



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 circuit.
- Hall amp with hysteresis characteristic.
- FG output function.

Specifications

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

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	P_d max1	Independent IC	3	W
	P_d max2	With infinite heat sink	20	W
Operating temperature	T_{opr}		-20 to +100	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

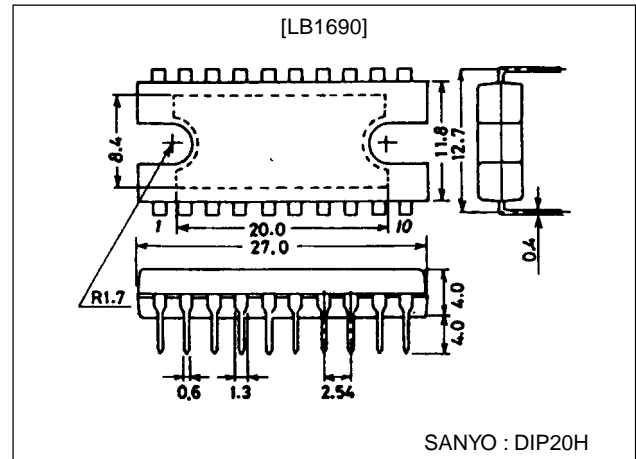
Allowable Operating Conditions at $T_a = 25^\circ\text{C}$

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

Package Dimensions

unit:mm

3037A-DIP20H



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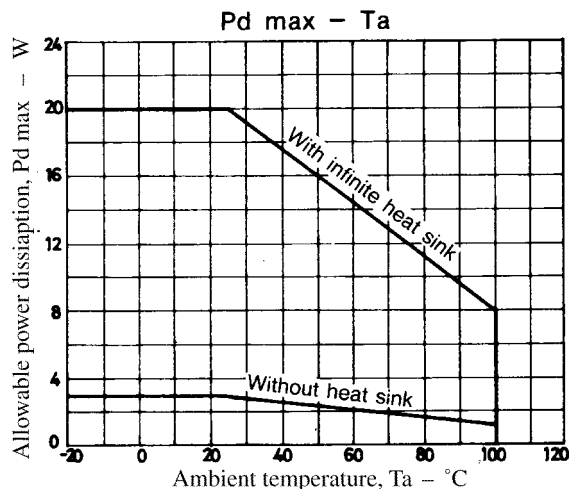
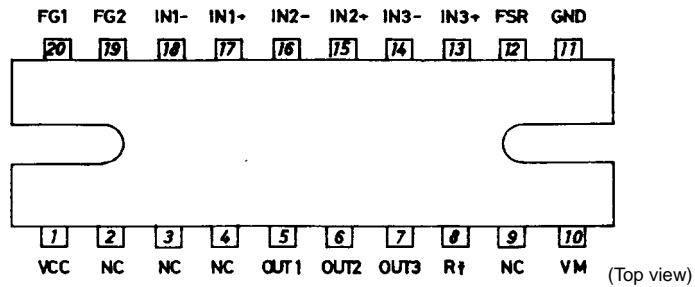
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LB1690

Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC}=5\text{V}$, $V_M=30\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current	I_{CC1}	Stop mode		3.5	5	mA
	I_{CC2}			10	15	mA
Output saturation voltage	$V_{O\text{ sat}1}$	$I_O=1\text{A } V_{O(\text{sink})}+V_{O(\text{source})}$		2.1	3.0	V
	$V_{O\text{ sat}2}$	$I_O=2\text{A } V_{O(\text{sink})}+V_{O(\text{source})}$		3.0	4.2	V
Output leakage current	$I_O\text{ leak}$				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 voltage	V_{FGL}	$I_{FG}=5\text{mA}$		0.16	0.4	V
Pull-up resistance value	R_{FG}		7.5	10	12.5	$\text{k}\Omega$
[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		$^\circ\text{C}$
Hysteresis width	ΔTSD			25		$^\circ\text{C}$
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



