PROLIFIC TECHNOLOGY INC.

PL392P-A
Single-phase Motor Pre-Driver with RD Output

Applications

- For Automotive DC brushless motor

Package: SOP-10F(strait pin)

4.9x3.9x1.4 (mm)

Features

- Built-in hall sensor
- Single phase full wave pre-driver
- Motor locked protection and automatic restart
- RD output
- Current limit
- Soft start function
- Built-in hysteresis comparator
- Built-in zener diode
- High balance and low thermal drift magnetic sensing
- Under voltage lock out protection
- RoHS compliance

Specifications

Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Conditions	Rating	Units
Maximum supply voltage	V_{DDmax}		20	V
Allowable power dissipation	Pd		833*1	mW
Operating temperature range	Ta		-40~+125	℃
Storage temperature	Ts		-50~+150	℃
Max. high side output voltage(O1P,O2P)	V_{HOMAX}		40	V
Max. low side output voltage(O1N,O2N)	V_{LOMAX}		20	V
Max. output current (O1P,O2P,O1N,O2N)	I_{OMAX}		50	mA
Max. RD output voltage	V_{RDMAX}		20	V
Max. RD output current	I_{RDMAX}		10	mA
Max. input voltage(SS)	V_{INMAX}		6	V
VREF driving capability	I_{VREF}		5	mA
Junction Temperature	T_{JMAX}		150	℃

*1: Reduced by 6.67mW for each increase in Ta of 1°C over 25°C When mounted on 50mm x 50mm x 1.6mm glass epoxy board

PROLIFIC TECHNOLOGY INC.
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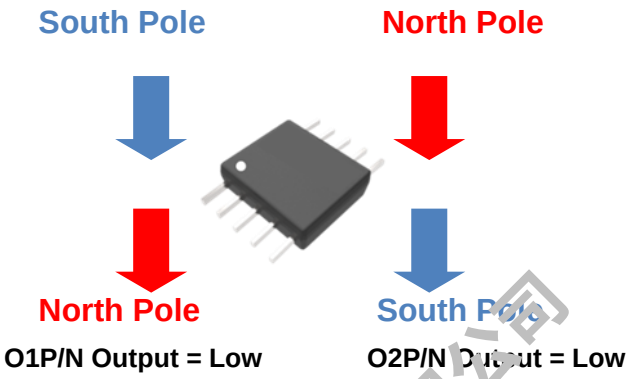
Electrical Characteristics (T_A=25°C, V_{DD}=12V)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Units
Supply Voltage	V_{DD}		3.8		18	V
High side output current	I_{HS}	V_{OH}=12V	9	12	15	mA
Low side output High Voltage	$V_{OH(ON)}$	@ I_{OLUT}=10mA	V_{DD}-0.7	V_{DD}-0.4		V
Low side output Low Voltage	$V_{OL(ON)}$	@ I_{OUT}=10mA		0.4	0.7	V
Output Breakdown Voltage	V_{BV}		36			V
Supply Current	I_{DD}	Output open		6	10	mA
RD output voltage	V_{RD}				18	V
RD sink voltage	V_{DSRD}	R_{FG}=4.7K		0.2	0.3	V
VREF Voltage	V_{REF}	I_{REF}=-2mA	3.6	3.8	4.0	V
SS Voltage	V_{SS}		GND		VREF	V
SS discharge current	I_{SS}	V_{SS}=1V		0.5		uA
Current limit Voltage	V_{CL}		220	250	280	mV
Shutdown Time	T_{SD}		2.8	4.2	5.6	S
Restart Time	T_{RS}		0.2	0.3	0.4	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}		10	30	60	G

Truth Table

Parameter	Condition	O1P	O1N	O2P	O2N	RD	Mode
South Pole to Marking side	B>Bop	L	L	H	H	L	During rotation
North Pole to Marking side	B<Brp	H	H	L	L	L	



General Specifications

The PL392P is a single phase full wave driving motor pre-driver IC with built-in high sensitivity Hall sensor. The built-in dynamic offset cancellation of pre-amplifier stage achieves optimal symmetrical magnetic sensing. The pre-driver provides the controls and driving of High/Low side power MOSFET of motor. This IC is an optimal solution for widely DC brushless fan motor application.

Lock Protection

In order to protect the motor, the pre-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 pre-driver's output state.

