



## DC Brushless Motor Hall Driver IC

# PT3935/3936

## 24V Single coil Hall Driver IC with RD/FG output

### Applications

- Single coil DC brushless motor
- Support pre-driver application

### Features

- Built-in hall sensor
- Single phase full wave driver
- Soft switching output driver
- Motor locked protection and automatic restart
- RD output (PT3935)
- FG output (PT3936)
- Built-in hysteresis comparator
- Built-in zener diode
- High balance and low thermal drift magnetic sensing
- Low power consumption and high driving efficiency
- Thermal protection
- AEC Q100 qualified
- Rohs 2.0

### Specifications

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

Parameter	Symbol	Conditions	Rating	Units
Maximum supply voltage	VDDmax	10u sec	34.5	V
Allowable power dissipation	Pd		800 <sup>*1</sup>	mW
Operating temperature	Ta		-40~+105	°C
Storage temperature	Ts		-50~+150	°C
Max. output current	I <sub>OMAX</sub>	0.5sec	800 <sup>*2</sup>	mA
RD/FG output current	I <sub>RD/FGMAX</sub>		20	mA
RD/FG output voltage	V <sub>RD/FGMAX</sub>		32	V
Maximum Junction temperature	T <sub>jmax</sub>		150	°C

\*1: Reduced by 4.54mW for each increase in Ta of 1°C over 25°C When mounted on 50mm x 50mm x 1.6mm glass epoxy board

\*2: Should not exceed Pd

### Package: DFN-10

- 3 : VDD/DC power supply
- 4 : O1/First output pin
- 5 : GND/DC ground
- 6 : O2/Second output pin
- 7 : RD/FG

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## PROLIFIC TECHNOLOGY INC.

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

**Electrical Characteristics ( $T_A=+25^\circ\text{C}$ ,  $V_{DD}=24\text{V}$ )**

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Units
Supply Voltage	$V_{DD}$		4.5		30	V
Output High Voltage	$V_{OH(ON)}$	@ $I_{OUT} = 200\text{mA}$	$V_{DD}-0.6$	$V_{DD}-0.4$		V
Output Low Voltage	$V_{OL(ON)}$	@ $I_{OUT} = 200\text{mA}$		0.4	0.6	V
Output Voltage Clamp	$V_{BV}$		32		42	V
Supply Current	$I_{DD}$	Output open		8	10	mA
RD/FG output voltage	$V_{RD/FG}$				30	V
RD/FG sink voltage	$V_{DSRD/FG}$	$I_{RD/FG}=5\text{mA}$		0.2	0.3	V
Shutdown Time	$T_{SD}$		2.8	3.5	4.2	S
Restart Time	$T_{RS}$		0.4	0.5	0.6	S
<b>Magnetic Characteristics (<math>T_A=+25^\circ\text{C}</math>, <math>V_{DD}=24\text{V}</math>)</b>						
Operate Point	$B_{OP}$		5	15	35	G
Release Point	$B_{RP}$		-35	-15	-5	G
Hysteresis	$B_{HYS}$		20	30	50	G

**General Specifications**

The PT3935/36 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. The supply voltage range is from 4.5V to 30V.

**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.

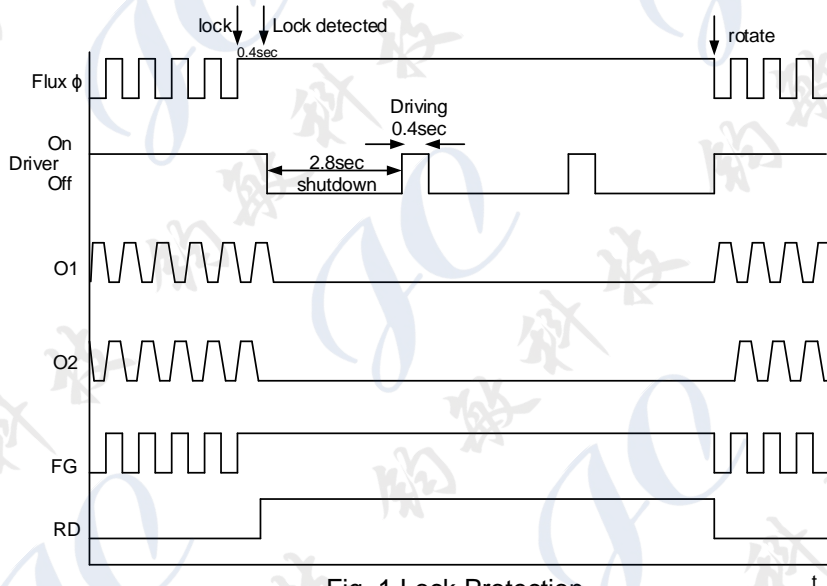


Fig. 1 Lock Protection

### 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.

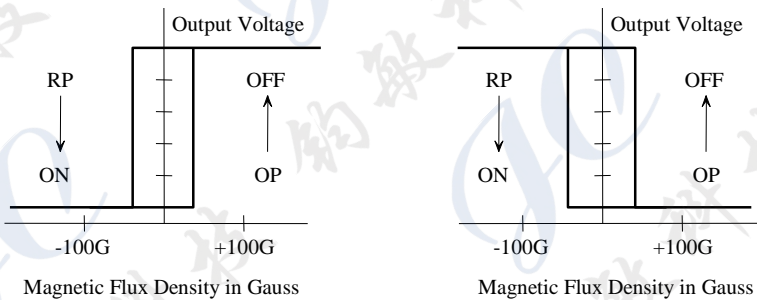


Fig 2. Magnetic Hysteresis Characteristics

### Thermal Protection

The thermal protection of PT3935/PT3936 is to utilize the internal Hall element signal variation over temperature to achieve. Once the junction temperature of PT3935/PT3936 is over  $150^{\circ}\text{C}$ , Hall element signal amplitude will be decreased to make sensitivity weaker.

That will make PT3935/PT3936 to operate in shutdown and auto-restart mode. This will turn off output driver to ensure safety.

