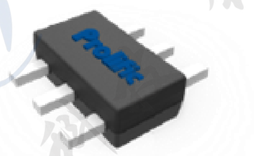
PT3923-A
Single coil Hall Driver IC

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

Package: TSOT26F/ DFN10(3x3)

TSOT 26



DFN10

Specifications
Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Conditions	Rating	Units
Maximum supply voltage	VDDmax		17	V
Maximum FG output voltage	V_{FGmax}		17	V
Maximum FG output current	I_{FGmax}		25	mA
Allowable power dissipation	Pd	TSOT26	500	mW
		DFN10	1860	mW
Operating temperature	Ta		-40~+105	℃
Storage temperature	Ts		-50~+165	℃
Max. output current	Peak		1000	mA
	Hold	0.5sec	800[*1]	mA
Junction Temperature	Tj		165	℃

*1: Should not exceed Pd

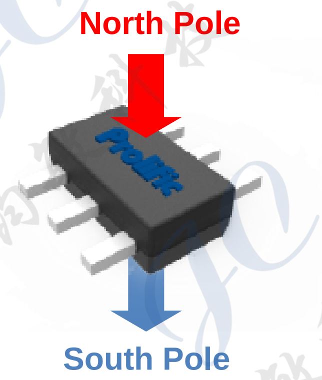
PROLIFIC TECHNOLOGY INC.
7F, No.48,Sec.3, Nan Kang Rd., Nan Kang, Taipei, 115, Taiwan.

Electrical Characteristics (T_A=+25°C, V_{DD}=12V)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Units
Supply Voltage	V_{DD}		2.4		16	V
Output High Voltage	$V_{OH(ON)}$	@ I_{OUT} =200mA	V_{DD}-0.6	V_{DD}-0.4		V
Output Low Voltage	$V_{OL(ON)}$	@ I_{OUT} =200mA		0.3	0.4	V
Output Voltage Clamp	V_{BV}		18			V
Supply Current	I_{DD}	Output open		8	10	mA
FG output voltage	V_{FG}				15	V
FG sink voltage	V_{DSFG}	R_{FG}=4.7K		0.2	0.3	V
PWM input H level	$V_{PWM(H)}$		2.5		10	V
PWM input L level	$V_{PWM(L)}$				1.5	V
Input Frequency	F_{PWM}		0.02		50	kHz
Shutdown Time	T_{SD}		2.1	2.8	3.5	S
Restart Time	T_{RS}		0.3	0.4	0.5	S
Magnetic Characteristics (T_A=+25°C, V_{DD}=12V)						
Operate Point	B_{OP}			15	35	G
Release Point	B_{RP}		-35	-15		G
Hysteresis	B_{HYS}			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	



O1 Output = Low

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.

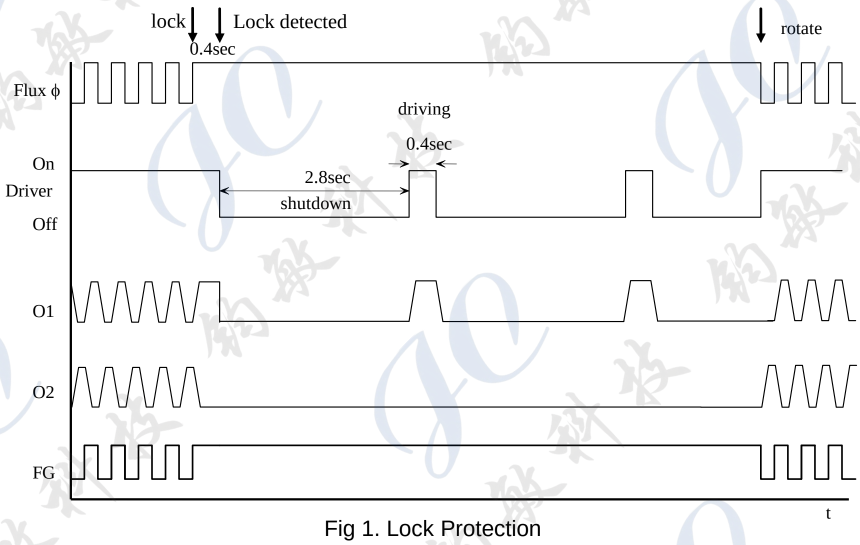


Fig 1. Lock Protection

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 +-15 Gauss.

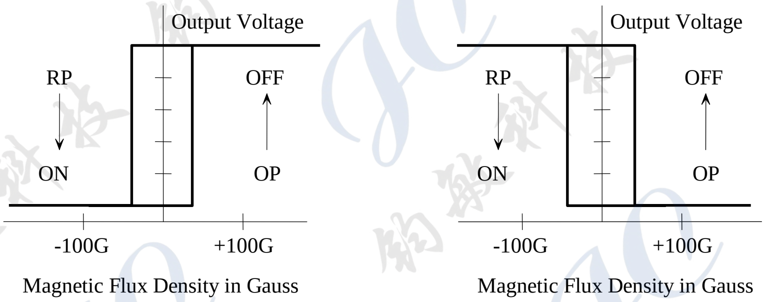


Fig 2. Magnetic Hysteresis Characteristics

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

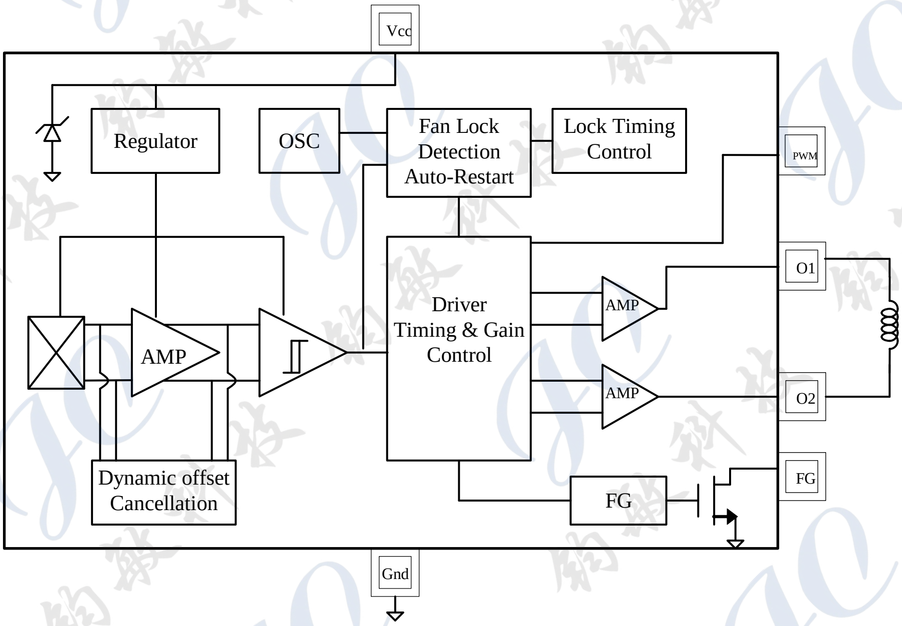


Fig. 3 Hall IC Architecture

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.

