



LB1857M

Three-Phase Brushless Motor Driver IC

Overview

The LB1857M is a three-phase brushless motor driver IC designed for use as a camcorder capstan or drum motor driver, or as a digital audio tape player/recorder motor driver.

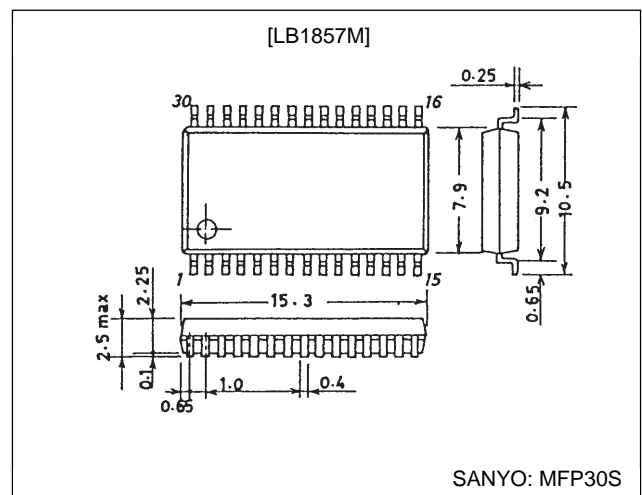
Features

- 120° voltage linear system
- Appropriate for portable applications, since the LB1857M reduces system power requirements by using motor voltage control for speed control.
- Built-in torque ripple compensation circuit
- Small external capacitances due to the adoption of a soft switching technique (chip capacitor).
- Built-in thermal shutdown circuit
- Built-in FG amplifier

Package Dimensions

unit: mm

3073A-MFP30S



Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	$V_{CC1 \text{ max}}$		7	V
	$V_{CC2 \text{ max}}$		16	V
	$V_S \text{ max}$		V_{CC2}	V
Output applied voltage	$V_O \text{ max}$		$V_S + 2$	V
Output current	$I_O \text{ max}$		1.5	A
Allowable power dissipation	$P_d \text{ max}$		1.0	W
Operating temperature	T_{opr}		-20 to +75	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +125	$^\circ\text{C}$

Allowable Operating Ranges at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC1}	$V_{CC1} \leq V_{CC2}$	4.0 to 6.0	V
	V_{CC2}		4 to 14	V
	V_S		Up to V_{CC2}	V

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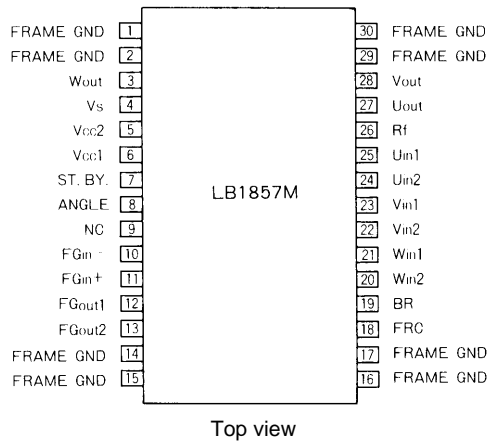
Electrical Characteristics at Ta = 25°C, VCC1 = 5 V, VCC2 = 7 V, VS = 3 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current	ICC1	VBR = 5 V		4.5	6.5	mA
	ICC2	VBR = 5 V		13	20	mA
	IS	VBR = 5 V, RL = ∞		6.5	9.0	mA
Output quiescent current	ICCOQ	VSTBY = 0 V			180	μA
	ISOQ	VSTBY = 0 V, RL = ∞			150	μA
Output saturation voltage	VO(sat)	IOUT = 0.6 A, sink + source			2.3	V
Output TRS withstand voltage	VO(sus)	IOUT = 20 mA*1	16			V
Output quiescent voltage	VOQ	VBR = 5 V	1.4	1.5	1.6	V
Hall amplifier input offset voltage	VHOFFSET	*1	-5		+5	mV
Hall amplifier common mode input voltage range	VHCOM		1.4		2.8	V
Hall I/O voltage gain	GVHO	Rangle = 8.2 kΩ	32.0	35.0	38.0	dB
Brake pin high level voltage	VBRH		2.0			V
Brake pin low level voltage	VBRL				0.8	V
Brake pin input current	IBRIN				100	μA
Brake pin leakage current	IBRLEAK				-30	μA
FRC pin high level voltage	VFRCH		2.8			V
FRC pin low level voltage	VFRCL				1.2	V
FRC pin input current	IFRCIN				100	μA
FRC pin leakage current	IFRCLEAK				-30	μA
Upper side residual voltage	VXH	IOUT = 100 mA, VCC2 = 6 V, VS = 2 V	0.32		0.49	V
Lower side residual voltage	VXL	IOUT = 100 mA, VCC2 = 6 V, VS = 2 V	0.39		0.48	V
Overlap level	OL	VCC2 = 6 V, VS = 3 V	60	70	80	%
Standby on voltage	VSTBYL	*2	-0.2		+0.1	V
Standby off voltage	VSTBYH		2		5	V
Standby pin bias current	ISTBYIN				10	μA
Thermal protection circuit operating temperature	TTSD	*1	150	180	210	°C
Thermal protection circuit hysteresis	ΔTTSD	*1		15		°C
[FG amplifier]						
Input offset voltage	VFG OFFSET		-8		+8	mV
Open loop voltage gain	GVFG	f = 1 kHz		60		dB
Source output saturation voltage	VFG OU	IO = -2 mA	3.7			V
Sink output saturation voltage	VFG OD	IO = 2 mA			1.3	V
Common mode signal exclusion ratio	CHR	*1		80		dB
FG amplifier common mode input voltage range	VFG CH		0		3.5	V
Phase margin	φM	*1		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 width	VFGS HIS	VFGIN+ = 2.5 V	20	40	60	mV

