



# PT3923-A

## Single coil Hall Driver IC

### Applications

- Single coils DC brushless motor

### Features

- Built-in hall sensor
- Single phase full wave driver
- Soft switching output driver
- Motor locked protection and automatic restart
- Speed controllable by PWM input signal
- FG output
- Built-in hysteresis comparator
- Built-in zener diode
- High balance and low thermal drift magnetic sensing
- Low power consumption and high driving efficiency
- RoHS 2.0 compliance
- MSL 3
- AEC Q100 qualified

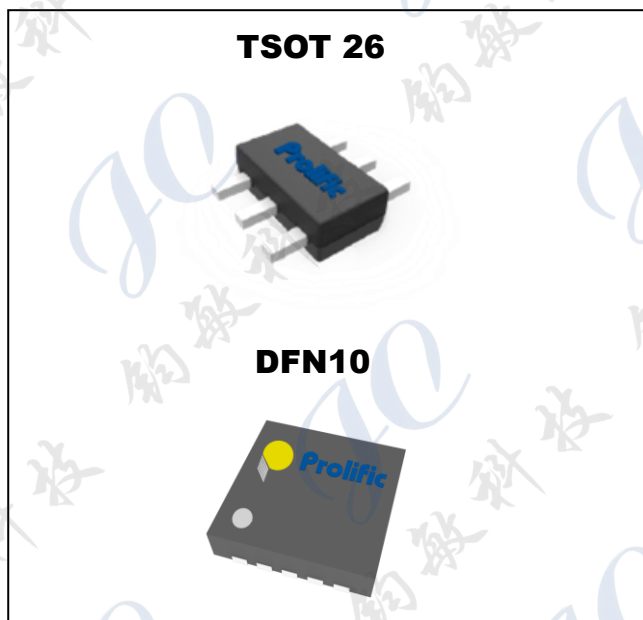
### Specifications

#### Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Conditions	Rating	Units
Maximum supply voltage	VDDmax		17	V
Maximum FG output voltage	V <sub>FGmax</sub>		17	V
Maximum FG output current	I <sub>FGmax</sub>		25	mA
Allowable power dissipation	Pd	TSOT26	500	mW
		DFN10	1860	mW
Operating temperature	Ta		-40~+105	°C
Storage temperature	Ts		-50~+165	°C
Max. output current	Peak		1000	mA
	Hold	0.5sec	800 <sup>*1</sup>	mA
Junction Temperature	Tj		165	°C

\*1: Should not exceed Pd

### Package: TSOT26F/ DFN10(3x3)



- ◆ All PROLIFIC products described or contained herein do not have specifications that can handle applications require extremely high levels of reliability, such as life-support systems, aircraft control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your PROLIFIC representative nearest you before using any PROLIFIC products described or contained herein in such applications.
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**PROLIFIC TECHNOLOGY INC.**

7F, No.48,Sec.3, Nan Kang Rd., Nan Kang, Taipei, 115, Taiwan.

**Electrical Characteristics (T<sub>A</sub>=+25°C, V<sub>DD</sub>=12V)**

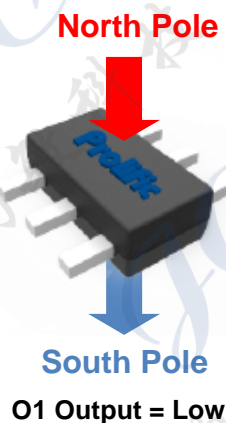
Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Units
Supply Voltage	V <sub>DD</sub>		2.4		16	V
Output High Voltage	V <sub>OH(ON)</sub>	@ I <sub>OUT</sub> =200mA	V <sub>DD</sub> -0.6	V <sub>DD</sub> -0.4		V
Output Low Voltage	V <sub>OL(ON)</sub>	@ I <sub>OUT</sub> =200mA		0.3	0.4	V
Output Voltage Clamp	V <sub>BV</sub>		18			V
Supply Current	I <sub>DD</sub>	Output open		8	10	mA
FG output voltage	V <sub>FG</sub>				15	V
FG sink voltage	V <sub>DSFG</sub>	R <sub>FG</sub> =4.7K		0.2	0.3	V
PWM input H level	V <sub>PWM(H)</sub>		2.5		10	V
PWM input L level	V <sub>PWM(L)</sub>				1.5	V
Input Frequency	F <sub>PWM</sub>		0.02		50	kHz
Shutdown Time	T <sub>SD</sub>		2.1	2.8	3.5	S
Restart Time	T <sub>RS</sub>		0.3	0.4	0.5	S

**Magnetic Characteristics (T<sub>A</sub>=+25°C, V<sub>DD</sub>=12V)**

Operate Point	B <sub>OP</sub>			15	35	G
Release Point	B <sub>RP</sub>		-35	-15		G
Hysteresis	B <sub>HYS</sub>			30		G

**Truth Table**

Parameter	Test Condition	O1	O2	FG	Mode
North Pole to Marking side	B<Brp	L	H	L	During rotation
South Pole to Marking side	B>Bop	H	L	H	



### General Specifications

The PT3923-A is designed for magnetic actuating using a bipolar magnetic field. The built-in dynamic offset cancellation of pre-amplifier stage achieves optimal symmetrical magnetic sensing. The output driver provides a linear drive to eliminate switching noise. This Hall-effect IC is optimal for DC brushless fan application with speed controllable by PWM input signal. The supply voltage range is from 2.4V to 15V and the output current is 450mA.

### Lock Protection

In order to protect the motor, the driver IC will be shutdown to drive the coil when the motor is locked over 0.4 seconds. Then, it restarts to drive the motor after 2.8 seconds. Figure 1 shows the timing diagram between the hall input signal and driver's output state.

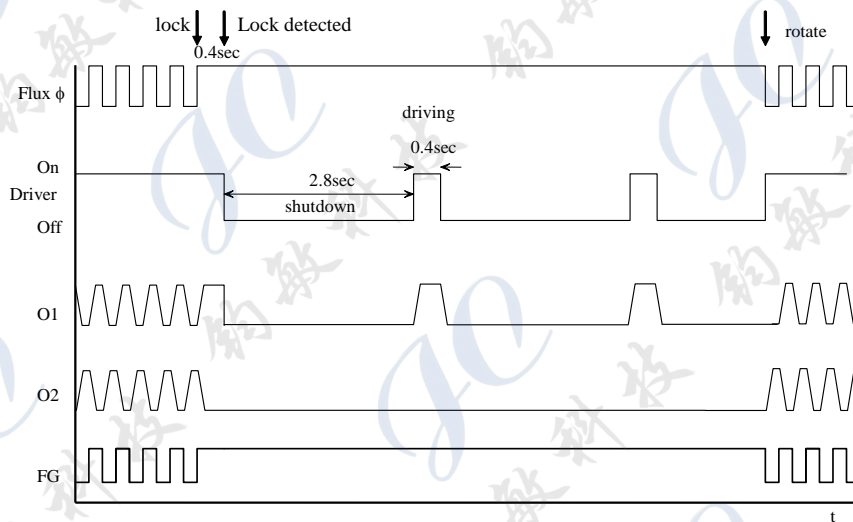


Fig 1. Lock Protection

### Hall Sensor

This Hall effect sensor IC integrates the sensor, pre-amplifier with dynamic offset cancellation and the hysteresis comparator in single chip. The hysteresis characteristic is illustrated in Fig. 2 and the threshold of the magnetic flux density is  $\pm 15$  Gauss.

