



March 2005

FAN8463

BTL Single Phase Full Wave BLDC Motor Driver

Features

- A low voltage operation : 2.3V to 5.5V
- Locked rotor protection and auto retry.
- Open collector FG output
- Open collector 1/2 FG output.
- Hall bias voltage output.
- TSD protection.

Typical Applications

- Instrumentation Fans
- Note PC Fans

Description

The FAN8463MP/MTC is a BTL single phase BLDC motor driver and it's typical application is note PC cooling fans with low voltage operation(3.3/5V).

14-TSSOP



10-MLP



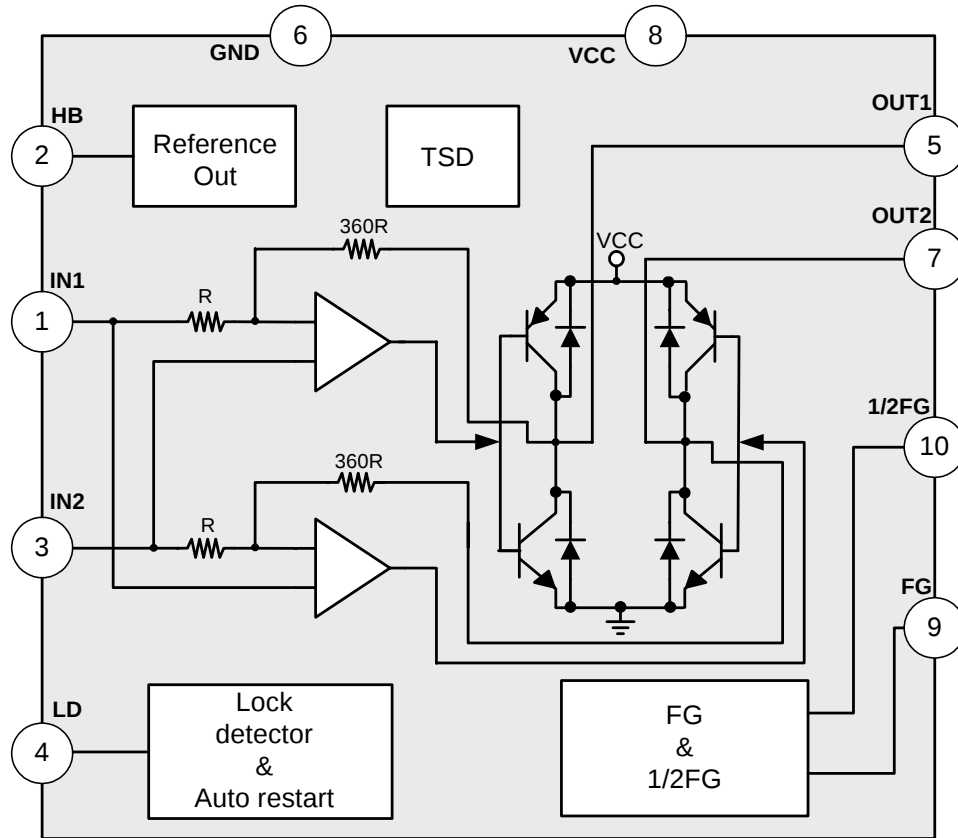
Ordering Information

Device	Package	Operating Temp.
FAN8463MTC	14-TSSOP	-30°C ~ 90°C
FAN8463MTCX	14-TSSOP	-30°C ~ 90°C
FAN8463MPX	10-MLP	-30°C ~ 90°C

Note

X : Tape & Reel

Block Diagrams(10MLP)

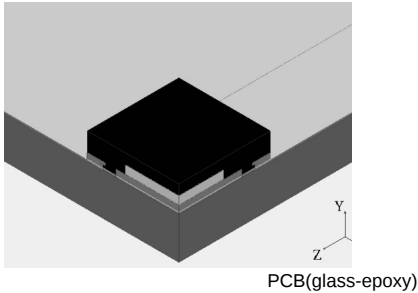
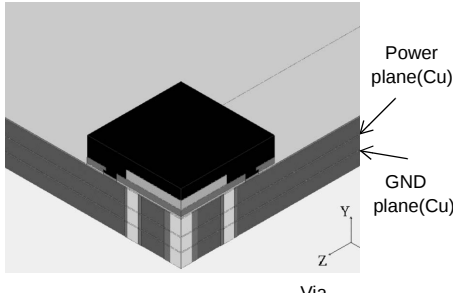


