

# FAN8412M/FAN8413M

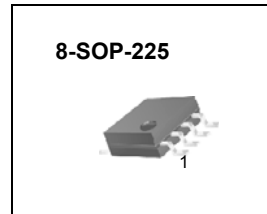
## 2 Phase Half Wave BLDC Motor Predriver

### Features

- A wide range of operation voltage: 4V to 28V
- Locked motor protection with open collector alarm out or speed out and auto retry
- Compact package: 8-SOP-225

### Description

The FAN8412M/FAN8413M is a monolithic integrated circuit, and suitable for DC cooling fan motors predriver.



### Typical Applications

- DC cooling fan motor

### Ordering Information

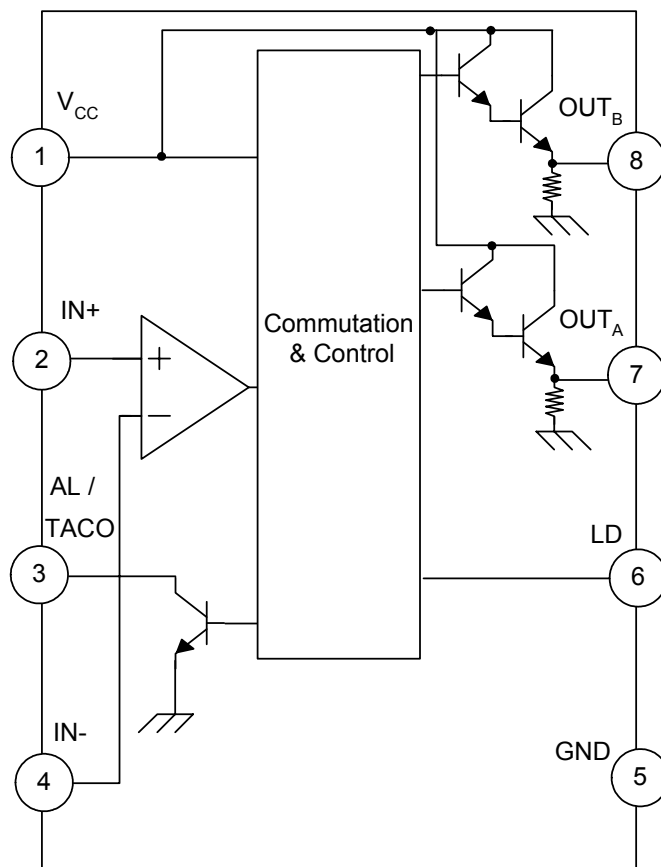
Device	Package	Operating Temp.
FAN8412M	8-SOP-225	-40°C ~ 95°C
FAN8412MX	8-SOP-225	-40°C ~ 95°C
FAN8413M	8-SOP-225	-40°C ~ 95°C
FAN8413MX	8-SOP-225	-40°C ~ 95°C
FAN8412M_NL	8-SOP-225	-40°C ~ 95°C
FAN8412MX_NL	8-SOP-225	-40°C ~ 95°C
FAN8413M_NL	8-SOP-225	-40°C ~ 95°C
FAN8413MX_NL	8-SOP-225	-40°C ~ 95°C

#### Note

X : Tape & Reel

NL : Lead Free

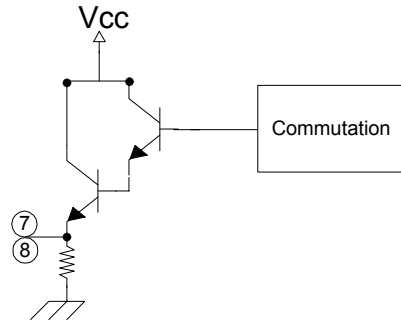
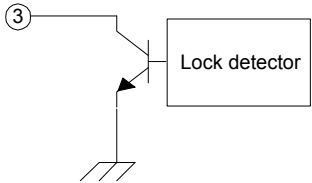
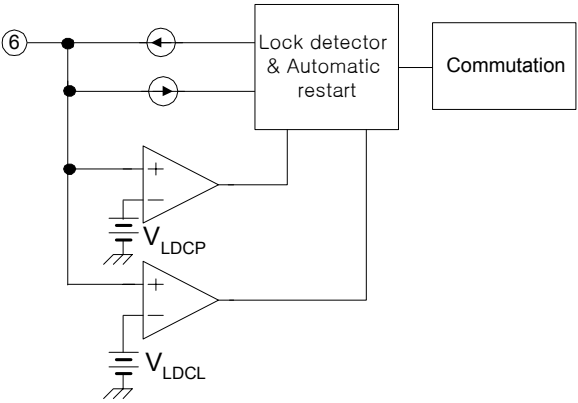
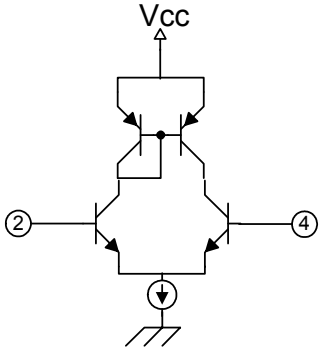
## Block Diagram



