16V Low Noise Single Coil Motor Driver

DESCRIPTION

EUM6830 is an all-in-one brushless DC fan driver. It integrates soft start, soft switch and minimal speed setting, which makes fans can operate in a quiet and reliable status.

EUM6830 operates from 3.5V to 16V and its maximum continuous current can be up to 450mA. It also integrates multiple protections, such as Reverse Voltage Protection (RVP), Under Voltage Lock Out (UVLO), Locked Rotor Protection (LRP), Thermal Shut Down (TSD) and FG short-circuit protection.

The EUM6830 is provided in an SOP-8 package with straight leads and an SOP-8 package with gull-wing leads. Both versions comply with RoHS specifications, and their lead frames are 100% lead-free.

FEATURES

- All-In-One fan driver, including high sensitivity Hall-effect sensor
- Wide Input Range 3.5V ~ 16V
- Accepts wide input frequency range
- Built-in pull up resistor on PWM
- Intelligent soft start suppresses high peak current during start-up
- PWM speed control with minimum speed setting
- Soft switch for low noise operation over wide speed range
- High magnetic sensitivity: ±3mT
- Protections
  - UVLO
  - LRP
  - Thermal Protection
  - Reverse Voltage Protection
- High ESD rating: ±8kV
- Available in SOP-8 Package

APPLICATIONS

- Brushless DC fans with 12V supply

Typical Application Circuit

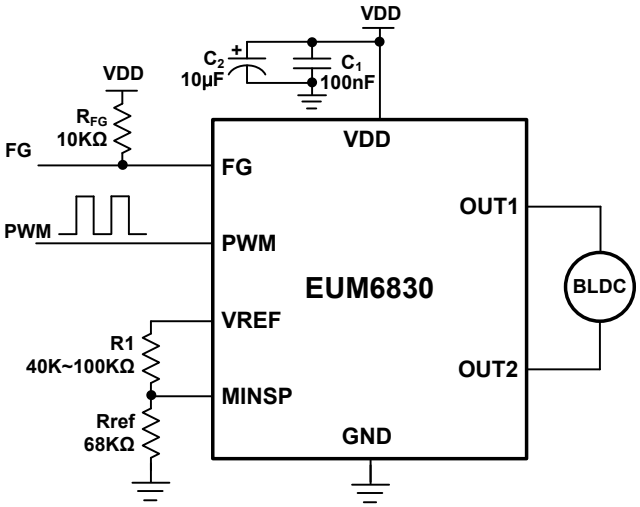
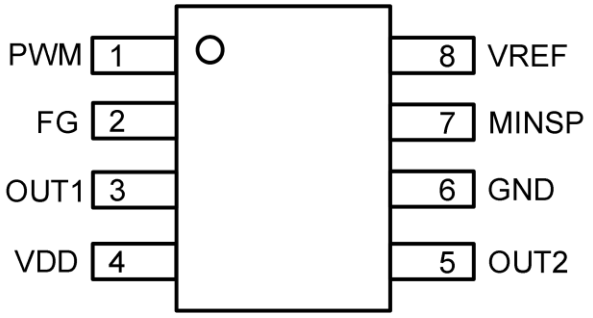


Figure 1.

Pin Configurations

Package Type	Pin Configurations
SOP-8 Straight Leads or Gull-Wing Leads	 (Top View)

Pin Description

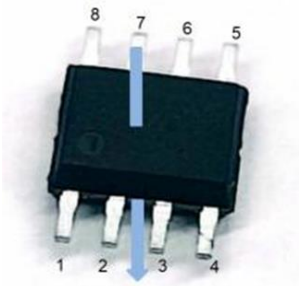
PIN#	NAME	TYPE	DESCRIPTION
1	PWM	I	PWM signal input terminal
2	FG	O	Open-drain tachometer output
3	OUT1	O	H-bridge output1
4	VDD	P	Supply voltage pin
5	OUT2	O	H-bridge output2
6	GND	/	Ground
7	MINSP	I	Minimum speed setting pin
8	VREF	P	Reference voltage output

Output Behaviour V.S Magnetic Pole

Unless otherwise specified, V_{DD}=12V, T_A=+25°C

Parameter	Test Conditions	OUT1	OUT2	FG
South pole	B > B_{OP}	Low	High	Low
North pole	B < B_{RP}	High	Low	High

Note:Magnetic pole facing the top side of the package.



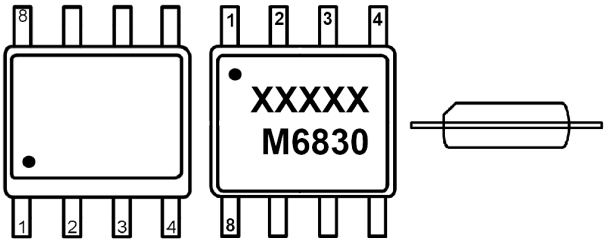
Ordering Information

Order Number	Package Type	Marking Side	Marking	Quantity per Reel
EUM6830D1IR1	SOP-8 Straight Leads	Bottom Side	XXXXX M6830	3000
EUM6830D2IR1	SOP-8 Gull-Wing Leads	Top Side	XXXXX M6830	3000

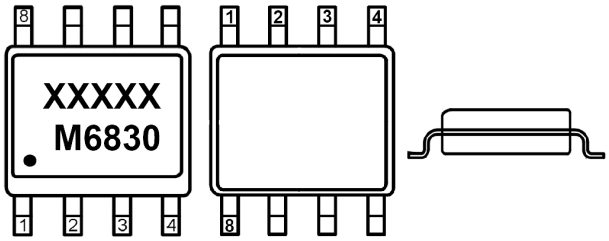
EUM6830□□□□

- Lead Free Code
  1: Lead Free, Halogen-Free
- Packing
  R: Tape & Reel
- Operating Temperature Range
  I: Industry Standard
- Package Type
  D1: SOP-8 Straight Leads
  D2: SOP-8 Gull-Wing Leads

