Ordering number : ENN*6181A

Monolithic Digital IC

LB11996,11996H

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

Preliminary

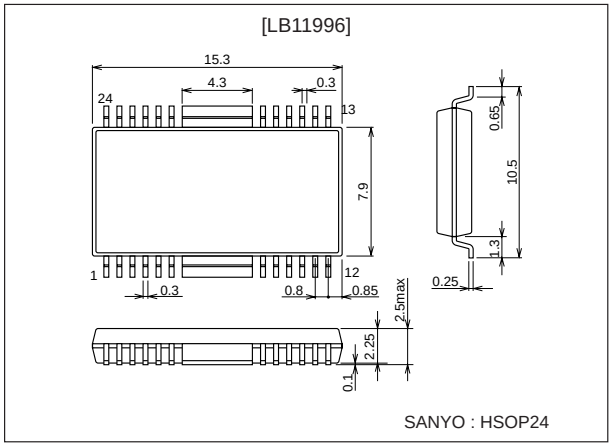
Features

- 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

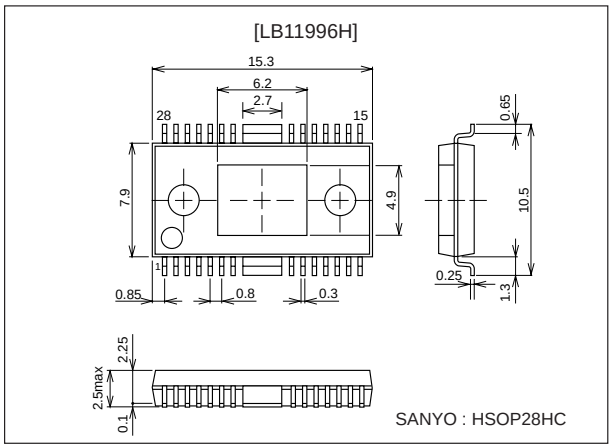
unit: mm

3227-HSOP24



unit: mm

3234-HSOP28HC



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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 mm^3 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.

