



LB1997

Three-Phase Brushless Motor Driver for CD-ROM Spindle Drive

Overview

The LB1997 is a three-phase brushless motor driver especially suited for CD-ROM spindle motor drives.

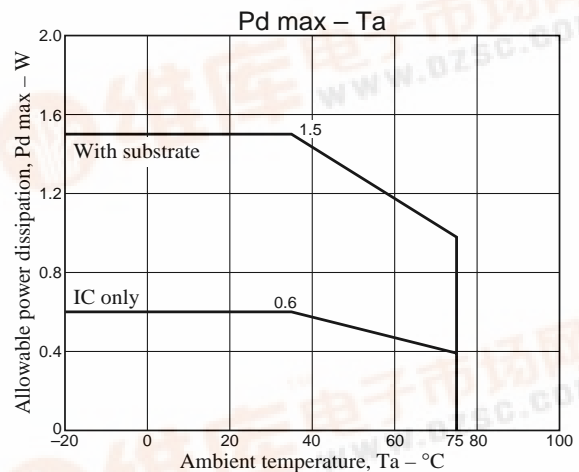
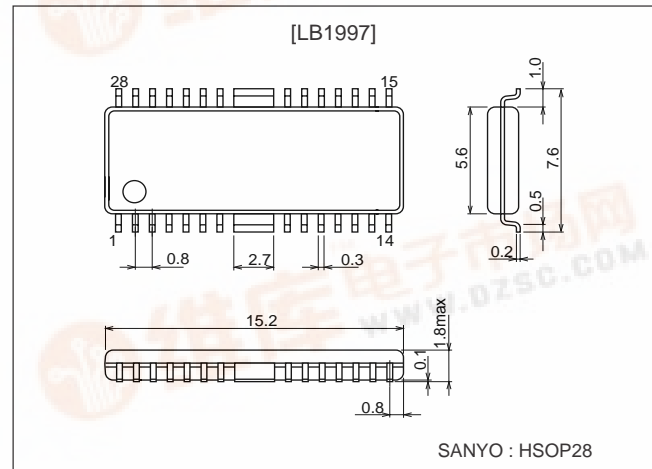
Functions

- Current linear drive
- Control V type amplifier
- Separate power supply for output upper side bias circuit allows low output saturation by boosting this power supply only (useful for 5V power supply types).
- Upper side current detection technique reduces loss voltage of current detection resistor. Voltage effect of this resistor reduces internal current drain of IC.
- Built-in short braking circuit
- Built-in reverse blocking circuit
- Hall FG output
- Built-in S/S function
- Built-in current limiter circuit
- Built-in Hall power supply
- Built-in thermal shutdown circuit
- V type control/single-side control switching pin allows CLV and CAV operation.

Package Dimensions

unit: mm

3222-HSOP28



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Specifications

Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	V_{CC1} max		7.0	V
	V_{CC2} max		14.4	V
	V_{CC3} max		14.4	V
Applied output voltage	V_O max		14.4	V
Applied input voltage	V_{IN} max		V_{CC1}	V
Output current	I_O max		1.3	A
Allowable power dissipation	Pd max	IC only	0.6	W
		with substrate ($114.3 \times 76.1 \times 1.6$ mm ³ , glass epoxy)	1.5	W
Operating temperature	Topr		-20 to +75	°C
Storage temperature	Tstg		-55 to +150	°C

Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	V_{CC1}		4 to 6	V
	V_{CC2}	$\geq V_{CC1}$	4 to 13.6	V
	V_{CC3}		4 to 13.6	V

Sample Application at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
12V type	V_{CC1}	Regulated voltage	4 to 6	V
	$V_{CC2} = V_{CC3}$	Unregulated voltage	4 to 13.6	V
5V type	$V_{CC1} = V_{CC3}$	Regulated voltage	4 to 6	V
	V_{CC2}	Boost-up voltage or regulated voltage (Note)	4 to 13.6	V

Note: When boost-up voltage is used at V_{CC2} , output can be set to low-saturation.

