Ordering number : EN5978A

Monolithic Digital IC

LB1997

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

Overview

The LB1997 is a three-phase brushless motor driver especially suited for CD-ROM spindle motor drives.

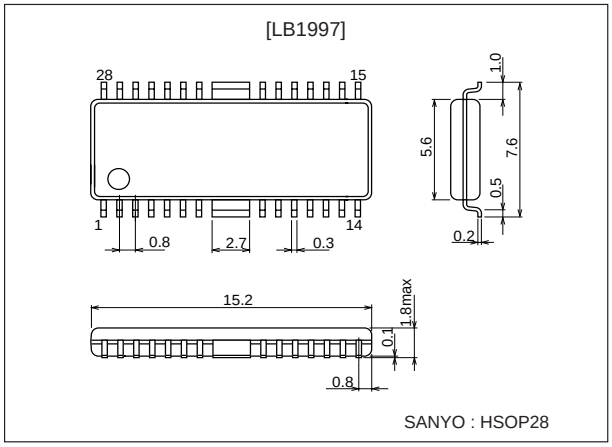
Functions

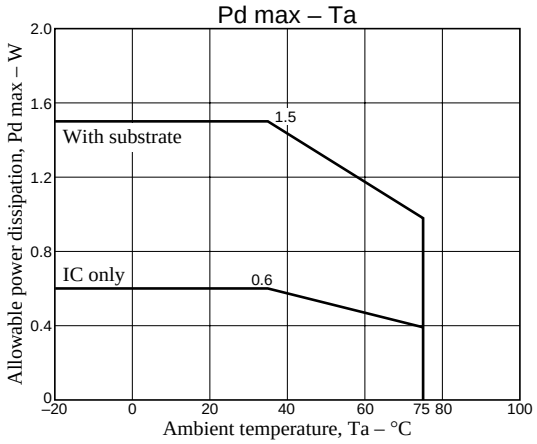
- Current linear drive
- Control V type amplifier
- Separate power supply for output upper side bias circuit allows low output saturation by boosting this power supply only (useful for 5V power supply types).
- Upper side current detection technique reduces loss voltage of current detection resistor. Voltage effect of this resistor reduces internal current drain 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
- V type control/single-side control switching pin allows CLV and CAV operation.

Package Dimensions

unit: mm

3222-HSOP28





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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	0.6	W
		with substrate (114.3 × 76.1 × 1.6 mm^3, glass exposy)	1.5	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
	$V_{CC}3$		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
	$V_{CC}2 = V_{CC}3$	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.

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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
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
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} = 0.43Ω		0.37		V
[Hall amplifier]						
Common mode input voltage range	V_{HCOM}		1.2		V_{CC}–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]						
	I_{VC}	V_C = V_{CREF} = 2.5V		1		µA
	I_{VCREF}	V_C = V_{CREF} = 2.5V		1		µA
Voltage gain	GV_{CO}	$\Delta V_{RF}/\Delta V_C$		0.25		times
Startup voltage	V_{CTH}	V_{CREF} = 2.5V	2.35		2.65	V
Startup voltage width	ΔV_{CTH}	V_{CREF} = 2.5V	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	℃
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
[Control switching]						
CC pin at High level	V_{CCH}		4		5	V
CC pin at Low level	V_{CCL}		0		1	V

Note:

- During S/S OFF (standby), the Hall comparator is at High.
- Design target values are not measured.

