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Flexible PWM Speed Control

Double Coil Brushless DC Motor

Pre-Driver

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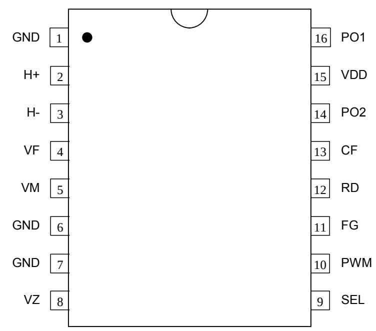
General Specifications

This IC is a two-phase, DC brushless fan motor pre-drive with pulse-width modulated (PWM) speed control. The fan speed is controlled by the external PWM command, with an adjustable fan speed versus PWM duty cycle relationship. Soft-start circuitry is included to eliminate excessive inrush driving current occurring during the start-up of the fan. Additionally, this device has various functions, such as setting minimum speed, tachometer signal generation, locked-rotor alarm, lock protection and self-restart.

Features and Benefits

- PWM fan speed control with adjustable speed curve
- Built-in soft-start circuitry to prevent excessive inrush driving current
- Directly connectable to a HALL effect sensor
- Lock protection and automatic self-restart
- Open-drain tachometer signal output
- Open-drain lock alarm output
- Highly reliable, small package (SSOP-16)

Pin Assignment



Pin Descriptions

Pin No.	***Pin Name***	***Signal Type***	***Description***
1, 6, 7	GND	Ground	Ground
2	H+	Analog Input	Hall Input
3	H-	Analog Input	Hall Input
4	VF	Analog Input	Declare for Full duty
5	VM	Analog Input	Declare for Minimum duty
8	VZ	Analog Input	Declare for Zero duty
9	SEL	Digital Input	GND:Keep minimum speed. VDD:Stop.
10	PWM	Digital Input	PWM control input
11	FG	Open Drain	Fan tachometer output
12	RD	Open Drain	Locked-rotor alarm
13	CF	Analog Input	Input noise filtering
14	PO2	Analog Output	Output pre-driver 2
15	VDD	Power	Supply voltage
16	PO1	Analog Output	Output pre-driver 1

Absolute Maximum Ratings (Unless otherwise noted, VDD=12V, T_A = 25 °C)

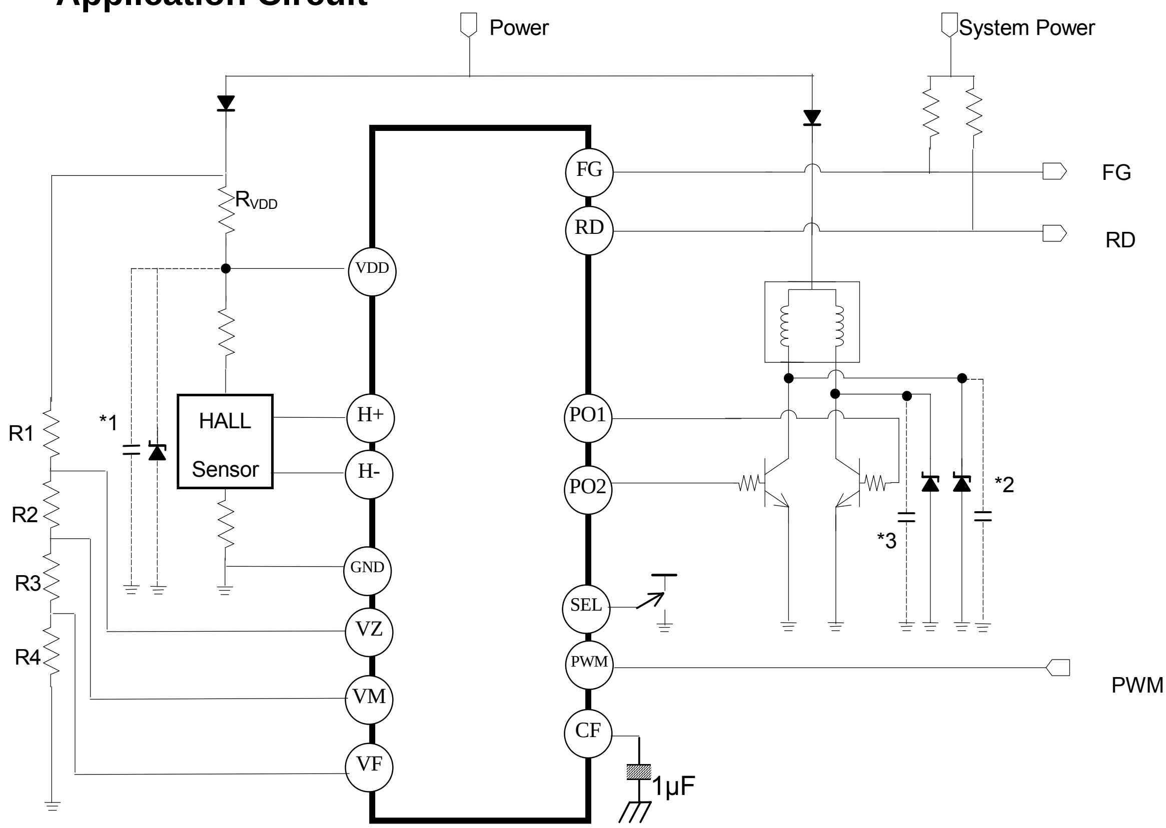
Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DD}	15	V
Input Voltage	V_{IN}	V_{DD}+0.4	V
PO1/PO2 Output Current	I_{OUT}	100	mA
FG/RD Output Current	I_{FG_RD}	10	mA
FG/RD Output voltage	V_{FG_RD}	15	V
Power Dissipation	P_D	0.68	W
Operating Temperature Range	T_A	-40 ~ 125	°C
Storage Temperature Range	T_S	-65 ~ 150	°C
Operating Junction Temperature	T_J	150	°C
Thermal Resistance, Junction to Ambient	θ_{JA}	120	°C/ W
Thermal Resistance, Junction to case	θ_{JC}	52	°C/ W

