Ordering number : ENA0082

LB11660RV

ON Semiconductor®

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Monolithic Digital IC

Single-Phase Full-Wave Driver For Fan Motor

Overview

The LB11660RV is a single-phase bipolar half pre-driver that can achieve high-efficient direct PWM drive with ease. It is ideal for driving small-sized cooling fans used in servers. The LB11660RV is provided with the RD (lock detection) output pin and the LB11660FV the FG (rotational speed detection) output pin, respectively.

Features

- Single-phase full-wave drive (15V-1.5A output transistor built in) upper output Tr incorporated half pre-driver.
- Variable speed control by an external signal.
  →Separately-excited upper TR direct PWM control method, enabling silent, low-vibration variable speed control.
- Lowest speed setting possible.
- Current limiter circuit (the circuit actuated at I_O = 1A when Rf = 0.5Ω, Rf determines the limiter value.).
- Kickback absorption circuit built in.
- Soft switching circuit achieves low power consumption, low loss, and low noise driving at a time of phase change.
- HB built in.
- Lock protection and automatic reset functions incorporated (including a circuit that changes the ON/OFF ratio according to the power supply voltage).
- RD (lock detection) output.
- Thermal protection circuit incorporated (design guaranteed).

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
V_{CC} maximum power supply voltage	V_{CC} max		20	V
VM maximum power supply voltage	VM max		20	V
OUT pin maximum output current	I_{OUT} max	Rf≥0.39Ω	1.5	A
OUT pin output withstand voltage 1	V_{OUT} max1		20	V
OUT pin output withstand voltage 2	V_{OUT} max2	T≤0.4µs	26.5	V
PRE pin maximum source current	IPSO max		30	mA
PRE pin maximum sink current	IPSI max		-7	mA
PRE pin output withstand voltage	VP max		20	V
HB maximum output current	HB		10	mA
VTH input pin withstand voltage	VTH max		7	V
RD output pin output withstand voltage	VRD max		18	V
RD output current	IRD max		10	mA
Allowable power dissipation	Pd max	Mounted on a specified board *1	0.8	W
Operating temperature range	Topr	*2	-30 to 95	°C
Storage temperature range	Tstg		-55 to 150	°C

*1 A circuit board for mounting (114.3mm×76.1mm×1.6mm, glass epoxy resin)

*2 Tj max = 150°C. Must be used within the operating temperature range in which Tj does not exceed 150°C.

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 Range at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
V_{CC} power supply voltage	V_{CC}		4 to 15	V
VM power supply voltage	V_{CC}		3 to 15	V
Current limiter operating range	ILIM		0.6 to 1.2	A
VTH input level voltage range	VTH		0 to 6	V
Hall input common phase input voltage range	VICM		0.2 to 3	V

Electrical Characteristics at Ta = 25°C, V_{CC} = 12V, unless otherwise specified

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Circuit current	$I_{CC}1$	During driving		9	12	mA
HB voltage	VHB	IHB=5mA	1.05	1.25	1.40	V
6VREG voltage	V6VREG	6VREG=5mA	5.80	6	6.20	V
CT pin H level voltage	VCTH		3.4	3.6	3.8	V
CT pin L level voltage	VCTL		1.4	1.6	1.8	V
ICT pin charge current 1	ICTC1	V_{CC}=12V	1.7	2.2	2.7	µA
ICT pin charge current 2	ICTC2	V_{CC}=6V	1.3	1.8	2.3	µA
ICT pin discharge current 1	ICTD1	V_{CC}=12V	0.11	0.15	0.19	µA
ICT pin discharge current 2	ICTD2	V_{CC}=6V	0.34	0.44	0.54	µA
ICT charge/discharge ratio 1	RCT1	V_{CC}=12V	12	15	18	
ICT charge/discharge ratio 2	RCT2	V_{CC}=6V	3	4	5	
ICT charge/discharge ratio threshold voltage	VRCT		6	6.6	7.3	V
VTH bias current	IBVTH		-2	-1	0	µA
OUT output H saturation voltage	VOH	I_O=200mA, R_L=1Ω		0.6	0.8	V
PRE output L saturation voltage	VPL	I_O=5mA		0.2	0.4	V
PRE output H saturation voltage	VPH	I_O= -20mA		0.9	1.2	V

