Ordering number : EN5979A

Monolithic Digital IC

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.

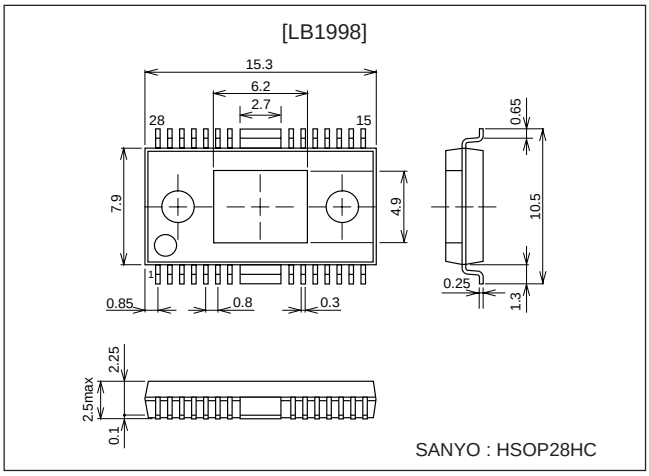
Functions

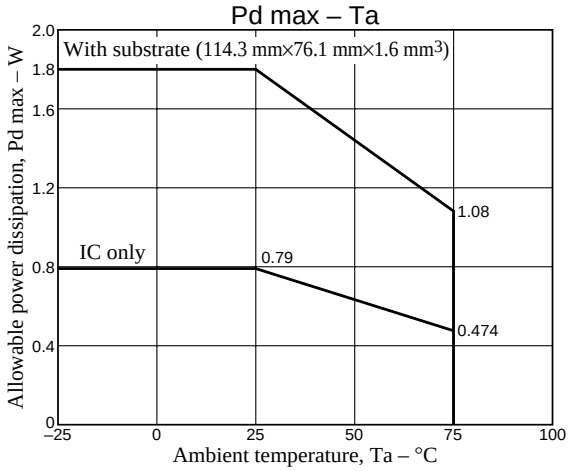
- Current linear drive
- Control V type amplifier
- Top side current detection technique reduces loss voltage of current detection resistor. Voltage effect of this resistor reduces internal current drain of IC.
- Built-in current limiter circuit
- Built-in reverse blocking circuit
- Hall FG output
- Built-in 1 Hall FG/3 Hall FG switching circuit
- Built-in short braking circuit
- Built-in Hall bias cicuit
- 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 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
Applied output voltage	V_O max		14.4	V
Applied intput voltage	V_{IN} max		$V_{CC}1$	V
Output current	I_O max		1.3	A
Allowable power dissipation	Pd max	IC only	0.79	W
		with substrate (114.3 × 76.1 × 1.6 mm^3, glass exposy)	1.80	W
Operating temperature	Topr		–20 to +75	℃
Storage temperature	Tstg		–55 to +150	℃

Operating Conditions 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

Sample Application at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
12V type	$V_{CC}1$	Regulated voltage	4 to 6	V
	$V_{CC}2$	Unregulated voltage	4 to 13.6	V

