Ordering number : ENA0845A

LV8800V

Bi-CMOS IC
For Notebook PC
Fan Motor Driver

ON Semiconductor®

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Overview

The LV8800V is a motor driver for notebook PC fans.

Feature

- Direct PWM sensorless motor driver

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	V_{CC} max		6.5	V
Predrive voltage (gate voltage)	VG max		10	V
Output pin current	I_{OUT} max		0.7	A
PWM input pin withstand voltage	V_{PWM} max		V_{CC}	V
FG output pin withstand voltage	V_{FG} max		6.0	V
FG output current	I_{FG} max		5.0	mA
Power dissipation 1	Pd max1	Independent IC	0.3	W
Power dissipation 2	Pd max2	Mounted on specified board *1	0.8	W
Operating temperature	Topr	*2	-30 to +95	°C
Storage temperature	Tstg		-55 to +150	°C

*1 : When mounted on 76.1mm×114.3mm×1.6mm glass epoxy board

*2 : Tj max = 150°C. Use the IC in the range where the temperature of the chip does not exceed Tj = 150°C during operation.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	V_{CC}		2.2 to 6.0	V

Electrical Characteristics Ta = 25°C, V_{CC} = 5V, unless specifically noted

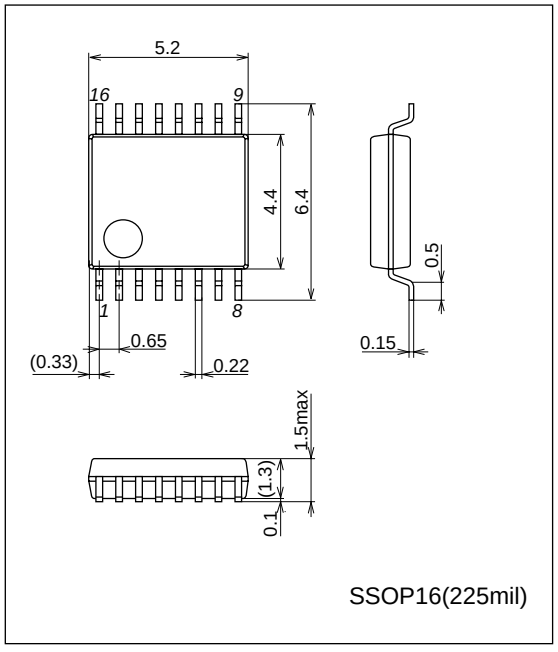
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply current 1	$I_{CC}1$	PWM pin = V_{CC}		1.8	2.5	mA
Power supply current 2	$I_{CC}2$	PWM pin = 0V		20	50	μA
Charge pump output						
Output voltage	VG			9.8		V
Output block						
Source	Ron (H)	I_O = 0.5A, VG = 9.5V		0.6	1.0	Ω
Sink	Ron (L)	I_O = 0.5A, V_{CC} = 5.0V		0.6	1.0	Ω
Source + sink	Ron (H+L)	I_O = 0.5A, V_{CC} = 5V, VG = 9.5V		1.2	2	Ω
Startup oscillation pin						
OSC pin charge current	IOSC1			-2.5		μA
OSC pin discharge current	IOSC2			2.5		μA
PWM input pin						
PWM pin high-level input voltage	VPWMH		V_{CC}×0.8		V_{CC}	V
PWM pin low-level input voltage	VPWML		0		V_{CC}×0.2	V
PWM pin input current	IPWM	PWM pin = 0V			-50	μA
PWM input frequency	fPWM		20	25	50	kHz
FG output pin						
FG output pin low-level voltage	VFG	When I_O = 0.5mA		0.1	0.2	V
Current limiter circuit						
Limiter voltage	VRf	RF = 0.5Ω	0.225	0.25	0.275	V
Constraint protection circuit						
Constraint protection detection time	RDT1			0.5	1.0	s
Constraint protection release time	RDT2			5		s
Thermal protection circuit						
Thermal protection circuit operating temperature	TSD	Design target *	150	180		°C
Temperature hysteresis width	ΔTSD	Design target *		30		°C

