Ordering number : EN7390

LB11650

Monolithic Digital IC

PWM Input Forward/Reverse Motor Driver

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Overview

The LB11650 is a full bridge driver that supports switching between forward and reverse directions. It operates in one of four modes under application control: forward, reverse, brake, and open. It also supports direct PWM control from an external signal. The LB11650 is optimal for driving brush DC motors and bipolar stepping motors.

Features

- Supports PWM input
- Built-in high and low side diodes
- Simultaneous on state prevention function (prevents through currents)
- Built-in thermal shutdown circuit (latching type)
- High and low side short circuit protection function (latching type overcurrent protection)
- Externally controllable modes: forward, reverse, brake, open
- Standby mode function

Specifications

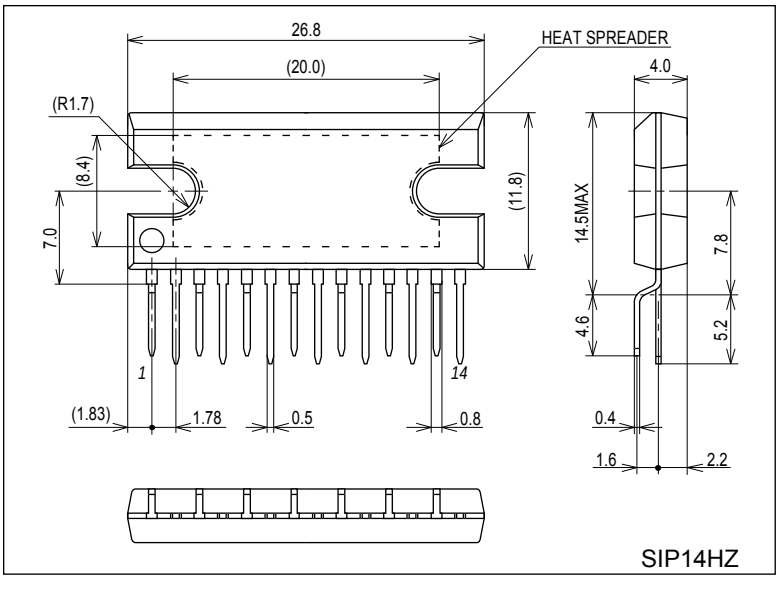
Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	unit
Motor supply voltage	VM max		30	V
Peak output current	I_O PEAK	tW ≤ 10μs	2.0	A
Continuous output current	I_O max	LVS pin	1.5	A
Logic system supply voltage	V_{CC} max	Independent IC	7.0	V
Allowable power dissipation	Pd max	When mounted on a glass epoxy circuit board (reference value) : 114.3 mm × 76.1 mm × 1.6 mm	3.5	W
Operating temperature	Topr		–20 to +85	°C
Storage temperature	Tstg		–55 to +150	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Package Dimensions

unit : mm



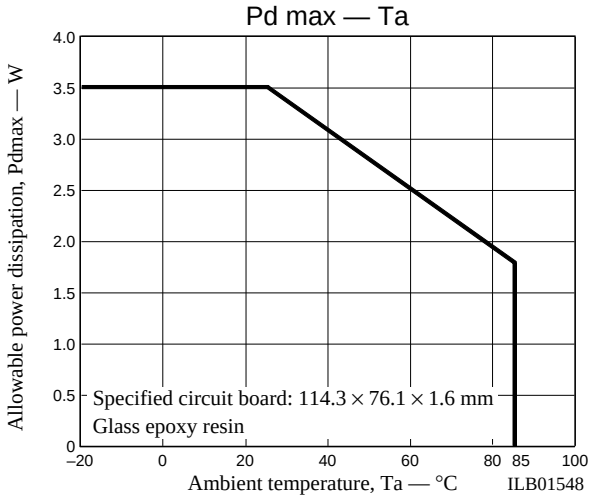
Recommended Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Motor supply voltage	VM		8 to 28	V
Logic system supply voltage	V_{CC}		3.0 to 5.25	V
Logic input voltage range	V_{IN}		–0.3 to V_{CC}	V