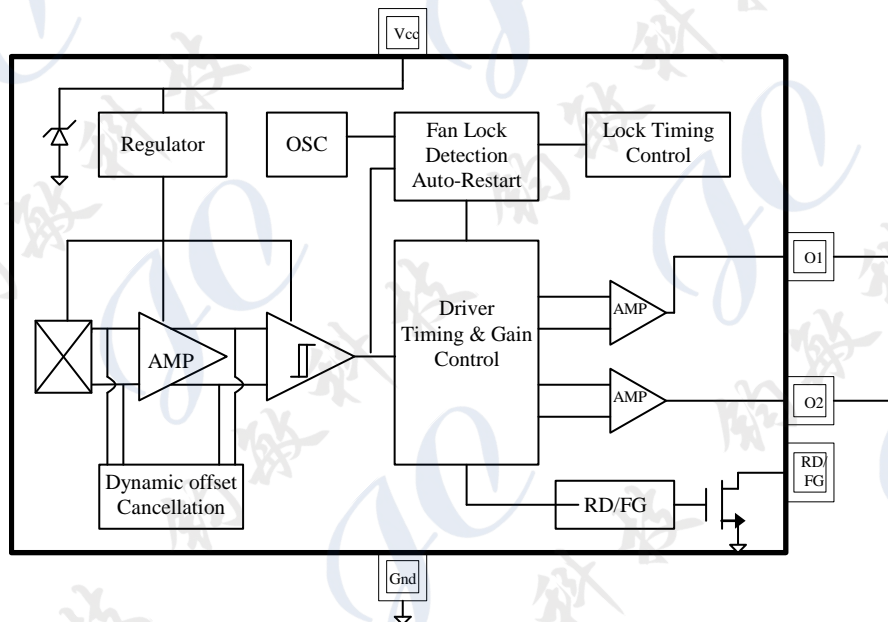
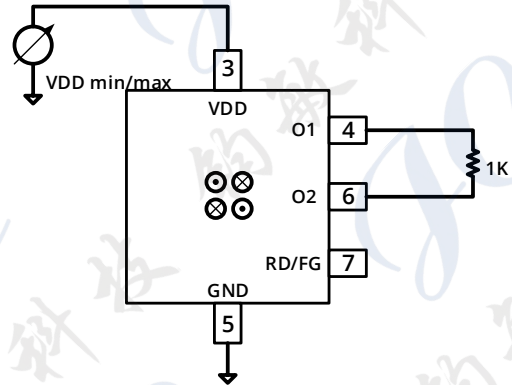
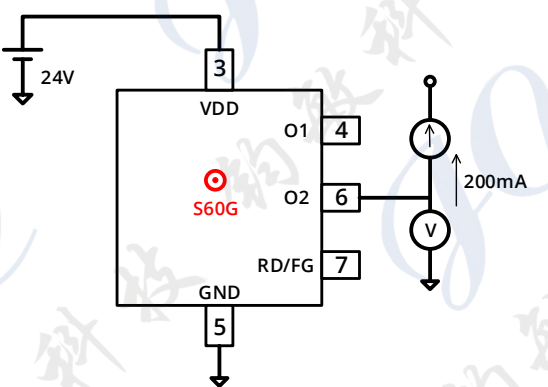
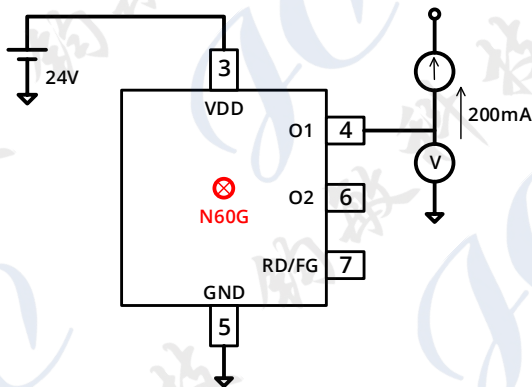
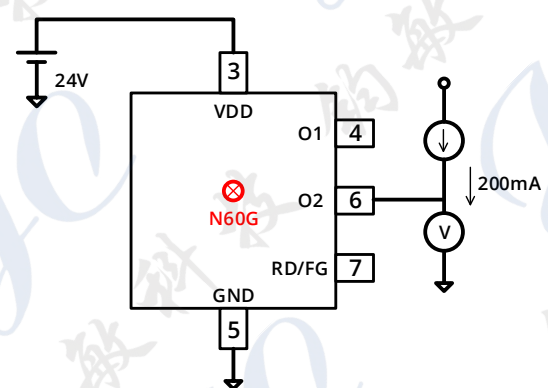
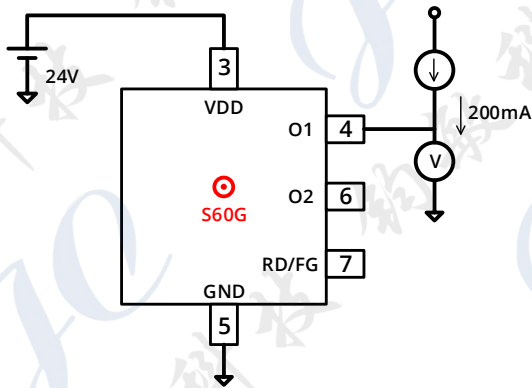
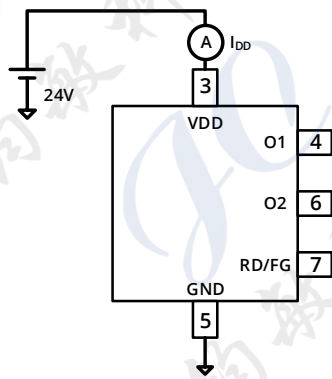
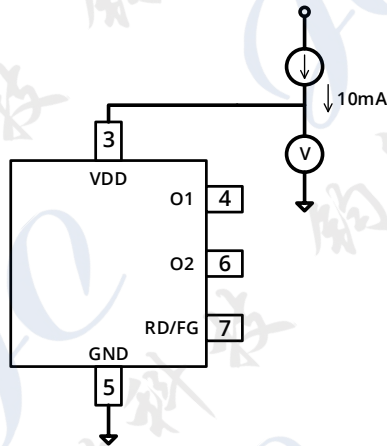


