

# FAN8461G

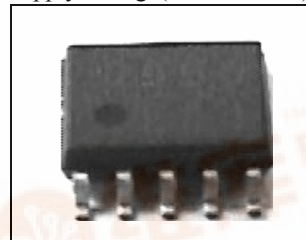
## Single Phase Full Wave BLDC Motor Driver

### 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).



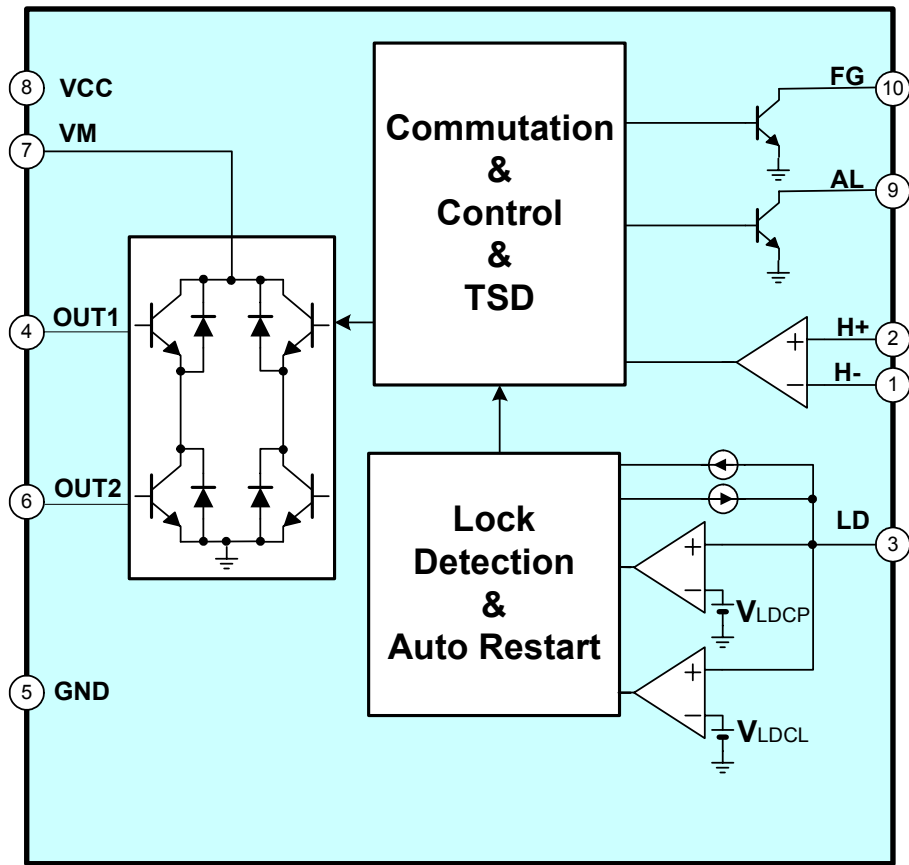
### Typical Applications

- 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



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## 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

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## 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 <sup>note</sup>	A
Maximum output peak current	IOPEAK	1.2 <sup>note</sup>	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

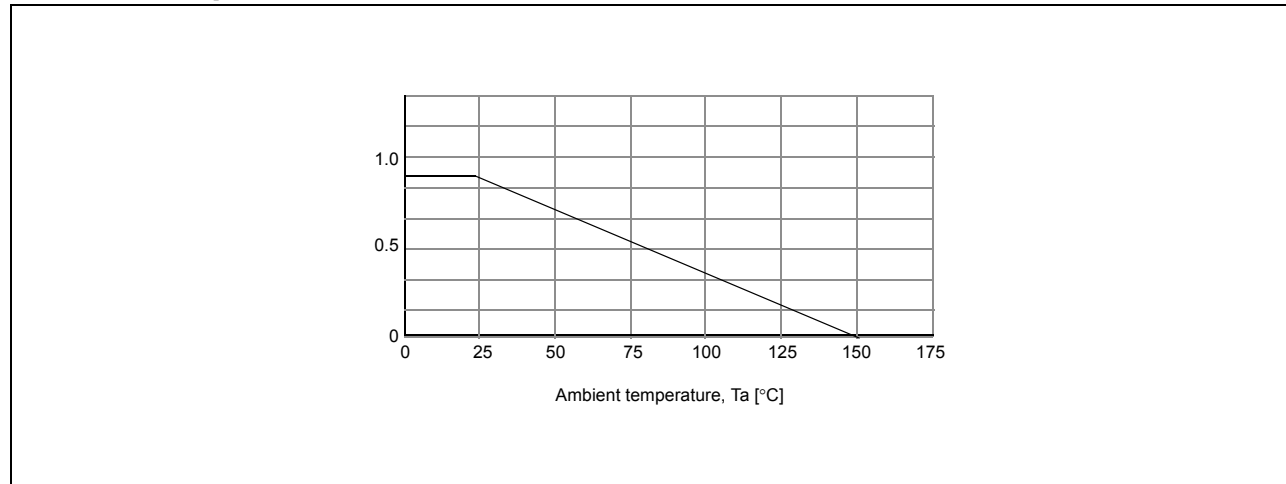
1 : Should not exceed PD or ASO value.

