Ordering number : EN6116A

SANYO Semiconductors
DATA SHEET

LB11995H — Monolithic Digital IC For CD-ROM Spindle Motor Driver Three-Phase Brushless Motor Driver

Overview

LB11995H is a 3-phase brushless motor driver especially suited for CD-ROM spindle motor drivers.

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 (selectable, 2 steps)
- Built-in Hall power supply
- Built-in thermal shutdown circuit
- Supports 3.3V DSP

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	$V_{CC}1$ max		7.0	V
	$V_{CC}2$ max		14.4	V
	$V_{CC}3$ max		14.4	V
Maximum applied output voltage	V_O max		14.4	V
Maximum applied intput voltage	V_I max		$V_{CC}1$	V
Maximum output current	I_O max		1.3	A
Allowable power dissipation	Pd max	Independent IC	0.8	W
		*With specified substrate	1.9	W
Operating temperature	Topr		-20 to +75	°C
Storage temperature	Tstg		-55 to +150	°C

* When mounted on the specified printed circuit board : 114.3mm × 76.1mm × 1.6mm, glass epoxy

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Operating Ratings at Ta = 25°C

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

Application Example at Ta = 25°C

Parameter	Power supply pin	Conditions	Ratings	Unit
12V type	$V_{CC}1$	Regulated voltage	4 to 6	V
	$V_{CC}2 = V_{CC}3$	Unregulated voltage	4 to 13.6	V
5V type	$V_{CC}1 = V_{CC}3$	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

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply current						
Power supply current	$I_{CC}1$	$V_C = V_{CREF}$		8		mA
	$I_{CC}2$	$V_C = V_{CREF}$		0		mA
	$I_{CC}3$	$V_C = V_{CREF}$		150	250	µA
Output idle current	$I_{CC}1OQ$	$V_{S/S}$ = 0V			200	µA
	$I_{CC}2OQ$	$V_{S/S}$ = 0V			30	µA
	$I_{CC}3OQ$	$V_{S/S}$ = 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	$V_{CL}1$	R_{RF} = 0.33Ω, LMC : OPEN		0.24		V
	$V_{CL}2$	R_{RF} = 0.33Ω, LMC : GND		0.37		V
Hall amplifier						
Common mode input voltage range	V_{HCOM}		1.2		V_{CC}-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
Leak current	$I_{S/SL}$	$V_{S/S}$ = 0V	-30			µA
Control						
V_C pin input current	I_{VC}	$V_C = V_{CREF}$ = 1.65V			1	µA
V_{CREF} pin input current	I_{VCREF}	$V_C = V_{CREF}$ = 1.65V			1	µA
Voltage gain	GV_{CO}	$\Delta V_{RE}/\Delta V_C$		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 = 5mA		0.8		V
Allowable current	I_H		20			mA
Thermal shutdown						
Operating temperature	T_{TSD}	Design target value *	150	180	210	°C
Hysteresis	ΔT_{TSD}	Design target value *		15		°C

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Short braking						
Brake pin at High level	V_{BRH}		4		5	V
Brake pin at Low level	V_{BRL}		0		1	V

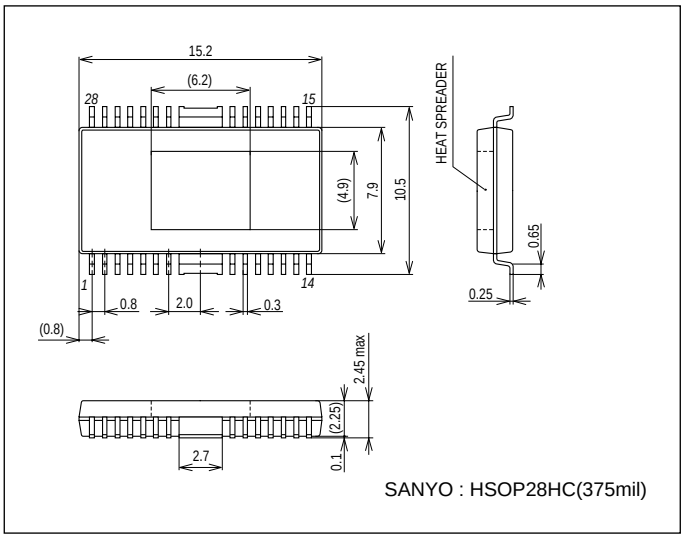
Note : During S/S OFF (standby), the Hall comparator is at High.

