

FAN8461G

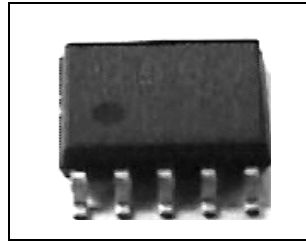
Single Phase Full Wave BLDC Motor Driver

Features

- A wide range of operating voltage: 2.8V to 28V
- Locked rotor protection with open collector output and auto retry
- Open collector FG output.
- Open collector Alarm output.
- TSD protection.

Description

The FAN8461G is a single phase BLDC motor driver and it's typical application is DC cooling fans with wide range of supply voltage(3.3/5/12/24V).



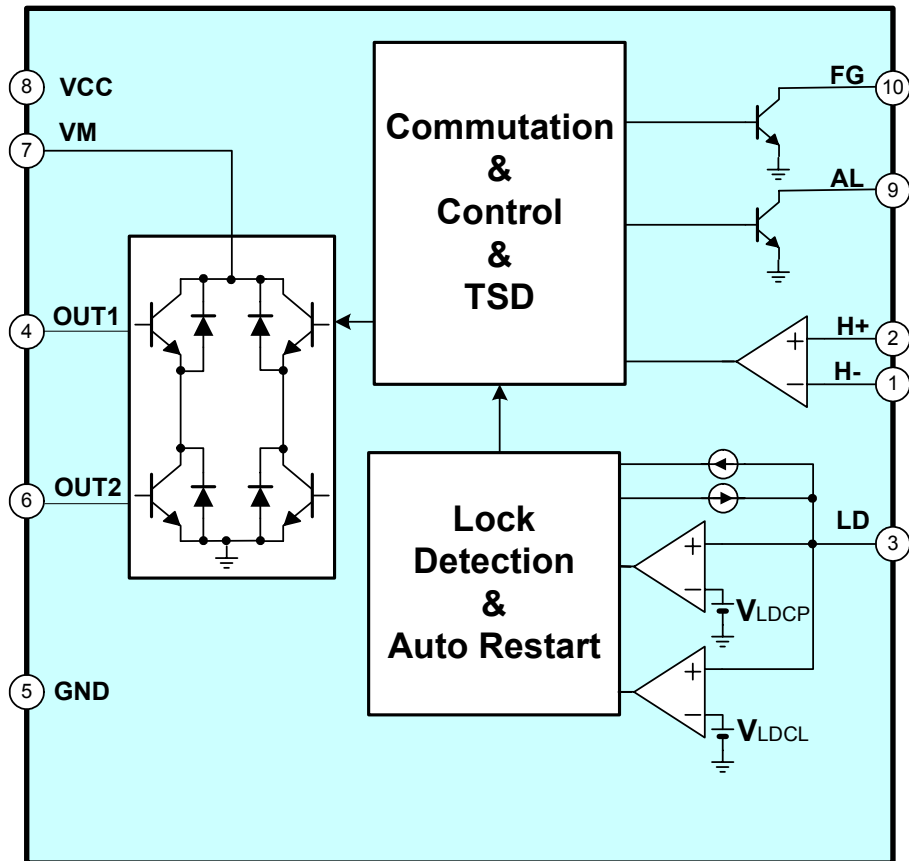
Typical Applications

- CPU Cooling Fans
- Instrumentation Fans
- Desktop PC Fans

Ordering Information

| Device | Package | Operating Temp. |
|-----------|---------|-----------------|
| FAN8461G | 10-SSOP | -30°C ~ 90°C |
| FAN8461GX | 10-SSOP | -30°C ~ 90°C |

Block Diagram



Pin Definitions

| Pin Number | Pin Name | I/O | Pin Function Description | Remark |
|------------|----------|-----|---|----------------|
| 1 | H- | A | Hall input - | |
| 2 | H+ | A | Hall input + | - |
| 3 | LD | A | Sawtooth wave generator for lock detector and automatic restart | - |
| 4 | OUT1 | A | Motor output 1 | |
| 5 | GND | P | Ground | - |
| 6 | OUT2 | A | Motor output 2 | - |
| 7 | VM | P | Motor power supply | - |
| 8 | VCC | P | Logic power supply | - |
| 9 | AL | O | Alarm output | Open collector |
| 10 | FG | O | Speed output | Open collector |

