**Monolithic Digital IC** 

## **3-phase sensor less Motor driver**



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#### Overview

The LB11685AV is a three-phase full-wave current-linear-drive motor driver IC. It adopts a sensor less control system without the use of a Hall Effect device. For quieter operation, the LB11685AV features a current soft switching circuit and be optimal for driving the cooling fan motors used in refrigerators, etc.

#### **Functions**

- Three-phase full-wave linear drive (Hall sensor-less method)
- Built-in three-phase output voltage control circuit
- Motor lock protection detection output
- Built-in thermal shut down circuit

- Built-in current limiter circuit
- Built-in motor lock protection circuit
- FG output made by back EMF
- Beat lock prevention circuit

#### **Specifications**

**Maximum Ratings** at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max		19	V
Input applied voltage	V <sub>IN</sub> max		-0.3 to V <sub>CC</sub> +0.3	V
Maximum output current	I <sub>O</sub> max *1		1.2	Α
Allowable power dissipation	Pd max	Mounted on a board *2	1.05	W
Operating temperature	Topr		-40 to 85	°C
Storage temperature	Tstg		-55 to 150	°C
Junction temperature	Tj max		150	°C

<sup>\*1:</sup> The IO is a peak value of motor-current.

Caution 1) Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

Caution 2) Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

<sup>\*2:</sup> Specified board: 76.1mm  $\times$  114.3mm  $\times$  1.6mm, glass epoxy board.

#### Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended Supply voltage	VCC		12.0	V
Operating supply voltage	V <sub>CC</sub> op		4.5 to 18.0	V

#### **Electrical Characteristics** at Ta = 25°C, $V_{CC} = 5.0$ V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	Unit
Supply current	ICC	FC1 = FC2 = 0V	5	10	20	mA
Internal regulate voltage	VREG		3.0	3.3	3.6	V
Output voltage (source)	VOSOUR	I <sub>O</sub> = 0.8A *3		1.3	1.7	V
Output voltage (sink)	VOSINK	I <sub>O</sub> = 0.8A *3		0.5	1.3	V
Current limiter	VOLIM		0.268	0.300	0.332	V
MCOM pin common-input voltage range	VINCOM		0		V <sub>CC</sub> - 2	V
MCOM pin Source current for hysteresis	ICOM+	MCOM = 7V	30		80	μА
MCOM pin Sink current for hysteresis	ICOM-	MCOM = 7V	30		80	μА
MCOM pin hysteresis current ratio	RTCOM	RTCOM = ICOM+ / ICOM-	0.6		1.4	
VCO input bias current	Ivco	V <sub>CO</sub> = 2.3V			0.2	μΑ
VCO oscillation minimum frequency	fvcomin	V <sub>CO</sub> = 2.1V, CX = 0.015μF Design target *2		930		Hz
VCO oscillation maximum frequency	f <sub>VCO</sub> max	V <sub>CO</sub> = 2.7V, CX = 0.015μF Design target *2		8.6		kHz
CX charge / discharge current	ICX	V <sub>CO</sub> = 2.5V, CX = 1.6V	70	100	140	μΑ
CX hysteresis voltage	ΔVCX		0.35	0.55	0.75	
C1 (C2) charge current	IC1(2)+	V <sub>CO</sub> = 2.5V, C1(2) = 1.3V	12	20	28	μΑ
C1 (C2) discharge current	IC1(2)-	V <sub>CO</sub> = 2.5V, C1(2) = 1.3V	12	20	28	μΑ
C1 (C2) charge / discharge current ratio	RTC1(2)	RTC1(2) = IC1(2)+ / IC1(2)-	0.8	1.0	1.2	
C1/C2 charge current ratio	RTCCHG	RTCCHG = IC1+ / IC2+	8.0	1.0	1.2	
C1/C2 discharge current ratio	RTCDIS	RTCDIS = IC1- / IC2-	0.8	1.0	1.2	
C1 (C2) cramp voltage width	VCW1(2)		1.0	1.3	1.6	V
FG output low level voltage	VFGL	IFG = 3mA			0.5	V
RD output low level voltage	VRDL	IRD = 3mA			0.5	٧
Thermal shut down operating temperature *1	TTSD	Junction temperature Design target *2	150	180		°C
Thermal shut down hysteresis temperature *1	ΔTTSD	Junction temperature Design target *2		15		°C

<sup>\*1:</sup> The thermal shut down circuit is built-in for protection from damage of IC. But its operation is out of Topr. Design thermal calculation at normal operation.

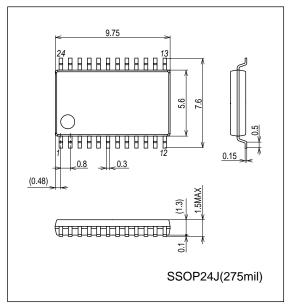
<sup>\*2:</sup> Design target value and no measurement is made.

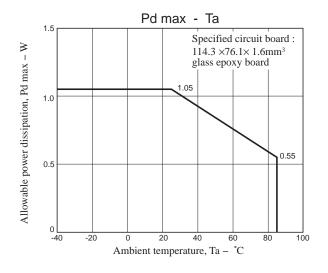
 $<sup>^{\</sup>star}3$ : The I $_{O}$  is a peak value of motor-current.

