

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)*



SITI

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General Specifications

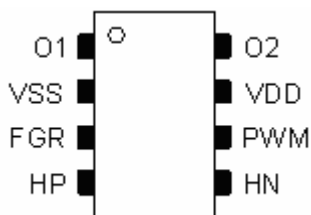
The device is a single coil DC brushless motor driver IC with soft-switch, PWM control, locked protection, thermal shut down protection circuit, power polarity reverse protection, frequency generator FG output for FD178, FG/2 output for FD178B, and rotating detector RD output for FD178C. The driver is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

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 | θ _{JA_TSOT28} | 220 | °C/ W |
| Thermal Resistance, Junction to Case | θ _{JC_TSOT28} | 92 | °C/ W |

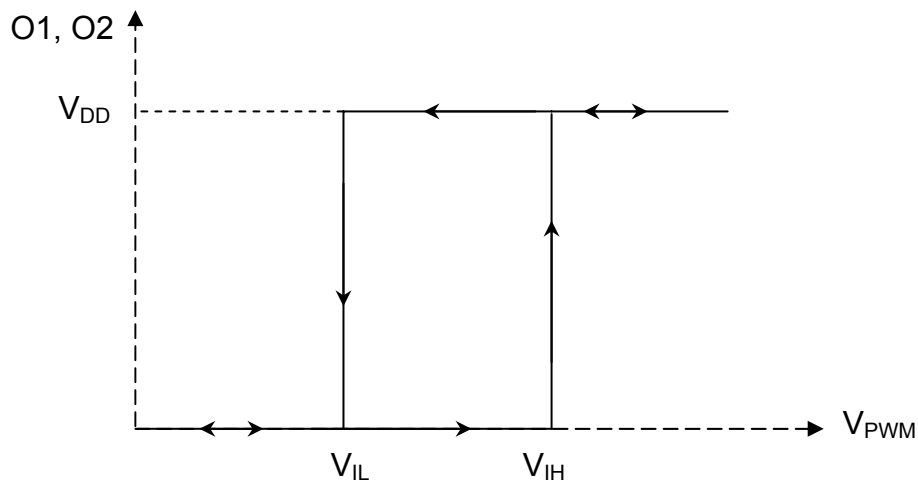
Electrical Characteristics

(Unless otherwise noted, V_{DD}=5V, T_A = 25 °C)

| Characteristic | Sym. | Condition | Limit | | | Unit |
|------------------------------------|------------------------|---------------------------|---------------------|------|---------------------|------|
| | | | Min. | Typ. | Max. | |
| Operation Voltage | V _{DD} | - | 2 | 5 | 6.5 | V |
| Supply Current | I _{CC} | - | | 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 | V _{Amplitude} | - | 20 | - | - | mV |

