PT392V-A
Single-phase Motor Driver with 2 Modes PWM speed control

Applications

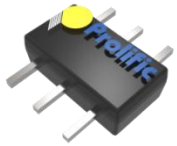
- Automotive cooling fan

Features

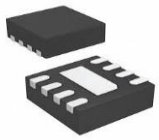
- Built-in high sensitivity hall sensor
- Linear Soft switching output driver
- Motor locked protection and automatic restart
- Speed controllable by Digital PWM or DC voltage two modes, identified automatically
- FG open drain output
- Quick start
- High Transient voltage dv/dt immune
- Back-EMF protection
- Thermal protection
- Built-in hysteresis comparator
- Built-in zener diode
- High balance and low thermal drift magnetic sensing
- Low power consumption and high driving efficiency
- Jump start protection
- AEC Q100 qualified

Package:

TSOT-6pin (2.9x1.6x0.75mm)



DFN-8pin (2.0x2.0x0.75mm)



Specifications

Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Conditions	Rating	Units
Maximum supply voltage	VDDmax	10u sec	20	V
Allowable power dissipation	Pd	TSOT-6L	500	mW
		DFN-8L	1250	mW
Operating temperature range	Tj		-40~+150	℃
Storage temperature	Ts		-50~+150	℃
Max. output voltage	V_{OMAX}		20	V
Max. output current	I_{OMAX}	0.5sec	1000*1	mA
Max. FG output voltage	V_{FGMAX}		20	V
Max. FG output current	I_{FGMAX}		10	mA
Max. input voltage (PWM)	V_{INMAX}		10	V

*1: Should not exceed Pd

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Electrical Characteristics (T_J=-40°C ~150°C, V_{DD}=12V)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Units
Supply Voltage	V_{DD}		3		18	V
Output High Voltage	$V_{OH(ON)}$	@ I_{OUT} =200mA	V_{DD}-0.6	V_{DD}-0.3		V
Output Low Voltage	$V_{OL(ON)}$	@ I_{OUT} =200mA		0.15	0.3	V
Supply Current	I_{DD}	Output open		6	8	mA
FG output voltage	V_{FG}				18	V
FG sink voltage	V_{DSFG}	I_{FG}=3mA		0.2	0.3	V
FG Leakage current	I_{Leak}	V_{FG}=12V			1	uA
PWM input H level	$V_{PWM(H)}$		2.5		10	V
PWM input L level	$V_{PWM(L)}$		0		0.8	V
PWM input frequency	f_{PWMI}		10		100	KHz
PWM input current	I_{PWM}	V_{PWM}=0V	-50			uA
PWM ON Duty 1	D1	V_{PWM}=1V	20	25	30	%
PWM ON Duty 2	D2	V_{PWM}=2V	70	75	80	%
Built-in PWM frequency	f_{PWMO}		20	25	30	KHz
Shutdown Time	T_{SD}		2.8	4.2	5.6	S
Restart Time	T_{RS}		0.2	0.3	0.4	S
Thermal Protection Temp	T_{JTSD}	T_J		165		℃
Shutdown Hysteresis	ΔT			25		℃
Magnetic Characteristics (T_J=-40°C ~150°C, V_{DD}=12V)						
Operate Point	B_{OP}		5	10	20	G
Release Point	B_{RP}		-20	-10	-5	G
Hysteresis	B_{HYS}		10	20	40	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 PT392V-A is a variable speed DC fan motor driver IC with built-in Hall sensor. 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. Furth, the linear driving of PT392V-A will benefit EMI performance. This IC is an optimal solution with PWM speed control for Automotive DC brushless fan motor application.

Lock Protection

In order to protect the motor, the driver IC will be shutdown to drive the coil when the motor is locked over 0.3 second. Then, it restarts to drive the motor after 4.2 seconds. Figure 1 shows the timing diagram between the hall input signal and driver's output state.

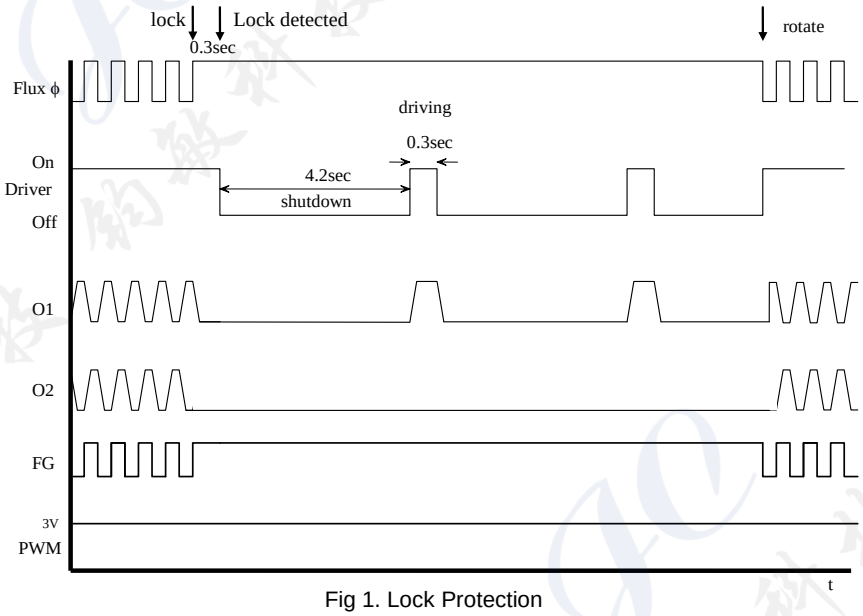


Fig 1. Lock Protection

Hall Sensor

This Hall effect sensor IC integrates 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 +-10 Gauss.