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Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC1} = 5\text{V}$, $V_{CC2} = V_{CC3} = 12\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Power supply current]						
Power supply current	I_{CC1}	$V_C = V_{CREF}$		8		mA
	I_{CC2}	$V_C = V_{CREF}$		0		mA
	I_{CC3}	$V_C = V_{CREF}$		150	250	μA
Output idle current	I_{CC1OQ}	$V_{S/S} = 0\text{V}$			200	μA
	I_{CC2OQ}	$V_{S/S} = 0\text{V}$			30	μA
	I_{CC3OQ}	$V_{S/S} = 0\text{V}$			30	μA
[Output]						
Saturation voltage, upper side 1 lower side 1	V_{OU1}	$I_O = -0.5\text{A}$, $V_{CC1} = 5\text{V}$, $V_{CC2} = V_{CC3} = 12\text{V}$		1.0		V
	V_{OD1}	$I_O = 0.5\text{A}$, $V_{CC1} = 5\text{V}$, $V_{CC2} = V_{CC3} = 12\text{V}$		0.3		V
Saturation voltage, upper side 2 lower side 2	V_{OU2}	$I_O = -0.5\text{A}$, $V_{CC1} = V_{CC3} = 5\text{V}$, $V_{CC2} = 12\text{V}$		0.3		V
	V_{OD2}	$I_O = 0.5\text{A}$, $V_{CC1} = V_{CC3} = 5\text{V}$, $V_{CC2} = 12\text{V}$		0.3		V
Current limiter setting voltage	V_{CL}	$R_{RF} = 0.43\Omega$		0.37		V
[Hall amplifier]						
Common mode input voltage range	V_{HCOM}		1.2		$V_{CC} - 1.0$	V
Input bias current	I_{HIB}			1		μA
Minimum Hall input level	V_{HIN}		60			mV _{P-P}
[S/S pin]						
High level voltage	$V_{S/SH}$		2.0		V_{CC1}	V
Low level voltage	$V_{S/SL}$				0.7	V
Input current	$I_{S/SI}$	$V_{S/S} = 5\text{V}$			200	μA
Leak current	$I_{S/SL}$	$V_{S/S} = 0\text{V}$	-30			μA
[Control]						
	I_{VC}	$V_C = V_{CREF} = 2.5\text{V}$		1		μA
	I_{VCREF}	$V_C = V_{CREF} = 2.5\text{V}$		1		μA
Voltage gain	GV_{CO}	$\Delta V_{RF}/\Delta V_C$		0.25		times
Startup voltage	V_{CTH}	$V_{CREF} = 2.5\text{V}$	2.35		2.65	V
Startup voltage width	ΔV_{CTH}	$V_{CREF} = 2.5\text{V}$	50		150	mV
[Hall power supply]						
Hall power supply voltage	V_H	$I_H = 5\text{mA}$		0.8		V
Allowable current	I_H		20			mA
[Thermal shutdown]						
Operating temperature	T_{TSD}	Design target value	150	180	210	$^\circ\text{C}$
Hysteresis	ΔT_{TSD}	Design target value		15		$^\circ\text{C}$
[Short braking]						
Brake pin at High level	V_{BRH}		4		5	V
Brake pin at Low level	V_{BRL}		0		1	V
[Control switching]						
CC pin at High level	V_{CCH}		4		5	V
CC pin at Low level	V_{CCL}		0		1	V

Note:

- During S/S OFF (standby), the Hall comparator is at High.
- Design target values are not measured.