Absolute Maximum Ratings (Ta = 25°C)

| Parameter | Symbol | Value | Unit |
|----------------------------------|----------------|---------------------|------|
| Maximum power supply voltage | VCCMAX, VM MAX | 32 | V |
| Thermal resistance | Rja | 150 | °C/W |
| Maximum power dissipation | PD MAX | 800 | mW |
| Maximum output voltage | VOMAX | 36 | V |
| Maximum output current | IOMAX | 0.8 ^{note} | A |
| Maximum output peak current | IOPEAK | 1.2 ^{note} | A |
| Maximum FG/Alarm output current | IFG/AL | 5 | mA |
| FG/Alarm output sustain voltage | VFG/AL | 36 | V |
| Hall output withstanding voltage | VHO | 36 | V |
| Operating temperature | TOPR | -30 ~ 90 | °C |
| Storage temperature | TSTG | -55 ~ 150 | °C |

note

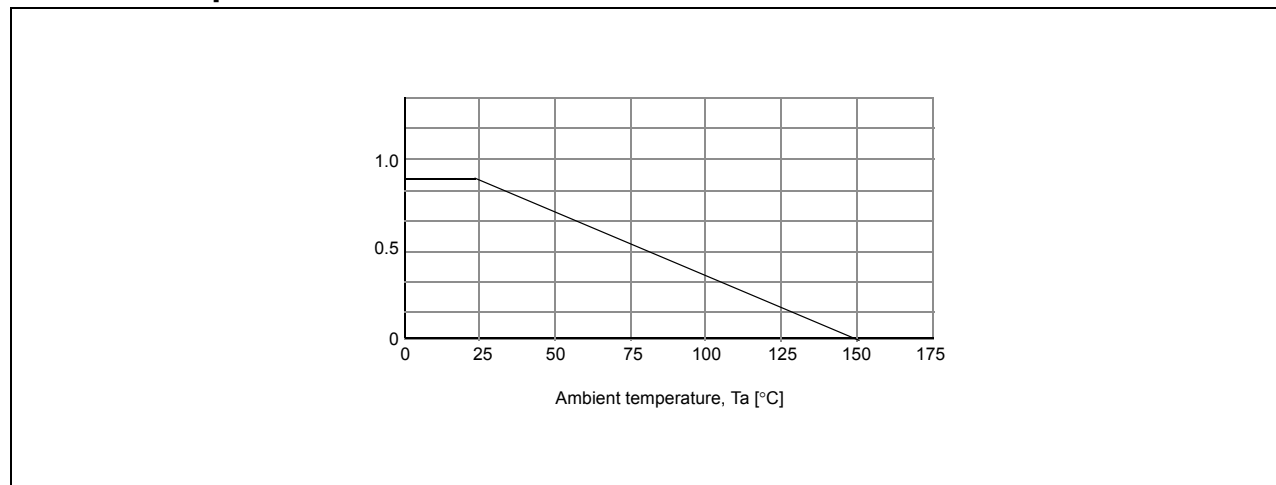
1 : Should not exceed PD or ASO value.

2 : IOPEAK time is within 2us.

Recommended Operating Conditions (Ta = 25°C)

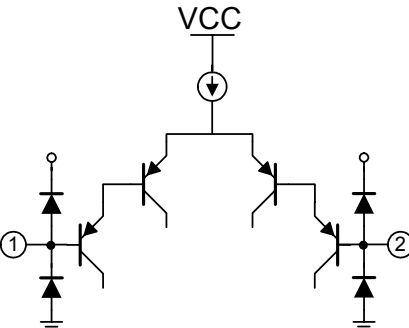
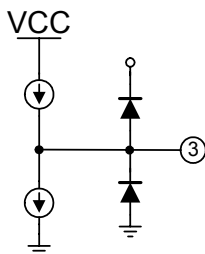
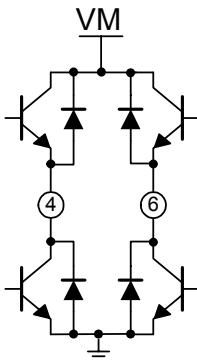
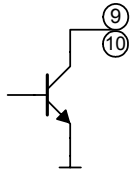
| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|----------------|--------|------|------|------|------|
| Supply voltage | VCC | 2.8 | - | 28 | V |

Power Dissipation Curve



PCB condition : When mounted on 76.2mm × 114mm × 1.57mm PCB (glass epoxy material).