Fig. 3 Hall IC Architecture

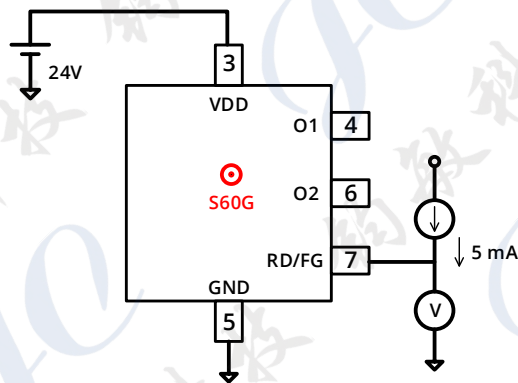
**Test circuit**
**VDD Min./Max.**

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




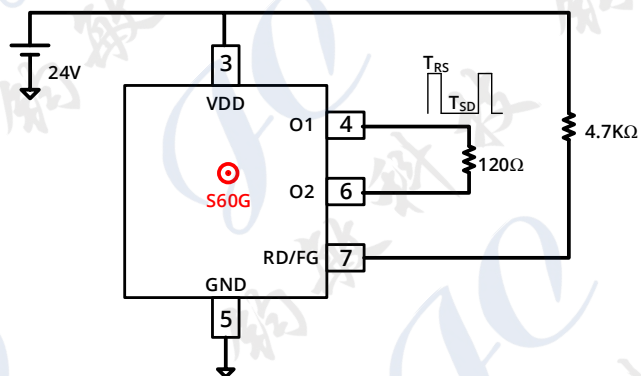
Voltage Clamp Vz



RD/FG Sink Voltage  $V_{DSRD/FG}$



Lock Time  $T_{RS}/T_{SD}$

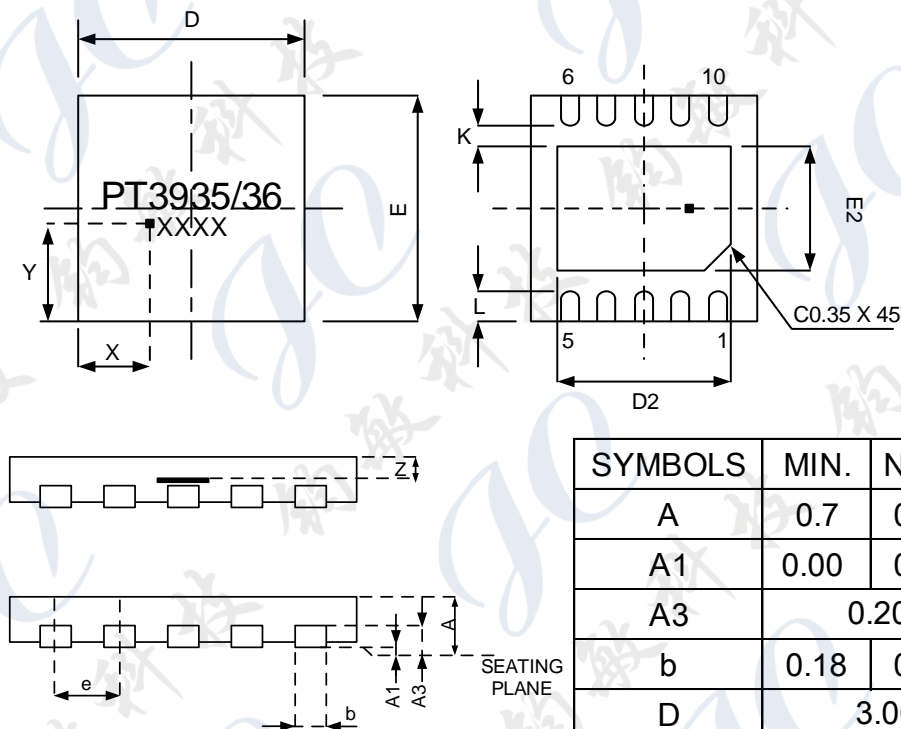


**Pin Description**

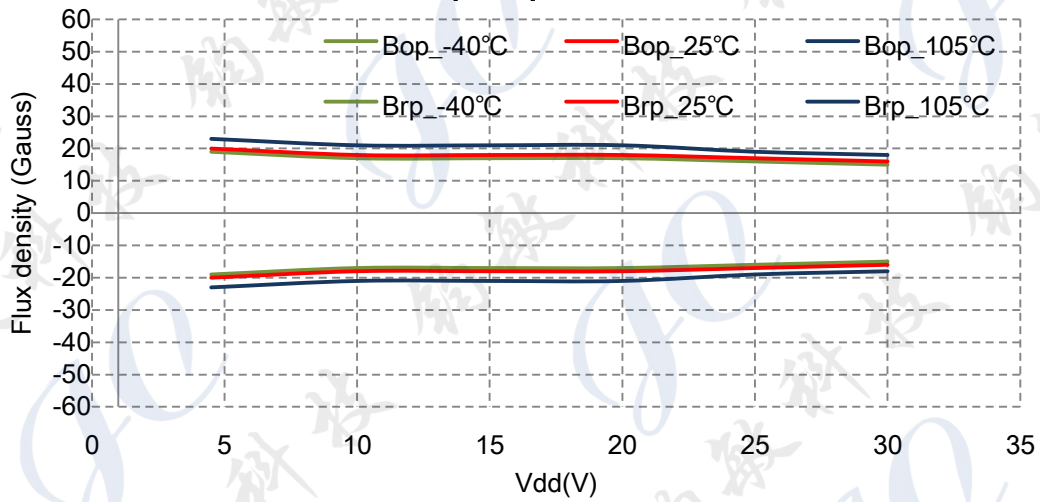
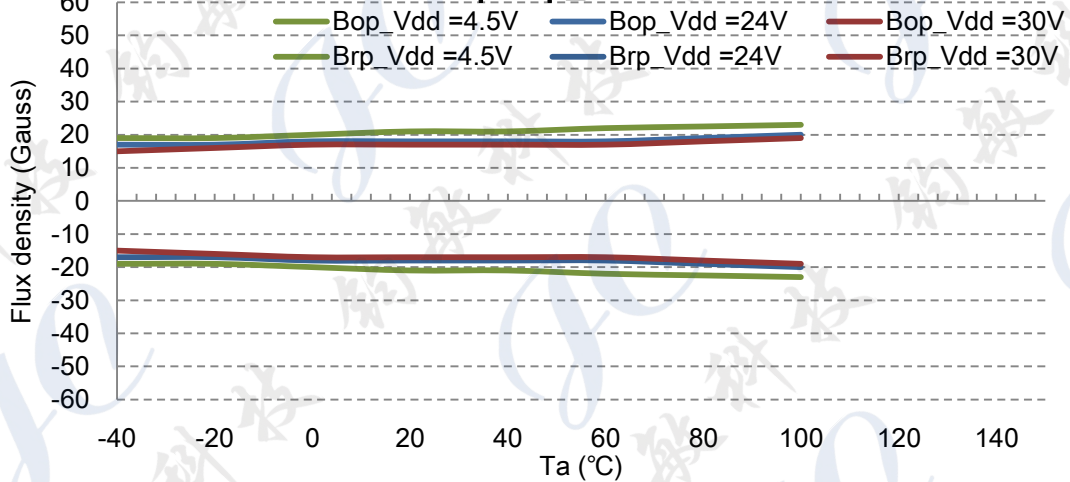
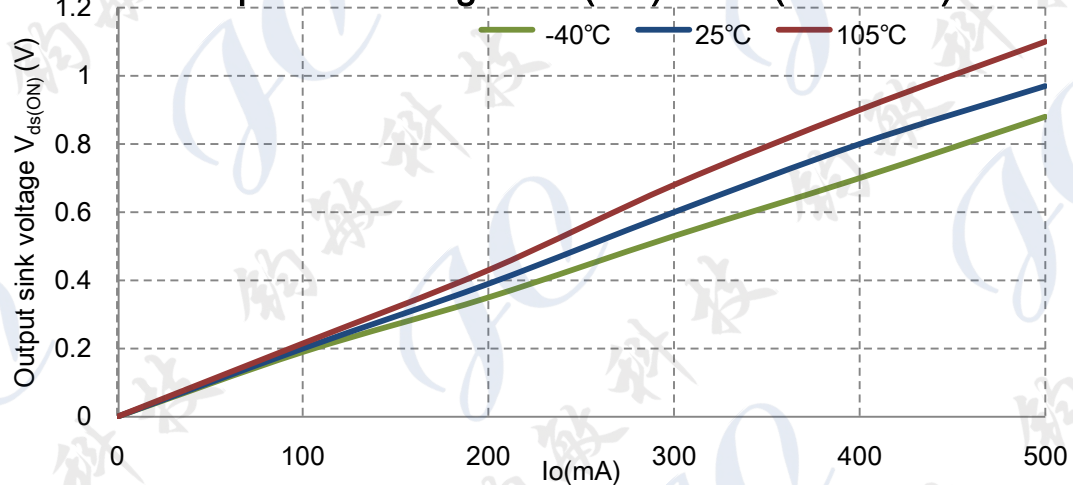
NAME	Pin	Description	Type	HBM (V)	MM (V)	Sustained Voltage (V)
Vdd	3	DC power supply	P	±8000	±1000	34
GND	5	DC ground	P	±8000	±1000	34
O1	4	First output pin	O	±8000	±1000	34
O2	6	Second output pin	O	±8000	±1000	34
RD/FG	7	Rotation Detection / Frequency Generation	O	±4000	±450	30

