EUTECH
MICROELECTRONICS

700mA PWM Fan Motor Driver

DESCRIPTION

EUM6189A is designed specifically for electronic commutation of single coil brushless DC motor applications. It is intended to be used as an interface between a HALL IC and a single coil motor. The functions built in EUM6189A are soft switched drive mode, PWM speed control mode, fan tachometer, lock detection, automatic restart and thermal shut-down.

Soft switched drive mode makes the output signal gentle when the amplitude of HALL signal is small. Oppositely, it makes the output signal steep when the amplitude of HALL signal is big. PWM speed control mode makes EUM6189A possible to change motor rotation speed by switching upper side power device. If the motor is stalled by external force or obstacles, overdrive current may incur coil overheat/burning. To prevent this, lock detection circuit can shut down the driver for 5 seconds after motor lockup. Then automatic restart circuit will try to power up the driver for 500ms every 5 seconds.

EUM6189A has FG output.

FEATURES

- Single-Phase Full-Wave driver System
- Soft switched drive
- PWM speed control mode
- Lock detection, Automatic restart
- Tachometer Output
  FG output
- Thermal Shutdown Protection
- Available in MSOP-8 Package
- RoHS Compliant and 100% Lead (Pb)-Free

APPLICATIONS

- NB FAN Motor

Application Circuit and Block Diagram

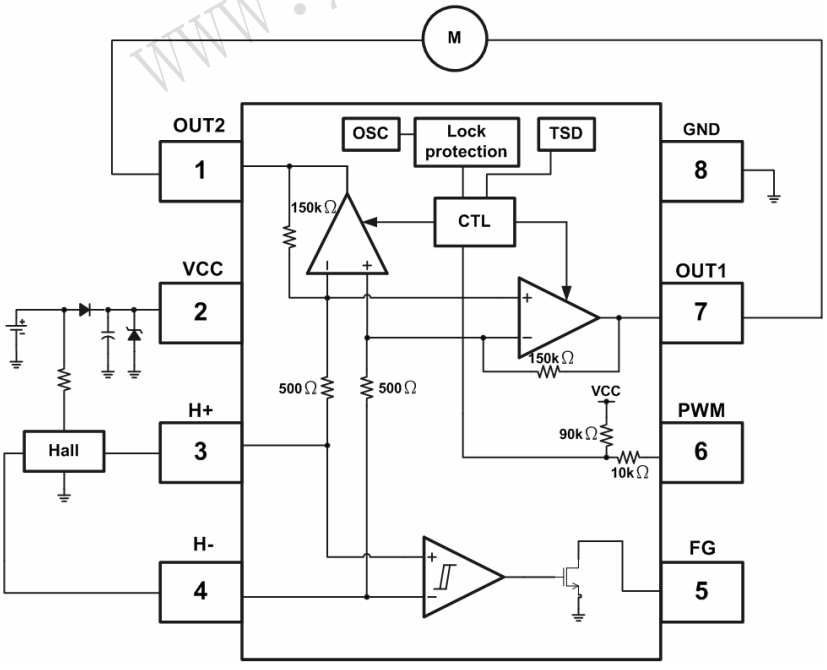
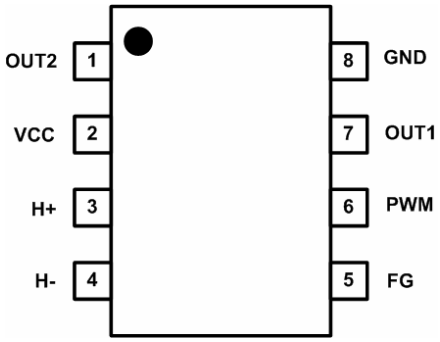


Figure 1.Application Circuit and Block Diagram

Pin Configurations

Package Type	Pin Configurations
MSOP-8	

Pin Description

NAME	PIN	DESCRIPTION
OUT2	1	Motor output terminal
VCC	2	Power supply terminal
H+	3	Hall input terminal
H-	4	Hall input terminal
FG	5	Output pin of fan tachometer (open-drain)
PWM	6	PWM control terminal
OUT1	7	Motor output terminal
GND	8	GROUND terminal

