Ordering number : EN4947A

Monolithic Digital IC

LB1886V

Three-Phase Brushless Motor Driver

Overview

The LB1886V is a three-phase brushless motor driver IC that is optimal for capstan and drum motor drive in camcorders and other VCR products and for motor drive in digital audio products.

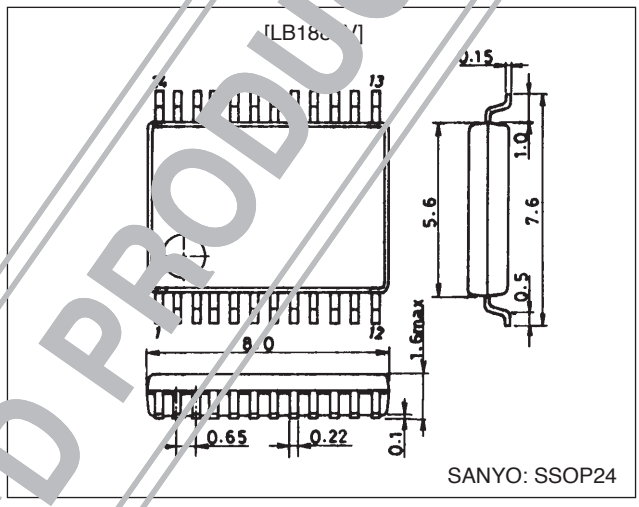
Features

- 120° voltage linear drive scheme
- Motor voltage control based speed control provides reduced power (and thus is optimal for use in portable equipment)
- Built-in torque ripple compensation filter
- Soft switching scheme requires a smaller external capacitance (thus chip capacitors can be used)
- Built-in thermal shutdown circuit
- Built-in FG amplifier

Package Dimensions

unit: mm

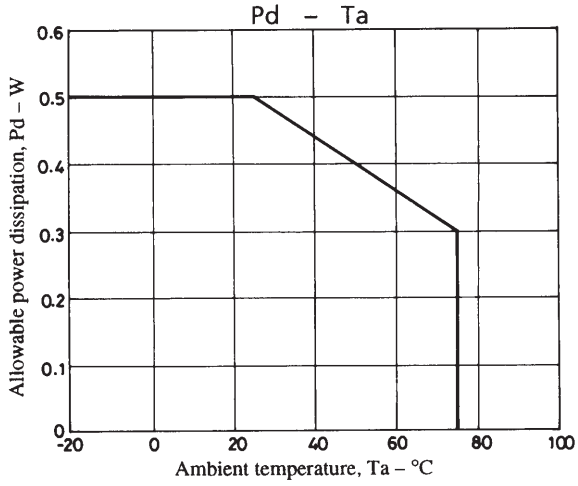
3175A-SSOP24



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage 1	$V_{CC}1$ max		7	V
Maximum supply voltage 2	$V_{CC}2$ max		12	V
Maximum supply voltage 3	V_S max		$V_{CC}2$	V
Applied output voltage	V_O max		V_S + 2	V
Applied input voltage	V_I max	All input pins	$V_{CC}1$	V
Output current	I_O max		1.0	A
Allowable power dissipation	P_d max		0.5	W
Operating temperature	Topr		–20 to +75	°C
Storage temperature	Tstg		–55 to +150	°C



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Allowable Operating Ranges at Ta = 25°C

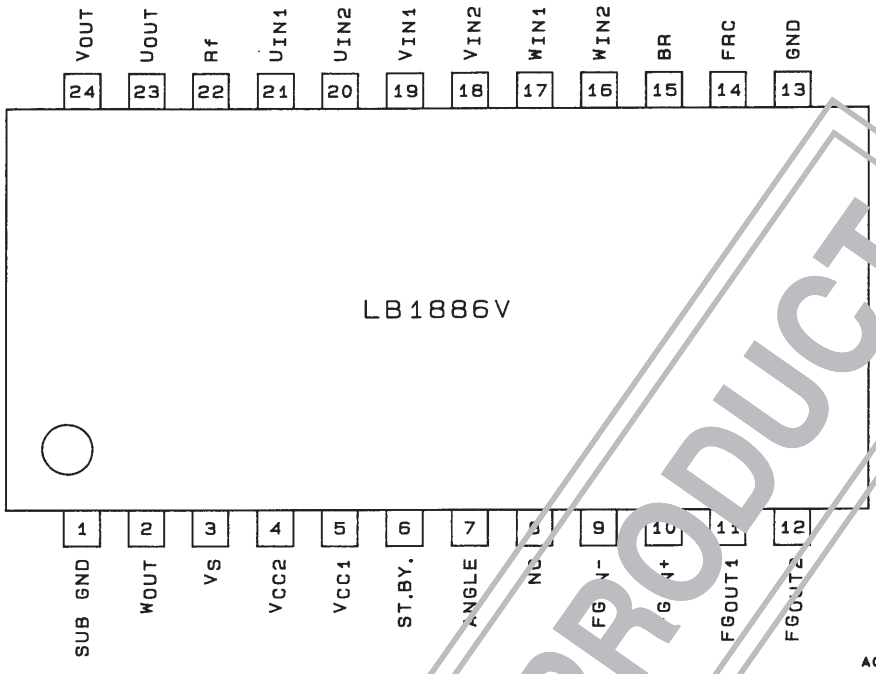
Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	$V_{CC}1$	$V_{CC}1 \le V_{CC}2$	4.0 to 6.0	V
Supply voltage 2	$V_{CC}2$		4 to 10	V
Supply voltage 3	V_S		up to $V_{CC}2$	V