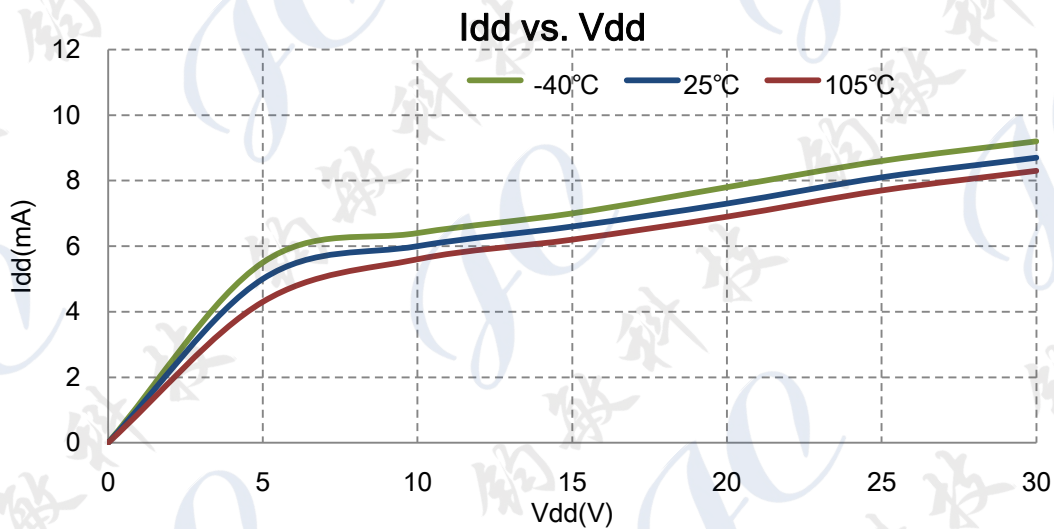
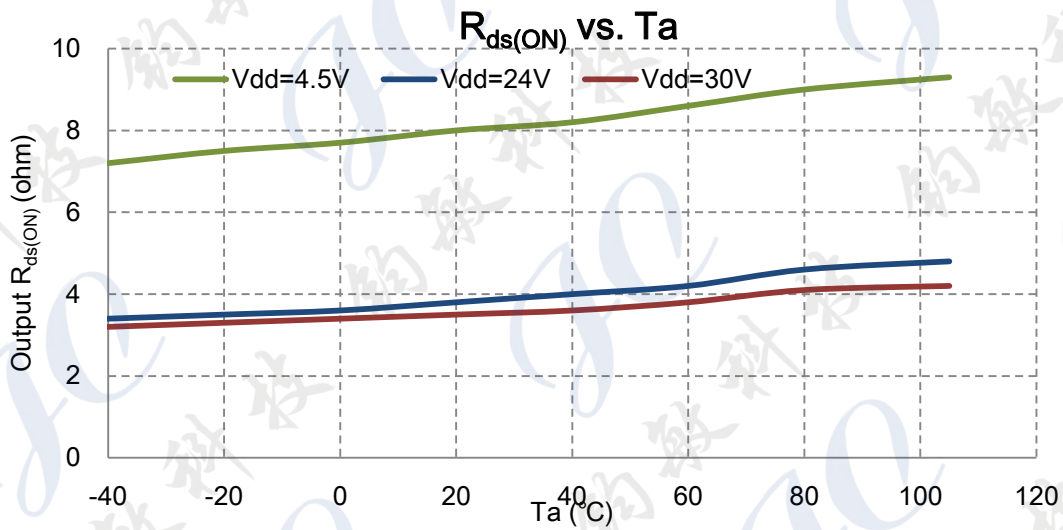
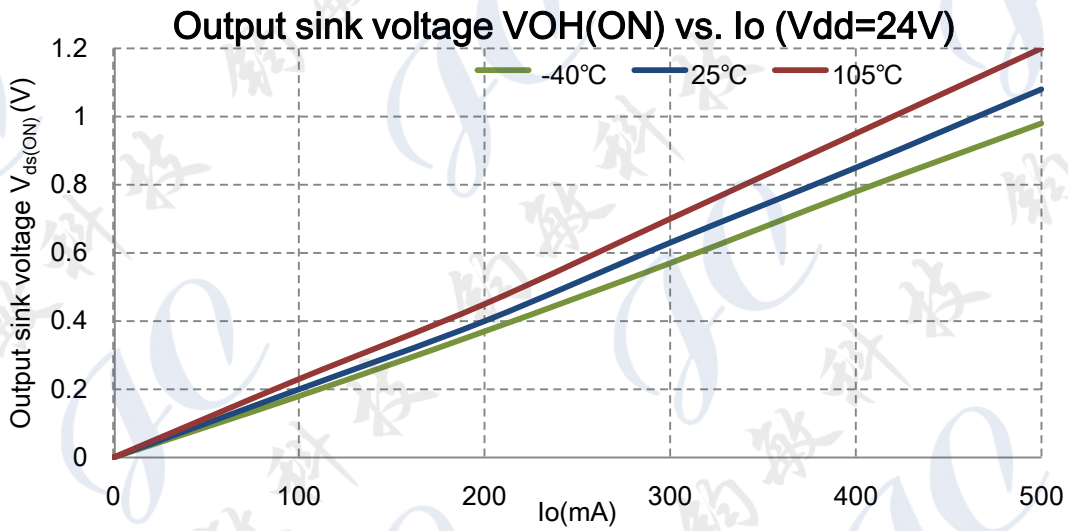
**Package Outline**

Datecode : xx(years)xx(weeks)

