# FAN8404D

## 2 Phase Half Wave BLDC Motor Driver

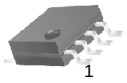
## Features

- A wide range of operation voltage: 4V to 15V
- Built-in motor lock detector.
- Automatic restart function
- Alarm output for a motor lock detection
- Built-in thermal shut down circuits
- Built-in reverse current protection diode
- Compact package: 8-SOP-225

## Description

The FAN8404D is a monolithic integrated circuit, and suitable for DC cooling fan motors.

**8-SOP-225**



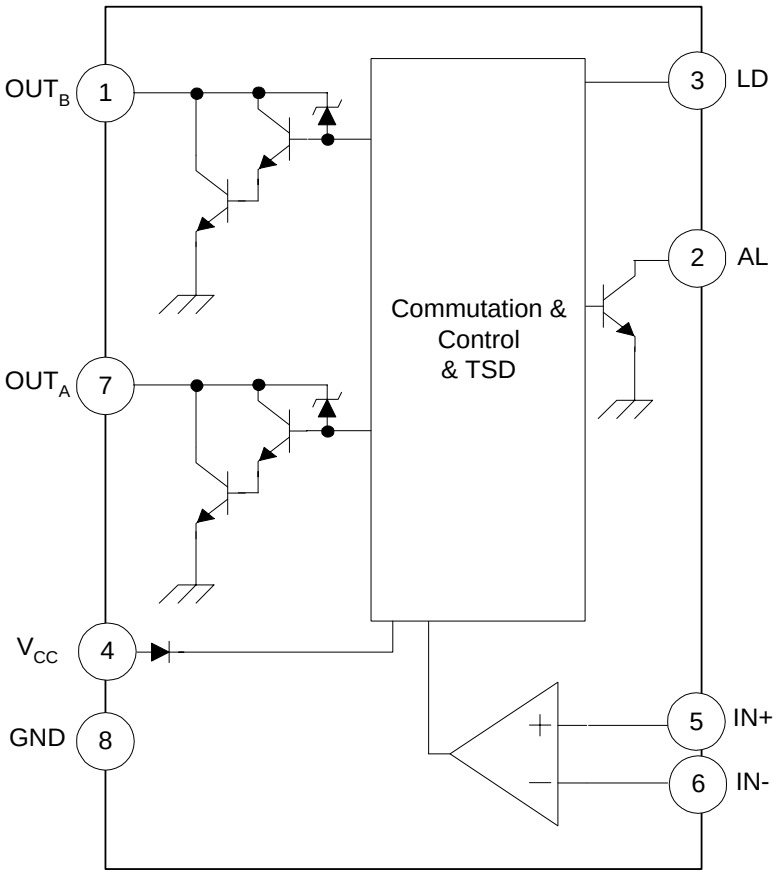

## Typical Applications

- DC cooling fan motor

## Ordering Information

| Device | Package | Operating Temp. |
|---|---|---|
| FAN8404D | 8-SOP-225 | –25°C ~ 85°C |
| FAN8404DTF | 8-SOP-225 | –25°C ~ 85°C |

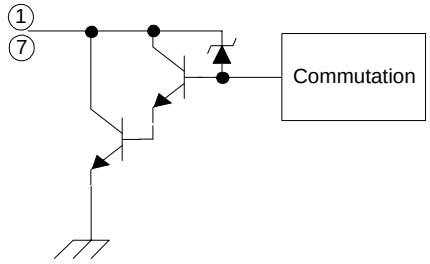
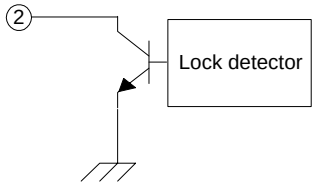
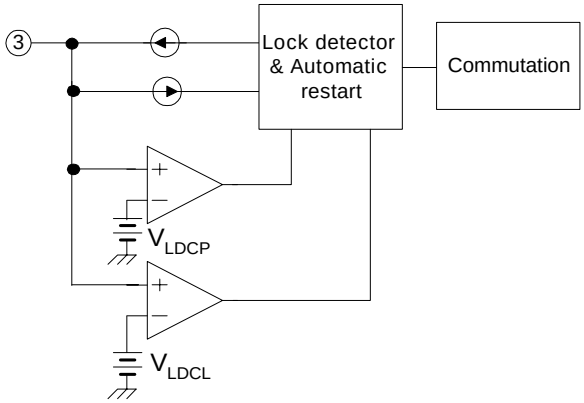
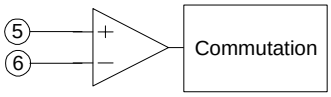
## Block Diagram