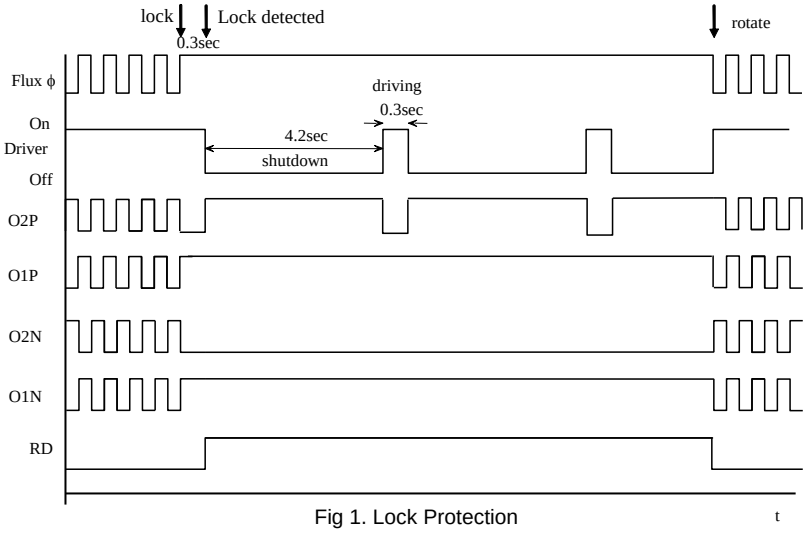


Fig 1. Lock Protection

Soft-Start function

The motor could be smoothly start-up when SS pin connecting a capacitor between VREF and SS pin. The Soft start function is released when the SS Voltage is lower than 0.5V. Therefore the soft-start timing changes depending on the capacitance of the soft-start setting capacitor. If the soft start function is not used, keeps this pin floating.

Current limit

This diver IC has built-in current limit function to protect Fan motor. The output current limit is activated when the current sensing voltage CS detected from RNF resistor exceeds 250mV (typical). The value of current limit is got by the formula 250mV/RNF. Example, the maximum output current is limited at 1A when the current detecting resistor RNF is 0.25ohm. The value of current limit is adjustable to meet different need by RNF changing. If the RNF=1ohm, the value of current limit is 250mA.

Current Limit (A) = 0.25(V) / RNF(Ω)

Low-pass filter constituted by R1,C1 could smooth RNF signal but also increase limit error due to sensing delay. R1,C1 value shall be decided first and match with coils. Then, adjust RNF resistor value to obtain ideal current limit value.

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.

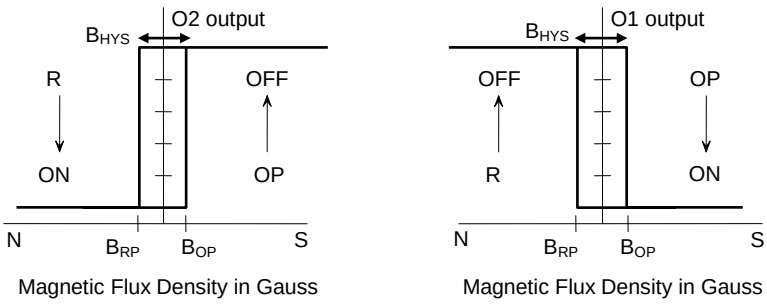


Fig 2. Magnetic Hysteresis Characteristics

The Pre-driver IC architecture block diagram is shown in Fig. 3.

