



LB1998

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

Overview

The LB1998 is a three-phase brushless motor driver especially suited for CD-ROM spindle motor drives.

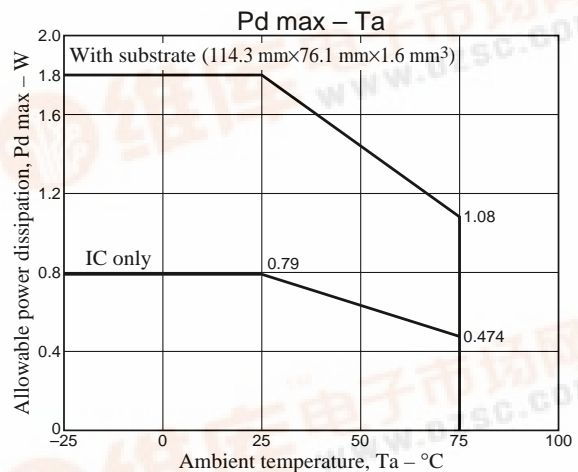
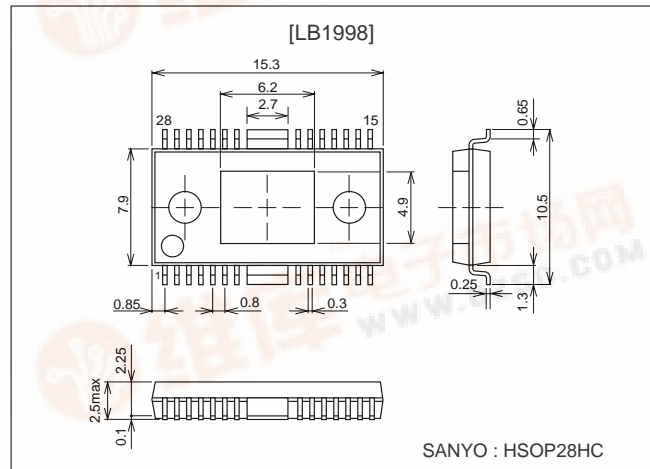
Functions

- Current linear drive
- Control V type amplifier
- Top side current detection technique reduces loss voltage of current detection resistor. Voltage effect of this resistor reduces internal current drain of IC.
- Built-in current limiter circuit
- Built-in reverse blocking circuit
- Hall FG output
- Built-in 1 Hall FG/3 Hall FG switching circuit
- Built-in short braking circuit
- Built-in Hall bias circuit
- Built-in thermal shutdown circuit
- Built-in S/S function
- Built-in 3 mode gain switching function ensures compatibility with 8/12 cm CAV and CLV discs

Package Dimensions

unit: mm

3234-HSOP28HC



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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	P_d max	IC only	0.79	W
		with substrate ($114.3 \times 76.1 \times 1.6$ mm ³ , glass epoxy)	1.80	W
Operating temperature	T_{opr}		-20 to +75	°C
Storage temperature	T_{stg}		-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

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}	Unregulated voltage	4 to 13.6	V

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

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Power supply current]						
Power supply current	I_{CC1}	$V_{CIN} = V_{CREF}$		8		mA
	I_{CC2}	$V_{CIN} = V_{CREF}$		250	300	mA
Output idle current	I_{CC1OQ}	$V_{S/S} = 0\text{V}$			200	μA
	I_{CC2OQ}	$V_{S/S} = 0\text{V}$			60	μA
[Output]						
Saturation voltage, upper side 1	V_{OU1}	$I_O = -0.5\text{A}$, $V_{CC1} = 5\text{V}$, $V_{CC2} = 12\text{V}$		1.0		V
Saturation voltage, lower side 1	V_{OD1}	$I_O = 0.5\text{A}$, $V_{CC1} = 5\text{V}$, $V_{CC2} = 12\text{V}$		0.3		V
Current limiter setting voltage	V_{CL}	$R_{RF} = 0.25\Omega$		0.25		V
[Hall amplifier]						
Common mode input voltage range	V_{HCOM}		1.2		$V_{CC1}-1.0$	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]						
V_{CIN} pin input current	I_{VC}	$V_{CIN} = V_{CREF} = 1.65\text{V}$			1	μA
V_{CREF} pin input current	I_{VCREF}	$V_{CIN} = V_{CREF} = 1.65\text{V}$			1	μA
Voltage gain	G_{VCO}	$\Delta V_{RF}/\Delta V_C$, Note 1		0.25		times
Startup voltage	V_{CTH}	$V_{CREF} = 1.65\text{V}$, Note 1	1.55		1.85	V
Startup voltage width	ΔV_{CTH}	$V_{CREF} = 1.65\text{V}$, Note 1	100		200	mV
[Gain switching amplifier]						
Input offset voltage	$V_{GCOFFSET}$	Design target value	-8		+8	mV
OPEN LOOP voltage gain	G_{VGC}	$f = 10\text{ kHz}$, Design target value		43		dB
Same-phase input voltage range	V_{GCOM}		0		3.5	V
[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
[1 Hall FG/3 Hall FG switching]						
FG _{SEL} pin at High level	V_{FSH}		4		5	
FG _{SEL} pin at Low level	V_{FSL}		0		1	
[Gain switching analog switch]						
Analog switch at High level	R_{INH}		$V_{CC}-0.5$		V_{CC1}	
Analog switch at Low level	R_{INL}		0		0.2	

