FD178/FD178B/FD178C

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Single Coil Brushless DC Motor Drivers with

Soft-Switching and PWM control

(2.0 to 6.5 Volts)

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General Specifications

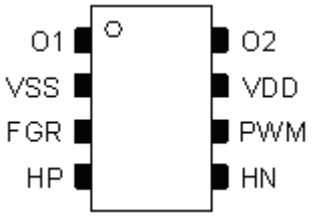
The device is a single coil DC brushless motor driver IC with soft-switch, PWM control, locked protection, thermal shut down protection circuit, power polarity reverse protection, frequency generator FG output for FD178, FG/2 output for FD178B, and rotating detector RD output for FD178C. The driver is optimal for single coil fan applications with less external components.

Features and Benefits

- Support single-phase full wave Brushless DC Motor Driver
- Built-in Hall sensor input signal amplifier
- PWM control circuit
- Low voltage startup (VDD=2.0V)
- High driving capability
- Lock detection and automatic self-restart
- Power polarity reverse protection
- Thermal shut down protection circuit
- Thin, compact, highly reliable package (TSOT-28)

Pin Description

FD178/FD178B/FD178C：TSOT-28



Package : TSOT-28

NO.	NAME	DESCRIPTION
1	O1	Output driving & sinking pin 1
2	VSS	Ground pin
3	FGR	Frequency generator or rotating detector FD178：FG FD178B：FG/2 FD178C：RD
4	HP	Hall sensor in+
5	HN	Hall sensor in-
6	PWM	PWM control pin
7	VDD	Power supply pin
8	O2	Output driving & sinking pin 2

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Absolute Maximum Ratings

(Unless otherwise noted, VDD=5V, T_A = 25 °C)

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DDM}	6.5	V
Output Current	I_{OUT}	500	mA
Output Current at Locked (TSOT-28)	I_{OL1}	1	A
Maximum FGR Output Current	I_{FGR_MAX}	10	mA
Maximum FGR Output Voltage	V_{FGR_MAX}	6.5	V
Operating Temperature Range	T_{OPR}	-30 ~ 85	°C
Storage Temperature Range	T_{STG}	-65 ~ 150	°C
Power Dissipation (TSOT-28)	P_D	568	mW
Thermal Resistance, Junction to Ambient	θJ_{A_TSOT28}	220	°C/ W
Thermal Resistance, Junction to Case	θ_{JC_TSOT28}	92	°C/ W

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Electrical Characteristics

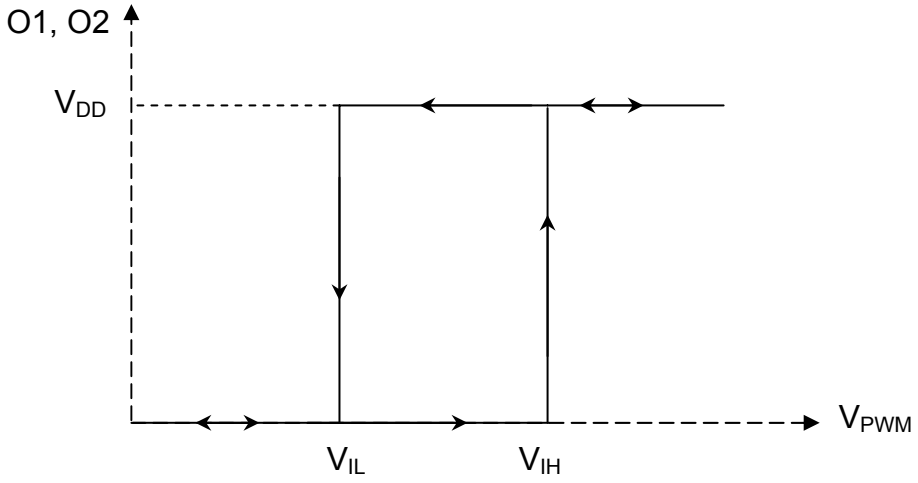
(Unless otherwise noted, VDD=5V, T_A = 25 °C)