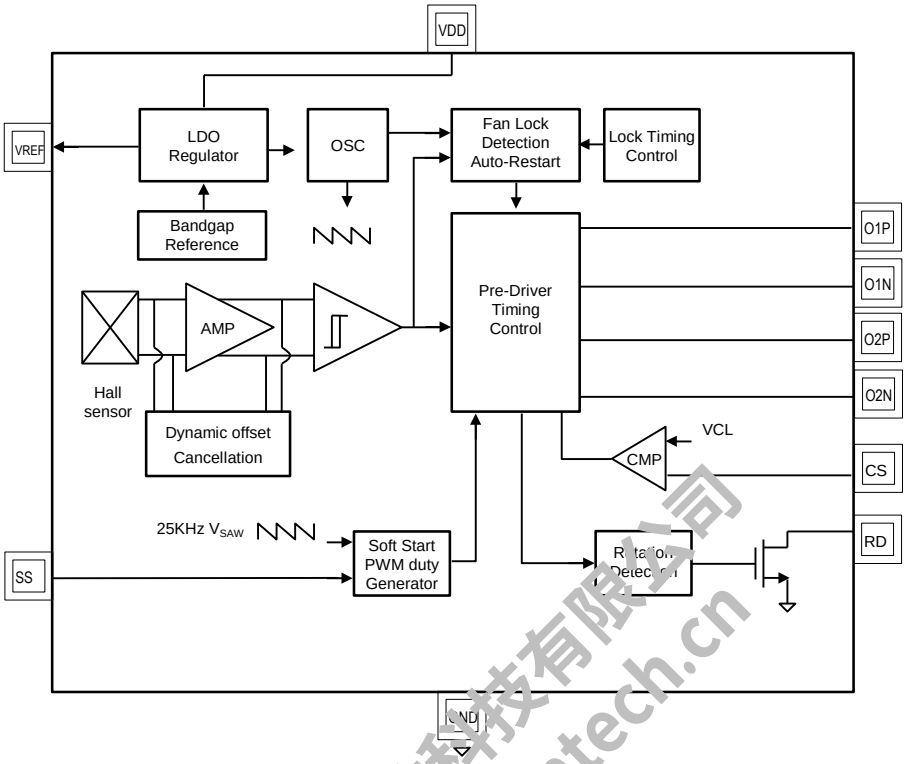
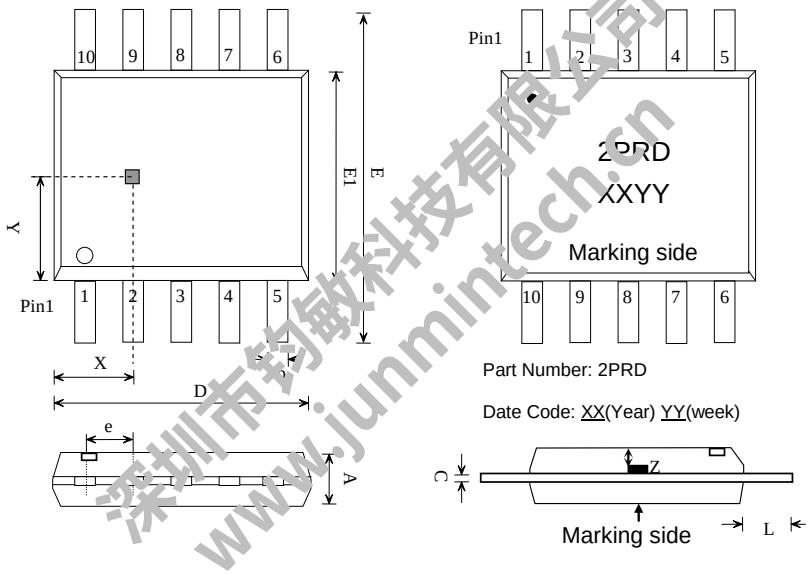


Fig3. Pre-Driver IC Architecture

Pin Description

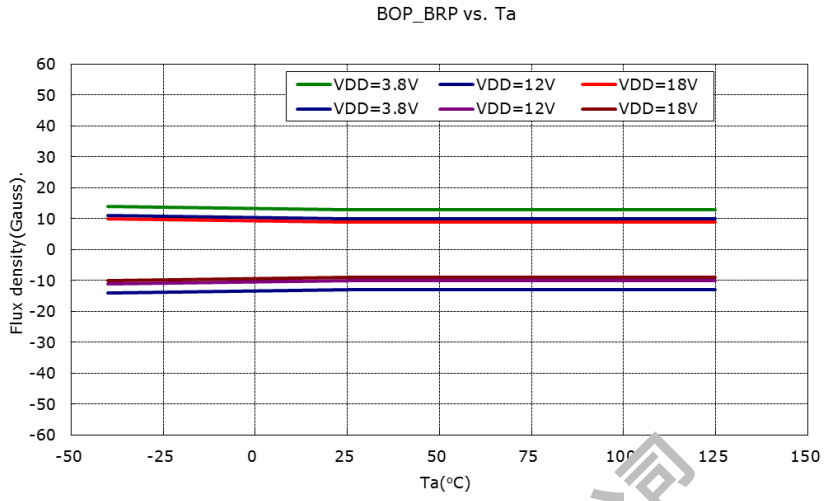
Name	Pin	Description	Type
VREF	1	Reference voltage output	O
O1N	2	First low side output pin	O
O1P	3	First high side output pin	O
SS	4	Soft Start Setting pin	I
GND	5	Ground pin	P
O2P	6	Second high side output pin	O
CS	7	Current sensing input	I
O2N	8	Second low side output pin	O
RD	9	RD Output pin	O
VDD	10	DC power supply	P