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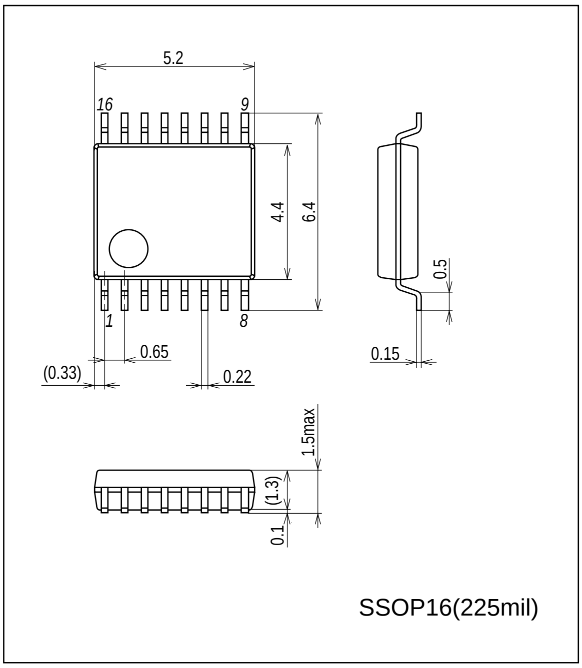
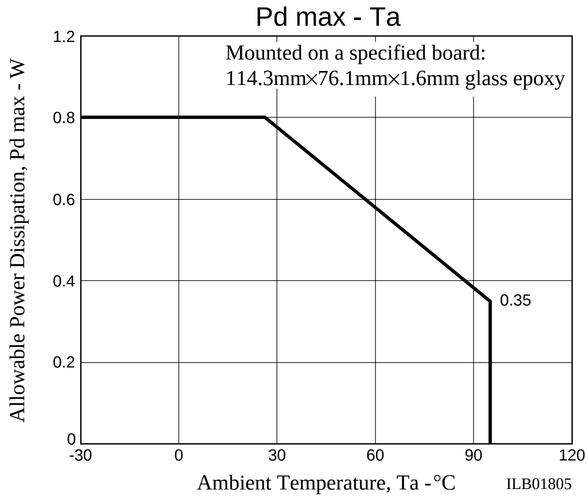
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current limiter	VRf	V_{CC}-VM	450	500	550	mV
PWM output H level voltage	VPWMH		2.2	2.5	2.8	V
PWM output L level voltage	VPWML		0.4	0.5	0.7	V
PWM external C capacitor charge current	IPWM1		-23	-18	-14	μA
PWM external C capacitor discharge current	IPWM2		18	24	30	μA
PWM oscillation frequency	FPWM	C=200pF	19	23	27	kHz
Hall input sensitivity	VHN	Zero peak value (including offset and hysteresis)		15	25	mV
RD output pin L voltage	VRD	IRD=5mA		0.2	0.3	V
RD output pin leak current	IRDL	VRD=7V			30	μA
Thermal protection circuit	THD	Design target value *3	150	180	210	°C

*3 These are design guarantee values, and are not tested.
The thermal protection circuit is implemented to prevent the IC from being thermally damaged or burned when exposed to an environment exceeding the guaranteed operating temperature range. Thermal design must be carried out so that the thermal protection circuit will never be activated while the fan is running in a stable condition.

