



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.

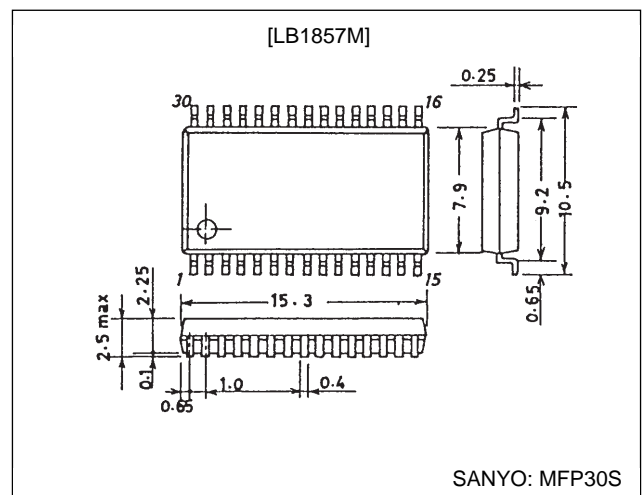
Features

- 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

LB1857M

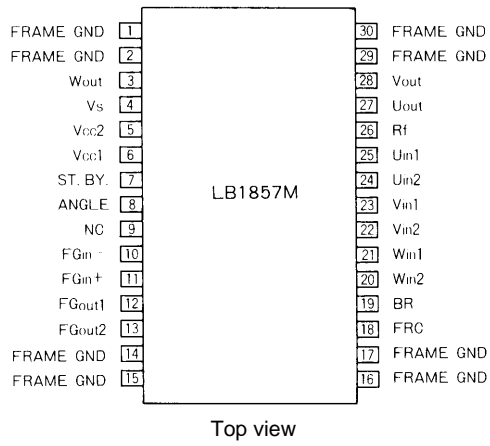
Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC1} = 5\text{ V}$, $V_{CC2} = 7\text{ V}$, $V_S = 3\text{ V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current	I_{CC1}	$V_{BR} = 5\text{ V}$		4.5	6.5	mA
	I_{CC2}	$V_{BR} = 5\text{ V}$		13	20	mA
	I_S	$V_{BR} = 5\text{ V}$, $R_L = \infty$		6.5	9.0	mA
Output quiescent current	I_{CCOQ}	$V_{STBY} = 0\text{ V}$			180	μA
	I_{SOQ}	$V_{STBY} = 0\text{ V}$, $R_L = \infty$			150	μA
Output saturation voltage	$V_{O(sat)}$	$I_{OUT} = 0.6\text{ A}$, sink + source			2.3	V
Output TRS withstand voltage	$V_{O(sus)}$	$I_{OUT} = 20\text{ mA}^{*1}$	16			V
Output quiescent voltage	V_{OQ}	$V_{BR} = 5\text{ V}$	1.4	1.5	1.6	V
Hall amplifier input offset voltage	$V_{HOFFSET}$	$*1$	-5		+5	mV
Hall amplifier common mode input voltage range	V_{HCOM}		1.4		2.8	V
Hall I/O voltage gain	GV_{HO}	$R_{angle} = 8.2\text{ k}\Omega$	32.0	35.0	38.0	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}				100	μA
Brake pin leakage current	I_{BRLEAK}				-30	μA
FRC pin high level voltage	V_{FRCH}		2.8			V
FRC pin low level voltage	V_{FRCL}				1.2	V
FRC pin input current	I_{FRCIN}				100	μA
FRC pin leakage current	$I_{FRCLEAK}$				-30	μA
Upper side residual voltage	V_{XH}	$I_{OUT} = 100\text{ mA}$, $V_{CC2} = 6\text{ V}$, $V_S = 2\text{ V}$	0.32		0.49	V
Lower side residual voltage	V_{XL}	$I_{OUT} = 100\text{ mA}$, $V_{CC2} = 6\text{ V}$, $V_S = 2\text{ V}$	0.39		0.48	V
Overlap level	OL	$V_{CC2} = 6\text{ V}$, $V_S = 3\text{ V}$	60	70	80	%
Standby on voltage	V_{STBYL}	$*2$	-0.2		+0.1	V
Standby off voltage	V_{STBYH}		2		5	V
Standby pin bias current	I_{STBYIN}				10	μA
Thermal protection circuit operating temperature	T_{TSD}	$*1$	150	180	210	$^\circ\text{C}$
Thermal protection circuit hysteresis	ΔT_{TSD}	$*1$		15		$^\circ\text{C}$
[FG amplifier]						
Input offset voltage	$V_{FG\ OFFSET}$		-8		+8	mV
Open loop voltage gain	GV_{FG}	$f = 1\text{ kHz}$		60		dB
Source output saturation voltage	$V_{FG\ OU}$	$I_O = -2\text{ mA}$	3.7			V
Sink output saturation voltage	$V_{FG\ OD}$	$I_O = 2\text{ mA}$			1.3	V
Common mode signal exclusion ratio	CHR	$*1$		80		dB
FG amplifier common mode input voltage range	$V_{FG\ CH}$		0		3.5	V
Phase margin	ϕ_M	$*1$		20		deg
Schmitt amplifier threshold voltage	$V_{FGS\ SH}$	$V_{FGIN^+} = 2.5\text{ V}$, when V_{FGOUT2} goes from high to low	2.45	2.50	2.55	V
Schmitt amplifier hysteresis width	$V_{FGS\ HIS}$	$V_{FGIN^+} = 2.5\text{ V}$	20	40	60	mV