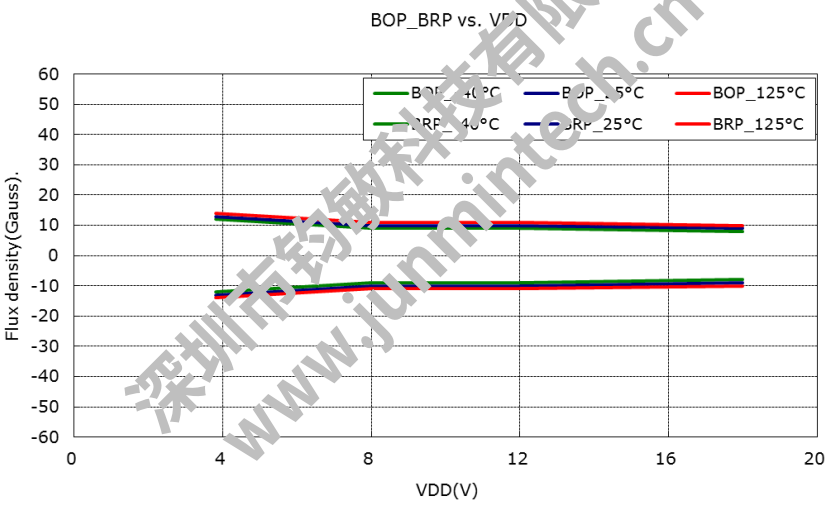
Package specification

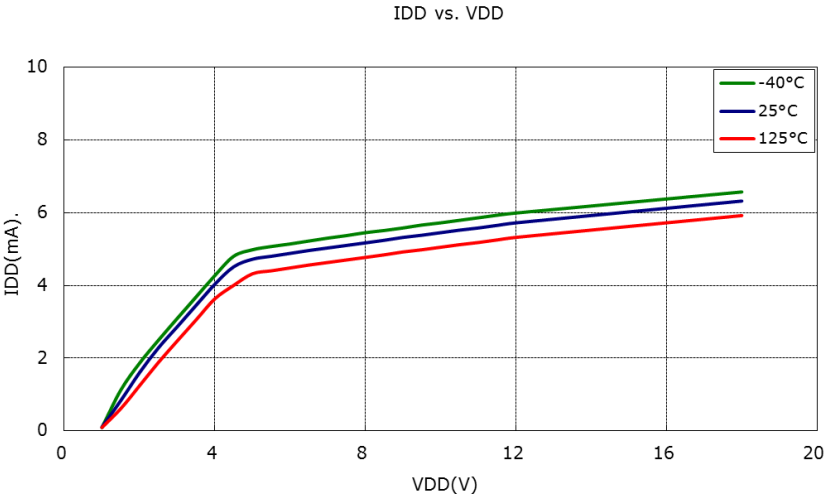


SYMBOLS	DIMENSIONS IN MILLIMETERS(mm)		
	MIN	NOM	MAX
A	1.25		1.50
b	0.30		0.45
C	0.10		0.25
D		4.90	
E	5.95		6.05
E1		3.90	
e	-	1.00	-
L	1.00	-	1.10
SENSOR LOCATION			
X	1.30	1.50	1.70
Y	1.65	1.85	2.05
Z	0.31	0.35	0.39