EUM6830D1IR1
SOP-8 Straight Leads



EUM6830D2IR1
Gull-Wing Leads



Functional Block Diagram

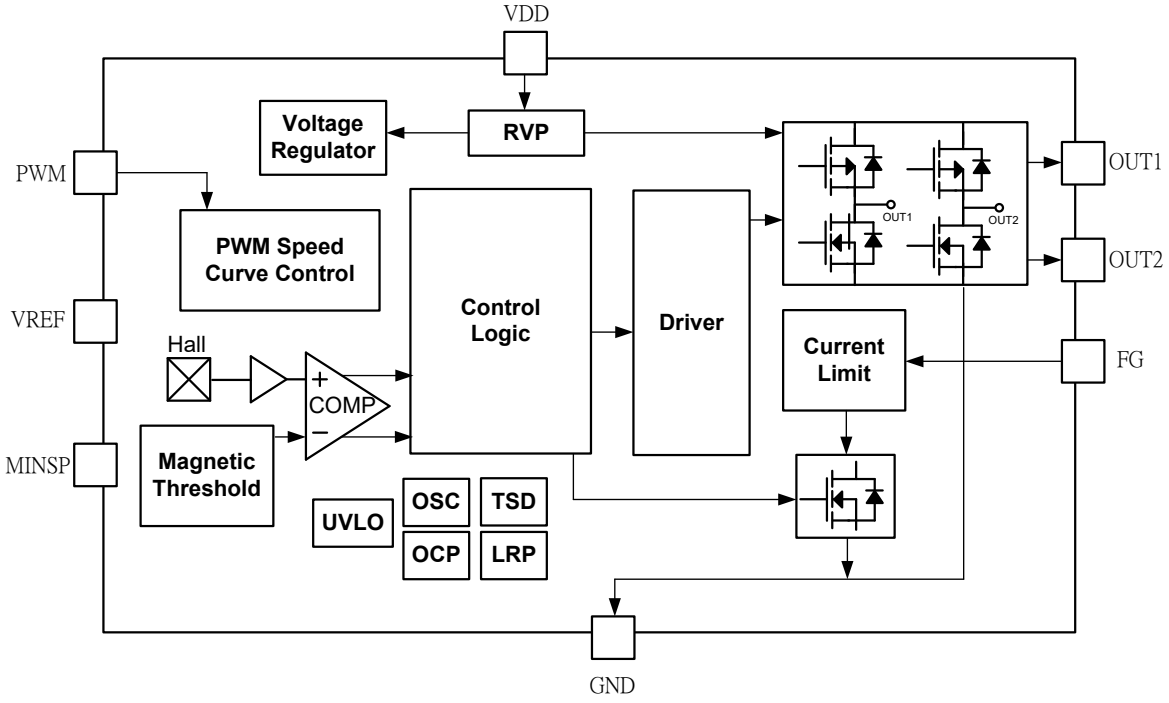


Figure 2.

Absolute Maximum Ratings (1)

- Supply Voltage (V_{DD}) ---------- 18V
- Supply Current (I_{DD}) ---------- 20mA
- Reverse Supply Voltage (V_{DDREV}) ---------- -18V
- Reverse Supply Current (I_{DDREV}) ---------- 1mA
- FG Output Voltage (V_{FG}) ---------- 18V
- FG Output Current (I_{FG}) ---------- 30mA
- Reverse FG Output Current (I_{FGREV}) ---------- -50mA
- PWM Input Voltage (V_{PWM}) ---------- 7V
- Reverse PWM Input Voltage (V_{PWMREV}) ---------- -0.3V
- MINSP Input Voltage (V_{MINSP}) ---------- 3.6V
- Reverse MINSP Input Voltage ($V_{MINSPREV}$) ---------- -0.3V
- Reverse Current on MINSP or PWM (I_{MINSP} , I_{PWM}) ---------- -10mA
- Average Output Current (I_{OUT}) ---------- 450mA
- Peak Output Current (I_{OUTMAX}) ---------- 1000mA
- Ambient Temperature Range (T_A) ---------- -40 ~ +150°C
- Storage Output Current (T_S) ---------- -55 ~ +150°C
- Maximum Junction Temperature (T_J) ---------- 165°C
- Magnetic Flux Density (B) ---------- Unlimited mT

ESD Ratings (2)

- ESD Voltage Protection, HBM (Human Body Model) ---------- ±8kV
- ESD Voltage Protection,CDM (Charged Device Model) ---------- ±2kV

Recommend Operating Conditions (3)

- Supply Voltage (V_{DD}) ---------- 3.5V to 16V
- Reverse supply voltage range (V_{DDREV}) ---------- -16V
- Reverse supply current range (I_{DDREV}) ---------- 1mA
- Operating Temperature Range (Ta)---------- -40°C to +105°C

Note (1): Stress beyond those listed under "Absolute Maximum Ratings" may damage the device.
Note (2): Devices are ESD sensitive. Handling precautions are recommended.
Note (3): The device is not guaranteed to function outside the recommended operating conditions.

Electrical Characteristics

Specifications in standard type face are for T_A=+25°C, V_{DD}=12V unless otherwise specified.

