



# LB1851M

## 3-Phase Brushless Motor Driver

### Overview

The LB1851M is a 3-phase brushless motor drive IC ideally suited for use in VCR capstan motor driver, drum motor driver, and DAT motor driver applications.

### Features

- 120°C voltage linear type.
- Less power dissipation because of speed control based on motor voltage control (suitable for use in portable sets).
- Torque ripple compensation circuit on chip.
- Small capacitance of external capacitor because of soft switching method (clip capacitor).
- Thermal shutdown circuit on chip.
- FG amplifier on chip.

### Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage1	$V_{CC1 \text{ max}}$		7	V
Maximum supply voltage2	$V_{CC2 \text{ max}}$		16	V
Maximum supply voltage3	$V_S \text{ max}$		$V_{CC2}$	V
Output supply voltage	$V_O \text{ max}$		$V_S + 2V$	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	°C
Storage temperature	$T_{stg}$		-55 to +125	°C

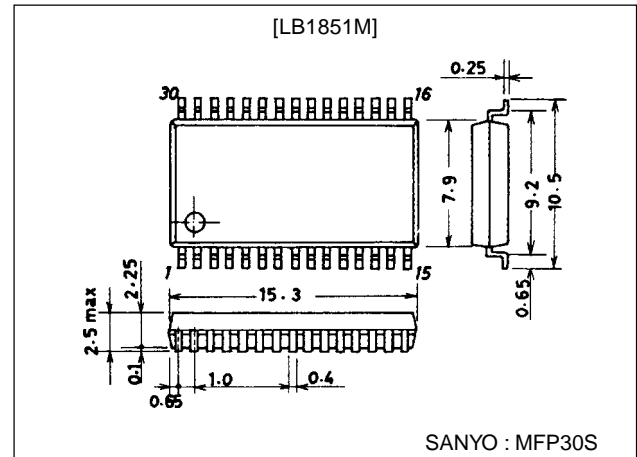
#### Absolute Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage1	$V_{CC1}$		4.0 to 6.0	V
Supply voltage2	$V_{CC2}$		4 to 14	V
Supply voltage3	$V_S$		up to $V_{CC2}$	V