2 : IOPEAK time is within 2us.

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

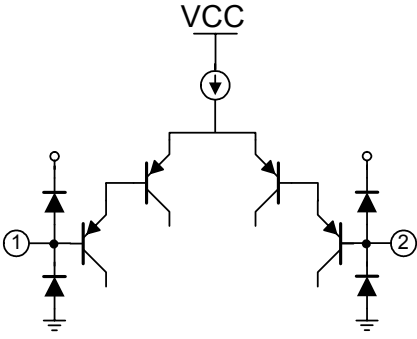
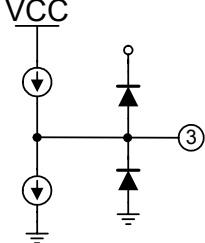
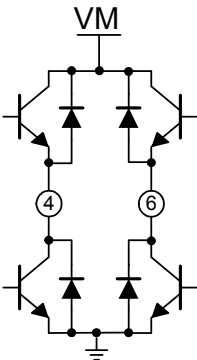
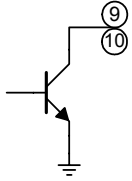
Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	VCC	2.8	–	28	V

## 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
<b>Total</b>						
Supply current	ICC		-	4.5	7	mA
<b>Lock Detector &amp; Auto Restart</b>						
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	VLDCL	-	2.3	2.6	2.9	V
LD comparator voltage	VLDPC	-	0.4	0.6	0.8	V
<b>Output Stage</b>						
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
<b>Speed output(FG) &amp; Lock Detection Output(AL)</b>						
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	IAL=5mA	-	0.1	0.3	V
AL output leakage current	IAL	VAL=12V	-	0.1	10	μA
<b>Hall Amplifier</b>						
Input range	VHDC	-	0	-	VS-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(CLD) connected LD pin is continually charged by internal current source(ILDC) to internal threshold (VLDCL) resulting from no Tzero pulse. When the voltage, VCLD on LD pin, reaches VLDCL, high side output power TR is turned-off to protect motor during TOFF and the alarm output (AL) becomes floating high. When the VCLD reaches upper threshold, VLDCL, VCLD starts to decrease with internal current sink(ILDD) to the low threshold, VLDCP. At that time, the VCLD ramps up again and one of two outputs is turned on depending on locked rotor position during TON. 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(TON), the motor protection time(TOFF), the locked rotor detection time(TLOCK) are proportional to external capacitor, CLD 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, CLD = 0.33uF, then TON= 0.3Sec, TOFF= 2Sec, TLOCK= 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.