Electrical Characteristics at Ta = 25°C, $V_{CC}1$ = 5V, $V_{CC}2$ = 12V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Power supply current]						
Power supply current	$I_{CC}1$	$V_{CIN} = V_{CREF}$		8		mA
	$I_{CC}2$	$V_{CIN} = V_{CREF}$		250	300	mA
Output idle current	$I_{CC}1OQ$	$V_{S/S}$ = 0V			200	μA
	$I_{CC}2OQ$	$V_{S/S}$ = 0V			60	μA
[Output]						
Saturation voltage, upper side 1	$V_{OU}1$	I_O = –0.5A, $V_{CC}1$ = 5V, $V_{CC}2$ = 12V		1.0		V
Saturation voltage, lower side 1	$V_{OD}1$	I_O = 0.5A, $V_{CC}1$ = 5V, $V_{CC}2$ = 12V		0.3		V
Current limiter setting voltage	V_{CL}	R_{RF} = 0.25Ω		0.25		V
[Hall amplifier]						
Common mode input voltage range	V_{HCOM}		1.2		$V_{CC}1$–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		$V_{CC}1$	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_{CIN} pin input current	I_{VC}	$V_{CIN} = V_{CREF}$ = 1.65V			1	μA
V_{CREF} pin input current	I_{VCREF}	$V_{CIN} = V_{CREF}$ = 1.65V			1	μA
Voltage gain	GV_{CO}	$\Delta V_{RF}/\Delta V_C$, Note 1		0.25		times
Startup voltage	V_{CTH}	V_{CREF} = 1.65V, Note 1	1.55		1.85	V
Startup voltage width	ΔV_{CTH}	V_{CREF} = 1.65V, 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 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 mA		0.8		V
Allowable current	I_H		20			mA
[Thermal shutdown]						
Operating temperature	T_{TSD}	Design target value	150	180	210	℃
Hysterisis	ΔT_{TSD}	Design target value		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 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		$V_{CC}1$	
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.

Truth Table

	Source –> Sink	Hall input			Control
		U	V	W	V_{CIN}
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:

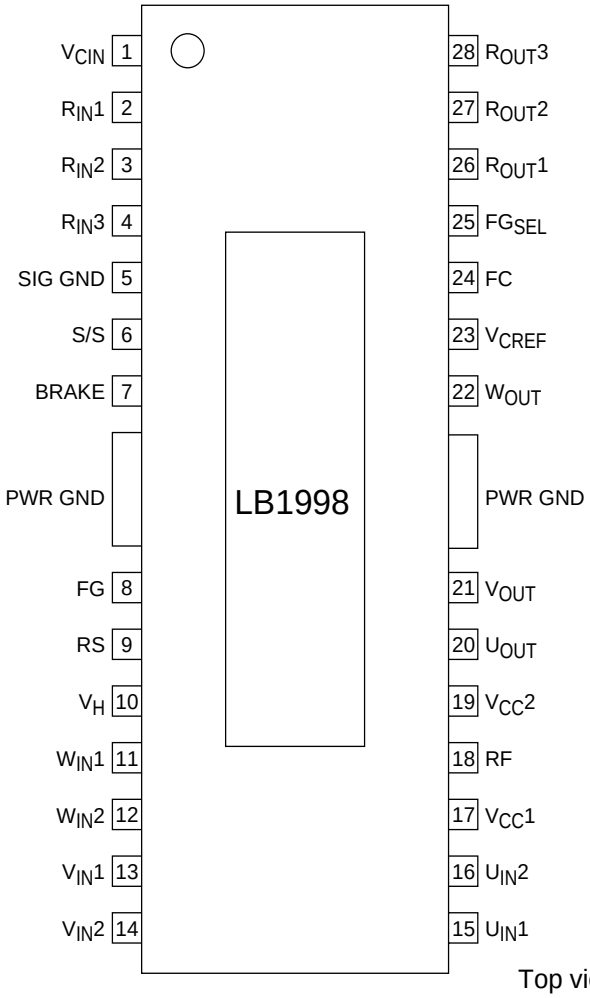
H: Input 1 is higher in potential than input 2 by at least 0.2V.