Note:

- During S/S OFF (standby), the Hall comparator is at High.
- Gain switching amplifier operated at a factor of 1.
- Design target values are not measured.

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Truth Table

	Source → Sink	Hall input			Control V_{CIN}
		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:

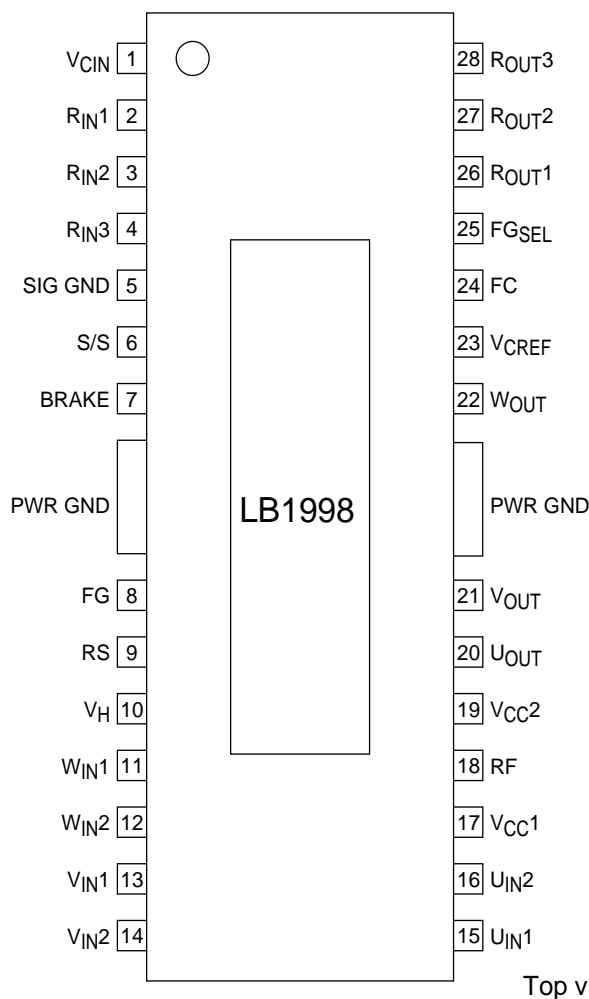
H: Input 1 is higher in potential than input 2 by at least 0.2V.