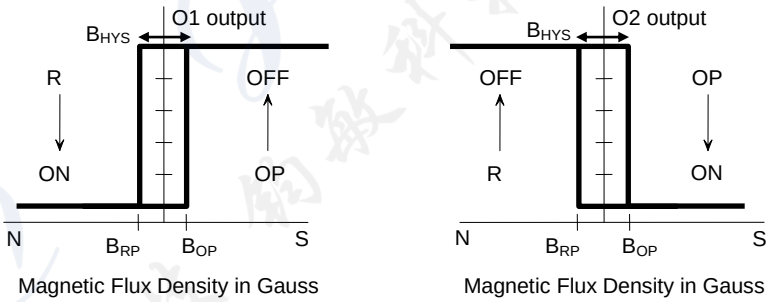


Fig 2. Magnetic Hysteresis Characteristics

PWM Speed Control

This Driver IC has built-in pulse width modulation to control motor speed. The output duty cycle of PWM is controlled by the DC voltage level of V_{PWM}. The V_{PWM} input voltage determines the PWM duty cycle and control the speed of fan motor as Fig 3a. The V_{PWM} Voltage is compared with an internal 0.5V-2.5V saw waveform V_{SAW} and output PWM duty control signal. The output PWM ON duty cycle is controlled by 0.5V~2.5V DC V_{PWM} voltage from 10% to 100%. The formula of PWM ON duty cycle is +Duty=50(V_{PWM}-0.5)%. The digital PWM input signal also can be converted to DC voltage level via an internal integrator to do variable speed control. The transfer function of PWM IN and OUT duty cycle is shown in Fig3b.

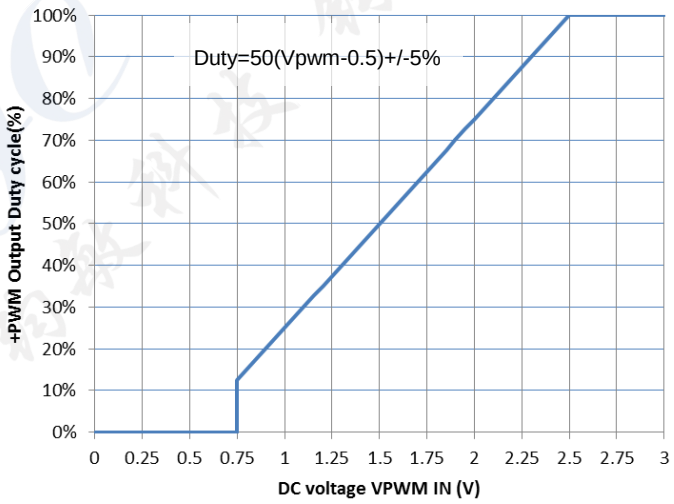


Fig. 3a PWM Output duty cycle vs. V_{PWM} IN voltage

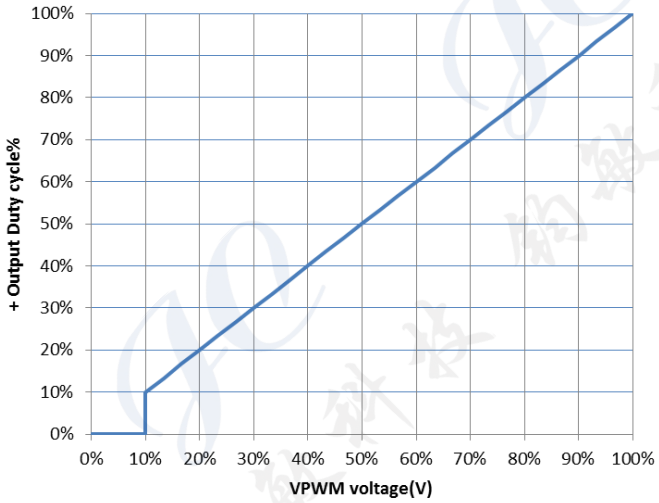


Fig. 3b PWM Output duty cycle vs. PWM IN duty cycle

Quick Start

Motor's speed is controlled by PWM input signal. When PWM pin is open or tied to High voltage (> 2.5V) , the motor will be full speed rotation. This PWM speed control make the lock protection off and stop the motor when the PWM input voltage keeps low level (<0.5V) for more than 25mS(typ.). The motor will be started directly without the lock protection time delay when the PWM voltage is above 0.5V as Fig4.