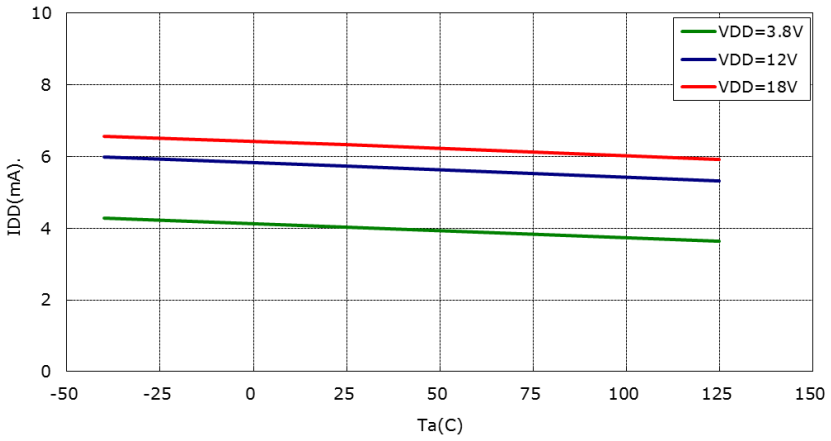
Performance curve



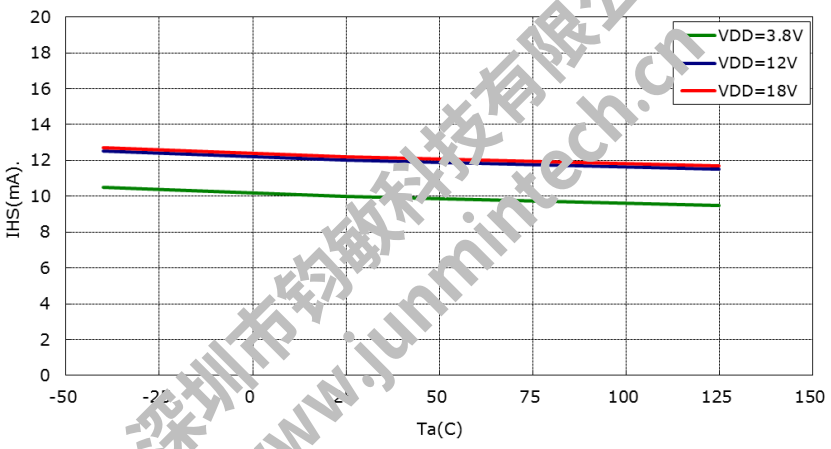




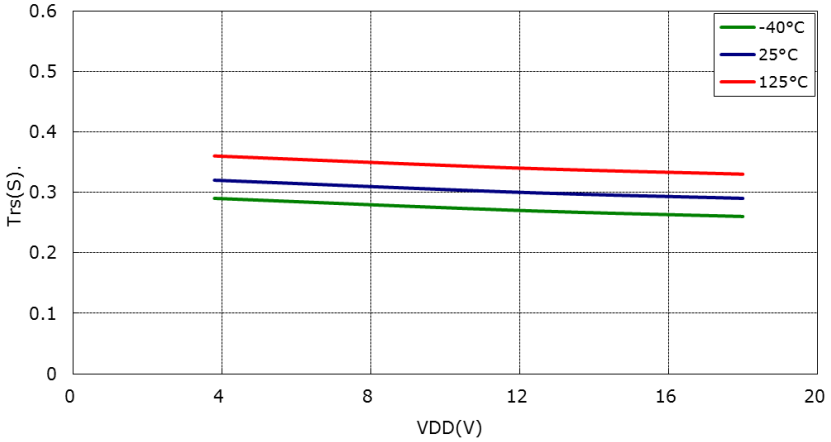
IDD vs. Ta



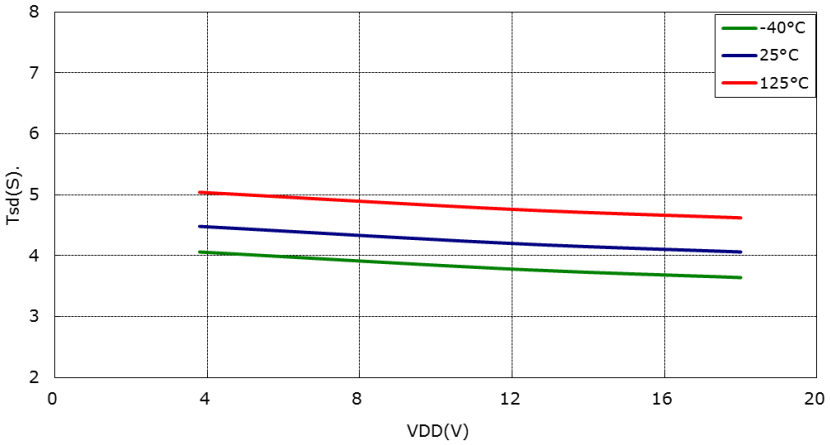
IHS vs. Ta



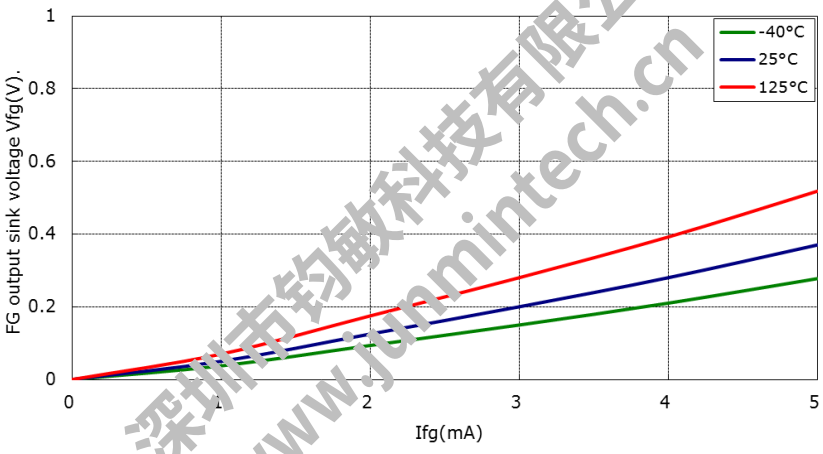
Lock Trs vs. VDD



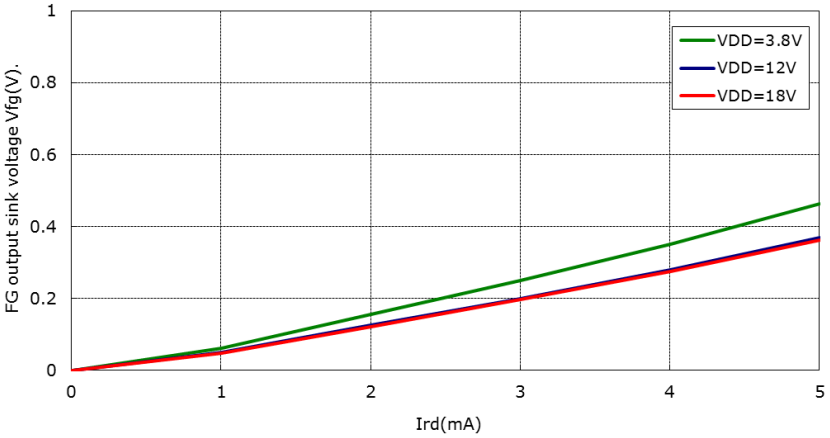
Lock Tsd vs. VDD



RD output sink voltage Vfg vs. Ird (VDD=12V)

