Ordering number:ENN3417

Monolithic Digital IC

LB1687M

3-Phase Brushless Motor Driver

Overview

The LB1687M is a 3-phase brushless motor driver IC ideally suited for use in VCR capstan motor, drum motor drive applications.

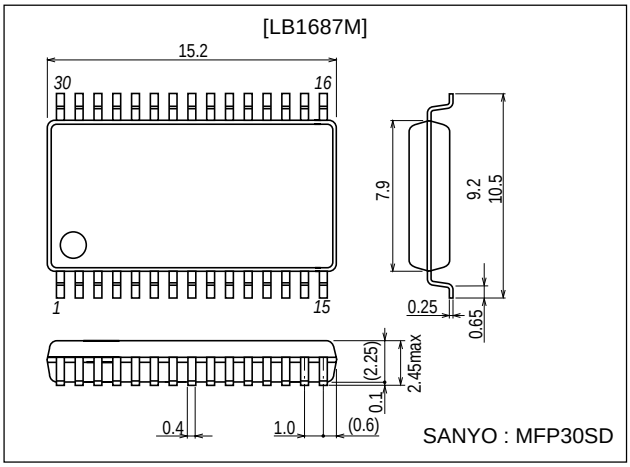
Features and Functions

- 120° voltage linear type.
- Soft switching type eliminating noises caused by current switching and making the value of external capacitors smaller (comparable to those of chip capacitors).
- On-chip FG amplifier.
- On-chip thermal shutdown circuit.
- FG signal can be used to detect the rotational speed of a motor so that the hall amplifier gain is changed in two steps, thus reducing torque ripple and noise.
- Motor drivable at voltage down to motor supply voltage 5V.

Package Dimensions

unit:mm

3073B-MFP30SD



Specifications

Absolute Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC}1$ max		20	V
	$V_{CC}2$ max		7.0	V
Output voltage	$V_{OUT.V.W}$		22	V
Output current	I_{OUT}		1.5	A
Allowable power dissipation	Pd max		1.05	W
Operating temperature	Topr		–20 to +75	˚C
Storage temperature	Tstg		–55 to +125	˚C

Allowable Operating Ranges at Ta = 25˚C

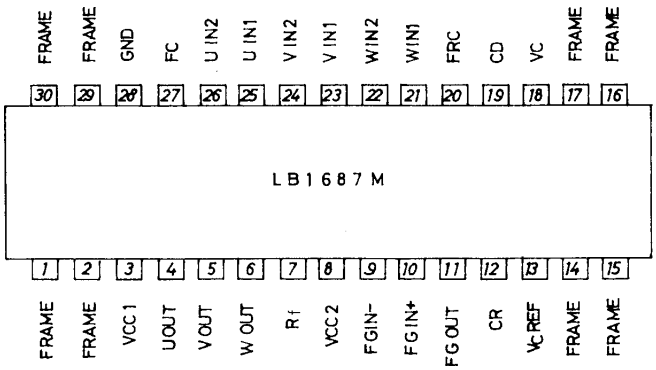
Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage range	$V_{CC}1$		5 to 18	V
	$V_{CC}2$		4.3 to 6.5	V