Power Dissipation

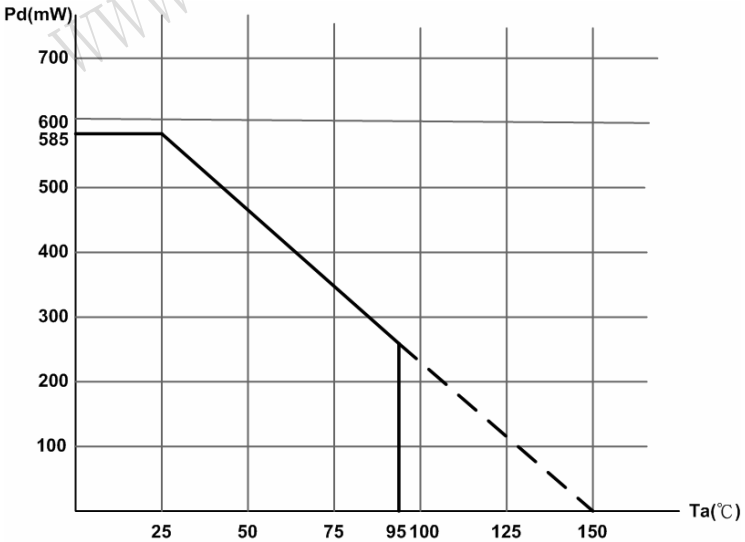


Figure 2. Power Dissipation

To use at temperature above Ta=25℃ reduce 4.68mW/℃

(On 70.0mn×70.0mn×1.6mm glass epoxy board)

Ordering Information

Order Number	Package Type	Marking	Operating Temperature Range
EUM6189AMIR1	MSOP-8	xxxxx 6189A	-40 °C to 95°C

EUM6189A □ □ □ □

Lead Free Code
1: Lead Free 0: Lead

Packing
R: Tape & Reel

Operating temperature range
I: Industry Standard

Package Type
M: MSOP-8

Truth Table for EUM6189A

H+	H-	PWM	OUT1	OUT2	FG
H	L	H	H	L	L (Output device: ON)
L	H	H	L	H	Z (Output device: OFF)
H	L	L	L	L	L (Output device: ON)
L	H	L	L	L	Z (Output device: OFF)

Absolute Maximum Ratings

- V_{CC} ---------- 7V
- V_{OUT} ---------- 7V
- I_{OUT} ---------- 900mA
  This value is not to be over Pd.
- IFG ---------- 10mA
- VFG---------- 7V
- Power Dissipation (MSOP-8)---------- 585mW
- Junction Temperature ---------- 150°C
- Operating Temperature Rang ---------- -40°C to 95°C
- Storage Temperature Range ---------- -55°C to 150°C
- Lead Temperature (Soldering, 10sec.) ---------- 260°C

Recommended Operating Conditions

- Supply Voltage, V_{CC} ---------- 2V to 6V
- Hall input voltage range---------- 0.3V to Vcc-1.1V

