T-52-13-25

Ordering number: EN3904

Monolithic Linear IC

No. 3904

LB1687NM

Three-phase, Brushless-motor Driver

OVERVIEW

The LB1687NM is a three-phase, brushless-motor driver IC for capstan and drum motors in video cassette recorders.

The LB1687NM features 120° electrical phasing, linear voltage control and soft switching, which eliminates switching noise and allows smaller output capacitors to be used.

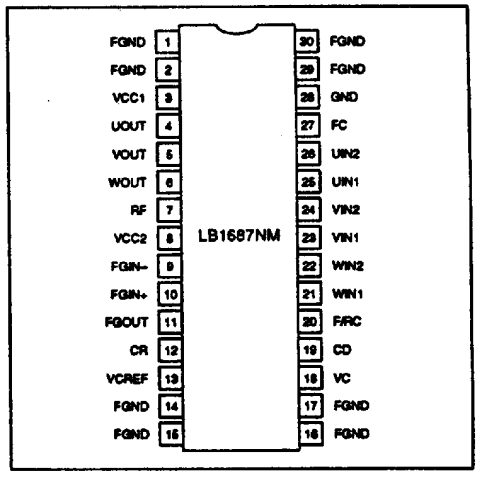
The LB1687NM incorporates a revolution detector input, output current feedback and thermal shutdown circuits, and an FG amplifier. The revolution detector input frequency controls the output current feedback circuit switching.

The LB1687NM operates from 5 to 18 V motor driver and 4.3 to 6.5 V control supplies, and is available in 30-pin MFPs.

FEATURES

- 120° electrical phasing
- Linear voltage control
- Soft switching
- No switching noise
- FG amplifier
- Revolution detector
- Output current feedback
- Thermal shutdown circuit
- 5 to 18 V motor driver and 4.3 to 6.5 V control supplies
- 30-pin MFP

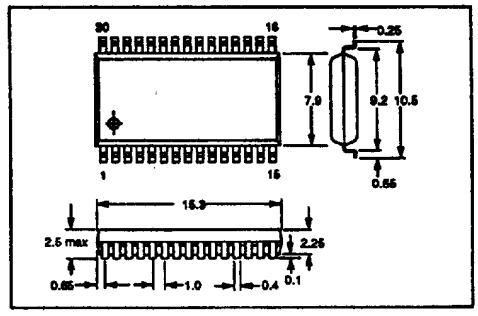
PINOUT



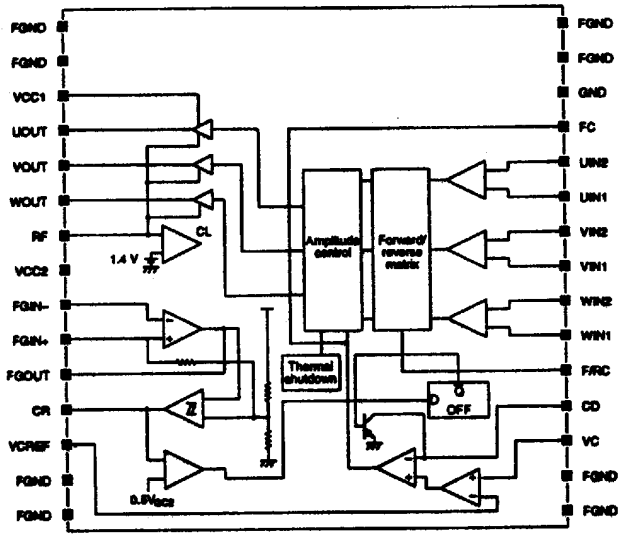
PACKAGE DIMENSIONS

Unit: mm

3073A-MFP30S



BLOCK DIAGRAM



PIN DESCRIPTION

Number	Name	Description
1, 2, 14 to 17, 29, 30	FGND	Frame ground
3	VCC1	Motor driver circuitry power supply
4	UOUT	U phase output
5	VOUT	V phase output
6	WOUT	W phase output
7	RF	Output transistor ground
8	VCC2	Control circuitry power supply
9	FGIN−	FG amplifier inverting input
10	FGIN+	FG amplifier non-inverting input
11	FGOUT	FG amplifier output
12	CR	Negative feedback control network connection
13	VCREF	Control reference-voltage input
18	VC	Motor-speed phase control input
19	CD	Output current negative feedback input
20	F/RC	Forward/reverse direction control input
21	WIN1	W phase Hall-effect amplifier inputs
22	WIN2	
23	VIN1	V phase Hall-effect amplifier inputs
24	VIN2	

Number	Name	Description
25	UIN1	U phase Hall-effect amplifier inputs
26	UIN2	
27	FC	Frequency compensation capacitor connection
28	GND	Ground

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Motor driver circuitry supply voltage	V_{CC1}	20	V
Control circuitry supply voltage	V_{CC2}	7.0	V
U, V and W phase output voltage	V_O	22	V
Output current	I_O	1.5	A
Power dissipation	P_D	1.05	W
Operating temperature range	T_{opg}	−20 to 75	°C
Storage temperature range	T_{stg}	−55 to 125	°C