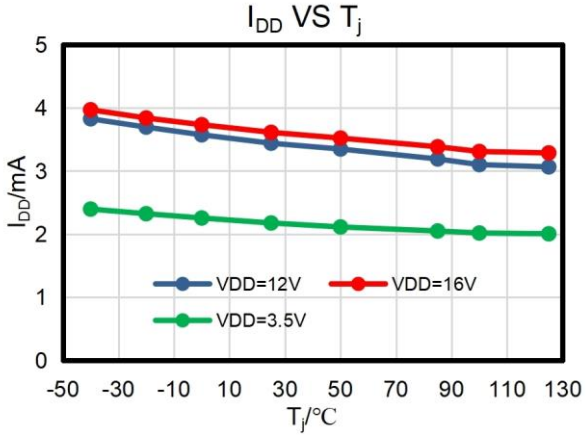
Parameters	Symbols	Conditions	EUP6830			Units
			Min.	Typ.	Max.	
Power						
Supply Voltage	V_{DD}		3.5	12	16	V
Supply Current	I_{DD}			3	6	mA
Reverse Supply Voltage	V_{DDREV}				-16	V
Reverse Supply Current	I_{DDREV}	V_{DD}= -16V			1	mA
PWM Control						
PWM Input Low Voltage	V_{IL}				0.8	V
PWM Input High Voltage	V_{IH}		2.1		5	V
PWM Input Frequency	F_{IN}	-2%<DC_{ERR}<2%	0.1		200	kHz
PWM Internal Pull-up Resistor	R_{IN}			10		kΩ
Output Drivers						
Full Bridge On Resistance	R_{DSON}	Tj=25°C, 12V, 350mA		2.4	6.6	Ω
		Tj=25°C, 3.5V, 150mA		3	9.4	Ω
Output PWM Frequency	F_{OUT}	10%<DC_{IN}<100%	18	24	33	kHz
Output Duty Cycle Range	DC_{OUT}	V_{MINSP}=0V	0		100	%
		Resistor R1 between MINSP to VREF, DC_{IN}<10%	10		100	%
Minimum Speed Setting Resistor	R_1	DC_{IN}<10%, 10%<DC_{OUT}<10 0%, RREF=68kΩ	40		100	kΩ
Duty Cycle Mismatch	DC_{ERR}	DC_{OUT}–DC_{IN}, VDD= 12V, TA=25°C	-2		2	%
Input Duty Cycle Threshold for Soft-start	DC_{in_SS}	V_{MINSP}=0V		6		%
Input Duty Cycle Threshold for Motor Stop	DC_{in_Stop}	V_{MINSP}=0V		3		%
Soft Start Initial Duty	D_{SOFT}			30		%
Soft Start Rotation Detector	E_{SOFT}			2		edges
Soft Start Time	t_{SOFT}	PWM Input Duty= 100%, (Dout 30% to 100%)		0.8	2	s
FG Output Saturation Voltage	V_{OL}	B>B_{OP},I_{OUT}=5mA		0.2	0.5	V
FG Output Current Limit	I_{CL}	B>B_{OP}	10	14	25	mA
FG Output Leakage Current	I_{OFF}	V_{DD}= 12V, B<B_{RP}		0.1	10	μA

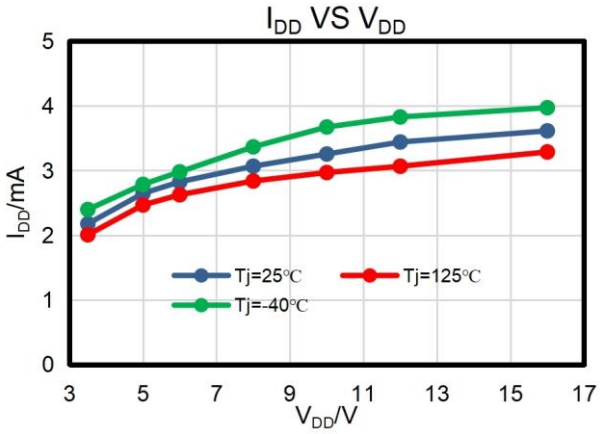
Electrical Characteristics (continued)

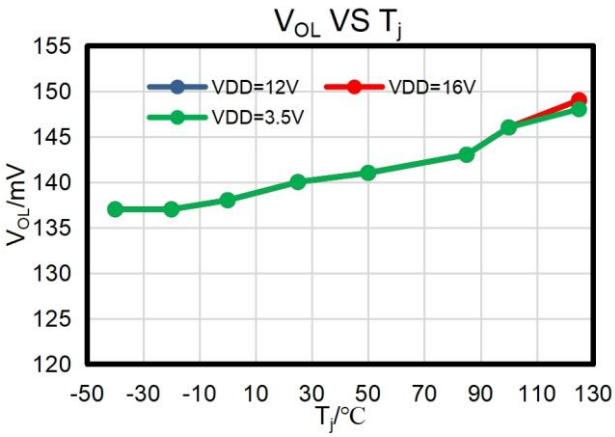
Specifications in standard type face are for T_A=+25°C, VDD=12V unless otherwise specified.

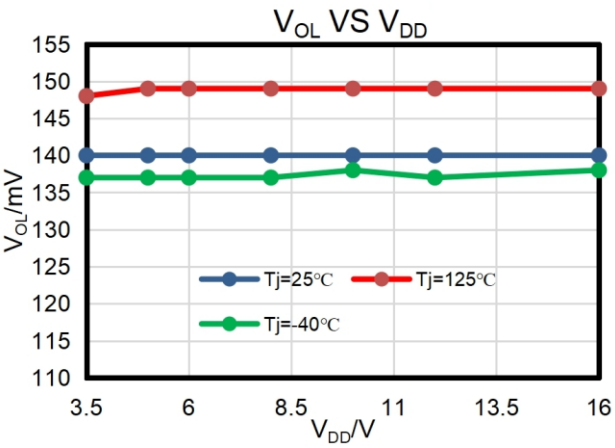
Magnetic field Switching Threshold	B_{HALL}	B_{OP}=|B_{HALL}| ， B_{RP}= -|B_{HALL}|		±3	±4	mT
Soft Switch Range	t_{SLOPE}	Total Regulation Range	400		5000	μs
Soft Switch Ratio	SLRATIO		10.5		12.5	%
Protections						
Reference Output Voltage	VREF		2.9	3.1	3.4	V
Reference Output Current Capability	IREF				2	mA
Input under-voltage lockout (UVLO) falling threshold	VUVLO_LOW		2.8	3.1	3.4	V
UVLO Detector Reaction Time	tBOD			8		ms
Locked Rotor Protection Detection Time	tLDT			0.3		s
Locked Rotor Protection On Time	tON	During operation		0.9		s
Locked Rotor Protection On Time	tON_SStart	During start-up		0.9		s
Locked Rotor Protection Off Time	tOFF			3.6		s
Thermal Protection Threshold	TSD (2)	Junction temperature		165		°C
Thermal Protection Hysteresis	THYS (2)	Junction temperature		15		°C