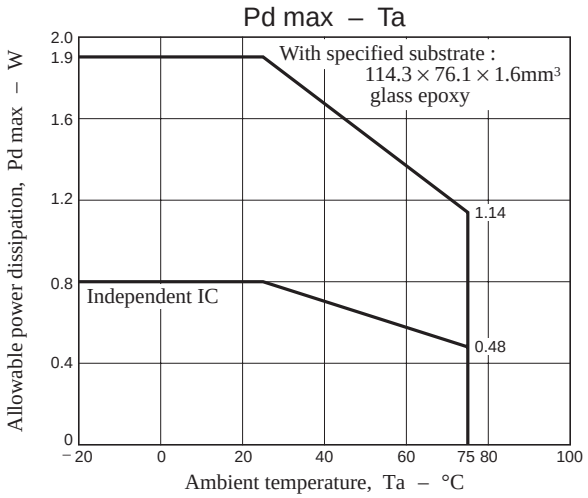
* Design target values are not tested.

Package Dimensions

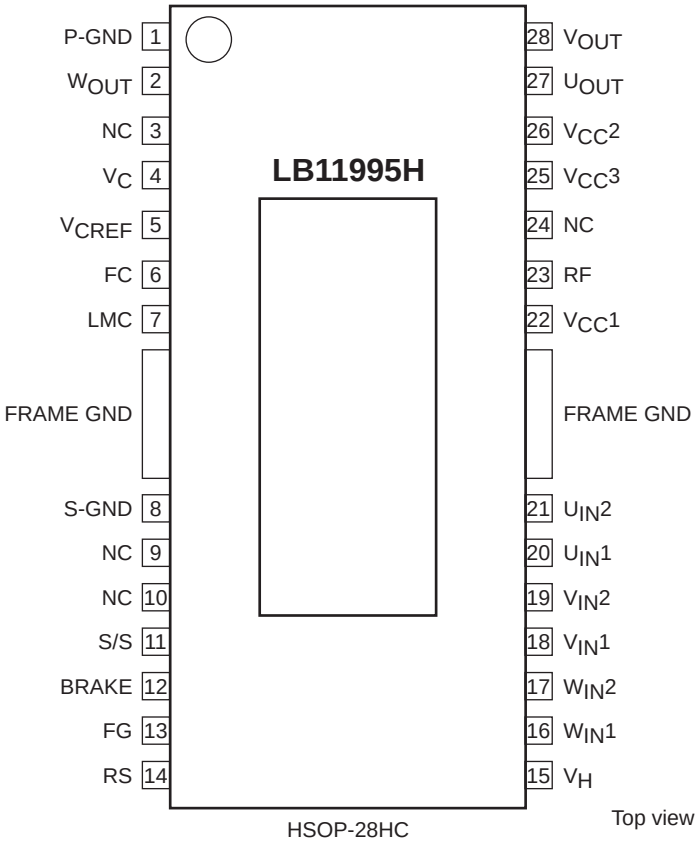
unit : mm (typ)

3234B





Pin Assignment



Truth Table

	Source / Sink	Hall input U	Hall input V	Hall 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 :