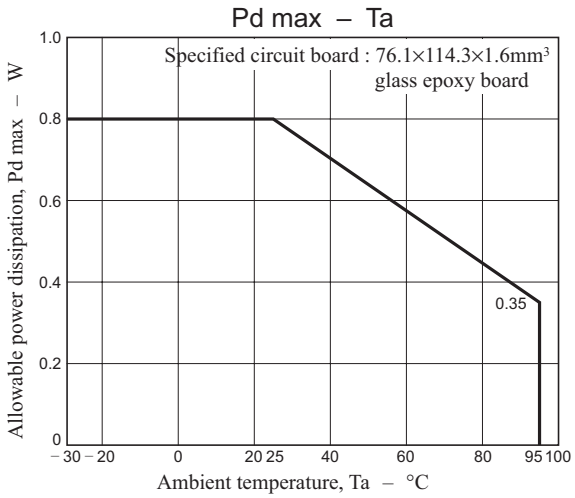
* : Design target value and no measurement is made. The thermal protection circuit is incorporated to protect the IC from burnout or thermal destruction. Since it operates outside the IC's guaranteed operating range, the customer's thermal design should be performed so that the thermal protection circuit will not be activated when the fan is running under normal operating conditions.

Package Dimensions

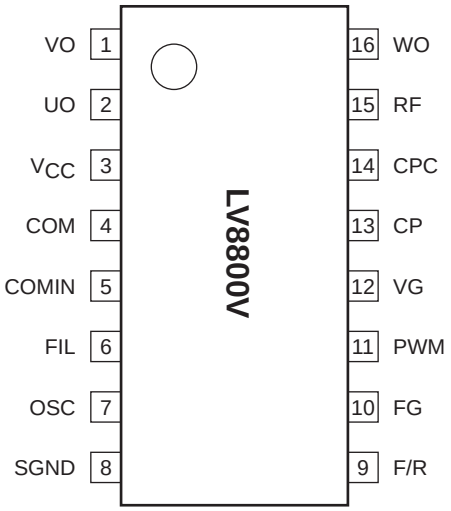
unit : mm (typ)