#### **Package Dimensions**

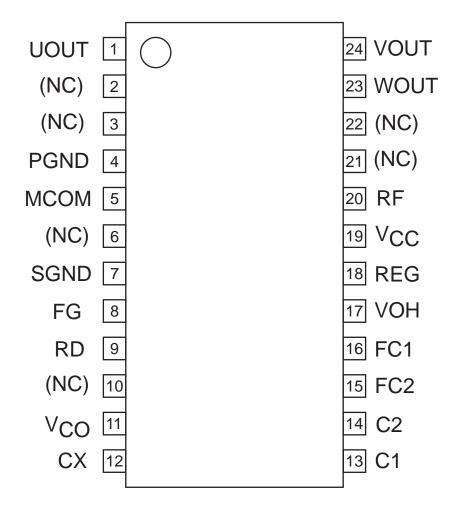
unit: mm (typ)

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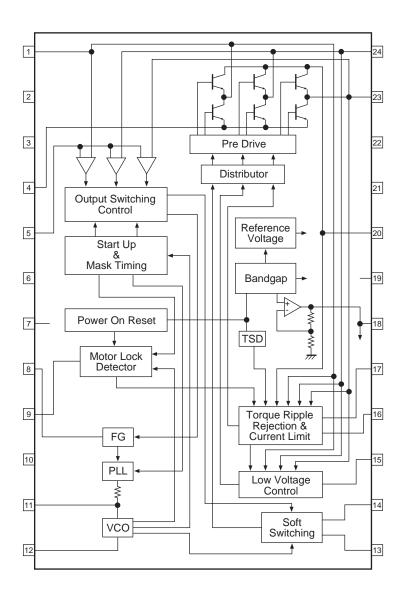




#### **Pin Assignment**



#### **Block Diagram**



#### **Pin Function**

Pin No.	Pin name	Function	Equivalent circuit
1	UOUT	Each output pin of three phases.	
23	WOUT		Pin No.20
24	VOUT		<b>—</b>
4	PGND	GND pin in the output part.  This pin is connected to GND. The SGND pin is also connected to GND	Pin No.1,23,24
20	RF	Pin to detect output current.  By connecting a resistor between this pin and V <sub>CC</sub> , the output current is detected as a voltage.  The current limiter is operated by this voltage.	Pin No.4
5	мсом	Motor coil midpoint input pin.  The coil voltage waveform is detected based on this voltage.	SGND SGND SGND  VCC  Pin No.5  SGND SGND  SGND  SGND  SGND  SGND  SGND
7	SGND	Ground pin (except the output part) This pin is connected to GND. The PGND pin is also connected to GND.	
8	FG	FG out made by back EMF pin. It synchronizes FG out with inverted V-phase. When don't use this function, open this pin.	Pin No.8 No.9
9	RD	Motor lock protection detection output pin.  Output with L during rotation of motor.  Open during lock protection of motor (High-impedance).  When don't use this function, open this pin.	SGND
11	vco	PLL output pin and VCO input pin.  To stabilize PLL output, connect a capacitor between this pin and GND.	VREG VCC Pin No.11 VREG VREG SGND VREG SGND VREG VREG SGND
12	СХ	VCO oscillation output pin.  Operation frequency range and minimum frequency are determined by the capacity of the capacitor connected to this pin.	Pin No.12 SGND

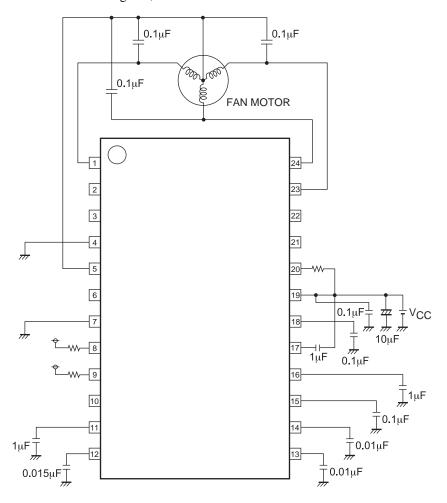
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Pin No.	Pin name	Function	Equivalent circuit
13 14	C1 C2	Soft switching adjustment pin.  The triangular wave from is form formed by connecting a capacitor with this pin.  And, the switching of three-phase output is adjusted by the slope.	Pin No.13 W SGND
15	FC2	Frequency characteristic correction pin 2.  To suppress the oscillation of control system closed loop of sink-side, connect a capacitor between this pin and GND.	VREG VCC Pin No.15 SGND
16	FC1	Frequency characteristic correction pin 1.  To suppress the oscillation of control system closed loop of source-side, connect a capacitor between this pin and GND.	Pin No.16 SGND
17	VOH	Three-phase output high level output pin.  To stabilize the output voltage of this pin, connect a capacitor between this pin and the V <sub>CC</sub> pin.	Pin No.17 SGND
18	VREG	DC voltage (3.3V) output pin.  Connect a capacitor between this pin and GND for stabilization.	Pin No.18
19	VCC	Pin to supply power-supply voltage.  To curb the influence of ripple and noise. The voltage should be stabilized.	

#### **Application Circuit Example**

\* Each fixed number in the following FIG, is the referential value.



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