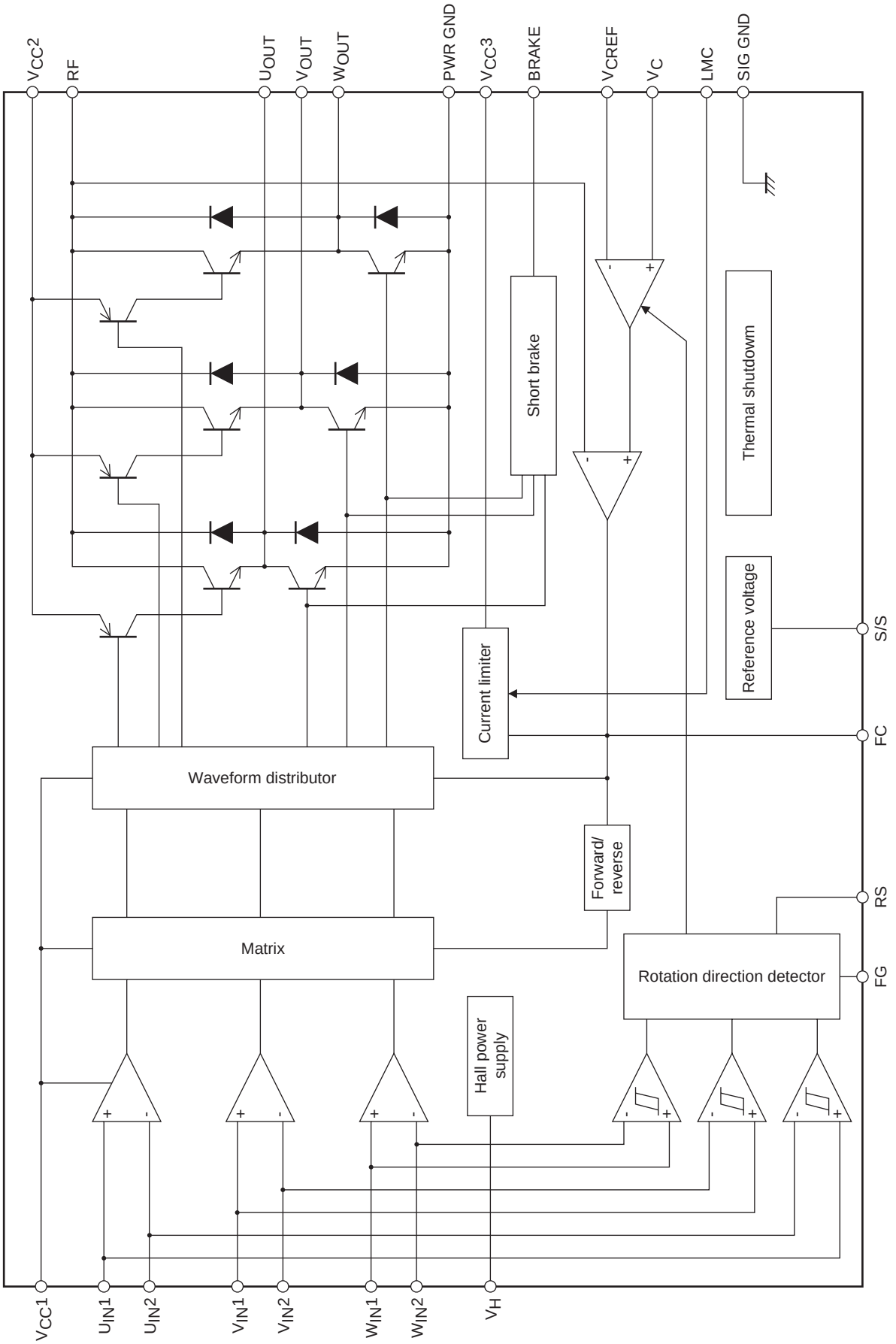
H : Input 1 is higher in potential than input 2 by at least 0.2V.

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

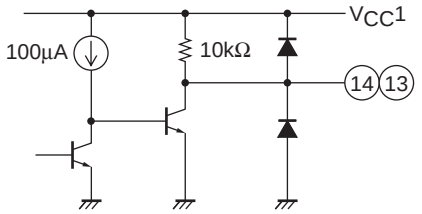
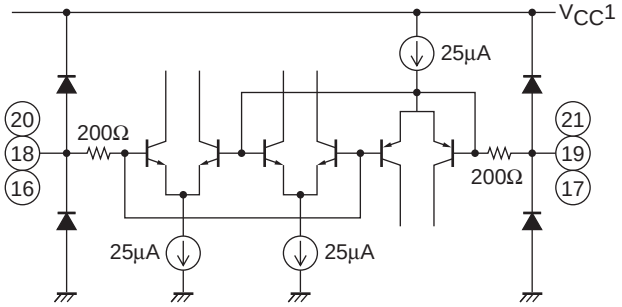
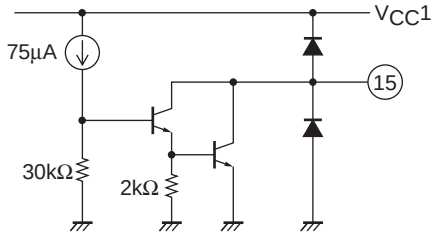
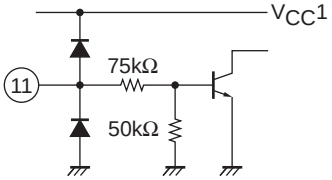
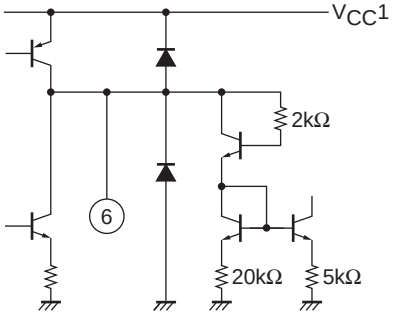
Brake Operation Truth Table