Equivalent Circuits

| Description | Pin No. | Internal Circuit |
|-------------|---------|--|
| Hall input | 1 , 2 |  |
| LD | 3 |  |
| Output | 4 , 6 |  |
| FG/AL | 9 , 10 |  |

FAN8461G Electrical Characteristics

(Ta = 25°C, VCC = 12V unless otherwise specified)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|-----------------|-------------------------|------|------|---------------------|------|
| Total | | | | | | |
| Supply current | ICC | | - | 4.5 | 7 | mA |
| Lock Detector & Auto Restart | | | | | | |
| LD charging current | ILDC | VLD=0V-->1.5V, VLD=1.5V | 1.4 | 2.2 | 2.9 | μA |
| LD discharging current | ILDD | VLD=3V-->1.5V, VLD=1.5V | 0.15 | 0.33 | 0.50 | μA |
| LD clamp voltage | VLDC | - | 2.3 | 2.6 | 2.9 | V |
| LD comparator voltage | VLDCP | - | 0.4 | 0.6 | 0.8 | V |
| Output Stage | | | | | | |
| High side output saturation voltage | VOSH | IO=200mA | - | 0.9 | 1.1 | V |
| Low side output saturation voltage | VOSL | IO=200mA | | 0.2 | 0.3 | V |
| Speed output(FG) & Lock Detection Output(AL) | | | | | | |
| FG output saturation voltage | VFGS | IFG=5mA | - | 0.1 | 0.3 | V |
| FG output leakage current | IFGO | VFG=12V | - | 0.1 | 10 | μA |
| AL output saturation voltage | VALS | I _{AL} =5mA | - | 0.1 | 0.3 | V |
| AL output leakage current | I _{AL} | V _{AL} =12V | - | 0.1 | 10 | μA |
| Hall Amplifier | | | | | | |
| Input range | VHDC | - | 0 | - | V _S -2.8 | V |
| Input offset | VHOF | - | -10 | - | 10 | mV |

Application Information

1. H-bridge motor driver(OUT1, OUT2)

Using an H-bridge to drive a single-phase BLDC motor provides several advantages for dc fans over a two phase motor commonly driven by two commutated low-side switches. A single phase motor has only two connections; hence, the H-bridge topology requires only two output terminals and two traces are needed on the fan PCB. Generally, this H-bridge method with single phase motor increases fan motor torque density over a typical unipolar drive method. In addition, the H-bridge topology eliminates the number of external component for snubbing and allows recirculation of winding current to maintain energy in a motor while switching occurs.

2. Locked Rotor Protection with Open Collector Output and Automatic Restart

When the rotor is locked, there is no change in input signal of hall amplifier and thus a internal TZERO pulse is not observed. A capacitor(C_{LD}) connected LD pin is continually charged by internal current source(I_{LDC}) to internal threshold (V_{LDCL}) resulting from no Tzero pulse. When the voltage, V_{CLD} on LD pin, reaches V_{LDCL}, high side output power TR is turned-off to protect motor during T_{OFF} and the alarm output (AL) becomes floating high. When the V_{CLD} reaches upper threshold, V_{LDCL}, V_{CLD} starts to decrease with internal current sink(I_{LDD}) to the low threshold, V_{LDCL}. At that time, the V_{CLD} ramps up again and one of two outputs is turned on depending on locked rotor position during T_{ON}. The charging and discharging repeat until locked condition is removed, or FAN8461G is powered down. The overall time chart is shown in figure.1. The auto- retry time(T_{ON}), the motor protection time(T_{OFF}), the locked rotor detection time(T_{LOCK}) are proportional to external capacitor, C_{LD} and each value can be calculated as follows;