Pin Definitions

Pin Number		Pin Name	I/O	Pin Function Description	Remark
14TSSOP	10MLP				
1	1	IN1	A	Hall amplifier input 1	
2	2	HB	O	Reference voltage output for hall bias	-
3	3	IN2	A	Hall amplifier input 2	-
4	-	NC	-	-	-
5	4	LD	A	Sawtooth wave generator for lock detector and automatic restart	
6	-	NC	-	-	-
7	5	OUT1	A	Motor output 1	-
8	6	GND	P	Ground	-
9	-	NC		-	
10	7	OUT2	A	Motor output 2	-
11	-	NC	-	-	
12	8	VCC	P	Power supply	-
13	9	FG	O	Speed output for 4 pole motor	Open collector
14	10	1/2FG	O	Speed output for 8 pole motor	Open collector

Absolute Maximum Ratings (Ta = 25°C)

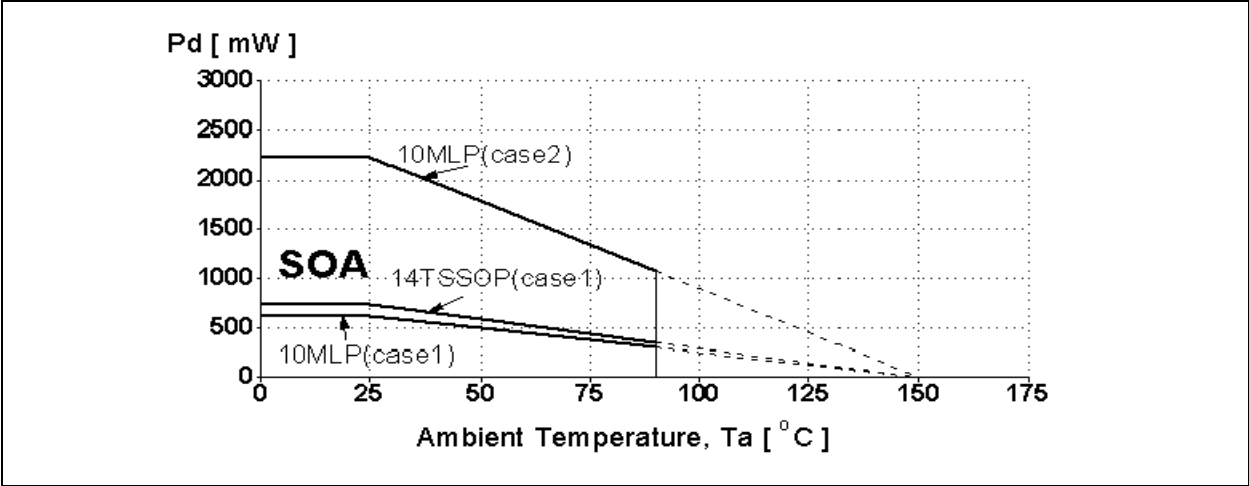
Parameter	Symbol	Value	Unit
Maximum power supply voltage	VCC _{MAX}	9.0	V
Thermal resistance	R _{ja}	178(14TSSOP case1)	°C/W
		208(10MLP case1) 57(10MLP case2)	
Maximum power dissipation	P _{DMAX}	0.7(14TSSOP case1)	W
		0.6(10MLP case1) 2.2(10MLP case2)	
Maximum output voltage	V _{OMAX}	10.5	V
Maximum output current	I _{OMAX}	0.5 ^{note1}	A
Maximum FG output current	I _{FG1}	5	mA
FG output withstanding voltage	V _{FG1}	9	V
Maximum 1/2FG output current	I _{FG2}	5	mA
1/2FG output withstanding voltage	V _{FG2}	9	V
Operating temperature	T _{OPR}	-30 ~ 90	°C
Storage temperature	T _{STG}	-55 ~ 150	°C

Case 1	Case 2	Remark
		Pd is measured base on the JEDEC/STD(JESD 51-2)
Pd= 0.6/0.7W	Pd= 2.2W	

Note

- Should not exceed P_D or SOA value.
- Refer: EIA/JESD 51-2 & EIA/JESD 51-3 & EIA/JESD 51-5 & EIA/JESD 51-7
- Case 1: Single layer PCB with 1 signal plane only, PCB size 76mm × 114mm × 1.6mm.
- Case 2: Multi layer PCB with 1 signal, 1 power and 1 ground planes, PCB size 76mm × 114mm × 1.6mm, Cu plane sizes for power and ground 74mm × 74mm × 0.035mm, thermal via hole pitch 0.9mm, via hole φ size 0.3mm, 6 via hole.