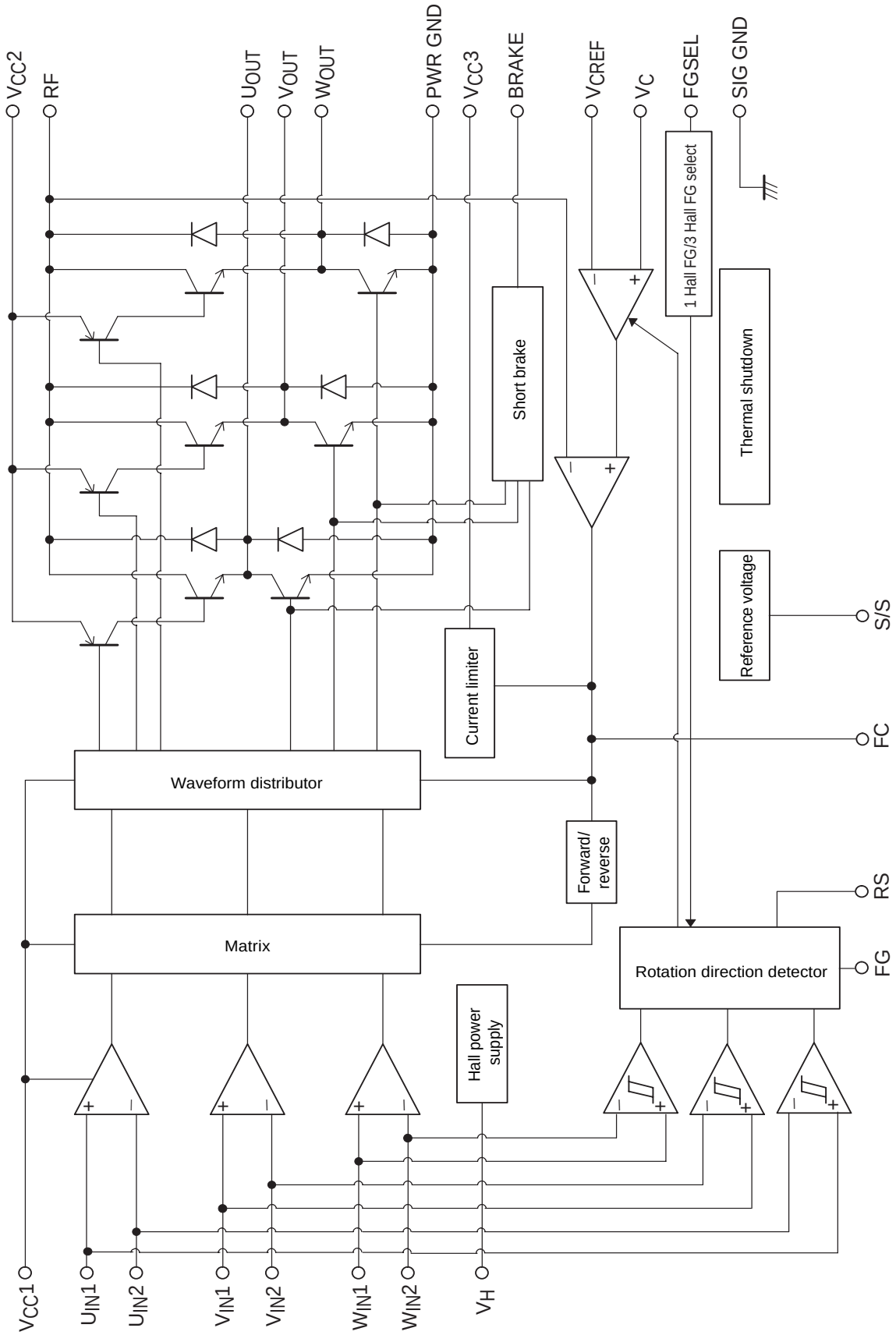
Brake Operation

Brake pin	Operation
H	Brake operation
L	Normal rotation

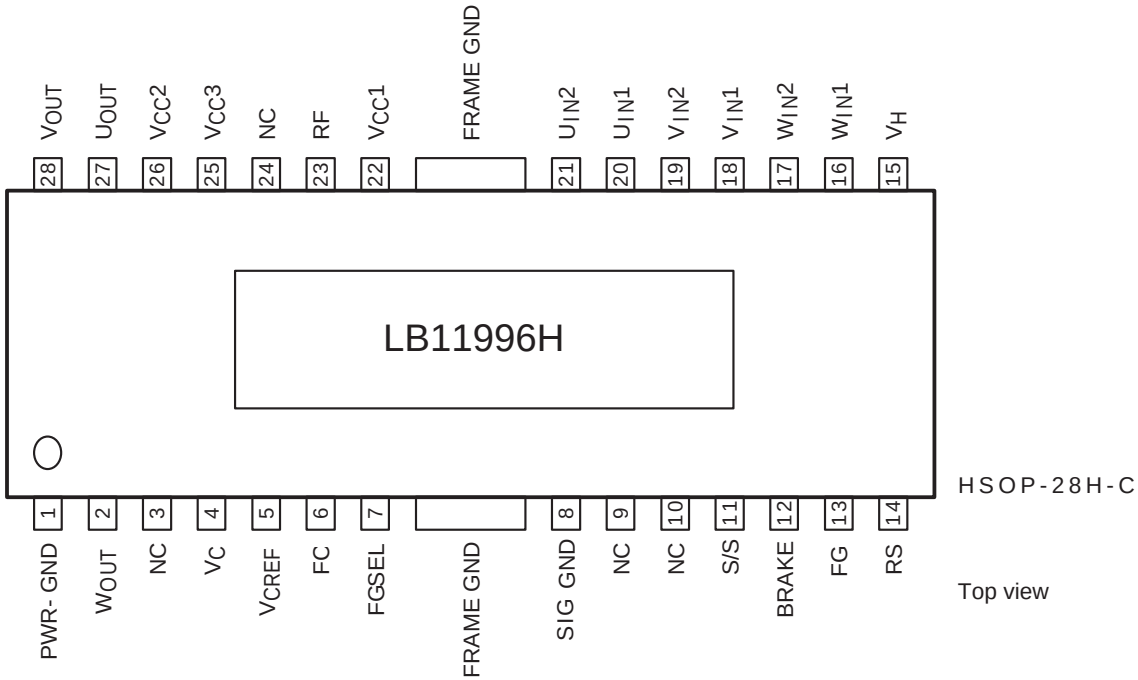
FGSEL (1 Hall /3 Hall select)