Electrical Characteristics at Ta = 25°C, $V_{CC}1$ = 5 V, $V_{CC}2$ = 7 V, V_S = 3 V

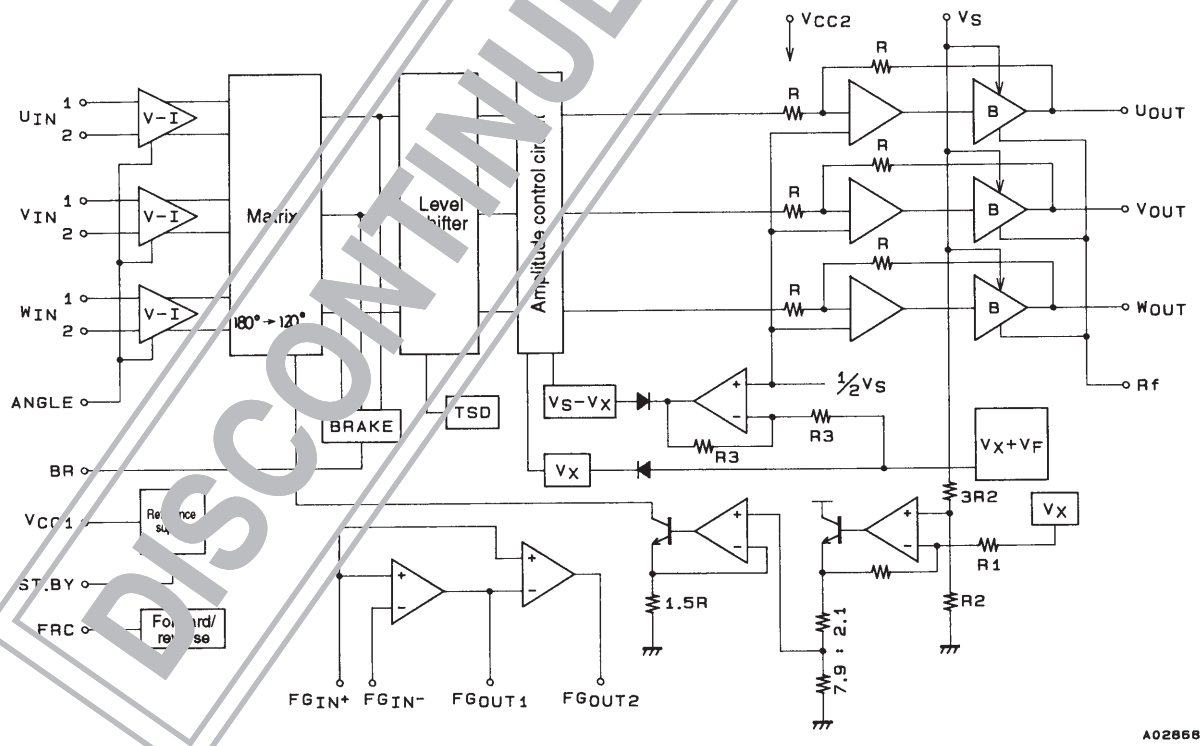
Parameter	Symbol	Conditions	min	typ	max	Unit
Current drain 1	$I_{CC}1$	V_{BR} = 5 V		3.0	5.0	mA
Current drain 2	$I_{CC}2$	V_{BR} = 5 V		6	10.0	mA
Current drain 3	I_S	V_{BR} = 5 V, R_L = ∞			5.0	mA
Quiescent current 1	I_{CCOQ}	V_{STBY} = 0 V			100	μA
Quiescent current 2	I_{SOQ}	V_{STBY} = 0 V, R_L = ∞			150	μA
Output saturation voltage	$V_{O\ (sat)}$	I_{OUT} = 0.6 A, sink + source			1.7	V
Output transistor breakdown voltage	$V_{O\ (sus)}$	I_{OUT} = 20 mA, *2				V
Quiescent voltage	V_{OQ}	V_{BR} = 5 V	1.45	1.55	1.65	V
Hall amplifier input offset voltage	$V_{H\ offset}$	*2	–5		+5	mV
Hall amplifier common mode input voltage range	V_{HCOM}		1.4		2.8	V
Hall I/O voltage gain	G_{VHO}	Rangle = 8.2 kΩ	34.5	37.5	40.5	dB
Brake pin high level voltage	V_{BRH}		2.0			V
Brake pin low level voltage	V_{BRL}				0.8	V
Brake pin input current	I_{BRIN}				120	μA
Brake pin leakage current	$I_{BR\ leak}$				–30	μA
FRC pin high level voltage	V_{FRCH}		2.8			μA
FRC pin low level voltage	V_{FRCL}				1.2	μA
FRC pin input current	I_{FRCIN}				100	μA
FRC pin leakage current	$I_{FRC\ leak}$				–30	μA
Upper side residual voltage	V_{XH}	I_{OUT} = 100 mA, $V_{CC}2$ = 6 V, V_S = 2 V	0.285		0.455	V
Lower side residual voltage	V_{XL}	I_{OUT} = 100 mA, V_{CC} = 6 V, V_S = 2 V	0.350		0.440	V