Power Dissipation Curve



Recommended Operating Conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	VCC	2.3	-	5.5	V

Equivalent Circuits

Description	Pin No. (10MLP)	Internal Circuit
Hall input	1, 3	
HB	2	
Output	5, 7	
FG/ 1/2FG	9, 10	

Electrical Characteristics

(Ta = 25°C, VCC = 3.3V unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Total						
Supply current	I _{CC}	Output off	-	15	21	mA
Hall bias voltage	V _{HB}	I _{ref} =5mA	1.1	1.2	1.3	V
Lock Detector & Auto Restart						
LD charging current	I _{LDC}	V _{LD} =0V-->1.0V, V _{LD} =1.0V	1.4	2.2	2.9	μA
LD discharging current	I _{LDD}	V _{LD} =2V-->1.0V, V _{LD} =1.0V	0.15	0.33	0.50	μA
LD clamp voltage	V _{LDCL}	-	0.8	1.2	1.6	V
LD comparator voltage	V _{LDCP}	-	0.4	0.6	0.8	V
Output Stage						
Output saturation voltage (Upper+Lower)	V _{OS}	I _O =100mA	-	0.2	0.4	V
Speed output(FG)						
FG output saturation voltage	V _{FGS1}	I _{FG1} =5mA	-	0.1	0.3	V
FG output leakage current	I _{FGL1}	V _{FG1} =5.5V	-	0.1	10	μA
1/2FG output saturation voltage	V _{FGS2}	I _{FG2} =5mA	-	0.1	0.3	V
1/2FG output leakage current	I _{FGL2}	V _{FG2} =5.5V	-	0.1	10	μA
Hall Amplifier						
Input range ^{note1}	V _{HDC}	-	0.3	-	VCC-1	V
Hall amplifier gain	GHA	-	47	50	53	dB

note:

1. Design guaranteed value

Application Information

1. BTL Single phase motor driver(OUT1, OUT2)

Using a BTL to drive a single-phase BLDC motor provides several advantages for dc fans over a H-bridge drive. A BTL drive has linear switching characteristics; hence, the BTL topology reduce commutation switching noise.

2. Locked Rotor Protection and Automatic Restart

When the rotor is locked, there is no change in input signal of hall amplifier and thus a internal T_{ZERO} 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} , the speed information output (FG, 1/2FG) becomes floating high or low. 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_{LDCP} . 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 FAN8463 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;

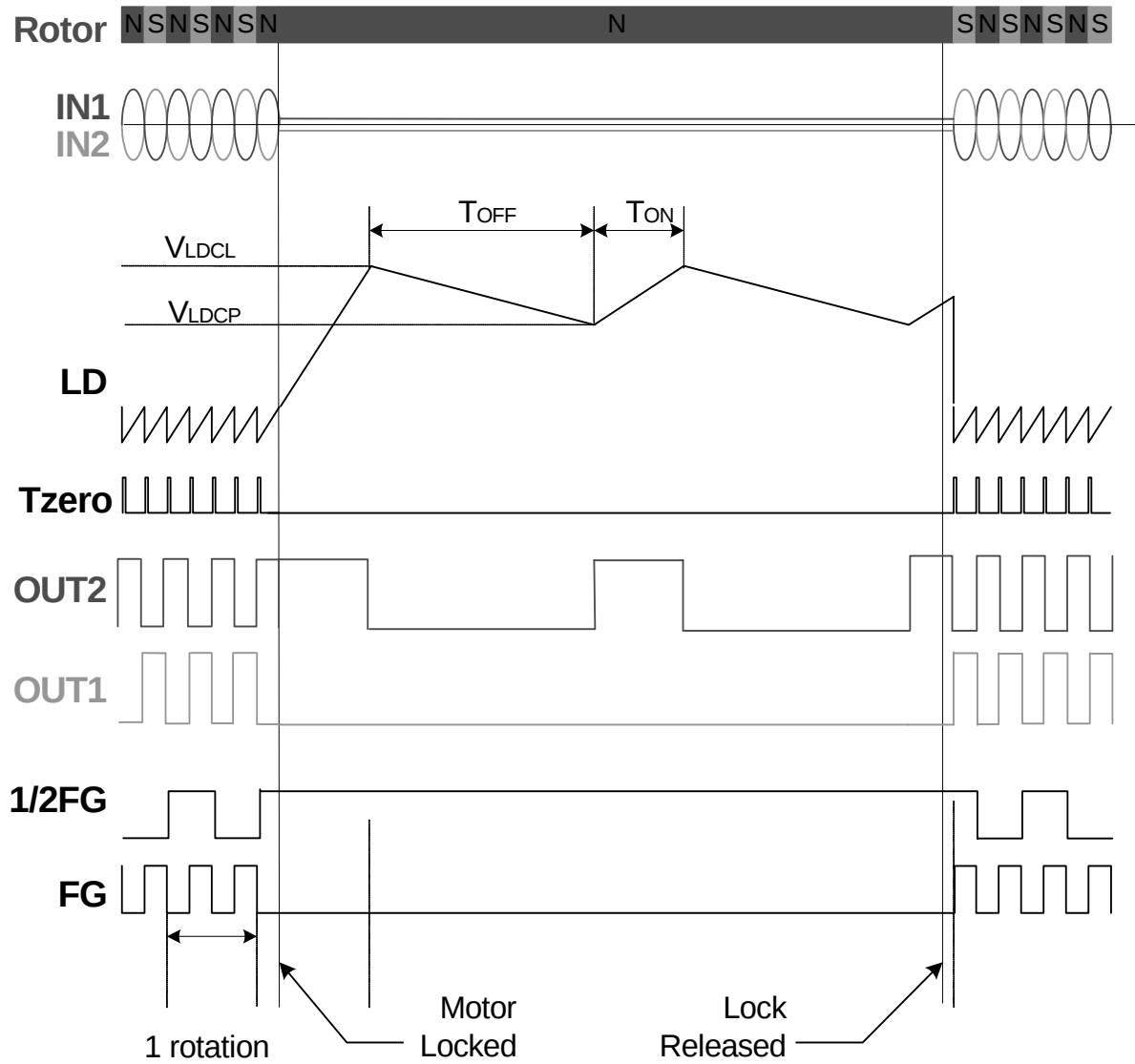
$$T_{ON} = \frac{C_{LD} \times (V_{LDCL} - V_{LDCP})}{I_{LDC}}$$