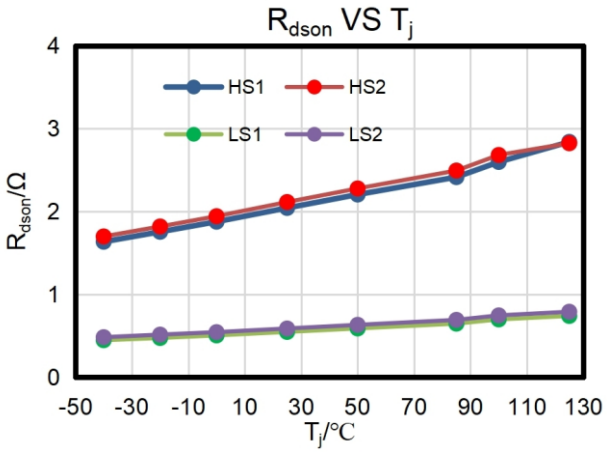
Typical Performance Characteristics

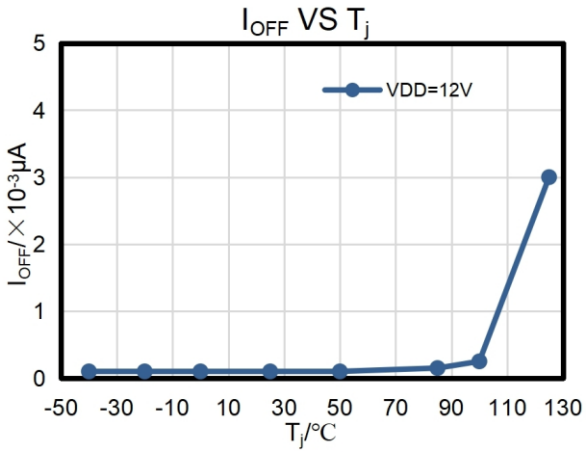


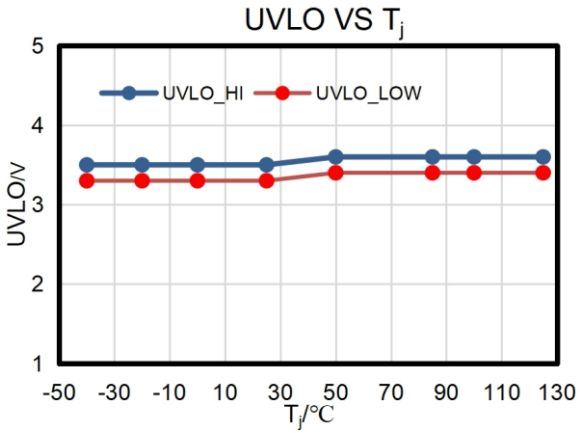












Functional Description

Overall

EUM6830 is an all-in-one IC which is designed to drive single-coil brushless DC motor like PWM cooling fans. The PWM pin has a built-in pull-up resistor of 10kΩ and a fail/safe functionality in case of PWM signal wire-break is provided. Soft start prevents very high peak current during start-up. It integrates high sensitivity hall sensor, which can help motor make commutation accurately. Built-in soft switch reduces noise during commutation. It can set minimal speed by using two inexpensive resistors through VREF pin and MINSP pin.

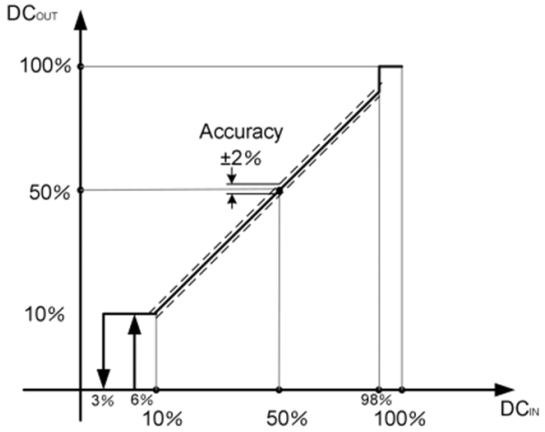
EUM6830 integrates multiple protections, such as Reverse Voltage Protection(rvp), Under Voltage Lock Out(UVLO), Locked Rotor Protection(LRP), thermal protection and FG short-circuit protection.

Input Voltage(VDD)

EUM6830 operates from 3.5V to 16V. A decoupling capacitor from 4.7μF or higher should be placed as close as possible to the VDD and GND pins. Ceramic capacitors with X7R dielectrics and package with 0805 are recommended.
In case of critical low voltage operation, the UVLO detector will automatically stop the IC operation until normal supply voltage in the operational range is applied.

PWM Control

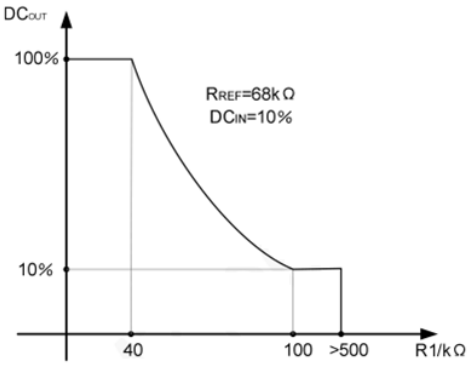
The PWM input allows very wide input frequency range (100Hz to 200kHz) while the output PWM frequency is kept constant above the audible frequency range. The output duty cycle is directly proportional to the input duty cycle and the accuracy is ±2%.

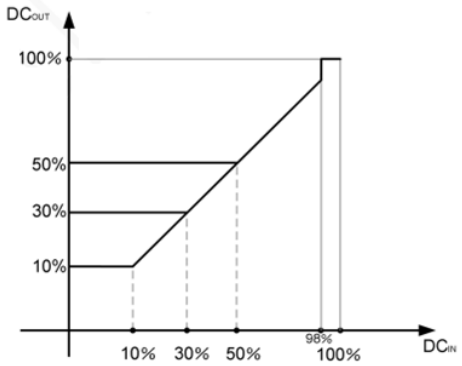


The PWM pin has a built-in pull-up resistor of 10kΩ, which is tied to VREF pin. Since the interface providing the PWM signal is generally open-collector/drain type, an external resistor is not required. Additionally, a fail/safe functionality as it will drive the motor at full speed in case of PWM signal wire-break is provided.