## Pin Definitions

Pin Number	Pin Name	I/O	Pin Function Description	Remark
1	VCC	P	Supply voltage	-
2	IN+	A	Hall input +	-
3	AL	O	Alarm output (For FAN8412M)	Open Collector
	TACO	O	Speed output (For FAN8413M)	Open Collector
4	IN-	A	Hall input -	-
5	GND	P	Ground	-
6	LD	A	Triangle pulse generator for lock detector and automatic restart	-
7	OUTA	A	Motor output A	-
8	OUTB	A	Motor output B	-

## Equivalent Circuits

Description	Pin No.	Internal Circuit
OUTA	7	
OUTB	8	
AL / TACO	3	
LD	6	
IN+	2	
IN-	4	

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

Parameter	Symbol	Value	Unit
Maximum Power Supply Voltage	VCCMAX	32	V
Maximum Power Dissipation <sup>note1</sup>	PDMAX	600	mW
Thermal Resistance <sup>note1</sup>	θJA	208	°C/W
Maximum Output Voltage	VOMAX	36	V
Maximum Output Current	IOMAX	0.07	A
Alarm Output Current	I <sub>AL</sub>	10	mA
Alarm Output Withstanding Voltage	V <sub>AL</sub>	36	V
TACO Output Current	I <sub>TACO</sub>	10	mA
TACO Output Withstanding Voltage	V <sub>TACO</sub>	36	V
Operating Temperature	T <sub>OPR</sub>	-40 ~ 95	°C
Storage Temperature	T <sub>STG</sub>	-55 ~ 150	°C

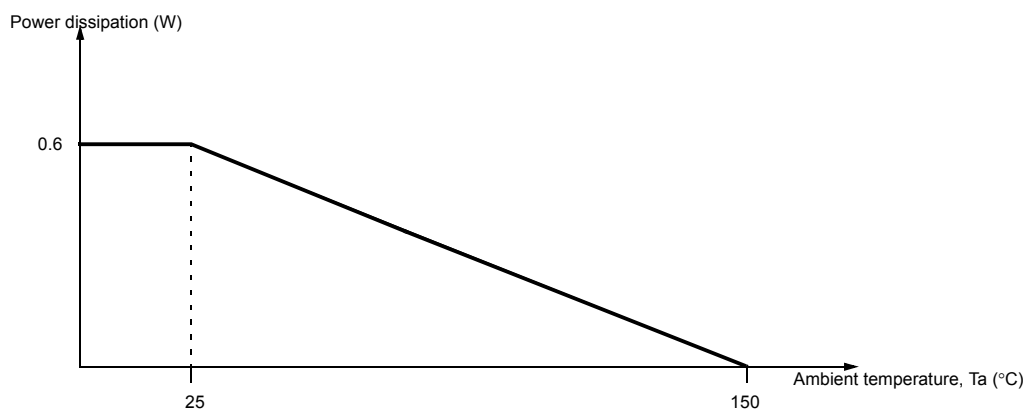
### Note1:

PCB Condition: Thickness (1.6mm), Dimension (76.2mm \* 114.3mm)

Refer: EIA/J SED 51-2 & EIA/J SED 51-3

Should not exceed PD or ASO value

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



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

Parameter	Symbol	Min.	Typ.	Max.	Unit
Function Compensation Operating Voltage	VCC	4.0	–	28.0	V