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Truth Table

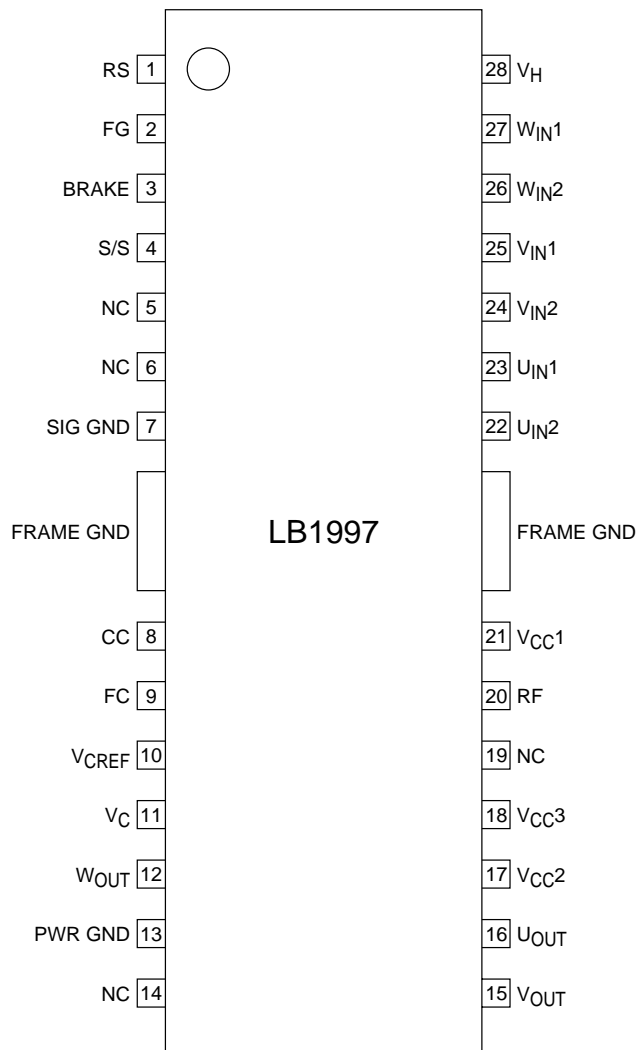
	Source -> Sink	Hall input			Control V _C
		U	V	W	
1	Phase W -> Phase V	H	H	L	H
	Phase V -> Phase W				L
2	Phase W -> Phase U	H	L	L	H
	Phase U -> Phase W				L
3	Phase V -> Phase W	L	L	H	H
	Phase W -> Phase V				L