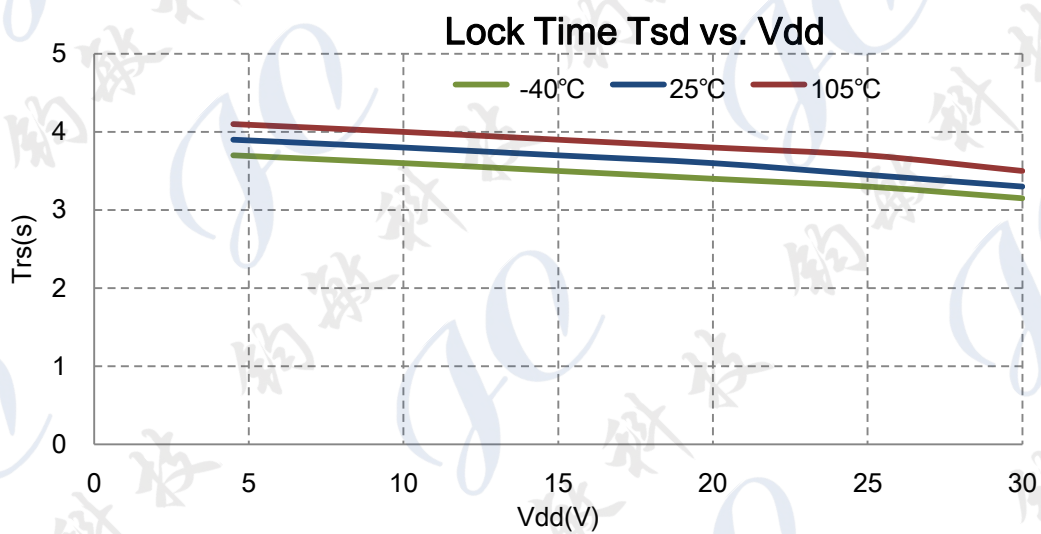
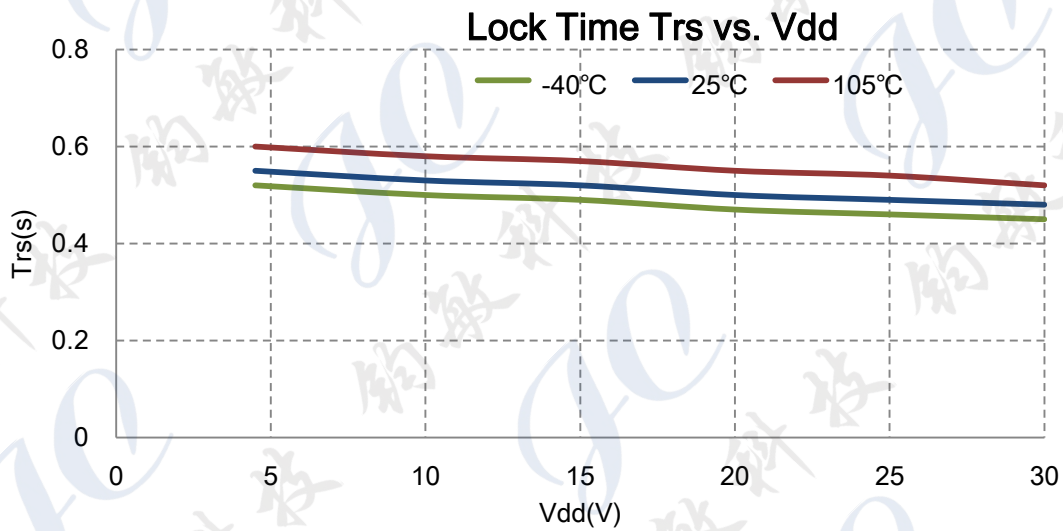
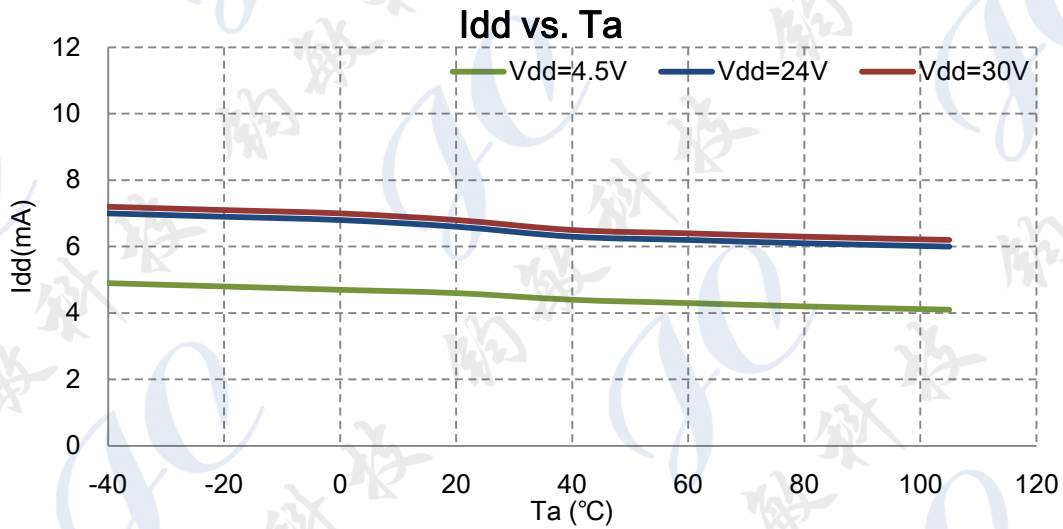