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

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

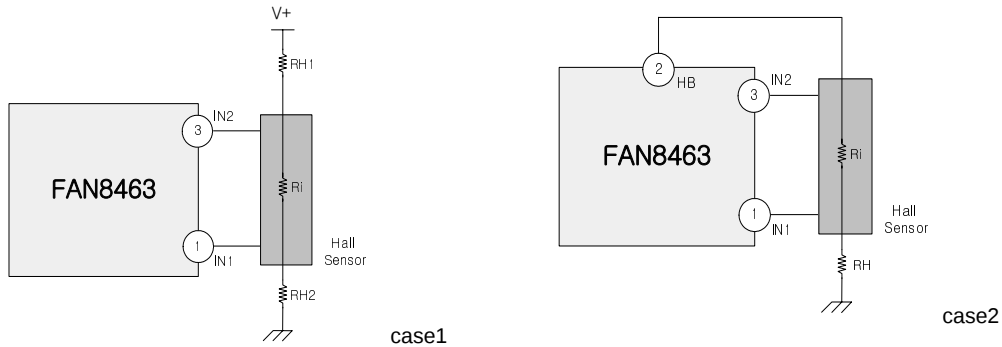
For example, $C_{LD} = 0.33\mu F$, then $T_{ON} = 0.09\text{Sec}$, $T_{OFF} = 0.6\text{Sec}$, $T_{LOCK} = 0.18\text{Sec}$.

Figure 1. The Overall Time chart



3. Hall Sensor Amplifier

Figure 2. Hall Sensor Interface



The hall current (I_H) is determined as follows;

$$I_H = \frac{V^+}{R_{H1} + R_{H2} + R_i} \quad \text{case1} \qquad I_H = \frac{V_{HB}}{R_H + R_i} \quad \text{case2}$$

Where, R_{H1} or R_{H2} is an external limiting resistor and R_i is input impedance of hall sensor. An external resistor, R_{H1} or R_{H2} , can be used to decide an amplitude of hall signal. The input range of hall amplifier is between 0.3V and $V_{CC}-1.0V$ as shown in following figure.