Electrical Characteristic

(Unless otherwise noted, VDD=12V, T_A = 25 °C)

Characteristic	Sym.	Condition	Limit			Unit
			Min.	Typ.	Max.	
Supply Voltage	V_{DD}	Operating	4	12	15	V
Quiescent Current	I_{DD}	No load, All Inputs = 0V or V_{DD}	-	5	10	mA
H+/H- Common-mode input range	V_{ICR}	-	1	-	V_{DD}-1	V
H+/H- Hall comparator input offset voltage	V_{IL}	-	-7	-	7	mV
H+/H- Hall comparator input bias current	I_{IH}		-	1	3	μA
PO1/PO2 Output Voltage High	V_{OH}	I_{OUT} = 60mA	11	11.3	-	V
PO1/PO2 Output Voltage Low	V_{OL}	I_{OUT} = 60mA	-	0.2	0.5	V
FG/RD Leakage Current	I_{Leak}	$V_{RD/FG}$ = 12V	-	0.1	5	μA
FG/RD output voltage Low	V_{FROL}	$I_{RD/FG}$ = 5mA	-	0.2	0.4	V
FG/RD Output Voltage High	V_{FROH}	-	-	-	15	V
PWM Input Voltage Low	V_{PWML}	V_{DD}= 5V or 12V	- 0.4	-	1.0	V
PWM Input Voltage High	V_{PWMH}	V_{DD}= 5V or 12V	2	-	V_{DD}+ 0.4	V
PWM input bias current	I_{PWM}		-15	-	1	μA
VZ/VM Input bias current	I_{bias}		-1	-	1	μA
VF Input bias current	I_{biasF}		-2	-	2	mA
SEL Input Voltage Low	V_{SELL}		- 0.4	-	0.25*V_{DD}	V
SEL Input Voltage High	V_{SELH}		0.6*V_{DD}	-	V_{DD}+ 0.4	V
SEL Input bias current	I_{bias}		-1	-	1	μA
On Time	T_{ON}		400	500	600	ms
Duty Ratio	R_{DR}	T_{OFF} / T_{ON}	6	7	8	

Application Circuit



*1, *2, *3 : The Zener diode and capacitors will increase system stability, if required.

Figure 1.

Typical Relationship of Fan Speed and PWM Duty Cycle Curve

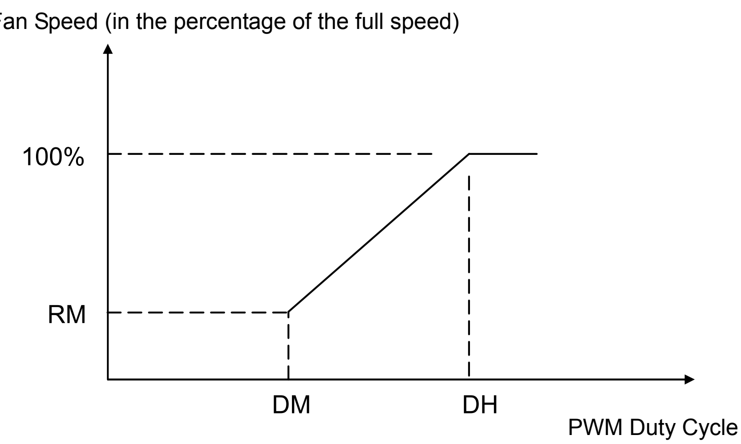


Figure 2. The Fan speed curve with PWM duty cycle.

