



# PL396V-A

## Single-phase Smart Fan Driver

### PWM speed control

### Applications

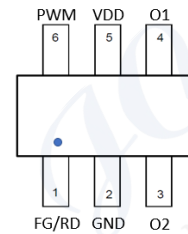
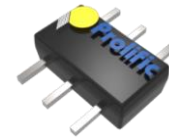
- Automotive cooling fan

### Features

- Built-in high sensitivity(10G) hall sensor
- PWM/DC voltage speed control
- PWM open loop and closed loop speed control
- PWM programmable speed curve
- PWM Soft Switching silent control option
- Kickback commutation control and Low EMI
- Soft Start control
- Lead/Lag angle control
- FG/RD open drain output
- Quick start
- Protections
  - Locked protection and automatic restart
  - Current limit/Over current/Short circuit protection
  - Over temperature protection
  - Jump start/load dump/Over voltage protection
- Built-in Zener diode
- High balance and low thermal drift magnetic sensing
- Low power consumption and high driving efficiency
- I2C programming
- AEC Q100 QTP

### Package:

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



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

Parameter	Symbol	Conditions	Rating	Units
Supply voltage	V <sub>DD</sub>		-0.3~40	V
Max. output voltage (O1, O2)	V <sub>OMAX</sub>		-0.3~V <sub>DD</sub> +0.3	V
Max. output current (O1, O2)	I <sub>OMAX</sub>		I <sub>ocp</sub>	mA
Max. FG/RD output voltage	V <sub>FG/RD MAX</sub>		-0.3~30	V
Max. FG/RD output current	I <sub>FG/RD MAX</sub>		10	mA
Max. input voltage (PWM)	V <sub>INMAX</sub>		-0.3~30	V
Junction temperature range	T <sub>j</sub>		-40~165	°C
Storage temperature	T <sub>s</sub>		-55~165	°C

\*1: Should not exceed Pdmax

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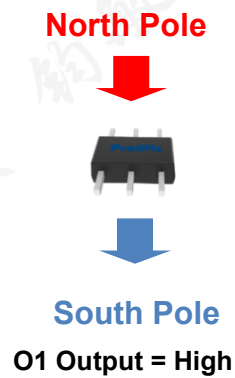
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**Electrical Characteristics** ( $T_J=25^{\circ}\text{C}$ ,  $V_{DD}=12\text{V}$ ; unless otherwise noted)