Minimal Speed Setting

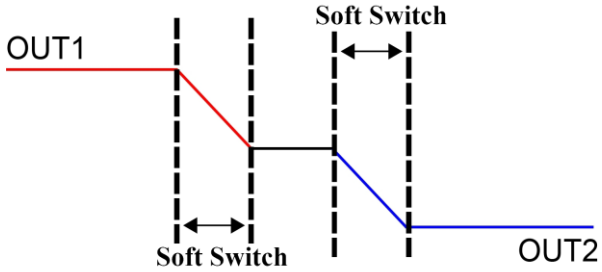
The Minimal Speed input allows setting of a minimum required rotation speed of the motor by using two inexpensive resistors. This is especially useful for applications where minimum cooling is a requirement to avoid system damage.





Soft Switch

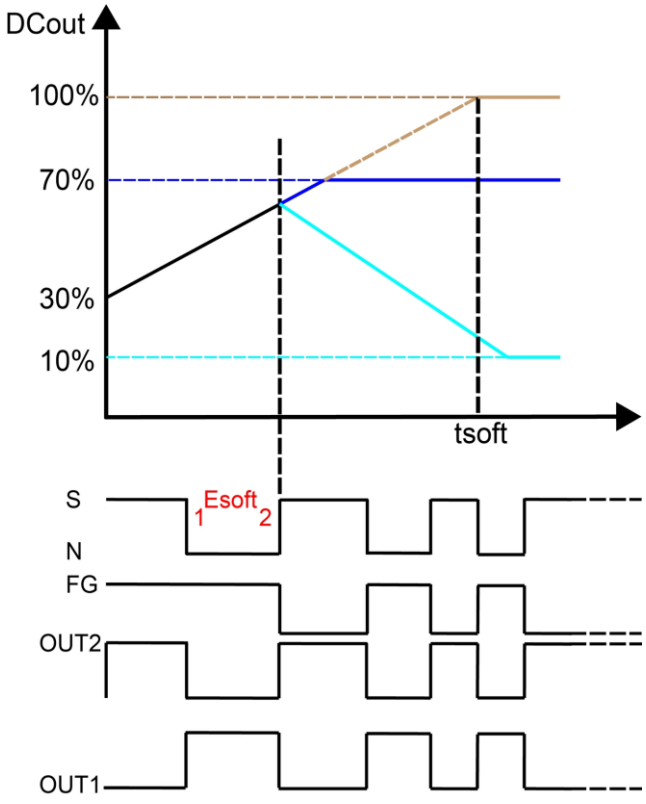
The Soft switch is performed using the output duty cycle rather than analog voltage sweep, leading to less power dissipation. The device automatically adjusts its slope duration targeting 10.5%~ 12.5% from the torque period independent of the rotor magnet strength, producing an optimum balance between high efficiency and low noise performance. The possibility for very long slope duration guarantees extremely quiet operation even at very low rotation speed.

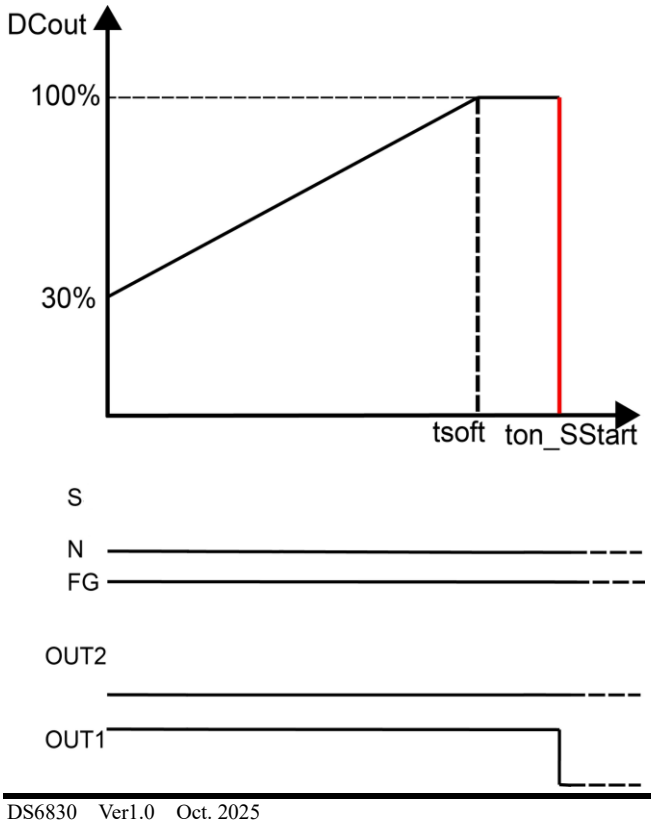


Soft Start

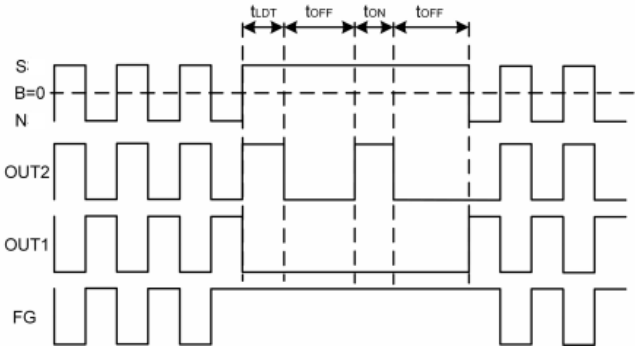
The intelligent soft start prevents very high peak current during start-up. An additional system guarantees proper motor start-up even with low PWM input duty cycle, ensuring enough initial torque to the motor is generated to enable rotation.
The initial duty Dsoft is 30%. If input duty cycle is not 100%, the output duty cycle will adjust linearly to the input duty cycle after two-time transitions in magnetic

field. If input duty cycle is equal to 100% or PWM pin hanged ，the output duty cycle will increase from 30% to 100% in tsoft.
If faults like locked rotor occurred during soft start, EUM6830 will turn to locked mode and the bridge driver will switch to off after ton_SStart 。During this period, FG output pin will remain high.