### Package Dimensions

unit:mm

#### 3073A-MFP30S



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

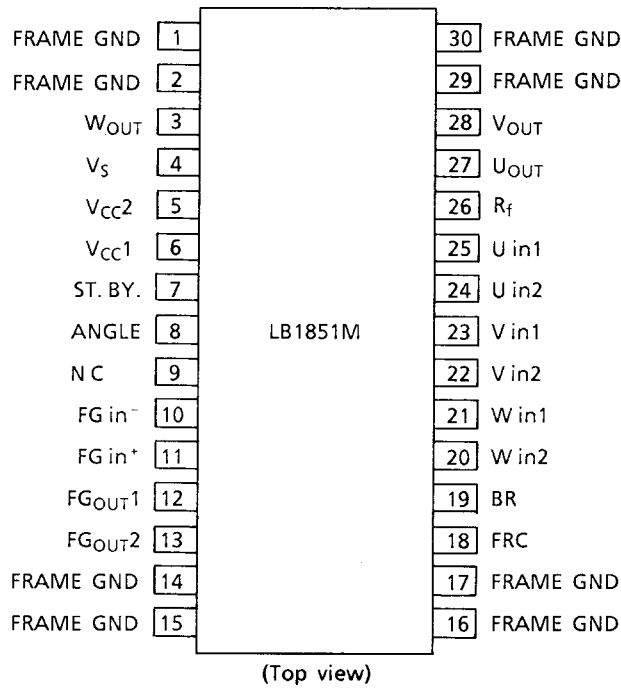
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current 1	I <sub>CC1</sub>	V <sub>BR</sub> =5V		4.5	6.5	mA
Supply current 2	I <sub>CC2</sub>	V <sub>BR</sub> =5V		15	20	mA
Supply current 3	I <sub>S</sub>	V <sub>BR</sub> =5V, R <sub>L</sub> =∞		6.5	9.0	mA
Output standby current 1	I <sub>CCOQ</sub>	V <sub>STBY</sub> =0V			180	μA
Output standby current 2	I <sub>SOQ</sub>	V <sub>STBY</sub> =0V, R <sub>L</sub> =∞			150	μA
Output saturation voltage	V <sub>O(sat)</sub>	I <sub>OUT</sub> =1.0A, sink+source			2.3	V
Output TRS voltage	V <sub>O(sus)</sub>	I <sub>OUT</sub> =20mA	16			V*
Output standby voltage	V <sub>OQ</sub>	I <sub>BR</sub> =5V	1.4	1.5	1.6	V
Hall amplifier input Offset vottage	V <sub>H offset</sub>		-5		+5	mV*
Hall amplifier common-mode Input voltage range	V <sub>HCOM</sub>		1.4		2.8	V
Hall input-output Voltage gain	G <sub>VHO</sub>	R <sub>angle</sub> =8.2kΩ	31.5	34.5	37.5	dB
Brake pin 'H'-level voltage			2.0			V
Brake pin 'L'-level voltage					0.8	V
Brake pin input current					100	μA
Brake pin leakage current					-30	μA
FRC pin 'H'-level voltage			2.8			V
FRC pin 'L'-level voltage					1.2	V
FRC pin input current					100	μA
FRC pin leakage current					-30	μA
Upper residual voltage	V <sub>XH</sub>	I <sub>OUT</sub> =100mA, V <sub>CC2</sub> =6V, V <sub>S</sub> =2V	0.38		0.55	V
Lower residual voltage	V <sub>XL</sub>	I <sub>OUT</sub> =100mA, V <sub>CC2</sub> =6V, V <sub>S</sub> =2V	0.41		0.5	V
Residual voltage inflection point				2.0		V
Overlap amount		V <sub>CC2</sub> =6V, V <sub>S</sub> =3V	60	70	80	%
Standby ON voltage			-0.2		+0.1	V
Standby OFF voltage		Open : standby off (note1)	2		5	V
Standby pin bias current		Pin GND			10	μA
Operating temperature of thermal shutdown circuit			150	180	210	°C*
Hysteresis of thermal shutdown circuit				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>	f=1kHz		60		dB
Source side output saturation voltage	V <sub>FG OUT</sub>	I <sub>O</sub> =-2mA	3.7			V
Sink side output saturation voltage	V <sub>FG OD</sub>	I <sub>O</sub> =2mA			1.3	V
Common-mode signal rejection	CHR			80		dB*
FG ampilier common-mode input voltage range	V <sub>FG CH</sub>		0		3.5	V
Phase margin				20		°C*
Schmitt amplifier threshold voltage		V <sub>FG in+</sub> =2.5V, V <sub>FGOUT2</sub> at H to L	2.45	2.50	2.55	V
Schmitt amplifier hysteresis		V <sub>FG in+</sub> =2.5V	20	40	60	mV

Note1 : When standby pin is left open, standby operation is turned to off.