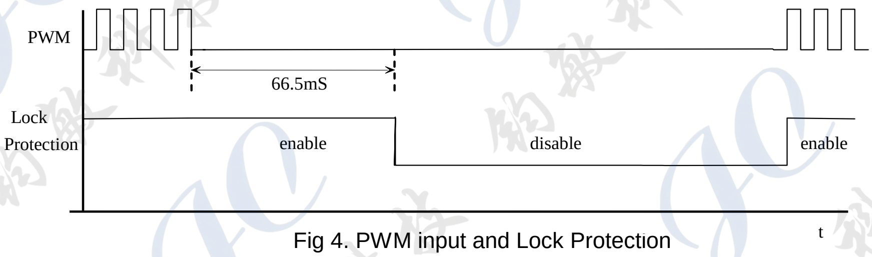
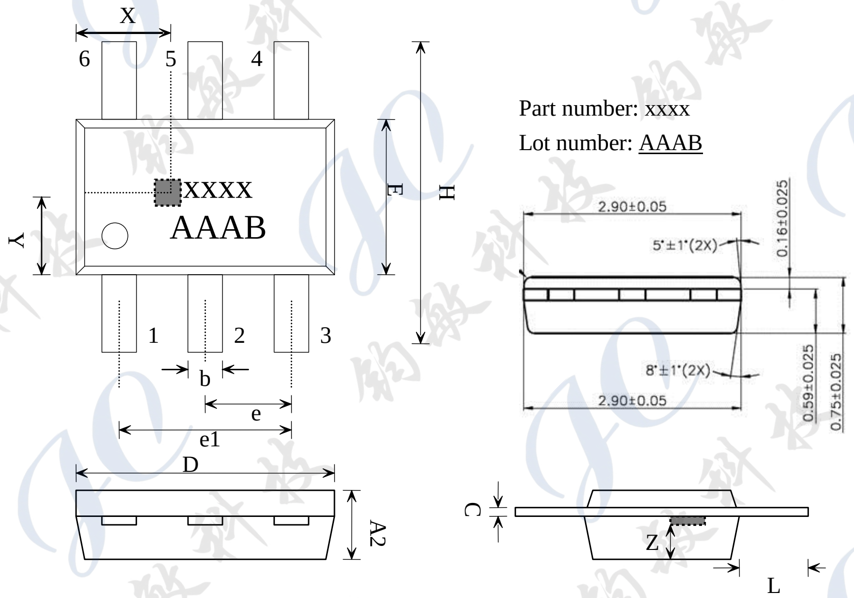


Fig 4. PWM input and Lock Protection

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

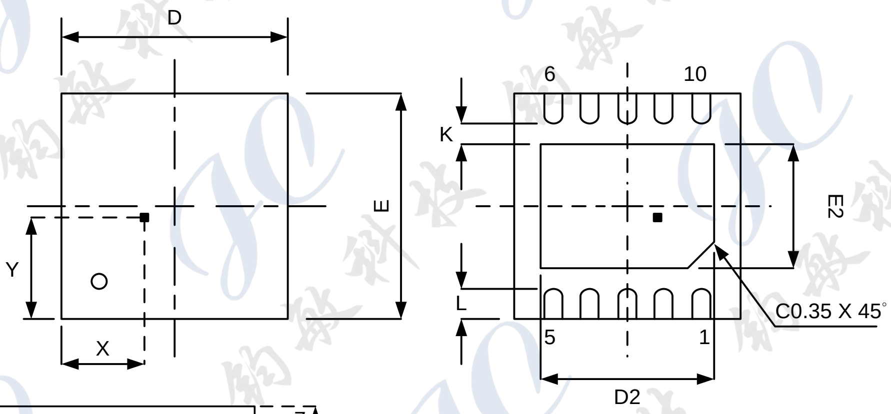


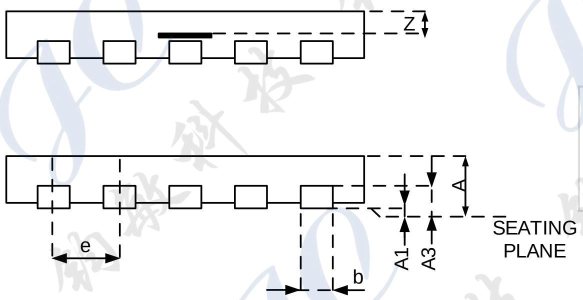
SYMBOLS	DIMENSIONS IN MILLIMETERS(mm)		
	MIN	NOM	MAX
A2	0.70	0.75	0.775
b	0.35	-	0.50
C	0.10	-	0.20
D	2.70	2.90	3.10
E	1.40	1.60	1.80
H	3.60	3.80	4.00
e	0.80	0.95	1.10
e1	1.70	1.90	2.10
L	0.95	1.10	1.25
SENSOR LOCATION			
X	0.85	1.00	1.15
Y	0.65	0.85	0.95
Z	0.20	0.25	0.30