$$T_{ON} = \frac{C_{LD} \times (V_{LDCL} - V_{LDCL})}{I_{LDC}}$$

$$T_{OFF} = \frac{C_{LD} \times (V_{LDCL} - V_{LDCL})}{I_{LDD}}$$

$$T_{LOCK} \cong \frac{C_{LD} \times V_{LDCL}}{I_{LDC}}$$

For example, C_{LD} = 0.33uF, then T_{ON}= 0.3Sec, T_{OFF}= 2Sec, T_{LOCK}= 0.4Sec. This AL output can be used to inform a locked rotor condition to super IO or system controller. Because the AL output is open collector type, end user can pull up this pin with a external resistor to the supply voltage of their choice(that is 5 or 3.3V). It is recommended that this AL output be higher than the GND potential.

3. Hall Sensor Amplifier

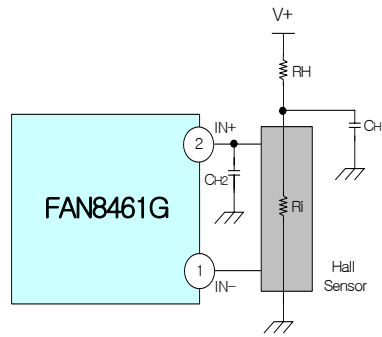


Figure 2. Hall Sensor Interface

The hall current (I_H) is determined as follows;

$$I_H = \frac{V_{CC}}{R_H + R_i}$$

Where, R_H is an external limiting resistor and R_i is input impedance of hall sensor. An external capacitor, C_{H1} , can be used to reduce a power supply noise. C_{H2} can reduce the instant peak current using H-bridge's commutation. The input range of hall amplifier is between 0V and $V_{CC}-2.8V$ as shown in following figure.

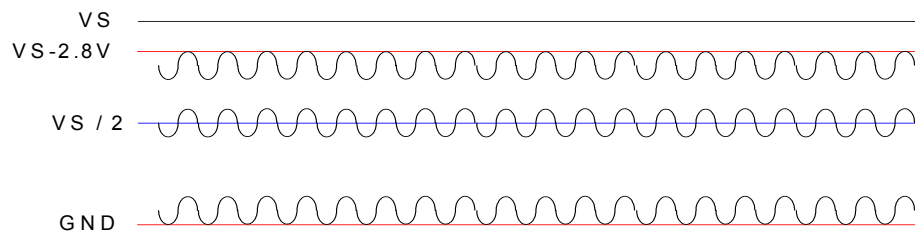


Figure 3. Hall Amplifier Input Range

Table 1. Hall Sensor Outputs and Related Pin outputs

| H+ | H- | LD | OUT 1 | OUT 2 | AL | TACO | Remark |
|----|----|-----------|-------|-------|----|--------|----------|
| H | L | Low Level | L | H | L | L | ROTATING |
| L | H | Low Level | H | L | L | H | |
| - | - | - | - | - | H | L or H | LOCK |

8. Open Collector FG Output for Speed Feedback

The FG output comes from the hall amplifier output. Because the FG output is open collector type, end user can pull up this pin with an external resistor to the supply voltage of their choice (that is 5 or 3.3V). This resulting output signal has two pulses per revolution on a four pole motor. It is recommended that this FG output be higher than the GND potential.