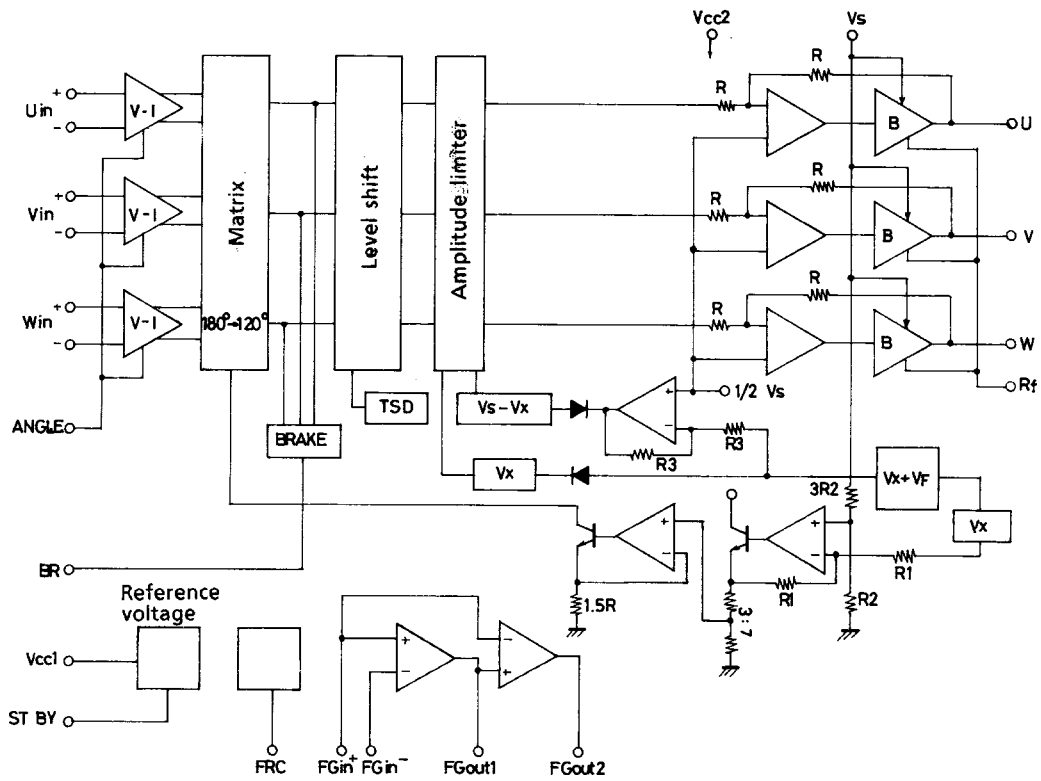
Note2\*: Values shown are design targets only. No measurements have been taken. Overlap spec. are regarded as test specification.

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## Pin Assignment

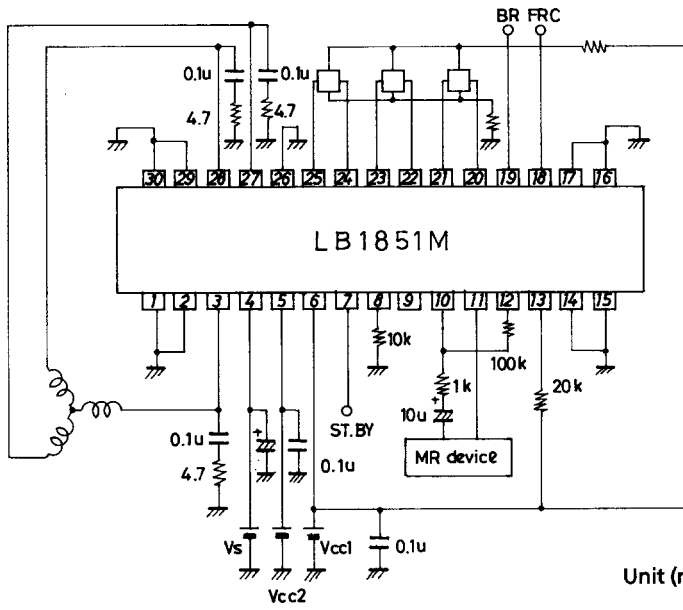


## Block Diagram



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## Sample Application Circuit

