

# 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

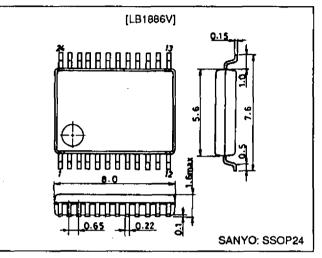
# Specifications

### Absolute Maximum Ratings at Ta = 25°C

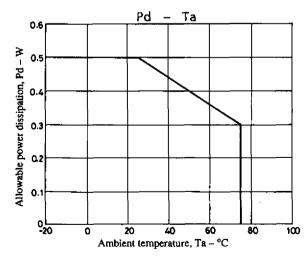
# **Package Dimensions**

unit: mm

3175A-SSOP24



Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage 1	V <sub>CC</sub> 1 max		7	V
Maximum supply voltage 2	V <sub>CC</sub> 2 max		12	V
Maximum supply voltage 3	V <sub>S</sub> max		V <sub>CC</sub> 2	V
Applied output voltage	V <sub>O</sub> max		V <sub>S</sub> +2	V
Applied input voltage	V <sub>j</sub> max	All input pins	V <sub>CC</sub> 1	V
Output current	I <sub>O</sub> max		1.0	A
Allowable power dissipation	Pd 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

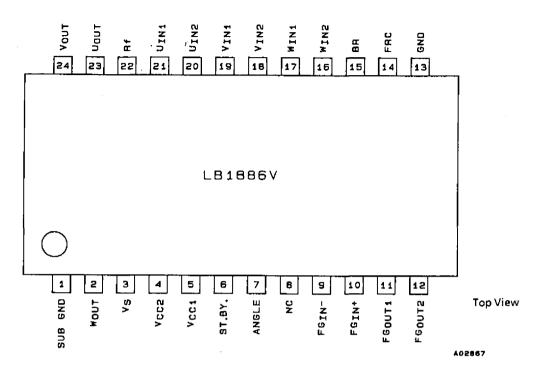
Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	V <sub>CC</sub> 1	$V_{CC}1 \leq V_{CC}2$	4.0 to 6.0	V
Supply voltage 2	V <sub>CC</sub> 2		4 to 10	V
Supply voltage 3	Vs		up to V <sub>CC</sub> 2	V

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

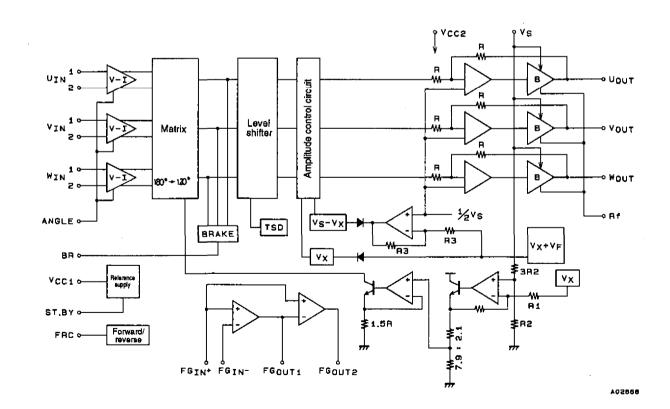
Parameter	Symbol	Conditions	min	typ	max	Unit
Current drain 1	lcc1	V <sub>BR</sub> = 5 V		3.0	5.0	mA
Current drain 2	I <sub>CC</sub> 2	V <sub>BR</sub> = 5 V		6.5	10.0	mA
Current drain 3	ls	V <sub>BR</sub> = 5 V, R <sub>L</sub> = ∞			5.0	mA
Quiescent current 1	lccoo	V <sub>STBY</sub> = 0 V			100	μA
Quiescent current 2	Isoa	V <sub>STBY</sub> = 0 V, R <sub>L</sub> ⊨ ∞			150	μA
Output saturation voltage	V <sub>O (sat)</sub>	I <sub>OUT</sub> = 0.6 A, sink + source			1,7	V
Output transistor breakdown voltage	V <sub>O (sus)</sub>	l <sub>OUT</sub> = 20 mA, *2	12			v
Quiescent voltage	Voq	V <sub>BR</sub> = 5 V	1.45	1.55	1.65	V
Hall amplifier input offset voltage	V <sub>H offset</sub>	•2	5		+5	mV
Hall amplifier common mode input voltage range	V <sub>HCOM</sub>		1.4		2.8	v
Hall I/O voltage gain	G <sub>VHO</sub>	Rangle = 8.2 kΩ	34.5	37,5	40.5	යප
Brake pin high level voltage	VBRH		2.0			V
Brake pin low level voltage	VBRL				0.8	v
Brake pin input current	IBRIN				120	μA
Brake pin leakage current	IBR leak				-30	μA
FRC pin high level voltage	VFRCH		2.8			μΑ
FRC pin low level voltage	VFRCL				1.2	μА
FRC pin input current	IFRCIN				100	μA
FRC pin leakage current	IFRC leak				-30	μА
Upper side residual voltage	V <sub>XH</sub>	I <sub>OUT</sub> = 100 mA, V <sub>CC</sub> 2 = 6 V, V <sub>S</sub> = 2 V	0.285		0.455	v
Lower side residual voltage	V <sub>XL</sub>	I <sub>OUT</sub> = 100 mA, V <sub>CC</sub> 2 = 6 V, V <sub>S</sub> = 2 V	0.350		0.440	V
Residual voltage inflection point	Vs∆Vx	IOUT = 100 mA, V <sub>CC</sub> 2 = 6 V. *2		0.9		V
Overlap	OL.	$V_{CC}2 = 6 V, V_S = 3 V, R_L = 100 \Omega (Y)$	69	79	89	%
Overlap vertical delta	∆OL	$V_{CC}2 = 6 V, V_S = 3 V, R_L = 100 \Omega (Y)$	-10	0	+10	%
Standby on voltage	VSTBYL	•1	-0.2		<del>8</del> .0+	V
Standby off voltage	VSTBYH		2		5	v
Standby pin bias current	ISTBYIN				100	μA
Thermal protection circuit operating temperature	T <sub>TSD</sub>	*2	150	180	210	۰C
Thermal protection circuit hysteresis	AT TSD	•2		15	_	°C
[FG Amplifier]						
FG amplifier Input offset voltage	V <sub>FG offset</sub>		-8		+8	mV
Open loop voltage gain	G <sub>VFG</sub>	í = 10 kHz		43	[	dB
Source output saturation voltage	VFG OU	l <sub>0</sub> ⊭ −2 mA	3.7			v
Sink output saturation voltage	VFG OD	l <sub>O</sub> = 2 mA			1,3	V
Common mode signal rejection ratio	GHR	*2		80		dB
FG amplifier common mode input voltage range	V <sub>FG CH</sub>		0		+3.5	v
Phase margin	øM	*2		20		deg
Schmitt amplifier threshold voltage	VFGS SH	VFGin* = 2.5 V, when VFGout2 goes from high to low	2.45	2.50	2.55	v
Schmitt amplifier hysteresis	VFGS HIS	VFGin+ = 2.5 V	20	40	60	m٧