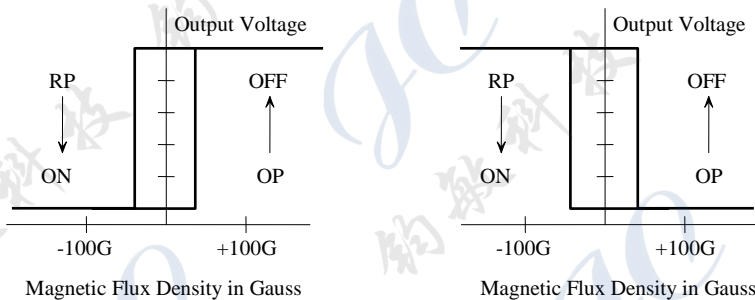


Fig 2. Magnetic Hysteresis Characteristics

The Hall IC architecture block diagram is shown in Fig. 3.

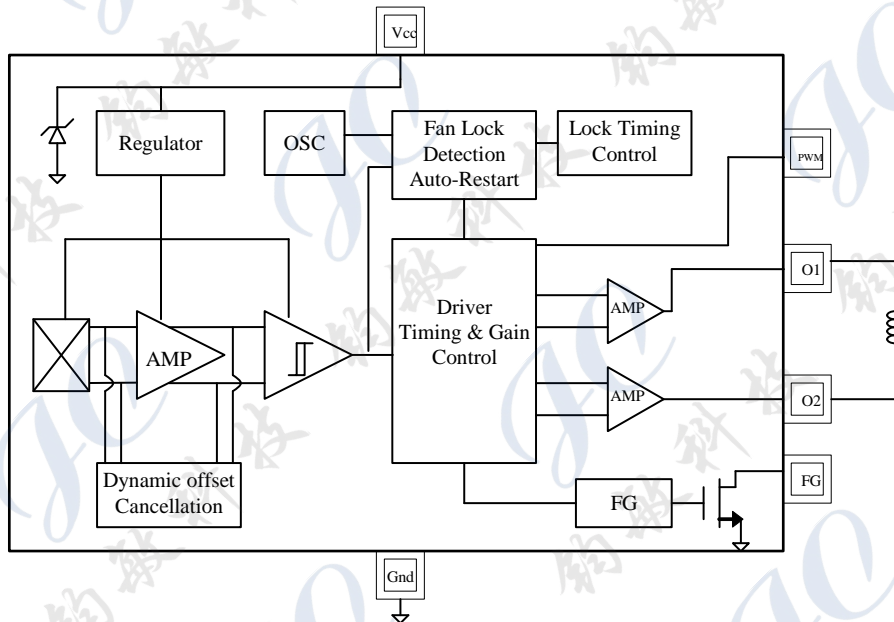


Fig. 3 Hall IC Architecture

### PWM speed control

This PWM speed control make the lock protection off, when the PWM input keeps low level for more than 66.5mS. The lock protect function does not work if PWM input frequency is slower than 15Hz, please input faster frequency more than 20Hz.

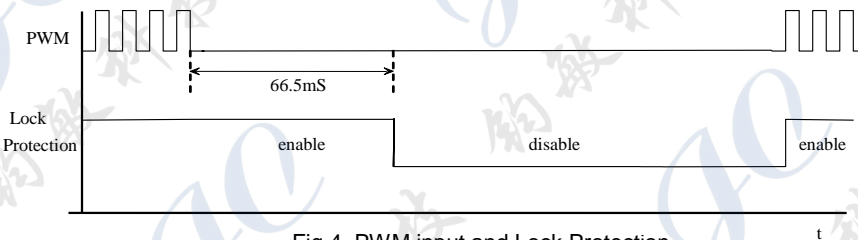
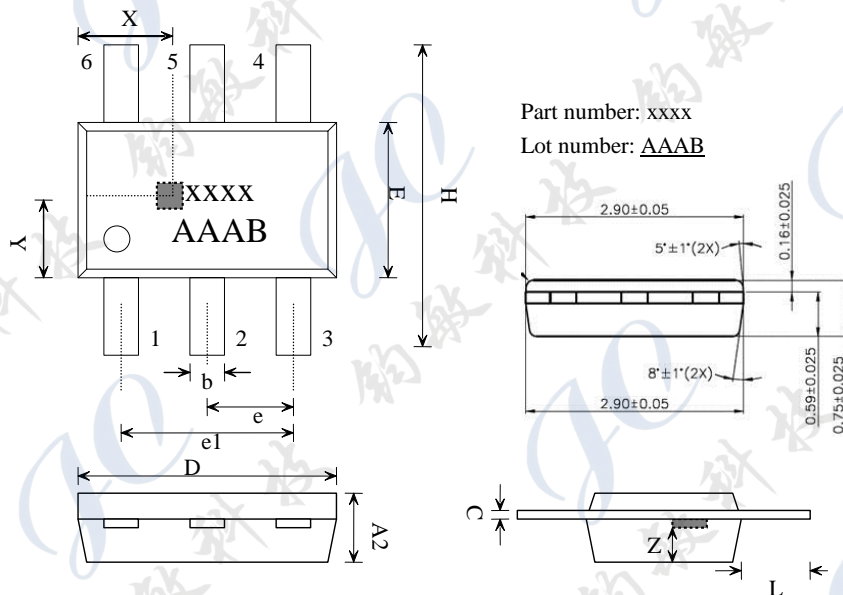