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



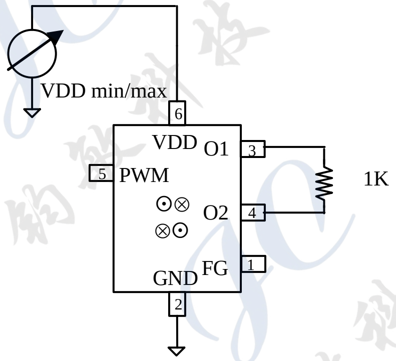


Part Number:XXXX
Date Code:XX(Year) YY(Week)
Lot Number:AAAB

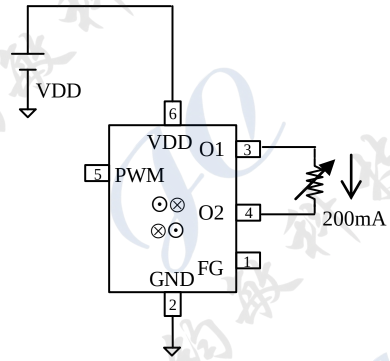
SYMBOLS	DIMENSIONS IN MILLIMETERS(mm)		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.203 (REF)		
b	0.18	0.25	0.30
D	3.00 BSC		
E	3.00 BSC		
e	0.50 BSC		
K	0.20	-	-
Pad Size			
D2	2.20	2.30	2.35
E2	1.55	1.65	1.70
L	0.30	0.40	0.50
Sensor location			
X	0.95	1.05	1.15
Y	1.25	1.35	1.45
Z	0.20	0.25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

Test circuit

VDD Min./Max.



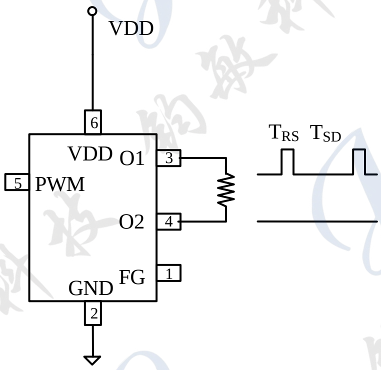
VOH(ON)/VOL(ON)



Supply Current IDD

FG Sink Voltage V_{DSFG}

Lock Time T_{RS}/T_{SD}

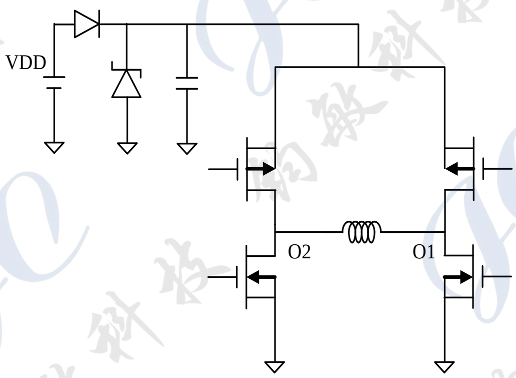


A. Suppress B-EMF impact

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

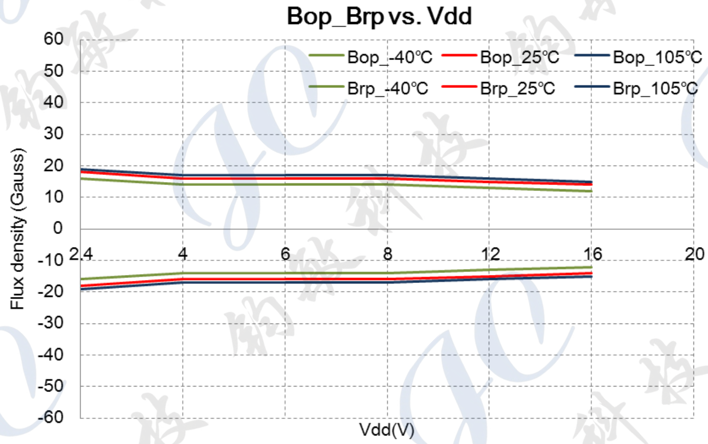
Since the absolute maximum rated voltage may be exceeded due to voltage rise by B-EMF, place Capacitor and/or Zener diode between VDD and GND.(a)

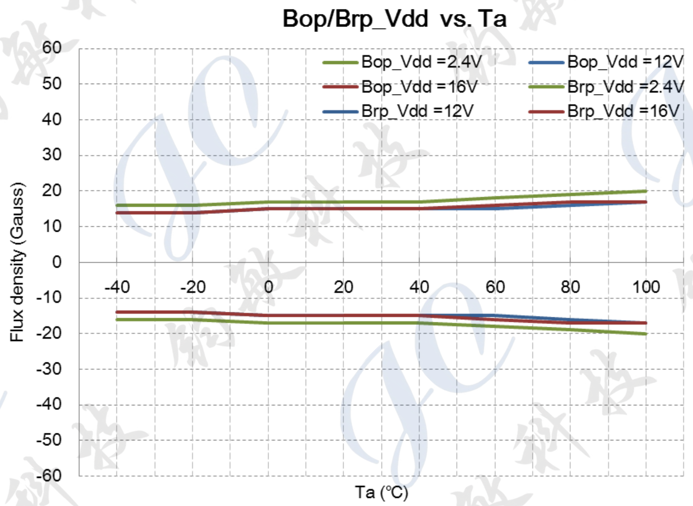


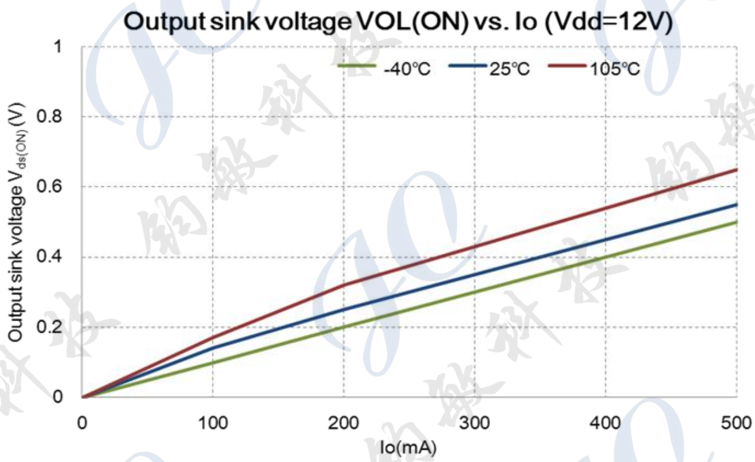
(a) (b)