Figure 3. Hall Amplifier Input Range

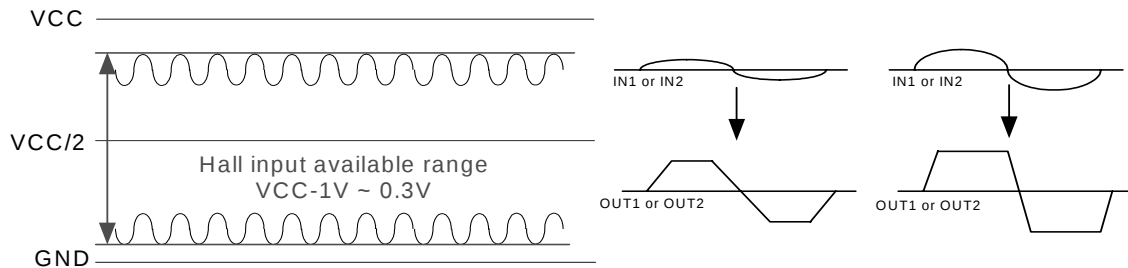


Table1. Hall Sensor Outputs and Related Pin outputs

IN1	IN2	LD	OUT 1	OUT 2	FG	Remark
L	H	Low Level	H	L	H	ROTATING
H	L	Low Level	L	H	L	
-	-	-	-	-	L or H	LOCK

4. Open Collector FG and 1/2FG 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 FG output signal has two pulses per revolution on a four pole motor and 1/2FG output signal has one pulse per revolution on a eight pole motor. It is recommended that this FG output be higher than the GND potential.

5. Supply Voltage Consideration

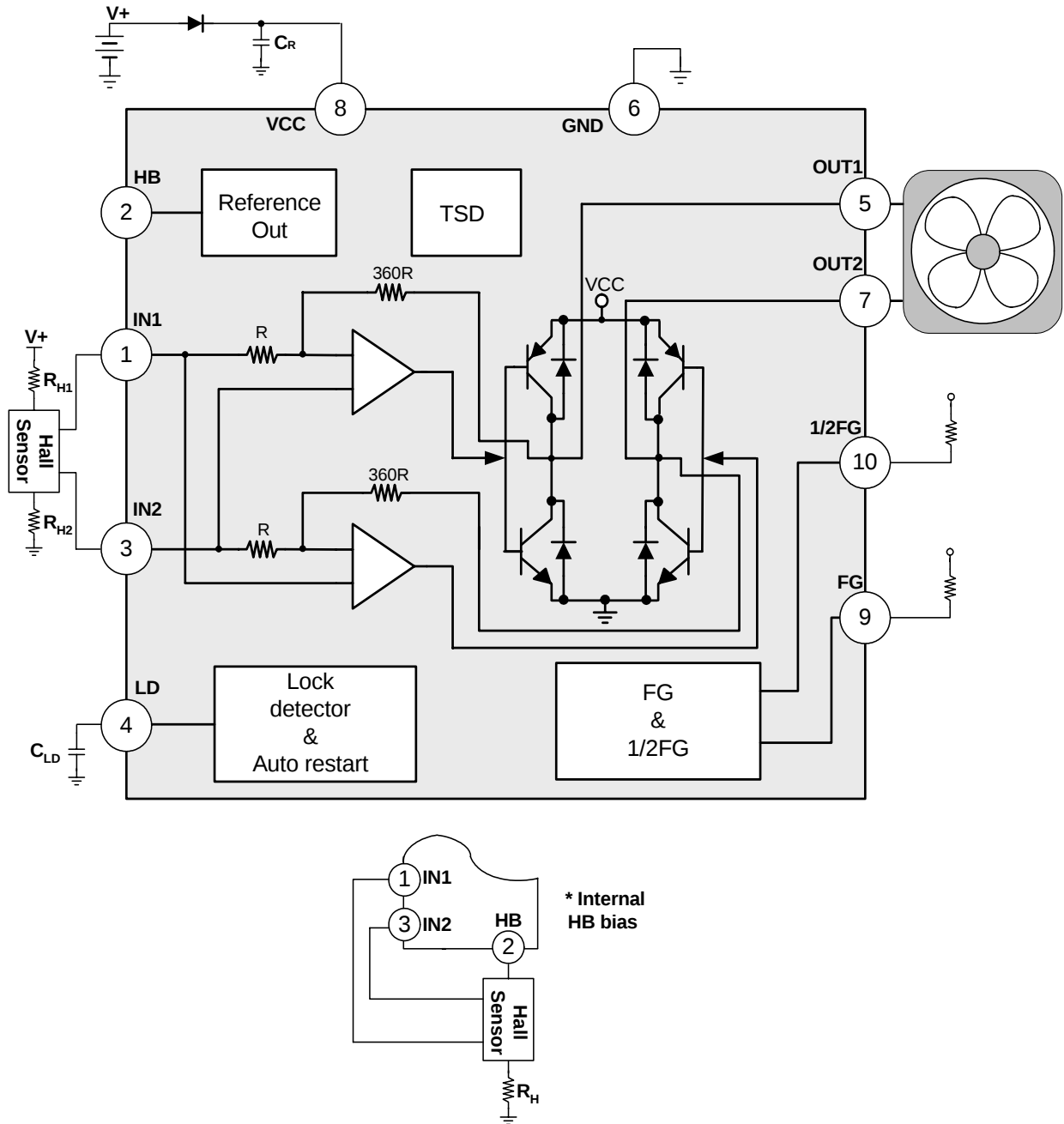
A supply sustain capacitor (C_R) should be placed as close to VCC pin with GND as layout permits. A reverse supply protection diode (D_R) prevent motor current from recirculating to power source when phase commutation occur. This results in increasing VCC pin voltage. This capacitor absorbs motor recirculating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