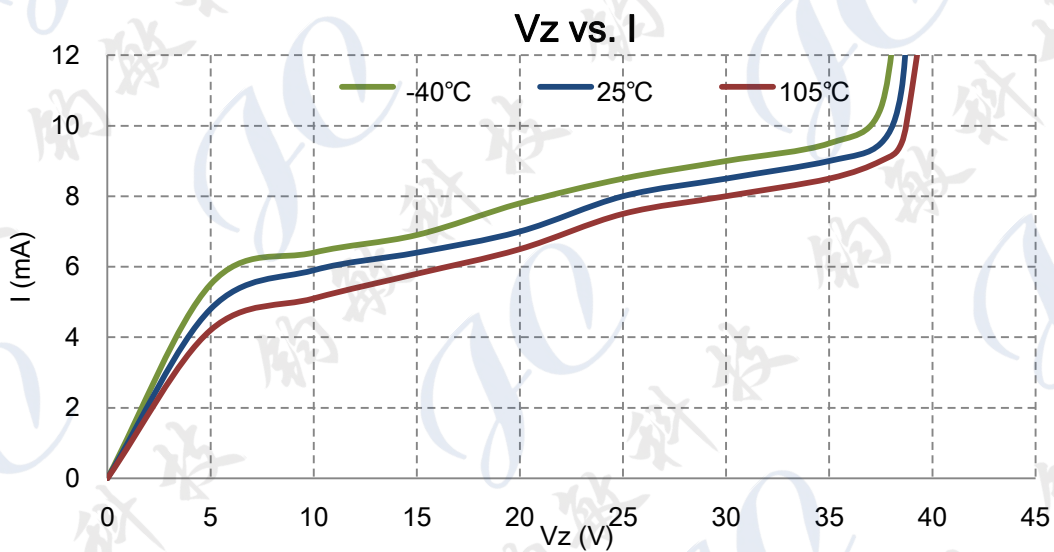
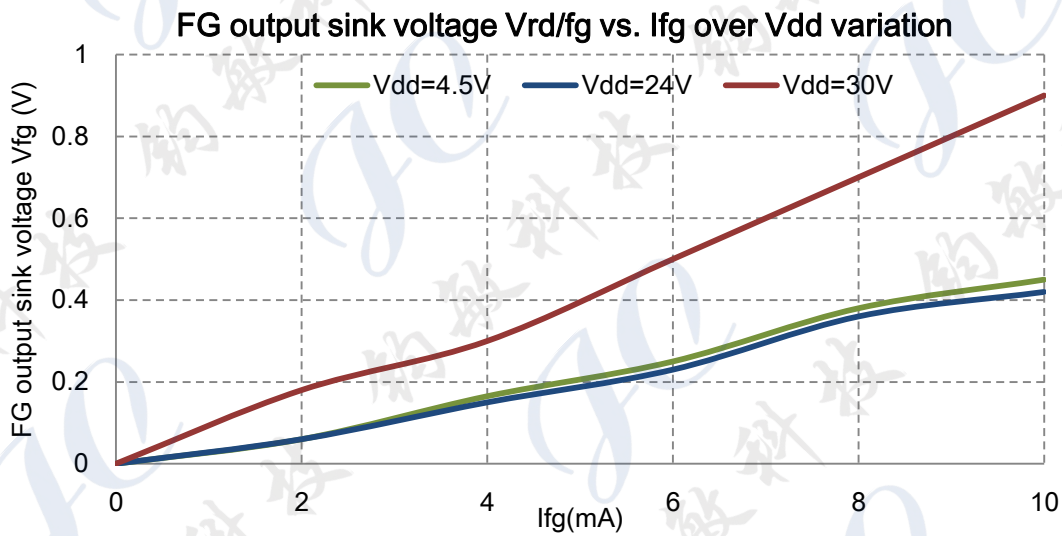
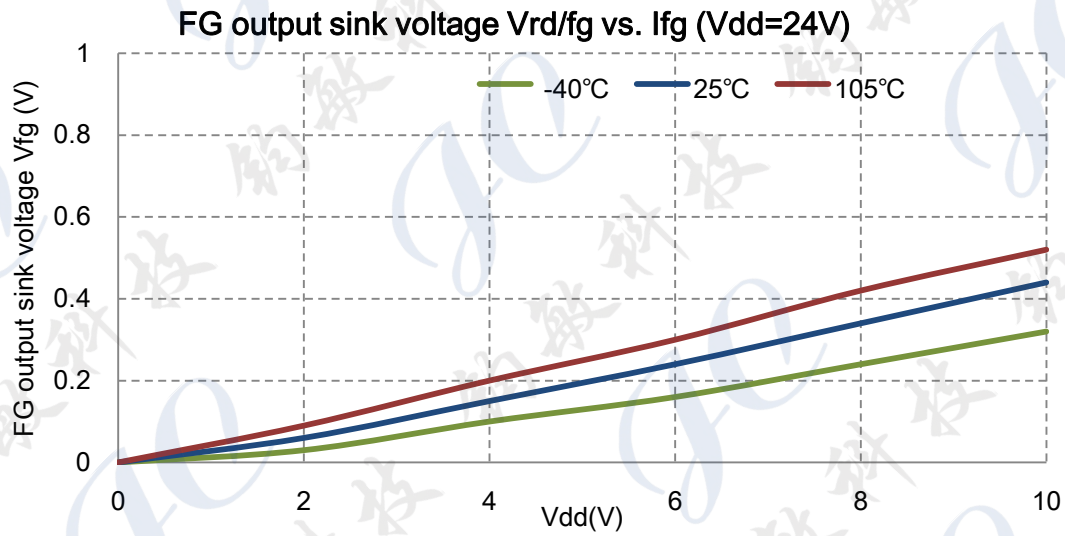
SYMBOLS	MIN.	NOM.	MAX.
A	0.7	0.75	0.8
A1	0.00	0.02	0.05
A3	0.203 REF		
b	0.18	0.25	0.3
D	3.00 BSC		
E	3.00 BSC		
e	0.50 BSC		
K	0.20	-	-
Pad Size			
D2	2.20	2.30	2.35
E2	1.55	1.65	1.70
L	0.30	0.40	0.50
Sensor Location			
X	0.95	1.05	1.15
Y	1.25	1.35	1.45
Z	0.35	0.38	0.42

**Performance curve**
**Bop\_Brp vs. Vdd**

**Bop/Brp\_Vdd vs. Ta**

**Output sink voltage VOL(ON) vs. Io (Vdd=24V)**




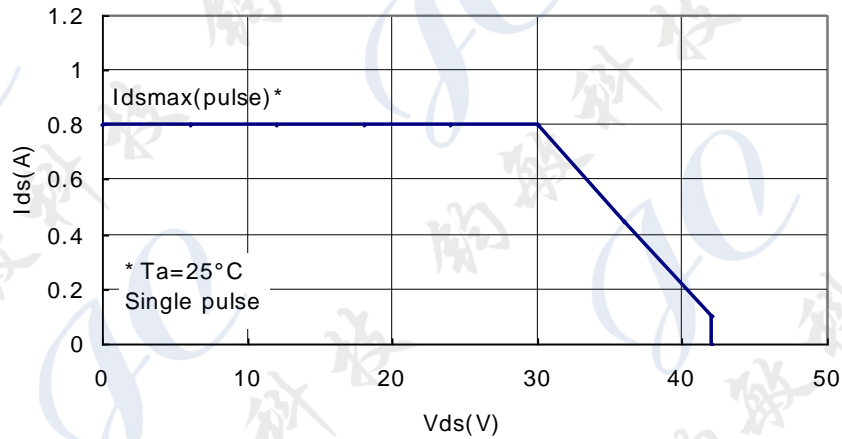
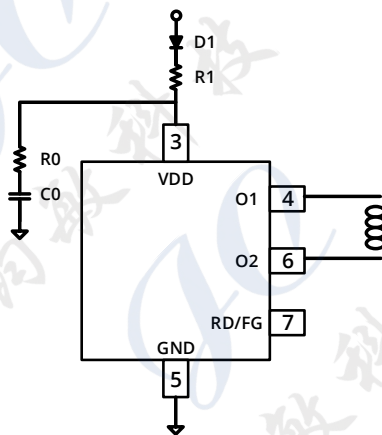






**A.S.O.**

A.S.O (Area of Safe Operation)