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

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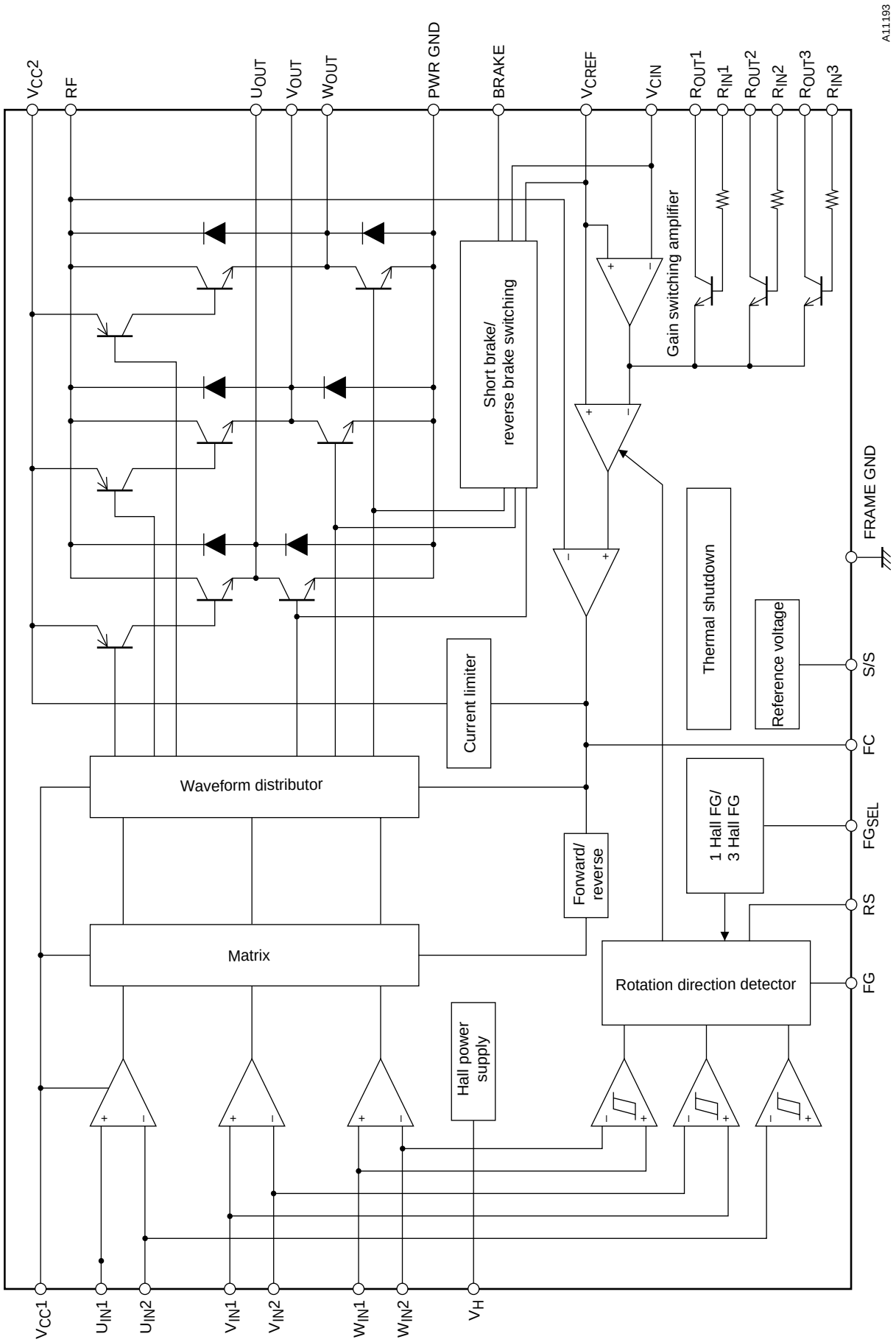
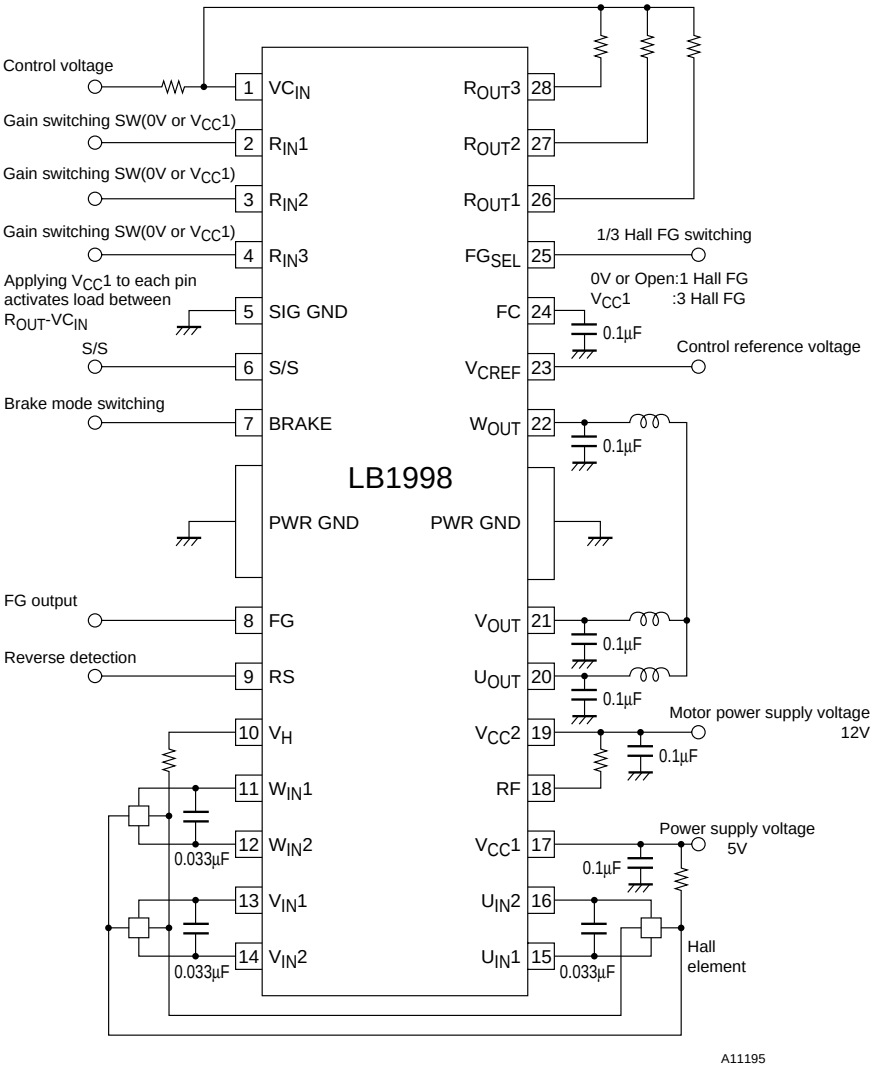
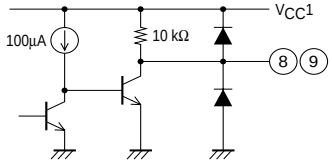
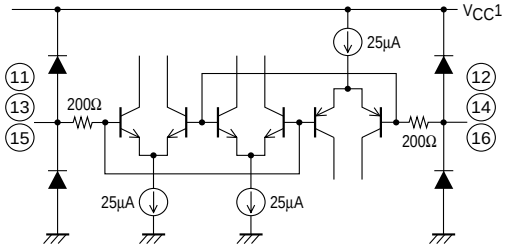
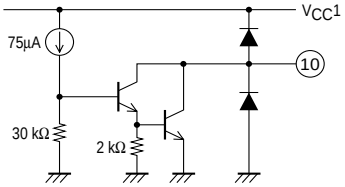
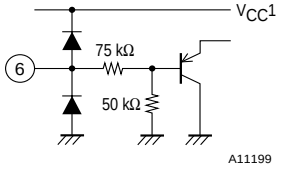
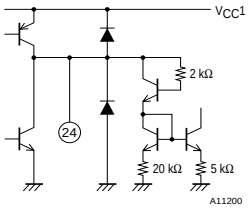
Block Diagram