BRAKE pin	Operation
H	Short brake
Low or open	Normal rotation

Block Diagram



Pin Functions

Pin No.	Pin name	Pin function	Pin voltage	Equivalent circuit
26	$V_{CC}2$	Source side predrive voltage supply pin.	4V to 13.6V	
25	$V_{CC}3$	Constant current control amplifier voltage supply pin.	4V to 13.6V	
22	$V_{CC}1$	Power supply pin for all circuits except output transistors, source predrive, and low current control amplifier.	4V to 6V	
14	RS	Reverse detector pin. Forward rotation : High Reverse rotation : Low		
13	FG	1 Hall element waveform Schmitt comparator composite output.		
20 21	$U_{IN}1$ $U_{IN}2$	U phase Hall element input and reverse detector U phase Schmitt comparator input pin. Logic High indicates $U_{IN}1 > U_{IN}2$.	1.2V to $V_{CC}1$-1V	
18 19	$V_{IN}1$ $V_{IN}2$	V phase Hall element input and reverse detector V phase Schmitt comparator input pin. Logic High indicates $V_{IN}1 > V_{IN}2$.		
16 17	$W_{IN}1$ $W_{IN}2$	W phase Hall element input and reverse detector W phase Schmitt comparator input pin. Logic High indicates $W_{IN}1 > W_{IN}2$.		
15	V_H	Hall element lower side bias voltage supply pin.		