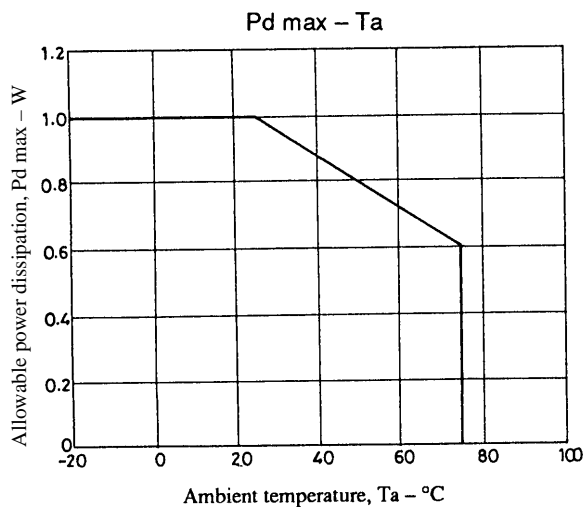
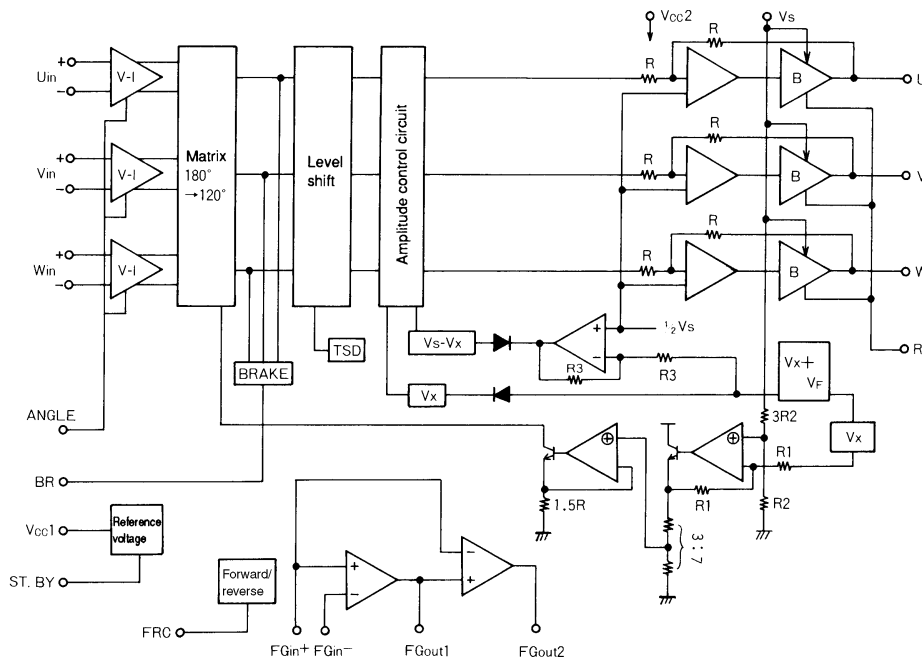
Note: 1. These are target settings, and are not measured. The overlap ratings are taken as test ratings without change.
2. When the standby pin is open the IC will be in the standby state.