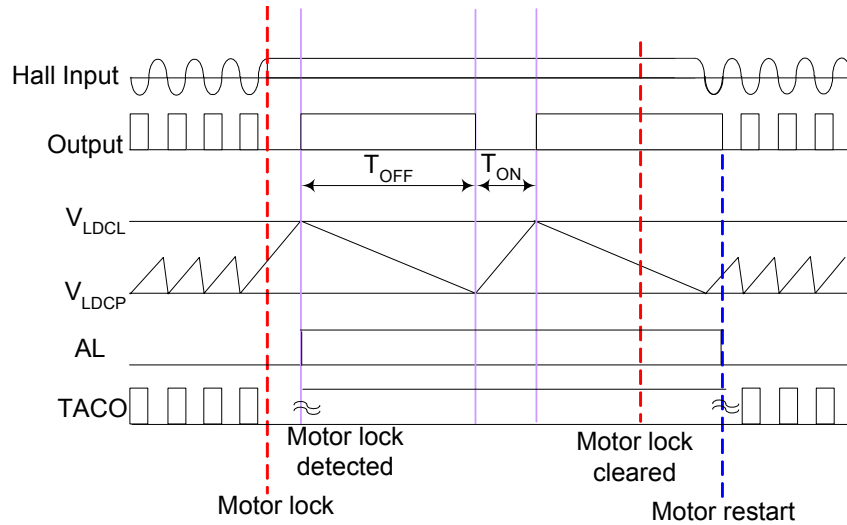
## Electrical Characteristics

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

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>TOTAL</b>						
Supply Current	ICC	When output is off.	-	3.2	5.0	mA
<b>HALL AMPLIFIER INPUT RANGE</b>						
Pin2,4 Hall Input Range	VHDC	-	1	-	Vcc-2	V
Pin2,4 Hall Input Offset	VHOF	-	15	-	-	mV
<b>LOCK DETECTOR &amp; AUTO RESTART</b>						
Pin6 Lock Detector Charging Current	ILDC	VLD=1.5V	2.2	3.8	5.7	μA
Pin6 Lock Detector Discharging Current	ILDD	VLD=1.5V	0.4	0.88	1.6	μA
Pin6 Lock Detector Charging/Discharging Ratio	RCD	RCD=ILDC/ILDD	3	5	7	-
Pin6 Lock Detector Capacitor Clamp Voltage	VLDC	-	2.54	2.94	3.34	V
Pin6 Lock Detector Capacitor Comparator Voltage	VLDCP	-	0.54	0.74	0.94	V
<b>OUTPUT STAGE</b>						
Pin7, 8 Output High Level Voltage	VOH	IO=10mA	10	10.5	-	V
Pin7, 8 Output Low Level Voltage	VOL	IO=10mA	-	-	0.5	V
<b>AL / TACO OUTPUT</b>						
Pin3 Alarm Output Low Level Voltage	VALL	IO=10mA	-	0.2	0.5	V
Pin3 Alarm Output Current Capacity	I <sub>AL</sub>	V <sub>AL</sub> =2.0V	8	-	-	mA
Pin3 Taco Output Low Level Voltage	VTACOL	IO=10mA	-	0.2	0.5	V
Pin3 Taco Output Current Capacity	I <sub>TACOL</sub>	V <sub>TACO</sub> =2.0V	8	-	-	mA

## Application Information

### 1. Lock Detection & Automatic Restart



FAN8412M/FAN8413M features a lock detection and an automatic restart. The functions can be operated as follows.

When the rotor is locked, there is no change in input signal of hall amplifier.

A capacitor( $C_{LD}$ ) connected LD pin is continually charged by internal current source ( $I_{LDC}$ ) to internal threshold( $V_{LDCL}$ ).

When the voltage,  $V_{CLD}$  on LD pin, reaches  $V_{LDCL}$ , output power  $TR$  is turned-off to protect motor during  $T_{OFF}$  and alarm output( $AL$ ) becomes floating high and taco output( $TACO$ ) becomes remain 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,  $V_{LDCLP}$ . At that time, the  $V_{CLD}$  charging repeat until locked condition is removed, or FAN8412M/FAN8413M is power down.

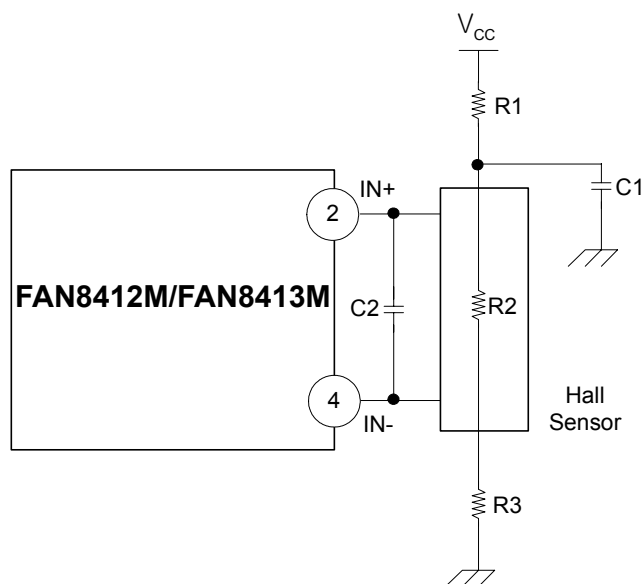
The auto-restart time ( $T_{ON}$ ), the motor protection time( $T_{OFF}$ ) are proportional to external capacitor,  $C_{LD}$  and each value can be calculated as follow;

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

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

For example,  $C_{LD}=1\mu F$ , then  $T_{ON}=0.57\text{Sec}$ ,  $T_{OFF}=2.2\text{Sec}$ . This  $AL$  or  $TACO$  output can be used to inform a locked rotor condition or speed information to super IO or system controller. Because the  $AL$  or  $TACO$  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).

## 2. Hall Amplifier Input Block



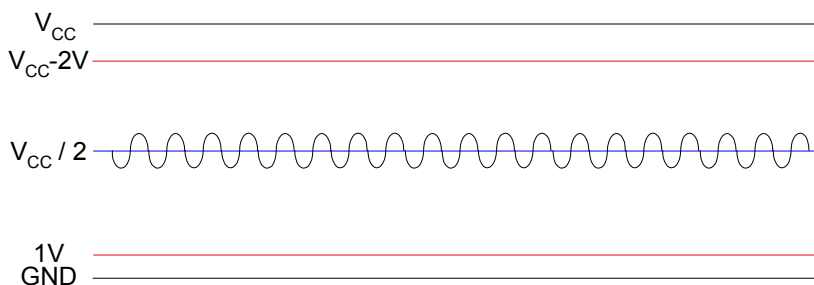
The hall current ( $I_H$ ) is determined by R1, R2 and R3.