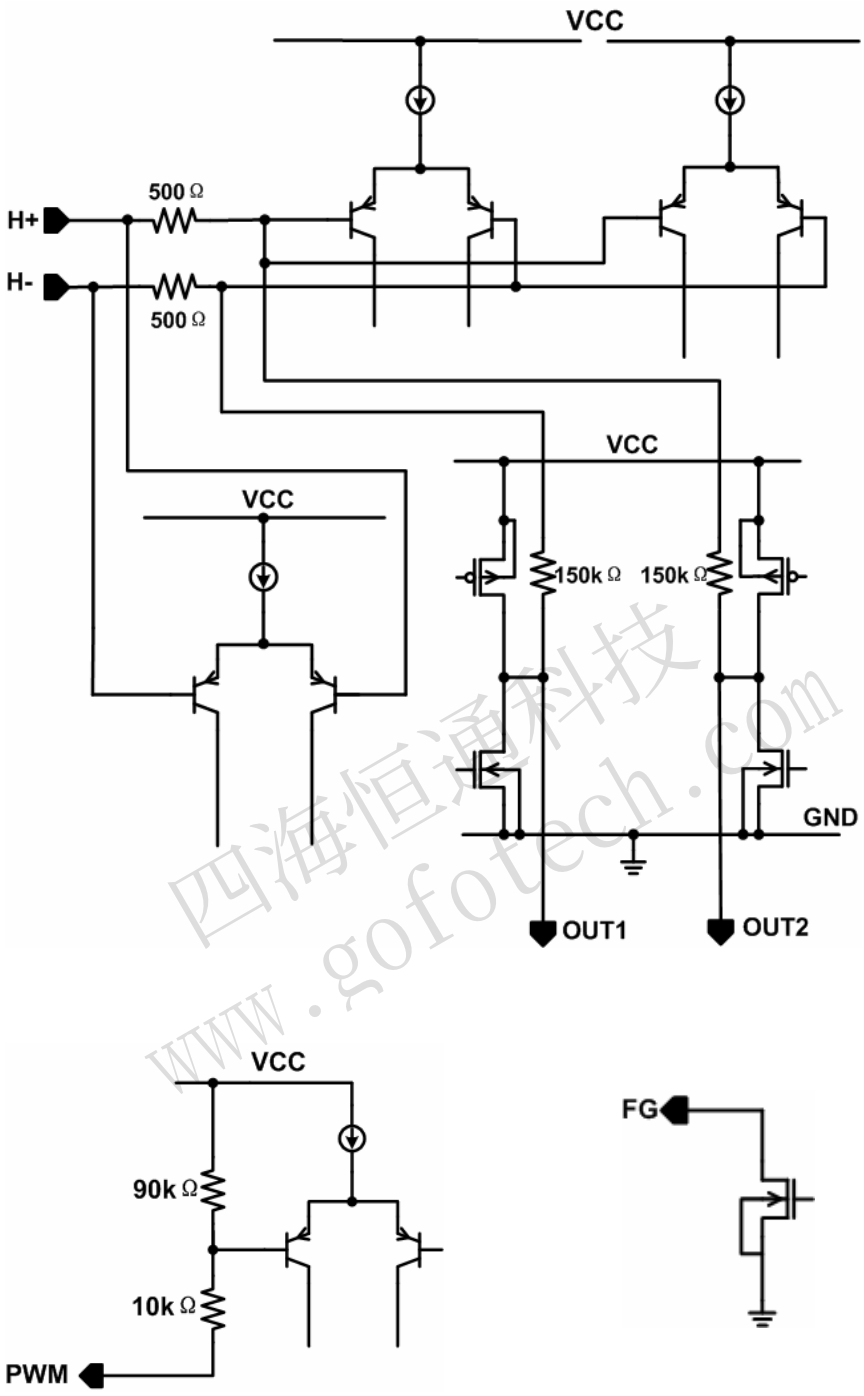
Electrical Characteristics

Specifications in standard type face are for Ta=25℃ and those with **boldface type** apply over the full Operating Temperature Range.(Ta=-40°C~95°C).V_{CC}＝5V unless otherwise specified.

	Parameter	Conditions	Limit			Unit
			Min	Typ	Max.	
ICC	Supply Current		--	2.1	**5.8**	mA
Hall input						
VHOFS	Input Offset Voltage		--	--	**±1.5**	mV
Output						
VO	Output Voltage	Io=250mA Upper and Lower total	--	0.27	**0.5**	V
Gio	Input-Output Gain		**45**	49	**51**	dB
FG signal output						
VFGL	FG Low Voltage	I_{FG}=3mA	--	--	**51**	mV
IFGL	FG Leak Current	V_{FG}=7V	--	--	**15**	μA
VHYS	Input hysteresis voltage		**±4.3**	±10	**±16.4**	mV
Lock protection						
TON	Lock Detection ON Time		0.41	0.61	0.66	sec
TOFF	Lock Detection OFF Time		3.8	6.3	7	sec
PWM input						
VPWMH	PWM Input H Level		2.5	-	VCC	V
VPWML	PWM Input L Level		0	-	0.7	V
FPWM	PWM Input Frequency		0.02	-	50	kHz

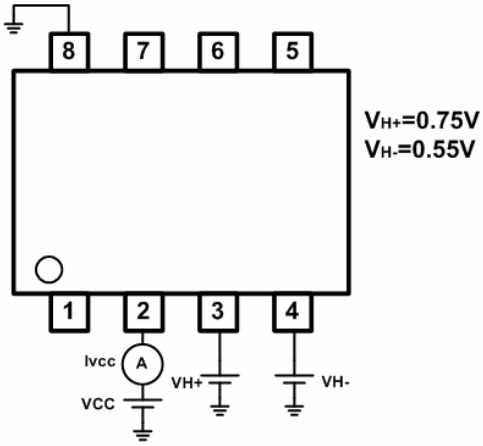
* This product is not designed for protection against radioactive rays.