Residual voltage inflection point	$V_S\Delta V_X$	I_{OUT} = 100 mA, V_{CC} = 6 V, *2		0.9		V
Overlap	OL	$V_{CC}2$ = 6 V, V_S = 3 V, R_L = 100 Ω (Y)	69	79	89	%
Overlap vertical delta	ΔOL	$V_{CC}2$ = 6 V, V_S = 3 V, R_L = 100 Ω (Y)	–10	0	+10	%
Standby on voltage	V_{STBYL}		–0.2		+0.8	V
Standby off voltage	V_{STBYH}		2		5	V
Standby pin bias current	I_{STBY}				100	μA
Thermal protection circuit operating temperature	T_{TSD}	*2	150	180	210	°C
Thermal protection circuit hysteresis	ΔT_{TSD}	*2		15		°C
[FG Amplifier]						
FG amplifier input offset voltage	$V_{FG\ offset}$		–8		+8	mV
Open loop voltage gain	G_{VFG}	f = 10 kHz		43		dB
Source output saturation voltage	$V_{FG\ OU}$	I_O = –2 mA	3.7			V
Sink output saturation voltage	$V_{FG\ CO}$	I_O = 2 mA			1.3	V
Common mode signal rejection ratio	CMR	*2		80		dB
FG amplifier common mode input voltage range	$V_{FG\ CH}$		0		+3.5	V
Phase margin	øM	*2		20		deg
Schmitt amplifier threshold voltage	$V_{FGS\ SH}$	$VFGin^+$ = 2.5 V, when VFGout2 goes from high to low	2.45	2.50	2.55	V
Schmitt amplifier hysteresis	$V_{FGS\ HIS}$	$VFGin^+$ = 2.5 V	20	40	60	mV

Note: 1. The IC goes to the standby state when the standby pin is open.
2. These are design target values and are not measured.
The overlap standard is taken as the test standard without change.

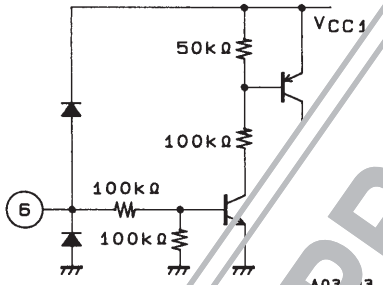
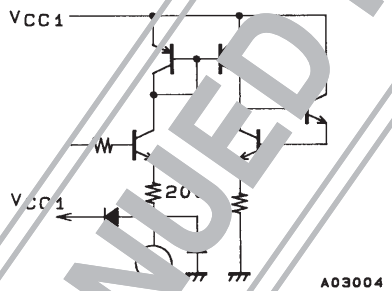
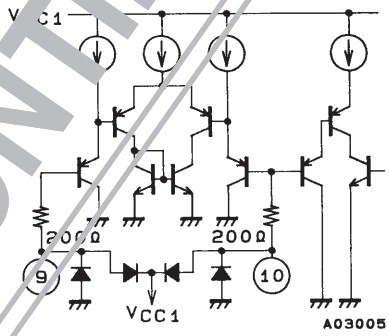
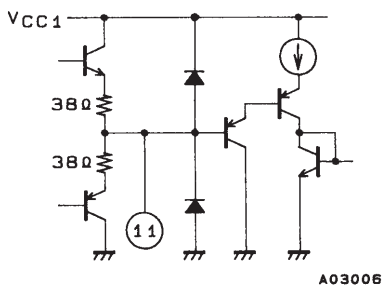
Pin Assignment