## Pin Definitions

| Pin Number | Pin Name | I/O | Pin Function Description | Remark |
|---|---|---|---|---|
| 1 | $OUT_B$ | O | Motor output B | - |
| 2 | AL | O | Alarm output | Open Collector |
| 3 | LD | - | Triangle pulse generator for lock detector and automatic restart | - |
| 4 | $V_{CC}$ | - | Supply voltage | - |
| 5 | IN+ | I | Hall input + | - |
| 6 | IN– | I | Hall input – | - |
| 7 | $OUT_A$ | O | Motor output A | - |
| 8 | GND | - | Ground | - |

## Equivalent Circuits

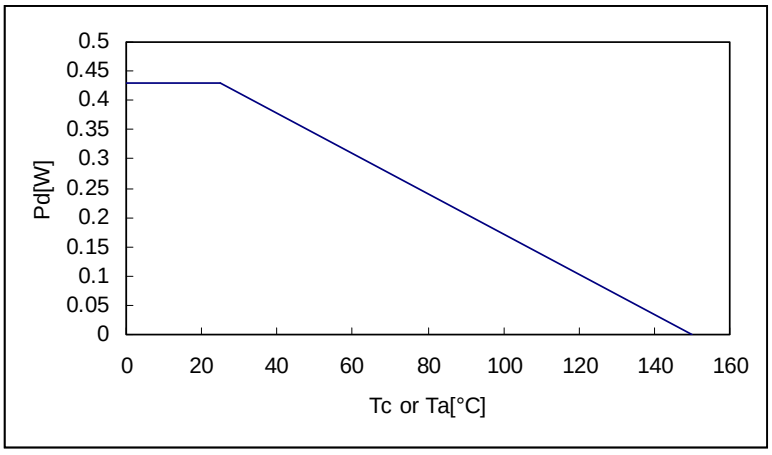
| Description | Pin No. | Internal Circuit |
|---|---|---|
| $OUT_B$ | 1 |  |
| $OUT_A$ | 7 | |
| AL | 2 |  |
| LD | 3 |  |
| IN+ | 5 |  |
| IN- | 6 | |