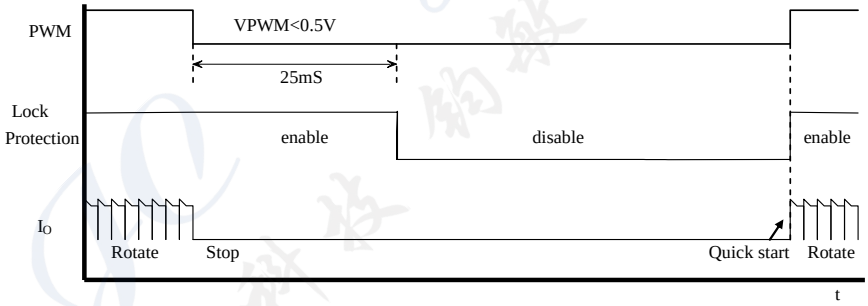


Fig 4. PWM input and Lock Protection

Jump start protection

During the jump-start overvoltage test, an overvoltage will be applied to V_{DD}. In that case, output current will increase and extra heat generated. PL392V-A will activate jump-start protection to avoid such kind of circumstance.

The Driver IC architecture block diagram is shown in Fig. 5.

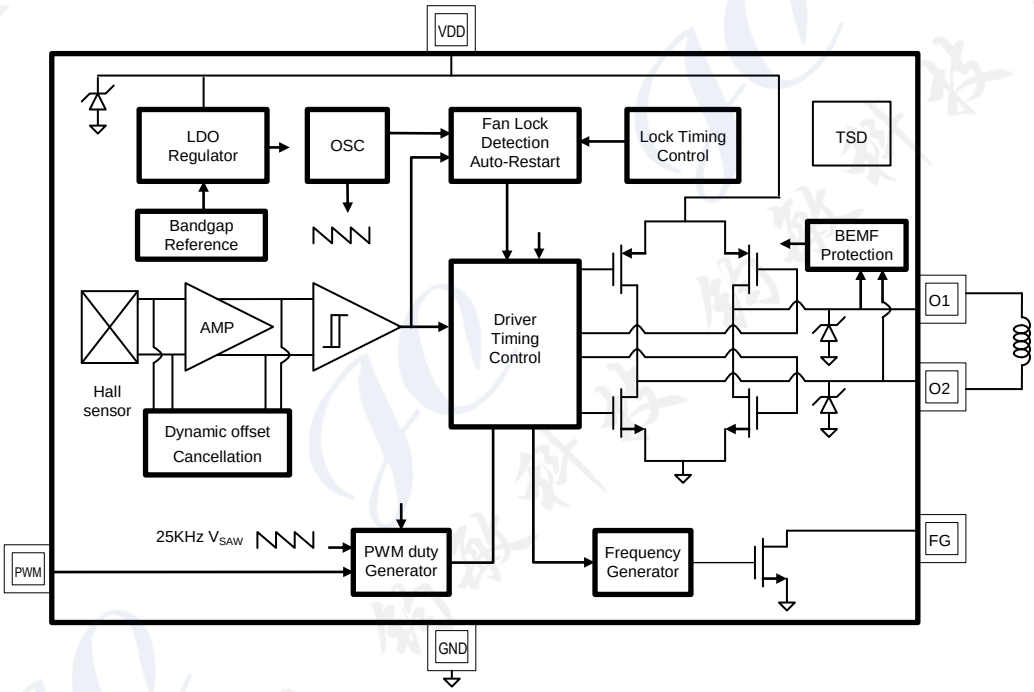
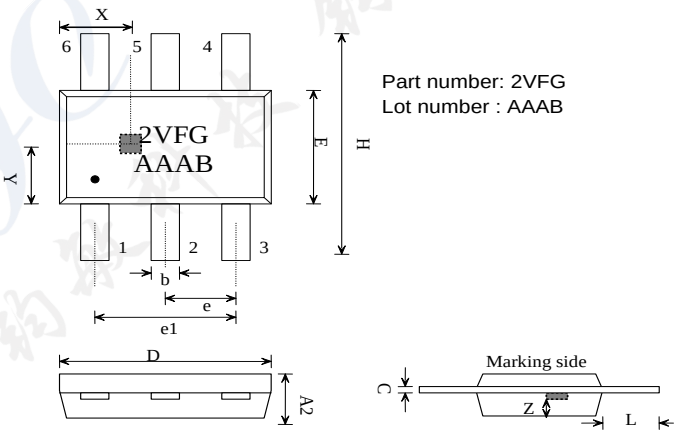


Fig5. PWM Driver IC Architecture

Pin Description

TSOT-6pin (2.9x1.6x0.75mm)

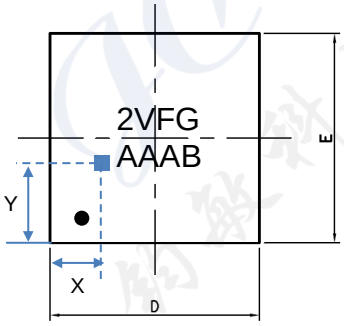
NAME	Pin	Description
FG	1	Frequency Generation output pin
GND	2	DC ground
O1	3	First output pin
O2	4	Second output pin
PWM	5	DC voltage/Direct PWM input pin
VDD	6	DC power supply