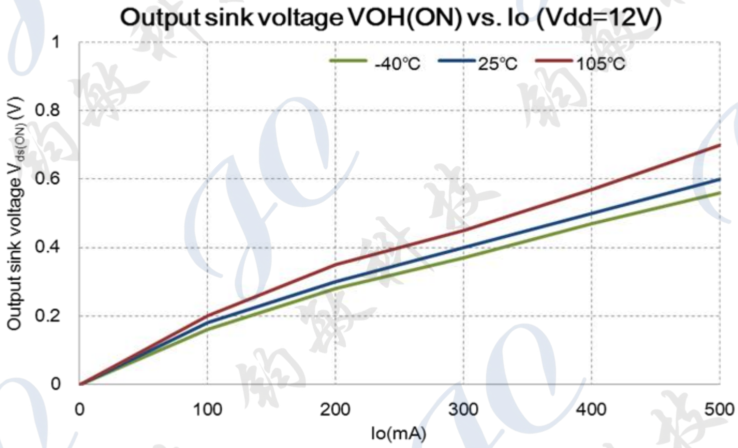
Two Schottky barrier diodes are added between VDD and Output to suppress B-EMF impact.(b)

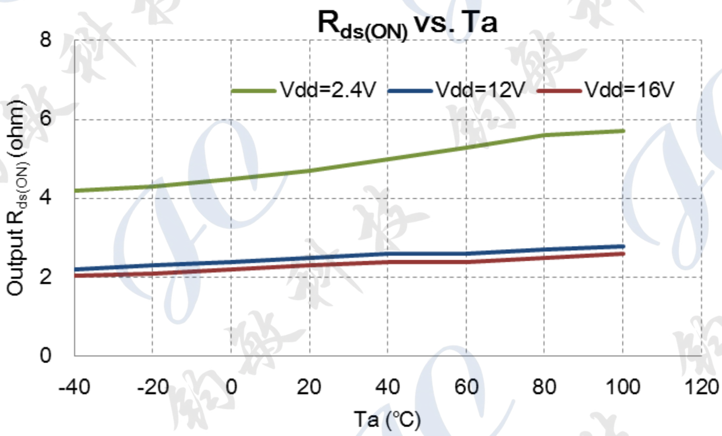
Performance curve

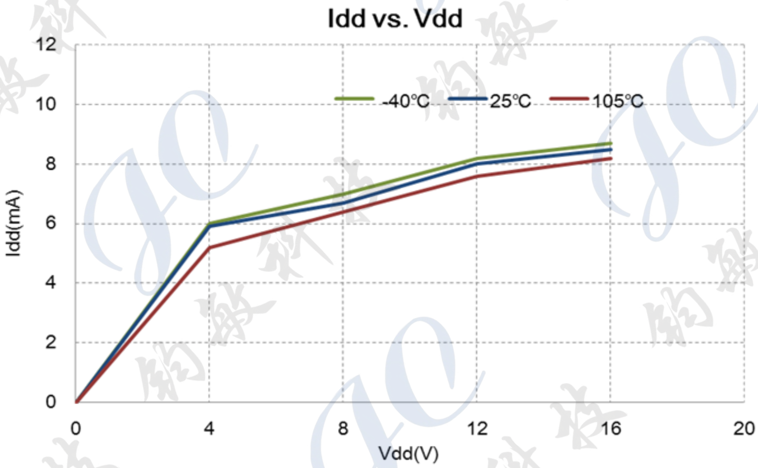


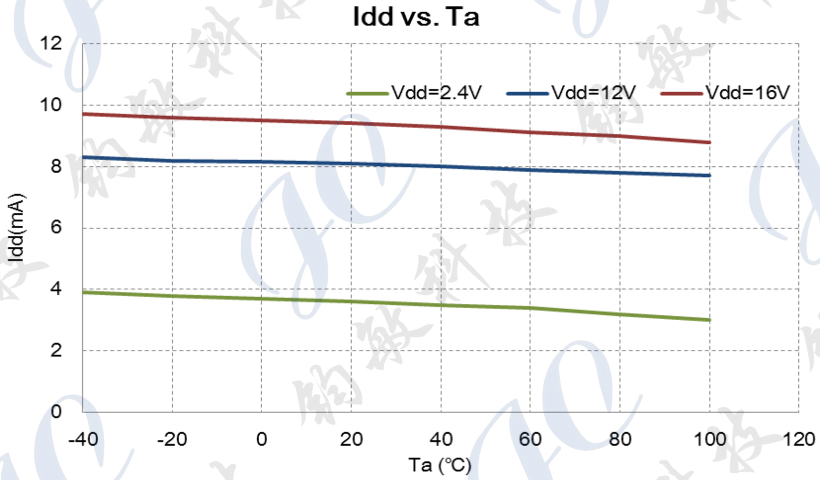


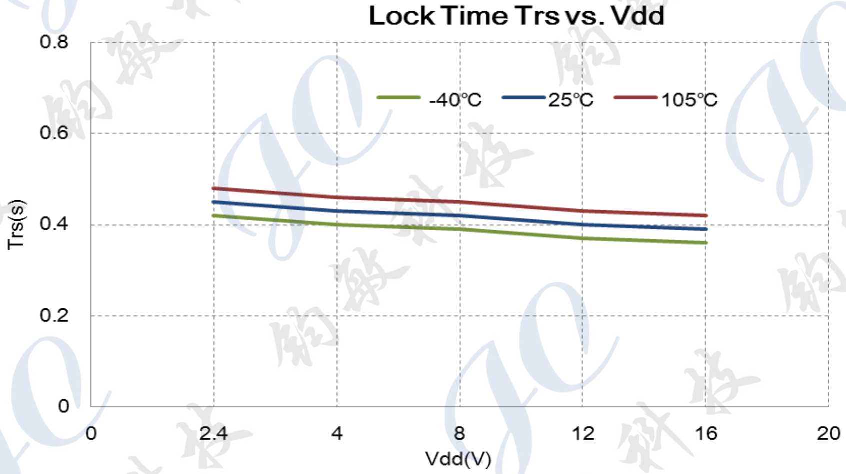


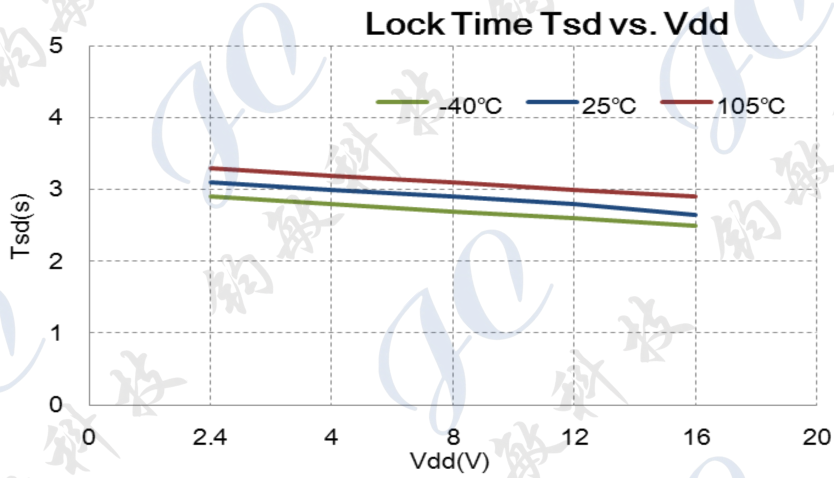

Output sink voltage VOH(ON) vs. Io (Vdd=12V)
-40°C
25°C
105°C
Output sink voltage Vds(ON) (V)
Io(mA)
0
0.2
0.4
0.6
0.8
1
100
200
300
400
500

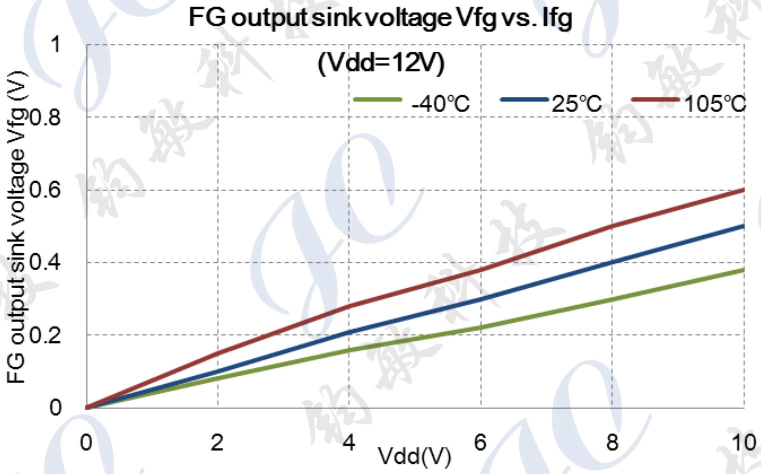

Rds(ON) vs. Ta
Vdd=2.4V
Vdd=12V
Vdd=16V
Output Rds(ON) (ohm)
Ta (°C)
0
2
4
6
8
-40
-20
20
40
60
80
100
120

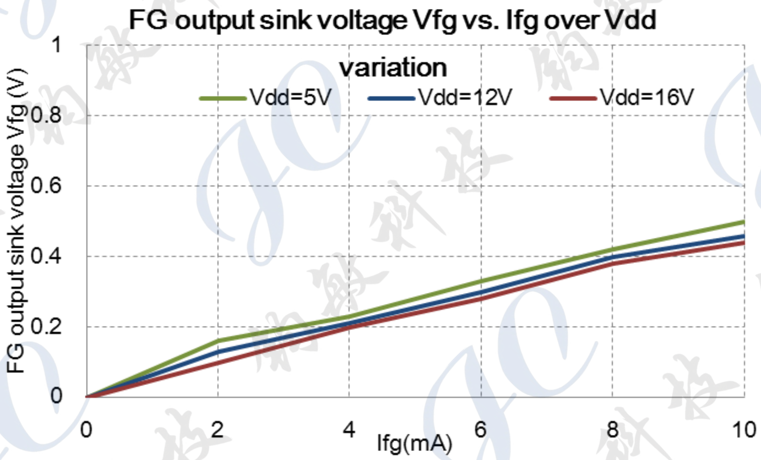