Characteristic	Sym.	Condition	Limit			Unit
			Min.	Typ.	Max.	
Operation Voltage	V_{DD}	-	2	5	6.5	V
Supply Current	Icc	-		3	5	mA
Maximum Output Voltage Range	V_{OH}	I_{OUT} = 300 mA	4.5	4.65	-	V
Minimum Output Voltage Range	V_{OL}	I_{OUT} = 300 mA	-	0.35	0.5	V
FG Output Low Voltage	V_{FGROL}	I_{FGR}= 3 mA	-	0.25	0.4	V
Hall Amplifier Offset	V_{OffSet}	-	-9	0	9	mV
Input-Output Gain	G_{IO}	-	45	48	51	dB
Automatic self-restart						
Lock detection on Time	T_{ON}	-	110	150	190	ms
Lock detection off Time	T_{OFF}	-	0.75	1.05	1.35	Sec
PWM signal control						
PWM input frequency	V_{PWM}	-	-	25	50	KHZ
PWM input high level voltage	V_{IH}	-	$\frac{2}{3}V_{DD}$	-	V_{DD}	V
PWM input low level voltage	V_{IL}	-	0	-	$\frac{1}{3}V_{DD}$	V
Hall signal output						
Hall average output DC voltage	V_{DC}	-	400	-	-	mV
Hall amplitude of waveform voltage	VAmplitude	-	20	-	-	mV

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Truth Table

PWM	Hall input	O1	O2
L	X	L	L
H	HP > HN	H	L
H	HP < HN	L	H

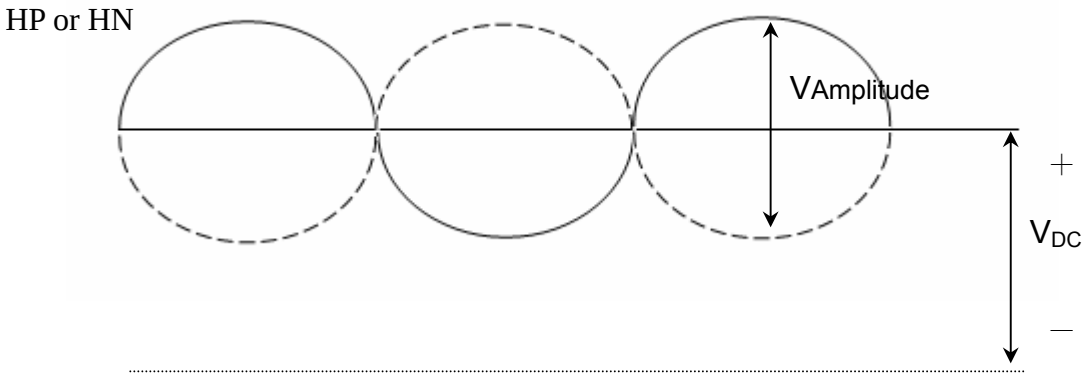


Hall Signal

□ In order to let FD178 normal work, two output signals of the Hall must satisfy the following two conditions：

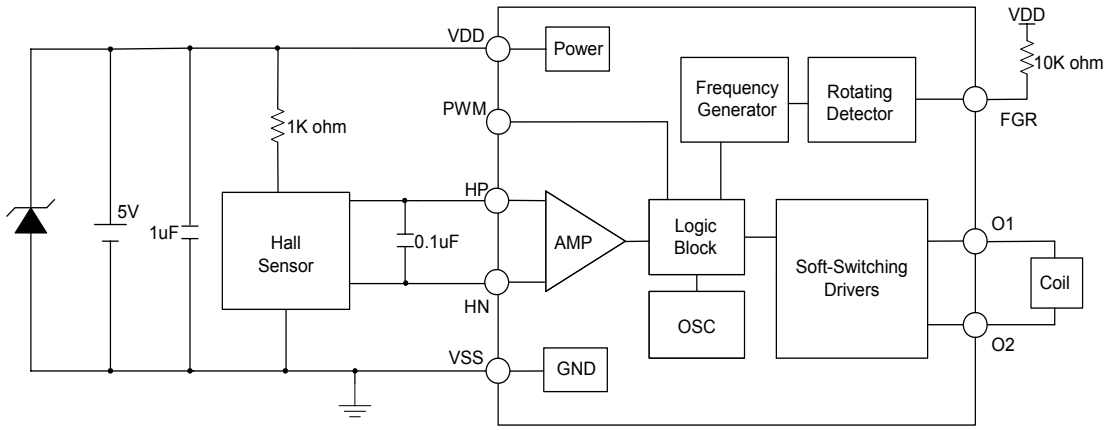
(a) Hall average output DC voltage, V_{DC}>400mV