9. Supply Voltage Consideration

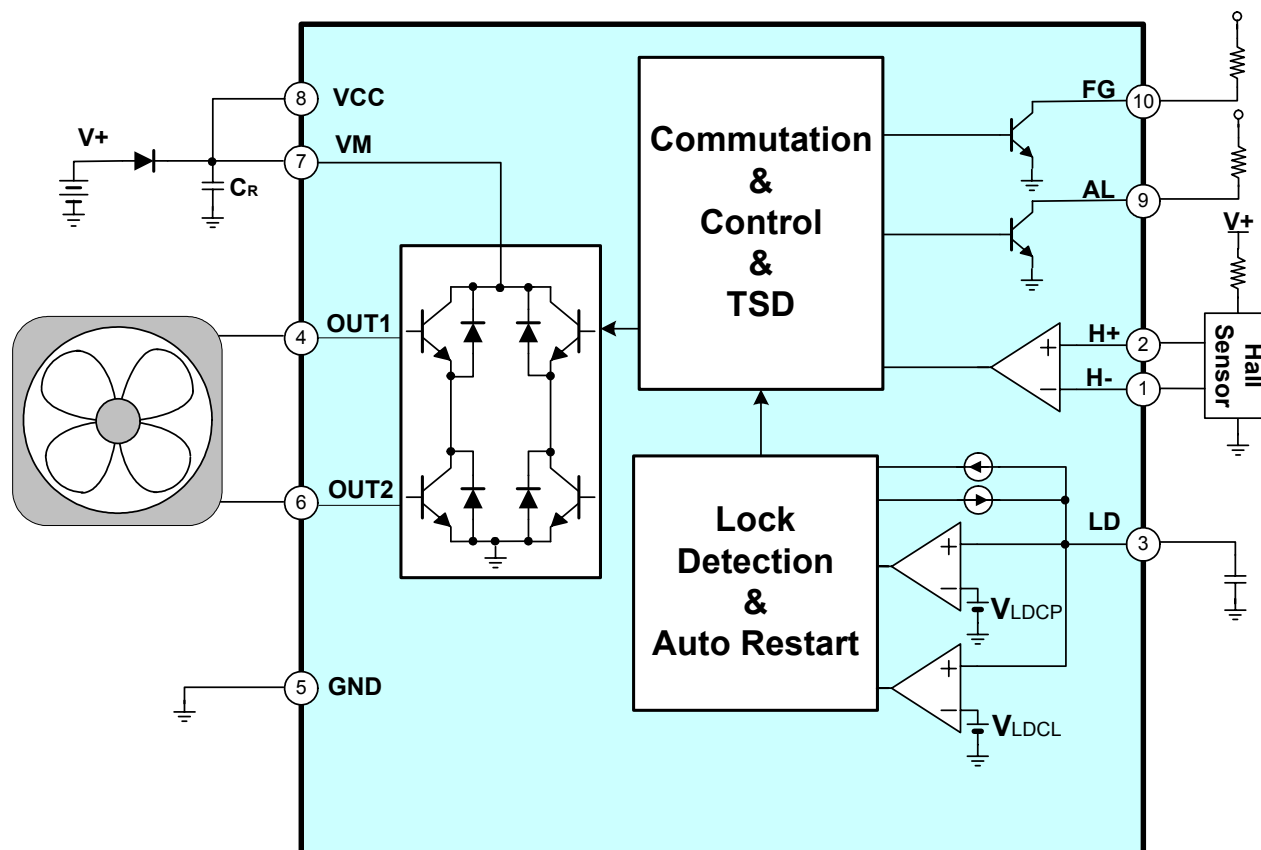
A supply sustain capacitor (C_R) should be placed as close to VCC pin with GND as layout permits. A reverse supply protection diode (D_R) prevents motor current from recirculating to the power source when phase commutation occurs. This results in increasing VCC pin voltage. This capacitor absorbs motor recirculating current and limits VCC pin voltage. In general, large motor winding inductance and current need a large value of C_R .

10. Thermal Shutdown

TSD on: Two high side outputs are off. (Typ. 175°C)