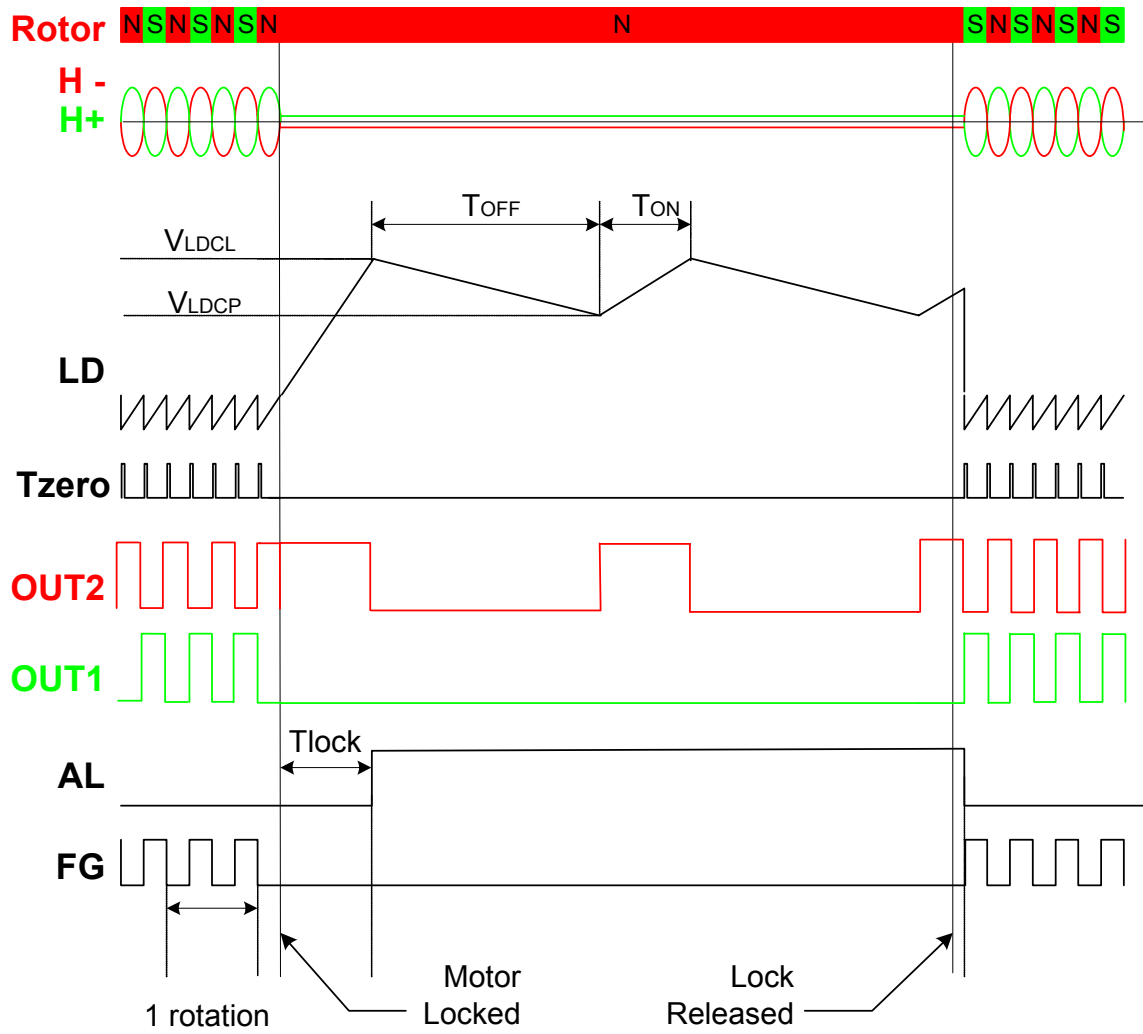


Figure 1. Overall Timing Chart



### 3. Hall Sensor Amplifier

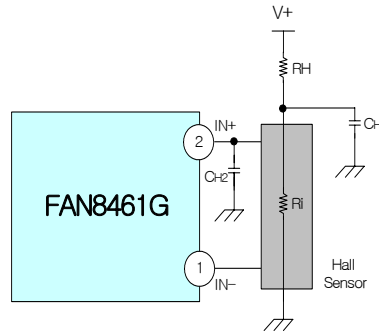


Figure 2. Hall Sensor Interface

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,  $CH_1$ , can be used to reduce a power supply noise.  $CH_2$  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.

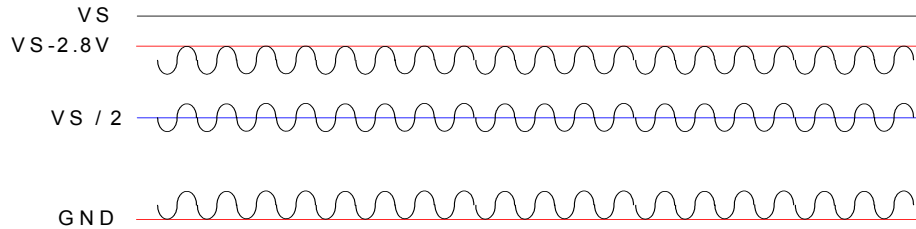


Figure 3. Hall Amplifier Input Range

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 a 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