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



LB1886V

### **Pin Functions**

Pin No.	Symbol	Pin voltage	Equivalent circuit	Function
3	vs	< V <sub>CC</sub> 2		Supply pin that determines the output amplitude. This pin must be set lower than the $V_{CC}2$ voltage.
4	V <sub>CC</sub> 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 <sub>CC</sub> 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 <sub>CC</sub> 1 is 5 V.)	50k a VCC 1 100k a 100k a 100	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		VCC1 VCC1 7 7 7 7 7 7 7 7 7 7 7 7 7	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 <sub>CC</sub> 1 is 5 V.)	V <sub>CC1</sub> V <sub>CC1</sub> V <sub>CC1</sub> V <sub>CC1</sub> V <sub>CC1</sub> V <sub>CC1</sub> V <sub>CC1</sub>	FG signal input
11	FGout1			FG amplifier output

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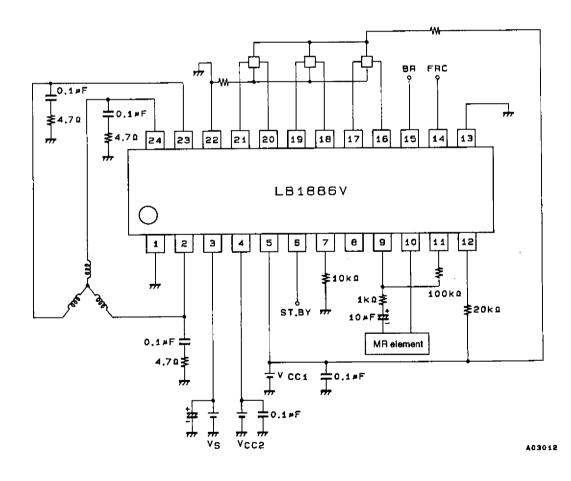
Pin No.	Symbol	Pin voltage	Equivalent circuit	Function
12	FGout2		VCC1	FG Schmitt amplifier output
14	FRC	H: 2.8 V min L: 1.2 V max (when V <sub>CC</sub> 1 is 5 V.)	VCC1	Motor forward/reverse control Low level: forward (1.2 V or lower: when V <sub>CC</sub> 1 ⊨ 5 V) High level: reverse (2.8 V or higher: when V <sub>CC</sub> 1 = 5 V)
15	BR	H: 2.0 V min L: 0.8 V max	VCC2	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 2.8 V (when V <sub>CC</sub> 1 is 5 V.)	2000 2000 2000 2000 2000 2000 2000 2000 2000 2000 2000 2000 2000 2000 2000 2000 20 2	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	Bf			Ground for the output transistors
23 24 2	Uout Vout Wout		VS VS VS (23) (24) (24) (24) (24) (24) (24) (24) (24) (24) (24) (24) (24) (24) (25) (24) (25) (25) (25) (26)	Outputs
1 13	SUB GND GND			Ground for all circuits other than the output transistor

#### **Truth Table**

	Pauras , sink		Input		Forward/reverse control	
	Source → şink	U	V	W	F/RC	
4	W phase → V phase V phase → W phase	н	н	L	L	
I					н	
2	W phase $\rightarrow$ U phase U phase $\rightarrow$ W phase	н	L	L	L	
~					н	
3	V phase → W phase W phase → V phase	L	L	н	L	
					н	
4	U phase $\rightarrow$ V phase		н	L	L	
	V phase → U phase				н	
5	V phase $\rightarrow$ U phase U phase $\rightarrow$ V phase	н	L	н	L	
5					н	
6	U phase $\rightarrow$ W phase $W$ phase $\rightarrow$ U phase	L	н	н	L	
0					н	

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<sub>CC</sub>1 Low: 0 V to 1.2 V

#### **Sample Application Circuit**



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