Ordering number:EN3294

Monolithic Digital IC

LB1690

3-Phase Motor Driver

Overview

The LB1690 is a driver IC for 3-phase brushless motors. It is ideally suited for DC fan motors of air-conditioner, hotwater system.

Features

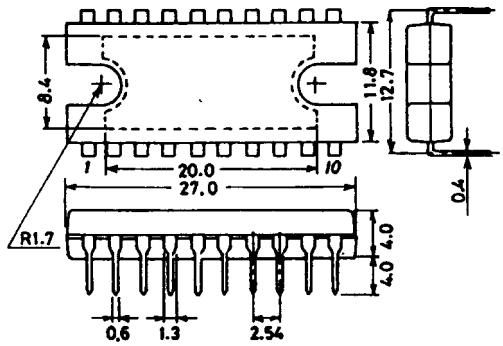
- 3-Phase brushless motor driver.
- 45V withstand voltage and 2.5A output current.
- Current limiter.
- Low-voltage protection circuit.
- Thermal shutdown circiut.
- Hall amp with hysteresis characteristic.
- FG output function.

Package Dimensions

unit:mm

3037A-DIP20H

[LB1690]



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Specifications

Absolute Maximum Ratings at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		10	V
	V_M max		45	V
Output current	I_O		2.5	A
Allowable power dissipation	Pd max1	Independent IC	3	W
	Pd max2	With infinte heat sink	20	W
Operating temperature	Topr		–20 to +100	˚C
Storage temperature	Tstg		–55 to +150	˚C

Allowable Operating Conditions at Ta = 25˚C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage rainge	V_{CC}		4.5 to 5.5	V
	V_M		5 to 42	V

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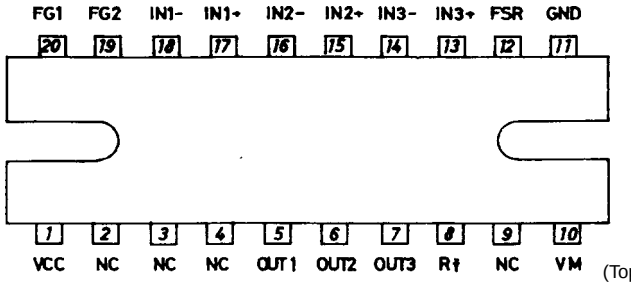
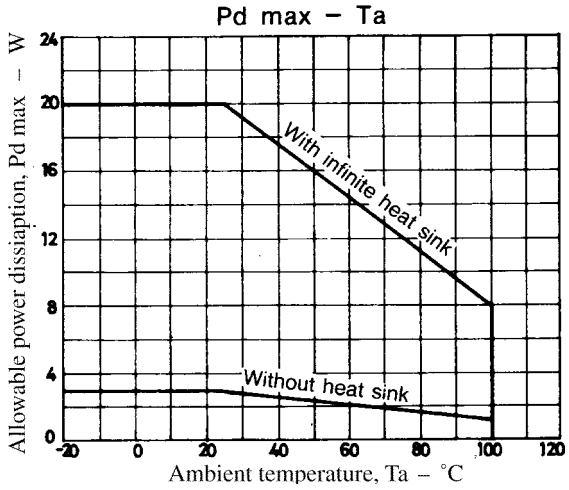
Electrical Characteristics at Ta = 25˚C, V_{CC}=5V, V_M=30V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current	$I_{CC}1$	Stop mode		3.5	5	mA
	$I_{CC}2$			10	15	mA
Output saturation voltage	V_O sat1	I_O=1A V_O(sink)+V_O(source)		2.1	3.0	V
	V_O satt2	I_O=2A V_O(sink)+V_O(source)		3.0	4.2	V
Output leakage current	I_O leak				100	µA
[Hall amplifier]						
Input bias current	I_{HB}			1	4	µA
Common-mode input voltage range			1.5		3.2	V
Hysteresis width	ΔV_{IN}		23	30	37	mV
Input voltage	V_{SLH}	[L]→[H]	5	15	25	mV
	V_{SHL}	[H]→[L]	–25	–15	–5	mV
[FG terminal] Speed pulse output						
Low-level output votlage	V_{FGL}	I_{FG}=5mA		0.16	0.4	V
Pull-up resistance value	R_{FG}		7.5	10	12.5	kΩ
[Forward/Stop/Reverse]						
Forward	V_{FSR1}			0	0.8	V
Stop	V_{FSR2}		2.1	2.5	2.9	V
Reverse	V_{FSR3}		4.2	5.0		V
Current limiter	V_{Rf}		0.42	0.5	0.6	V
Thermal shutdown temperature	TSD	Design target	150	180		˚C
Hysteresis width	ΔTSD			25		˚C
Low-voltage protection voltage	V_{LVSD}		3.5	3.8	4.1	V
Hysteresis width	ΔV_{LVSD}		0.2	0.3	0.4	V