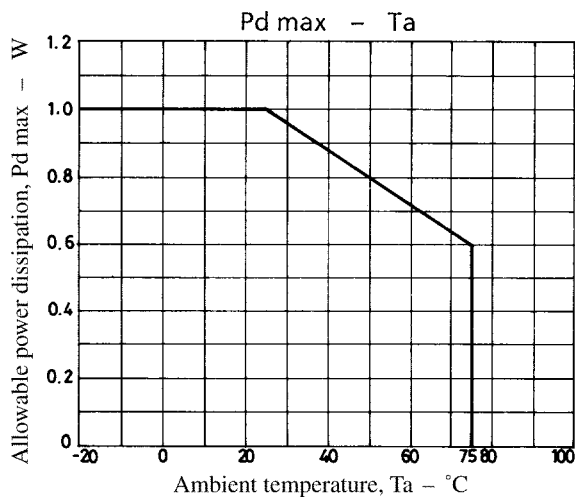


## Truth Table

Mode	Source	Sink	Input			Forward/Reverse Control
			U	V	W	
1	W phase → V phase		H		L	L
	V phase → W phase		H	H		H
2	W phase → U phase		H	L	L	L
	U phase → W phase		H		L	H
3	V phase → W phase		L	L	H	L
	W phase → V phase		L	L		H
4	U phase → V phase		L	H	L	L
	V phase → U phase		L	H		H
5	V phase → U phase		H	L	H	L
	U phase → V phase		H	L		H
6	U phase → W phase		L	H	H	L
	W phase → U phase		L	H		H

Input : "H" : Input 1 of each phase is at a potential which is higher by more than 0.2V relative to input 2.  
 "L" : Input 1 of each phase is at a potential which is lower by more than 0.2V relative to input 2.

Forward/reverse control : "H" : 2.8V to V<sub>CC1</sub>  
 "L" : 0V to 1.2V



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## Pin Description

Unit (resistance :  $\Omega$ )

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
4	$V_S$	$<V_{CC2}$		Power supply pin for fixing the output amplitude. Must be lower than $V_{CC2}$ voltage.
5	$V_{CC2}$	4V to 14V		Power supply pin for amp circuit other than motor driver transistor. Power supply pin for supplying voltage to other than the control section whose supply voltage is $V_{CC1}$ .
6	$V_{CC1}$	4V to 6V		Power supply pin for supplying voltage to the hall amp, forward /reverse control, FG amp, thermal shutdown circuit.
7	ST. BY	L : 0.1V max H : 2.0V min (When $V_{CC1}=5V$ )		When this pin is grounded, all the circuitry stops operating. In this case, the supply current is approximately 100 $\mu$ A. In the normal operation mode, this pin is left open or made to be at a potential of more than 2V.
8	ANGLE			The hall input-output gain (slope of motor waveform) can be changed by changing the resistance connected across this pin and GND.
10 11	FG in <sup>-</sup> FG in <sup>+</sup>	min 0V max 3.5V (When $V_{CC1}=5V$ )		FG signal input pin.
12	FG <sub>OUT1</sub>			FG amp output pin.
13	FG <sub>OUT2</sub>			FG schmitt amp output pin.
18	FRC	L : 1.2V max H : 2.8V min (When $V_{CC1}=5V$ )		Pin for forward/reverse control of motor L level : Forward (Less than 1.2V : When $V_{CC1}=5V$ ) H level : Reverse (More than 2.8V : When $V_{CC1}=5V$ ).
19	BR	L : 0.8V max H : 2.0V min		Pin for stopping the motor L level : Motor drive (Less than 0.8V). H level : Motor stop (More than 2.0V).

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Continued from preceding page.

Unit (resistance :  $\Omega$ )

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
20	Win2	min 1.4V max 2.8V (When $V_{CC1}=5V$ )		W phase hall element input pin Logic "H" : Win1>Win2
21	Win1			V phase hall element input pin Logic "H" : Vin1>Vin2
22	Vin2			U phase hall element input pin Logic "H" : Uin1>Uin2
23	Vin1			
24	Uin2			
25	Uin1			
26	Rf			GND for output transistor.
27	U <sub>OUT</sub>			Output pin.
28	V <sub>OUT</sub>			
30	W <sub>OUT</sub>			
1,2 14,15 16,17 29,30	FRAME (GND)			GND for other than output.

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