Idd vs. Vdd
-40°C
25°C
105°C
Idd(mA)
Vdd(V)
0
2
4
6
8
10
12
16
20


Idd vs. Ta
Vdd=2.4V
Vdd=12V
Vdd=16V
Idd(mA)
12
10
8
6
4
2
0
-40
-20
0
20
40
60
80
100
120
Ta (℃)


Lock Time Trs vs. Vdd
-40℃
25℃
105℃
Trs(s)
0.8
0.6
0.4
0.2
0
0
2.4
4
8
12
16
20
Vdd(V)

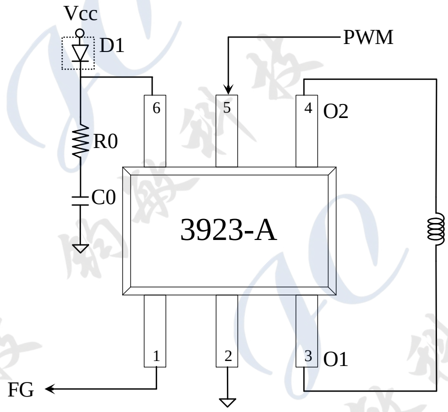

Lock Time Tsd vs. Vdd
-40℃
25℃
105℃
Tsd(s)
5
4
3
2
1
0
0
2.4
4
8
12
16
20
Vdd(V)


FG output sink voltage Vfg vs. Ifg
(Vdd=12V)
-40℃
25℃
105℃
FG output sink voltage Vfg (V)
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
Vdd(V)


FG output sink voltage Vfg vs. Ifg over Vdd
variation
Vdd=5V
Vdd=12V
Vdd=16V
FG output sink voltage Vfg (V)
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
Ifg(mA)