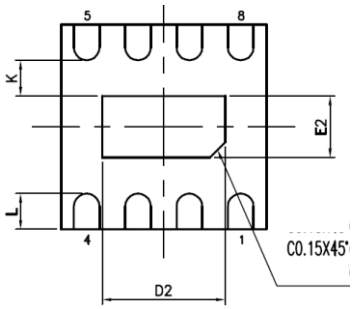


SYMBOLS	DIMENSIONS IN MILLIMETERS(mm)		
	MIN	NOM	MAX
A2	0.70	0.75	0.775
b	0.35	-	0.50
C	0.10	-	0.20
D	2.70	2.90	3.10
E	1.40	1.60	1.80
H	3.60	3.80	4.00
e	0.80	0.95	1.10
e1	1.70	1.90	2.10
L	0.95	1.10	1.25
SENSOR LOCATION			
X	0.85	1.00	1.15
Y	0.65	0.85	0.95
Z	0.20	0.25	0.30

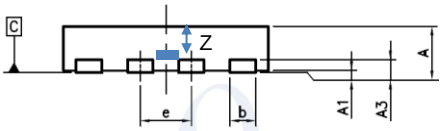
DFN-8pin (2x2x0.75mm)

NAME	Pin	Description
VDD	1	DC power supply
PWM	2	DC voltage/Direct PWM input pin
VDD	3	DC power supply
O1	4	First output pin
GND	5	DC ground
O2	6	Second output pin
NC	7	No connection
FG	8	Frequency Generation output pin





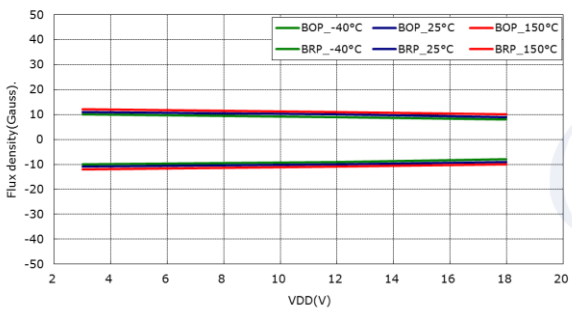
Part Number : 2VFG
Lot number: AAAB



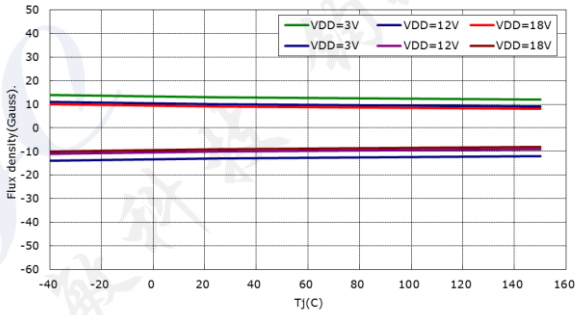
SYMBOLS	DIMENSIONS IN MILLIMETERS(mm)		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3		0.127	
b	0.20	0.25	0.30
D		2.00	
E		2.00	
e		0.50	
L	0.25	0.30	0.35
K	0.20		
E2	0.65	0.70	0.75
D2	1.55	1.60	1.65
SENSOR LOCATION			
X	0.30	0.45	0.60
Y	0.70	0.85	1.00
Z		0.10	

Performance curve

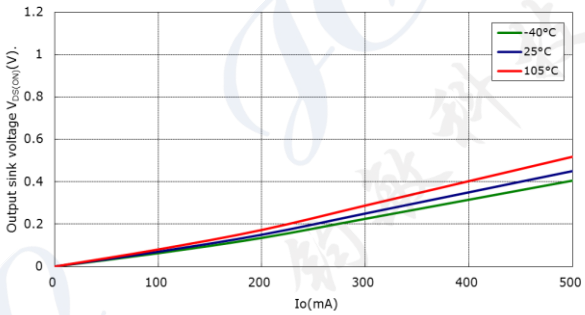
BOP_BRP vs. VDD



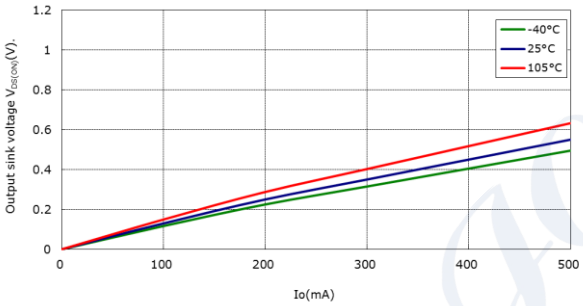
BOP_BRP vs. Tj



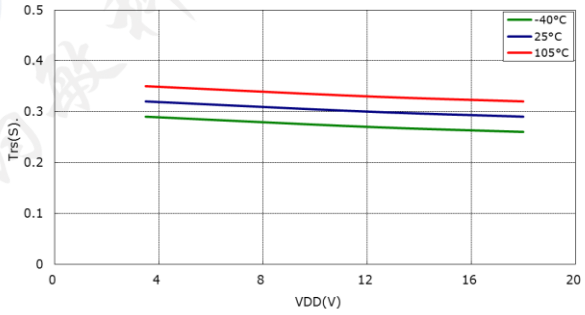
Output sink voltage VOL(ON) vs. Io (VDD=12V)



