Ordering number : ENN*6181A

Monolithic Digital IC

LB11996,11996H

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

Preliminary

Features

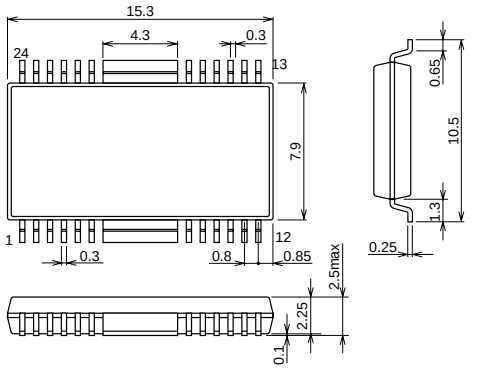
- Current linear drive
- Control V type amplifier
- Separate power supply for output upper side bias circuit allows low output saturation by boosting this power supply only (useful for 5V power supply types).
- Upper side current detection technique loses loss voltage of current detection resistor. Voltage 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

[LB11996]

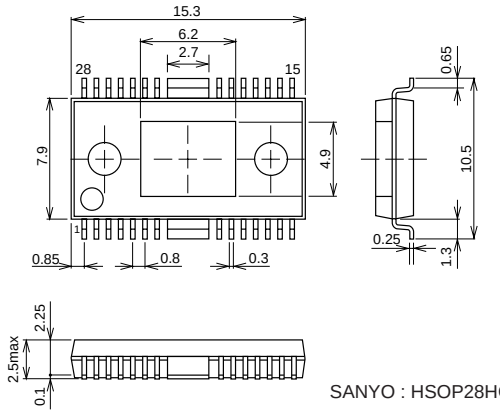


SANYO : HSOP24

unit: mm

3234-HSOP28HC

[LB11996H]



SANYO : HSOP28HC

SANYO Electric Co.,Ltd. Semiconductor Company

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Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions		Ratings	Unit
Maximum power supply voltage 1	$V_{CC}1$ max			7.0	V
Maximum power supply voltage 2	$V_{CC}2$ max			14.4	V
Maximum power supply voltage 3	$V_{CC}3$ max			14.4	V
Maximum applied output voltage	Vo max			14.4	V
Maximum applied intput voltage	Vi max			$V_{CC}1$	V
Maximum output current	Io max			1.3	A
Allowable power dissipation	Pd max	[LB11996]	IC only	0.79	W
			*With specified substrate	*1.8	
		[LB11996H]	IC only	0.8	
			*With specified substrate	*1.9	
Operating temperature	Topr			–20 to +75	℃
Storage temperature	Tstg			–55 to +150	℃

* Specified substrate: 114.3 × 76.1 × 1.6 mm³ glass epoxy

Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage 1	$V_{CC}1$		4 to 6	V
Power supply voltage 2	$V_{CC}2$	≥$V_{CC}1$	4 to 13.6	V
Power supply voltage 3	$V_{CC}3$		4 to 13.6	V

Sample Application at Ta = 25°C

(1) 12V type

Power supply pin	Conditions	Ratings	Unit
$V_{CC}1$	Regulated voltage	4 to 6	V
$V_{CC}2 = V_{CC}3$	Unregulated voltage	4 to 13.6	V

(2) 5V type

Power supply pin	Conditions	Ratings	Unit
$V_{CC}1 = V_{CC}3$	Regulated voltage	4 to 6	V
$V_{CC}2$	Boost-up voltage or regulated voltage (Note)	4 to 13.6	V

Note: When boost-up voltage is used at $V_{CC}2$, output can be set to low-saturation.

Electrical Characteristics at Ta = 25°C, $V_{CC}1$ = 5V, $V_{CC}2$ = $V_{CC}3$ = 12V (unless otherwise specified)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Power supply current]						
Power supply current 1	$V_{CC}1$	$V_C = V_{CREF}$		8		mA
Power supply current 2	$V_{CC}2$	$V_C = V_{CREF}$		0		mA
Power supply current 3	$V_{CC}3$	$V_C = V_{CREF}$		150	250	µA
Output idle current 1	$I_{CC}1OQ$	$V_{S/S}$ = 0V			200	µA
Output idle current 2	$I_{CC}2OQ$	$V_{S/S}$ = 0V			30	µA
Output idle current 3	$I_{CC}3OQ$	$V_{S/S}$ = 0V			30	µA
[Output]						
Saturation voltage, upper side 1	$V_{OU}1$	I_O = –0.5A, $V_{CC}1$ = 5V, $V_{CC}2$ = $V_{CC}3$ = 12V		1.0		V
Saturation voltage, lower side 1	$V_{OD}1$	I_O = 0.5A, $V_{CC}1$ = 5V, $V_{CC}2$ = $V_{CC}3$ = 12V		0.3		V
Saturation voltage, upper side 2	$V_{OU}2$	I_O = –0.5A, $V_{CC}1$ = $V_{CC}3$ = 5V, $V_{CC}2$ = 12V		0.3		V
Saturation voltage, lower side 2	$V_{OD}2$	I_O = 0.5A, $V_{CC}1$ = $V_{CC}3$ = 5V, $V_{CC}2$ = 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		$V_{CC}1$–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		$V_{CC}1$	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	IV_{CREF}	VC = V_{CREF} = 1.65V			1	µA
Voltage gain	GV_{CC}	$\Delta V_{RF}/\Delta V_C$		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	℃
Hysteresis	ΔT_{TSD}	(Target)		15		℃
[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 U	Input V	Input W	Control V_C
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.