Application circuits

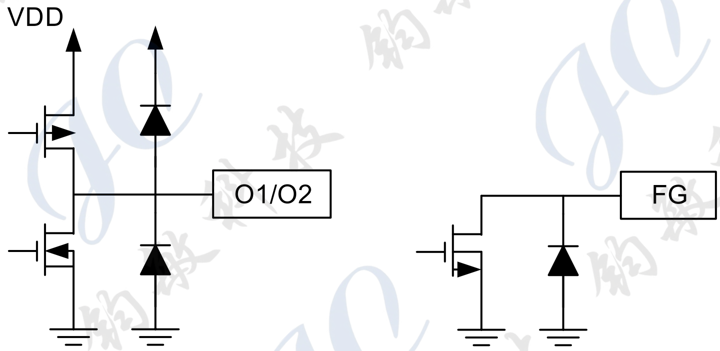
5V/12V application



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

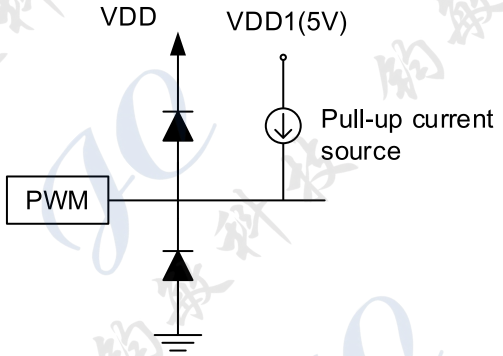
C0: decoupling capacitor 0.1uF ~ 1uF

I/O Equivalent circuits



O1/O2 Output

FG Output



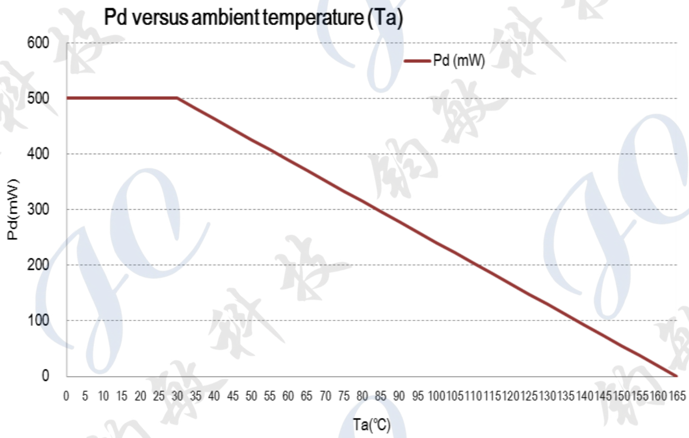
PWM Input

TSOT26

Thermal resistance

Parameter	Symbol	Conditions	Rating	Units
Allowable power dissipation	P_d		500	mW
Junction to ambient thermal resistance	θ_{JA}		270	℃/W
Junction to case thermal resistance	θ_{JC}		85	℃/W
Maximum junction temperature	T_J		165	℃

*1: Reduced by 13.3mW for each increase in Ta of 1°C over 25°C When mounted on 50mm x 50mm x 1.6mm glass epoxy board

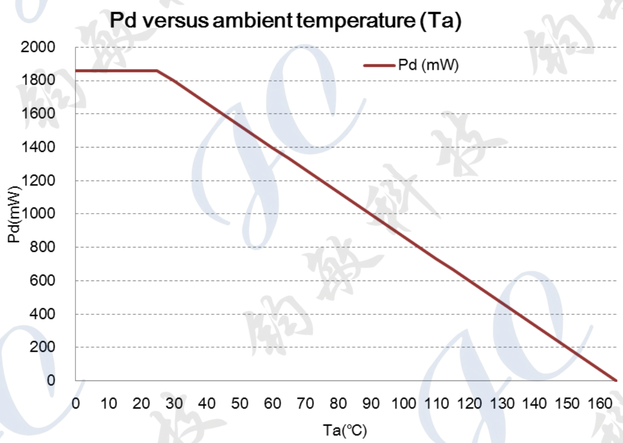


DFN10

Thermal resistance

Parameter	Symbol	Conditions	Rating	Units
Allowable power dissipation	P_d		1860	mW
Junction to ambient thermal resistance	θ_{JA}		75	℃/W
Junction to case thermal resistance	θ_{JC}		10	℃/W
Maximum junction temperature	T_J		165	℃

*1: Reduced by 13.3mW for each increase in Ta of 1°C over 25°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) : Vdd * Idd

Driving power dissipation (Pd_drv) : Io * Vsat

Switching loss (Pd_sw) : duration of switching * period of per rotation * Io * Vdd

Note. V_{OH} = Vdd-Va. V_{OL} = Vb-Gnd Vsat = V_{OH} + V_{OL}

Example :

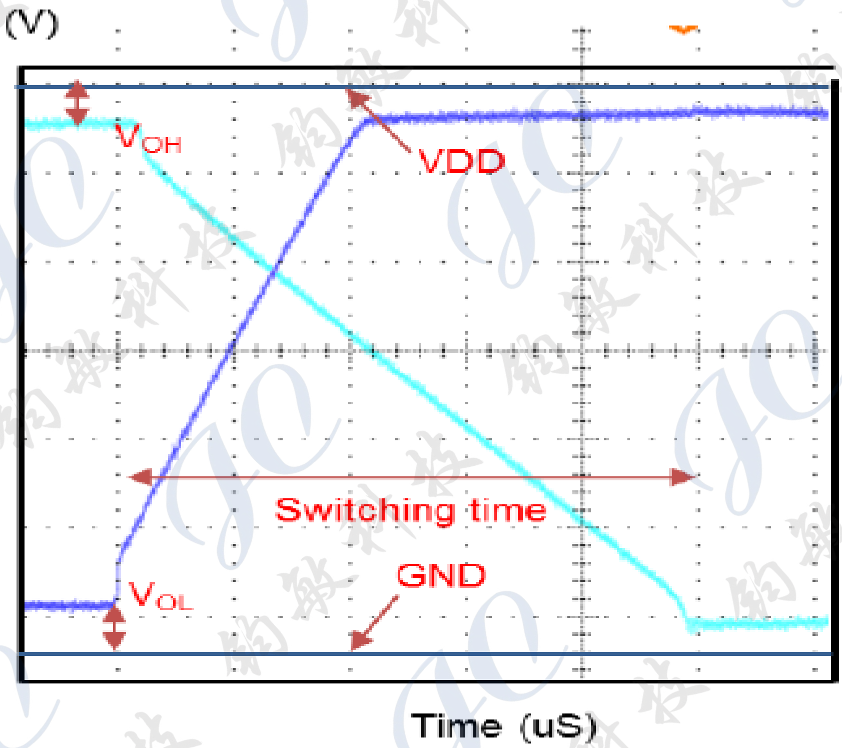
When Vdd = 12V , Idd = 8mA , Io = 430mA , RPM = 4000, Switching time = 100uS , 4-pole fan motor