Locked Rotor Protection
EUM6830 has locked rotor protection(LRP) to avoid overheating issues in case of a mechanical blockage of the rotor or bearing failure. If the EUM6830 did not detect a single transition in the magnetic field within tLDT during normal operation, the bridge driver will switch to off.
During locked rotor protection, EUM6830 will restart the motor after a period of tOFF. If the EUM6830 did not detect a single transition in the magnetic field within tON, the bridge driver will switch to off until the fault is solved.

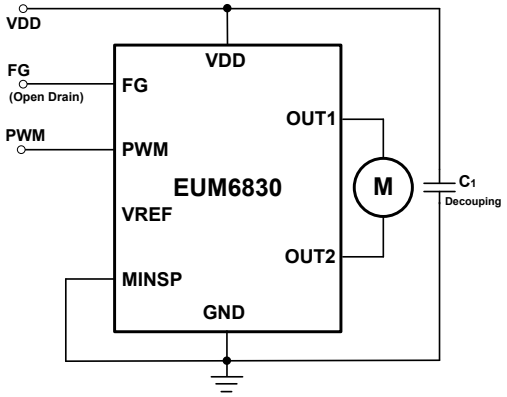


FG Output
The FG pin is an open-drain output, connecting a pull up resistor to a high level voltage for the speed detection function. It has current limit protection.

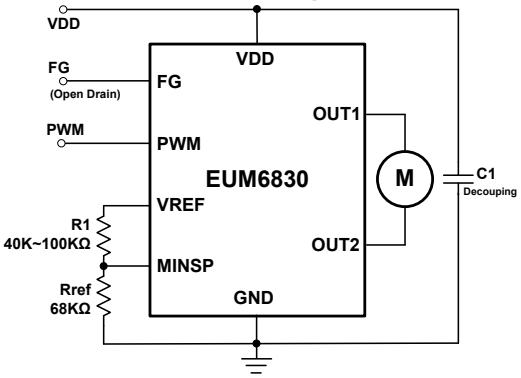
Thermal Protection
When internal junction temperature reaches 165˚C, the output devices will be switched off. When the IC's junction temperature cools by 15˚C, the thermal sensor will turn the output devices on again.

Application Information

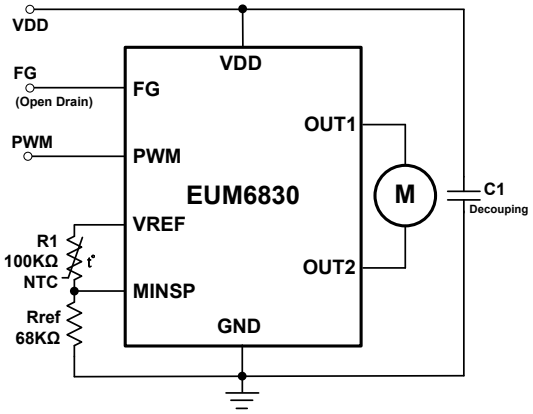
4-Wire PWM Cooling Fan (no minimal speed setting)



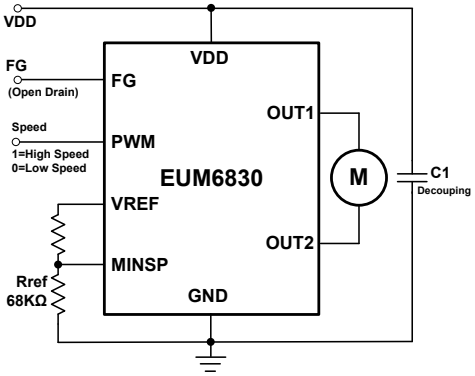
Temperature Controlled Cooling Fan



4-Wire PWM Cooling Fan(with minimal speed setting)