3178B



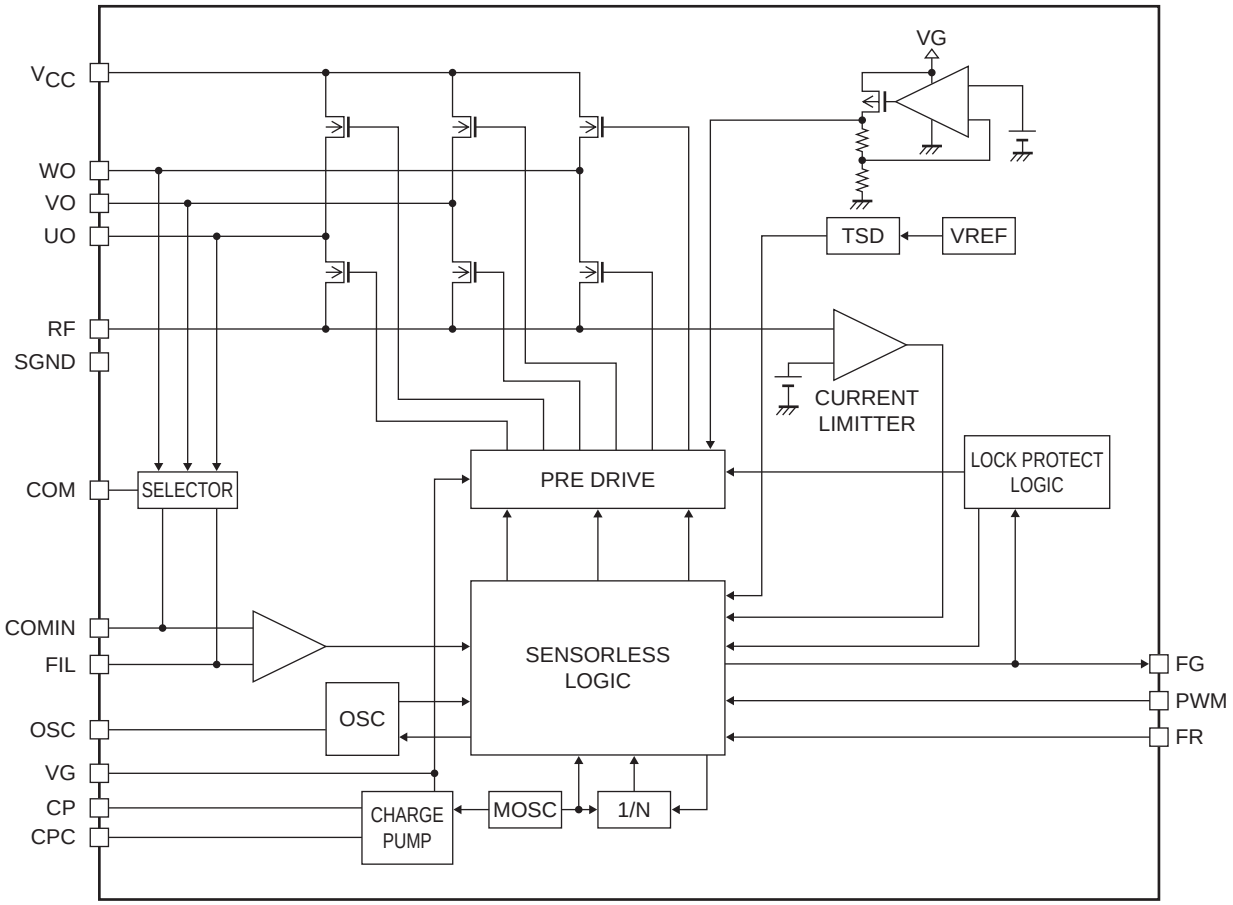


Pin Assignment

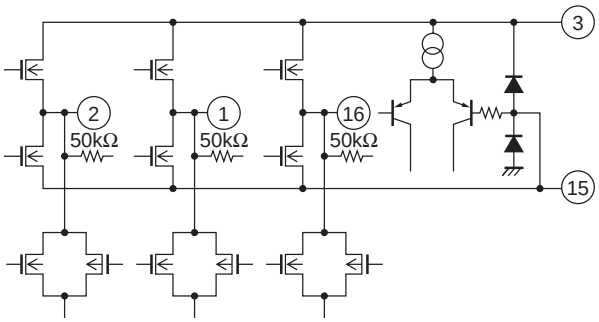
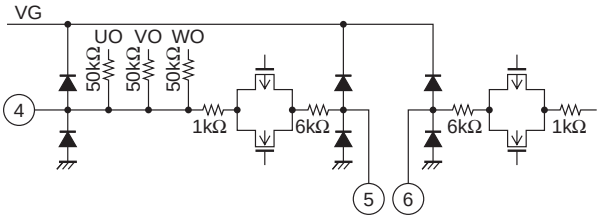
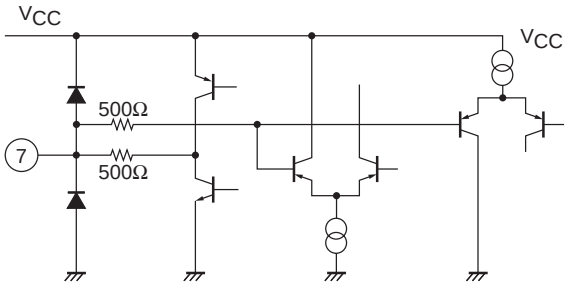
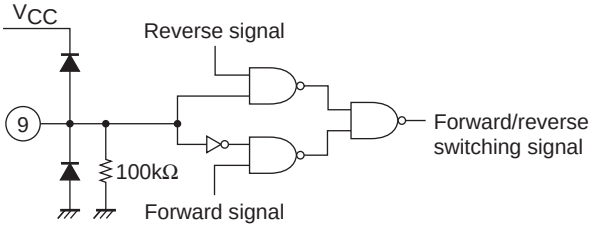
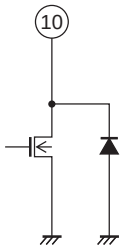
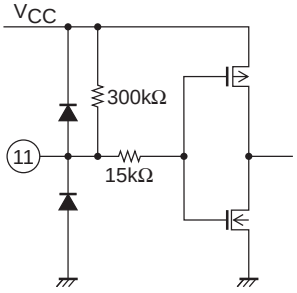


