



LB11996,11996H

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

Preliminary

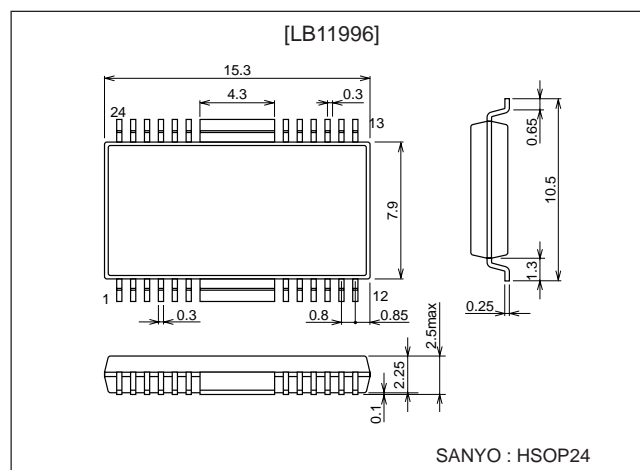
Features

- 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 loses loss voltage of current detection resistor. Voltage drop caused by this resistor reduces internal power dissipation 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
- 1 Hall FG/3 Hall FG switchable
- Supports 3.3V DSP

Package Dimensions

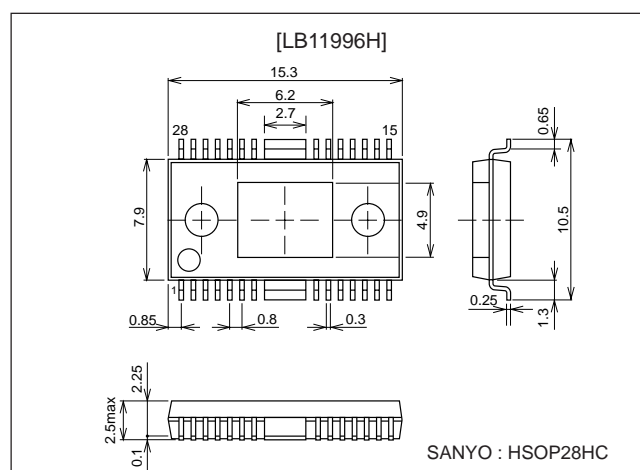
unit: mm

3227-HSOP24



unit: mm

3234-HSOP28HC



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Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum power supply voltage 1	$V_{CC1\text{ max}}$		7.0	V
Maximum power supply voltage 2	$V_{CC2\text{ max}}$		14.4	V
Maximum power supply voltage 3	$V_{CC3\text{ max}}$		14.4	V
Maximum applied output voltage	$V_o\text{ max}$		14.4	V
Maximum applied input voltage	$V_i\text{ max}$		V_{CC1}	V
Maximum output current	$I_o\text{ max}$		1.3	A
Allowable power dissipation	$P_d\text{ max}$	[LB11996] IC only	0.79	W
		*With specified substrate	*1.8	
		[LB11996H] IC only	0.8	
		*With specified substrate	*1.9	
Operating temperature	T_{opr}		$-20\text{ to }+75$	$^{\circ}\text{C}$
Storage temperature	T_{stg}		$-55\text{ to }+150$	$^{\circ}\text{C}$

* Specified substrate: $114.3 \times 76.1 \times 1.6\text{ mm}^3$ glass epoxy

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

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage 1	V_{CC1}		4 to 6	V
Power supply voltage 2	V_{CC2}	$\geq V_{CC1}$	4 to 13.6	V
Power supply voltage 3	V_{CC3}		4 to 13.6	V

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

(1) 12V type

Power supply pin	Conditions	Ratings	Unit
V_{CC1}	Regulated voltage	4 to 6	V
$V_{CC2} = V_{CC3}$	Unregulated voltage	4 to 13.6	V