Internal Equivalent Circuit Block Diagram



Pin Functions

Pin No.	Symbol	Pin voltage	Equivalent circuit	Function
3	V_S	< $V_{CC}2$		Supply pin that determines the output amplitude. This pin must be set lower than the $V_{CC}2$ voltage.
4	$V_{CC}2$	4 to 10 V		Power amplifier system power supply for transistors other than those that drive the motor. Power supply voltage for control blocks other than those provided by $V_{CC}1$
5	$V_{CC}1$	4 to 6 V		Power supply voltage for the Hall amplifier, forward/reverse, FG amplifier, and thermal shutdown circuits
6	ST. BY	H: 2.0 V min L: 0.8 V max (when $V_{CC}1$ is 5 V.)		All circuits are turned off by connecting this pin to ground or leaving it open. The current drain is about 0 μA in this mode. Apply 2.0 V or higher for motor drive operation.
7	ANGLE			Connect a resistor between this pin and ground. The Hall input/output gain can be changed by changing the value of this resistor.
9 10	FGin − FGin+	min 0 V max 3.5 V (when $V_{CC}1$ is 5 V.)		FG signal input
11	FGout1			FG amplifier output

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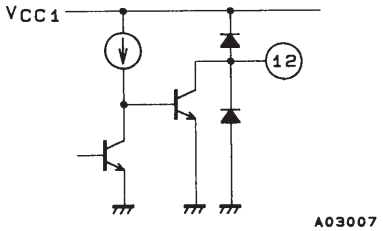
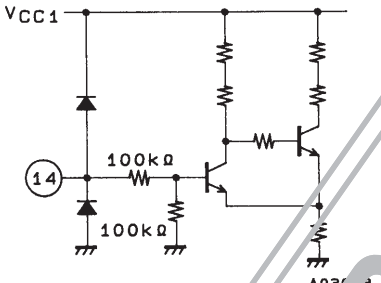
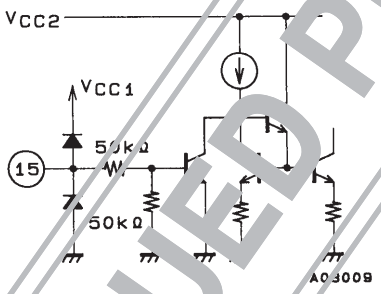
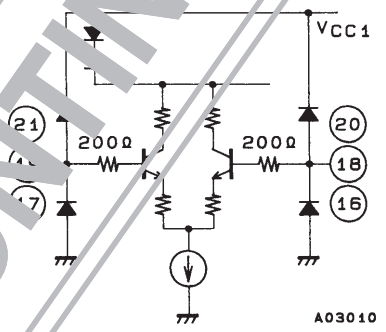
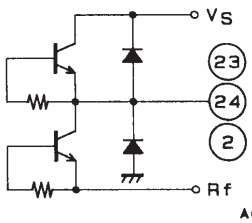
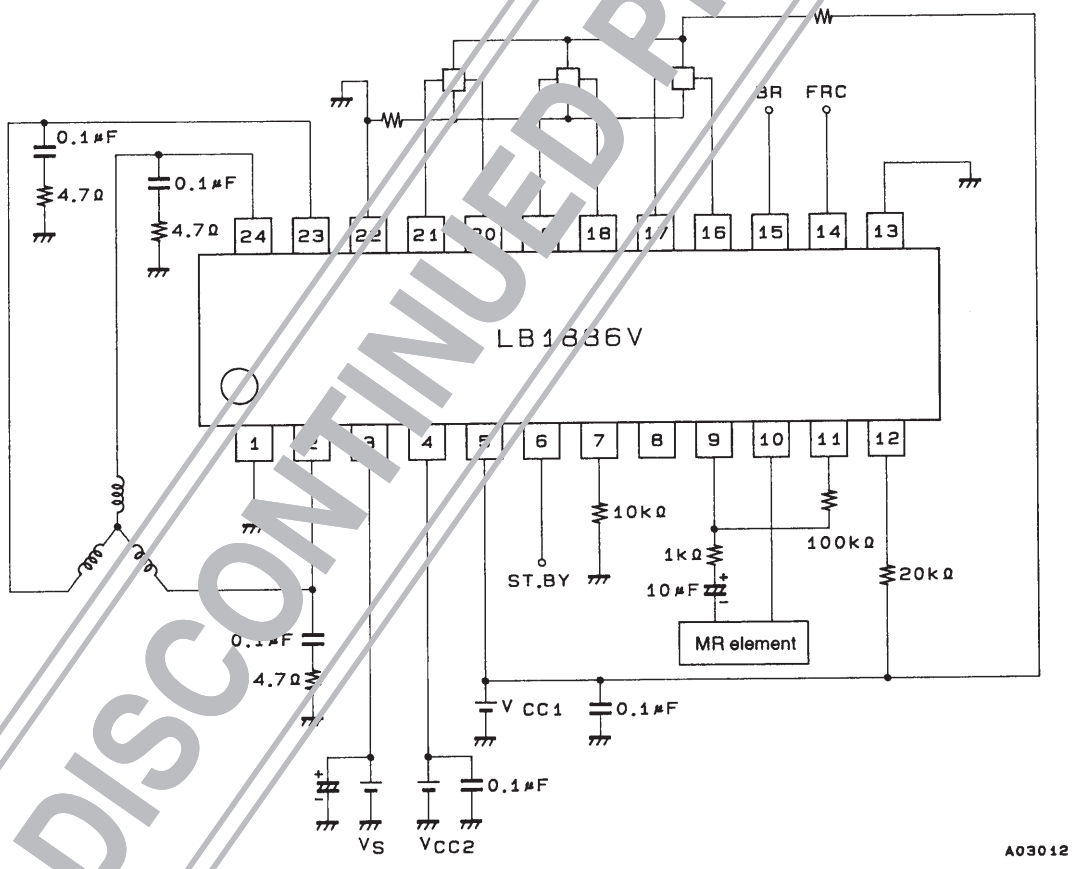
Pin No.	Symbol	Pin voltage	Equivalent circuit	Function
12	FGout2			FG Schmitt amplifier output