Top view

Block Diagram

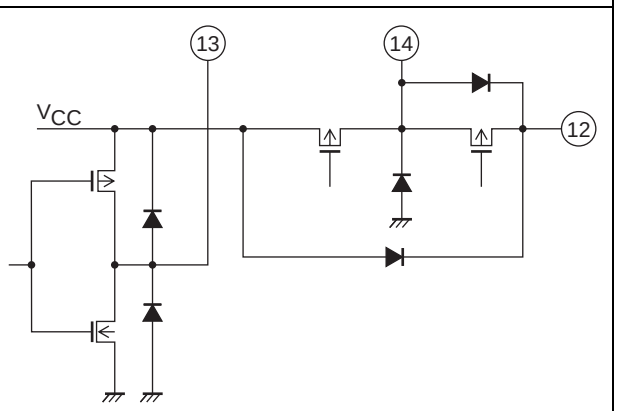


Pin Functions

Pin No.	Pin name	Function	Equivalent circuit
3	V_{CC}	Power supply for the IC and motor. A capacitor must be connected between this pin and ground.	
2 1 16	UO VO WO	Output pins. Connect the motor coil.	
15	RF	Output current detection. The drive current is detected by connecting a resistor between this pin and ground.	
4	COM	Motor middle point connection.	
5	COMIN	Motor position detection comparator filter pin. A capacitor must be connected between this pin and the FIL pin (pin 6).	
6	FIL	Motor position detection comparator filter pin. A capacitor must be connected between this pin and the COMIN pin (pin 5).	
7	OSC	Motor startup frequency setting. A capacitor must be connected between this pin and ground. The startup frequency is adjusted by controlling the charge/discharge current (±2.5μA) and the capacitance of the capacitor.	
8	SGND	Ground for IC.	
9	F/R	Motor rotation direction switching. A high-level input causes current to flow into the motor in the order of U, V, and W and a low-level input in the order of U, W, and V. Changing the order of current application turns the motor in the opposite direction.	
10	FG	FG pulse output. This pin outputs a Hall sensor system equivalent pulse signal.	
11	PWM	PWM signal input. A high-level input turns on the output transistors. A low-level input turns off the output transistors and motor stops. The motor speed is set by controlling the duty cycle of the input PWM signal. The motor runs at full speed when this pin is held open.	

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Pin No.	Pin name	Function	Equivalent circuit
12	VG	Charge pump step-up output. A capacitor must be connected between this pin and ground.	
13	CP	Charge pump step-up pulse output pin. A capacitor must be connected between this pin and the CPC pin (pin 14).	
14	CPC	Charge pump step-up pin. A capacitor must be connected between this pin and the CP pin (pin 13).	

LV8800V Functional Description and Notes on External Components

Read the following notes before designing driver circuits using the LV8800V to design a system with fully satisfactory characteristics.

1. Output drive circuit and speed control methods
   The LV8800V adopts the synchronous commutation PWM drive method to minimize power loss in the output circuits. Low on-resistance DMOS devices (total high and low side on-resistance of output block : 1.2Ω, typical) are used as the output transistors.
   The speed control of the driver is performed with an externally input PWM signal.
   PWM controls the speed by performing switching in accordance with the duty cycle that is input to the PWM pin (11-pin). The output transistor is on when a high-level voltage is input to the PWM pin, and off when a low-level voltage is input. When the motor is used with the PWM pin open, the built-in resistor causes the PWM pin to change to high-level voltage and the motor speed rises to full speed. When the PWM pin is fixed at low-level voltage, the motor decelerates, and after the motor stops it enters “Power Saving Mode.

2. Soft Switching Circuit
   This IC adopts variable duty soft switching to minimize the motor drive noise.

3. Current limiter circuit
   The current limiter circuit limits the output current peak value to a level determined by the equation I = VRF/RF (VRF = 0.25V typical). The current limiter circuit detects the peak current of the output transistors at the RF pin (pin 15) and turns off the transistor of the PWM phase.

4. OSC circuit
   The OSC pin (pin 7) is an oscillation pin provided for sensorless motor startup commutation. When a capacitor is connected between the OSC pin and ground, the OSC pin starts self-oscillation, and this becomes the startup frequency. The oscillator frequency can be adjusted by changing the value of the external capacitor (i.e. reducing the value of the capacitor increases the startup frequency).
   It is necessary to select a value of the capacitor that provides the optimal startup characteristics.

5. Position Detector Comparator Circuit for Rotor
   The position detection comparator circuit for the rotor is a comparator for detecting rotor positional information with the back EMF signal generated when the motor rotates. The IC determines the timing at which the output block applies current to the motor based on the position information obtained here. Insert a capacitor (between 1,000 and 10,000pF) between the COMIN pin (pin 5) and FIL (pin 6) to prevent any motor startup missoperation that is caused by the comparator input noise.

6. FG Output Circuit
   The FG pin (pin 10) is the FG output pin. It provides a pulse signal equivalent to that provided by systems that use a Hall-effect sensor.

Since the FG pin has an open drain output structure, it must be used with a pull-up resistor. Connect a pull-up resistor on the side of the power supply where the FG signal is input. A pull-up resistor with a resistance of about 10kΩ is recommended.

7. Charge Pump Circuit

The LV8800V n-channel DMOS output structure allows it to provide a charge pump based voltage step-up circuit. A voltage 2 times the VCC voltage can be acquired by inserting capacitors (recommended value : 0.1μF or larger) between the CP pin (pin 13) and CPC pin (pin 14). Note that this circuit is designed so that the stepped-up voltage (VG) is clamped at about 9.5VDC. A larger capacitor must be used between the VG pin (pin 12) and ground if the ripple on the stepped-up voltage (VG) results in VG exceeding 10V(VG max).