Package Dimensions

unit : mm (typ)
3178B



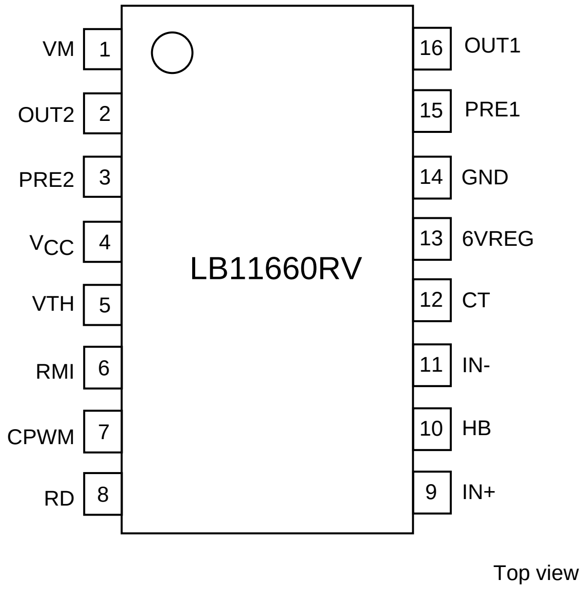


Truth Table

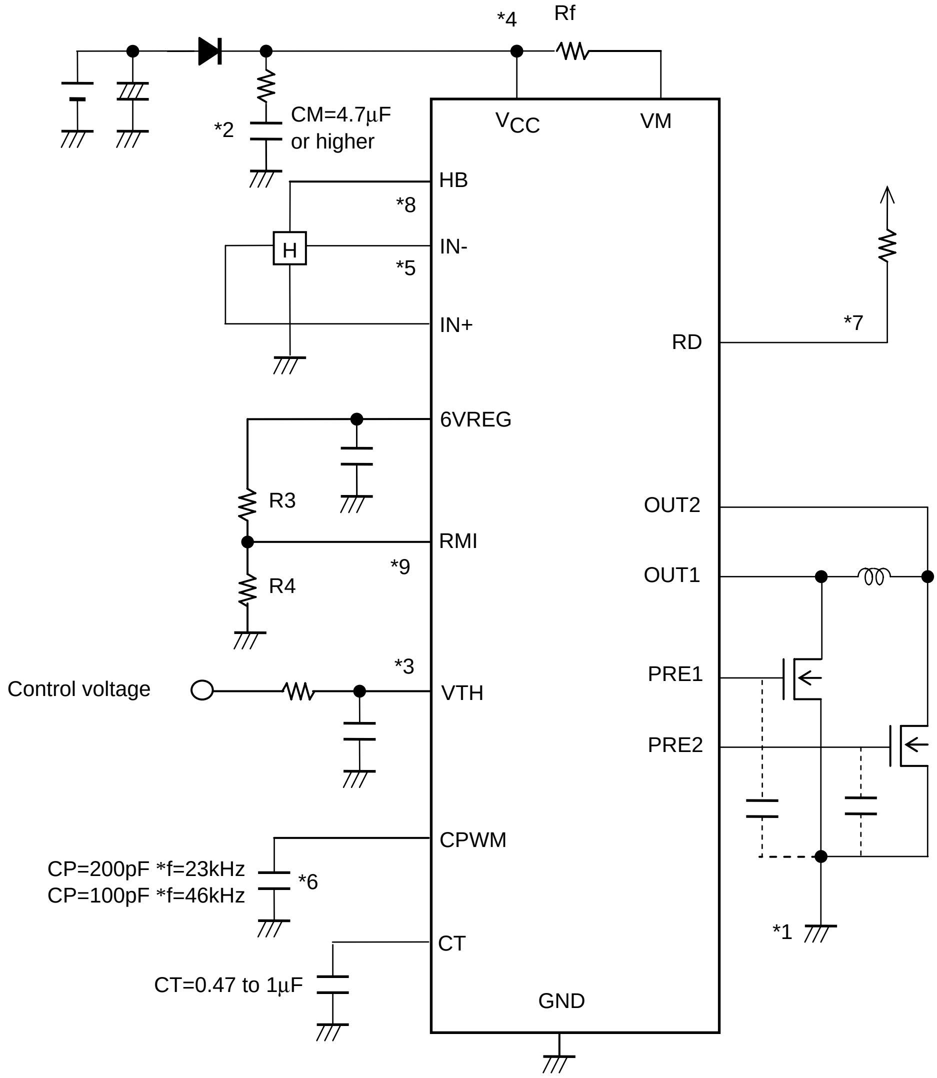
IN-	IN+	VTH	CPWM	CT	OUT1	OUT2	PRE1	PRE2	RD	Mode
H	L	L	H	L	H	OFF	L	H	L	Rotating - drive
L	H				OFF	H	H	L		
H	L	H	L		OFF	OFF	L	H		Rotating - regeneration
L	H				OFF	OFF	H	L		
H	L	-	-	H	OFF	OFF	L	H	OFF	Lock protection
L	H				OFF	OFF	H	L		

CPWM-H: CPWM>VTH, CPWM-L: CPWM<VTH

Pin Assignment



Sample Application Circuit 1



*1 <Power supply - GND wiring>
GRD of the IC is connected to the control circuit power supply system and GRD of the external N-channel is connected to the motor power supply system. Groundings must be installed separately and all external control components must be connected to the GND line of the IC.

*2 <Power stabilization capacitor for regeneration>
For the CM capacitor, that is a power stabilization capacitor for PWM drive and for absorption of kick-back, a capacitance of 4.7µF/25V or higher must be used. The CM capacitor must be connected without fail to prevent the IC from being damaged when power is tuned on or off.

*3 <Speed control>
1) Control voltage
The PWM duty ratio is determined by comparing the VTH pin voltage and the PWM oscillation waveforms. When the VTH pin voltage drops, the 'ON' duty ratio increases, and when it drops to or below the PWM output L level voltage, the duty ratio is 100%.