Application Notes

1. The fan speed can be controlled by external PWM input signal. The fan speed curve can be adjusted by setting appropriate voltage levels of the pins SEL, VZ, VM and VF. The typical fan speed curve is shown in Figure.2, which indicates that the full speed is achieved when the duty cycle of the PWM is DH (maximum PWM input duty), and RM ratio of the full speed (say, 50%, for example) is achieved when the duty cycle is DM (minimum PWM input duty). As for the duty cycle below DM, the fan will either stop or keep rotating at the constant speed RM ratio of the full speed, depending on the voltage level of SEL (stop when SEL= VDD and keep rotating at a constant speed when SEL=GND).

SEL Voltage	Fan Speed (under the minimum PWM duty)
VDD	STOP
GND	Keep Minimum speed

2. The voltage setting of VZ, VM and VF determine DM, DH and RM. The input voltage of CF pin will determine the fan speed by controlling the duty of output terminals. The setting and relation of control voltage are shown in Figure 3.

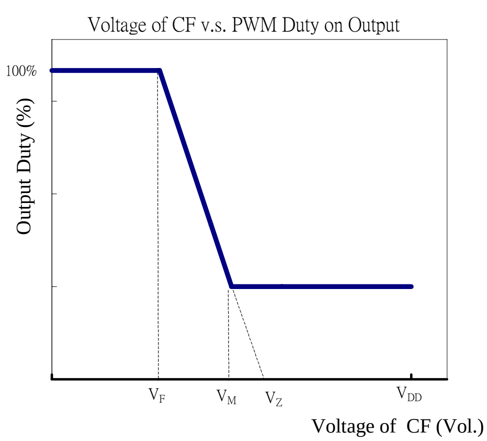


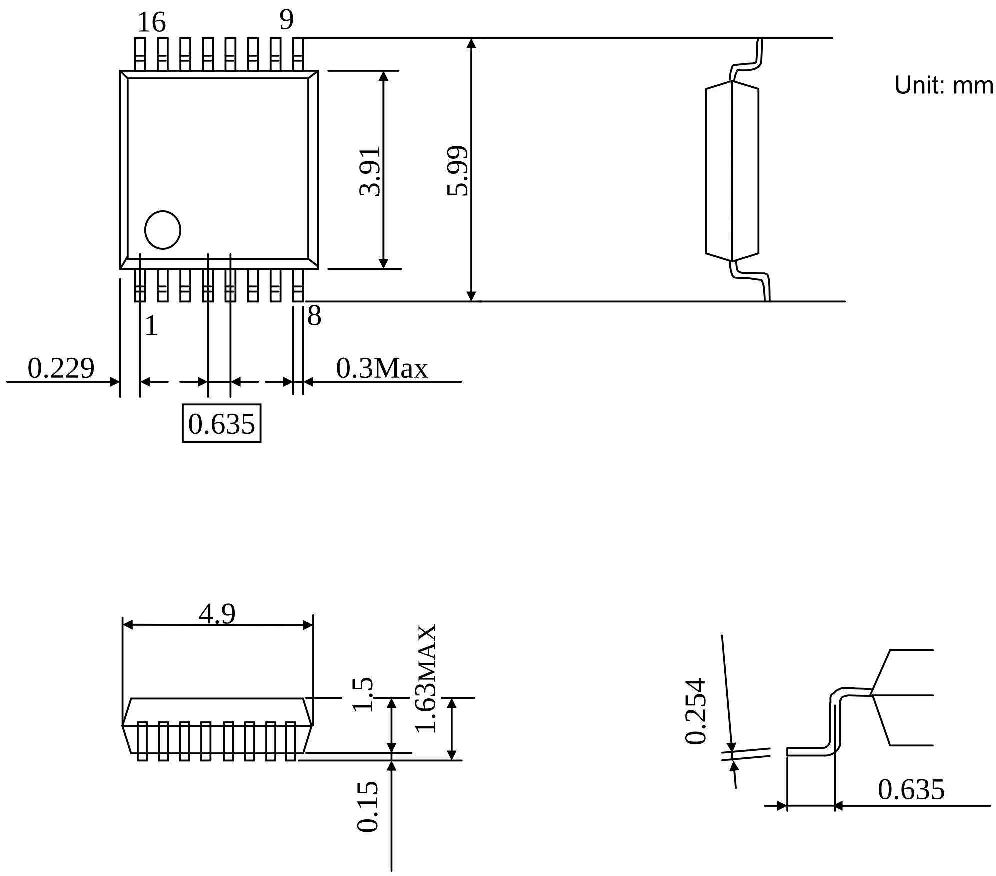
Figure 3. The relations of the voltage of VZ, VM, VF and PWM duty ratio on output terminal.

3. Roughly, the VZ, VM, VF can be expressed by the following equations:

$$VF = \frac{VDD}{K}(2 - D_{MAX}); \quad VM = \frac{VDD}{K}(2 - D_{MIN}); \quad VZ = \frac{VM - D_{MIN} \cdot VF}{1 - D_{MIN}}$$, where K is constant.

To get motor precision speed curve, the voltage setting of VF, VM and VZ must be refined with fan motor.

Package Specifications (SSOP-16)



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