6. 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)

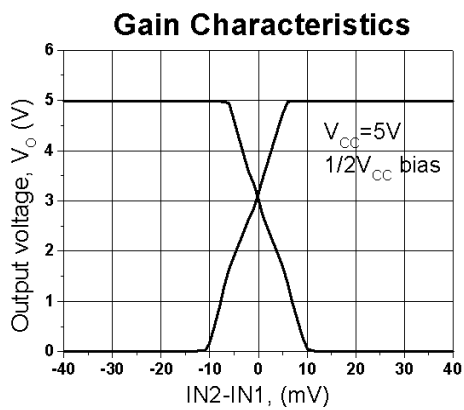
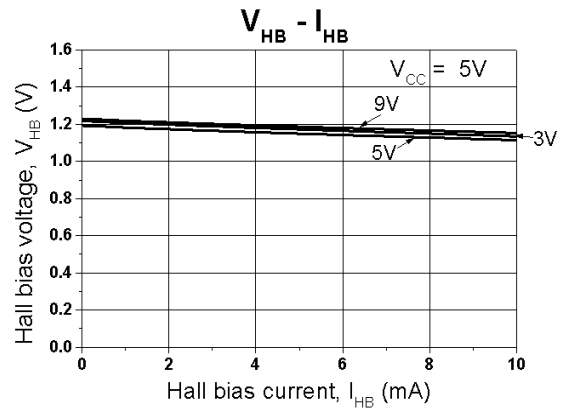
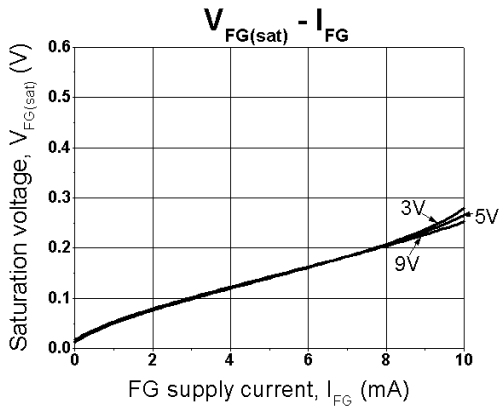
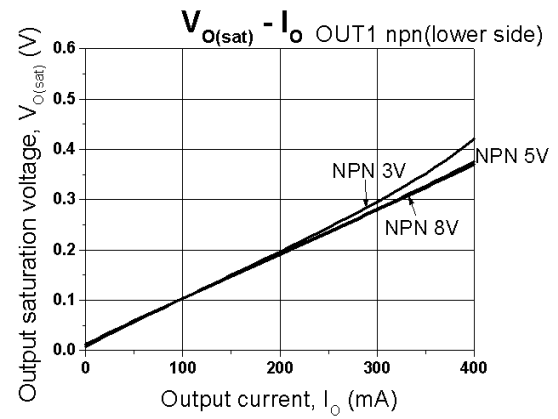
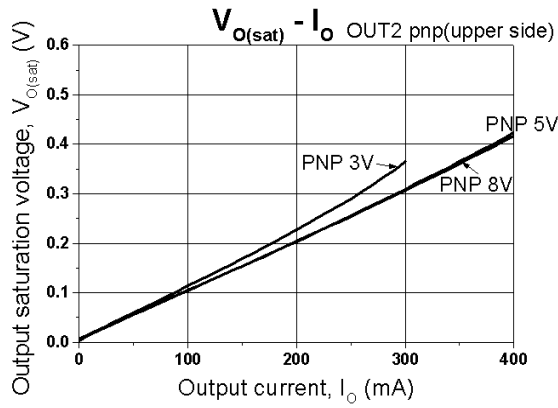
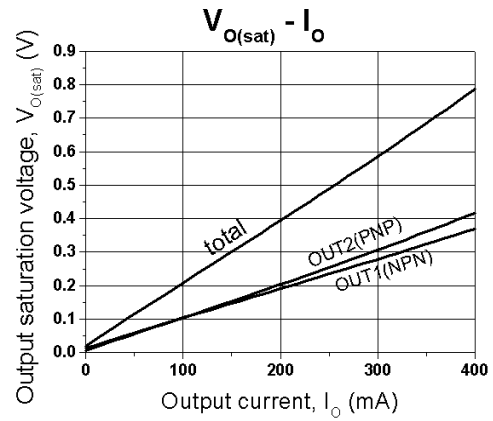
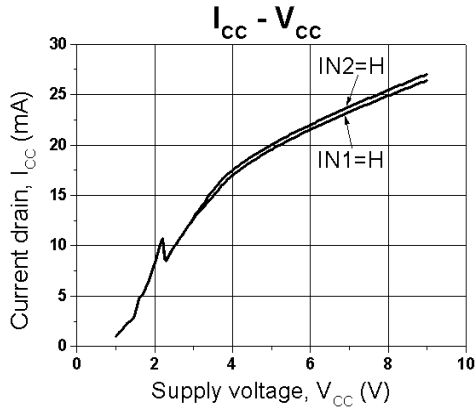
Typical Application Circuits