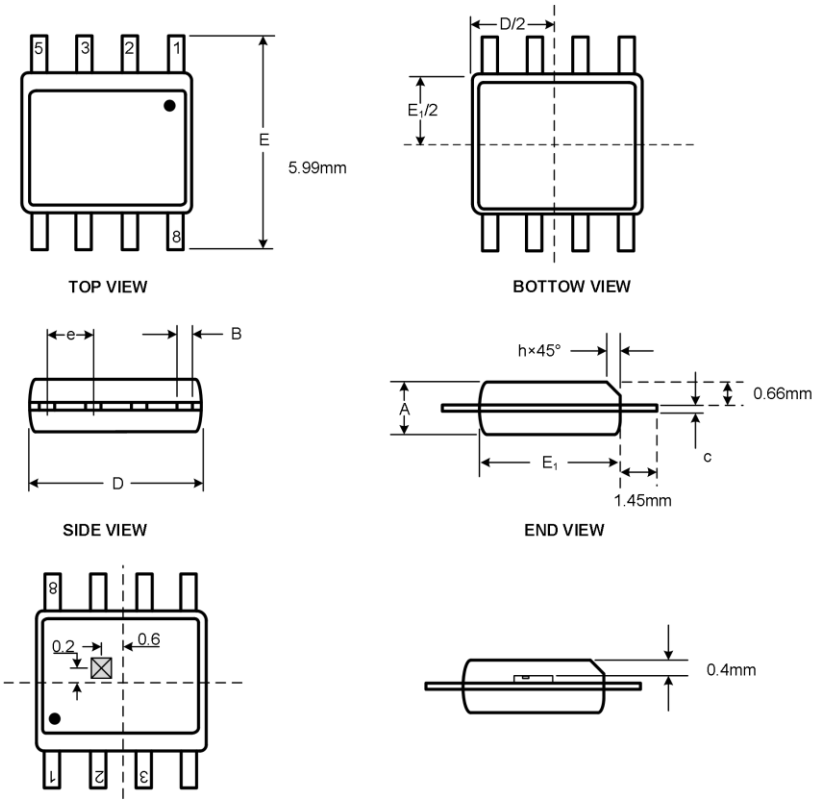


2-Speed Cooling Fan



Packaging Information

1. SOP-8 with Straight Leads (EUM6830D1IR1)



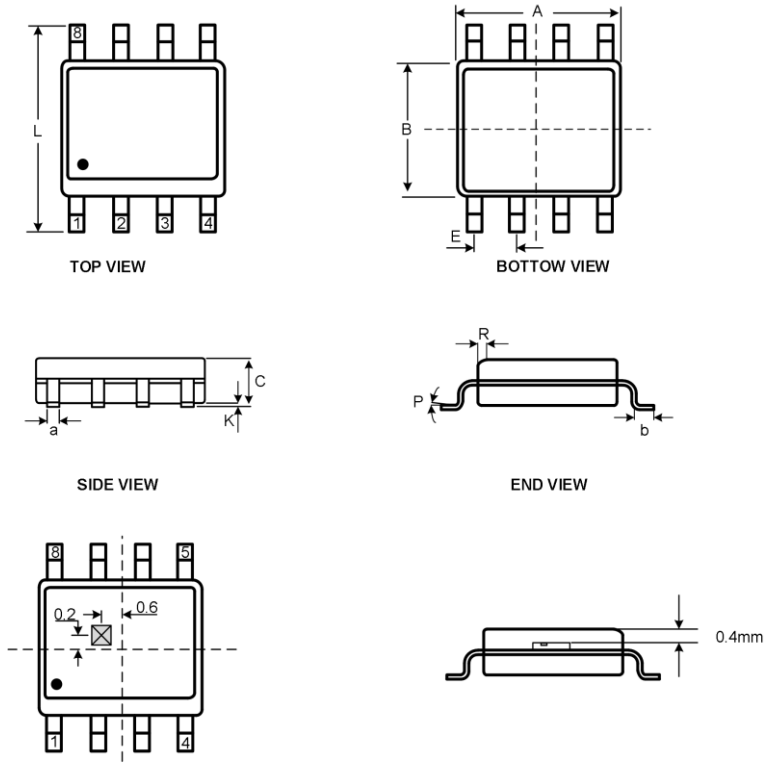
Note: Package outline drawing is for reference only.

SYMBOLS	MILLIMETERS		
	MIN.	Normal	MAX.
A	1.40	1.47	1.55
B	0.35	0.41	0.49
c	0.19	0.20	0.25
D	4.80	4.93	4.98
E1	3.81	3.94	3.99
e		1.27	
E	5.84	5.99	6.20
h	0.25	0.33	0.41

Notes:

1) All Dimensions are in Millimeter.
2) Package length does not include mold flash, protrusion or gate burr.
3) Package width does not include inter lead flash or protrusion.
4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
5) Pin 1 is upper left pin when reading top mark from left to right.

2. SOP-8 with Gull-Wing Leads (EUM6830D2IR1)



Note: Package outline drawing is for reference only.

SYMBOLS	Dimensions In Millimeters		SYMBOLS	Dimensions In Millimeters/Degrees	
	Min.	Max.		Min.	Max.
A	4.70	5.10	C	1.35	1.75
B	3.70	4.10	a	0.35	0.49
L	5.80	6.20	R	0.30	0.60
E	1.27 BSC		P	0°	7°
K	0.12	0.22	b	0.40	1.25

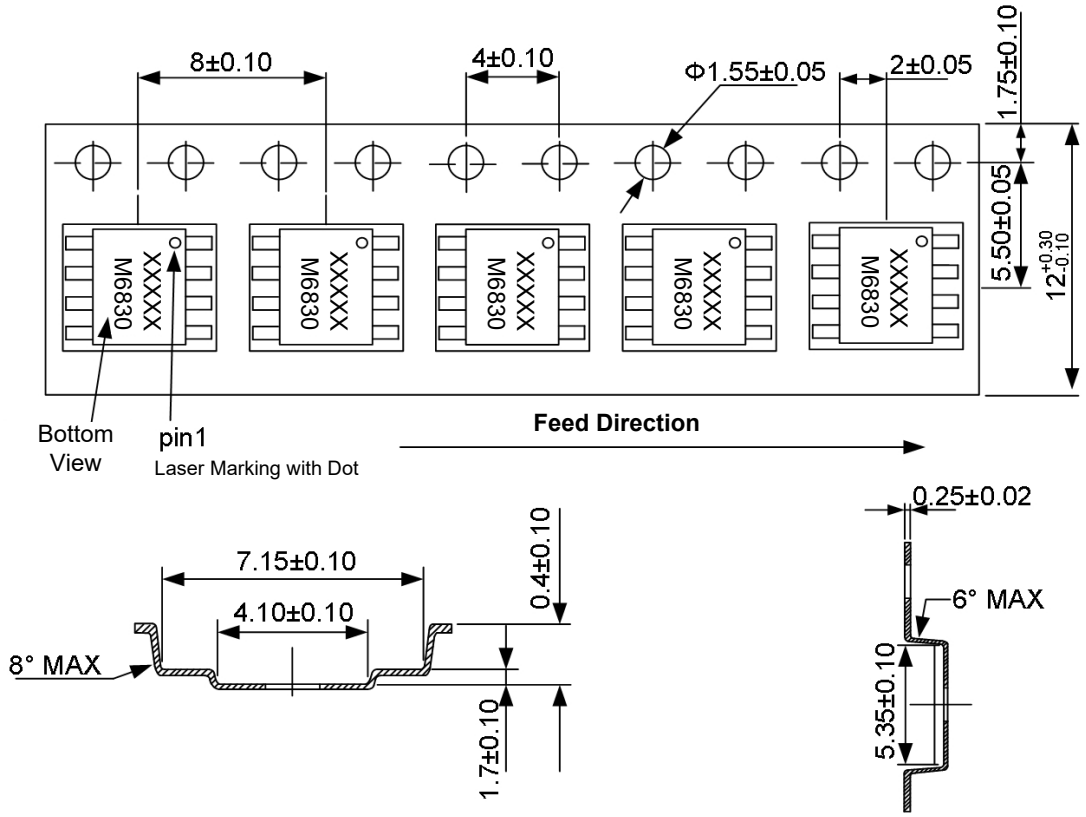
Notes:

1) All Dimensions are in Millimeter and degrees (°)..
2) Package length does not include mold flash, protrusion or gate burr.
3) Package width does not include inter lead flash or protrusion.
4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
5) Pin 1 is upper left pin when reading top mark from left to right.