(2) 5V type

Power supply pin	Conditions	Ratings	Unit
$V_{CC1} = V_{CC3}$	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 Ta = 25°C, V_{CC1} = 5V, V_{CC2} = V_{CC3} = 12V (unless otherwise specified)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Power supply current]						
Power supply current 1	V _{CC1}	V _C = V _{CREF}		8		mA
Power supply current 2	V _{CC2}	V _C = V _{CREF}		0		mA
Power supply current 3	V _{CC3}	V _C = V _{CREF}		150	250	μA
Output idle current 1	I _{CC1OQ}	V _{S/S} = 0V			200	μA
Output idle current 2	I _{CC2OQ}	V _{S/S} = 0V			30	μA
Output idle current 3	I _{CC3OQ}	V _{S/S} = 0V			30	μA
[Output]						
Saturation voltage, upper side 1	V _{OU1}	I _O = −0.5A, V _{CC1} = 5V, V _{CC2} = V _{CC3} = 12V		1.0		V
Saturation voltage, lower side 1	V _{OD1}	I _O = 0.5A, V _{CC1} = 5V, V _{CC2} = V _{CC3} = 12V		0.3		V
Saturation voltage, upper side 2	V _{OU2}	I _O = −0.5A, V _{CC1} = V _{CC3} = 5V, V _{CC2} = 12V		0.3		V
Saturation voltage, lower side 2	V _{OD2}	I _O = 0.5A, V _{CC1} = V _{CC3} = 5V, V _{CC2} = 12V		0.3		V
Current limiter setting voltage	V _{CL}	R _{RF} = 0.33Ω		0.37		V
[Hall amplifier]						
Common mode input voltage range	V _{HCOM}		1.2		V _{CC1} −1.0	V
Input bias current	V _{HIB}			1		μA
Minimum Hall input level	V _{HIN}		60			mVp-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} = 5V			200	μA
Leakage current	I _{S/SL}	V _{S/S} = 0V	−30			μA
[Control]						
VC pin input current	I _{VC}	V _C = V _{CREF} = 1.65V			1	μA
VCREF pin input current	I _{VCREF}	V _C = V _{CREF} = 1.65V			1	μA
Voltage gain	GV _{CC}	ΔV _{RF} /ΔV _C		0.35		times
Startup voltage	V _{CTH}	V _{CREF} = 1.65V	1.5		1.8	V
Startup voltage width	ΔV _{CTH}	V _{CREF} = 1.65V	50		150	mV
[Hall power supply]						
Hall power supply voltage	V _H	I _H = 5 mA		0.8		V
Allowable current	I _H		20			mA
[Thermal shutdown]						
Operating temperature	T _{TSD}	(Target)	150	180	210	°C
Hysteresis	ΔT _{TSD}	(Target)		15		°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 select]						
FGSEL pin at High level	V _{FSH}		4		5	V
FGSEL pin at Low level	V _{FSL}		0		1	V

Note:

- During S/S OFF (standby), the Hall comparator is at High.
- Items shown to be “Target” are not measured.

Truth Table

	Source Sink	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.