**Application circuits**


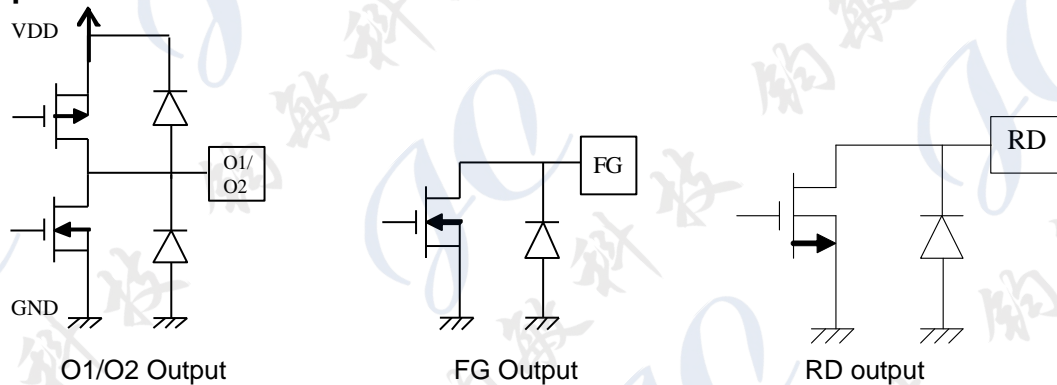
R1: 0~ 12ohm

R0: RC Snubber resistor 0ohm~12ohm

C0: decoupling capacitor 1nF ~ 0.1uF

dv/dt recommendation value of Vdd: 300V/usec max

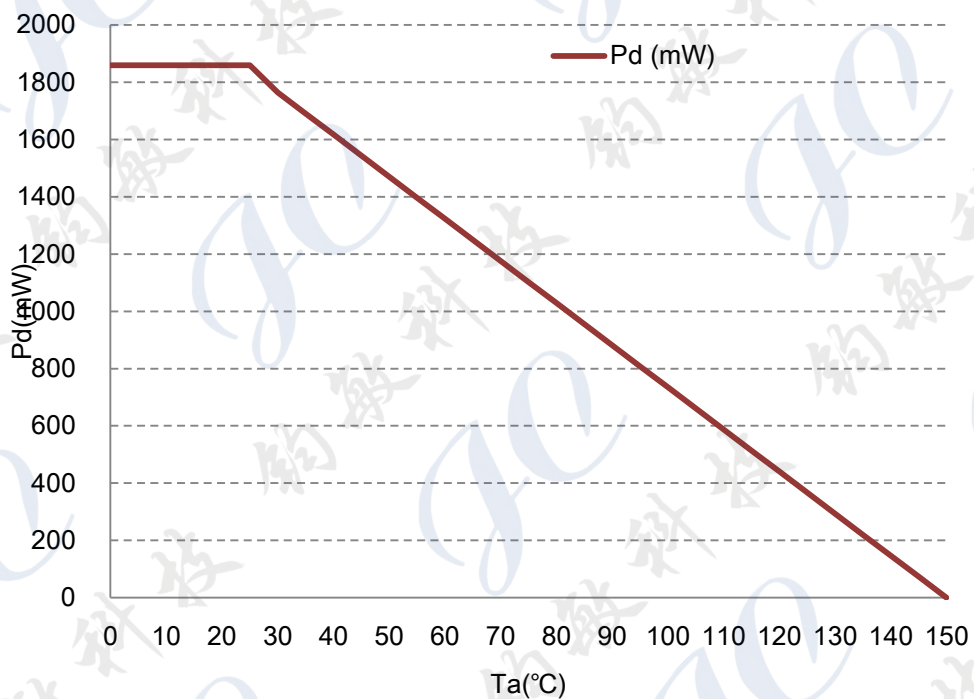
All electrical characteristics shall be satisfied at this application.

**I/O Equivalent circuits**


**Thermal resistance**

Parameter	Symbol	Conditions	Rating	Units
Allowable power dissipation	$P_d$		1860 <sup>*1</sup>	mW
Junction to ambient thermal resistance	$\theta_{JA}$		68	°C/W
Junction to case thermal resistance	$\theta_{JC}$		12	°C/W
Maximum junction temperature	$T_J$		150	°C

\*1: Reduced by 6.4mW for each increase in  $T_a$  of 1°C over 25°C When mounted on 50mm x 50mm x 1.6mm glass epoxy board

**Pd versus ambient temperature ( $T_a$ )**


## 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 :

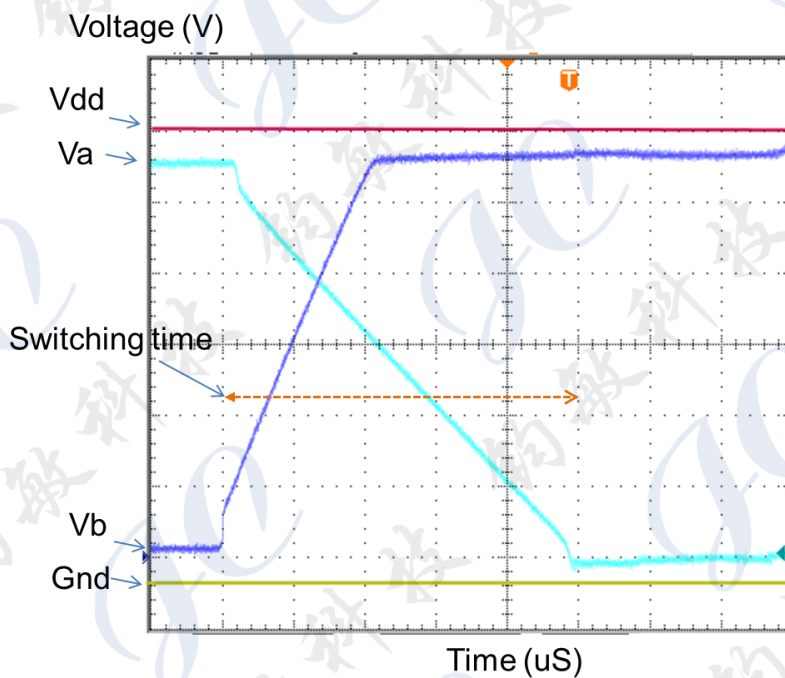
When  $V_{dd} = 12V$  ,  $I_{dd} = 8mA$  ,  $I_o = 430mA$  , RPM = 4000, Switching time = 100uS ,  
 4-pole fan motor

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

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

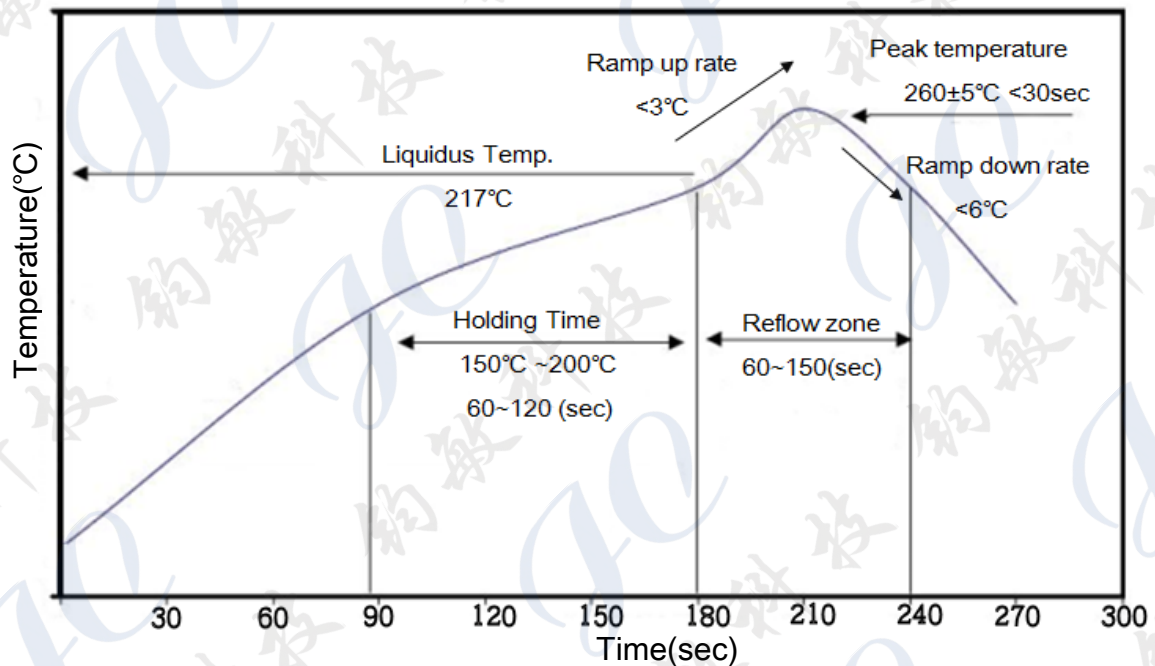
$Pd_{sw}$  :  $100 / 30 * 4000 * 10^{-6} * 430 * 12 = 69 mW$

