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.

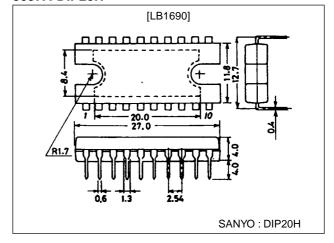
Features

- 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



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	Io		2.5	Α
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

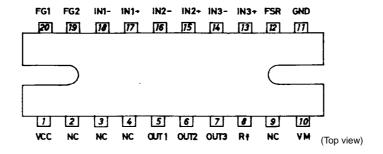
Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage rainge	V _{CC}		4.5 to 5.5	V
	٧ _M		5 to 42	V

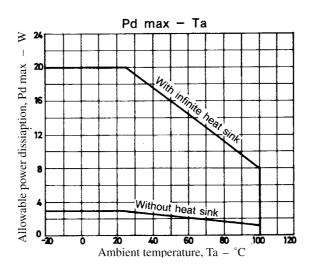
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Electrical Characteristics at Ta = 25 $^{\bullet}C,\,V_{CC}\!\!=\!\!5V\!,V_{M}\!\!=\!\!30V$

Parameter	Symbol	Conditions	Ratings			Unit
Farameter	Symbol	Conditions	min	typ	max	Offic
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	μΑ
[Hall amplifier]	•		•	•		
Input bias current	I _{HB}			1	4	μΑ
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





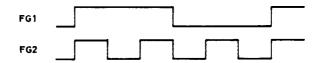
Truth Table

lk a ma	Source Sink	Input			Forward/Reverse	
Item	Source Sink	IN1	IN2	IN3	Control FSR	
1	OUT 3 → OUT 2	Н	Н	L	L	
1	OUT 2 → OUT 3	П			Н	
2	OUT 3 → OUT 1	Н	L	1	L	
	OUT 1 → OUT 3	F1		L	Н	
3	OUT 2 → OUT 3	L	L	Н	L	
	OUT 3 → OUT 2	L			Н	
4	OUT 1 → OUT 2	L	Н		L	
	OUT 2 → OUT 1	.		L	Н	
5 —	OUT 2 → OUT 1	Н	L	Н	L	
	OUT 1 → OUT 2				Н	
6 -	OUT 1 → OUT 3	1	Н	Н	L	
	OUT 3 → OUT 1		""	-	Н	

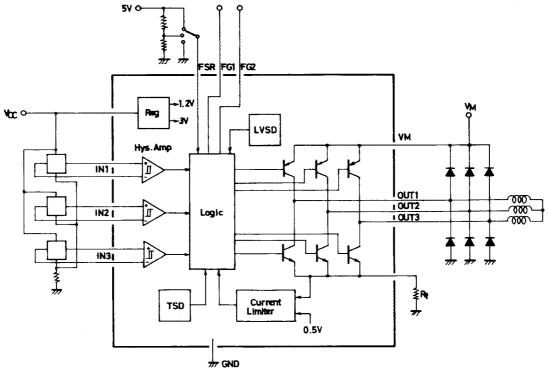
FSR

Forward L Reverse H 0 to 0.8V 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.

$$V_{M} \ge V_{CC}$$

5. FG output circuit

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

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