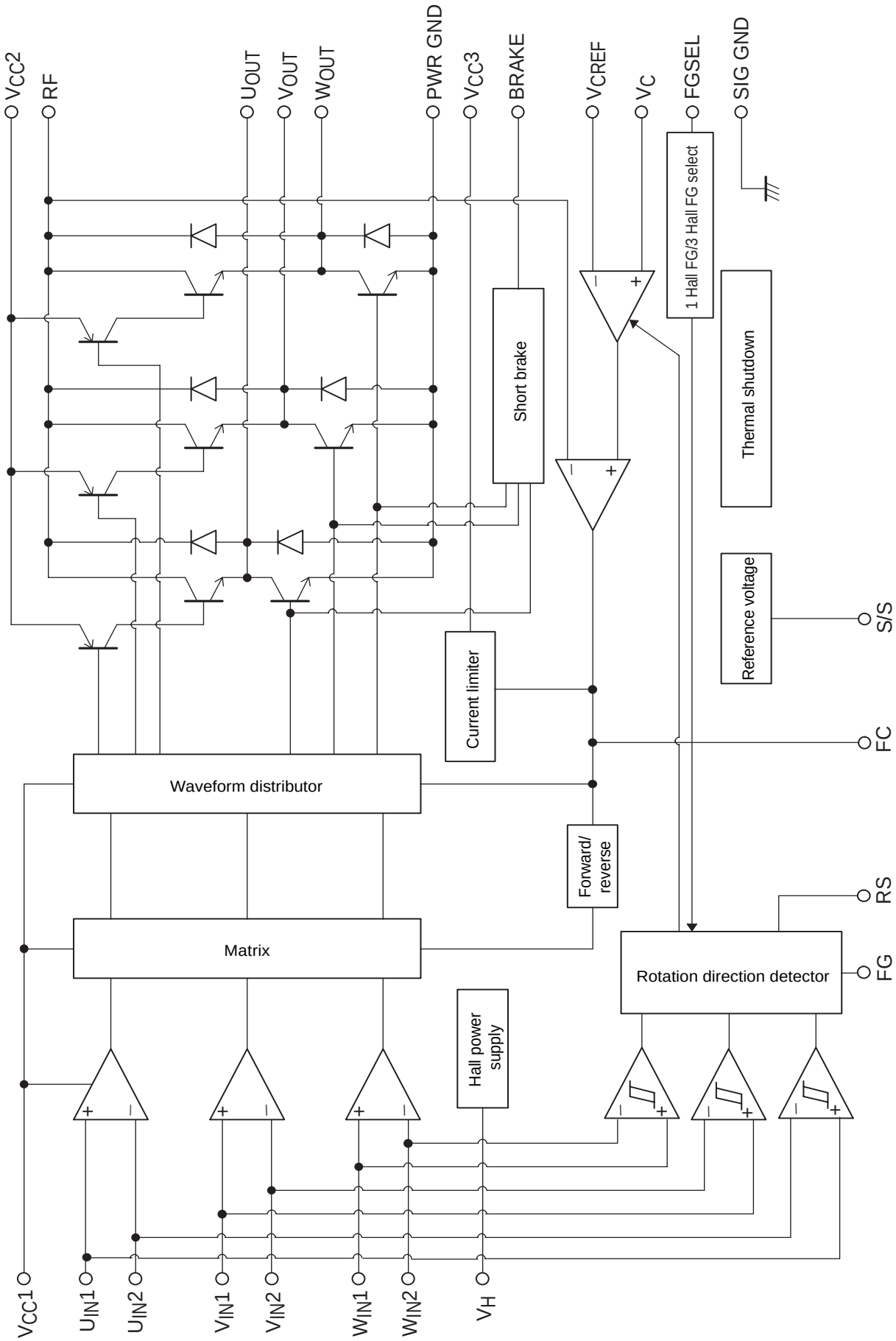
Brake Operation

Brake pin	Operation
H	Brake operation
L	Normal rotation

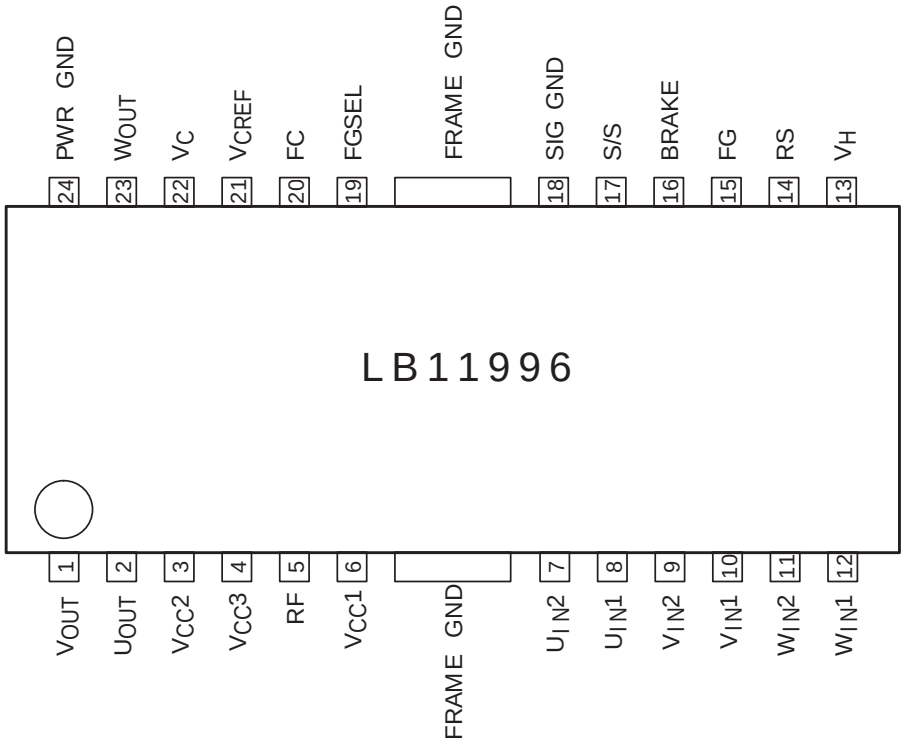
FGSEL (1 Hall /3 Hall select)