Fig 4. PWM input and Lock Protection

**Pin assignment**  
**TSOT26F-6L**

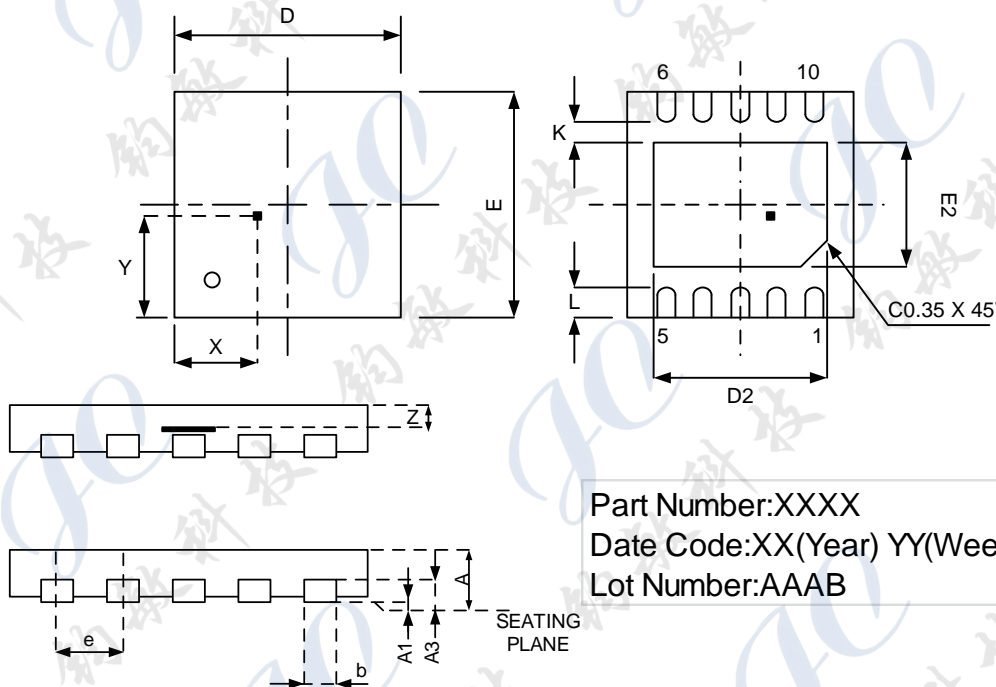
NAME	Pin	Description	Type	HBM (V)	MM (V)
Vdd	6	DC power supply	P	±8000	±1000
GND	2	DC ground	P	±8000	±1000
O1	3	First output pin	O	±8000	±1000
O2	4	Second output pin	O	±8000	±1000
FG	1	Frequency Generation	O	±4000	±450
PWM	5	PWM Speed Control	I	±4000	±1000



SYMBOLS	DIMENSIONS IN MILLIMETERS(mm)		
	MIN	NOM	MAX
A2	0.70	0.75	0.775
b	0.35	-	0.50
C	0.10	-	0.20
D	2.70	2.90	3.10
E	1.40	1.60	1.80
H	3.60	3.80	4.00
e	0.80	0.95	1.10
e1	1.70	1.90	2.10
L	0.95	1.10	1.25
SENSOR LOCATION			
X	0.85	1.00	1.15
Y	0.65	0.85	0.95
Z	0.20	0.25	0.30

**Pin assignment**  
**DFN10**

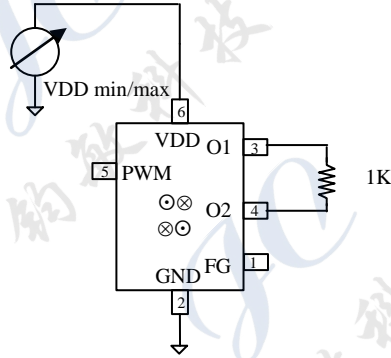
NAME	Pin	Description	Type	HBM (V)	MM (V)
Vdd	3	DC power supply	P	±8000	±1000
GND	5	DC ground	P	±8000	±1000
O1	6	First output pin	O	±8000	±1000
O2	4	Second output pin	O	±8000	±1000
FG	7	Frequency Generation	O	±4000	±450
PWM	2	PWM Speed Control	I	±4000	±1000



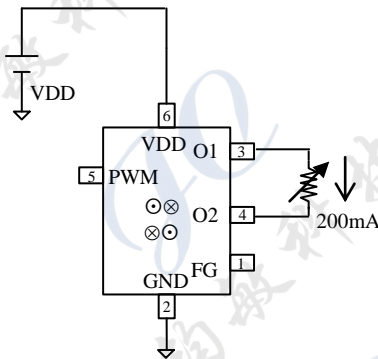
SYMBOLS	DIMENSIONS IN MILLIMETERS(mm)		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.203 (REF)		
b	0.18	0.25	0.30
D	3.00 BSC		
E	3.00 BSC		
e	0.50 BSC		
K	0.20	-	-
Pad Size			
D2	2.20	2.30	2.35
E2	1.55	1.65	1.70
L	0.30	0.40	0.50
Sensor location			
X	0.95	1.05	1.15
Y	1.25	1.35	1.45
Z	0.20	0.25	0.30

**Test circuit**

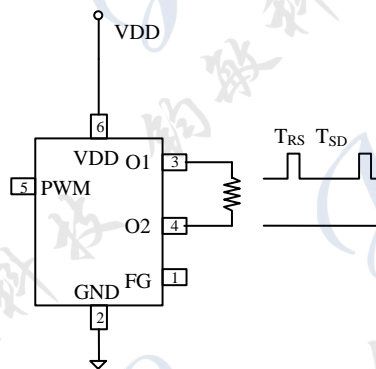
**VDD Min./Max.**



**VOH(ON)/VOL(ON)**



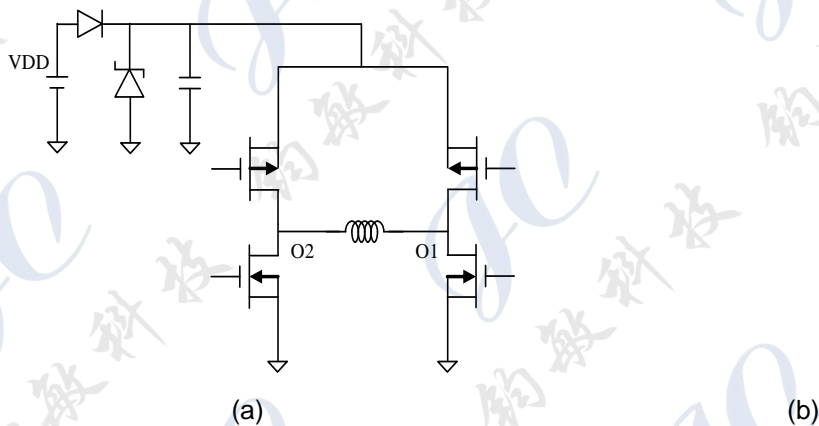
**Supply Current IDD**

**FG Sink Voltage  $V_{DSFG}$** 
**Lock Time  $T_{RS}/T_{SD}$** 

**A. Suppress B-EMF impact**

Back electromotive force (B-EMF) is the voltage induced by changed field strength on coils. After power is off, remaining B-EMF from coils might be enough to keep PT3923-A frequency generator function working as B-EMF is higher than minimum supply voltage.