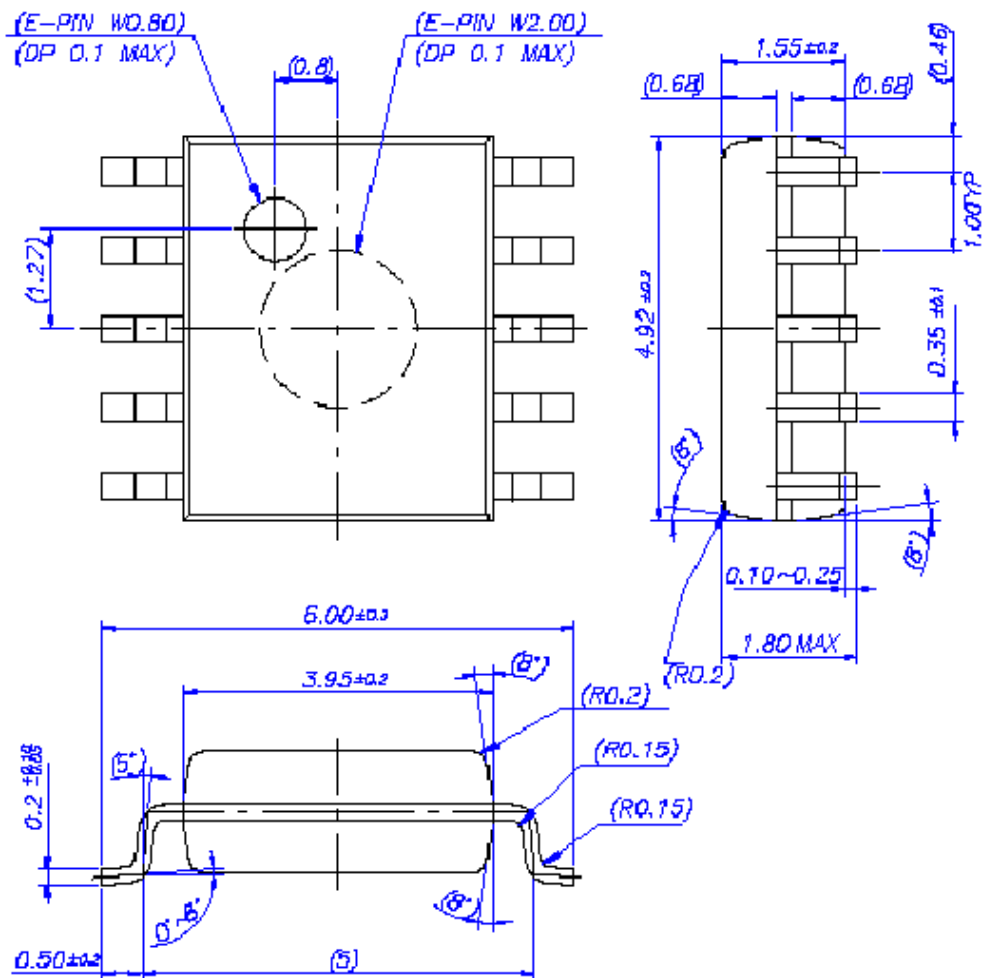
TSD off: The circuit can be reactivated and begin to operate in a normal condition. (Typ. 150°C)

Typical Application Circuits 1

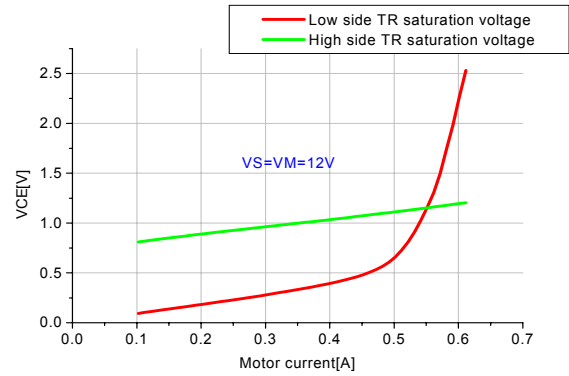
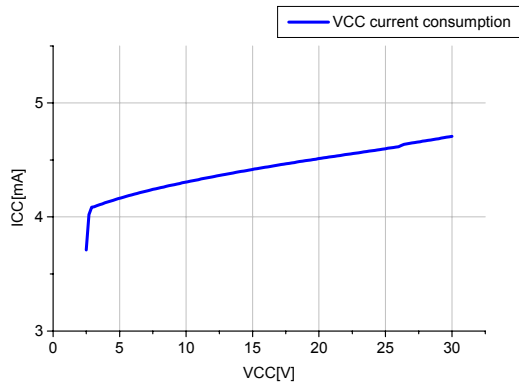


Package Dimensions (Unit: mm)

10-SSOP-225



Typical Performance characteristics



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