Pd_static : 12 * 8 = 96mW

Pd_drv : 430 * Vsat (e.g. 1V) = 430mW

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

Pd_total = 96 + 430 +69 = 595 mW



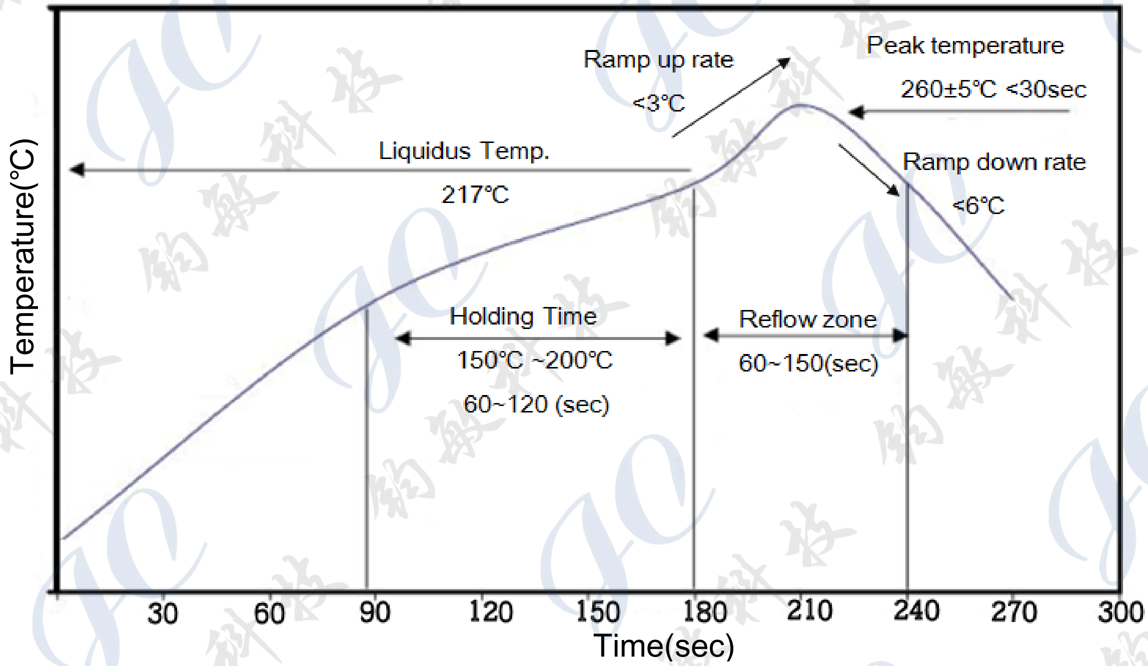
Soldering recommendations

1. JEDEC J-STD-20
2. Iron Soldering

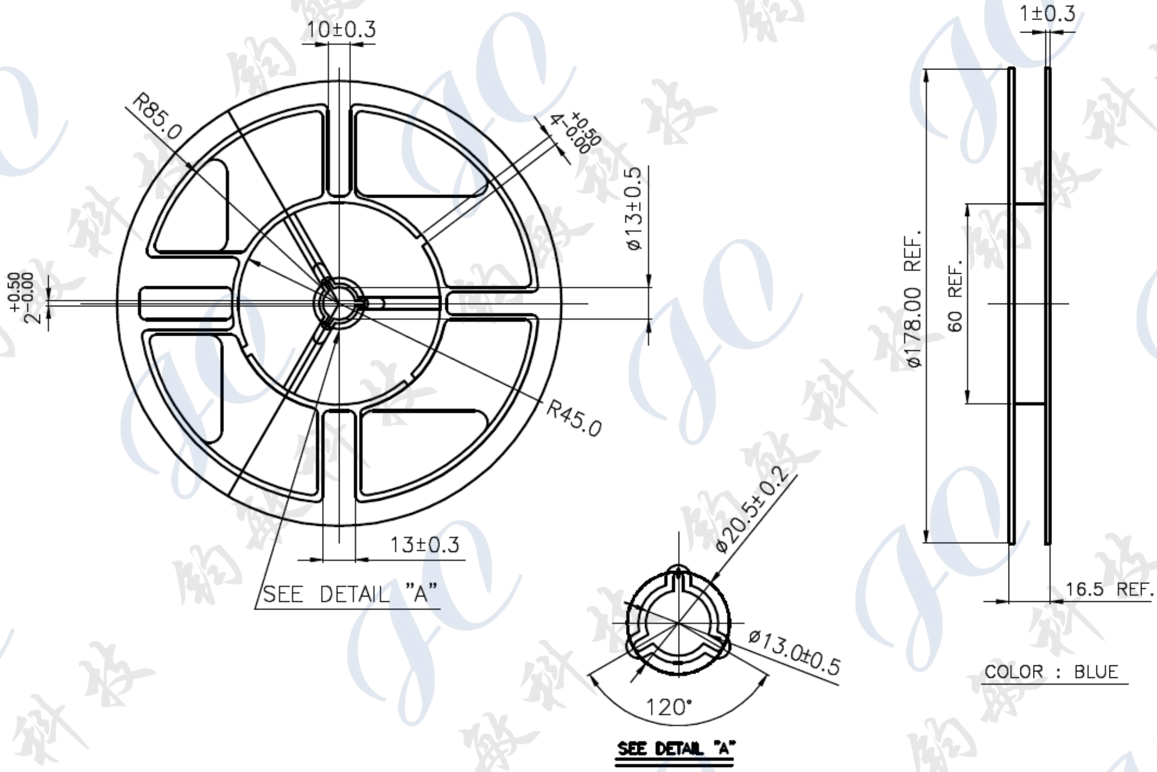
Temperature and Time: 350^{o}C, 3S

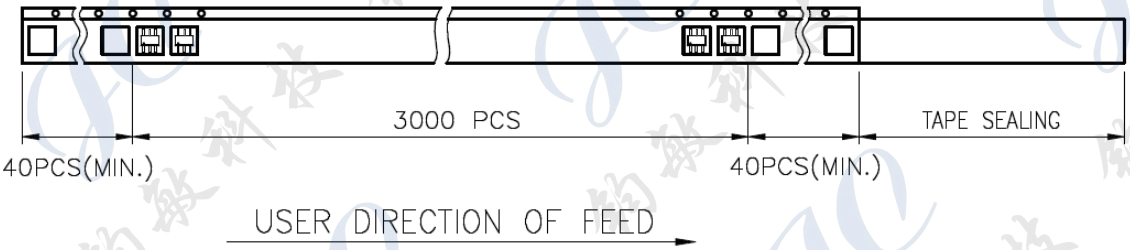
3. Reflow

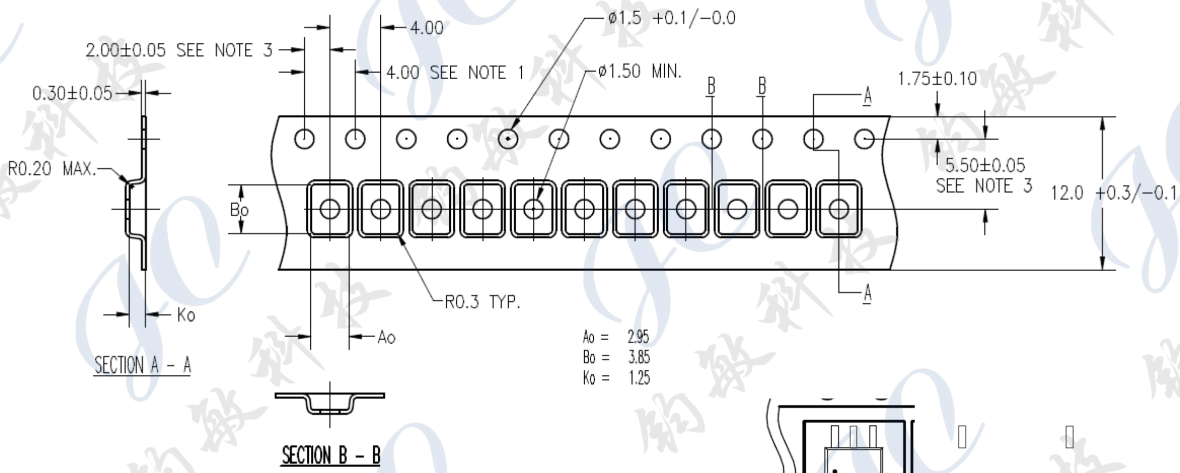