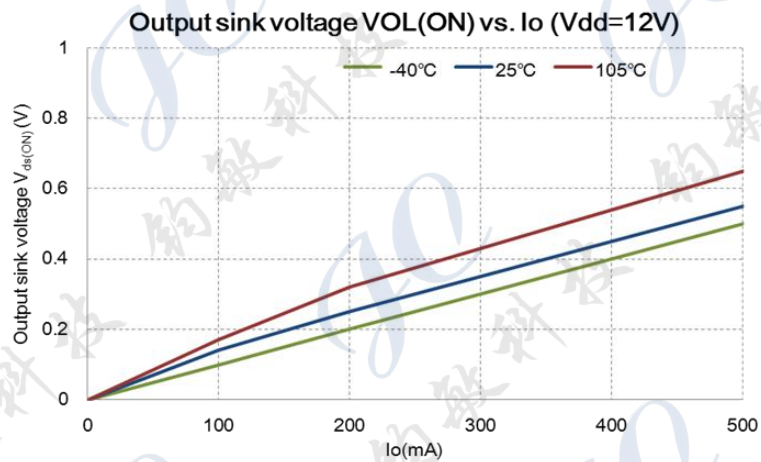
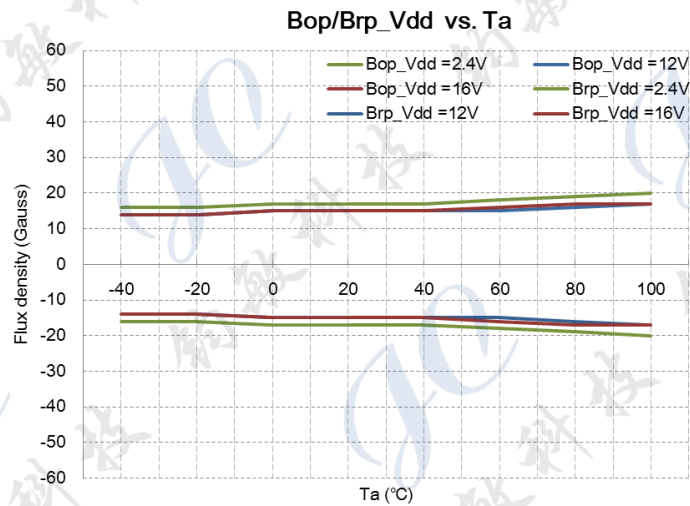
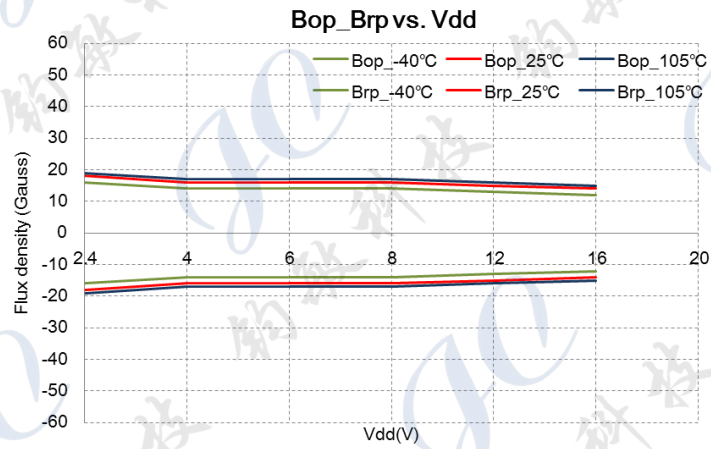
**B. Measure against VDD voltage rise by B-EMF**

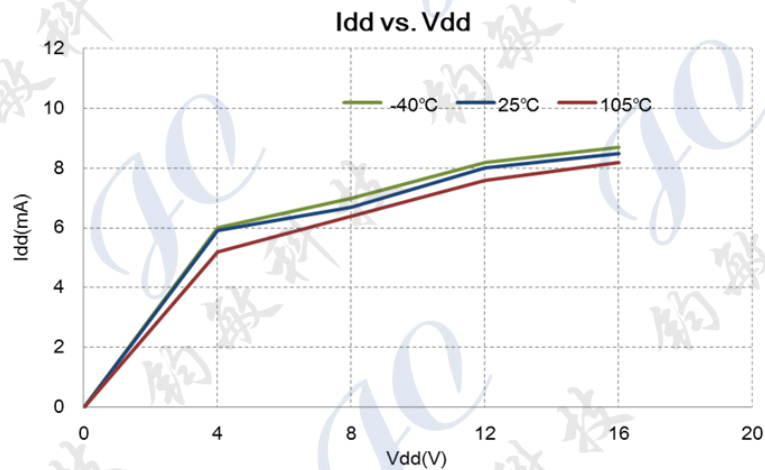
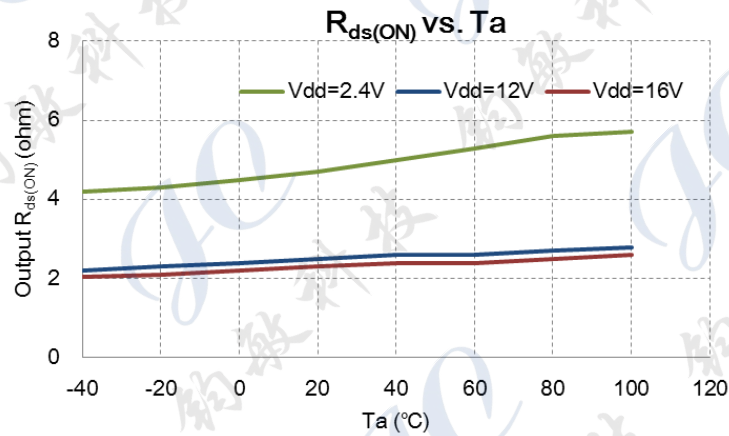
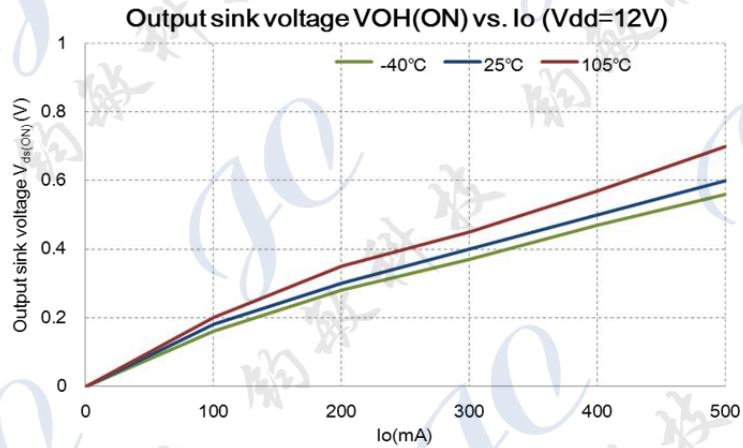
Since the absolute maximum rated voltage may be exceeded due to voltage rise by B-EMF, place Capacitor and/or Zener diode between VDD and GND.(a)