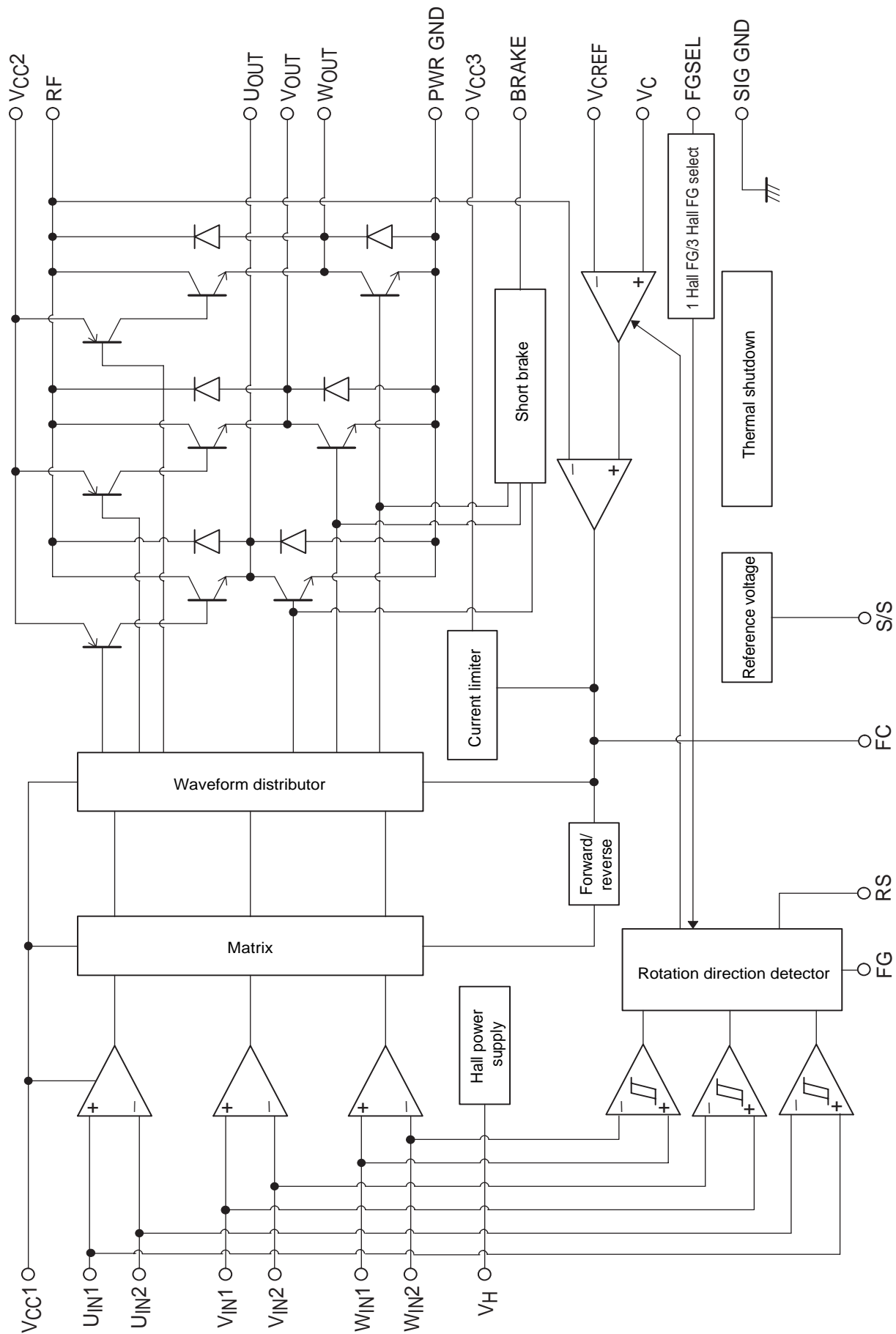
Brake Operation

Brake pin	Operation
H	Brake operation
L	Normal rotation

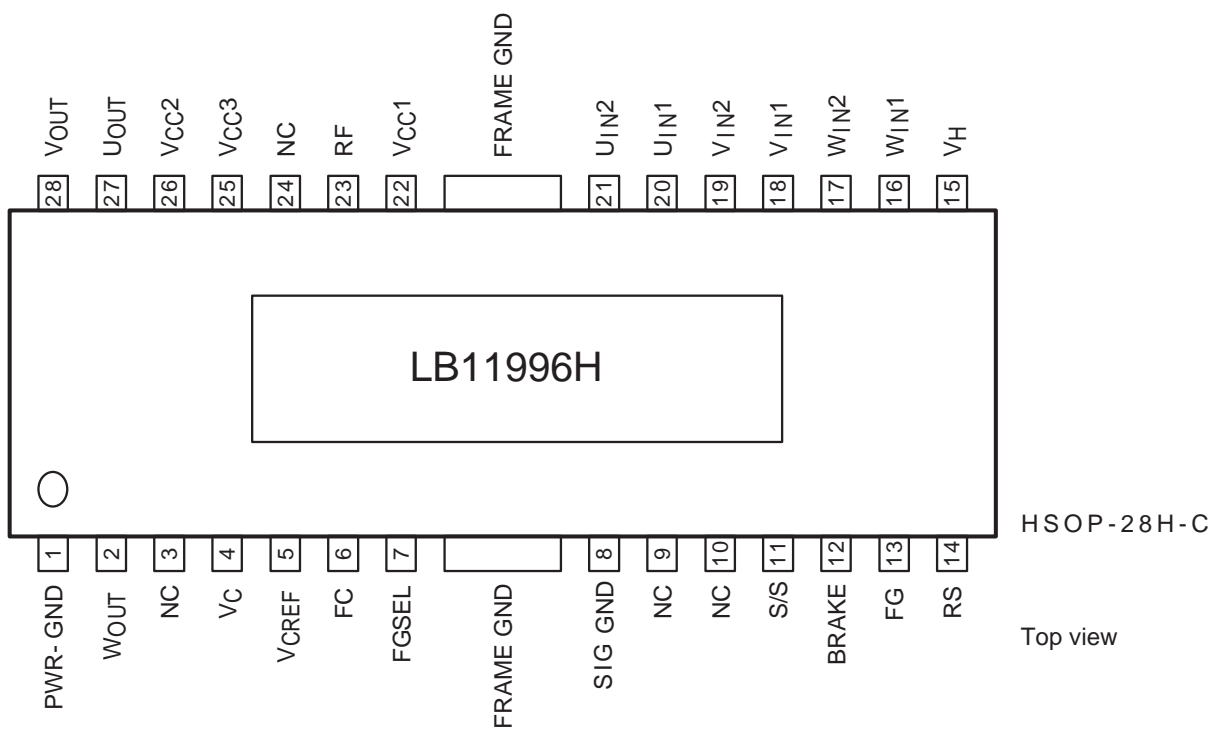
FGSEL (1 Hall /3 Hall select)