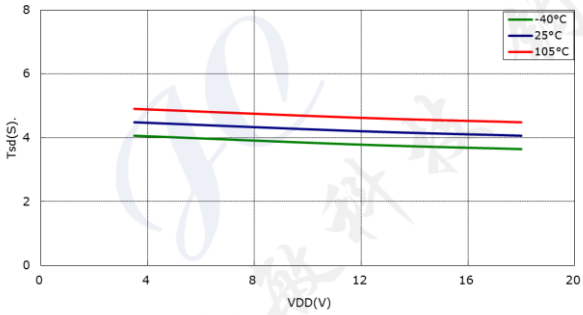
Output sink voltage VOH(ON) vs. Io (VDD=12V)



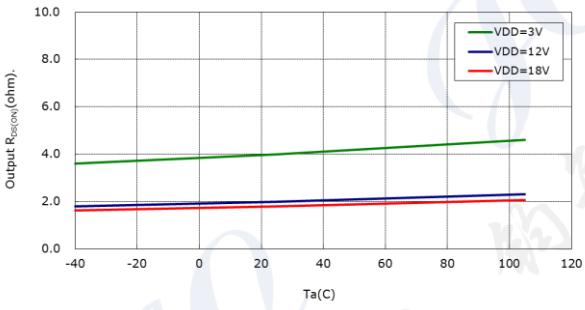
Lock Trs vs. VDD



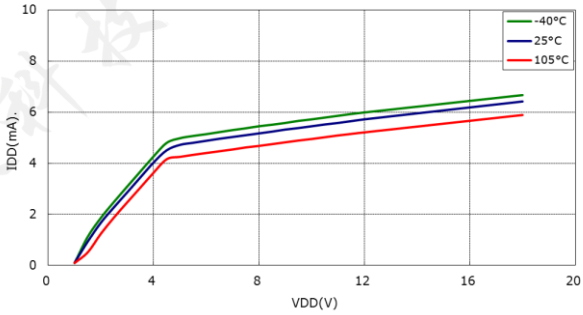
Lock Tsd vs. VDD



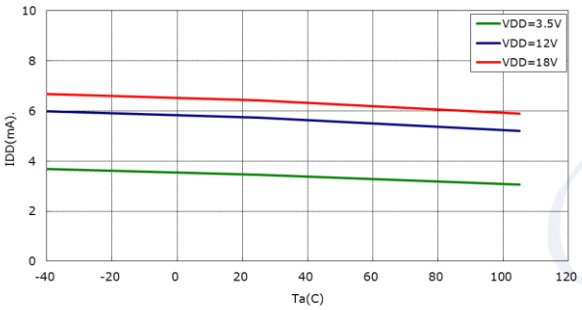
$R_{DS(ON)}$ vs.Ta



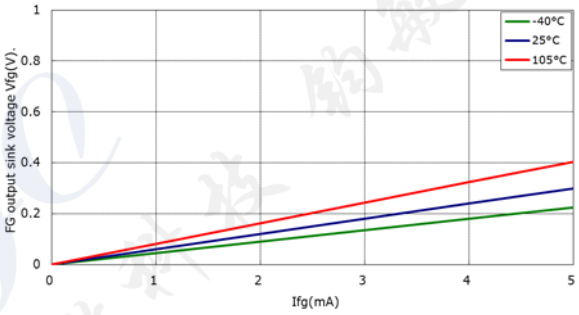
IDD vs. VDD



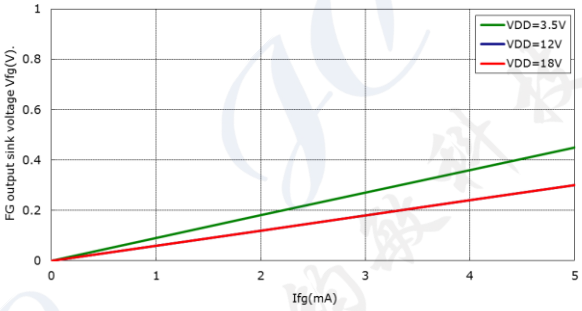
IDD vs. Ta



FG output sink voltage Vfg vs. Ifg (VDD=12V)

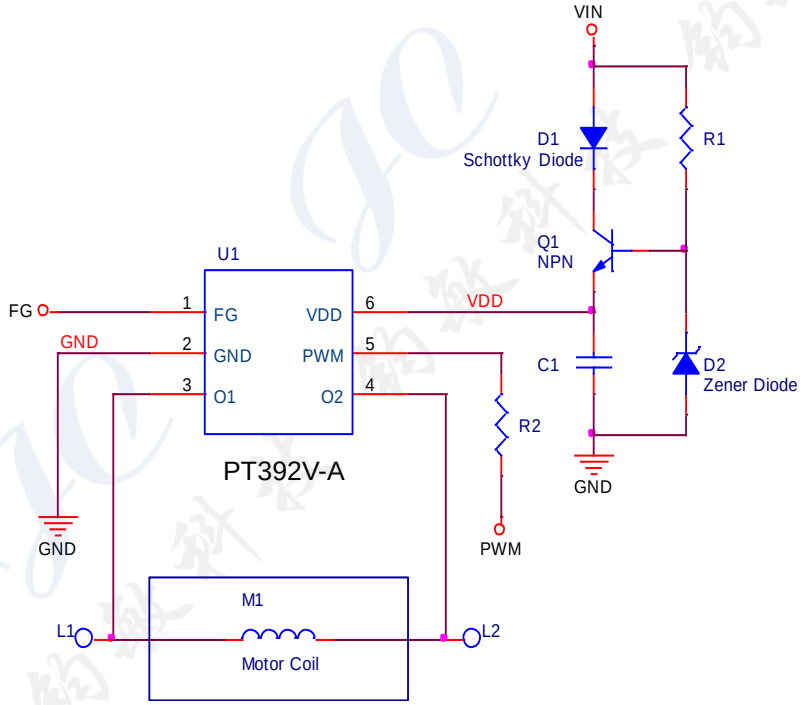


FG output sink voltage vs. Ifg (Ta=25C)