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

Brake Mode Switching Truth Table

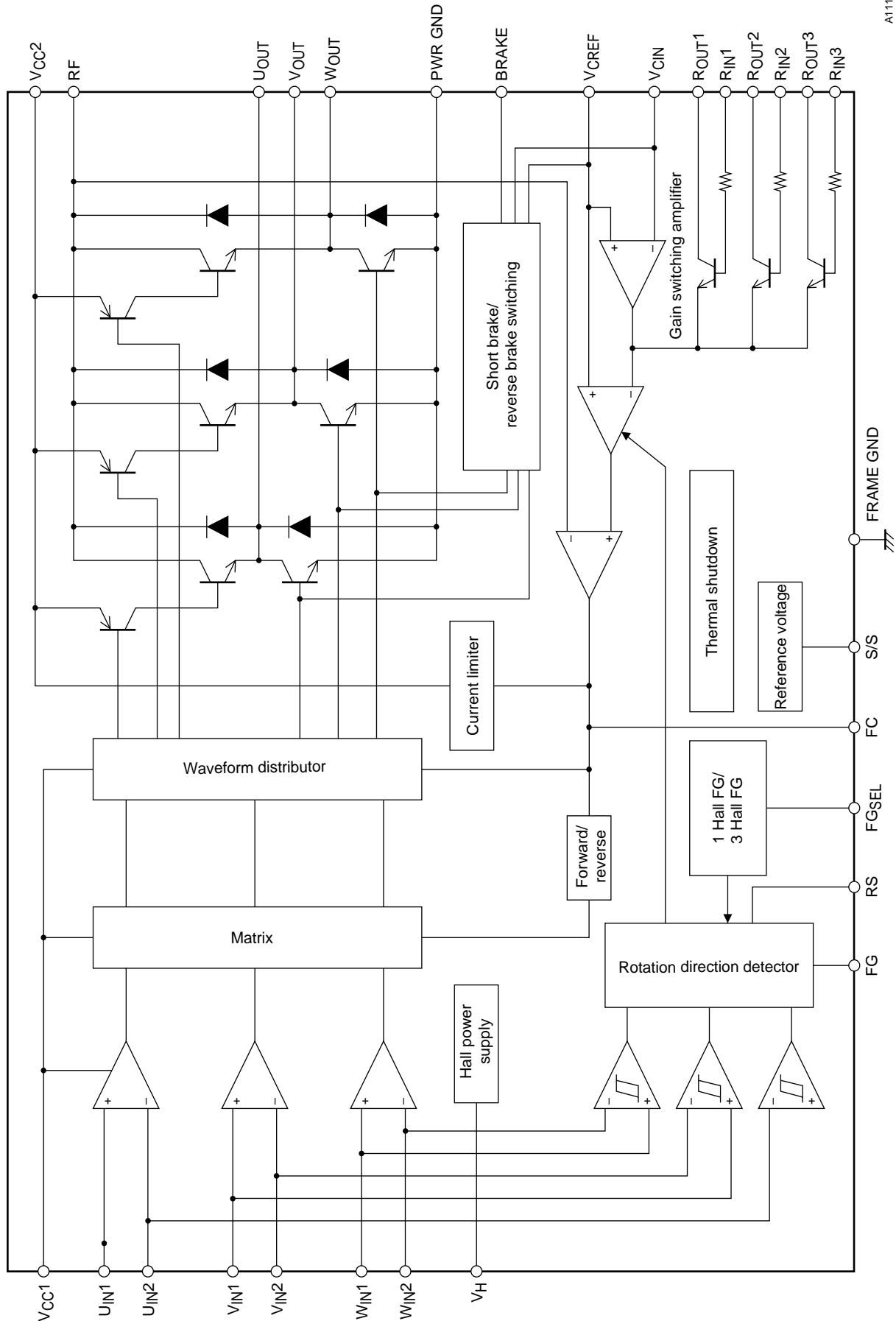
BRAKE pin	$V_{CIN} > V_{CREF}$	$V_{CIN} < V_{CREF}$
L, OPEN	Foward	Reverse brake
H	Foward	Short brake