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

Block Diagram

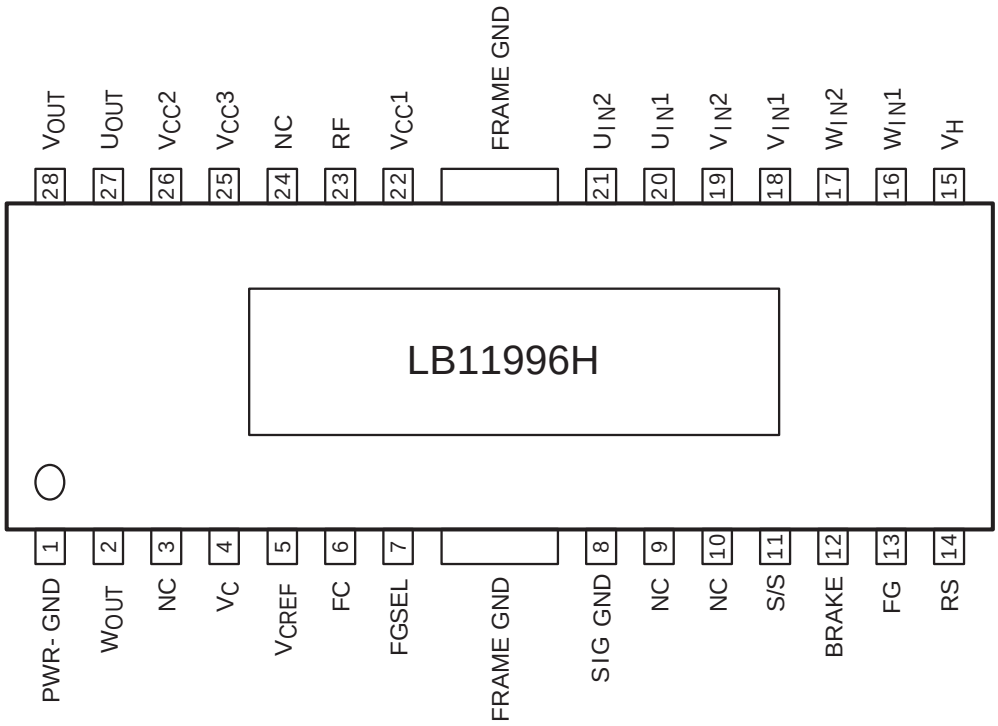


Pin Assignments



HSOP-24

Top view