Application circuits

5V/12V application



D1: Schottky diode.
D2: Zener diode.
Q1: NPN transistor.
R1: Recommend 1K ohm.
R2: PWM resistor 15K ohm.
C1: Decoupling capacitor 1.0uF ~ 2.2uF

PS. R1, Q1, and D2 are used for overvoltage protection. If VIN (power supply) can be stabilized within 18V, the part can be saved.

Output PWM duty cycle=+50(Vpwm-0.5)%

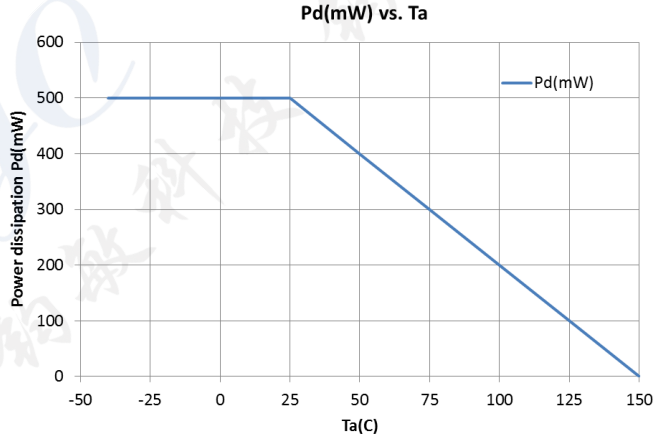
PWM Voltage(Vpwm)	Output PWM +Duty%	FAN Speed
0V~0.5V	0	Stop
1.0V	25	Low speed
1.5V	50	
2.0V	75	
2.5V	100	Full speed
3.0V~	100	Full speed

Thermal resistance

TSOT-6pin

Parameter	Symbol	Conditions	Rating	Units
Allowable power dissipation	P_d		500*1	mW
Junction to ambient thermal resistance	θ_{JA}		250	℃/W
Junction to case thermal resistance	θ_{JC}		80	℃/W
Maximum junction temperature	T_J		150	℃

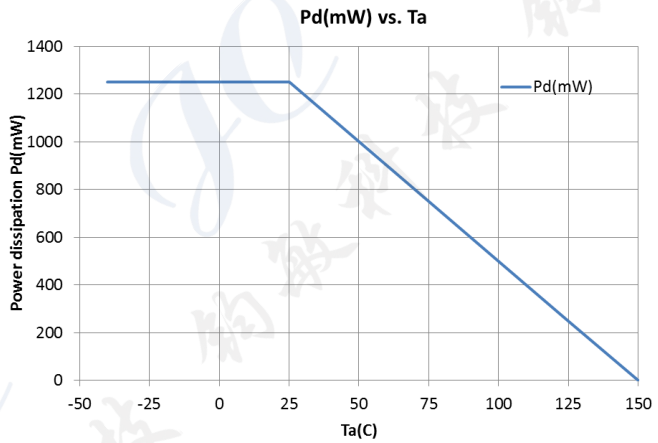
*1: Reduced by 4 mW for each increase in Ta of 1°C over 25°C When mounted on 50mm x 50mm x 1.6mm glass epoxy board