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Truth Table

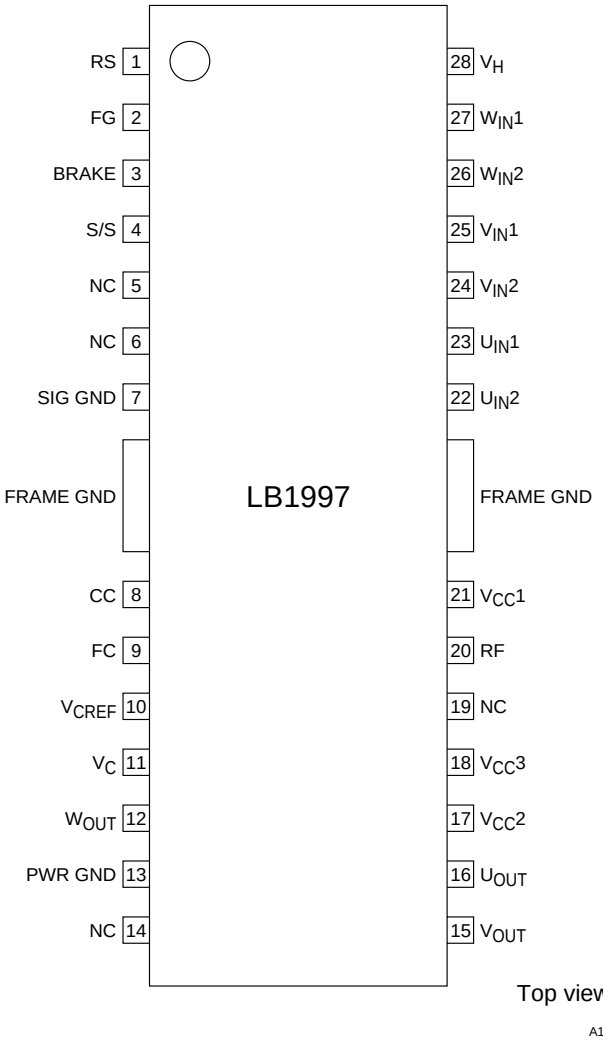
	Source –> Sink	Hall input			Control
		U	V	W	V_C
1	Phase W –> Phase V	H	H	L	H
	Phase V –> Phase W				L
2	Phase W –> Phase U	H	L	L	H
	Phase U –> Phase W				L
3	Phase V –> Phase W	L	L	H	H
	Phase W –> Phase V				L
4	Phase U –> Phase V	L	H	L	H
	Phase V –> Phase U				L
5	Phase V –> Phase U	H	L	H	H
	Phase U –> 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.

Pin Assignment



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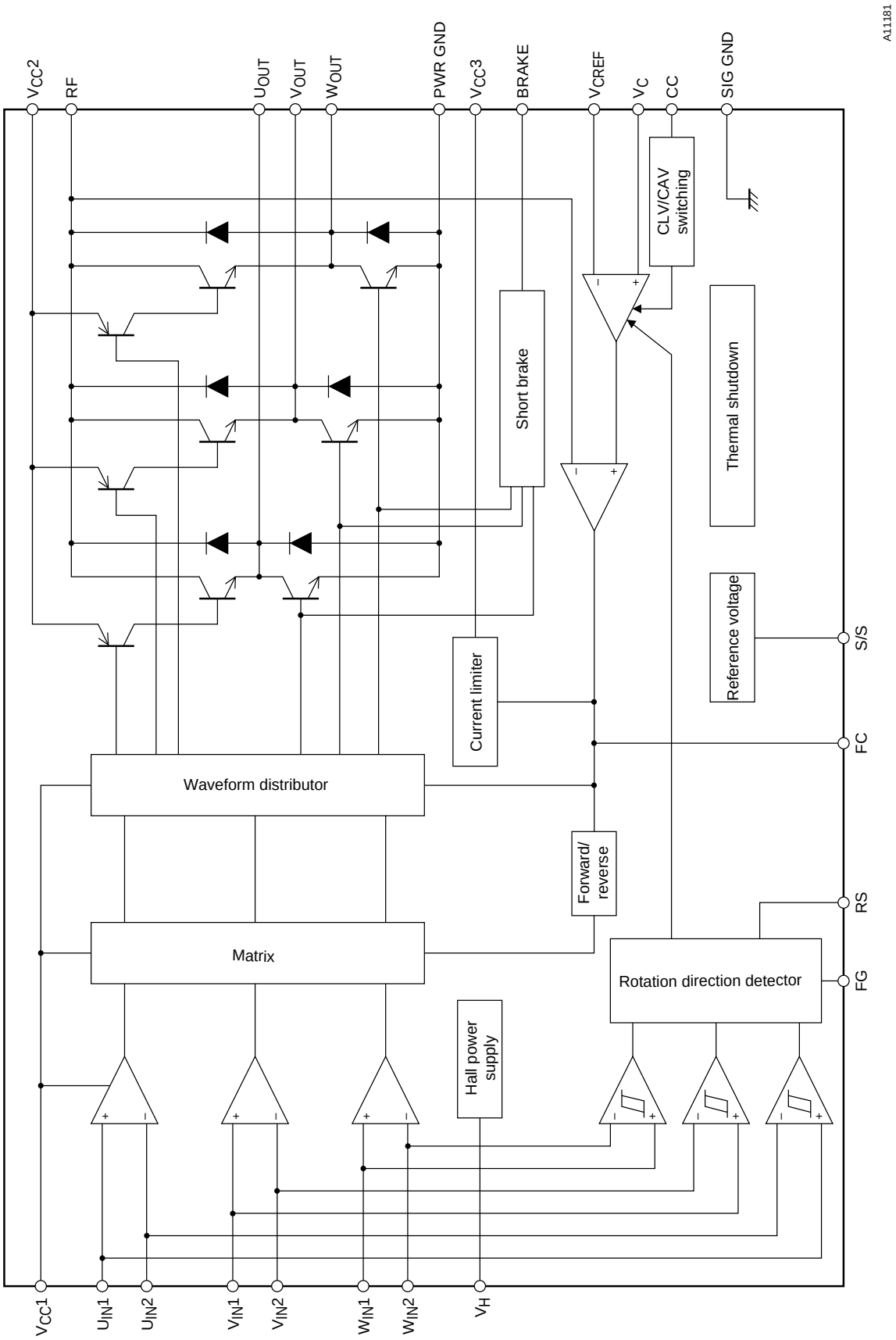
Block Diagram