Input Output Circuit

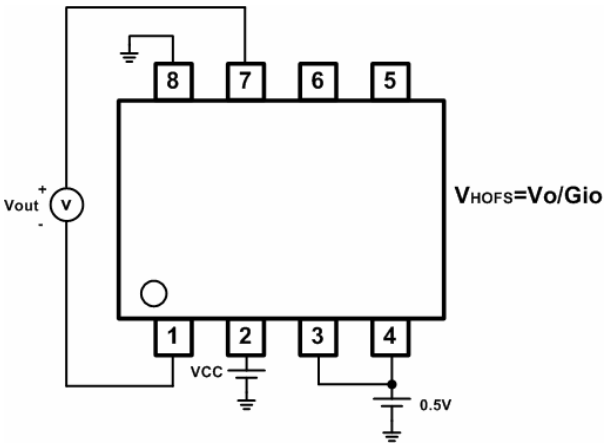


Measurement

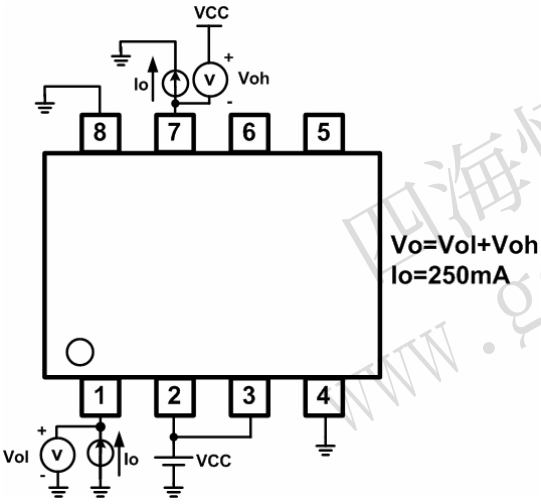
Supply Current



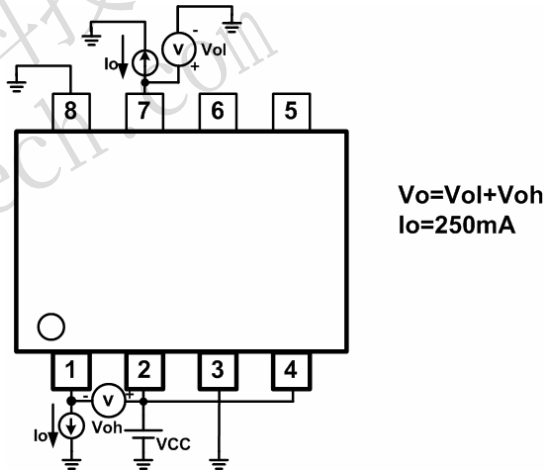
Input Offset Voltage



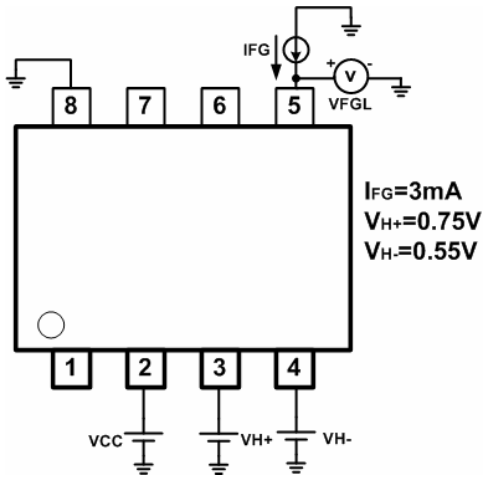
Output Voltage



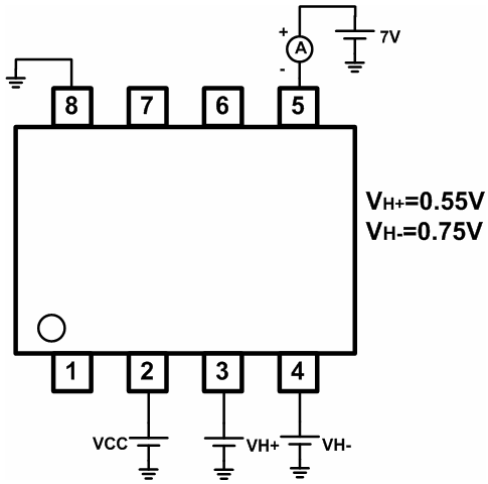
Output Voltage



FG Low Voltage



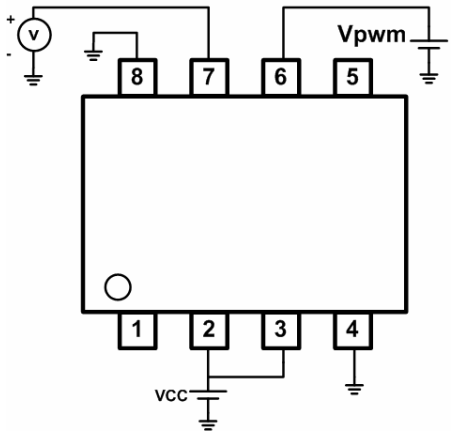
FG Leak Current



PWM Input H/L Level

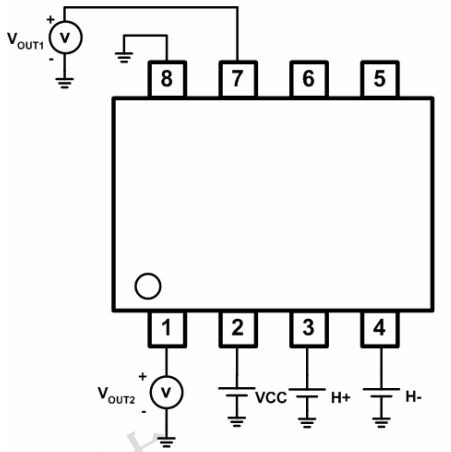
V_{PWMH}: Sweep up V_{PWM} from 0V