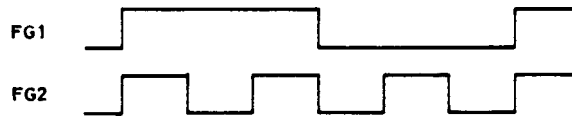
LB1690

Truth Table

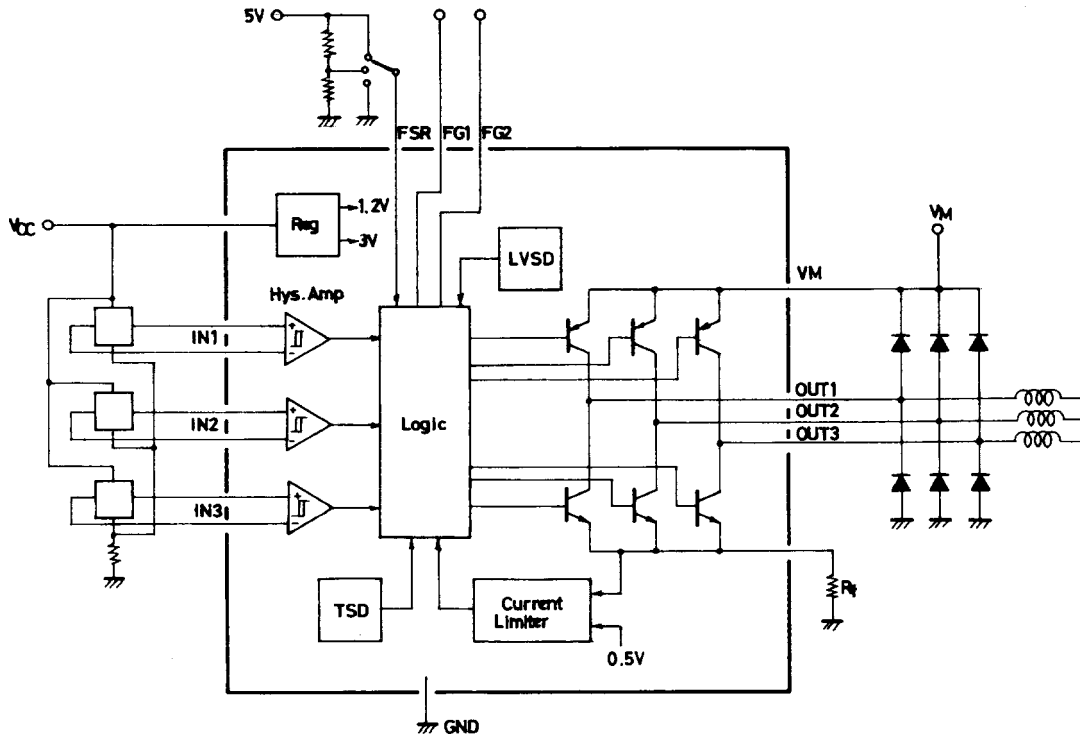
Item	Source Sink	Input			Forward/Reverse Control FSR
		IN1	IN2	IN3	
1	OUT 3 → OUT 2	H	H	L	L
	OUT 2 → OUT 3				H
2	OUT 3 → OUT 1	H	L	L	L
	OUT 1 → OUT 3				H
3	OUT 2 → OUT 3	L	L	H	L
	OUT 3 → OUT 2				H
4	OUT 1 → OUT 2	L	H	L	L
	OUT 2 → OUT 1				H
5	OUT 2 → OUT 1	H	L	H	L
	OUT 1 → OUT 2				H
6	OUT 1 → OUT 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	20	Output pin1 for speed pulses on-chip pull-up resistor.
FG2	19	Output pin2 for speed pulses on-chip pull-up resistor.

1. Position detection circuit (Hall element input circuit).

The position 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.

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

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 limiter to the V_M current. (A current setting no greater than 60% to 70% of the current value of current limiter 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 voltage.

$$V_M \geq V_{CC}$$

5. FG output circuit

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

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