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

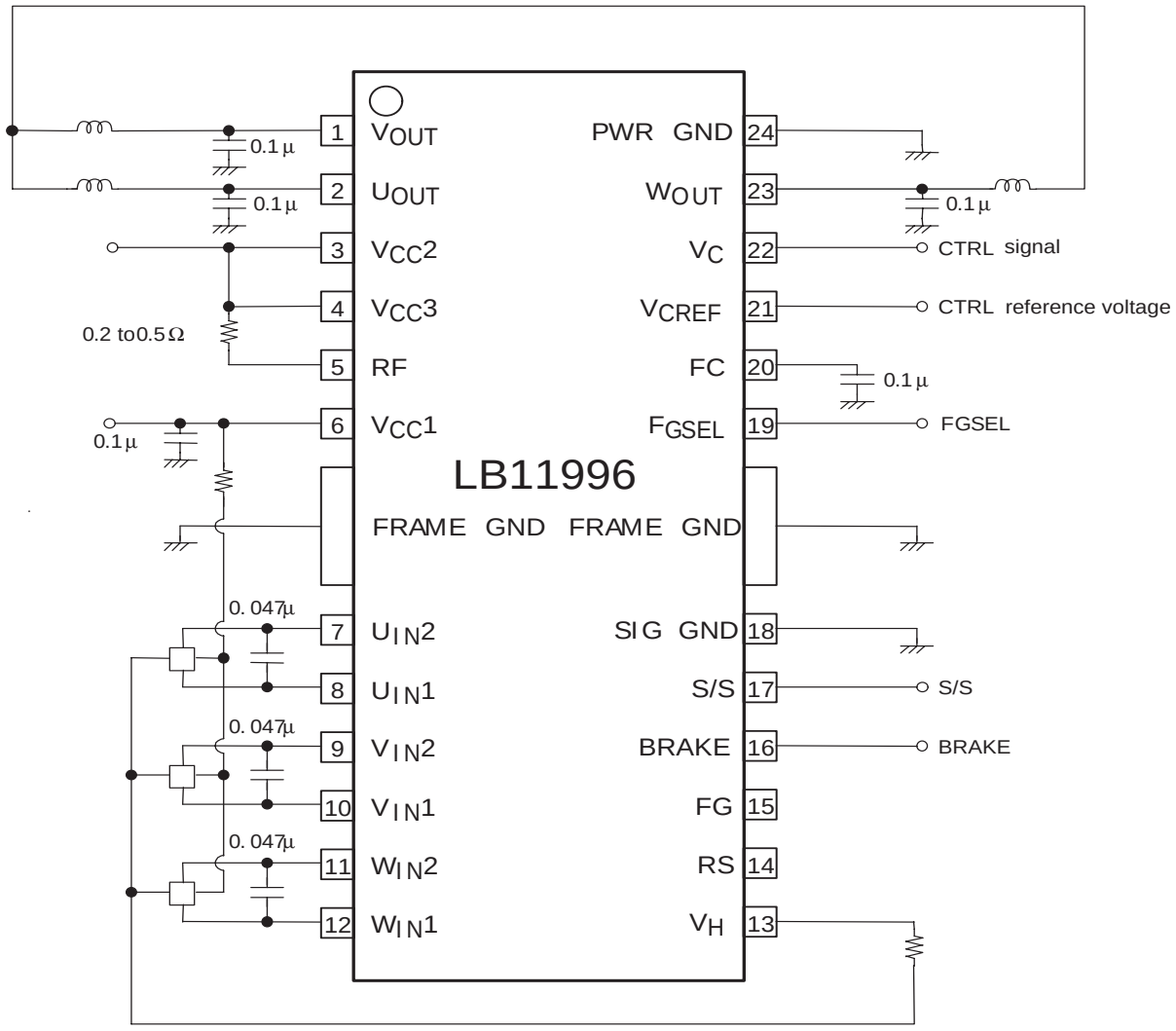
Block Diagram



Pin Assignments



Sample Application Circuit



Unit (capacitance: F)

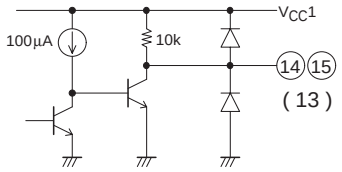
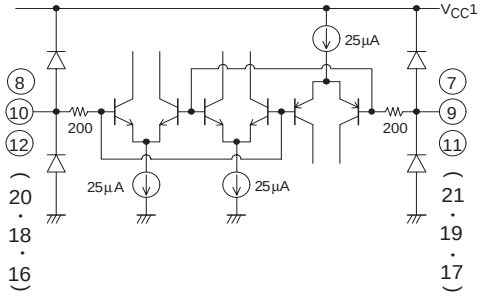
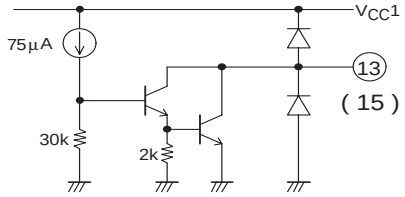
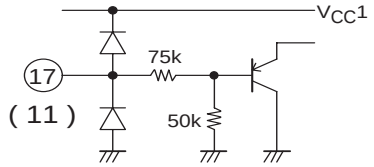
Power supply - GND
Output - GND
Between Hall inputs

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.

Continued on next page