(b) Hall amplitude of waveform voltage, $V_{Amplitude}$>20mV

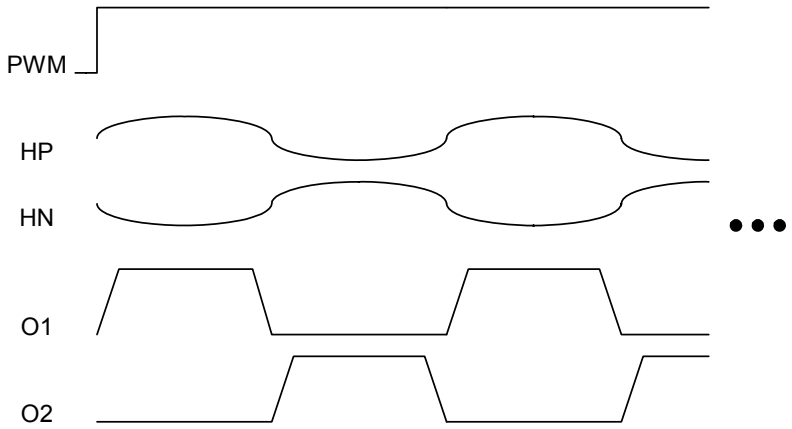


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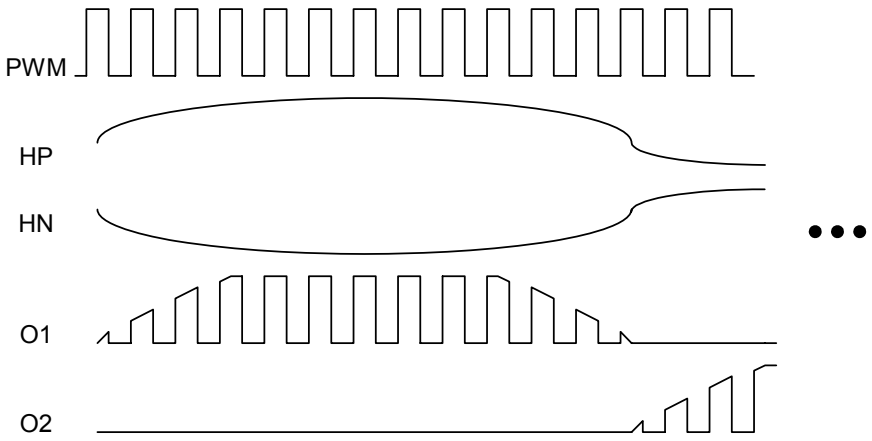
Application Circuit



Output Waveform



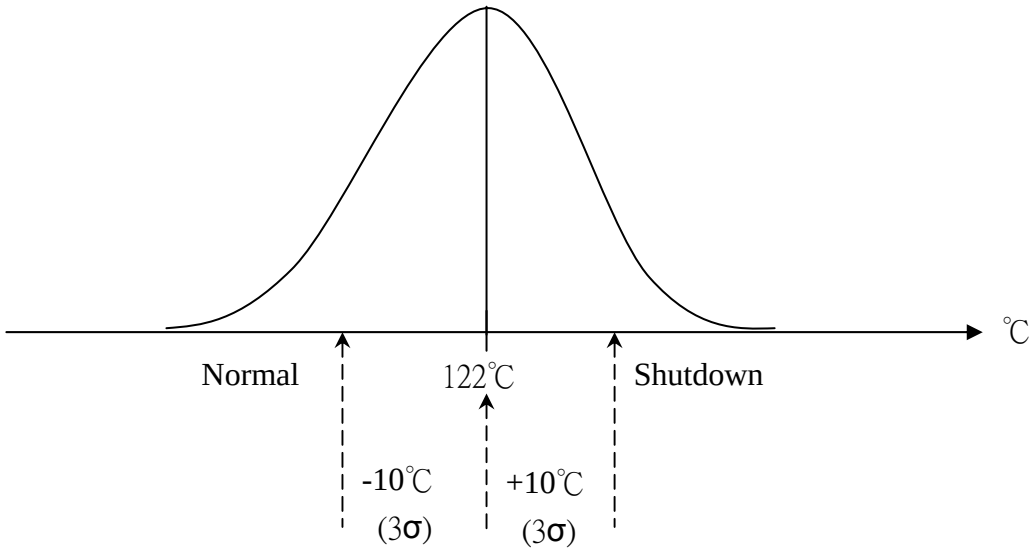
PWM control



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Thermal Shutdown

- The FD178 provides a temperature error detection circuit, once the temperature reaches approximately above 122°C, shutdown signal will cause the driver to shutdown all the outputs.