Recommended Parts Values

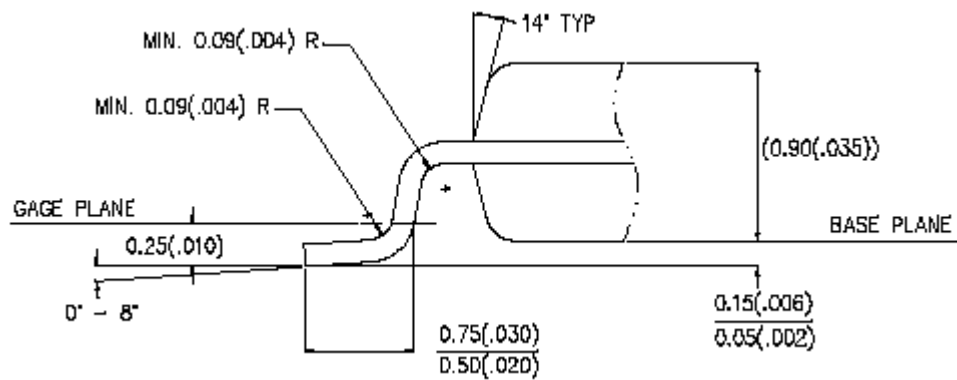
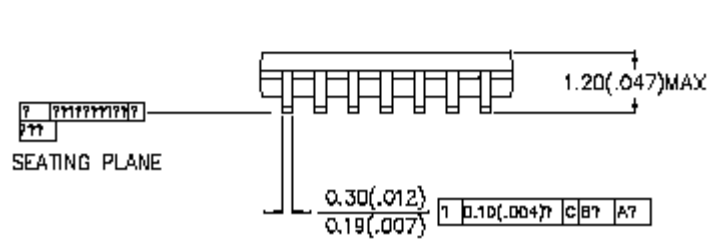
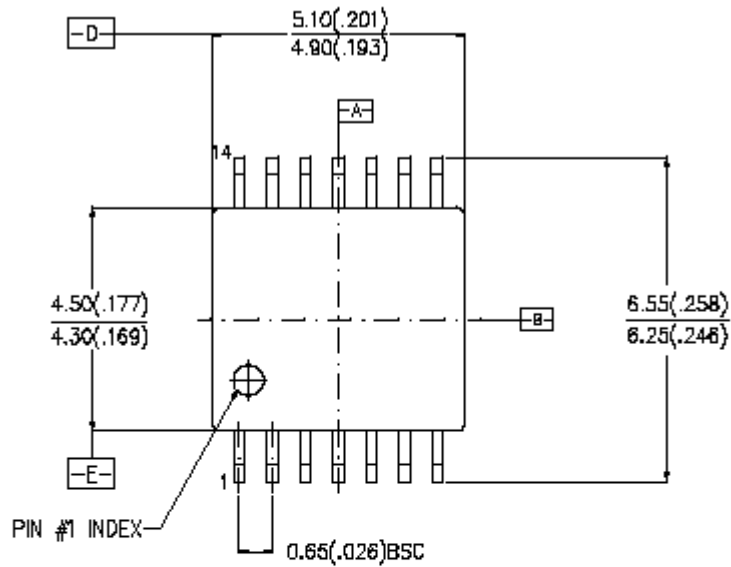
V+	CLD	RH1	RH2	RH	Condition
5V	0.33μF	1KΩ	220Ω	220Ω	Hall input impedance : Ri Hall output impedance : Ro Ri=Ro=300Ω
3.3V		1KΩ	0Ω	150Ω	

* Resistor (RH1, RH2, RH) values depend on the motor.