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

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 2 / 4) of the device.

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

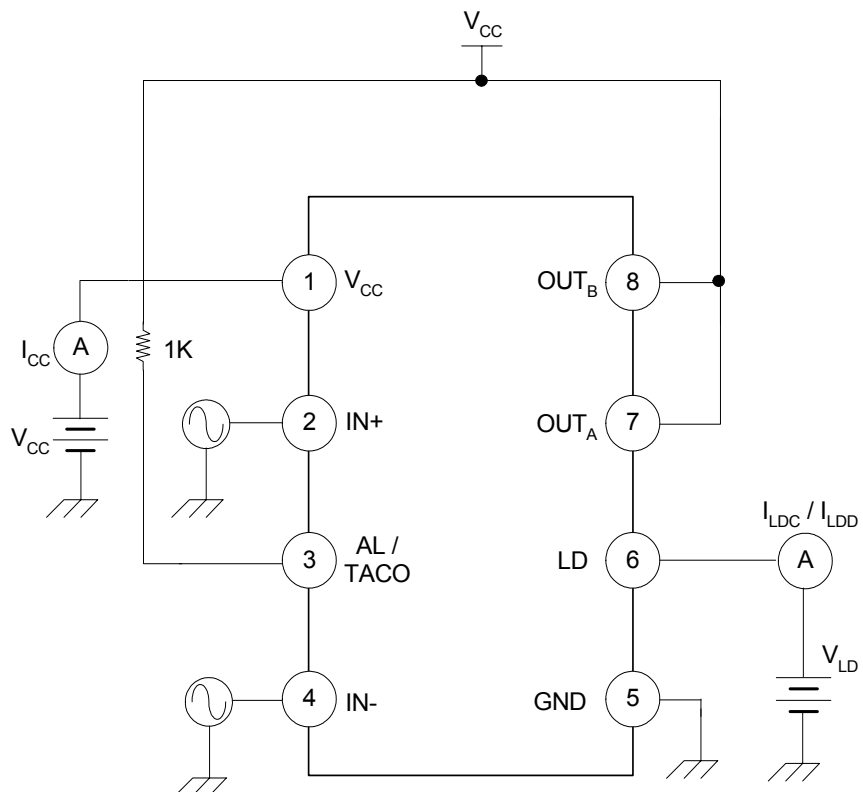


It is recommended that R1 and R3 should have the same value to make the output signal of hall sensor centered as  $V_{CC}/2$ .

## Operation Truth Table

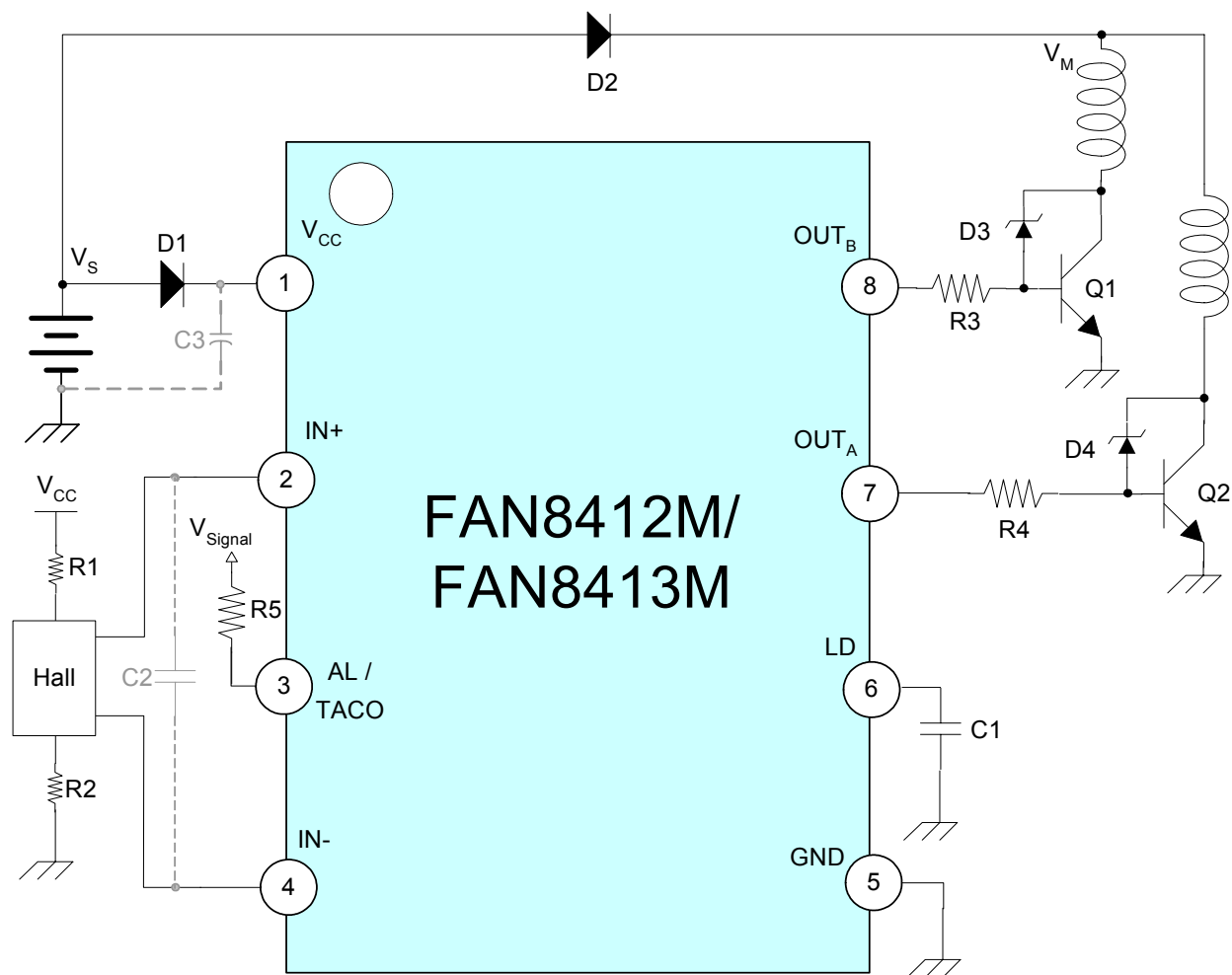
IN+	IN-	OUT <sub>A</sub>	OUT <sub>B</sub>	AL	TACO	Remark
High	Low	High	Low	Low	High	Rotating
Low	High	Low	High	Low	Low	
Low or High	Low or High	Low or High	Low or High	High	Low or High	Lock

