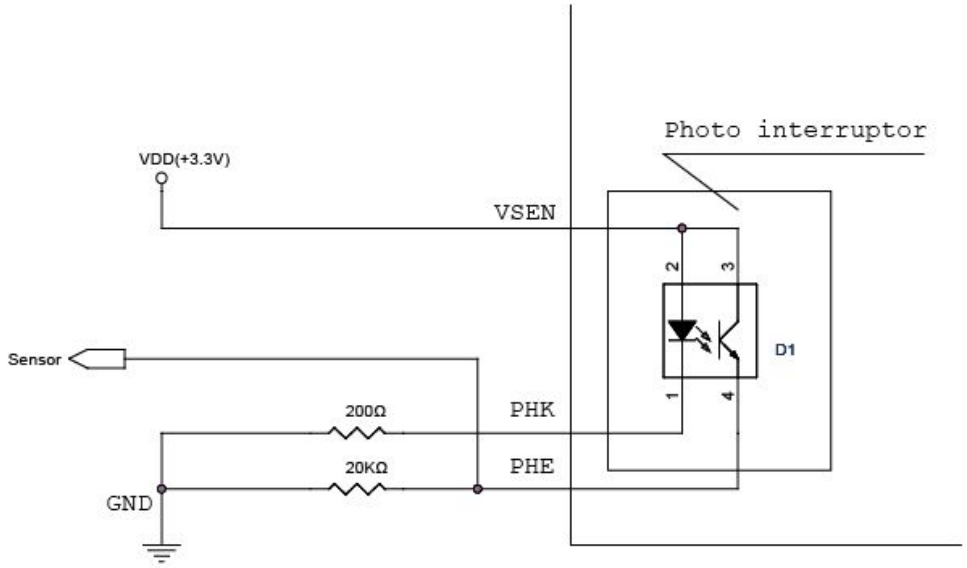
2.5.2 For cutter connector on control circuit

No.	Signal name
1	VSEN
2	PHE
3	PHK
4	MT/A
5	MT/$\overline{\text{A}}$
6	MT/B
7	MT/$\overline{\text{B}}$
8	NC

2.6 Photo interpreter specification

2.6.1 Paper detection sensor

Has a reflexive sensor. These two situations might destroy the reflection, and output the high level: Platen released or paper out.
As follows:
When everything is normal, the sensor will output low level.
The circuit driver of opto detection as follows: The logic voltage could be 3.3V or 5V.
When the paper out or platen released, do not start printer.



Electro-Optical Characteristics (Ta=25℃)

Parameter		Symbol	Min	Typ.	Max.	Unit	Conditions
Input	Forward oltage	V_F	---	1.2	1.6	V	I_F=20mA
	Reverse Current	I_R	---	---	10	μA	V_R=5V
Outpu	Collector-Emitter Voltage	BV_{CEO}	30	---	----	V	I_C=0.5mA
	Emitter-Collector Voltage	BV_{ECO}	5	---	---	V	I_E=0.1mA
	Dark Current	I_{CEO}	---		100	nA	V_{CE}=10V
	C-E Saturation Voltage	$VCE_{(SAT)}$	---	---	0.4	V	I_C=2mA E_e=1mW/cm^2
Transfer Characteristics	Light Current	IC(ON)	180	---	440	μA	V_{CE}=5V I_F=10mA
	Leakage Current	ICEOD	---	---	1		
	Rise time	tr	---	20	---	μsec	V_{CE}=2V I_C=100μA R_L=1KΩ
	Fall time	tf	---	20	---	μsec	

2.6.2 Head position sensor

Maximum ratings (Ta=25℃)

Item		Symbol	Rating	Unit
Input	Power dissipation（Ta ≤25℃）	P_D	80	mW
	Reverse voltage	V_R	5	V
	Forward current	I_F	50	mA
	Peak Forward Current (*1) Pulse width ≦100μs	I_{FP}	1	A
Output	Collector Power Dissipation（Ta ≤25℃）	P_C	80	mW
	Collector Current	I_C	30	mA
	C-E Breakdown Voltage	BV_{CEO}	30	V
	E-C Breakdown Voltage	BV_{ECO}	4.5	V
Operating Temperature		T_{opr}	-20~+85	℃
Storage Temperature		T_{stg}	-20~+85	℃
Soldering Temperature （*2）		T_{sol}	260	℃

Note：(*1) tw≦100μs T=10ms （*2） t=5 Sec

Electrical Characteristics（Ta=25℃）

Parameter		Symbol	Min	Typ.	Max.	Unit	Conditions
Input	Forward Voltage	V_F		1.2	1.6	V	I_F=10mA
	Reverse Current	I_R			10	μA	V_R=5V
Output	Dark Current	I_{CEO}			0.5	μA	V_{CE}=20V
	C-E Saturation Voltage	$V_{CE(sat)}$			0.4	V	I_C=0.1mA I_F=10mA
	Light Current	I_L	0.3	1		mA	V_{CE}=5V I_F=20 mA
Transfer Characteristic	Rise time	tr		10		μsec	V_{CC}=5V I_F=20mA R_L=100Ω
	Fall time	tf		10		μsec	