4	Phase U -> Phase V	L	H	L	H
	Phase V -> Phase U				L
5	Phase V -> Phase U	H	L	H	H
	Phase U -> Phase V				L
6	Phase U -> Phase W	L	H	H	H
	Phase W -> Phase U				L

Input:

H: Input 1 is higher in potential than input 2 by at least 0.2V.

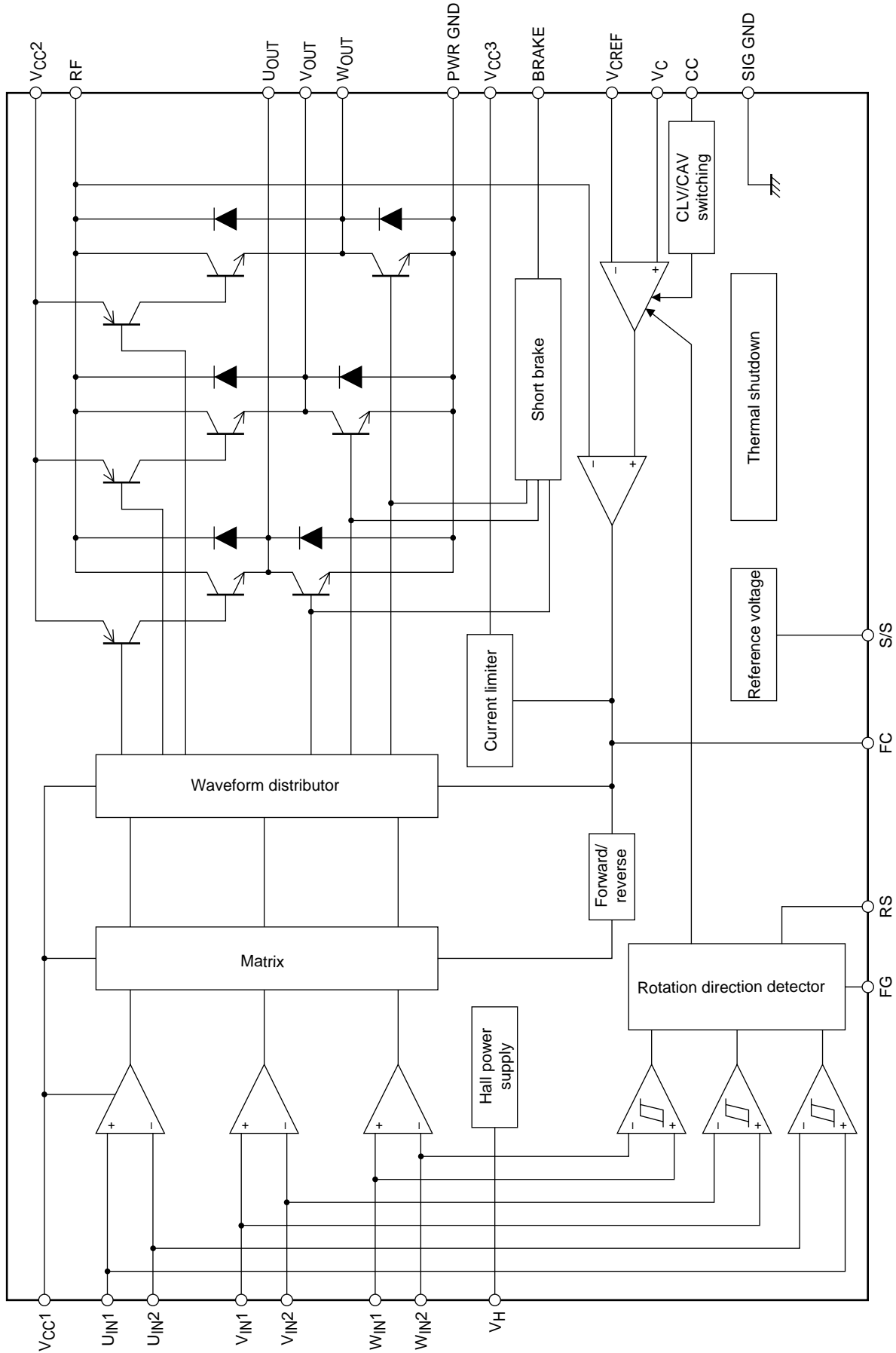
L: Input 1 is lower in potential than input 2 by at least 0.2V.