DFN-8pin

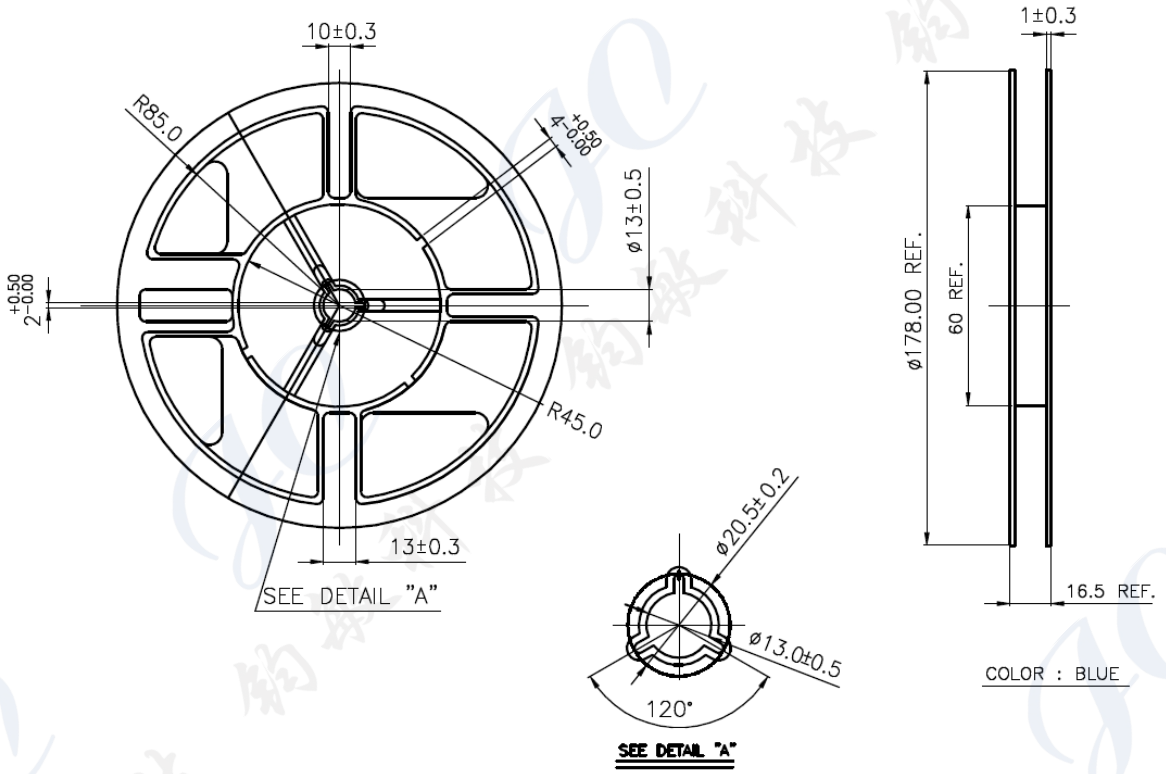
Parameter	Symbol	Conditions	Rating	Units
Allowable power dissipation	P_d		1250*1	mW
Junction to ambient thermal resistance	θ_{JA}	2s0p PCB, still-air	100	℃/W
Junction to case thermal resistance	θ_{JC}		10	℃/W
Maximum junction temperature	T_J		150	℃

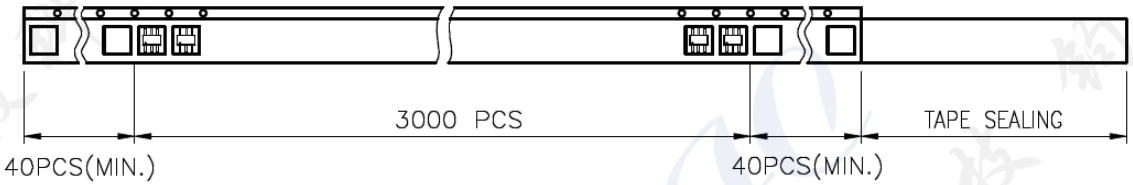
*1: Reduced by 10mW for each increase in Ta of 1°C over 25°C When mounted on 50mm x 50mm x 1.6mm glass epoxy board