2) Thermistor
In thermistor applications, the 6VREG voltage is usually divided by a resistor, and the voltage thus generated is supplied to the VTH pin.
The PWM duty ratio is varied by the changes in the VTH pin voltage which result from changes in temperature.

*4 < Setting the current limiter >
The current limiter is actuated when the voltage of the current-sensing resistors between V_{CC} and VM increases to 0.5V or more.
Since the current of a current limiter circuit is limited by the current determined by I_O = VRf/Rf (where VRf = 0.5V typ, Rf: current-sensing resistance), the current limiter is actuated at I_O = 1A when Rf = 0.5Ω. The Rf resistor must be connected without fail, and its constant must be within the recommended operating range for current limiters.

*5 <Hall input>
Wiring need to be short to prevent carrying of the noise. The Hall input circuit is a comparator having a hysteresis of 20mV. It is recommended that the Hall input level be more than three times (60mVp-p) this hysteresis.

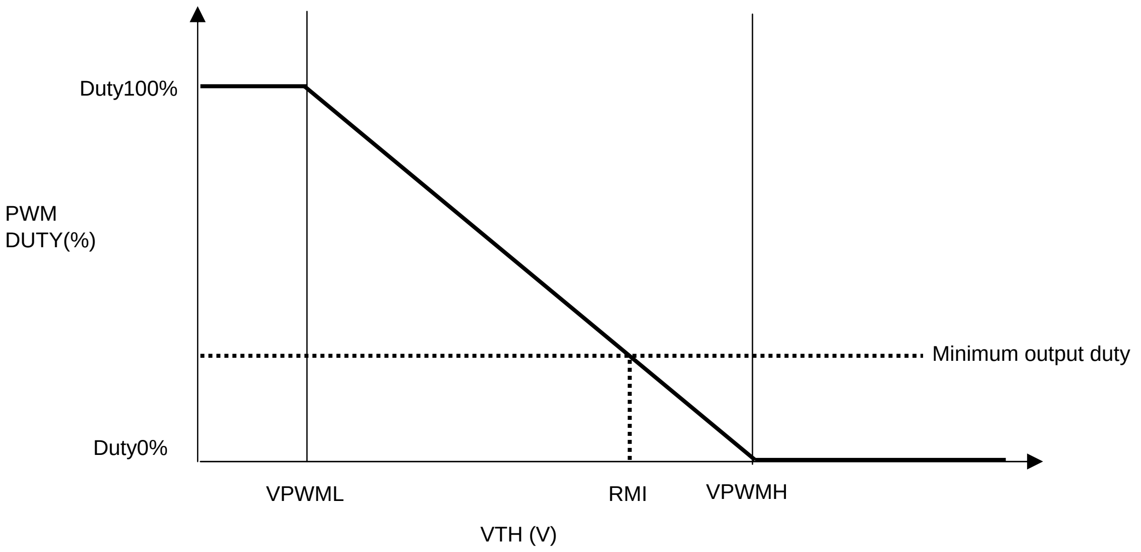
*6 < PWM oscillation frequency setting capacitor >
The oscillation frequency is 23kHz when CP = 200pF and 46kHz when CP = 100pF, and this serves as the PWM fundamental frequency.
For the most part, the PWM frequency can be obtained from the following formula:
$f\ [kHz] \approx (4.6\times10^6) \div C\ [pF]$

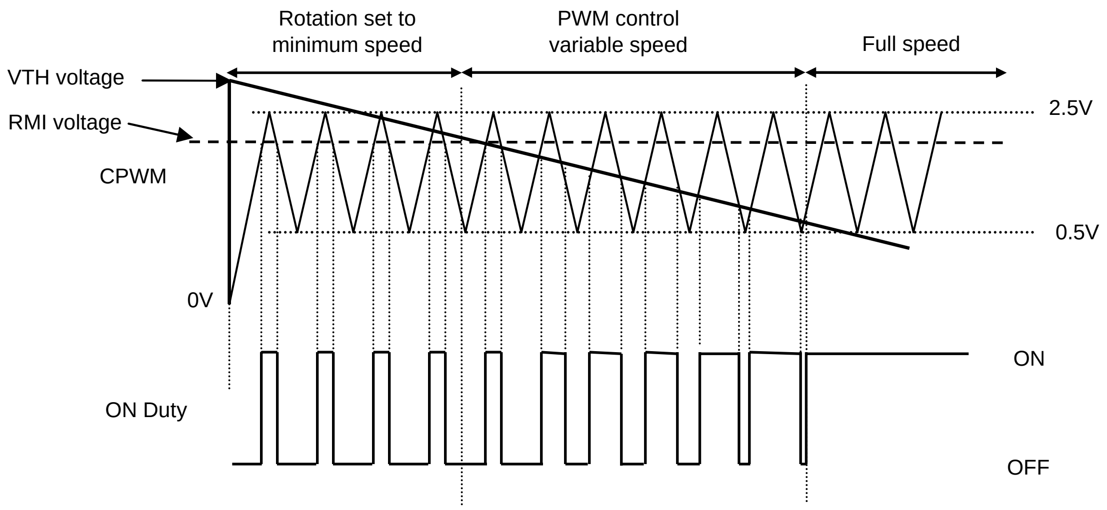
*7 <RD output>
This is the open collector type output, which outputs "L" during rotation. It is set to 'OFF' when a lock is detected. This output is left open when not in use.