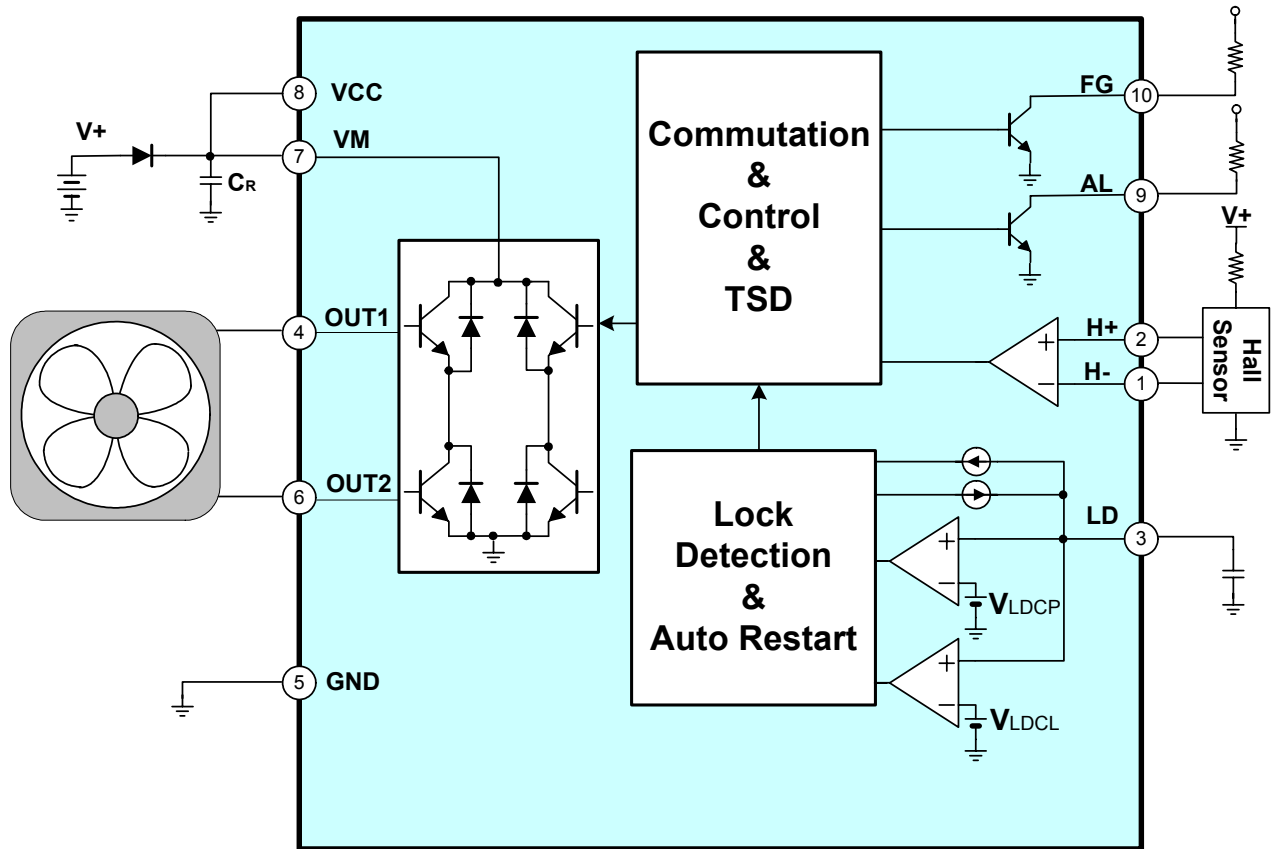
A supply sustain capacitor( $CR$ ) should be placed as close to VCC pin with GND as layout permits. A reverse supply protection diode( $DR$ ) prevent motor current from recirculating to power source when phase commutation occur. This results in increasing VCC pin voltage. This capacitor absorbs motor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