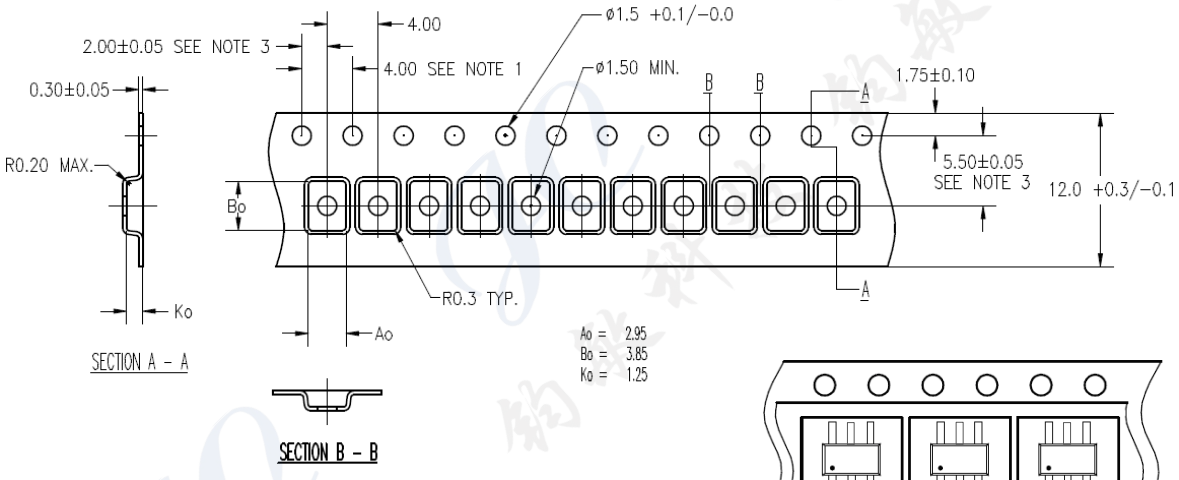
Carrier Tape & Reel specifications

TSOT-6pin



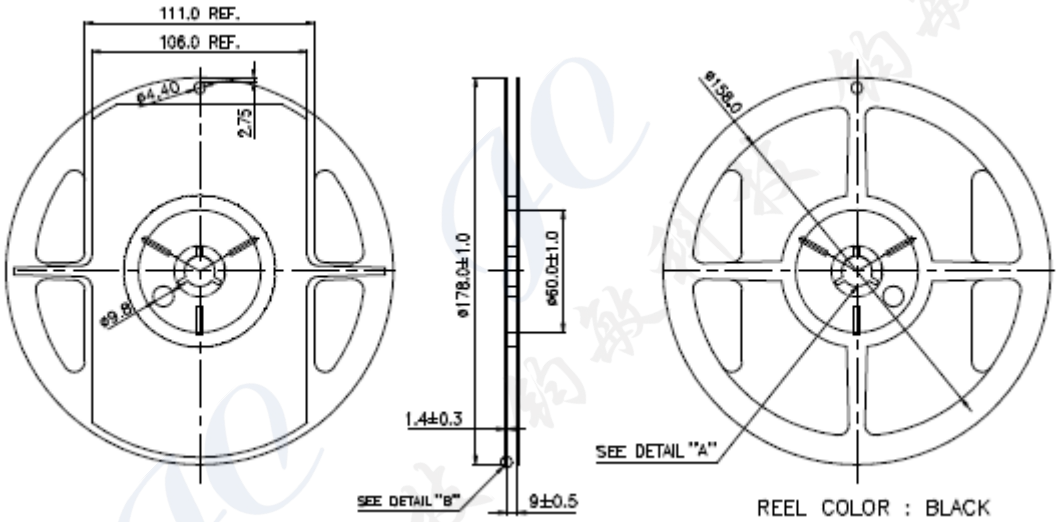


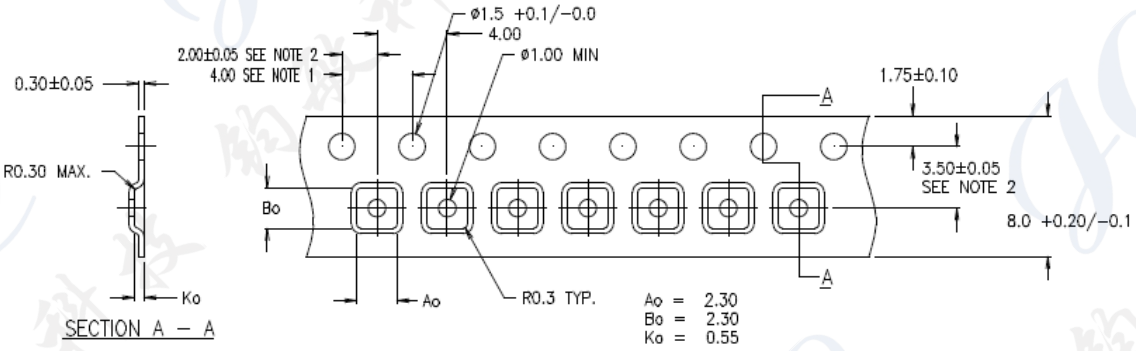
USER DIRECTION OF FEED

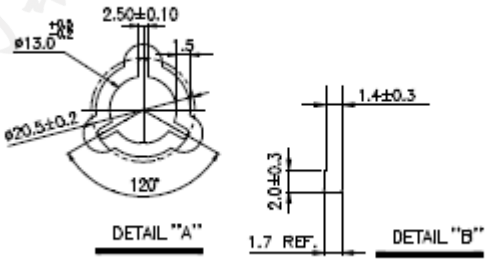


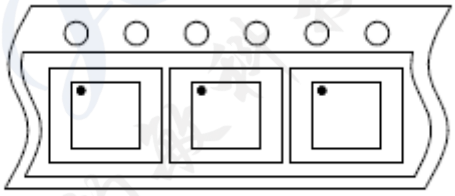
TSOT−26 (F/P : 2.2mm 平腳)

DFN-8pin



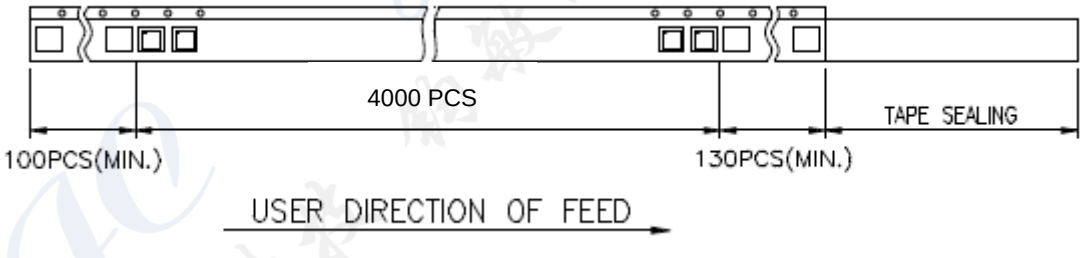






X2QFN 2.0X2.0X0.35mm

4000 EA/PER REEL



Ordering information

Product	Function Code	Temp. Code(Tj)	Package Code
PT392V-A	FG	A(-40°C~+150°C)	GD(TSOT-6L, Forward)
PT392V-A	FG	A(-40°C~+150°C)	HE(DFN-8L, Forward)

Please issue order Part No. like: **PT392V-AFGAGD or PT392V-AFGAHE.**