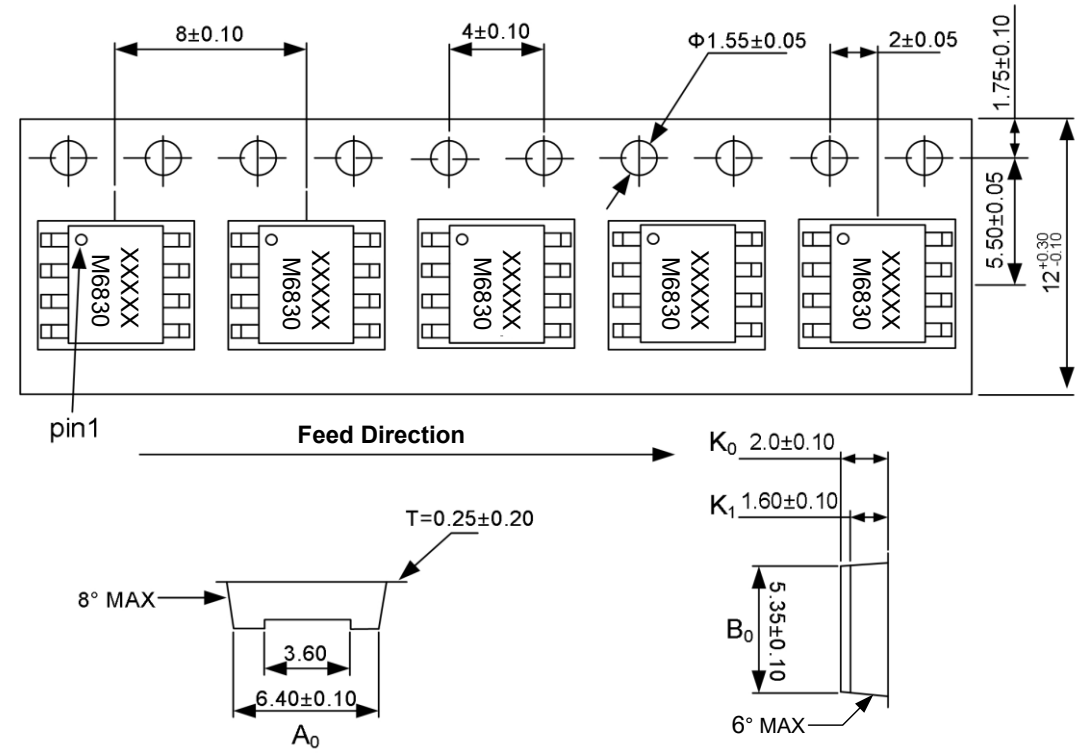
Taping and Reel Specification

1.Taping Orientation

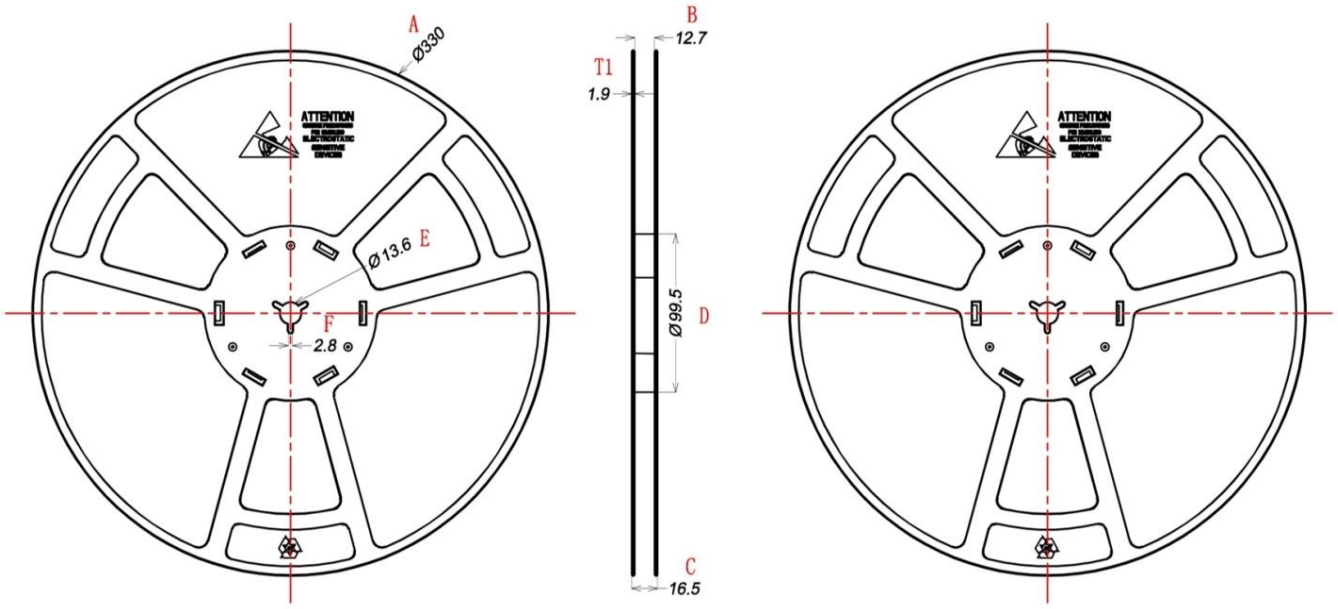
SOP-8 with Straight Leads (EUM6830D1IR1)



SOP-8 with Gull-Wing Leads (EUM6830D2IR1)



2.Reel Information



Unit: mm

A	B	C	D	E	F	T1
Ø 330±1	12.7±0.5	16.5±0.3	Ø 99.5±0.5	Ø 13.6±0.2	2.8±0.2	1.9±0.2

Notes:

1) All Dimensions are in Millimeter.

2) Quantity of Units per Reel is 3000.

3) MSL level is level 3.