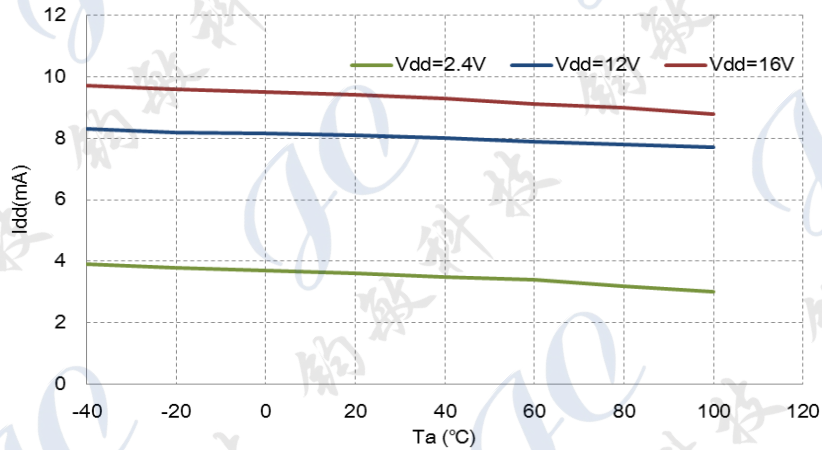
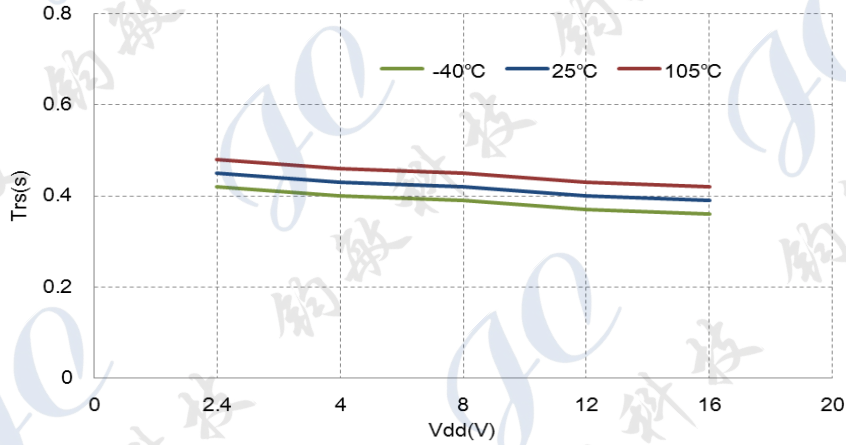
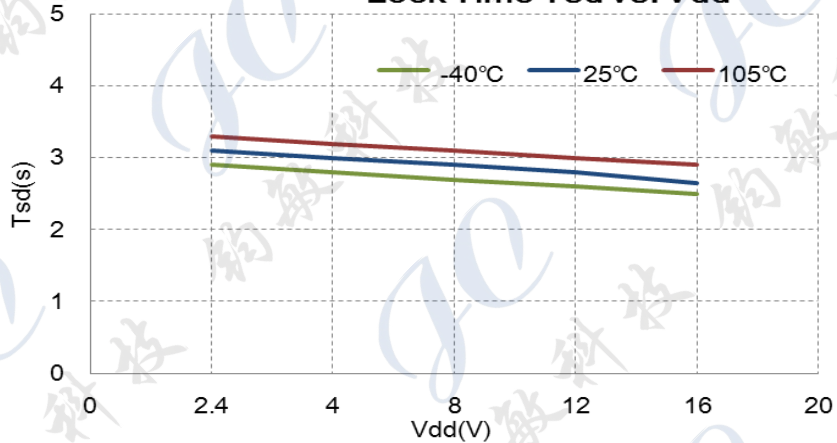


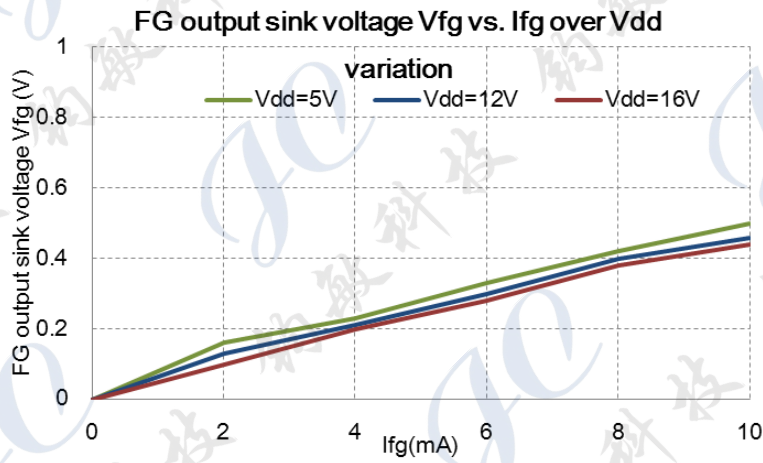
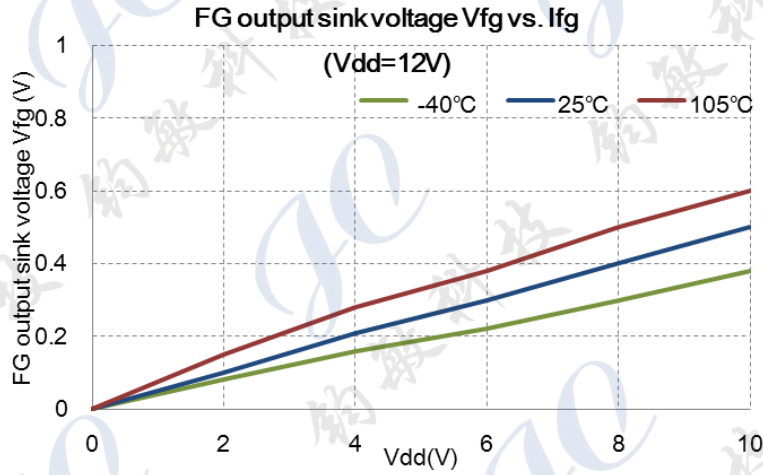
Two Schottky barrier diodes are added between VDD and Output to suppress B-EMF impact.(b)