FGSEL	FG output principle
H	3 Hall FG output
L	1 Hall FG output

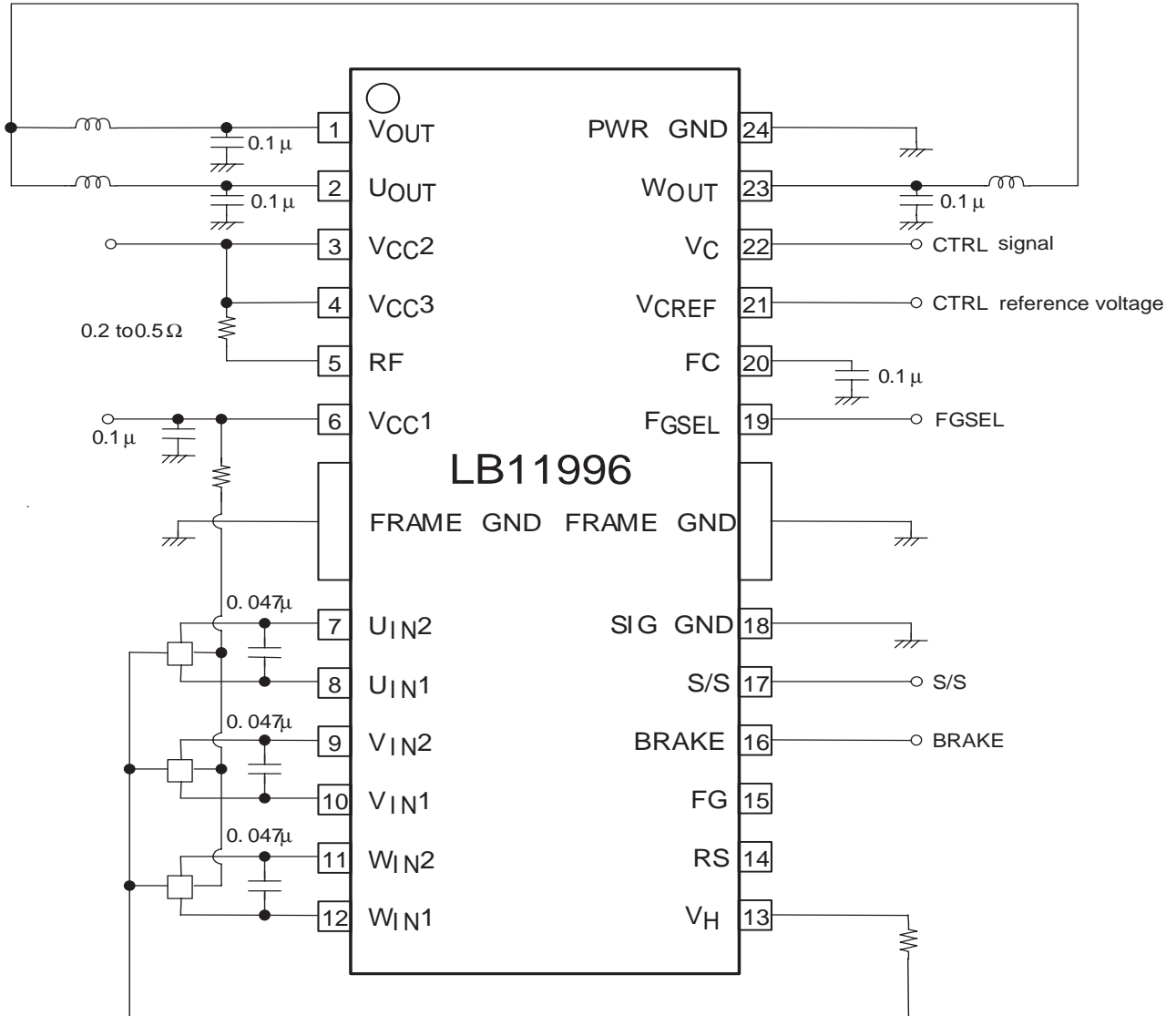
Block Diagram



Pin Assignments



Sample Application Circuit



Unit (capacitance: F)