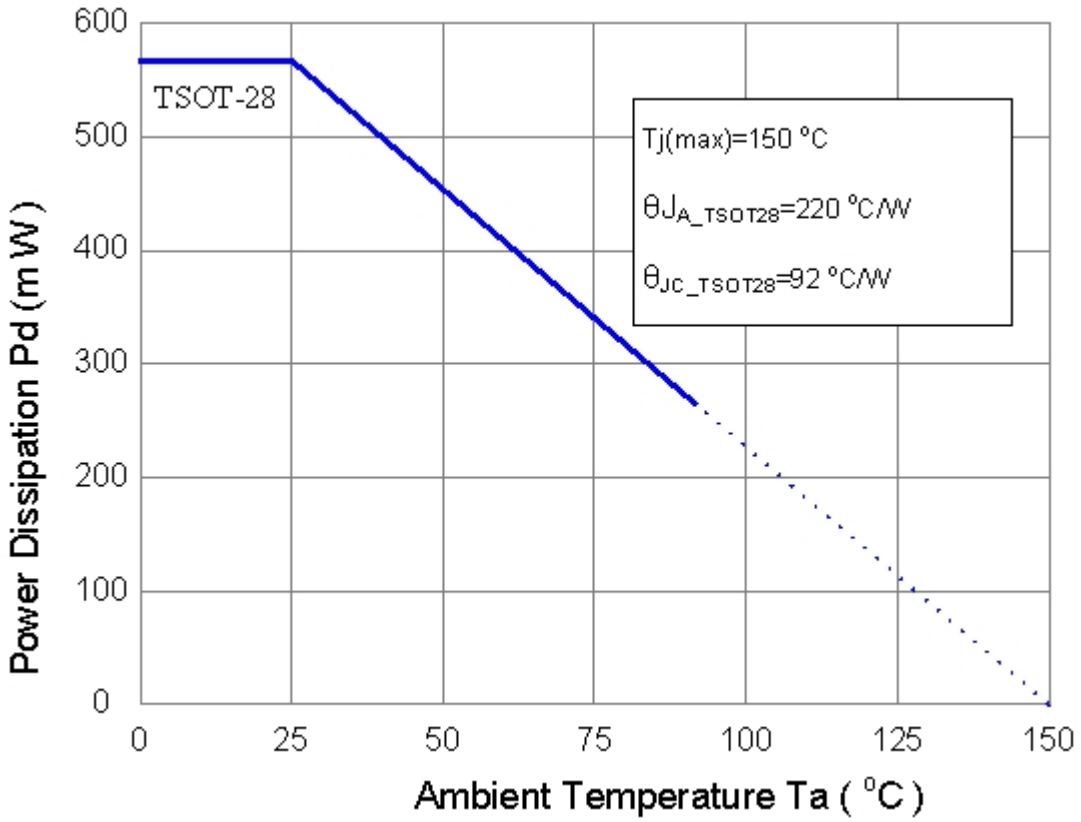


Application Notes

- The device is operated within wide supply voltage range from 2.0 to 6.5 Volts. The design, specifications and performance have been optimized for 5V brushless DC motor applications.
- The output driver node O1/O2 will be “turned to drive/sink” when V(HP) > V(HN). Similarly, the output O1/O2 will be “turned to sink/drive” when V(HP) < V(HN).
- The output frequency on **FGR** pin is the same frequency with hall switching for FD178, dividing the hall switching frequency with 2 for FD178B, and the rotating detection for FD178C.
- There is no need of external timing capacitor for lock protection and auto-restart function. For 5V application, the drivers will be shut down roughly 1 second after the motor is locked. When the drivers have been shut down, the automatic self-restart circuit will try to power up the drivers every 1 second until lock is released.