Temperature profile should conform to described in JEDEC-020 standard

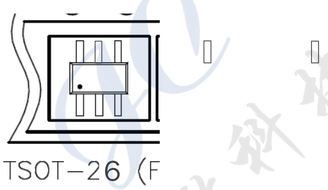


Carrier Tape & Reel specifications
TSOT26









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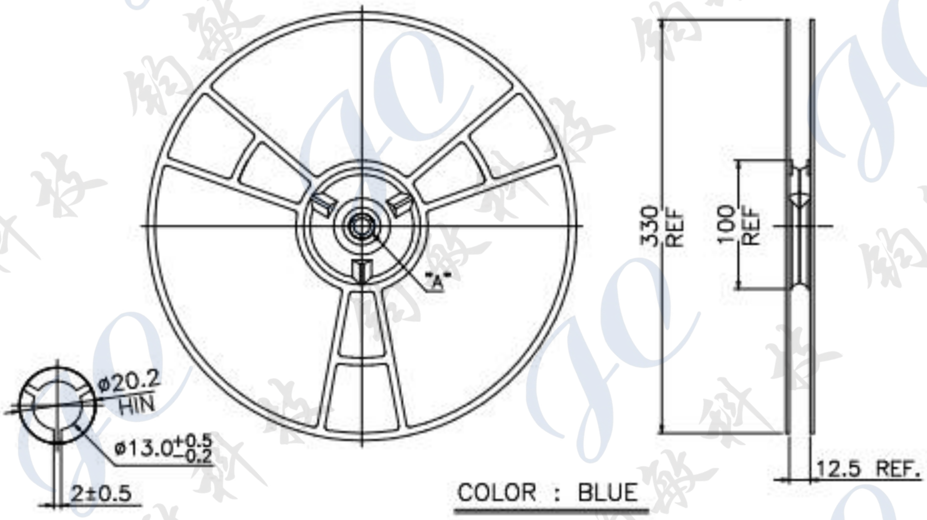

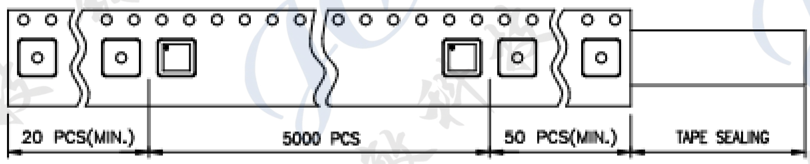

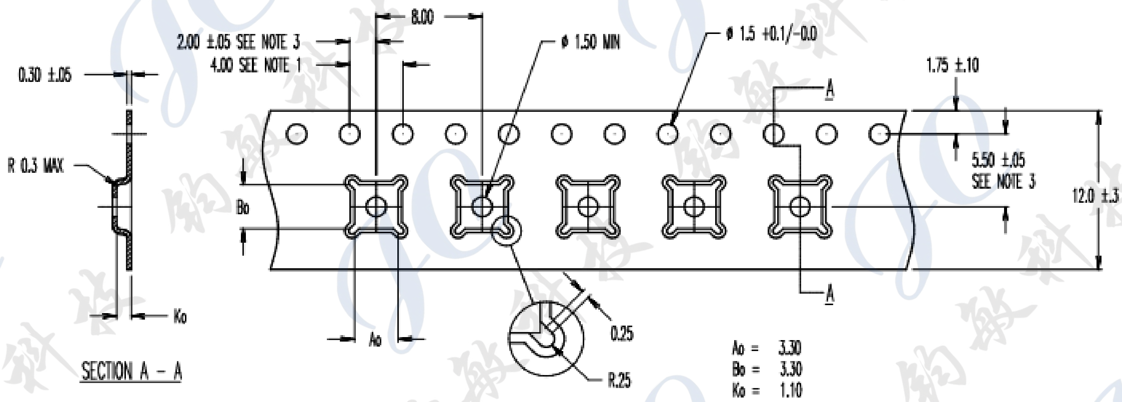

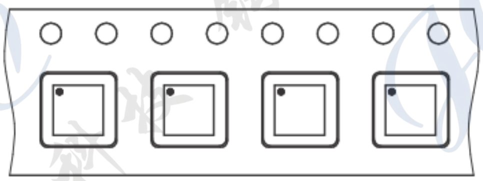

WSON(DFN) 3X3

QUANITITY: 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