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

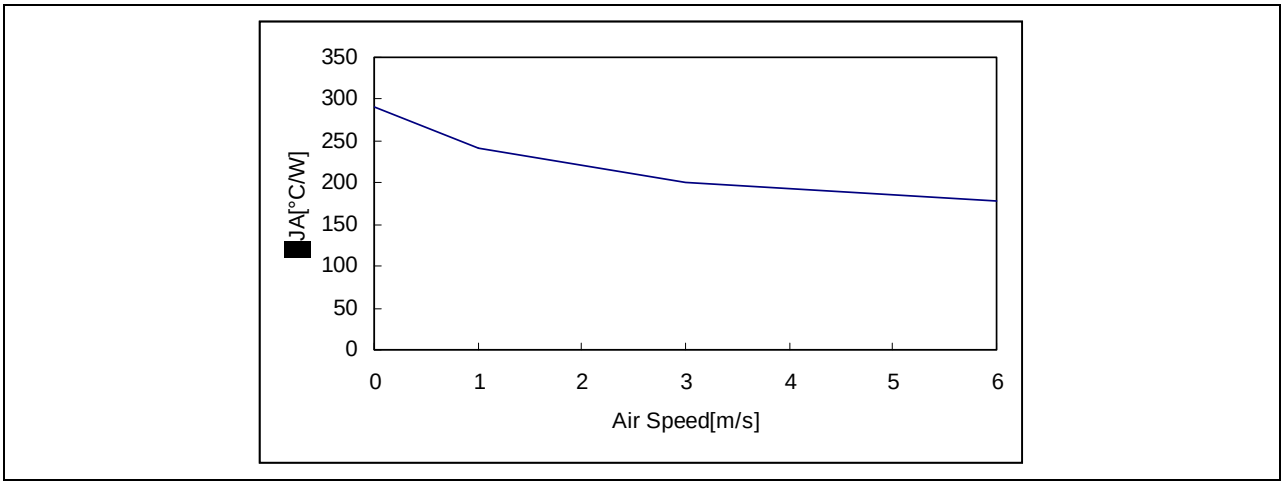
| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Maximum power supply voltage | $V_{CCMAX}$ | 18 | V |
| Maximum power dissipation[note1] | $P_{DMAX}$ | 429[note2] | mW |
| | | 620[note3] | |
| Thermal resistance[note1] | $\Theta_{JA}$ | 291.61[note2] | °C/W |
| | | 201.52[note3] | |
| Maximum output voltage | $V_{OMAX}$ | 30 | V |
| Maximum output current | $I_{OMAX}$ | 1.2[note4] | A |
| Alarm output current | $I_{AL}$ | 10 | mA |
| Alarm output withstanding voltage | $V_{AL}$ | 36 | V |
| Maximum hall input AC level | $V_{HACMAX}$ | 6 | V |
| Operating temperature | $T_{OPR}$ | –25 ~ 85 | °C |
| Storage temperature | $T_{STG}$ | –55 ~ 150 | °C |

**Note1:**
PCB Condition: Thickness (1.6mm), Dimension (76.2mm * 114.3mm)
Refer: EIA/J SED 51-3 & EIA/J SED 51-7
**Note2:** Air condition (0m/s)
**Note3:** Air condition (3m/s)
**Note4:** Should not exceed $P_D$ or ASO value

## Power Dissipation Curve (Air condition = 0m/s)



## Air Speed & $\Theta_{JA}$




## Recommended Operating Conditions (Ta = 25°C)

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Function compensation operating voltage | $V_{CC}$ | 4.0 | – | 15.0 | V |