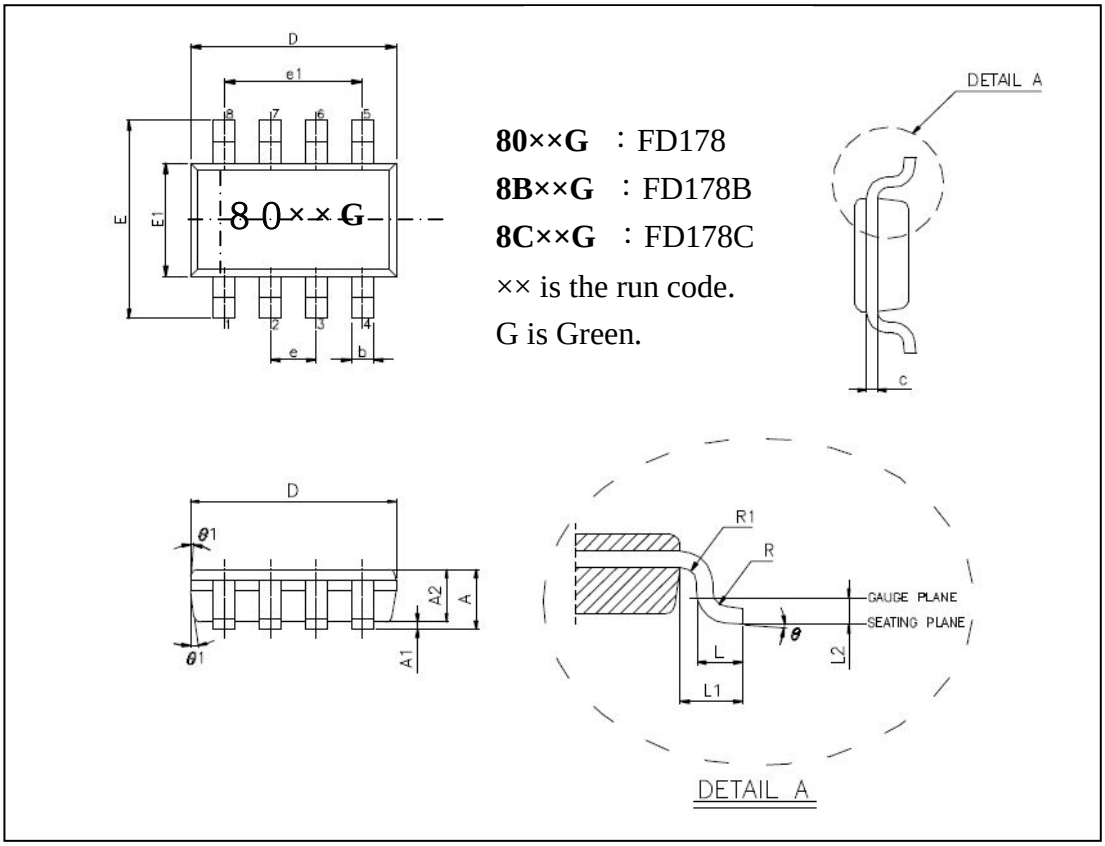
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- There is no requirement of protection diode for power reverse fault in normal applications. The power polarity reverse protection circuit is built-in.
- The connection of the capacitor 1uF between VDD and GND and the capacitor 0.1uF between Hall sensor HP and HN will increase the system stability when motor is rotating.
- The power dissipated by the IC varies widely with the supply voltage, the output current, and loading. It is important to ensure the application does not exceed the allowable power dissipation of the IC package. The recommended motor driver power dissipation versus temperature is depicted as follows:



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Package Specifications
FD178 : TSOT-28



80××G ：FD178
8B××G ：FD178B
8C××G ：FD178C
×× is the run code.
G is Green.

VARIATION(ALL DIMENSIONS SHOWN IN MM)

SYMBOL	MIN.	NOM.	MAX.
A	0.750	-	0.800
A1	0	-	0.050
A2	0.700	0.750	0.775
b	0.220	-	0.380
c	0.100	-	0.200
D	2.800	2.900	3.000
E	2.600	2.800	3.000
E1	1.500	1.600	1.700
e	0.650 BSC		
e1	1.950 BSC		
L	0.370	0.450	0.600
L1	0.600 REF		
L2	0.250 BSC		
R	0.100	-	-
R1	0.100	-	0.250
θ	0^o	4^o	8^o
θ1	4^o	10^o	12^o

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