Pin Assignment



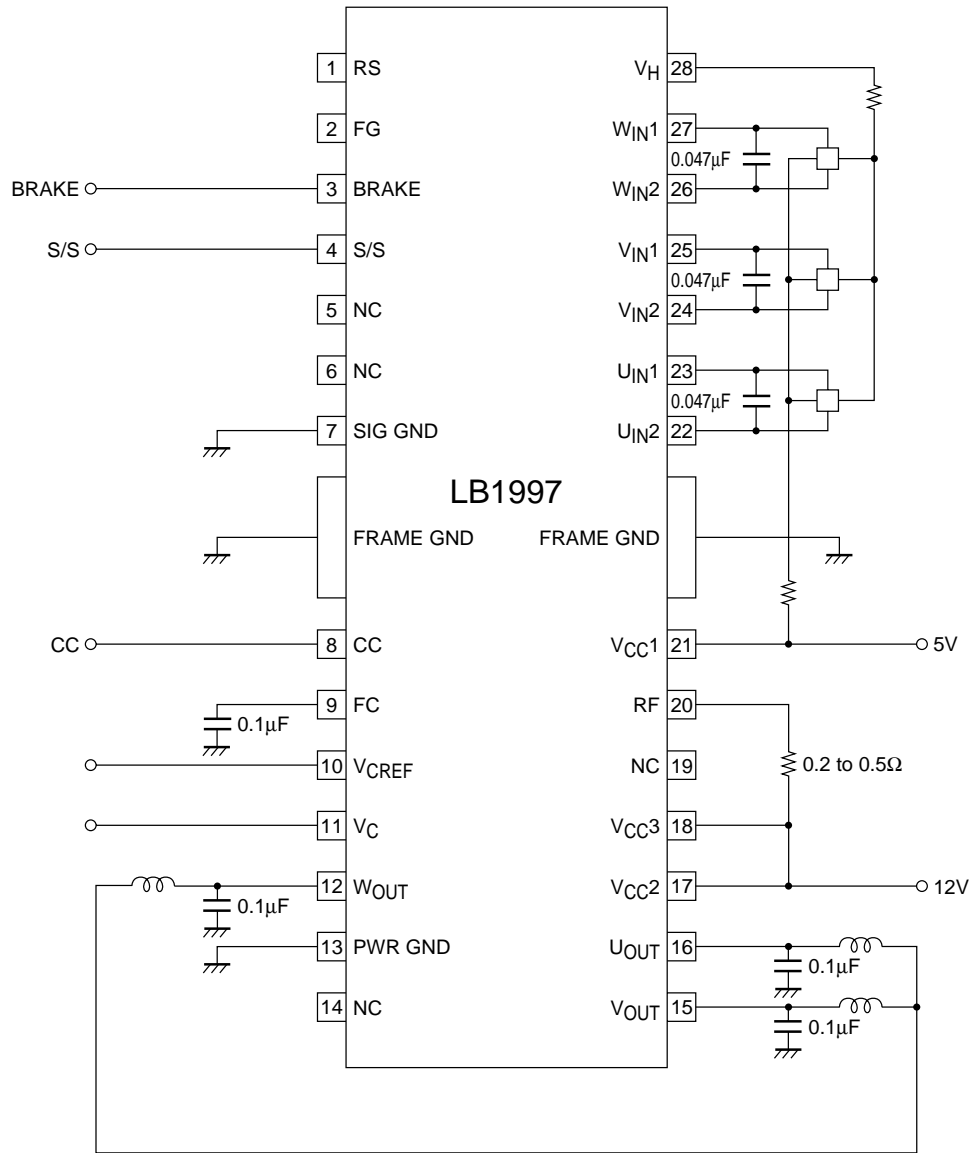
Top view

Block Diagram



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Sample Application Circuit



A11183

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Pin Descriptions

Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
17	V _{CC2}	4V to 13.6V		Source side predrive voltage supply pin
18	V _{CC3}	4V to 13.6V		Constant current control amplifier voltage supply pin
21	V _{CC1}	4V to 6V		Power supply pin for all circuits except output transistors, source predriver, and low current control amplifier
1	RS		<p style="text-align: right;">A11184</p>	Reverse detector pin Forward rotation: High Reverse rotation: Low
2	FG			1 Hall element waveform Schmitt comparator composite output
23 22	U _{IN1} U _{IN2}	1.2V to V _{CC1} -1V	<p style="text-align: right;">A11185</p>	U phase Hall element input and reverse detector U phase Schmitt comparator input pin Logic High indicates U _{IN1} > U _{IN2} .
25 24	V _{IN1} V _{IN2}			V phase Hall element input and reverse detector V phase Schmitt comparator input pin Logic High indicates V _{IN1} > V _{IN2} .
27 26	W _{IN1} W _{IN2}			W phase Hall element input and reverse detector W phase Schmitt comparator input pin Logic High indicates W _{IN1} > W _{IN2} .
28	V _H		<p style="text-align: right;">A11186</p>	Hall element lower side bias voltage supply pin
4	S/S	0V to V _{CC1}	<p style="text-align: right;">A11187</p>	When this pin is at 0.7V or lower, or when it is open, all circuits are inactive. When driving motor, set this pin to 2V or higher.
7	SIG GND			GND pin for all circuits except output
9	FC		<p style="text-align: right;">A11188</p>	Control loop frequency compensator pin. Connecting a capacitor between this pin and GND prevents closed loop oscillation in current limiting circuitry.

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Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
10	V _{CREF}	2V to 3V		Control reference voltage supply pin. Determines control start voltage.
11	V _C	0V to V _{CC1}		Speed control voltage supply pin V type control technique V _C > V _{CREF} : Forward V _C < V _{CREF} : Slowdown (Reverse-blocking circuit built in to prevent reverse rotation.)
12	W _{OUT}			W phase output
13	PWR GND			Output transistor GND
15	V _{OUT}			V phase output
16	U _{OUT}			U phase output
20	RF			Upper side output PNP transistor collector pin (common for all 3 phases). For current detection, connect resistor between V _{CC3} pin and RF pin. Constant current control and current limiter works by detecting this voltage.
8	CC			V type control/single-side control switching pin CC: High → Single-side control Low/Open → V type control
3	BRAKE			Short brake pin BRAKE: High → Short brake operation Low/Open → Motor drive operation

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