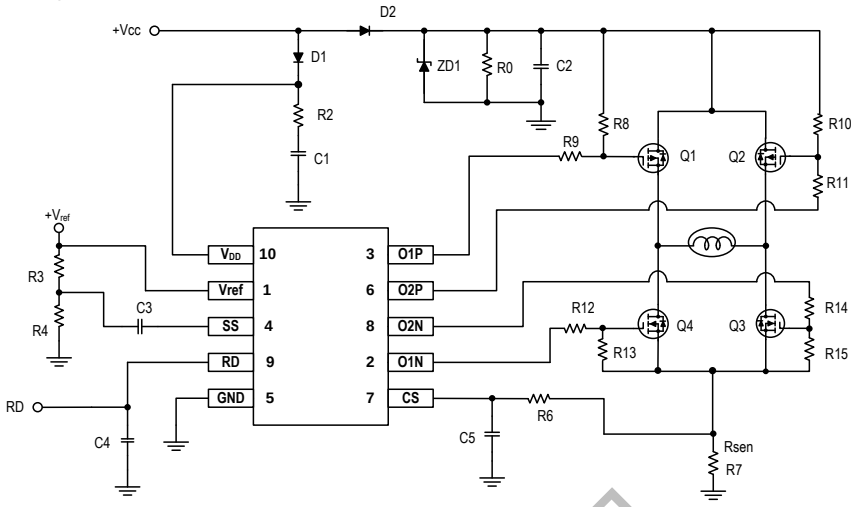


FG output sink voltage vs. Ird (Ta=25C)



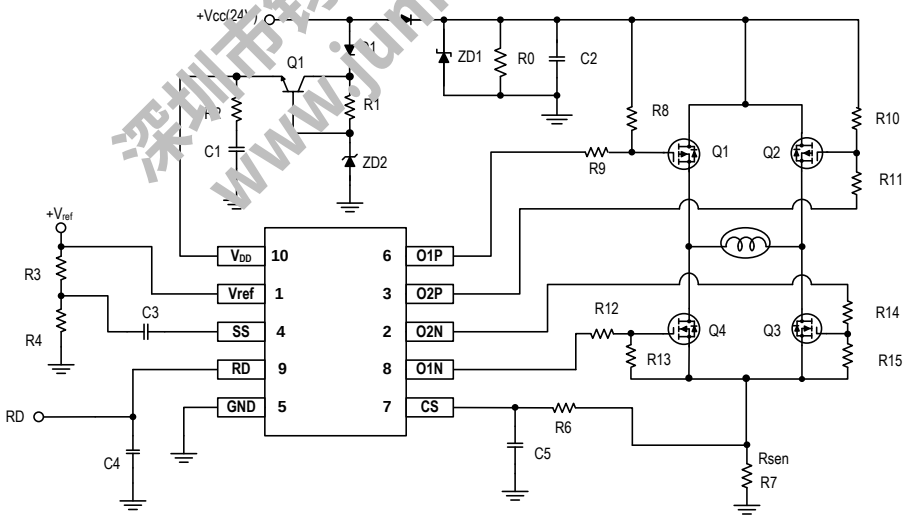
Application circuits

12V power supply



R0: C2 Discharger resistor ;(option)
C1: decoupling capacitor 0.1uF ~ 1uF
R2: Snubber circuit resistor 3.3ohm~10ohm
R7(RNF): Current sensing resistor (ex. 0.25ohm for 1A current limit)
R6, C5: Low pass filter (ex. C1=1n~0.01uF, R1=1K~10K; need to match with coil)
R9, R11, R12, R14: MOSFET slew rate adjustment, 0~100ohm
R13, R15: NMOSFET gate stabilization, 4.7K ~15Kohm
C4: 0.001uF(Option)
R8, R10: PMOSFET Bias, 560~1Kohm
ZD1: recommend 30V Zener Diodes(option)
C2: Back EMF filter 1uF~2.2uF