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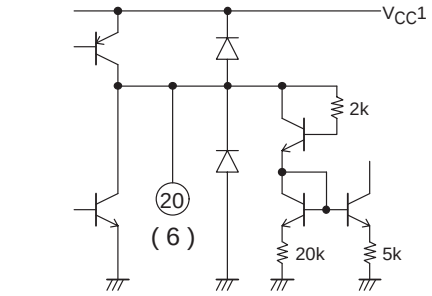
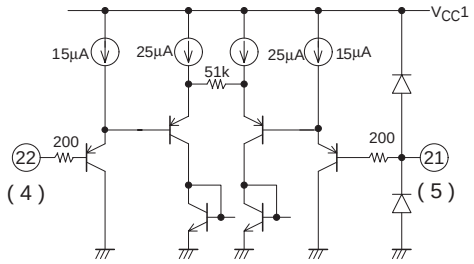
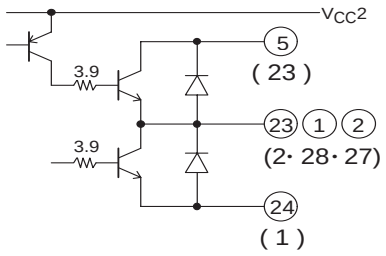
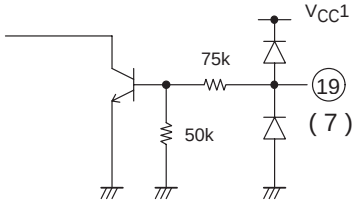
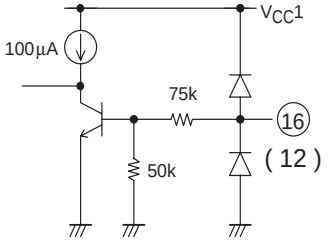
Unit (resistance: Ω)

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

This catalog provides information as of November, 1999. Specifications and information herein are subject to change without notice.