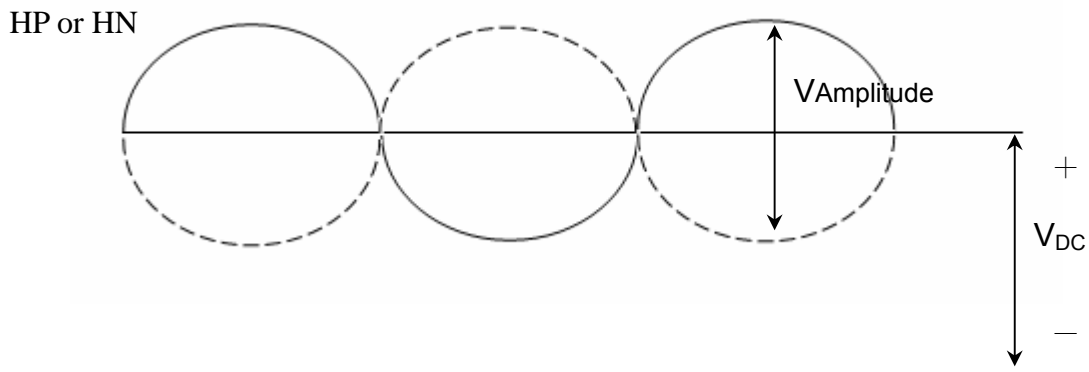
Truth Table

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

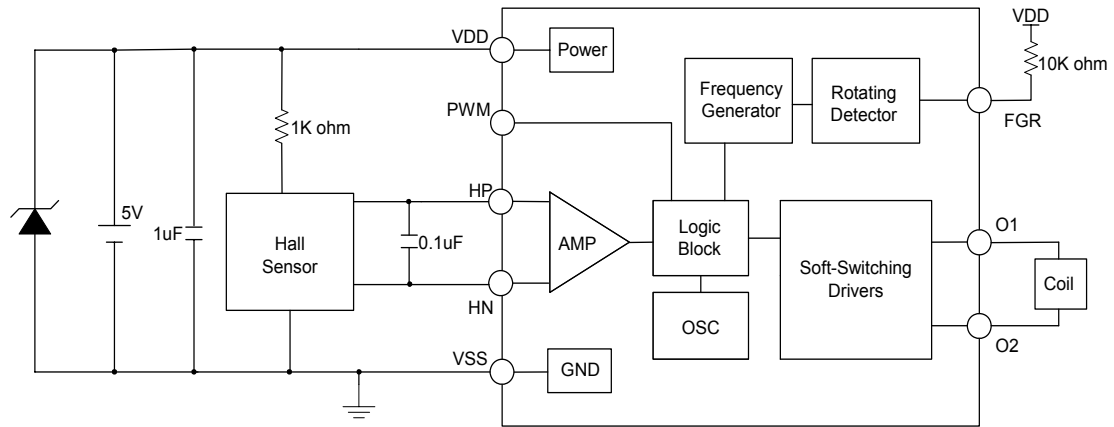


Hall Signal

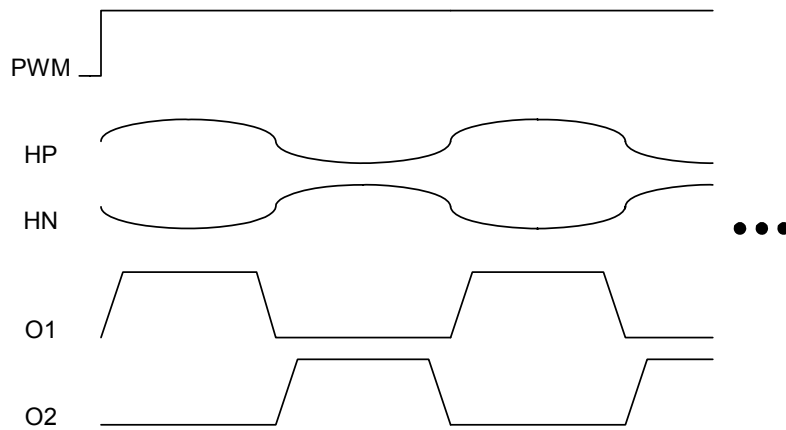
- In order to let FD178 normal work, two output signals of the Hall must satisfy the following two conditions :
 - (a) Hall average output DC voltage, $V_{DC} > 400mV$
 - (b) Hall amplitude of waveform voltage, $V_{Amplitude} > 20mV$