**Performance curve**


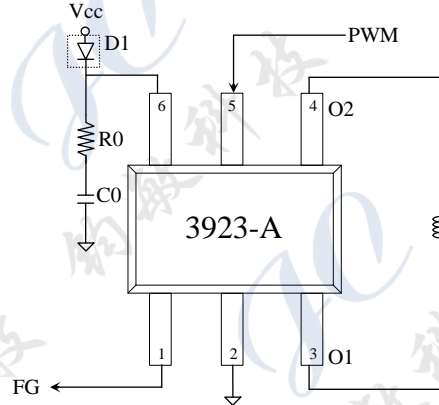


**I<sub>dd</sub> vs. T<sub>a</sub>**

**Lock Time Trs vs. V<sub>dd</sub>**

**Lock Time Tsd vs. V<sub>dd</sub>**




## Application circuits

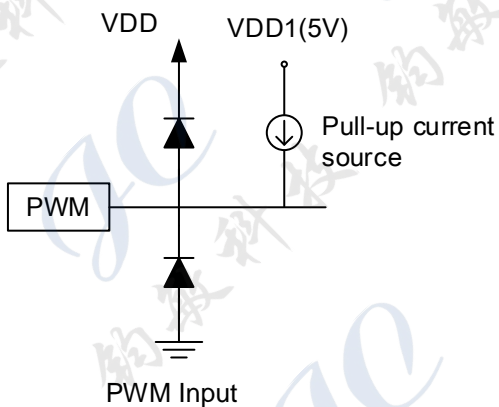
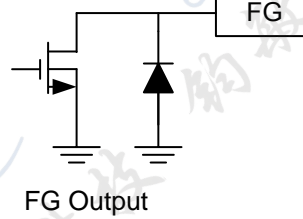
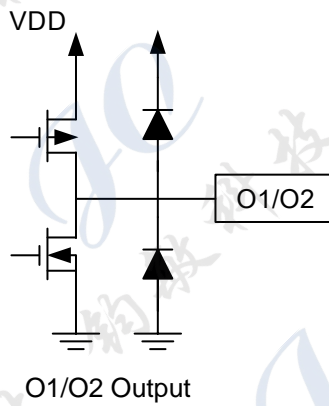
### 5V/12V application



R0: Snubber circuit resistor 4.7ohm~10ohm for reducing surge voltage

C0: decoupling capacitor 0.1uF ~ 1uF

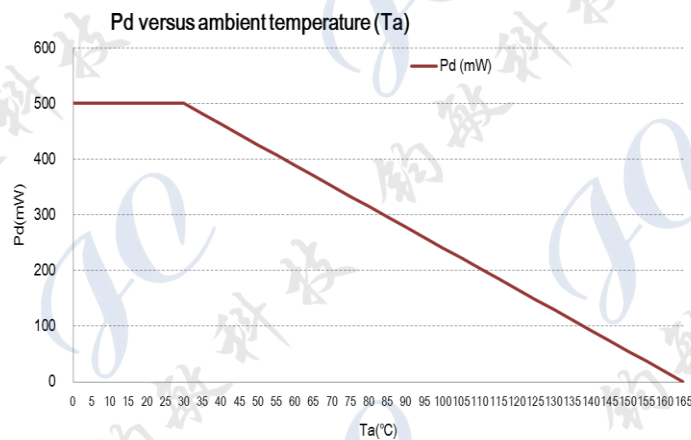
### I/O Equivalent circuits



**TSOT26**
**Thermal resistance**

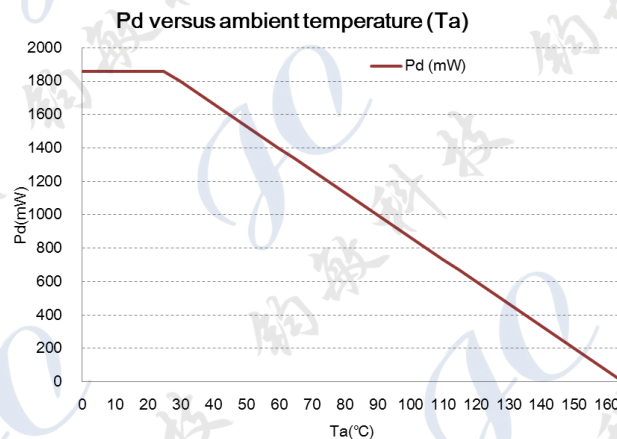
Parameter	Symbol	Conditions	Rating	Units
Allowable power dissipation	$P_d$		500	mW
Junction to ambient thermal resistance	$\theta_{JA}$		270	$^{\circ}\text{C}/\text{W}$
Junction to case thermal resistance	$\theta_{JC}$		85	$^{\circ}\text{C}/\text{W}$
Maximum junction temperature	$T_J$		165	$^{\circ}\text{C}$

\*1: Reduced by 13.3mW for each increase in  $T_a$  of  $1^{\circ}\text{C}$  over  $25^{\circ}\text{C}$  When mounted on 50mm x 50mm x 1.6mm glass epoxy board


**DFN10**
**Thermal resistance**

Parameter	Symbol	Conditions	Rating	Units
Allowable power dissipation	$P_d$		1860	mW
Junction to ambient thermal resistance	$\theta_{JA}$		75	$^{\circ}\text{C}/\text{W}$
Junction to case thermal resistance	$\theta_{JC}$		10	$^{\circ}\text{C}/\text{W}$
Maximum junction temperature	$T_J$		165	$^{\circ}\text{C}$

\*1: Reduced by 13.3mW for each increase in  $T_a$  of  $1^{\circ}\text{C}$  over  $25^{\circ}\text{C}$  When mounted on 50mm x 50mm x 1.6mm glass epoxy board



### Power Dissipation Calculation:

Power Dissipation Total = Static power dissipation ( $Pd_{static}$ ) + Driving power dissipation ( $Pd_{drv}$ ) + Switching loss ( $Pd_{sw}$ )

Static power dissipation ( $Pd_{static}$ ) :  $V_{dd} * I_{dd}$

Driving power dissipation ( $Pd_{drv}$ ) :  $I_o * V_{sat}$

Switching loss ( $Pd_{sw}$ ) : duration of switching \* period of per rotation \*  $I_o * V_{dd}$

Note.  $V_{OH} = V_{dd} - V_a$      $V_{OL} = V_b - Gnd$      $V_{sat} = V_{OH} + V_{OL}$

Example :

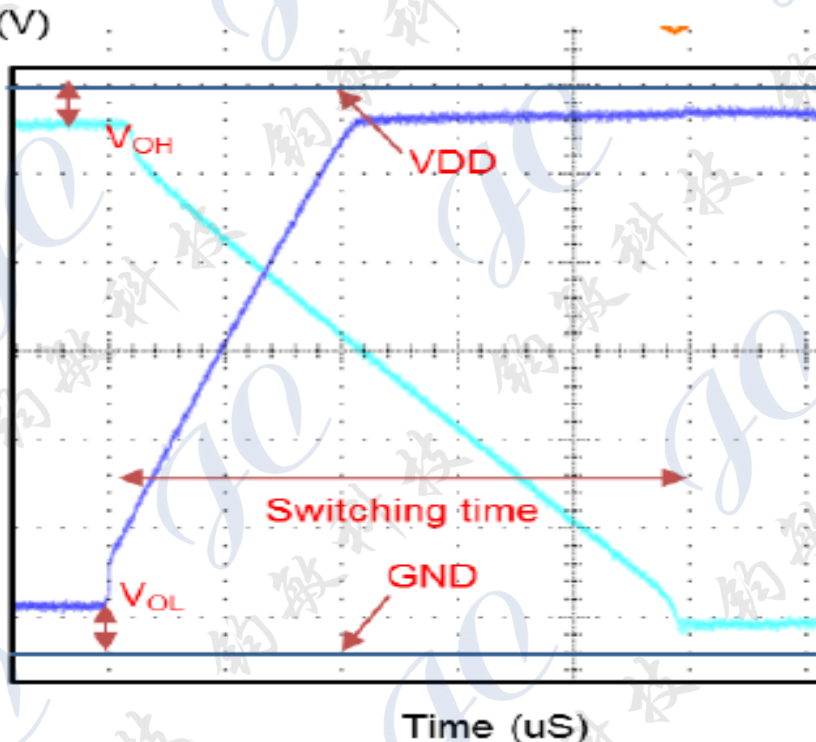
When  $V_{dd} = 12V$  ,  $I_{dd} = 8mA$  ,  $I_o = 430mA$  , RPM = 4000, Switching time = 100uS , 4-pole fan motor