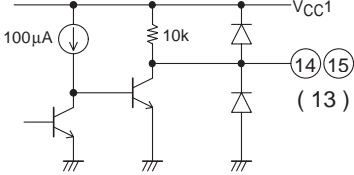
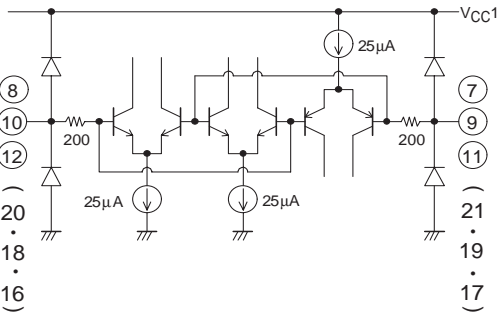
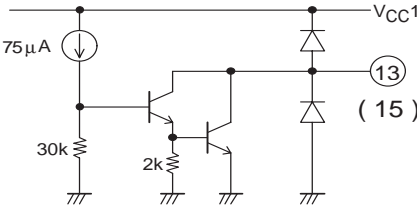
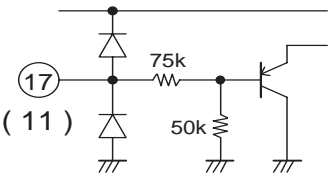
Power supply - GND
Output - GND
Between Hall inputs

Capacitor requirements may change depending on motor.
For some motors, capacitor between Hall inputs may not be needed.

Pin Description

(): LB11996H, other pins: identical

Unit (resistance: Ω)

Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
3 (26)	V_{CC2}	4V to 13.6V		Source side predrive voltage supply pin.
4 (25)	V_{CC3}	4V to 13.6V		Constant current control amplifier voltage supply pin.
6 (22)	V_{CC1}	4V to 6V		Power supply pin for all voltage except output transistors, source predrive, and constant current control amplifier.
14	RS	1.2V to V_{CC1} -1V		Reverse detector pin Forward rotation: High Reverse rotation: Low
15 (13)	FG			1 Hall element waveform Schmitt comparator composite output
8 (20)	U_{IN1}	1.2V to V_{CC1} -1V		U phase Hall element input and reverse detector U phase Schmitt comparator input pin. Logic High indicates $U_{IN1} > U_{IN2}$.
7 (21)	U_{IN2}			V phase Hall element input and reverse detector V phase Schmitt comparator input pin. Logic High indicates $V_{IN1} > V_{IN2}$.
10 (18)	V_{IN1}			W phase Hall element input and reverse detector W phase Schmitt comparator input pin. Logic High indicates $W_{IN1} > W_{IN2}$.
9 (19)	V_{IN2}			
12 (16)	W_{IN1}			
11 (17)	W_{IN2}			
13 (15)	V_H			Hall element lower side bias voltage supply pin.
17 (11)	S/S	0V to V_{CC1}		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.

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Unit (resistance: Ω)

Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
18 (8)	SIG GND			GND pin for all circuits except output.
20 (6)	FC			Control loop frequency compensator pin. Connecting a capacitor between this pin and GND prevents closed loop oscillation in current limiting circuitry.
21 (5)	V _{CREF}	0V to 3.5V		Control reference voltage applied pin. Determines control start voltage.
22 (4)	V _C	0V to V _{CC1}		Speed control voltage applied pin. V type control technique V _C > V _{CREF} : Forward V _C < V _{CREF} : Slowdown (Reverse-blocking circuit prevents reverse rotation.)
23 (2)	W _{OUT}			W-phase output.
24 (1)	PWR GND			Output transistor GND.
1 (28)	V _{OUT}			V-phase output.
2 (27)	U _{OUT}			U-phase output.
5 (23)	RF			Upper side output NPN 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.
19 (7)	FGSEL			3 Hall FG/1 Hall FG select pin. FGSEL: High → 3 Hall FG Low/Open → 1 Hall FG
16 (12)	BRAKE			Short brake pin. BRAKE: High → Brake Low/Open → Drive

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