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Pin Assignment



Block Diagram



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Pin Functions

Unit (resistance: Ω)

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
4	V_S	$\leq V_{CC2}$		Power supply input that determines the output amplitude. It must be set to a voltage equal or lower than V_{CC2} .
5	V_{CC2}	4 to 14 V		Power supply for power amplifier systems other than motor drive transistors. Power supply pin that provides voltage for blocks other than control blocks supplied by V_{CC1} .
6	V_{CC1}	4 to 6 V		Power supply that provides voltage for the Hall amplifier, the forward/reverse circuit, the FG amplifier, and the thermal shutdown circuit.
7	ST. BY	(H): 0.1 V max (L): 2.0 V min (When V_{CC1} is 5 V)		All circuits can be made inoperative either by connecting this pin to GND, or by leaving it open. In that state the supply current will be approximately 100 μ A. Hold at 2 V or higher during normal operation.
8	ANGLE			Connect a resistor between this pin and GND. Changing the value of this resistor will change the Hall input-output gain (motor waveform slope).
10 11	FG_{IN}^- FG_{IN}^+	0 V min 3.5 V max (When V_{CC1} is 5 V)		FG signal input pin
12	FG_{OUT1}			FG amplifier output pin

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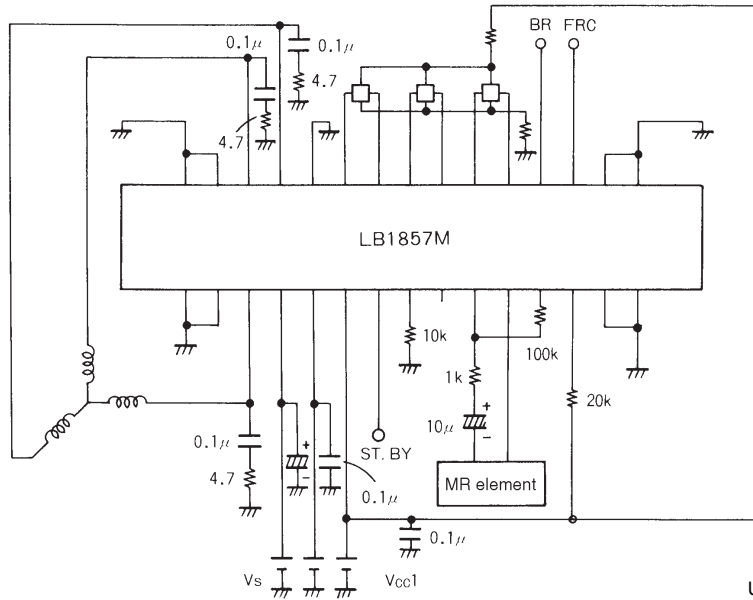
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Unit (resistance: Ω)

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
13	FG _{OUT2}			FG Schmitt amplifier output pin
18	FRC	(H): 2.8 V min (L): 1.2 V max (When V _{CC1} is 5 V)		Pin for setting the motor to forward or reverse rotation Low level: Forward rotation (under 1.2 V: when V _{CC1} is 5 V) High level: Reverse rotation (over 2.8 V: when V _{CC1} is 5 V)
19	BR	(H): 2.0 V min (L): 0.8 V max		Motor brake pin Low level: Motor drive (under 0.8 V) High level: Motor brake (over 2.0 V)
20 21 22 23 24 25	W _{IN2} W _{IN1} V _{IN2} V _{IN1} U _{IN2} U _{IN1}	1.4 V min 2.8 V max (When V _{CC1} is 5 V)		W phase Hall element input pins. Logic high is defined to be states where W _{IN1} > W _{IN2} . V phase Hall element input pins. Logic high is defined to be states where V _{IN1} > V _{IN2} . U phase Hall element input pins. Logic high is defined to be states where U _{IN1} > U _{IN2} .
26	R _f			Output transistor GND
27 28 3	U _{OUT} V _{OUT} W _{OUT}			Output pin
1, 2, 14, 15, 16, 17, 29, 30	FRAME (GND)			GND for all circuits other than output transistors.

Sample Application Circuit



Units (resistance: Ω, capacitance: F)

Logic Value Table

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

Inputs:

High: For each phase, the input 1 potential is at least 0.2 V higher than the input 2 potential.

Low: For each phase, the input 1 potential is at least 0.2 V lower than the input 2 potential.

Forward/reverse control:

High: 2.8 V to Vcc1

Low: 0 to 1.2 V

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