Measure V_{PWM} when V_{OUT1}: L→H

V_{PWML}: Sweep down V_{PWM} from 4.5V
Measure V_{PWM} when V_{OUT1}: H→L

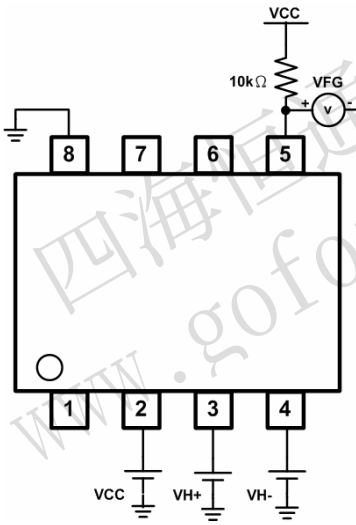


Input-Output Gain

STEP1: V_{H+} =0.505V
V_{H-} =0.5V
V1 =V_{OUT1}-V_{OUT2}
STEP2: V_{H+} =0.515V
V_{H-} =0.5V
V2 =V_{OUT1}-V_{OUT2}
STEP3: Gio=20log[(V2-V1)/0.01]



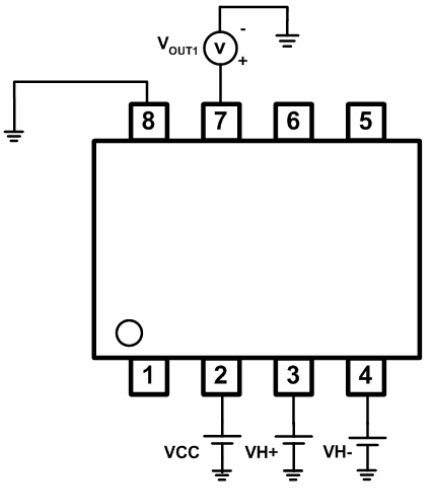
Input Hysteresis Voltage



Upper
V_{H-}=0.5V V_{H+}=0.45V V_{FG}=H
Sweep up V_{H+}, when V_{FG}: H→L
Measure V_{H+} V_{HYS}=V_{H+}-0.5V