Electrical Characteristics at Ta = 25˚C, $V_{CC}1$=12V, $V_{CC}2$=5V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Power supply]						
Supply current 1	$I_{CC}1$	V_C=0, R_L=∞		17	30	mA
Supply current 2	$I_{CC}2$	V_C=0		6.5	9.5	mA
[Output]						
Output saturation voltage	$V_{O(sat)}1$	I_{OUT}=0.5A, sink+source		1.6	2.2	V
	$V_{O(sat)}2$	I_{OUT}=1.0A, sink+source		2.0	3.0	V
Output TRS withstand voltage	$V_{O(sus)}$	I_{OUT}=20mA *	20			V
Output static voltage	V_{OQ}	V_C=0	5.8	6.1	6.4	V
[Hall input-output]						
Hall amplifier input offset voltage	V_H offset		–5		+5	mV
Hall amplifier input bias current	I_H bias			1	5	µA
Hall amplifier common-mode input voltage range	V_H ch		1.3		3.7	V
Hall input-output voltage gain	$G_{VHO}1$			56		dB
	$G_{VHO}2$			43		dB
[Control-output]						
Control amplifier input impedance						
Control-output drive gain	G_{VCO}		38	41	44	dB
Control-output CH difference	ΔG_{VCO}		–2		+2	dB
[FG amplifier]						
FG amplifier input offset voltage	VFG offset		–8		+8	mV
Open loop voltage gain	G_{VFG}	f=1kHz		60		dB
Source output saturation voltage	$V_{FG\ OU}$	I_O=2mA	3.7			V
Sink output saturation voltage	$V_{FG\ OD}$	I_O=–2mA			1.3	V
Common-mode signal rejection ratio	CHR	*		80		dB
FG amplifier common-mode input voltage range	$V_{FG\ CH}$		0		3.5	V
Phase margin		*		20		deg.
[Motor detection]						
Motor detection amplifier hysteresis width			35	50	65	mV
CR pin threshold voltage		VCR low to high	2.35	2.5	2.65	V
[Thermal shutdown]						
Thermal shutdown temperature	T_{SD}	*	150	180	210	˚C
Thermal shutdown hysteresis	ΔT_{SD}	*		15		˚C

Note : * indicates design goals not measured values.

Pin Assignment



Note : All FRAME pins are connected to GND

Truth Table

Item	Source → sink	Input			Forward/ reverse control
		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

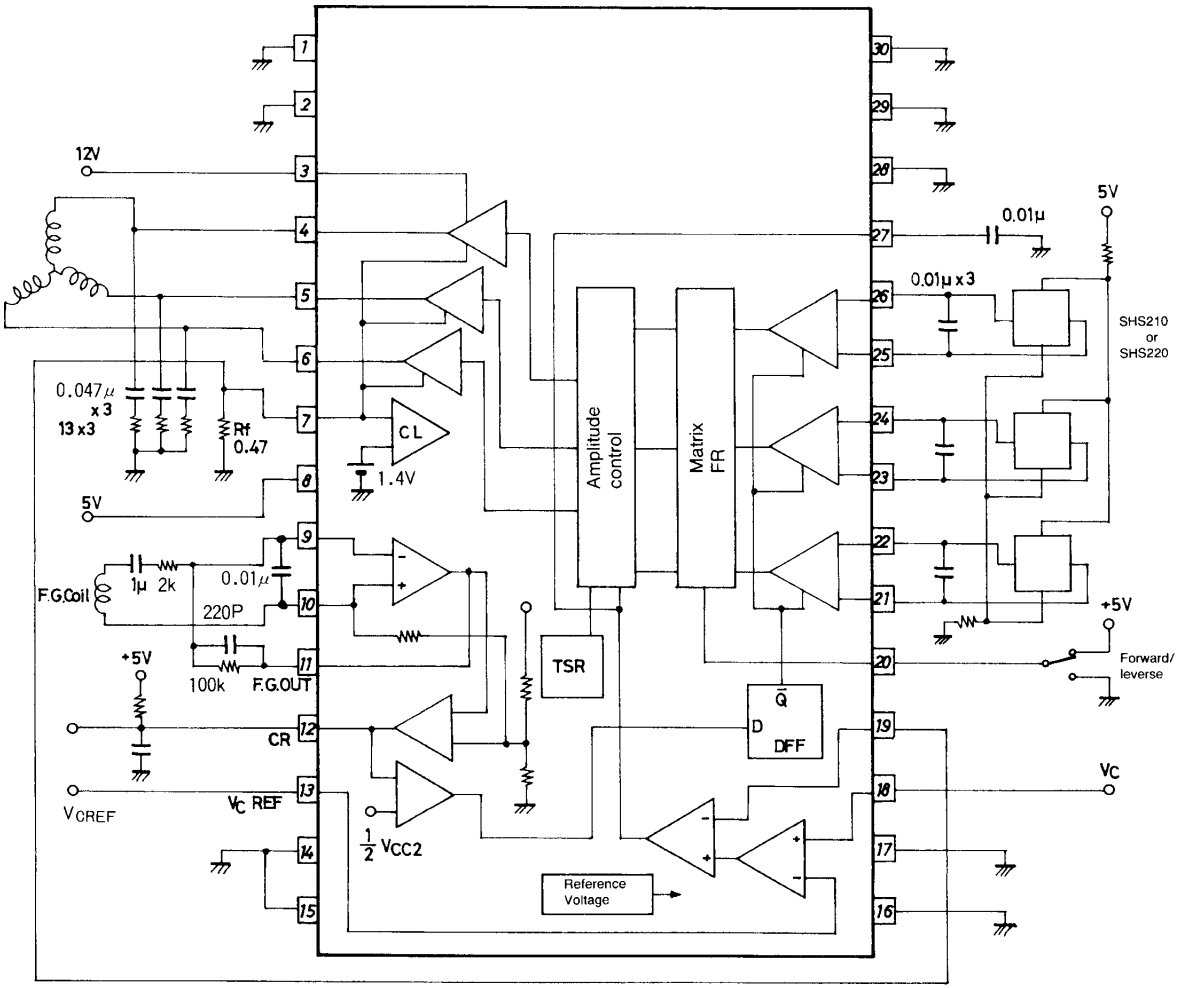
Input :
- High : Each phase input 1 is more than 0.2V higher than each phase input 2.
- Low : Each phase input 1 is more than 0.2V lower than each phase input 2.