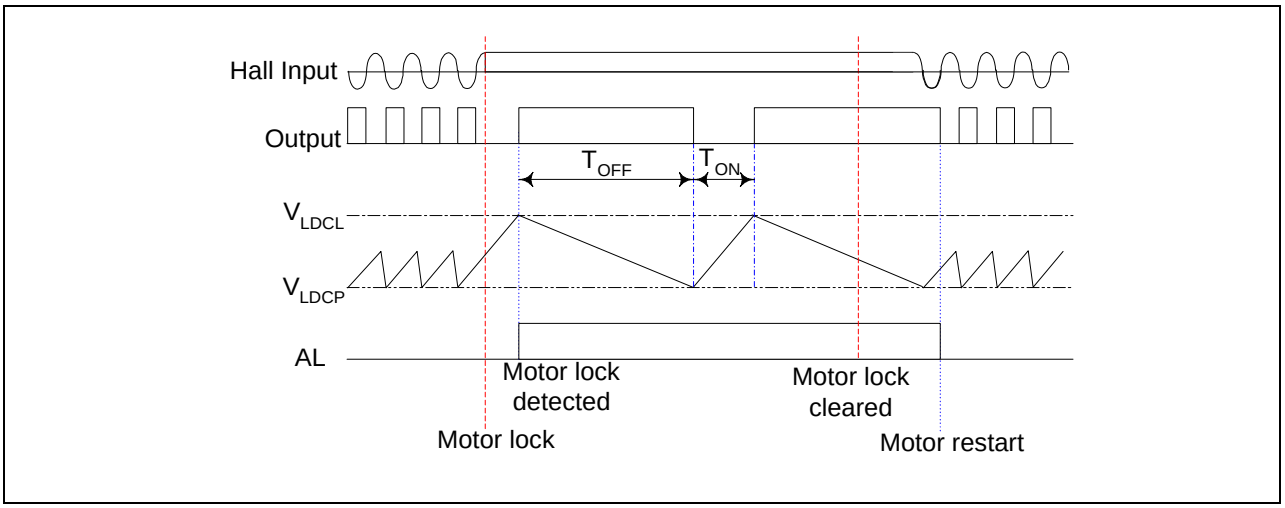
## Electrical Characteristics

(Ta=25°C, $V_{CC}$=12V unless otherwise specified)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply current | $I_{CC}$ | When output is off. | - | - | 3.0 | mA |
| Lock detector charging current | $I_{LDC}$ | $V_{LD}$=1.8V | 2.38 | 3.40 | 4.42 | µA |
| Lock detector discharging current | $I_{LDD}$ | $V_{LD}$=1.8V | 0.48 | 0.68 | 0.88 | µA |
| Lock detector charging/discharging ratio | $R_{CD}$ | $R_{CD}=I_{LDC}/I_{LDD}$ | 3.0 | 5.0 | 7.0 | – |
| Lock detector capacitor clamp voltage | $V_{LDCL}$ | - | 2.4 | 2.85 | 3.3 | V |
| Lock detector capacitor comparator voltage | $V_{LDCP}$ | - | 0.7 | 0.99 | 1.2 | V |
| Output low level voltage | $V_{OL}$ | $I_O$=200mA | - | 0.9 | 1.2 | V |
| Output leakage current | $I_{OL}$ | - | - | 0 | 10 | µA |
| Output zener voltage | $V_{OZ}$ | Clamp current=10mA | 28 | 30 | 32 | V |
| Alarm output pin low level voltage | $V_{ALL}$ | $I_O$=10mA | - | 0.2 | 0.5 | V |
| Alarm output pin leakage current | $I_{ALL}$ | - | - | 0 | 10 | µA |
| Hall input DC range | $V_{HDC}$ | - | 1 | - | $V_{CC}$-2V | V |
| Hall Input Offset | $V_{HOF}$ | $V_{REF}$=6V | -10 | - | 10 | mV |

# Application Information

## 1. Lock Detection & Automatic Restart




FAN8404D features a lock detection and an automatic restart. The functions can be operated as follows.

1) When the hall signal stop switching, a motor can be locked.
2) The voltage, $V_{LD}$ on pin 3, is increasing until it reaches $V_{LDCL}$.
3) When the voltage, $V_{LD}$ reaches $V_{LDCL}$, the alarm output (AL) becomes high as a motor lock has been detected.
4) If LD pin is connected to GND, the lockup protection is disabled.
5) While a motor is locked, the output repeats switching ON / OFF, but the other output is always OFF. The switching time can be determined by an external capacitor on charging / discharging time of the capacitor, switching ON / OFF time can be calculated as follows.