Sample Application Circuit



Pin Descriptions

Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
19	$V_{CC}2$	4V to 13.6V		Source side predrive voltage and constant current control amplifier voltage supply pin
17	$V_{CC}1$	4V to 6V		Power supply pin for all circuits except output transistors, source predriver, and low current control amplifier
9	R S			Reverse detector pin Forward rotation: High Reverse rotation: Low
8	FG			1 Hall or 3 Hall element waveform Schmitt comparator combined output
15 16	$U_{IN}1$ $U_{IN}2$	1.2V to $V_{CC}1$–1V		U phase Hall element input and reverse detector U phase Schmitt comparator input pin Logic High indicates $U_{IN}1 > U_{IN}2$.
13 14	$V_{IN}1$ $V_{IN}2$			V phase Hall element input and reverse detector V phase Schmitt comparator input pin Logic High indicates $V_{IN}1 > V_{IN}2$.
11 12	$W_{IN}1$ $W_{IN}2$			W phase Hall element input and reverse detector W phase Schmitt comparator input pin Logic High indicates $W_{IN}1 > W_{IN}2$.
10	V_H			Hall element lower side bias voltage supply pin
6	S/S	0V to $W_{CC}1$		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.
5	SIG GND			GND pin for all circuits except output
24	F C			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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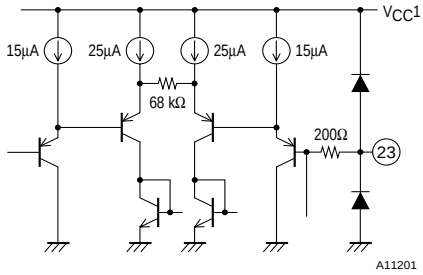
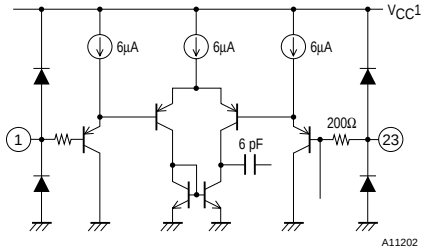
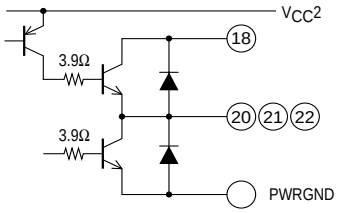
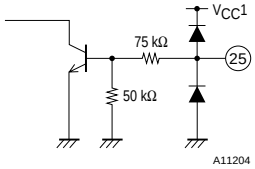
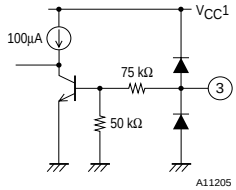
Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
23	V_{CREF}	0V to 3.5V		Control reference voltage supply pin. Determines control start voltage.
1	V_{CIN}	0V to 3.5V		Speed control voltage supply pin V type control technique $V_C > V_{CREF}$: Forward $V_C < V_{CREF}$: Slowdown (Reverse-blocking 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 $V_{CC}3$ 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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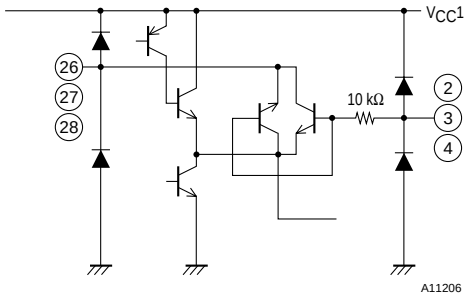
Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
2	$R_{IN}1$	0 to $V_{CC}1$ Low: 0V High: $V_{CC}1$		Gain switching selector pin When set to High ($V_{CC}1$), resistor connected between $R_{OUT}1$ and V_{CIN} is selected as negative feedback resistor.
3	$R_{IN}2$			Gain switching selector pin When set to High ($V_{CC}1$), resistor connected between $R_{OUT}2$ and V_{CIN} is selected as negative feedback resistor.
4	$R_{IN}3$			Gain switching selector pin When set to High ($V_{CC}1$), resistor connected between $R_{OUT}3$ and V_{CIN} is selected as negative feedback resistor.
26	$R_{OUT}1$			Negative feedback resistor connector pins Connect negative feedback resistors between these pins and V_{CIN}.
27	$R_{OUT}2$			
28	$R_{OUT}3$			