Recommended Operating Conditions

T_a = 25 °C

Parameter	Symbol	Rating	Unit
Motor driver circuitry supply voltage range	V_{CC1}	5 to 18	V
Control circuitry supply voltage range	V_{CC2}	4.3 to 6.5	V

Electrical Characteristics

T_a = 25 °C, V_{CC1} = 12 V, V_{CC2} = 5 V

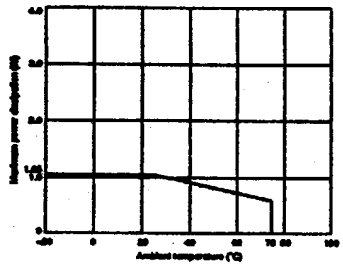
Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Motor driver circuitry supply current	I_{CC1}	V_C = 0 V, R_L = ∞	–	17	30	mA
Control circuitry supply current	I_{CC2}	V_C = 0 V	–	6.5	9.5	mA
Output saturation voltage	V_{Osat}	I_O = 0.5 A	–	1.6	2.2	V
		I_O = 1.0 A	–	2.0	3.0	
Output TRS sustaining voltage	V_{Osus}	I_O = 20 mA	20	–	–	V
Quiescent output voltage	V_{OO}	V_C = 0 V	5.8	6.1	6.4	V
Hall-effect amplifier input offset voltage	V_{Hoff}		−5	–	5	mV
Hall-effect amplifier input bias current	I_{Hbias}		–	1	6	μA
Hall-effect amplifier common-mode input voltage	V_{Hcm}		1.3	–	3.7	V
Hall-effect amplifier voltage gain	G_{VHO}		–	43	–	dB
Control gain	G_{VCO}		38	41	44	dB
Channel gain differential	ΔG_{VCO}		−2	–	2	dB

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
FG amplifier input offset voltage	V_{FGof}		−8	−	8	mV
FG amplifier open-loop voltage gain	G_{VFG}	f = 1 kHz	−	60	−	dB
FG amplifier output saturation voltage (source)	V_{FGOU}	I_O = 2 mA	3.7	−	−	V
FG amplifier output saturation voltage (sink)	V_{FGOD}	I_O = −2 mA	−	−	1.3	V
FG amplifier rejection ratio	CHR	See note.	−	80	−	dB
FG amplifier common-mode input voltage	V_{FGCM}		0	−	3.5	V
FG amplifier phase margin	Φ_{FG}	See note.	−	20	−	°
Revolution detector hysteresis voltage	V_{RH}		35	50	65	mV
CR LOW- to HIGH-level voltage margin	V_{CR}		2.35	2.50	2.65	V
Thermal shutdown temperature	T_{SD}	See note.	150	180	210	°C
Thermal shutdown hysteresis	ΔT_{SD}	See note.	−	15	−	°C

Note
Estimated values

Typical Performance Characteristics

Maximum power dissipation vs. ambient temperature



FUNCTIONAL DESCRIPTION

The motor driver output source phases and sink phases are selected by the voltages on the phase, Hall-effect transducer amplifier inputs and on the motor direction control input as shown in table 1.

Table 1. Output phase control

Source phase	Sink phase	F/RC	Hall-effect transducer amplifier inputs		
			U	V	W
W	V	LOW	HIGH	HIGH	LOW
V	W	HIGH			
W	U	LOW	HIGH	LOW	LOW
U	W	HIGH			
V	W	LOW	LOW	LOW	HIGH
W	V	HIGH			
U	V	LOW	LOW	HIGH	LOW
V	U	HIGH			
V	U	LOW	HIGH	LOW	HIGH
U	V	HIGH			
U	W	LOW	LOW	HIGH	HIGH
W	U	HIGH			

Notes

1. A Hall-effect transducer amplifier input is HIGH when input 1 is more than 0.2 V above input 2, and LOW, when input 1 is more than 0.2 V below input 2.
2. F/RC is HIGH when $V_{F/RC}$ is 2.0 V to V_{CC2}, and LOW, when $V_{F/RC}$ is 0 to 0.3 V.

The voltage on VC controls the motor speed. The VC voltage should exceed the threshold voltage on VCREF.

The output transistors connect to ground through RF. The voltage across R_f, the current sensing resistor between RF and ground, is input on CD as output current feedback that is used for output over-current protection. The 10 kΩ resistor between CD and RF reduces the gain of the output current feedback circuit. When feedback is not used, CD should be connected to ground.

The revolution detector input frequency controls the feedback circuit switching. The detector pulse frequency determines the voltage at R_s and C_s, the resistor and capacitor connected to CR. This voltage controls the internal transistor connected to CD. The transistor collector is either made high-impedance, and feedback is ON, or pulled LOW, and feedback is OFF.

The control circuitry power supply, V_{CC2}, should be filtered to provide protection against supply ripple and noise.

TYPICAL APPLICATION