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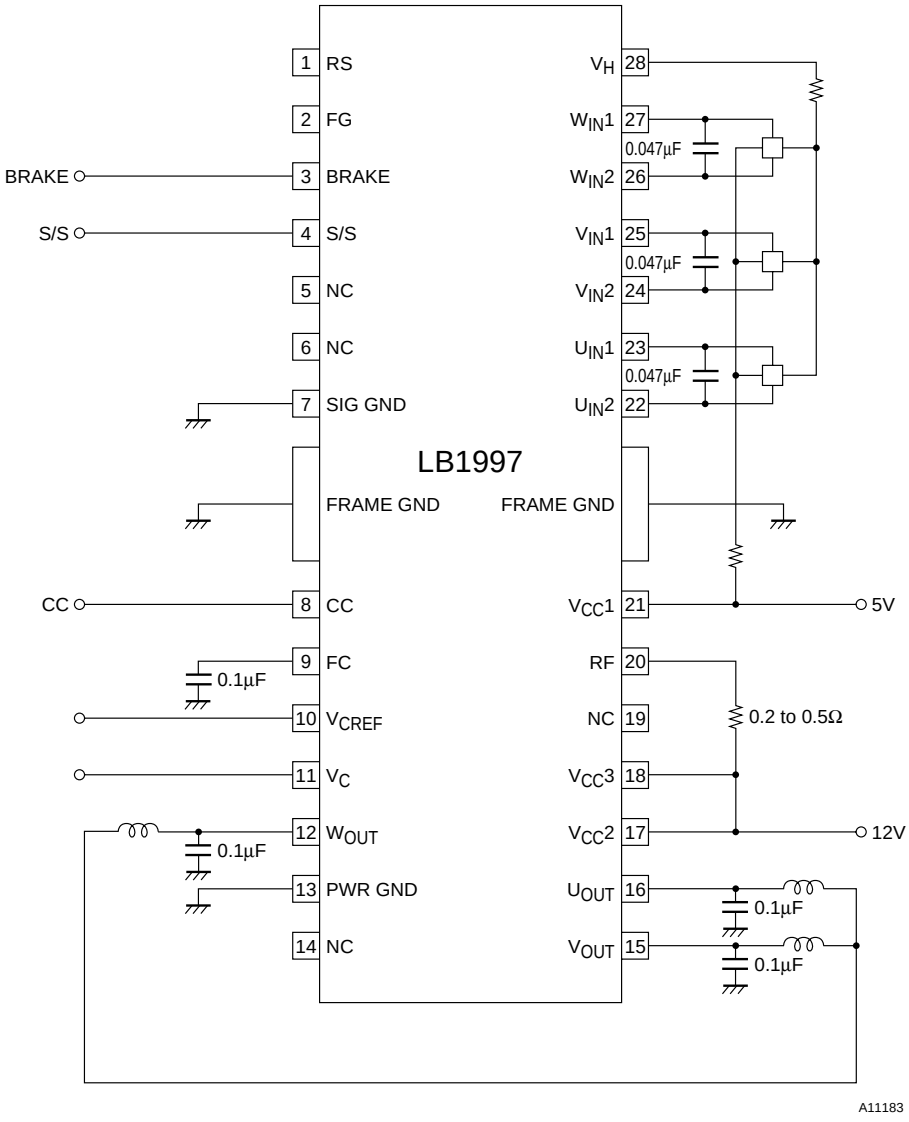
Sample Application Circuit