Forward/reverse control :
- High : 2.0 to $V_{CC}2$
- Low : 0 to 0.3V

Pin Function

Pin	Pin No.	Functions
$U_{IN}1$, $U_{IN}2$	25, 26	U phase Hall element input pin ; 'H' of logic ; $V_{IN}1 > V_{IN}2$
$V_{IN}1$, $V_{IN}2$	23, 24	V phase Hall element input pin ; 'H' of logic ; $V_{IN}1 > V_{IN}2$
W_{IN}, $W_{IN}2$	21, 22	W phase Hall element input pin ; 'H' of logic ; $V_{IN}1 > V_{IN}2$
U_{OUT}	4	U phase output pin
V_{OUT}	5	V phase output pin
W_{OUT}	6	W phase output pin
$V_{CC}1$	3	Power supply pin for applying output
$V_{CC}2$	8	Power supply pin for applying voltage section other than output section ; this voltage must be stabilized to be free from ripple, noise, etc.
Rf	7	Output current detect pin ; by connecting Rf across this pin and ground, output current is detected as voltage. The result is used to control the overcurrent protection circuit.
C_D	19	Pin for fetching current (voltage) detected with Rf ; to take feed back for Rf, the control-output voltage gain can be reduced ; when not using, ground.
F_C	27	Frequency characteristic correction pin
V_C	18	Speed-phase control pin Control is of voltage-controlled type that controls output voltage.
V_{CREF}	13	Control reference voltage.
GND	28	Ground except for output The minimum output transistor potential is at Rf pin.
F/RC	20	Foward/reverse control pin By setting this pin to high (more than 2V) or low (less than 0.3V), truth value is changed to perform forward and reverse rotation.
FGin–, FGin+	9, 10	FG signal input pin
FG_{OUT}	11	FG amplifier output pin
CR	12	The voltage at this pin can be used to change the hall input gain. Connection of an external resistor and capacitor makes it possible to detect the rotational speed of a motor and change the hall input-output voltage gain in two steps.

Equivalent Circuit Block Diagram



Unit (resistance: Ω, capacitance: F)