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

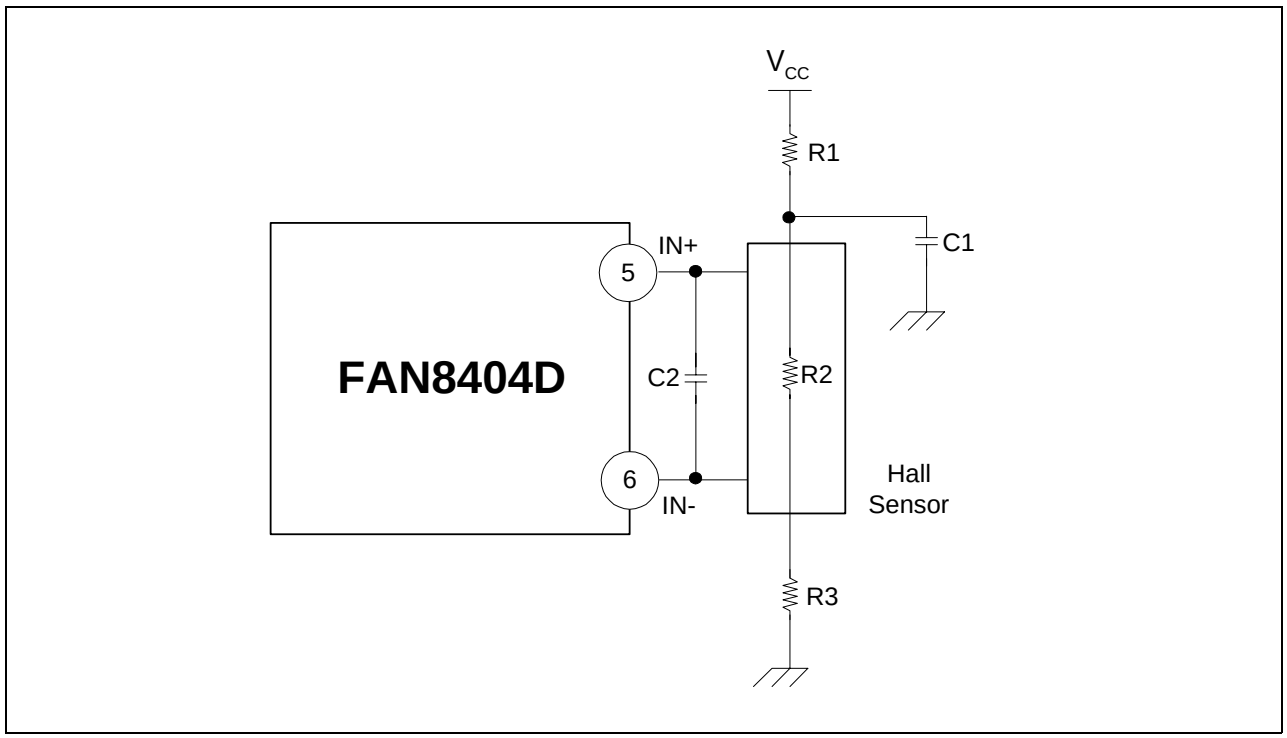
$$T_{OFF} = \frac{C_{LD} \times (V_{LDCL} - V_{LDCP})}{I_{LDD}}$$

Where, The $C_{LD}$ is an external capacitor connected to pin 3, LD.
The $V_{LDCL}$ is the clamp voltage on pin 3, LD.
The $V_{LDCP}$ is the comparator voltage on pin 3, LD.
The $I_{LDC}$ is the charging current on pin 3, LD.
The $I_{LDD}$ is the dischaging current on pin 3, LD.

## 2. Thermal Shut Down

TSD On: All the outputs are off.(Typ. 175°C)
TSD Off: The circuit can be reactivated and begin to operate in a normal condition. (Typ. 150°C)