24V power supply



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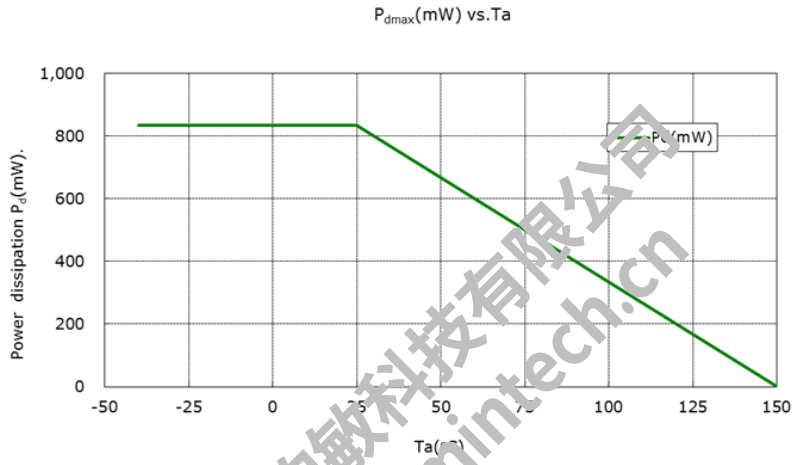
C4: 0.001uF(Option)
R8, R10: PMOSFET Bias, 560~1Kohm
ZD1: recommend 30V Zener Diodes
ZD2:12V or 15V Zener Diodes
C2: Back EMF filter 1uF~2.2uF

Thermal resistance

Parameter	Symbol	Conditions	Rating	Units
Allowable power dissipation	P_d		833*1	mW
Junction to ambient thermal resistance	θ_{JA}	2s0p PCB, still-air	150	℃/W
Junction to case thermal resistance	θ_{JC}		50	℃/W
Maximum junction temperature	T_{Jmax}		150	℃

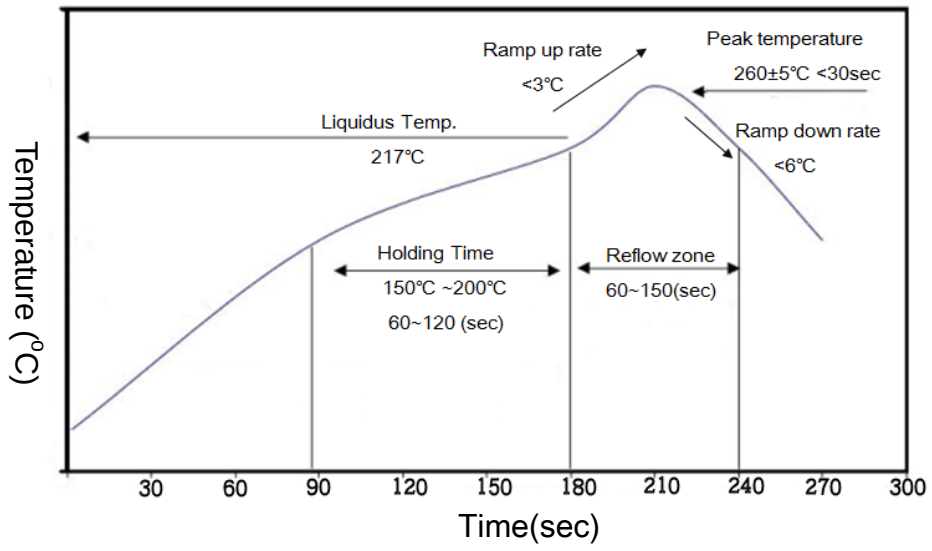
*1: Reduced by 6.67mW for each increase in Ta of 1°C over 25°C When mounted on 50mm x 50mm x 1.6mm glass epoxy board



