



# LB1854M

## Three-Phase Brushless Motor Driver IC

### Overview

The LB1854M is a three-phase brushless motor driver IC and is optimal, in particular, for driving VCR capstan and drum motors.

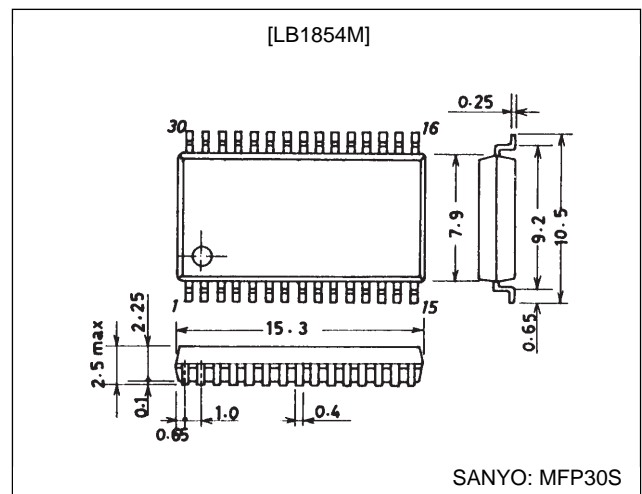
### Features

- 120° voltage linear drive technique
- The LB1854M soft switching scheme allows smaller external capacitors to be used (e.g., chip capacitors).
- Built-in thermal-shutdown function
- Built-in overcurrent protection circuit
- Built-in FG amplifiers (operational amplifier and Schmitt amplifier)
- Control start voltage set by an external voltage
- The output current feedback level can be changed by changing the control gain to one of two levels.

### Package Dimensions

unit: mm

#### 3073A-MFP30S



### Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC1\text{ max}}$		20	V
	$V_{CC2\text{ max}}$		7.0	V
Applied output voltage	$V_{OU, v, w}$		22	V
Maximum output current	$I_{OUT\text{ max}}$		1.5	A
Allowable power dissipation	$P_d\text{ max}$		1.05	W
Operating temperature	$T_{opr}$		-20 to +75	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-55 to +150	$^\circ\text{C}$

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

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	$V_{CC1}$		5 to 18	V
	$V_{CC2}$		4.3 to 6.5	V

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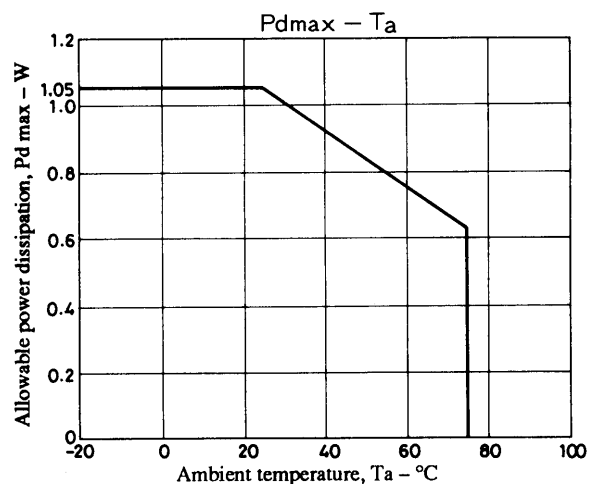
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### Electrical Characteristics at $T_a = 25^\circ\text{C}$ , $V_{CC1} = 12\text{ V}$ , $V_{CC2} = 5\text{ V}$