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Units
Supply Voltage	$V_{DD}$		3.2		32*	V
Over Voltage Protection threshold	$V_{OVpx}$	In $V_{DD}$ rising OTP setting		17~35		V
Over Voltage Protection Hysteresis	$V_{OVp\_Hys}$	In $V_{DD}$ falling		1		V
Over Current Protection	$I_{OCP}$		1.6	1.8	2	A
Over Current de-bounce time	$t_{OCD}$			0.5		$\mu\text{s}$
Output On Resistance (High side+ Low side)	$R_{DS(ON)}$	$T_J=25^{\circ}\text{C}$ , $V_{DD}=12\text{V}$ , $I_O=0.5\text{A}$	1	1.5	2	ohm
		$T_J=25^{\circ}\text{C}$ , $V_{DD}=3.5\text{V}$ , $I_O=0.3\text{A}$	1.1	1.7	2.6	ohm
		$T_J=150^{\circ}\text{C}$ , $V_{DD}=12\text{V}$ , $I_O=0.5\text{A}$		2.2		ohm
Supply Current	$I_{DD}$	Output open		3.5	5	mA
FG(SDA) input H voltage	$V_{IHSDA}$	I2C mode	2			V
FG(SDA) input L voltage	$V_{ILSDA}$	I2C mode	GND		0.5	V
FG/RD output sink voltage	$V_{DSFG/RD}$	$I_{FG/RD}=5\text{mA}$		0.1	0.3	V
FG/RD output leakage current	$I_{FG/RD\_Leak}$	$V_{FG}=12\text{V}$		0.1	1	$\mu\text{A}$
PWM digital input H voltage	$V_{IHPWM}$		2			V
PWM digital input L voltage	$V_{ILPMM}$		GND		0.5	V
PWM input frequency	$f_{PWI}$		0.03		100	KHz
PWM input current	$I_{PWM}$	$V_{PWM}=0\text{V}$	-200	-150	-100	$\mu\text{A}$
PWM analog input voltage range (0%~100%)	$V_{SP}$	VSP mode	0.5		2.4	V
PWM output frequency	$f_{PWO}$		20	25	30	KHz
Current limit	$I_{CLx}$	OTP setting		250~1050		mA
Current limit de-bounce time	$t_{CLD}$			1.5		$\mu\text{s}$
Lock detection time	$T_{LOCK}$	OTP setting	0.32		1.6	S
Lock protection on time	$T_{ON}$	OTP setting	0.16		1.28	S
Lock protection off/on ratio	$T_{OFF}/T_{ON}$	OTP setting	6		20	-
Thermal Protection Temperature	$T_{JTSd}$	In temperature rising		165		$^{\circ}\text{C}$
Thermal Protection Hysteresis	$\Delta T_{TSd}$	In temperature falling		25		$^{\circ}\text{C}$
<b>Magnetic Characteristics</b> ( $T_J=25^{\circ}\text{C}$ , $V_{DD}=12\text{V}$ , unless otherwise noted)						
Operate Point	BOP		5	10	25	G
Release Point	B <sub>RP</sub>		-25	-10	-5	G
Hysteresis	B <sub>HYS</sub>		10	20	40	G

**Truth Table**

Parameter	Test Condition	O1	O2	Rotation Mode		Lock Mode	
				FG	RD	FG	RD
North Pole	B<Brp	H	L	L	L	H	H
South Pole	B>Bop	L	H	H	L	H	H



### General Specifications

The PL396V-A is a variable speed smart fan 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 PWM soft switching to eliminate acoustic noise. Further, the lead/lag angle commutation phase control to achieve optimal motor efficiency and EMI performance. PL396V-A is also featuring with jump start and load dump protection according to ISO16750-2. This IC is an optimal solution with PWM speed control for Automotive DC brushless fan motor application.

The Driver IC architecture block diagram is shown in Fig. 1.