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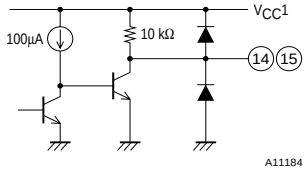
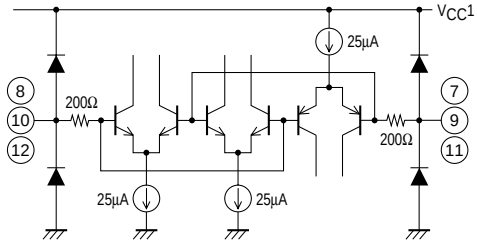
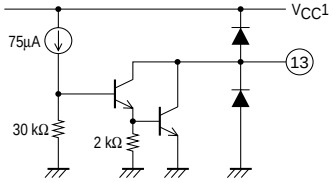
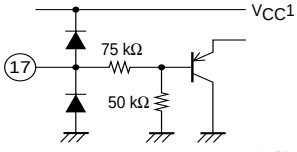
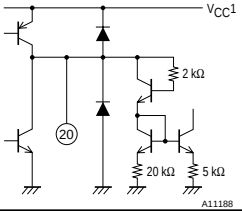
Pin Descriptions

Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
17	$V_{CC}2$	4V to 13.6V		Source side predrive voltage supply pin
18	$V_{CC}3$	4V to 13.6V		Constant current control amplifier voltage supply pin
21	$V_{CC}1$	4V to 6V		Power supply pin for all circuits except output transistors, source predriver, and low current control amplifier
1	RS			Reverse detector pin Forward rotation: High Reverse rotation: Low
2	FG			1 Hall element waveform Schmitt comparator composite output
23 22	$U_{IN}1$ $U_{IN}2$	1.2V to $V_{CC}1$–1V		U phase Hall element input and reverse detector U phase Schmitt comparator input pin Logic High indicates $U_{IN}1 > U_{IN}2$.
25 24	$V_{IN}1$ $V_{IN}2$			V phase Hall element input and reverse detector V phase Schmitt comparator input pin Logic High indicates $V_{IN}1 > V_{IN}2$.
27 26	$W_{IN}1$ $W_{IN}2$			W phase Hall element input and reverse detector W phase Schmitt comparator input pin Logic High indicates $W_{IN}1 > W_{IN}2$.
28	V_H			Hall element lower side bias voltage supply pin
4	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.
7	SIG GND			GND pin for all circuits except output
9	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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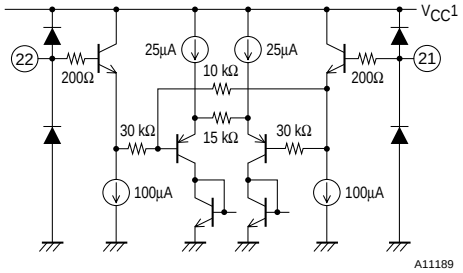
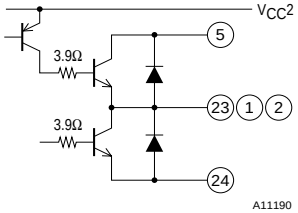
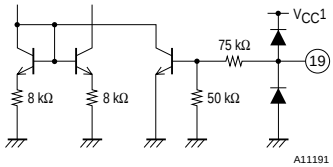
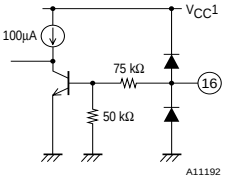
Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
10	V_{CREF}	2V to 3V		Control reference voltage supply pin. Determines control start voltage.
11	V_C	0V to $V_{CC}1$		Speed control voltage supply pin V type control technique $V_C > V_{CREF}$: Forward $V_C < V_{CREF}$: Slowdown (Reverse-blocking circuit built in to prevent reverse rotation.)
12	W_{OUT}			W phase output
13	PWR GND			Output transistor GND
15	V_{OUT}			V phase output
16	U_{OUT}			U phase output
20	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.
8	CC			V type control/single-side control switching pin CC: High –> Single-side control Low/Open –> V type control
3	BRAKE			Short brake pin BRAKE: High –> Short brake operation Low/Open –> Motor drive operation

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