11	S/S	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.	0V to $V_{CC}1$	
8	SIG GND	GND pin for all circuits except output.		
6	FC	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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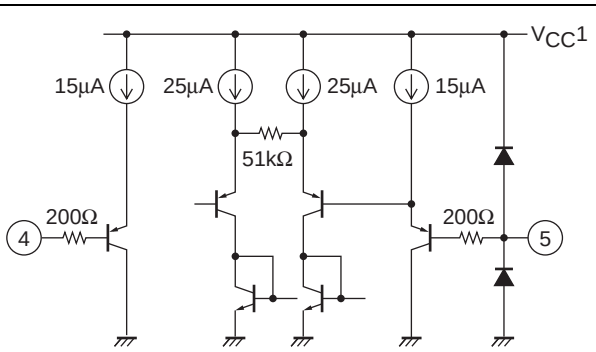
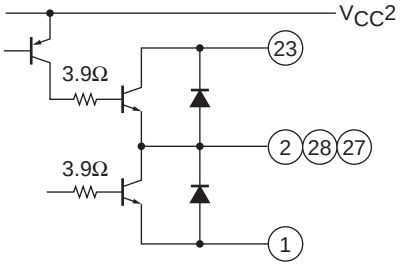
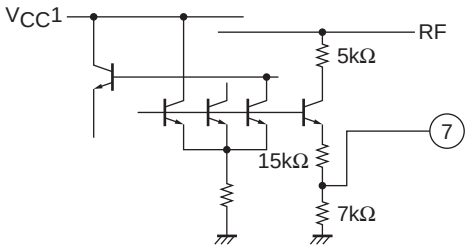
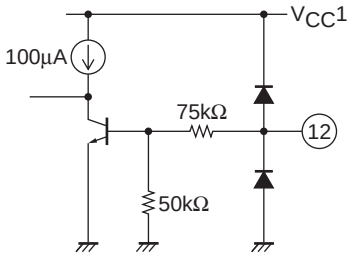
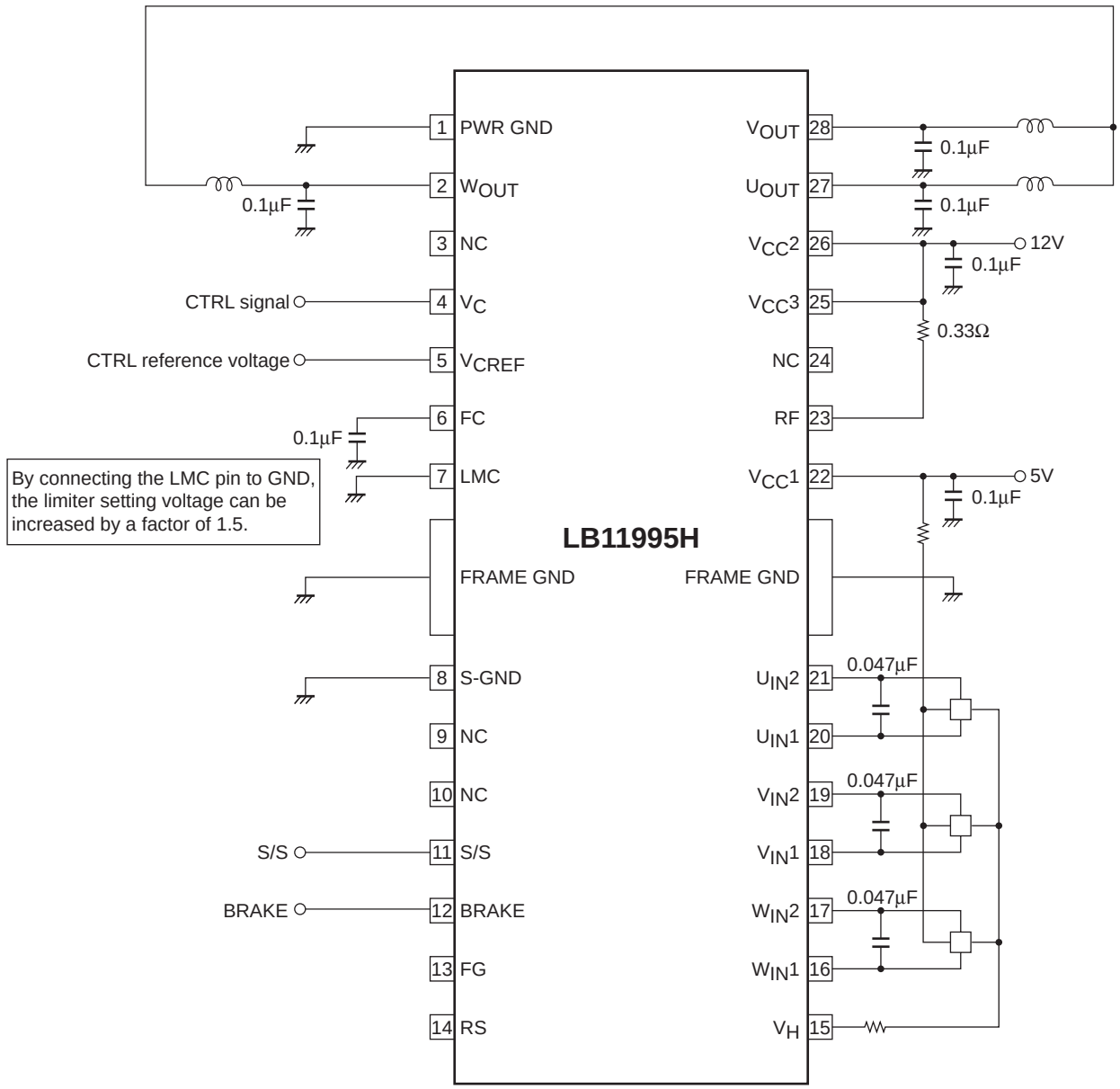
Pin No.	Pin name	Pin function	Pin voltage	Equivalent circuit
5	V_{CREF}	Control reference voltage applied pin. Determines control start voltage.	0V to $V_{CC}1$ -1.5V	
4	V_C	Speed control voltage applied pin. V type control technique $V_C > V_{CREF}$: Forward $V_C < V_{CREF}$: Slowdown (Reverse-blocking circuit prevents reverse rotation.)	0V to $V_{CC}1$	
2	W_{OUT}	W-phase output.		
1	PWR GND	Output transistor GND.		
28	V_{OUT}	V-phase output.		
27	U_{OUT}	U-phase output.		
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.		
7	LMC	When this pin is connected to GND, the limiter setting current is increased by a factor of 1.5.		
12	BRAKE	Short brake pin. BRAKE : High → Brake Low/Open → Drive		