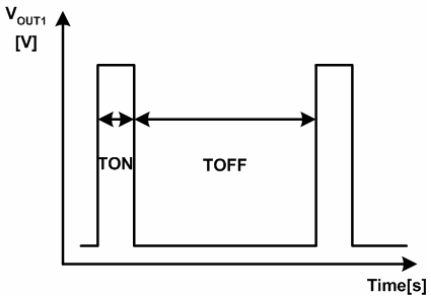
Lower
V_{H-}=0.5V V_{H+}=0.55V V_{FG}=L
Sweep down V_{H+}, when V_{FG}: L→H
Measure V_{H+} V_{HYS}=V_{H+}-0.5V

Lock Detection ON/OFF Time



V_{H+}=0.5V
V_{H-}=0.4V

Ton: the time V_{OUT1}=H
Toff: the time V_{OUT1}=L
(L<0.5V,H>4.95V)



Notes

Absolute maximum ratings

This product is produced with strict quality control, but destroyed in using exceed the absolute maximum ratings. Once IC destroyed, failure mode cannot be defined (like short-mode or open-mode). Therefore, physical security countermeasure, like fuse, is to be given when a specific mode to exceed the absolute maximum ratings is considered.

GND potential

The GND terminal should be the location of the lowest voltage on the chip.

Thermal design

The thermal design should allow enough margins for actual power dissipation.

Mounting failures

Mounting failures, such as misdirection or mismount, may destroy the device. The electrical short caused by falling particle, between outputs; power supply and output; or output and ground, may damage the device.

Electromagnetic field

A strong electromagnetic field may cause malfunction.

ASO

Please consider output transistors not to exceed absolute maximum ratings and ASO.

Hall signal input terminals (H+、H-)

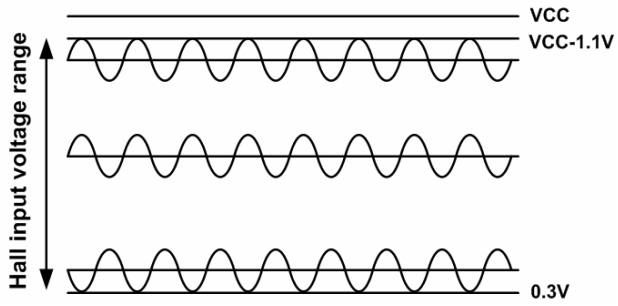


Figure 3. Hall Input Voltage Range

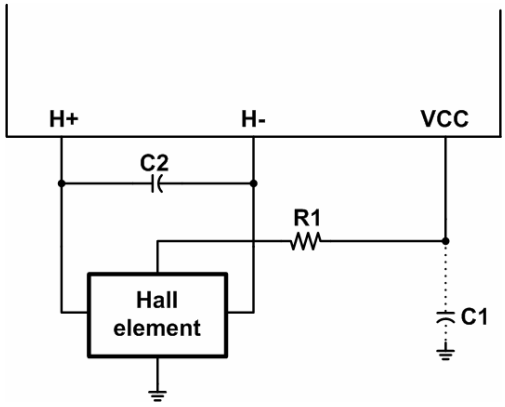


Figure 4. Connection of Hall Element

Please adjust Hall input voltage by value of R1 so that hall signal contains amplitude input within range 0.3V~Vcc-1.1V. In case VCC noise influence the hall signal by board wiring pattern, please connect capacitor C1. In the case of long board wiring pattern from hall element to hall signal input terminal, please connect capacitor C2.