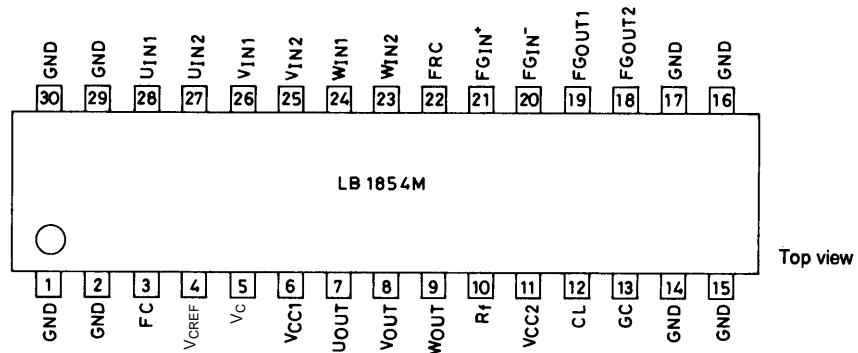
Parameter	Symbol	Conditions	min	typ	max	Unit
Current drain	$I_{CC1}$	$V_C = 0\text{ V}$ , $R_L = \infty$		17	30	mA
	$I_{CC2}$	$V_C = 0\text{ V}$		6.5	9.5	mA
[Drive Block]						
Output saturation voltage	$V_O(\text{sat}) 1$	$I_{OUT} = 0.5\text{ A}$ , sink + source		1.6	2.2	V
	$V_O(\text{sat}) 2$	$I_{OUT} = 1.0\text{ A}$ , sink + source		2.0	3.0	V
Output TRS breakdown voltage	$V_O(\text{sus})$	$I_{OUT} = 20\text{ mA}^*$	20			V
Output resting potential	$V_{OQ}$	$V_C = 0\text{ V}$	5.7	6.0	6.3	V
Hall amplifier input offset voltage	$V_H$ offset		-5		+5	mV
Hall amplifier input bias current	$I_H$ bias			1	5	$\mu\text{A}$
Hall amplifier common mode input voltage range	$V_H$ ch		1.3		2.2	V
Hall input/output voltage gain	$GV_{HO}$		43	46	49	dB
[Control Block]						
Control output drive gain	$GV_{CO1}$	High gain	37	40	43	dB
	$GV_{CO2}$	Low gain	31	34	37	dB
Control output CH difference	$\Delta GV_{CO}$		-2		+2	dB
Control start voltage	$V_{CTH}$	When $V_{OUTP-p} = 2\text{ V}$		2.5		V
Gain control switching high level			4		5	V
Gain control switching middle level		Middle level when the input is open	2		3	V
Gain control switching low level			0		1	V
[FG Amplifier]						
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	$V_{FG\text{ OU}}$	$I_O = 2\text{ mA}$	37			V
Sink output saturation voltage	$V_{FG\text{ OD}}$	$I_O = -2\text{ mA}$			1.3	V
Common-mode signal rejection ratio	CHR	*		80		dB
FG amplifier common-mode input voltage range	$V_{FG\text{ CH}}$		0		3.5	V
Phase margin		*		20		Deg
Schmitt hysteresis	$\Delta V_{sh1}$	$FG_{OUT2}$ : High to low		22		mV
	$\Delta V_{sh2}$	$FG_{OUT2}$ : Low to high		22		mV
Schmitt input voltage range	$V_{shCH}$		0.7		3.5	V
[Thermal Shutdown]						
Operating temperature	TSD	*	150	180	210	$^\circ\text{C}$
Hysteresis	$\Delta TSD$	*		15		$^\circ\text{C}$

Note: \* Items marked with an asterisk are design target values and are not measured.