Pin Assignment



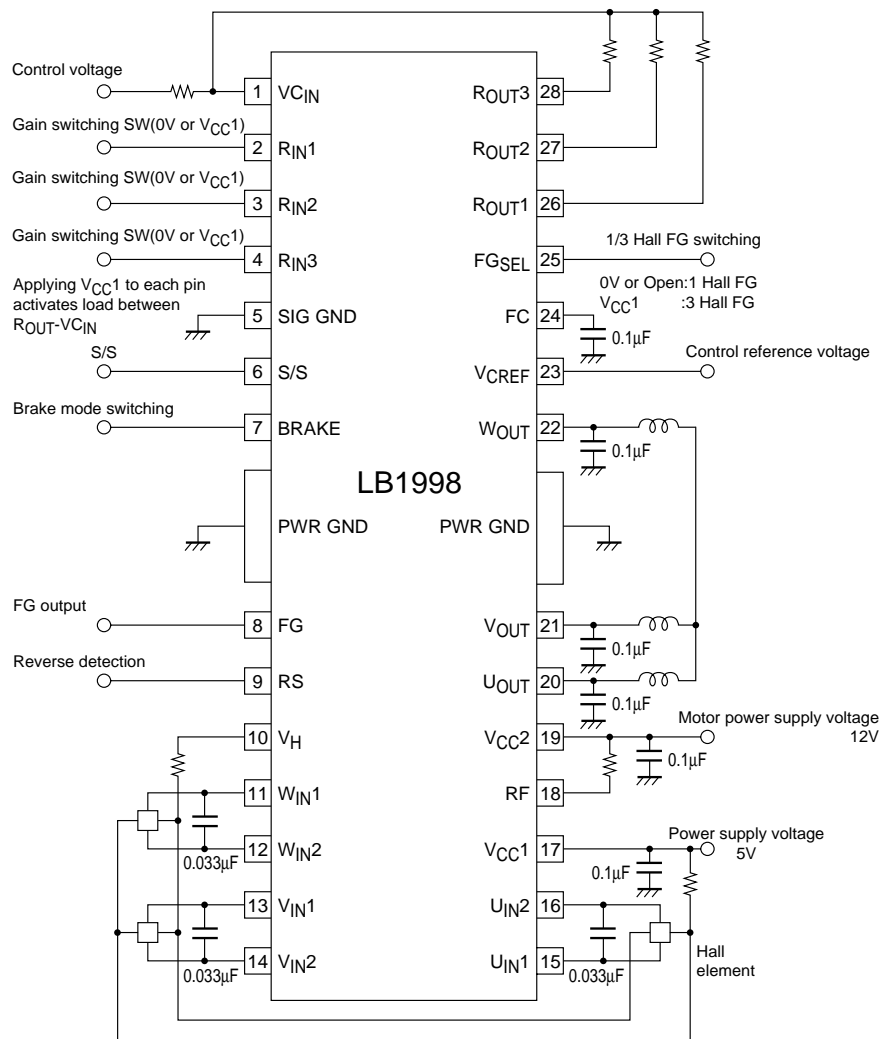
Top view

Block Diagram



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Sample Application Circuit



A11195

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Pin Descriptions

Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
19	V _{CC2}	4V to 13.6V		Source side predrive voltage and constant current control amplifier voltage supply pin
17	V _{CC1}	4V to 6V		Power supply pin for all circuits except output transistors, source predriver, and low current control amplifier
9	RS		<p style="text-align: right;">A11196</p>	Reverse detector pin Forward rotation: High Reverse rotation: Low
8	FG			1 Hall or 3 Hall element waveform Schmitt comparator combined output
15 16	U _{IN1} U _{IN2}	1.2V to V _{CC1} -1V	<p style="text-align: right;">A11197</p>	U phase Hall element input and reverse detector U phase Schmitt comparator input pin Logic High indicates U _{IN1} > U _{IN2} .
13 14	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} .
11 12	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} .
10	V _H		<p style="text-align: right;">A11198</p>	Hall element lower side bias voltage supply pin
6	S/S	0V to V _{CC1}	<p style="text-align: right;">A11199</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.
5	SIG GND			GND pin for all circuits except output
24	FC		<p style="text-align: right;">A11200</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
23	V _{CREF}	0V to 3.5V		Control reference voltage supply pin. Determines control start voltage.
1	V _{CIN}	0V to 3.5V		Speed control voltage supply pin V type control technique V _C > V _{CREF} : Forward V _C < V _{CREF} : Slowdown (Reverse-blocking circuit prevents reverse rotation.)
22	W _{OUT}			W phase output
	PWR GND			Output transistor GND
21	V _{OUT}			V phase output
20	U _{OUT}			U phase output
18	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.
25	FG _{SEL}			1 Hall FG/3 Hall FG output, switching pin: High → 3 Hall FG Low/Open → 1 Hall FG
7	BRAKE			Brake mode switching pin BRAKE: High → Short brake Low/Open → Reverse brake Brake mode changes when V _{CIN} > V _{CREF} .

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Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
2	R_{IN1}	0 to V_{CC1} Low: 0V High: V_{CC1}		Gain switching selector pin When set to High (V_{CC1}), resistor connected between R_{OUT1} and V_{CIN} is selected as negative feedback resistor.
3	R_{IN2}			Gain switching selector pin When set to High (V_{CC1}), resistor connected between R_{OUT2} and V_{CIN} is selected as negative feedback resistor.
4	R_{IN3}			Gain switching selector pin When set to High (V_{CC1}), resistor connected between R_{OUT3} and V_{CIN} is selected as negative feedback resistor.
26	R_{OUT1}			Negative feedback resistor connector pins Connect negative feedback resistors between these pins and V_{CIN} .
27	R_{OUT2}			
28	R_{OUT3}			

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