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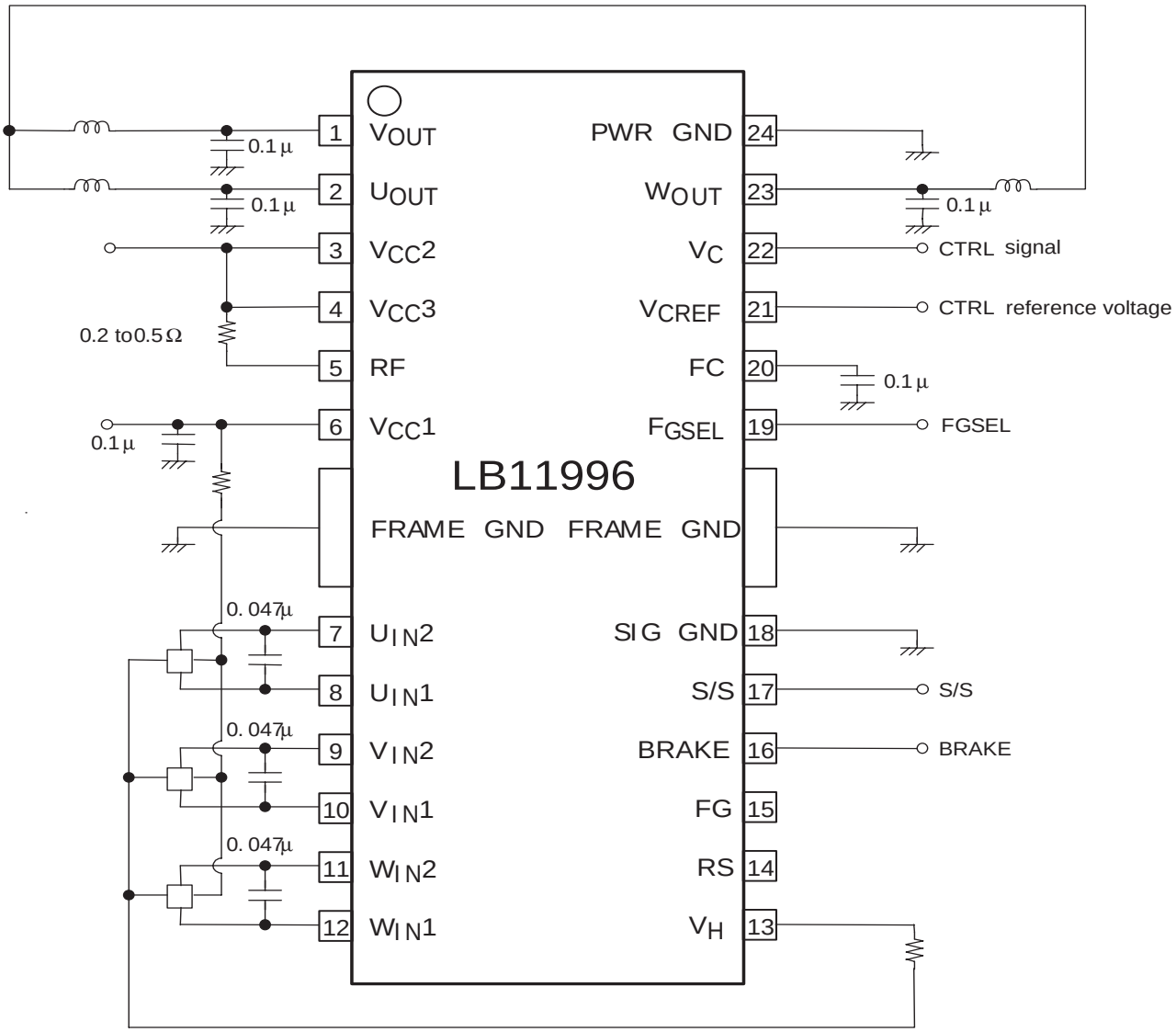
Top view

Sample Application Circuit



Unit (capacitance: F)