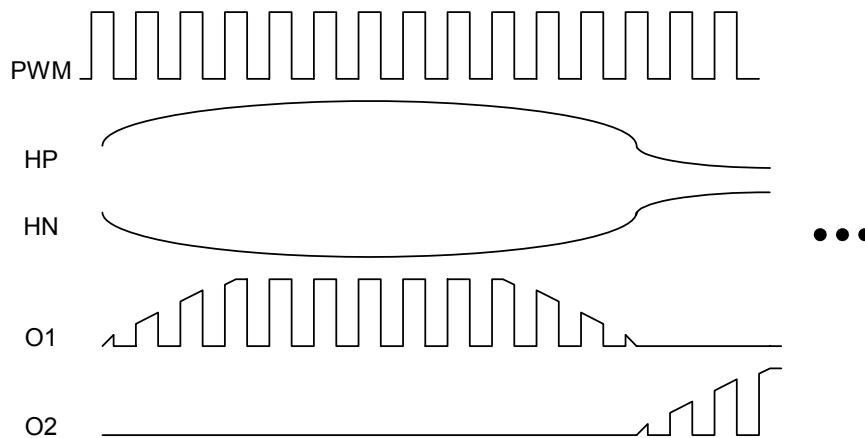
Application Circuit



Output Waveform

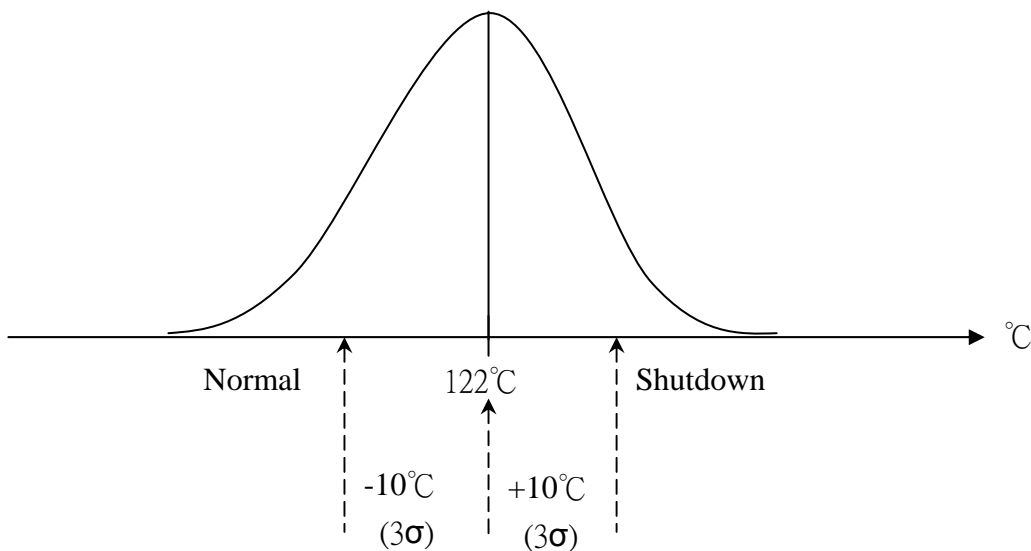


PWM control



Thermal Shutdown

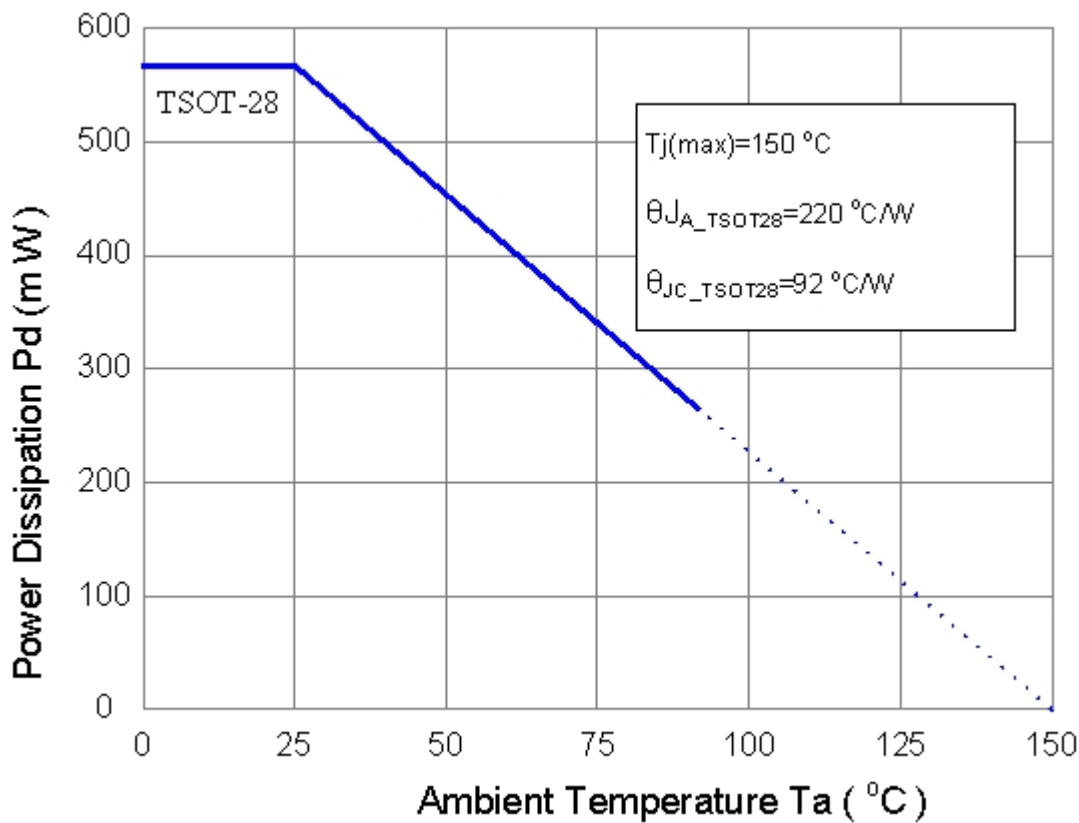
- The FD178 provides a temperature error detection circuit, once the temperature reaches approximately above 122°C, shutdown signal will cause the driver to shutdown all the outputs.