$Pd_{static}$  :  $12 * 8 = 96mW$

$Pd_{drv}$  :  $430 * V_{sat}$  (e.g. 1V) = 430mW

$Pd_{sw}$  :  $100 / 30 * 4000 * 10^{-6} * 430 * 12 = 69 mW$

$Pd_{total} = 96 + 430 + 69 = 595 mW$



### Soldering recommendations

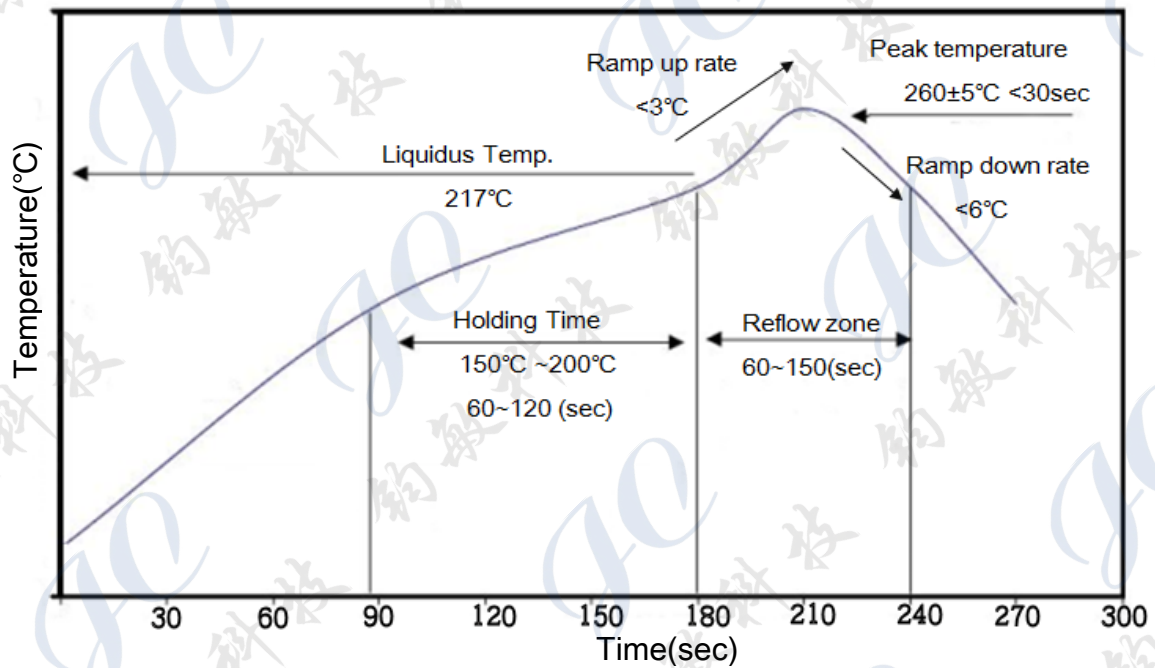
1. JEDEC J-STD-20

2. Iron Soldering

Temperature and Time: 350°C, 3S

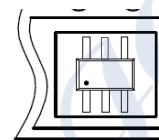
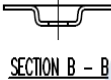
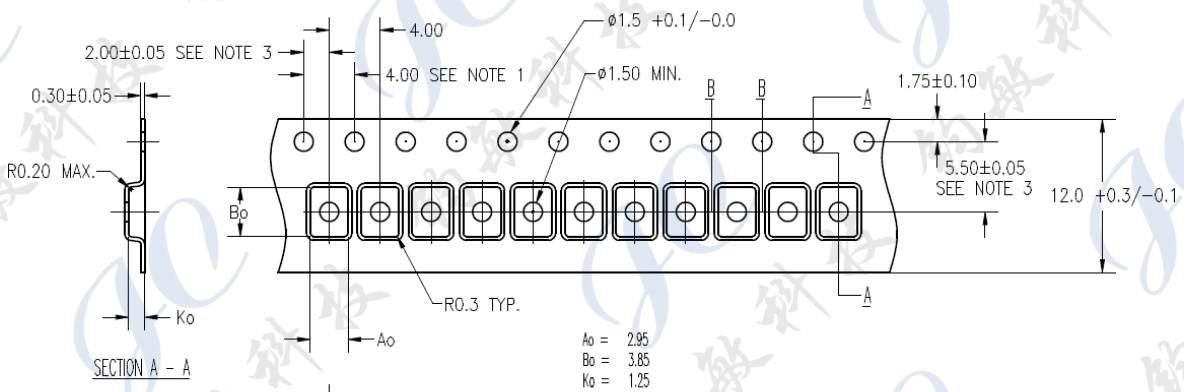
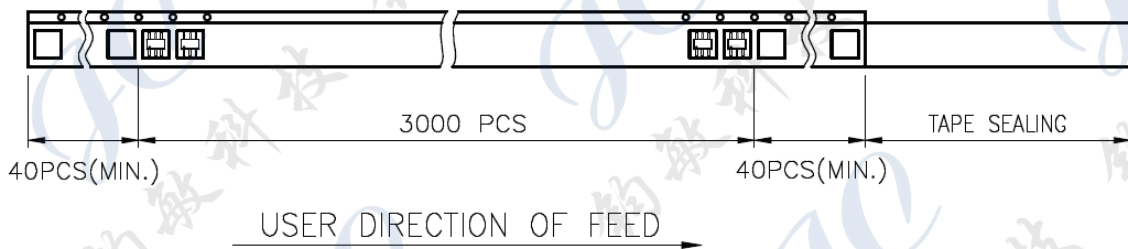
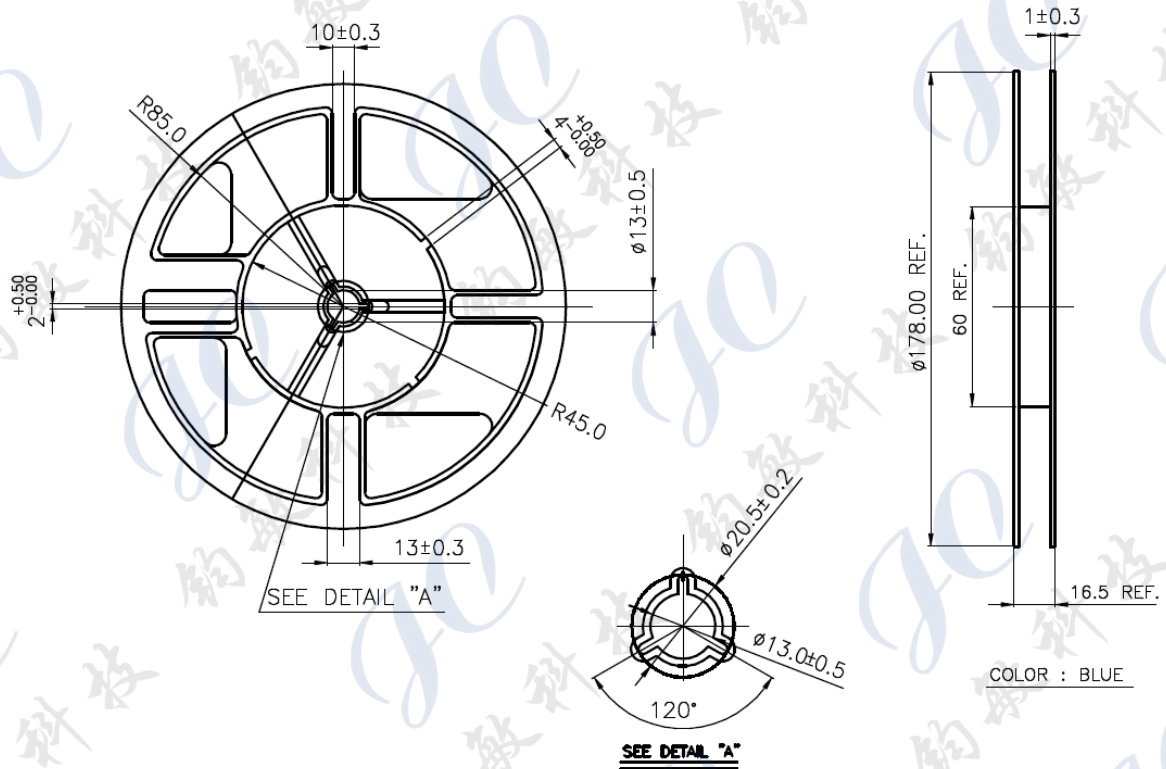
3. Reflow

