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



# **Specifications**

#### Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max		10	V
	V <sub>M</sub> max		45	V
Output current	IO		2.5	А
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	Vcc		4.5 to 5.5	V
	VM		5 to 42	V

- Any and all SANYO products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO representative nearest you before using any SANYO products described or contained herein in such applications.
- SANYO assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges,or other parameters) listed in products specifications of any and all SANYO products described or contained herein.

SANYO Electric Co., Ltd. Semiconductor Bussiness Headquaters TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

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

Parameter	Symbol	Conditions		Ratings		
Parameter	Symbol	Conditions	min	typ	max	Unit
Supply current	ICC1	Stop mode		3.5	5	mA
	I <sub>CC</sub> 2			10	15	mA
Output saturation voltage	V <sub>O</sub> sat1	I <sub>O</sub> =1A V <sub>O</sub> (sink)+V <sub>O</sub> (source)		2.1	3.0	V
	V <sub>O</sub> satt2	I <sub>O</sub> =2A V <sub>O</sub> (sink)+V <sub>O</sub> (source)		3.0	4.2	V
Output leakage current	I <sub>O</sub> leak				100	μΑ
[Hall amplifier]			,			
Input bias current	I <sub>HB</sub>			1	4	μΑ
Common-mode input voltage range			1.5		3.2	V
Hysteresis width	ΔV <sub>IN</sub>		23	30	37	mV
Input voltage	V <sub>SLH</sub>	$[L] \rightarrow [H]$	5	15	25	mV
	VSHL	[H]→[L]	-25	–15	-5	mV
[FG terminal] Speed pulse output						
Low-level output votlage	V <sub>FGL</sub>	I <sub>FG</sub> =5mA		0.16	0.4	V
Pull-up resistance value	R <sub>FG</sub>		7.5	10	12.5	kΩ
[Forward/Stop/Reverse]	·					
Forward	V <sub>FSR1</sub>			0	0.8	V
Stop	V <sub>FSR2</sub>		2.1	2.5	2.9	V
Reverse	V <sub>FSR3</sub>		4.2	5.0		V
Current limiter	V <sub>Rf</sub>		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	VLVSD		3.5	3.8	4.1	V
Hysteresis width	∆V <sub>LVSD</sub>		0.2	0.3	0.4	V

#### **Pin Assignment**





#### **Truth Table**

	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		L		L	
2	OUT 1 → OUT 3	Н			Н	
	OUT 2 → OUT 3	L	L	н	L	
3	OUT 3 → OUT 2				Н	
4	OUT 1 → OUT 2	L	н	1	L	
4	OUT 2 → OUT 1	L .		L	Н	
5	OUT 2 → OUT 1	н	L	н	L	
5	OUT 1 → OUT 2				Н	
6 -	OUT 1 → OUT 3	L	н	н	L	
	OUT 3 → OUT 1				н	

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 <sup>+</sup> , IN1 <sup>-</sup>	17, 18	OUT1:Hall element input pins for Phase 1. High logic is the state when $IN^+ > IN^-$ .		
IN2 <sup>+</sup> , IN2 <sup>-</sup>	15, 16	OUT2: Hall element input pins for Phase 2. High logic is the state when $IN^+ > IN^-$ .		
IN3 <sup>+</sup> , IN3 <sup>-</sup>	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 <sub>CC</sub>	1	Power supply pin for applying voltage to each section other than output section.		
VM	10	Power supply for output section.		
R <sub>f</sub>	8	Output current detect pin; R <sub>f</sub> 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 <sub>f</sub> 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 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  $V_{\mbox{\scriptsize M}}$  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 proportinal to the rotation speed and is  $1 \times (FG1)$  or  $3 \times (FG2)$  when seen from each position detection.

- Specifications of any and all SANYO products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- SANYO Electric Co., Ltd. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any and all SANYO products described or contained herein fall under strategic products (including services) controlled under the Foreign Exchange and Foreign Trade Control Law of Japan, such products must not be exported without obtaining export license from the Ministry of International Trade and Industry in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of SANYO Electric Co., Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO product that you intend to use.
- Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of August, 1998. Specifications and information herein are subject to change without notice.