### 10. Thermal Shutdown

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

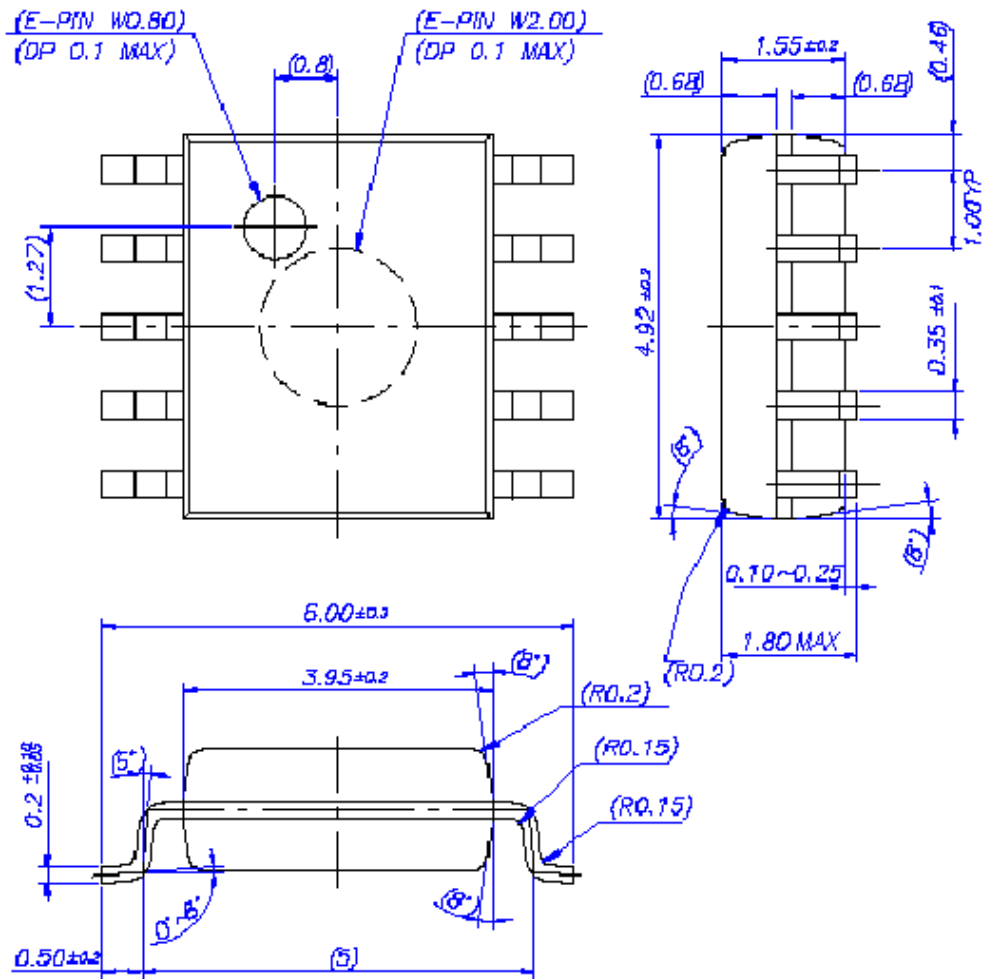
TSD off:The circuit can be reactivated and begin to operate in a normal condition. (Typ. 150°C)

# Typical Application Circuits 1

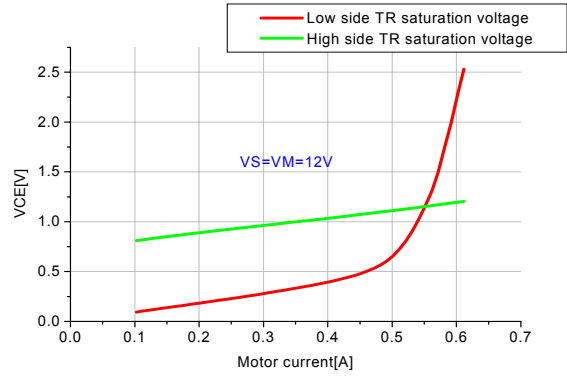
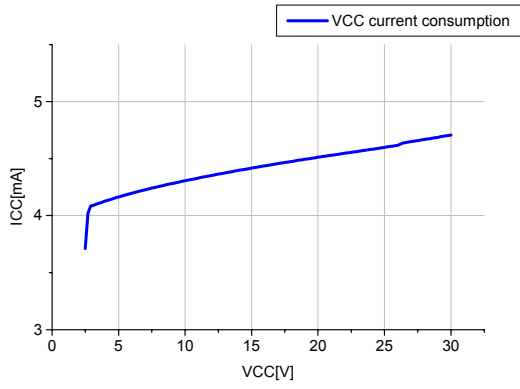


Package Dimensions (Unit: mm)

### 10-SSOP-225



## Typical Performance characteristics





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