Pin Assignment



(Top view)

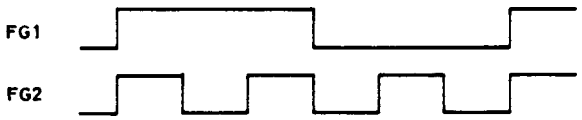


Truth Table

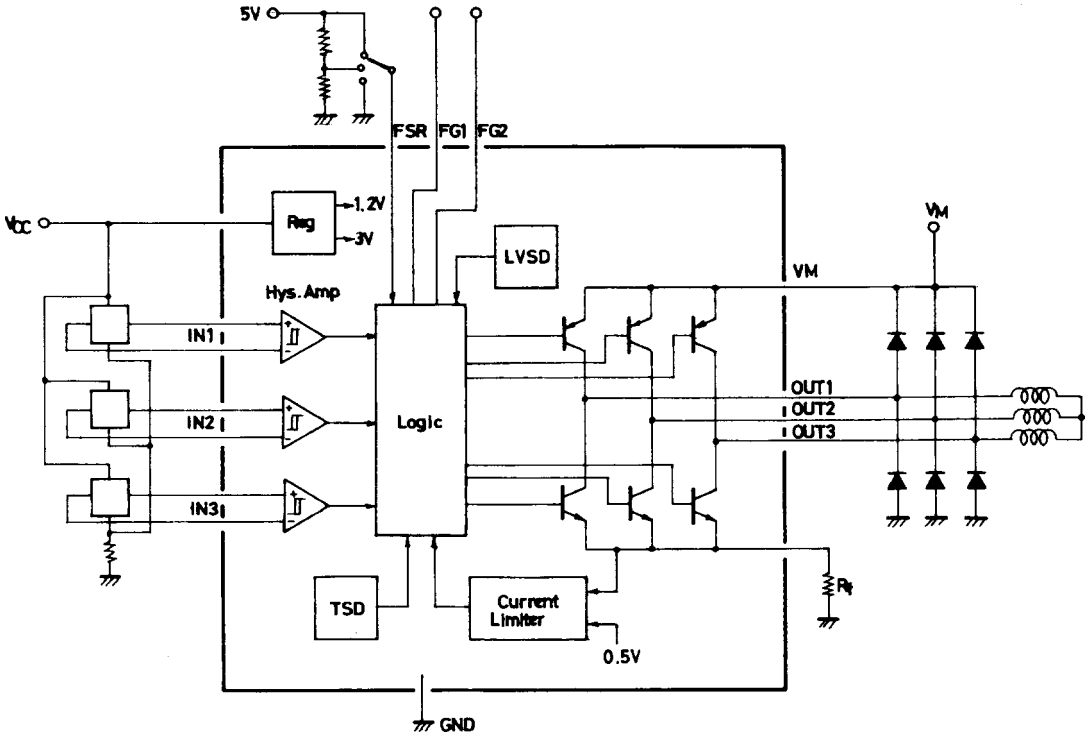
Item	Source Sink	Input			Forward/Reverse Control FSR
		IN1	IN2	IN3	
1	OUT 3 → OUT 2	H	H	L	L
	OUT 2 → OUT 3				H
2	OUT 3 → OUT 1	H	L	L	L
	OUT 1 → OUT 3				H
3	OUT 2 → OUT 3	L	L	H	L
	OUT 3 → OUT 2				H
4	OUT 1 → OUT 2	L	H	L	L
	OUT 2 → OUT 1				H
5	OUT 2 → OUT 1	H	L	H	L
	OUT 1 → OUT 2				H
6	OUT 1 → OUT 3	L	H	H	L
	OUT 3 → OUT 1				H