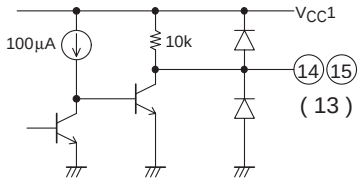
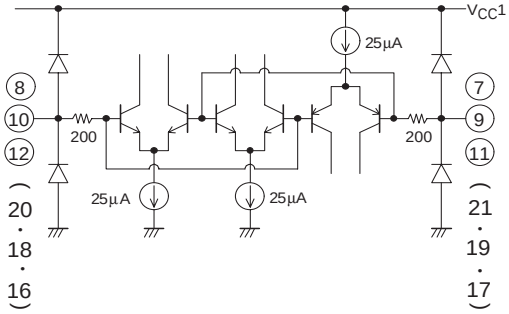
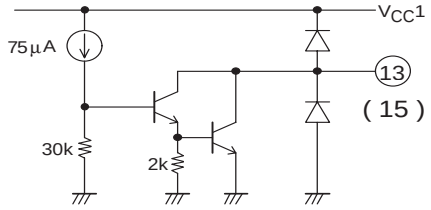
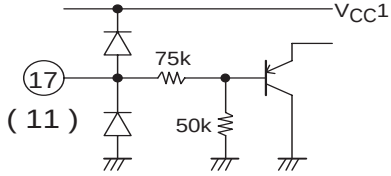
Power supply - GND
Output - GND
Between Hall inputs

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)	$V_{CC}2$	4V to 13.6V		Source side predrive voltage supply pin.
4 (25)	$V_{CC}3$	4V to 13.6V		Constant current control amplifier voltage supply pin.
6 (22)	$V_{CC}1$	4V to 6V		Power supply pin for all voltage except output transistors, source predrive, and constant current control amplifier.
14	RS			Reverse detector pin Forward rotation: High Reverse rotation: Low
15 (13)	FG			1 Hall element waveform Schmitt comparator composite output
8 (20)	$U_{IN}1$	1.2V to $V_{CC}1$–1V		U phase Hall element input and reverse detector U phase Schmitt comparator input pin. Logic High indicates $U_{IN}1 > U_{IN}2$.
7 (21)	$U_{IN}2$			
10 (18)	$V_{IN}1$			V phase Hall element input and reverse detector V phase Schmitt comparator input pin. Logic High indicates $V_{IN}1 > V_{IN}2$.
9 (19)	$V_{IN}2$			
12 (16)	$W_{IN}1$			W phase Hall element input and reverse detector W phase Schmitt comparator input pin. Logic High indicates $W_{IN}1 > W_{IN}2$.
11 (17)	$W_{IN}2$			
13 (15)	V_H			Hall element lower side bias voltage supply pin.
17 (11)	S/S	0V to $V_{CC}1$		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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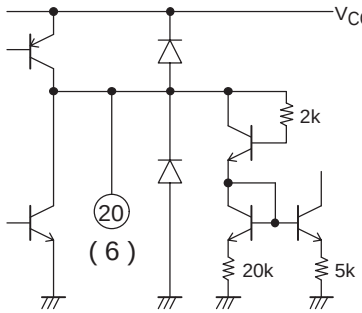
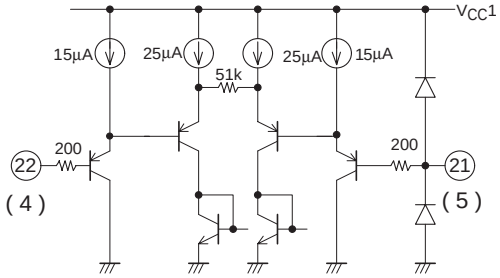
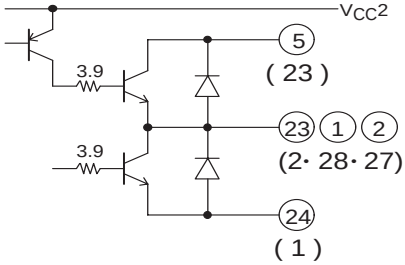
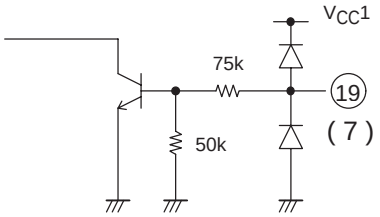
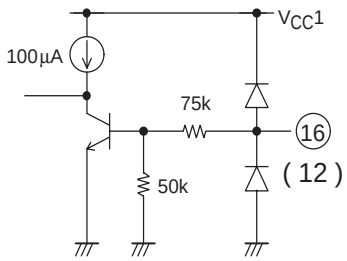
Unit (resistance: Ω)

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 $V_{CC}1$		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 $V_{CC}3$ 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