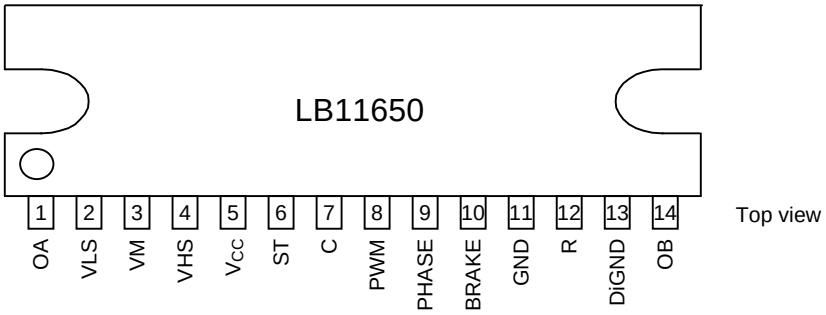
Electrical Characteristics at Ta = 25°C, VM = 24 V, V_{CC} = 5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Output Block]						
Output stage supply current 1	IM ON	With no load, ST = high	0.84	1.2	1.56	mA
Output stage supply current 2	IM wt	With no load, ST = low			50	µA
Output saturation voltage 1	V_O sat1	I_O = +0.5 A, sink side		0.3	0.5	V
Output saturation voltage 2	V_O sat2	I_O = +1.0 A, sink side		0.5	0.7	V
Output saturation voltage 3	V_O sat3	I_O = –0.5 A, source side		1.5	1.8	V
Output saturation voltage 4	V_O sat4	I_O = –1.0 A, source side		1.7	2.0	V
Output leakage current	I_O leak	V_O = VM, sink side			50	µA
		V_O = 0 V, source side	–50			µA
[Logic Block]						
Logic supply current	I_{CC} ON	V_{CC} = 5 V, with the R pin open BRAKE: LOW, PWM: HI, ST: HI	50	68	85	mA
		V_{CC} = 3.3 V, with the R pin shorted to V_{CC} BRAKE: LOW, PWM: HI, ST: HI	55	75	95	mA
	I_{CC} BR	BRAKE: HI, PWM: HI, ST: HI	3.4	4.7	6.0	mA
	I_{CC} OFF	BRAKE: LOW, PWM: LOW, ST: HI	4.0	5.2	6.5	mA
	I_{CC} wt	ST: LOW			50	µA
Input voltage	VINH		2.0			V
	VINL				0.8	V
Input current	IINH	V_{IN} = 3.3 V	35	50	75	µA
	IINL	V_{IN} = 0.8 V	5	10	13	µA
C pin charge current	IC	VC = 0 V	35	50	65	µA
C pin output off threshold voltage	Vtc		1.17	1.3	1.43	V
VHS pin current detection threshold voltage	VtVHS		VM – 0.55	VM – 0.5	VM – 0.45	V
VLS pin current detection threshold voltage	VtVLS		0.45	0.5	0.55	V
Low voltage cutoff voltage	VLVSD		2.25	2.5	2.75	V
Low voltage cutoff hysteresis	VLVHYS		0.15	0.2	0.25	V
Thermal shutdown temperature	TTSD	Design target value*	150	175		°C

*: This is a design target value and is not measured.



Pin Assignment



Truth Table

PHASE	BRAKE	ST	PWM	OA	OB	Operating mode
H	L	H	H	H	L	Forward
L	L	H	H	L	H	Reverse
X	L	H	L	OFF	OFF	Output off
X	H	H	X	H	H	Brake
X	X	L or OPEN	X	OFF	OFF	Standby mode (circuits off)

X: H or L

Pin Functions

Pin No.	Pin	Pin function
1	OA	Output
14	OB	Output
4	VHS	High side current sensing (Insert an external resistor between VM and VHS. When the voltage across this resistor reaches 0.5 V, the outputs are turned off.)
2	VLS	Low side current sensing (Insert an external resistor between VLS and ground. When the voltage across this resistor reaches 0.5 V, the outputs are turned off.)
7	C	Connection for an external filter capacitor that prevents incorrect operation of the current sensing output shutdown and thermal shutdown circuits.
3	VM	Motor system power supply
5	V_{CC}	Logic system power supply
9	PHASE	Forward/reverse switching pin
10	BRAKE	Brake control input. A high input switches the IC to brake mode.
6	ST	Standby mode control. The IC operates in standby mode when this pin is low or open.
8	PWM	PWM input. High: on Low: off
12	R	Low side drive current switching. (Short R to V_{CC} when V_{CC} is 3.3 V, and leave R open when V_{CC} = 5.0 V.)
11	GND	Ground
13	DiGND	Lower side regeneration diode ground connection

High/Low Short Protection Function

This function turns the outputs off to prevent destruction of the IC if a problem such as an output pin being shorted to VM or ground occurs and excessive current flows in the output transistors.
When an excessive current flows in an output transistor, a potential will occur across either the high side or the low side current sense resistor. If that value exceeds the current detection threshold voltage, the capacitor connected to the C pin starts to charge. Then, when the C pin voltage is charged to the output off threshold voltage, the output transistors are turned off.
To restart the IC once it has gone to the output off state, either set the ST pin to the low level, or temporarily cut the V_{CC} power supply, and then reapply power.
The overcurrent detection current setting can be set to an arbitrary level with the resistor inserted between VM and VHS for current flowing in the high side output transistor, and with the resistor inserted between VLS and ground for current flowing in the low side output transistor.
When the resistor connected to VHS or VLS pin is R (Ω), the detected current I (A) will be as follows.

$$I\ (A) = 0.5\ (V) / R\ (\Omega)$$

For example, if R is 0.5 Ω, the detected current I will be 1 A.
This function is not an output current limiter function.
The detection current described above has the meaning that the short-circuit protection circuit begins to operate when a current in excess of the detection current flows in the outputs. Therefore, if an output pin is shorted to VM or ground, the maximum possible overcurrent that the output transistors are capable of will flow until the mask time set with the filter circuit has elapsed. Designers must exert great care in designing the mask time setting.