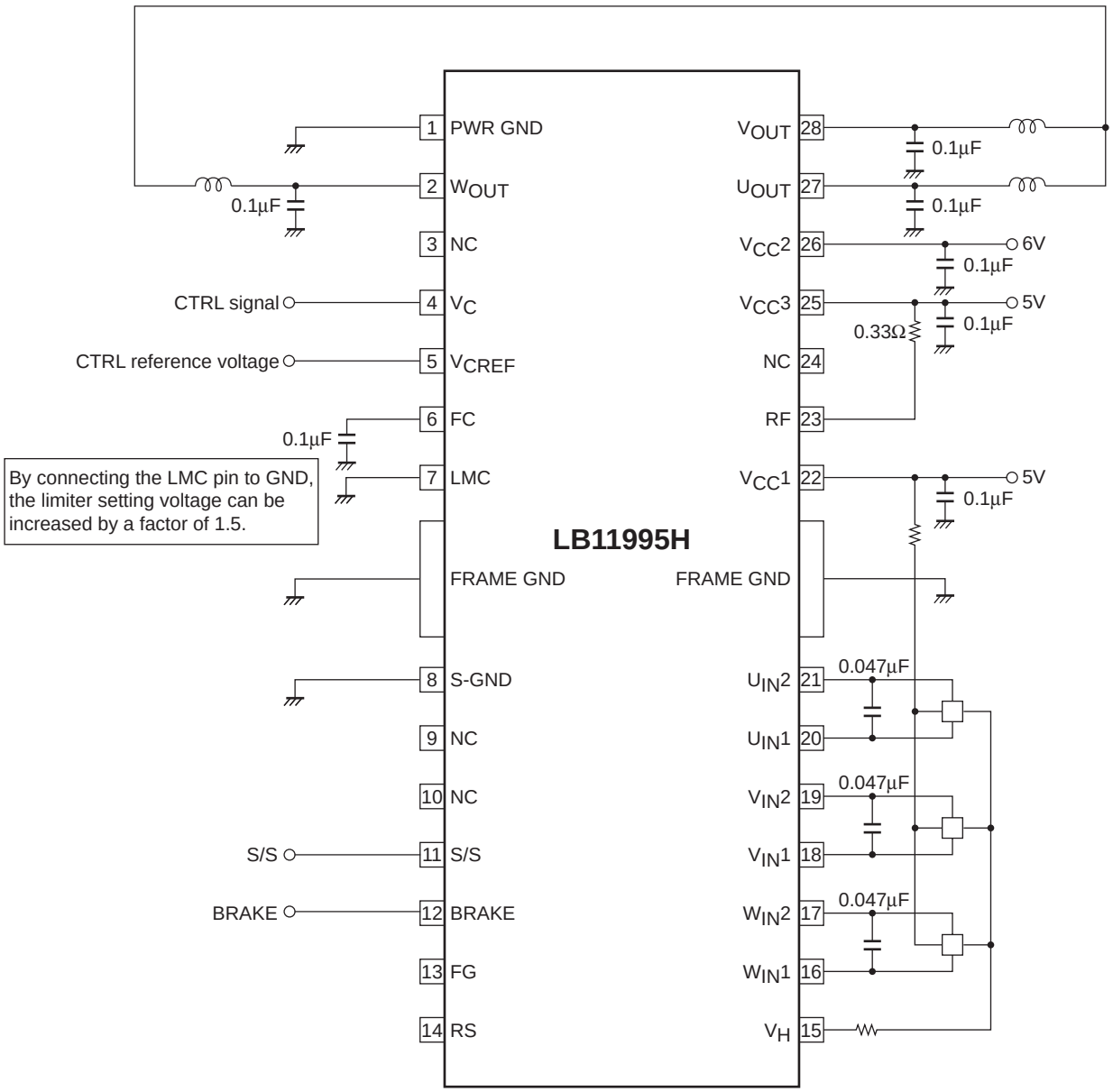
Sample Application Circuit (12V Version)



Power supply-GND
Output-GND
Between Hall input

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

Sample Application Circuit (5V Version)



Power supply-GND
Output-GND
Between Hall input

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