### 3. Hall Amplifier Input Block



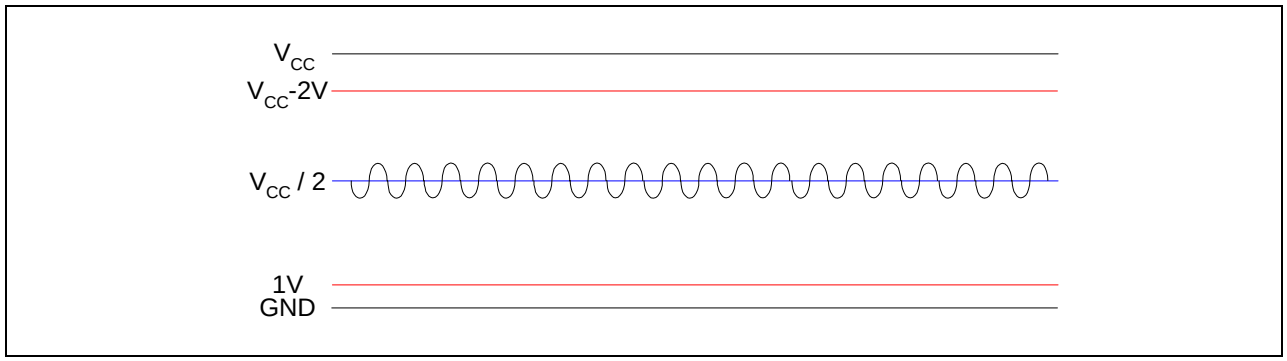

The hall current ($I_H$) is determined by R1, R2 and R3.

$$I_H = \frac{V_{CC}}{R1 + R2 + R3}$$

Where, the R2 is the impedance of hall sensor.

An external capacitor, C1, can be used to reduce a power supply noise. In addition, C2 is to remove a noise which is caused in case the line is long from the hall sensor output to the hall input (pin 5 / 6) of the device.

The input bias voltage of hall amplifier is between 1V and $V_{CC}$-2V as following figure.

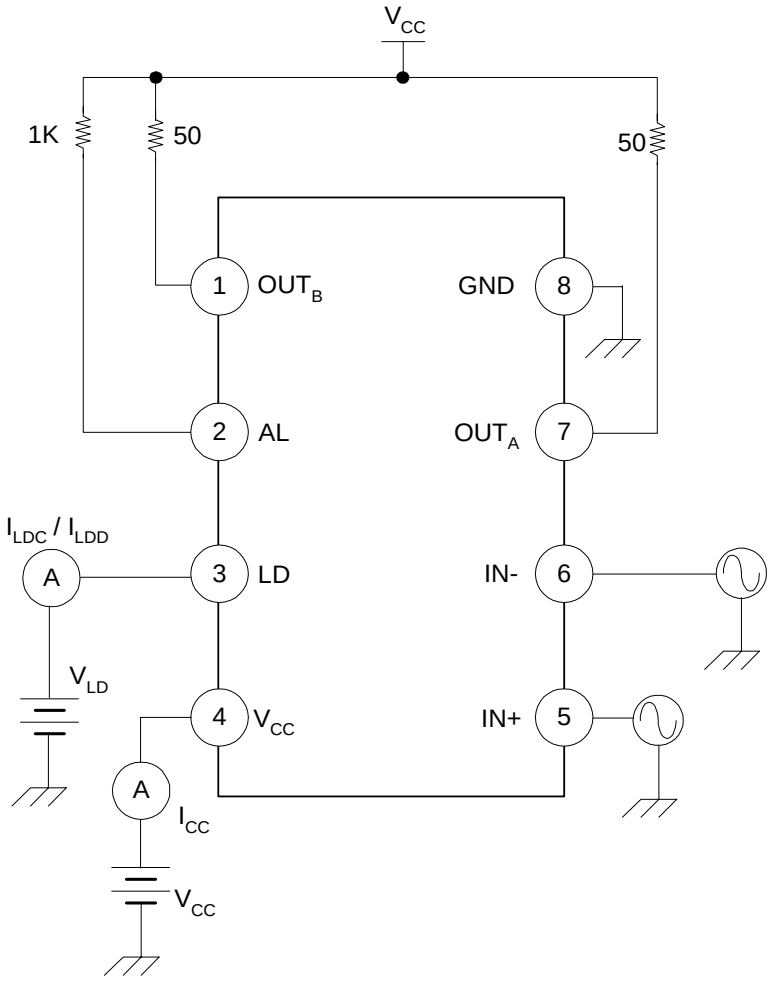



It is recommended that R1 and R3 should have the same value to make the output signal of hall sensor centered as $V_{CC}/2$.