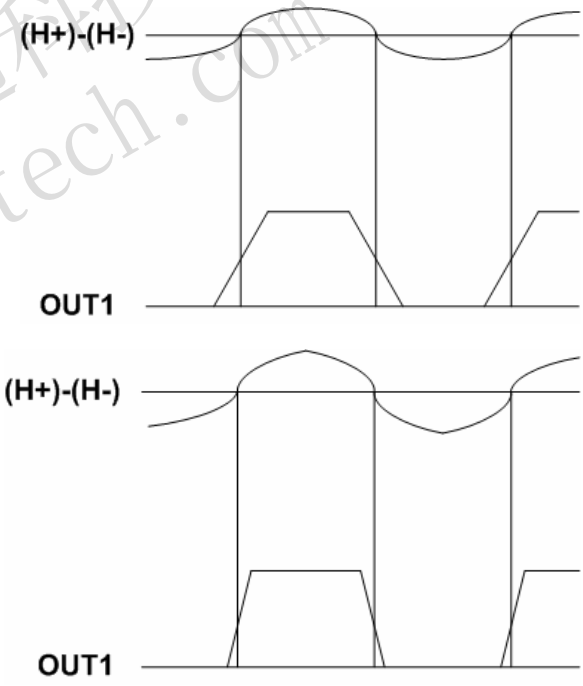


Figure 5. Difference of Output Signal Depending on Hall Input Signal

The output signal of this IC is the amplified hall input signal, therefore, the output signal depends on hall input signal. When the amplitude of hall signal is small, the output signal becomes gentle. Oppositely, the amplitude is big, the output signal becomes steep. The hall-input/output gain is about 300 times (TYP). So, please input the suitable signal to make an adequate amplitude of the output signal.

PWM input terminal

This IC is able to control motor rotation speed by switching upper side power device. To charge the motor coil current or to re-circulate the motor coil current depends on the input signal of PWM terminal.

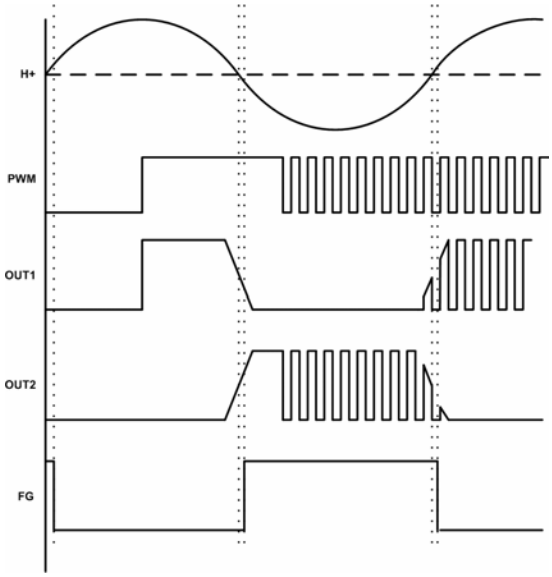


Figure 6. PWM Control Timing Chart

When the PWM input signal is H, the upper side power device is ON, so the current in motor coil is charged.
When the PWM input signal is L, the upper side power device is OFF, so the current in motor coil is re-circulated.
When the PWM terminal is open, it is equal to H.
(0.4V input Hysteresis is designed in PWM comparator.)

Thermal shut down (TSD)

This IC is built-in TSD.

TSD has the temperature hysteresis.

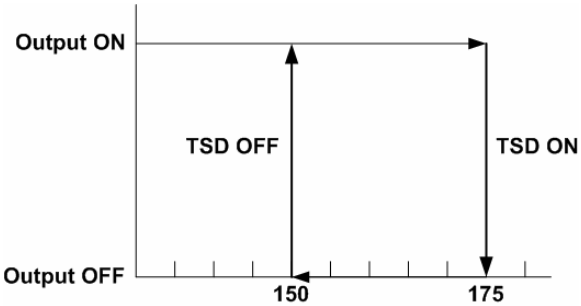


Figure 7. TSD

TSD ON (TYP. :175℃) All output transistor OFF.

TSD OFF (TYP. :150℃) Reset ordinary motion.

(It has the temperature hysteresis of 25℃ <TYP>)

Reverse connection of power supply

Reverse connection of power supply may break the device. A countermeasure is needed such as using reverse current protection diode between power supply and VCC terminal.

Power supply line

The Back Electromotive Force (BEMF) causes re-circulate current back to the power supply. VCC, which can raise power supply momentarily and generate a sharp voltage spike. To ensure EUM6189A working properly, bypass VCC to GND with a 2.2μF ceramic capacitor very close to IC.

Lock detection , automatic restart circuit

This IC detect the rotation of the motor by hall signal, and adjust lock detection ON time (Ton) and lock detection OFF time (Toff) by the internal counter. These time (Ton, Toff) are showed below.