Filter Circuit

To prevent the overcurrent protection and thermal shutdown circuits from operating incorrectly due to noise, the LB11650 includes a circuit that sets a mask time so that when an abnormality is detected, it only turns the outputs off if that state continues for a certain length of time.
When the capacitor connected between the C pin and ground is C (pF), the mask time T (μs) will be as follows.

$$T\ (\mu s) = 2.6 \times 10^{-2} \times C\ (pF)$$

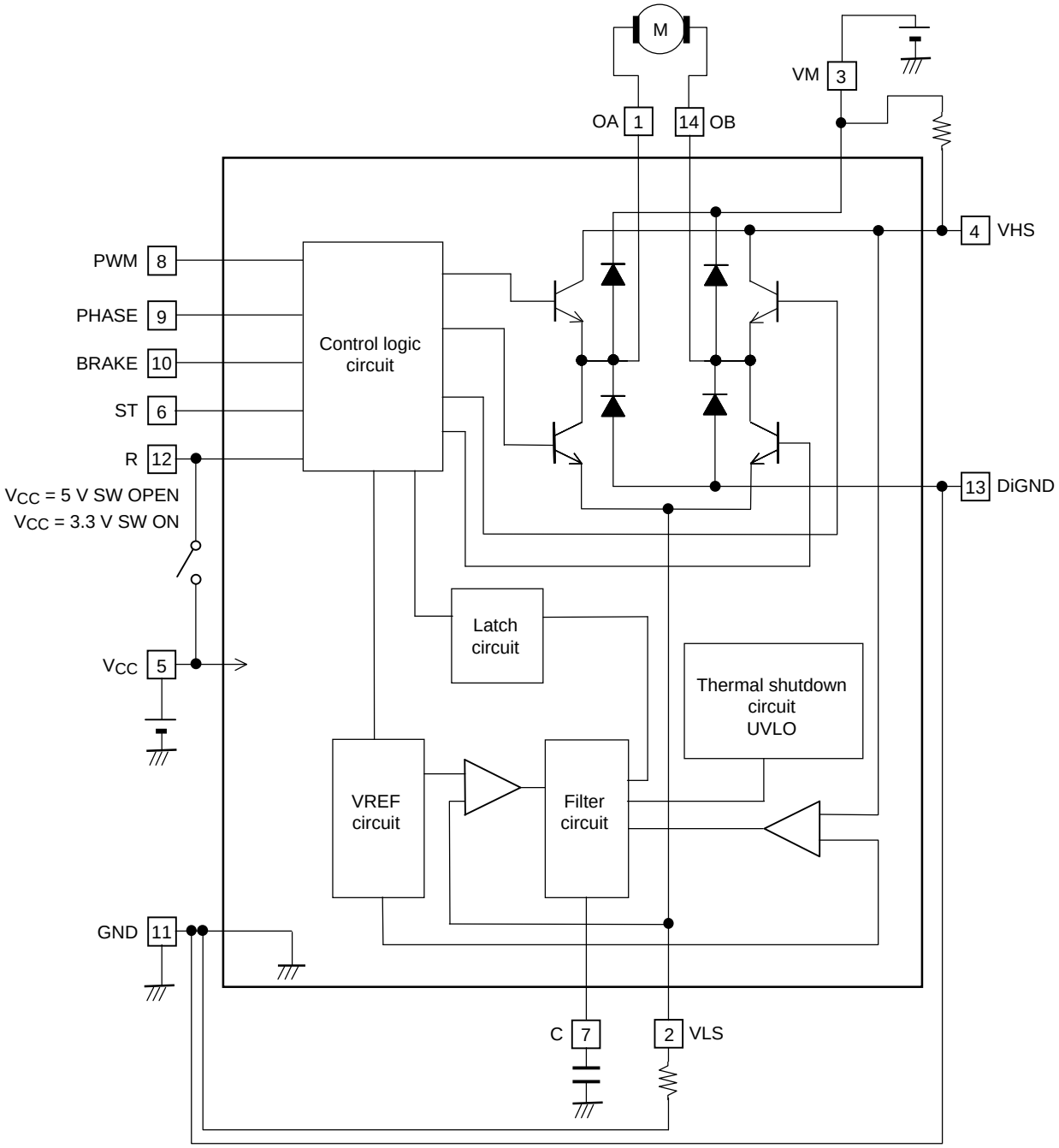
For example, if C is 50 pF, the mask time T will be 1.3 μs.

Low Side Transistor Drive Current Switching Pin

Since the lower side output transistor drive current is created from V_{CC}, if the V_{CC} power supply level is reduced, the drive current will also be reduced. Therefore, the LB11650 is provided with a pin for switching the drive current so that the LB11650 can provide the same drive current when used with 3.3 V specifications as it does when used with 5 V specifications.

When V_{CC} = 5 V: Leave the R pin open.
When V_{CC} = 3.3 V: Short the R pin to V_{CC}.

Block Diagram



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