Temperature profile should conform to described in JEDEC-020 standard

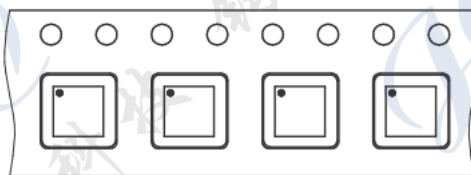
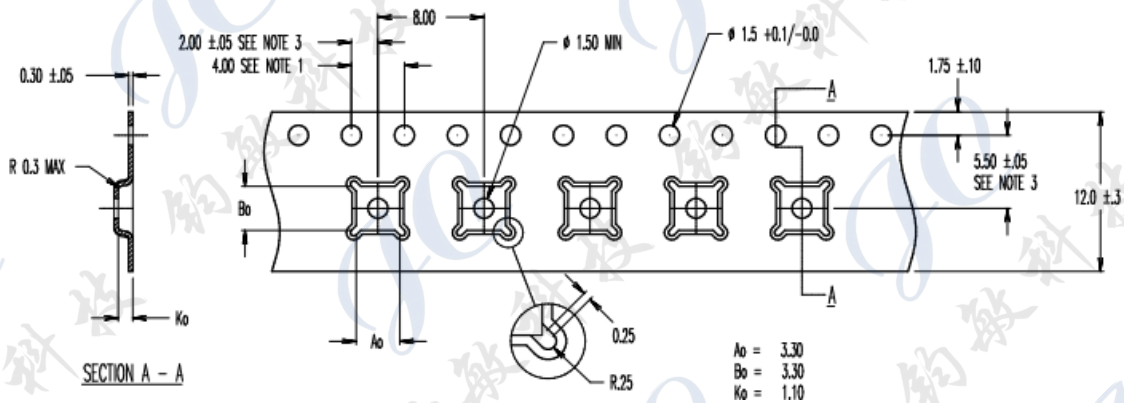
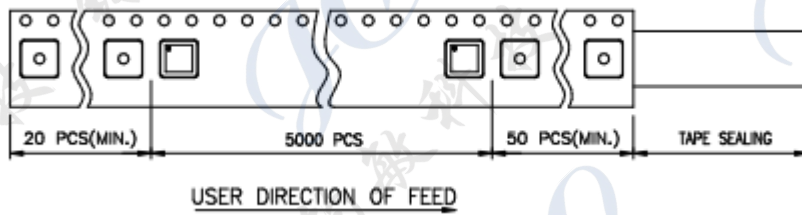
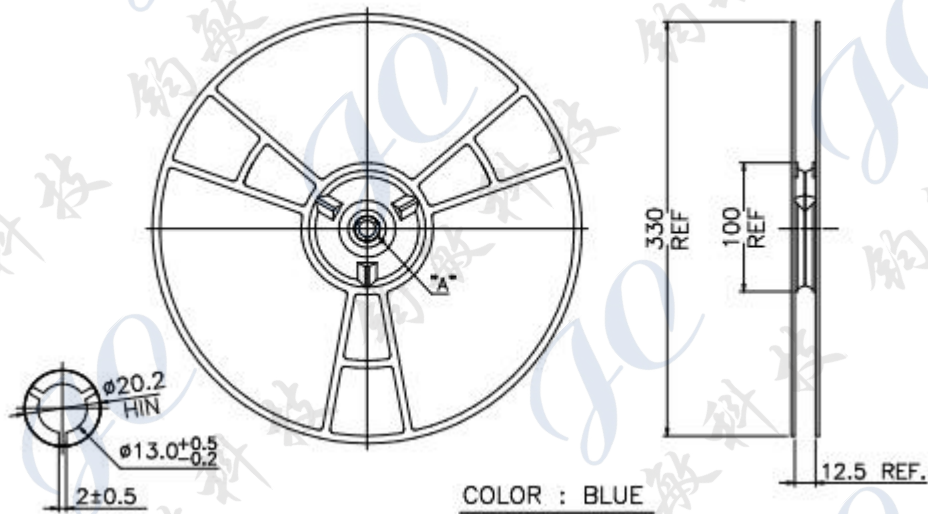




**Carrier Tape & Reel specifications**  
**TSOT26**



**DFN10**



WSON(DFN) 3X3

QUANTITY : 5000 EA/PER REEL 1 REEL/BOX

**Order information**

Part Number	Temperature Range	Package Type	Package Qty	MOQ
PT3923M1GDG8PA	-40°C~+105°C	TSOT26	3000 pcs/Reel	60K EA/BOX
PT3923M1HFG8PA	-40°C~+105°C	DFN10	5000 pcs/Reel	25K EA/BOX

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