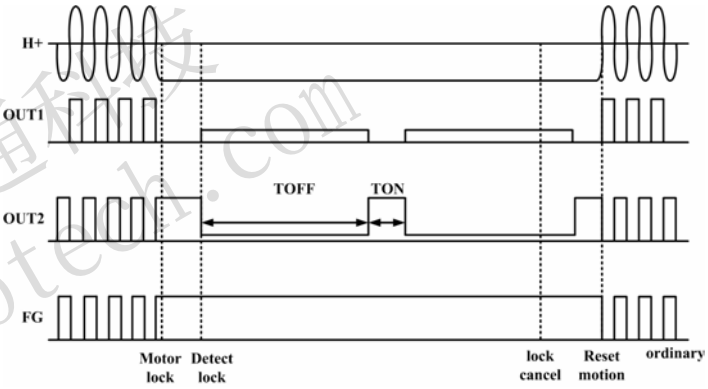


Figure 8. Lock Detect and Auto Restart Motion

*Motor does not restart while lock detection off time.

EUM6189A will turn off lock protection function, if PWM keeps low for more than 66.5mS (Typ.)

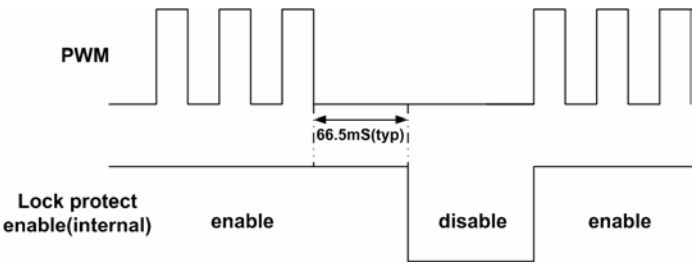
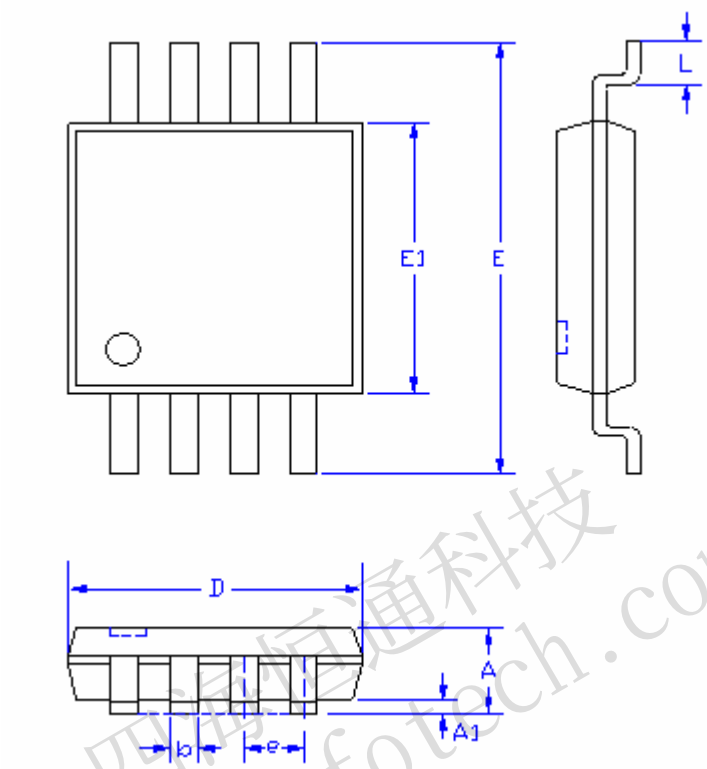


Figure 9. PWM Input Signal and Lock Protect Functions

If PWM frequency is small than 15Hz (Typ.), the lock protection function will not work. 20Hz or bigger PWM frequency is recommend.

Packaging Information

MSOP-8



SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	-	1.10	-	0.043
A1	0.00	0.15	0.000	0.006
D	3.00		0.118	
E1	3.00		0.118	
E	4.70	5.10	0.185	0.201
L	0.40	0.80	0.016	0.031
b	0.22	0.38	0.008	0.015
e	0.65		0.026	