FSR
Forward L 0 to 0.8V
Reverse H 4.2 to 5.0V

FG Output



Block Diagram and Peripheral Circuit Diagram



Pin Description

Pin Name	Pin No.	Description
$IN1^+$, $IN1^-$	17, 18	OUT1:Hall element input pins for Phase 1. High logic is the state when $IN^+ > IN^-$.
$IN2^+$, $IN2^-$	15, 16	OUT2: Hall element input pins for Phase 2. High logic is the state when $IN^+ > IN^-$.
$IN3^+$, $IN3^-$	13, 14	OUT3: Hall element input pins for Phase 3. High logic is the state when $IN^+ > IN^-$.
OUT1	5	Output pin for Phase 1.
OUT2	6	Output pin for Phase 2.
OUT3	7	Output pin for Phase 3.
V_{CC}	1	Power supply pin for applying voltage to each section other than output section.
V_M	10	Power supply for output section.
R_f	8	Output current detect pin; R_f is inserted between this pin and ground to detect the output current as a voltage.
GND	11	Ground for other output The minimum potential of output transistor is at the R_f pin.
FSR	12	Forward/Stop/Reverse control pin. The motor is driven forward, stopped, or driven in reverse according to the voltage at this pin. Forward : 0 to 0.8V Stop : 2.1 to 2.9V Reverse : 4.2 to 5.0V
FG1 FG2	20 19	Output pin1 for speed pulses on-chip pull-up resistor. Output pin2 for speed pulses on-chip pull-up resistor.

1. Position detection circuit (Hall element input circuit).
   The posistion detection circuit is a differential amp with hysteresis (30mV typ.). For the operation DC level, use within the common-mode phase input voltage range (1.5V to V_{CC}–1.8V). Also it is recommended that the input level is at least three times (120 to 160mVp-p) the hysteresis.

2. Current limiter circuit
   The current is limited by moving the sink side transistor from saturated to unsaturated, so ASO can be a problem.

$$I = \frac{V_{Rf}}{R_f} (A)$$

   Therefore, design so that as much as possible the current limiter is not triggered.
   Also, take particular care not to exceed the maximum output current (2.5A) when the current limiter is triggered. Add a current limitter to the V_M current. (A current setting no greater than 60% to 70% of the current value of current limitter circuit and a short delay time are recommended.)

3. Protection circuits
   3-1. Low-voltage protection circuit
      If the voltage at the V_{CC} pin falls below the regulated voltage, the sink side output driver is switched off. This circuit is to prevent malfunctioning.

   3-2. Thermal shutdown circuit
      If the junction temperature rises above the regulated temperature, just as in 3-1. the sink side output driver is switched off.

4. Minimum voltage at V_M power supply
   Use a voltage greater than the V_{CC} voltage for the V_M power supply votlage.
   $V_M \geq V_{CC}$

5. FG output circuit
   This circuit combines the IN1, IN2 and IN3 position detection signals, forms the wave, and outputs the result. The frequency ot this output is proportinal to the rotation speed and is 1× (FG1) or 3× (FG2) when seen from each position detection.