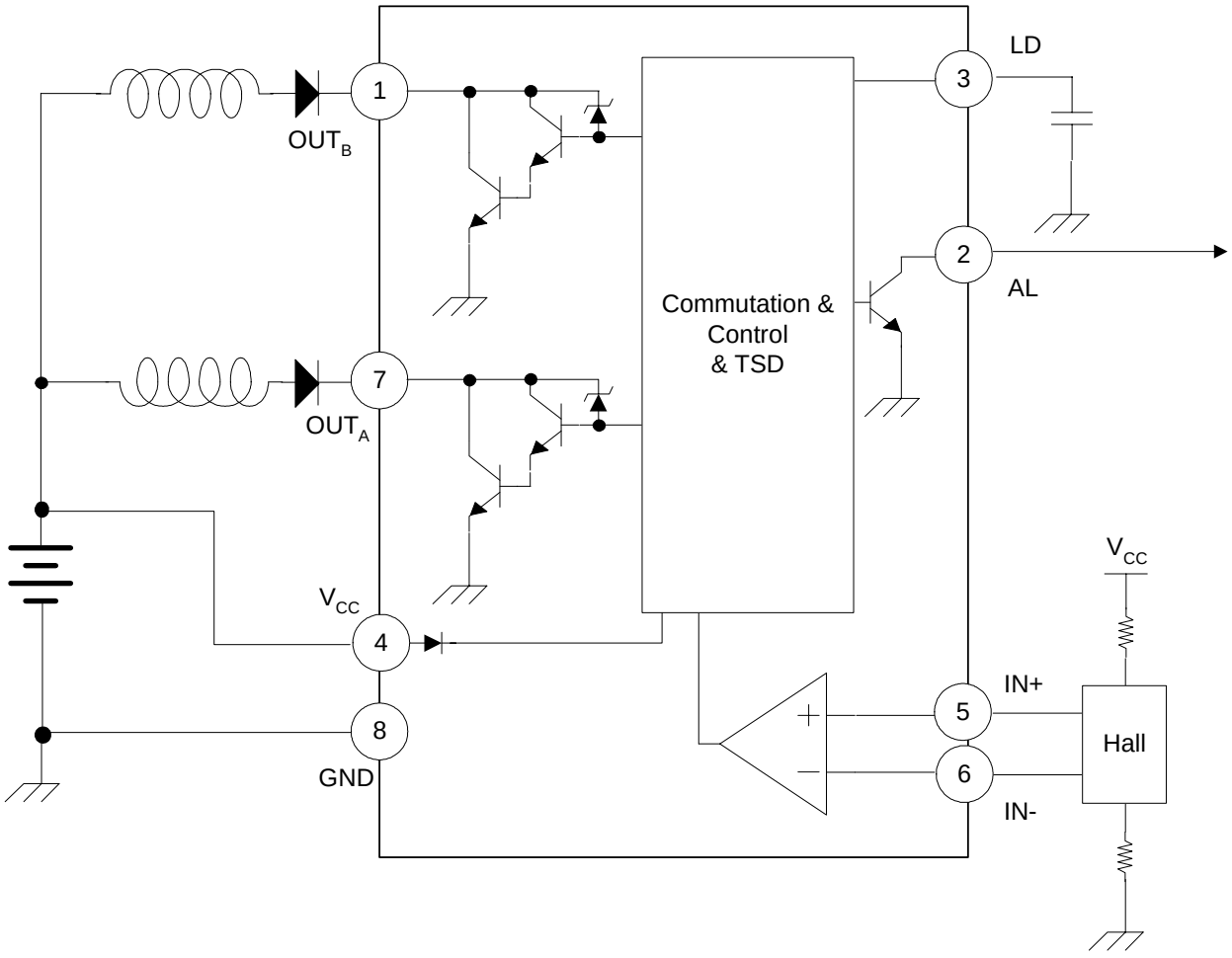
## Operation Truth Table

| IN+ | IN- | $OUT_A$ | $OUT_B$ |
|---|---|---|---|
| High | Low | High | Low |
| Low | High | Low | High |