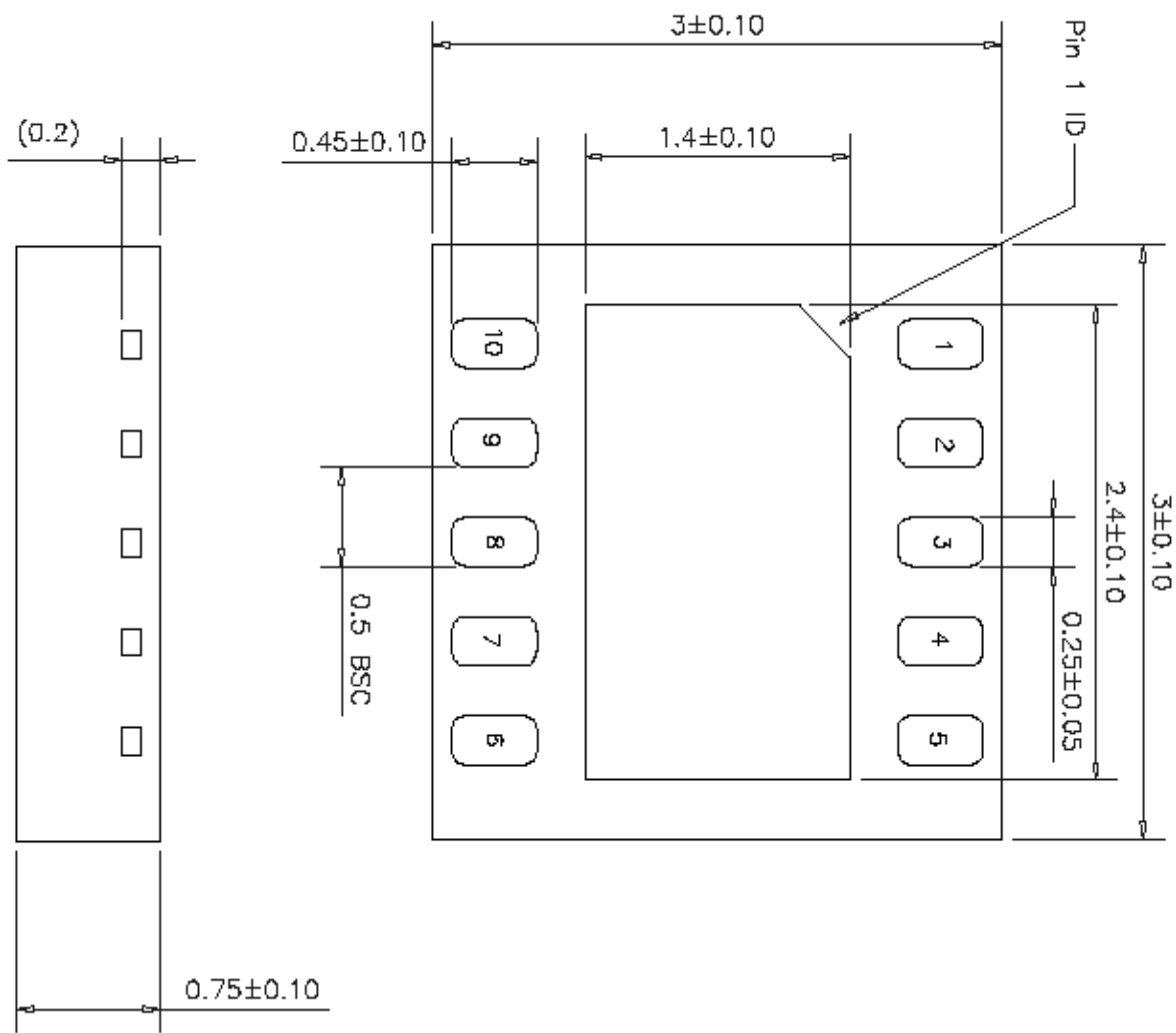
Package dimensions

14-TSSOP



Package Dimensions (Unit: mm)

10MLP



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