## Test Circuits



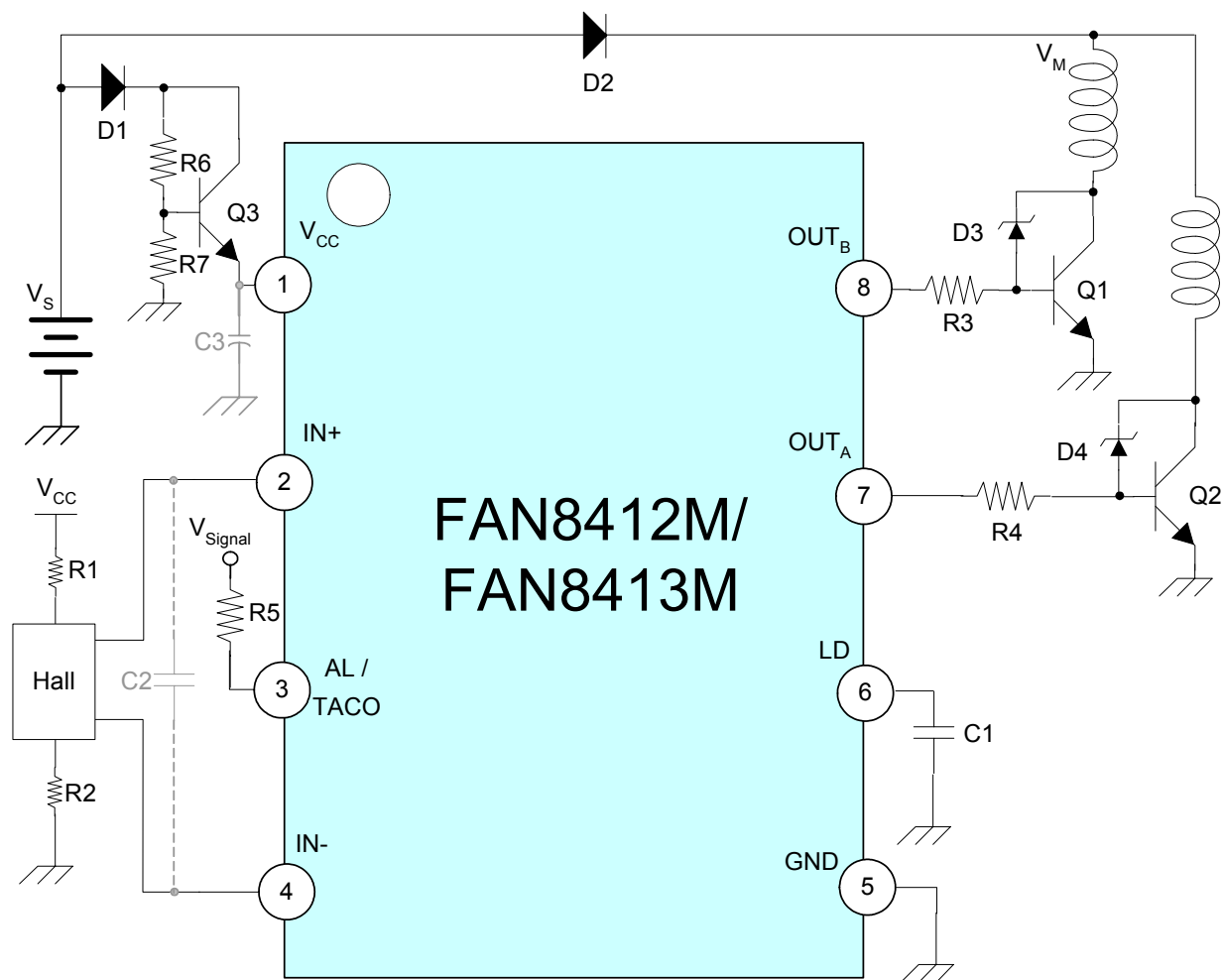


## Typical Application Circuits1 (12V / 24V)



- 1.D1 : A reverse protection diode for IC.
  - 2.D2 : A reverse protection diode for motor coil.
  - 3.D3/D4 : Zener diode for freewheeling.
  - 4.R1/R2 : A resistor to set DC hall bias level.
  - 5.R3/R4 : A resistor to limit a base current of external power TR.
  6. R5 : A pull-up resistor for taco output signal when a fan motor is locked.
  7. C1 : A Capacitor for lock protection and detection of a fan motor.
- If lock protection and detection functions are not necessary , LD pin should be connect ground.
- 8.C2 : A capacitor to reduce a noise in hall input stage. This is not necessary in case of no noise.
  - 9.C3 : This is not necessary in case the stable input on V<sub>CC</sub> is provided.
  - 10.Q1/Q2 : An external power TR .

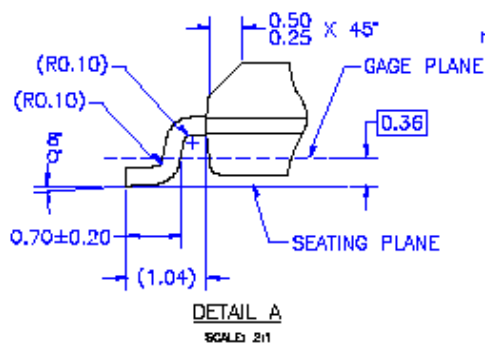
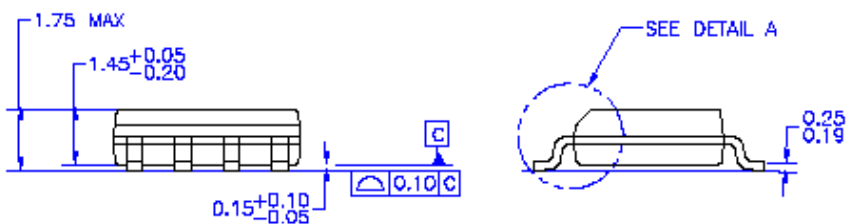