## Test Circuits



## Typical Application Circuits

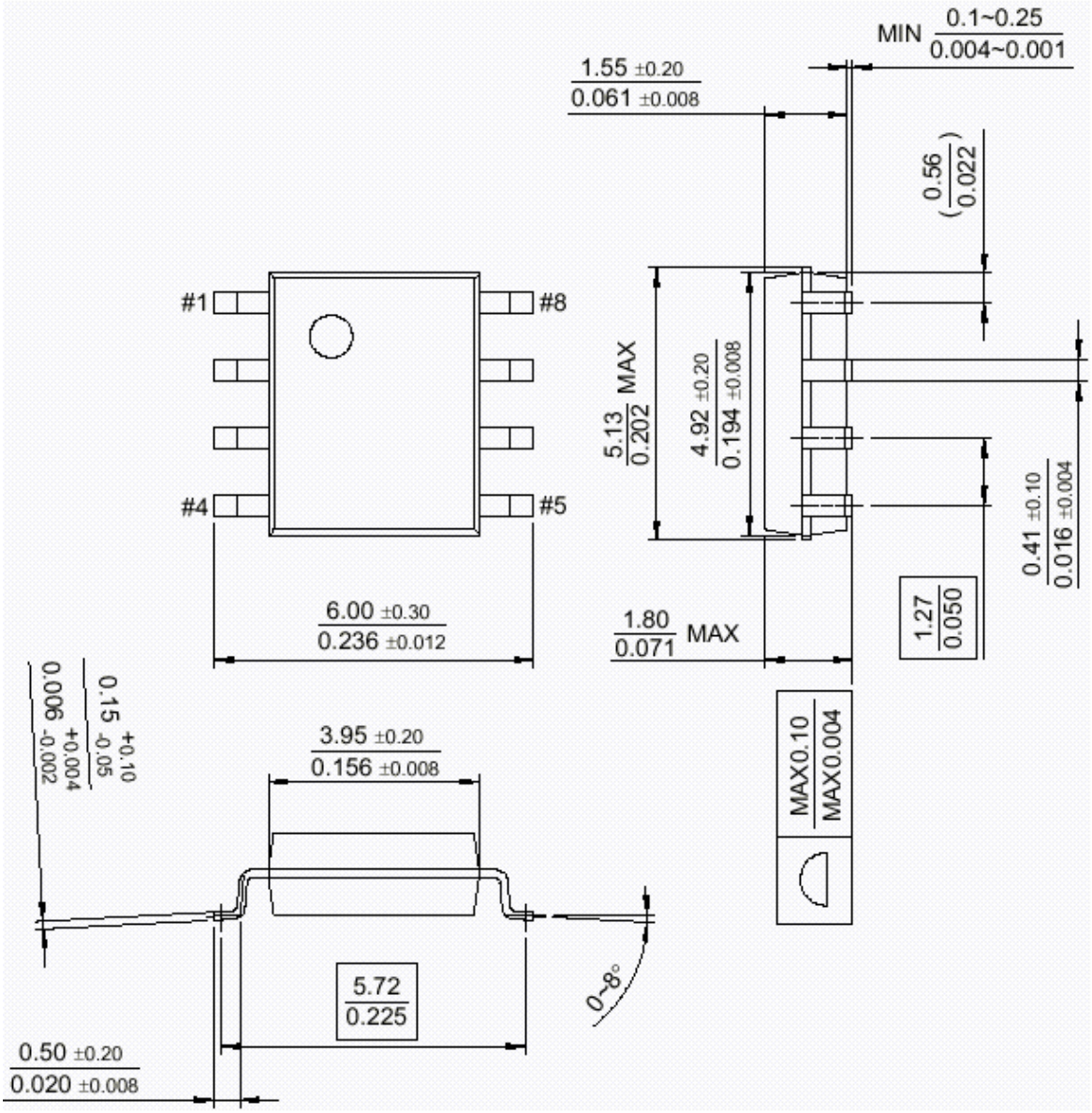



### Precaution

In case of improper connection (change between power and ground), diodes are required to protect motor.

## Package Dimensions (Unit: mm)

### 8-SOP-225



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