*8 <HB pin>
This is a Hall element bias pin, that is, the 1.25V constant-voltage output pin.

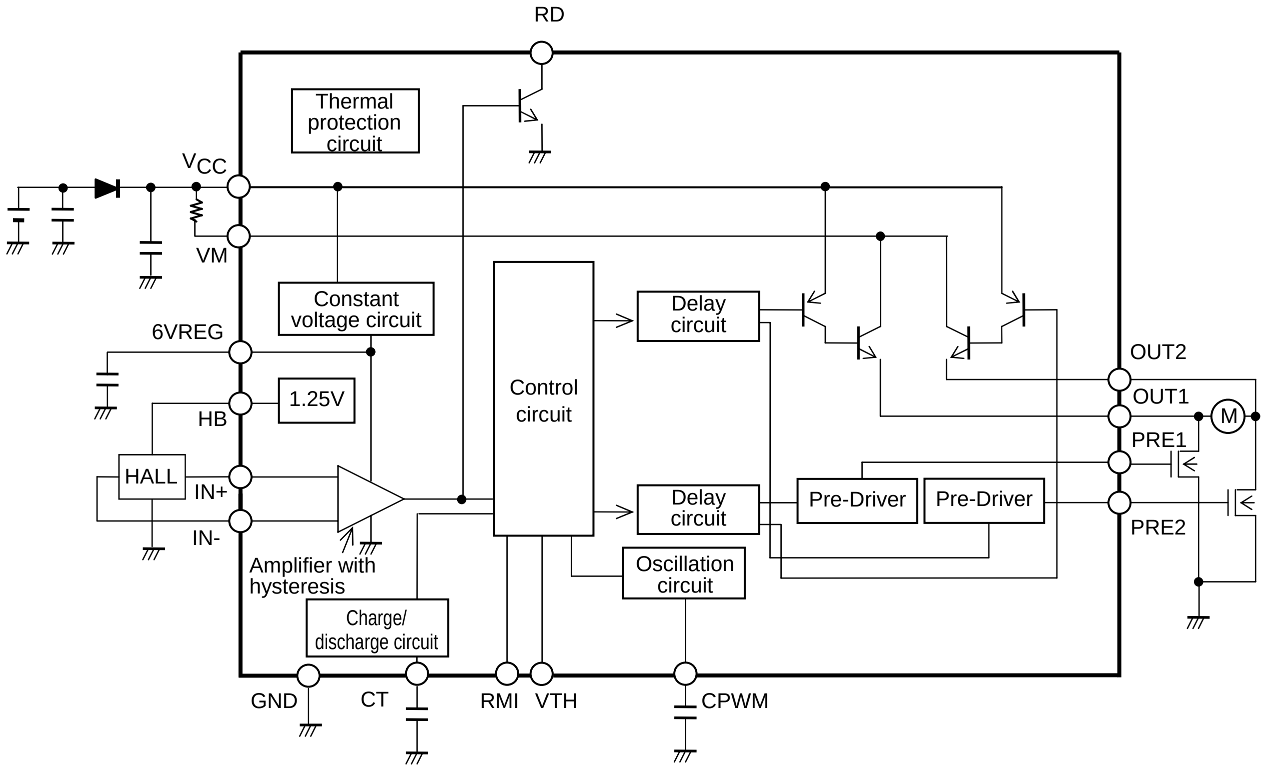
*9 <RMI pin>
Lowest speed setting pin for speed control.
The minimum output duty setting is made with R3 and R4. The R4 is left open to stop operation at a duty ratio of 0%.

Rotation Speed Control Chart





Internal Equivalent Circuit Diagram



Sample Application Circuit 2 <no minimum speed setting, thermistor input>