14	FRC	H: 2.8 V min L: 1.2 V max (when $V_{CC}1$ is 5 V.)		Motor forward/reverse control Low level: forward (1.2 V or lower when $V_{CC}1$ = 5 V) High level: reverse (2.8 V or higher: when $V_{CC}1$ = 5 V)
15	BR	H: 2.0 V min L: 0.8 V max		Motor stop control Low level: motor drive (0.8 V or lower) High level: Motor stop (2.0 V or higher)
16 17 18 19 20 21	Win2 Win1 Vin2 Vin1 Uin2 Uin1	min 1.4 V max 2.3 V (when $V_{CC}1$ is 5 V.)		W phase Hall element input pin logic High refers to the state where $W_{IN}1 > W_{IN}2$ V phase Hall element input pin logic High refers to the state where $V_{IN}1 > V_{IN}2$ U phase Hall element input pin logic High refers to the state where $U_{IN}1 > U_{IN}2$
22	Rf			Ground for the output transistors
23 24 2	Uout Vout Wout			Outputs
1 13	SUB GND GND			Ground for all circuits other than the output transistor

Truth Table

	Source → sink	Input			Forward/reverse control F/RC
		U	V	W	
1	W phase → V phase V phase → W phase	H	H	L	L
					H
2	W phase → U phase U phase → W phase	H	L	L	L
					H
3	V phase → W phase W phase → V phase	L	L	H	L
					H
4	U phase → V phase V phase → U phase	L	H	L	L
					H
5	V phase → U phase U phase → V phase	H	L	H	L
					H
6	U phase → W phase W phase → U phase	L	H	H	L
					H

Input high: Indicates that the phase 1 input is at least 0.2 V higher than the phase 2 input for each phase.
Input low: Indicates that the phase 1 input is at least 0.2 V lower than the phase 2 input for each phase.
Forward/reverse control: High: 2.8 V to $V_{CC}1$
Low: 0 V to 1.2 V

Sample Application Circuit



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