Soldering recommendations

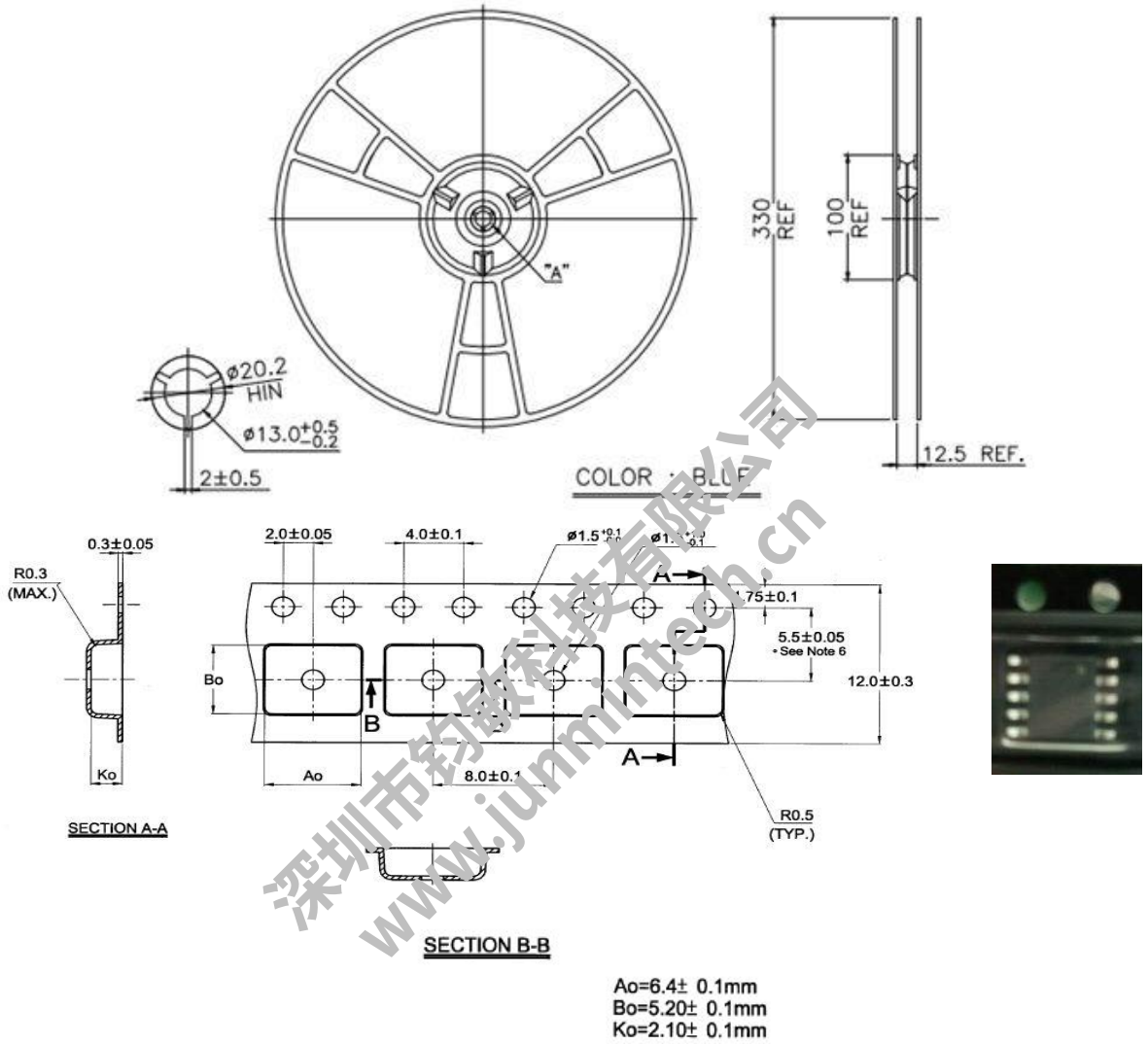
1. JEDEC J-STD-20
2. Iron Soldering
   Temperature and Time: 350°C, 3S
3. Reflow

Temperature profile should conform to described in JEDEC-020 standard

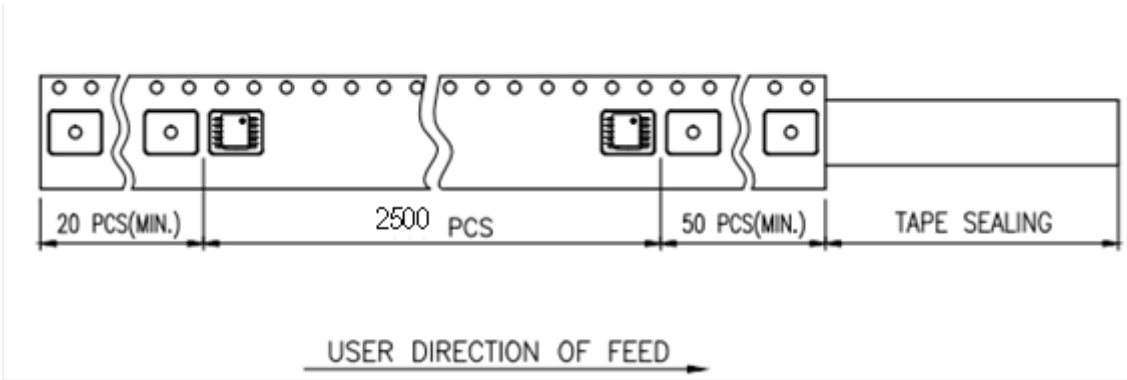


Packing specification

SOP-10F



Ao=6.4± 0.1mm
Bo=5.20± 0.1mm
Ko=2.10± 0.1mm



Order information

Product	Temp. Code	Package Code	MOQ
PL392P-ARD	K(-40°C~+125°C)	PR(SOP-10F, Reversed)	12.5K EA/BOX

Please issue order Part No. like : **PL392P-ARDKPR.**

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