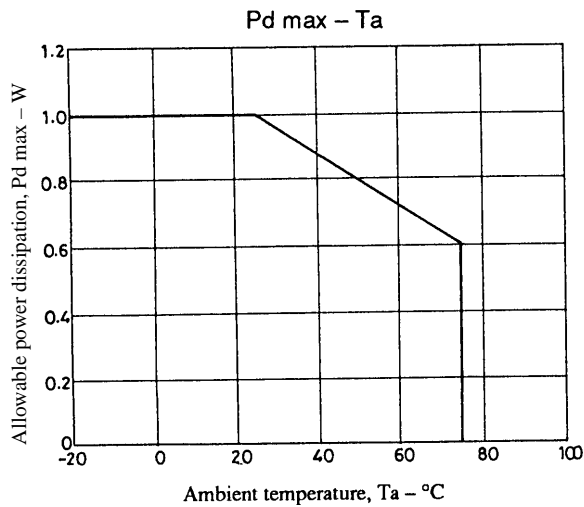
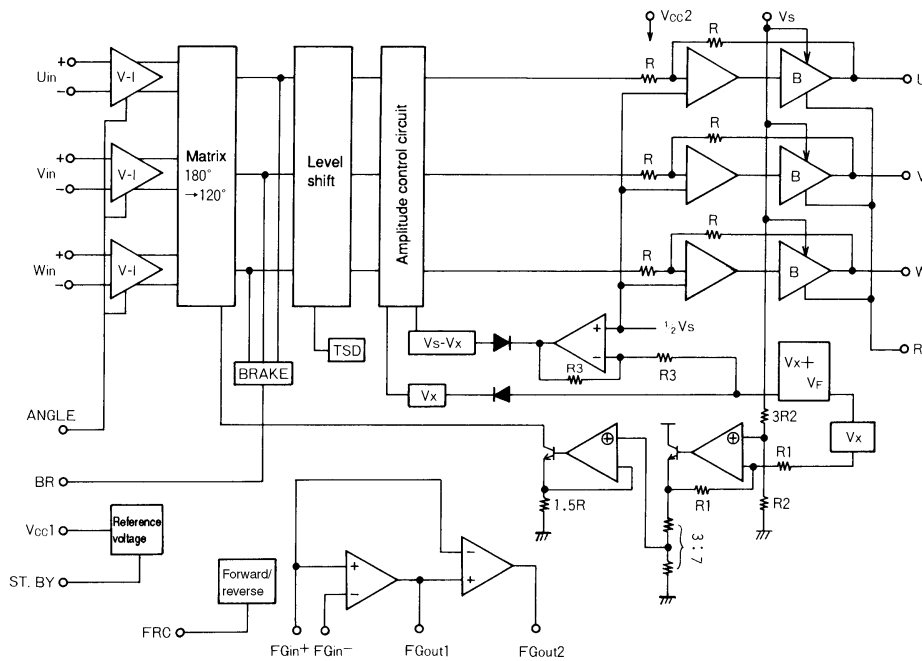
Note: 1. These are target settings, and are not measured. The overlap ratings are taken as test ratings without change.
2. When the standby pin is open the IC will be in the standby state.

LB1857M

Pin Assignment



Block Diagram



LB1857M

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

Continued on next page

LB1857M

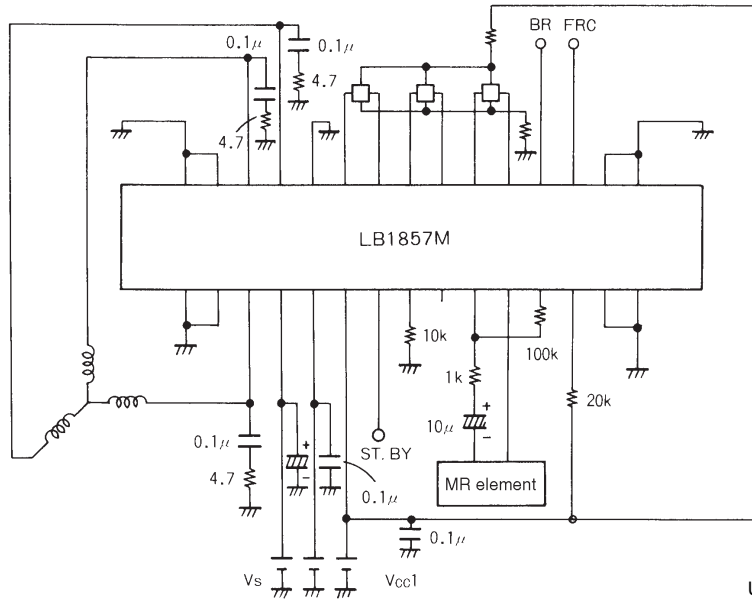
Continued from preceding page.

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.

LB1857M

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 V_{CC1}

Low: 0 to 1.2 V

- No products described or contained herein are intended for use in surgical implants, life-support systems, aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury, death or property loss.
- Anyone purchasing any products described or contained herein for an above-mentioned use shall:
 - ① Accept full responsibility and indemnify and defend SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors and all their officers and employees, jointly and severally, against any and all claims and litigation and all damages, cost and expenses associated with such use:
 - ② Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors or any of their officers and employees jointly or severally.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of March, 1998. Specifications and information herein are subject to change without notice.