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



### Soldering recommendations

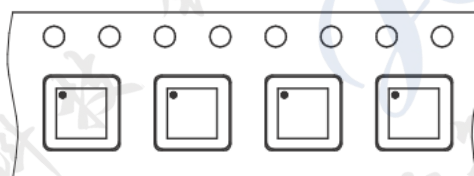
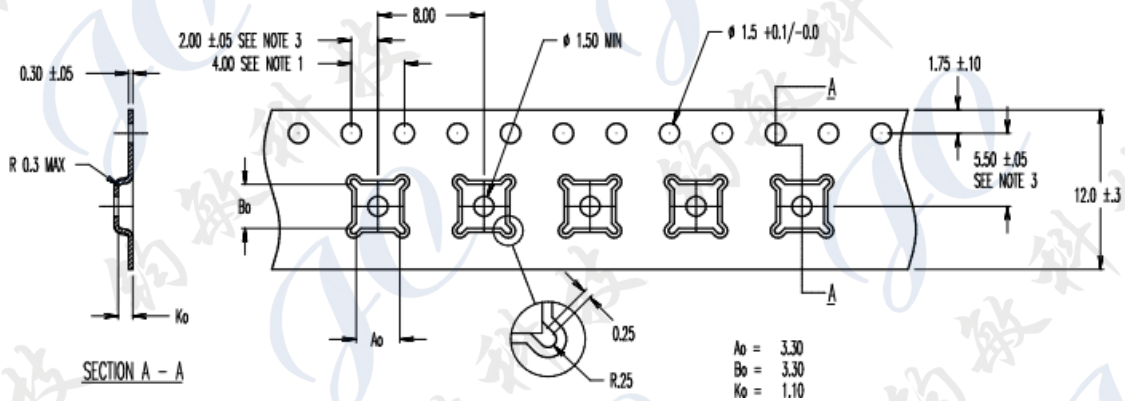
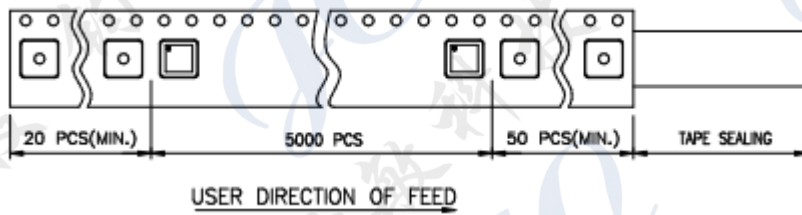
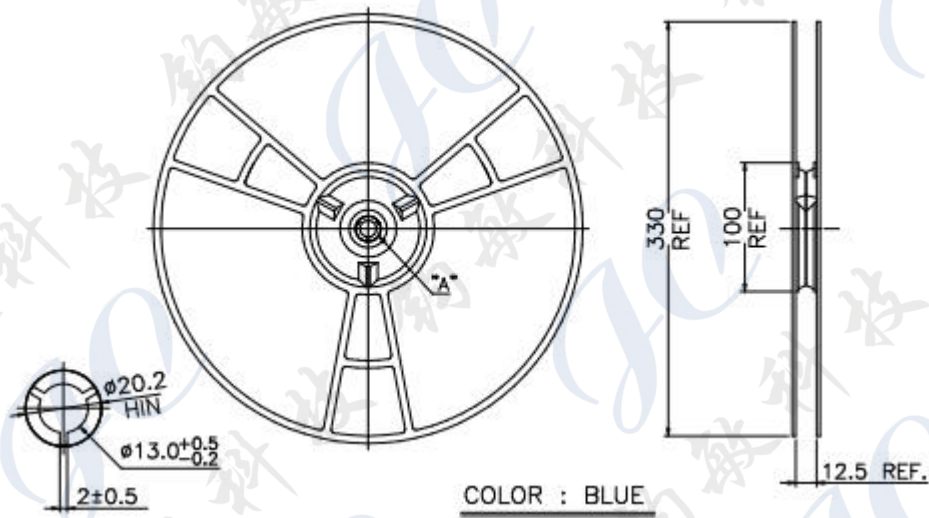
1. JEDEC J-STD-20
2. Iron Soldering  
Temperature and Time: 350°C, 3S
3. Reflow  
Temperature profile should conform to described in JEDEC-020 standard



### ESD Sensitivity level

Immunity test	Standard	Class	Sensitivity Range
HBM	MIL-STD-883H / Method 3015.8	3A	4000V
MM	ANSI/ESD S5.2- 2009	M4	450V

**Carrier Tape & Reel specifications**

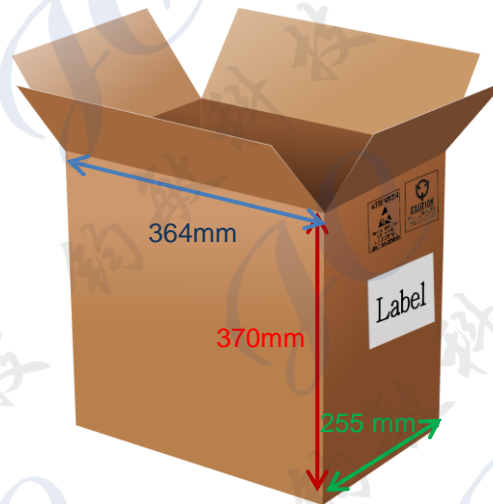
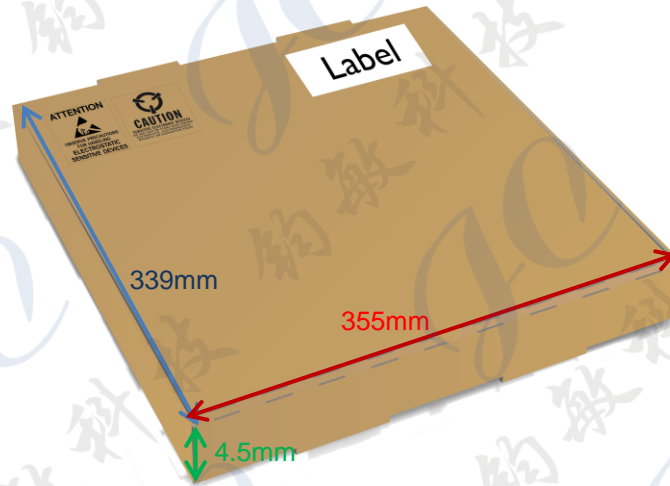


WSON(DFN) 3X3

QUANTITY : 5000 EA/PER REEL    1 REEL/BOX

### Packing specification

1. Reference document: PD-3-75-010
2. Dimension:



3. Quantity:

Type	Package	Amount Per Reel (EA)	Amount Carton (EA)
DFN10	Reel	5000	25000



**Order information**

Part Number	Temperature Range	Package Type	Delivery	MOQ
PT3936I1HFG8P1	-40°C~+105°C	DFN10	Reel	25000

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