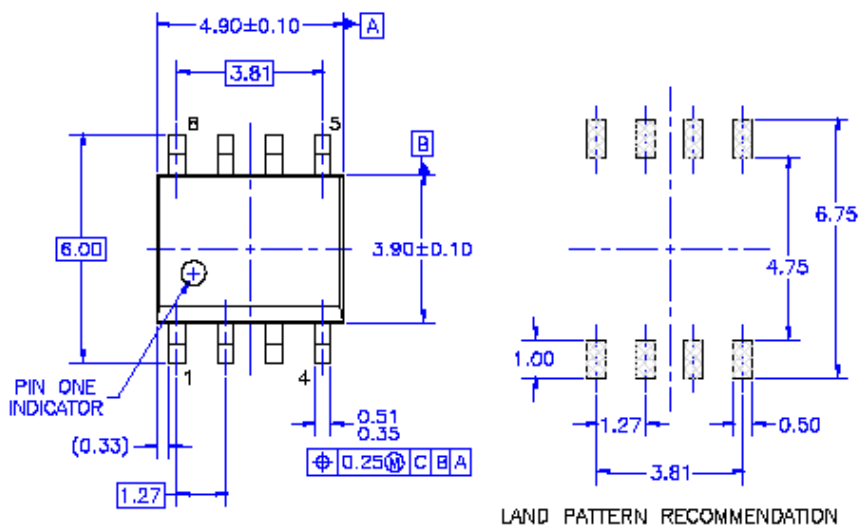
## Typical Application Circuits2 (48V)



- 1.D1 : A reverse protection diode for IC.
  - 2.D2 : A reverse protection diode for motor coil.
  - 3.D3/D4 : Zener diode for freewheeling.
  - 4.R1/R2 : A resistor to set DC hall bias level.
  - 5.R3/R4 : A resistor to limit a base current of external power TR.
  - 6.R5 : A pull-up resistor for taco output signal when a fan motor is locked.
  - 7.R6/R7 : A resistor to set a output voltage of TR(Q3).
  - 8.C1 : A Capacitor for lock protection and detection of a fan motor.
- If lock protection and detection functions are not necessary , LD pin should be connect ground.
- 9.C2 : A capacitor to reduce a noise in hall input stage. This is not necessary in case of no noise.
  - 10.C3 : This is not necessary in case the stable input on VCC is provided.
  - 11.Q1/Q2 : An external power TR .
  - 12.Q3 : An external power TR to control output voltage.