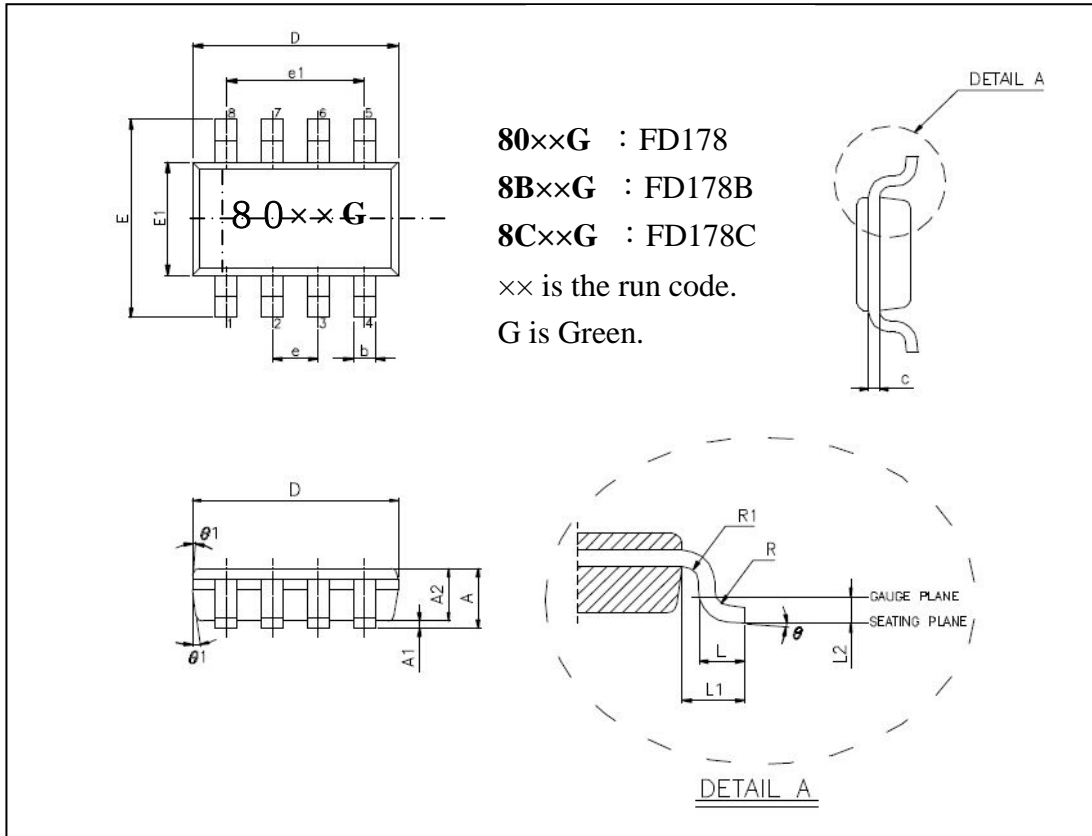
Application Notes

- 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.

- 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:



Package Specifications
FD178 : TSOT-28



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° | 4° | 8° |
| θ1 | 4° | 10° | 12° |

The products listed herein are designed for ordinary electronic applications, such as electrical appliances, audio-visual equipment, communications devices and so on. Hence, it is advisable that the devices should not be used in medical instruments, surgical implants, aerospace machinery, nuclear power control systems, disaster/crime-prevention equipment and the like. Misusing those products may directly or indirectly endanger human life, or cause injury and property loss.

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