Observe the following points if the VG voltage is supplied from external circuits.

(1) The VG voltage supplied from the external circuits must not exceed the absolute maximum rating VG max.

(2) The capacitors between the CP pin (pin 13) and CPC pin (pin 14) are not required.

(3) Observe the correct sequence when turning the power supply on. Apply the VG voltage after first turning the V_{CC} voltage on, and cancel the VG voltage application before turning the V_{CC} off.

(4) There is an IC-internal diode between the V_{CC} and VG pins. Therefore, supply voltages such that V_{CC} > VG must never be applied to this IC.

8. Notes on PCB Pattern Design

The LV8800V is a system driver IC implemented using the Bi-CMOS process; the IC chip includes bipolar circuits, MOS logic circuits, and MOS drive circuits. As a result, extreme care is required with respect to the pattern layout when designing application circuits.

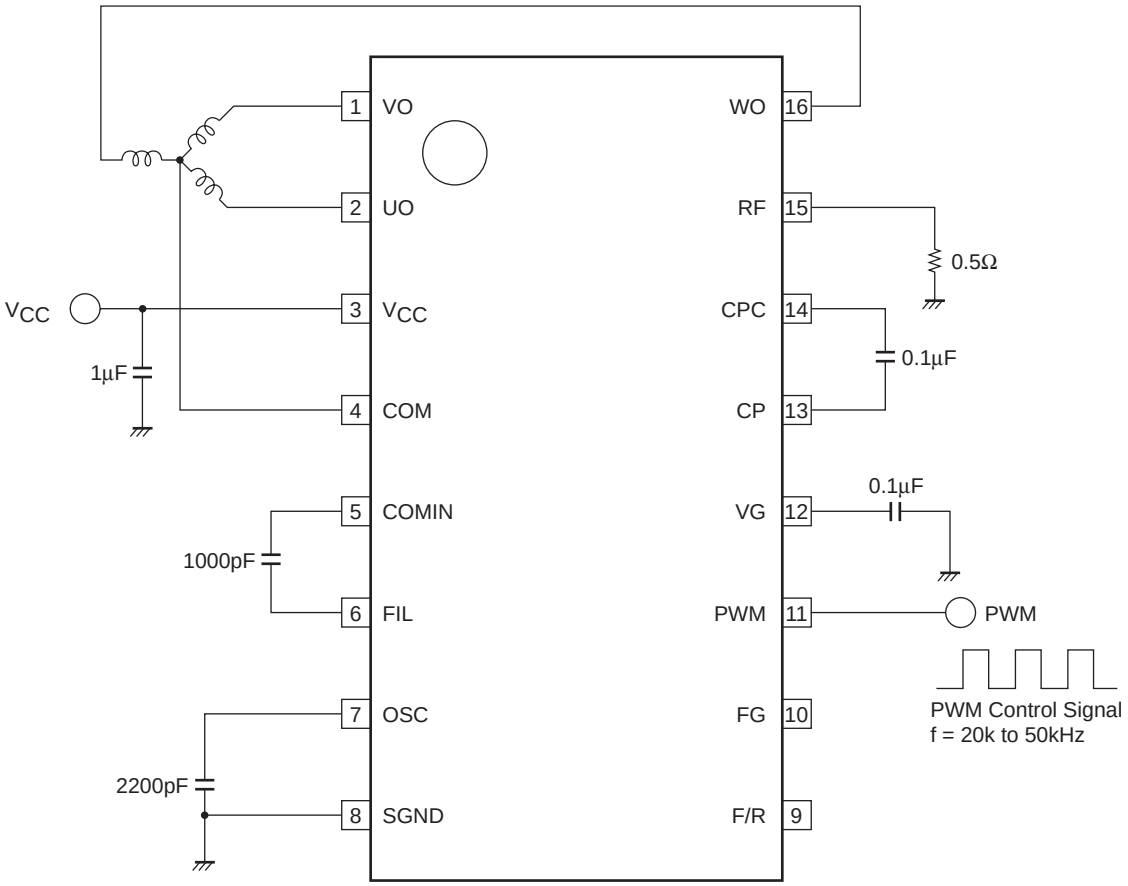
(1) Ground and V_{CC} wiring layout

Insert a capacitor (recommended value : 1μF or larger) as near as possible to the pin between the power pin (pin 3) and ground pin (pin 8).

(2) Positioning the external components

The external components that are connected to ground must be connected with lines that are as short as possible. External components connected between IC pins must be placed as near to the pins as possible.

Application Circuit Example



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