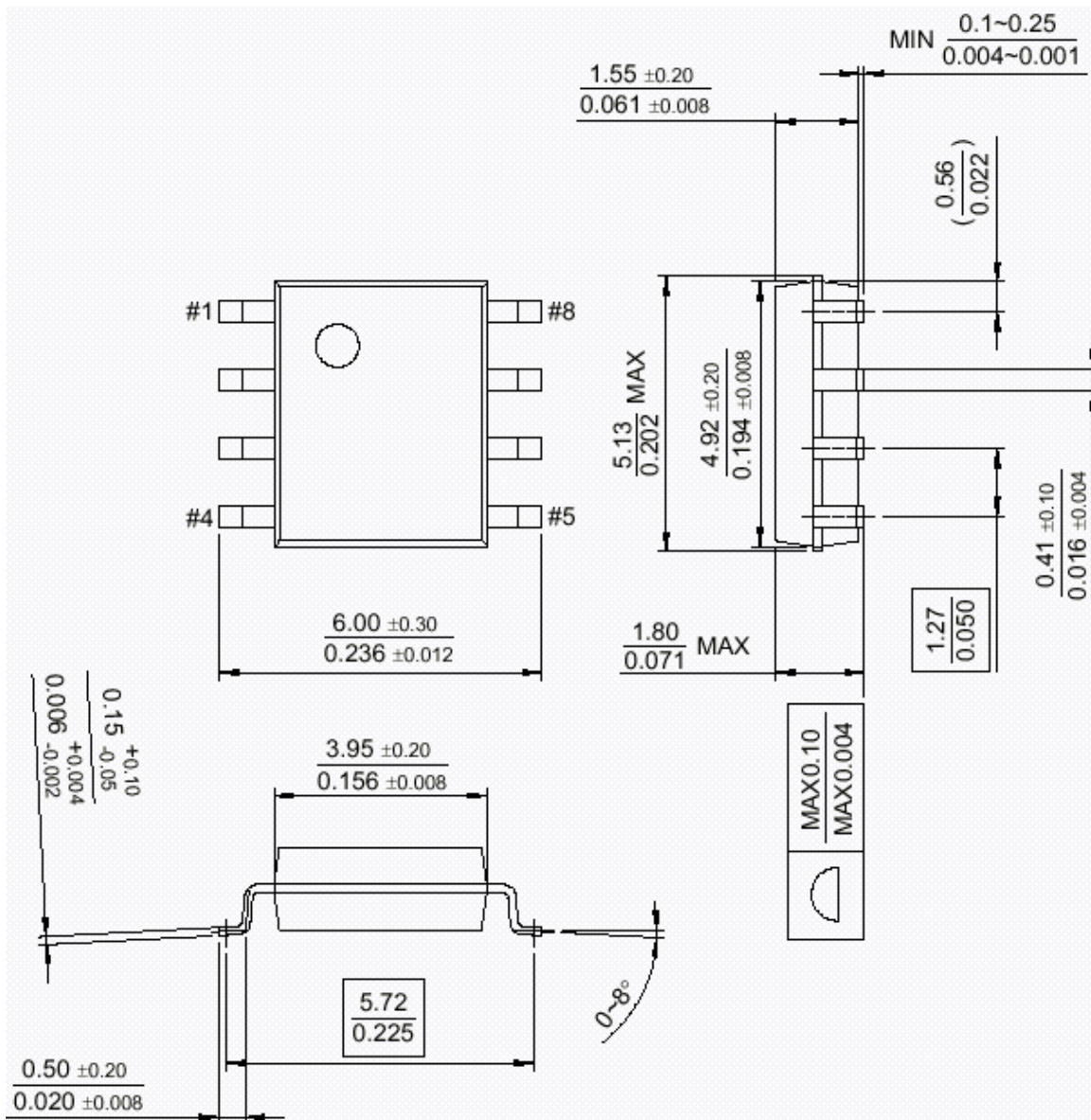
Package Dimensions (Unit: mm)