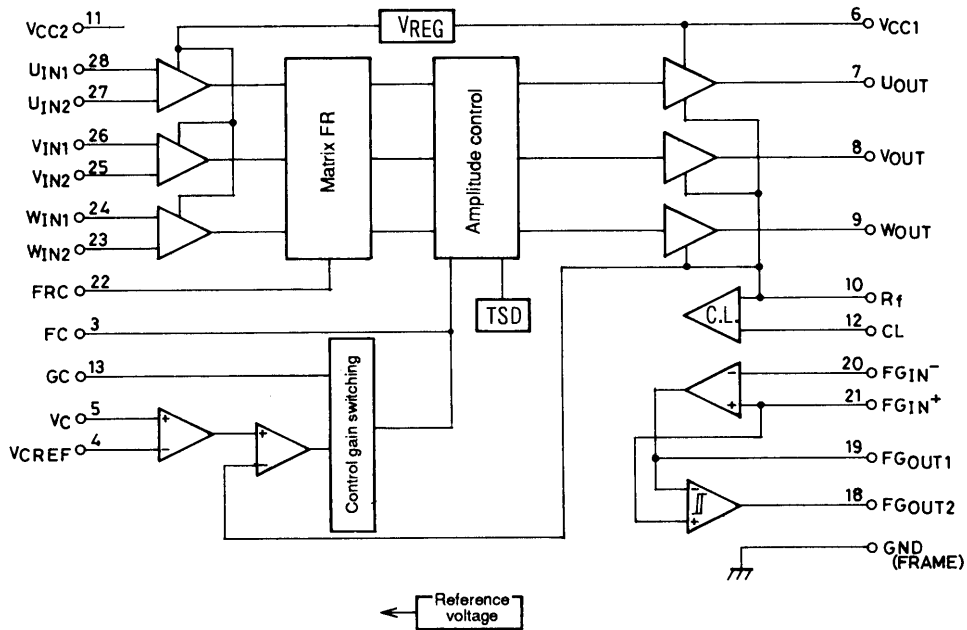


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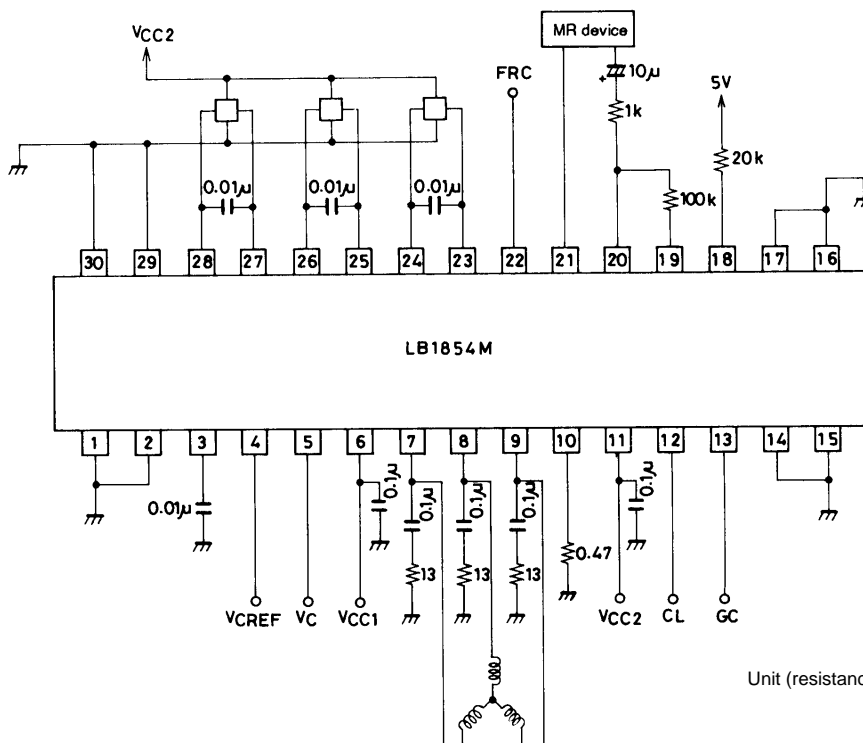
## Pin Assignment



## Block Diagram



## Sample Application Circuit



Unit (resistance: Ω, capacitance: F)

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### Truth 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
2	W phase → U phase	H	L	L	L
	U phase → W phase				H
3	V phase → W phase	L	L	H	L
	W phase → V phase				H
4	U phase → V phase	L	H	L	L
	V phase → U phase				H
5	V phase → U phase	H	L	H	L
	U phase → V phase				H
6	U phase → W phase	L	H	H	L
	W phase → U phase				H

Input high: Phase 1 is 0.2 V or more higher than the corresponding phase 2 for each phase input.

Low: Phase 1 is 0.2 V or more lower than the corresponding phase 2 for each phase input.

Forward and reverse control high: 2.3 V to  $V_{CC1}$

Low: 0 V to 0.7 V

### Pin Functions

Unit (resistance:  $\Omega$ )

Pin No.	Symbol	Pin voltage	Equivalent circuit	Function
1, 2, 14, 15, 16, 17, 29, 30	FRAME (GND)			Ground for all circuits except the outputs
3	FC			The gain frequency characteristics can be lowered by connecting a capacitor between this pin and ground to prevent oscillation.
4 5	$V_{C REF}$ $V_C$	1.5 V min $V_{CC2}$ max 0 V min $V_{CC2}$ max		Speed control The LB1854M implements a voltage control scheme in which the output voltage is controlled by the pin 5 voltage. The pin 4 voltage determines the control start voltage.
6	$V_{CC1}$	5 to 18 V		Power supply that provides the drive outputs

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Unit (resistance:  $\Omega$ )

Pin No.	Symbol	Pin voltage	Equivalent circuit	Function
7 8 9	$U_{OUT}$ $V_{OUT}$ $W_{OUT}$			Output pins
10	$R_f$			Output transistor ground Feedback can be applied to the control amplifier by inserting resistor between this pin and GND and detecting the output current as a voltage. The overcurrent protection circuit (current limiter) operates by detecting the voltage on this pin.
11	$V_{CC2}$	4.3 to 6.5 V		Power supply provided to all blocks other than the output block This voltage must be stabilized so that no ripple or other noise is present.
12	CL	0 V min $V_{CC2}$ max		The current limiter operates when the $R_f$ pin reaches the same potential as pin 12. The pin 12 potential is set up externally.
13	GC	0 V min $V_{CC2}$ max		Control input to output gain switching pin High level (4 to 5 V): 34 dB Middle level (2 to 3 V) or open: 40 dB (low speed): 34 dB (high speed) Low level (0 to 1 V): 40 dB However, note that this applies when $V_{CC2}$ is 5 V.
18	$FG_{OUT2}$			FG Schmitt amplifier output
19	$FG_{OUT1}$			FG amplifier output

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Unit (resistance:  $\Omega$ )

Pin No.	Symbol	Pin voltage	Equivalent circuit	Function
20 21	FG <sub>IN-</sub> FG <sub>IN+</sub>	0 V min 3.5 V max (when V <sub>CC2</sub> is 5 V)		FG signal input
22	FRC	High: 2.3 V min Low: 0.7 V max		Motor forward/reverse control pin Low level (0.7 V or lower): forward High level (2.3 V or higher): reverse
23 24 25 26 27 28	W <sub>IN2</sub> W <sub>IN1</sub> V <sub>IN2</sub> V <sub>IN1</sub> U <sub>IN2</sub> U <sub>IN1</sub>	1.4 V min 2.0 V max		W phase Hall sensor input Logic high is the W <sub>IN1</sub> > W <sub>IN2</sub> state. V phase Hall sensor input Logic high is the V <sub>IN1</sub> > V <sub>IN2</sub> state. U phase Hall sensor input Logic high is the U <sub>IN1</sub> > U <sub>IN2</sub> state.

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