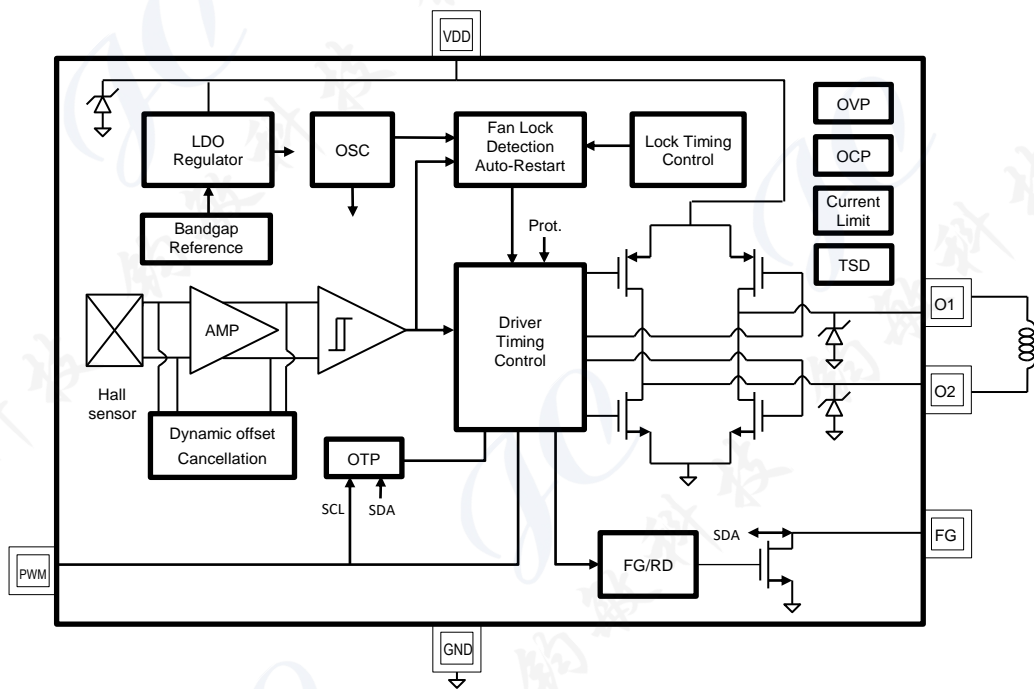


Fig1. Smart Fan Driver IC block diagram

### 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.

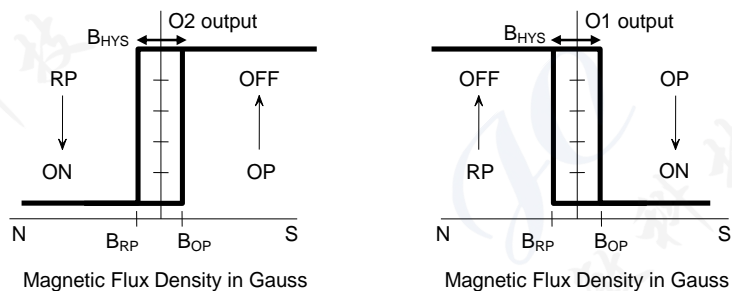
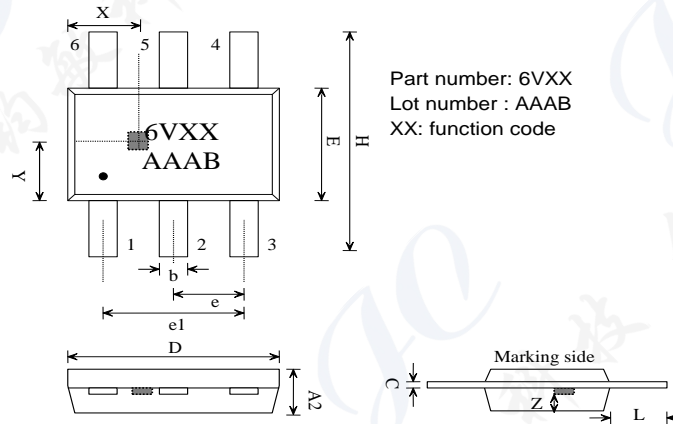


Fig 2. Magnetic Hysteresis Characteristics(Marking side)

## Pin Description and Package Information

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

NAME	Pin	Description
FG/RD(SDA)	1	FG/RD output pin; SDA: programming mode: Data I/O
GND	2	DC ground
O2	3	Second output pin
O1	4	First output pin
VDD	5	DC power supply
PWM(SCL)	6	PWM input pin; SCL: programming mode: Clock input.



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	2.80	2.90	3.00
E	1.50	1.60	1.70
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

### Thermal resistance

#### TSOT-6pin

Parameter	Symbol	Conditions	Rating	Units
Junction to ambient thermal resistance	$\theta_{JA\_1s0p}$	TSOT-6L, 1-layer PCB, JEDEC standard test board, still-air	240	$^{\circ}\text{C}/\text{W}$
Junction to case thermal resistance	$\theta_{JC}$		15	$^{\circ}\text{C}/\text{W}$
Junction to ambient thermal resistance	$\theta_{JA\_2s0p}$	TSOT-6L, 2-layer PCB, JEDEC standard test board, still-air	180	$^{\circ}\text{C}/\text{W}$
Junction to case thermal resistance	$\theta_{JC}$		15	$^{\circ}\text{C}/\text{W}$





**Revision history table**

Revision Date	Description of Revision
2023/11/27	● First release.

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