8-SOP-225

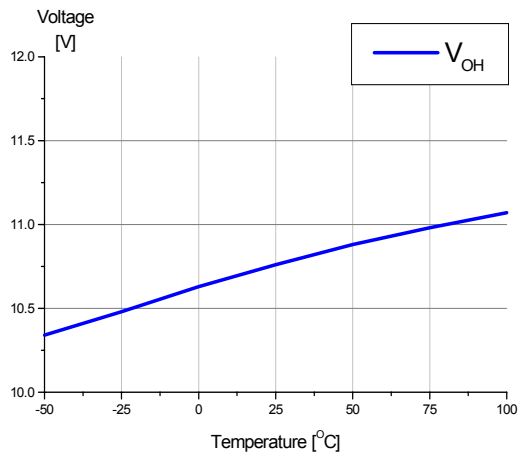
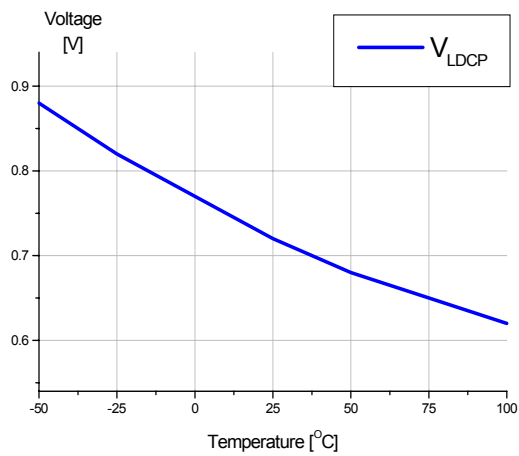
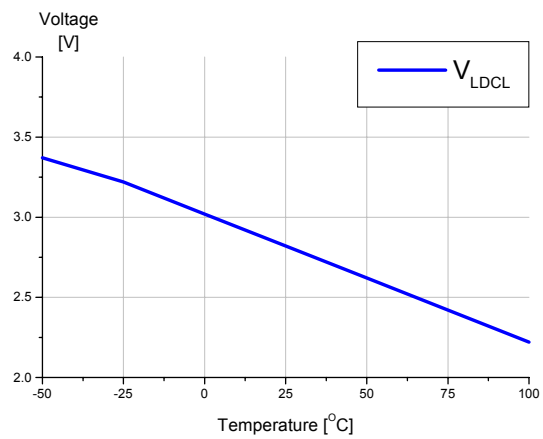
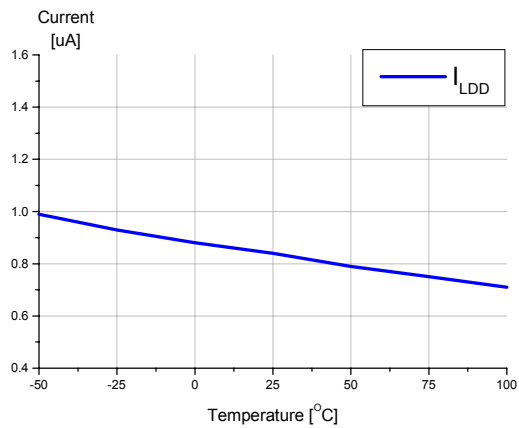
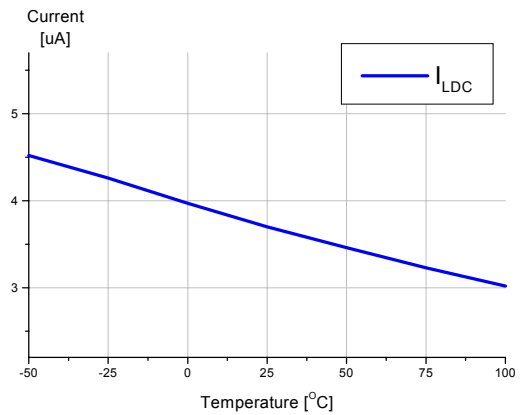
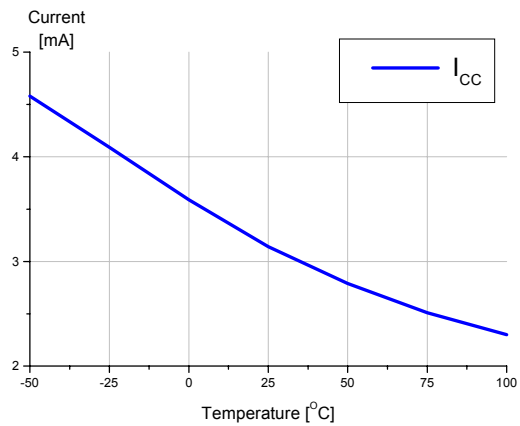


Package Dimensions (Unit: mm)

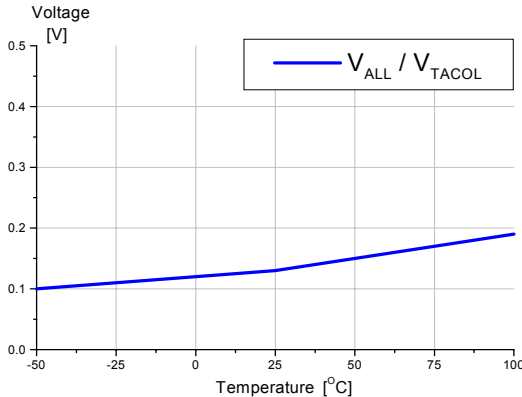
8-SOP Lead Free



## Typical Performance characteristics



### Typical Performance characteristics(Continued)





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