

<b>SANYO</b>	No.4695A	<b>LB1885M</b>
	<b>Three-Phase Bipolar Brushless/ Sensorless Motor Driver</b>	

### Overview

The LB1885M is a sensorless three-phase brushless motor driver that does not use a Hall-effect element.

### Functions

- Three-phase brushless motor driver
- Sensorless drive
- Soft switching
- Support for forward and reverse rotation
- Built-in thermal shutdown circuit
- Built-in FG and PG amplifiers
- The LB1885M can also drive motors with a  $V_s$  of 1 V or lower.

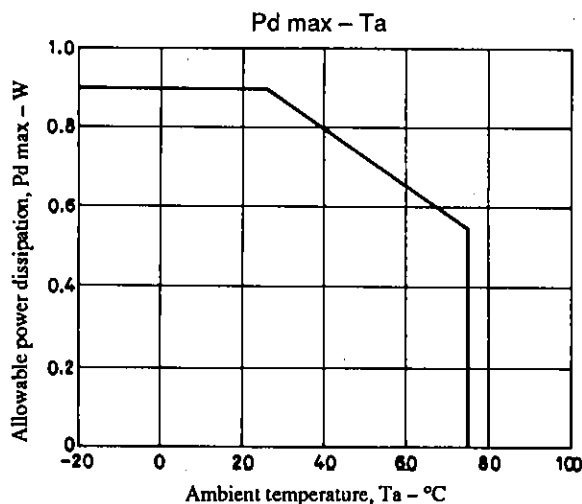
### Specifications

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

Parameter	Symbol	Ratings	Unit
Supply voltage	$V_{CC1}$	7	V
	$V_{CC2}$	12	V
	$V_{CC3}$	7	V
Motor supply voltage	$V_s$	$V_{CC2}$	V
Output applied voltage	$V_o$	$V_{CC2} + 1$	V
Output current	$I_o$	800	mA
Allowable power dissipation	$P_d \text{ max}$	0.9	W
Operating temperature	$T_{opr}$	-20 to +75	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-50 to +150	$^\circ\text{C}$

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

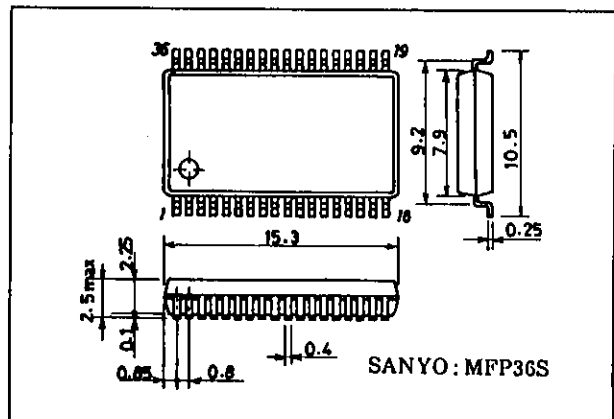
Parameter	Symbol	Ratings	Unit
Supply voltage	$V_{CC1}$	4 to 6	V
	$V_{CC2}$	4 to 10	V
	$V_{CC3}$	4 to 6	V
Motor supply voltage	$V_s$	1 to $V_{CC2} - 1$	V



### Package Dimensions

unit: mm

3129-MFP36S



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## Electrical Characteristics

Motor Drive Block at  $T_a = 25^\circ\text{C}$ ,  $V_{CC1} = 5\text{ V}$ ,  $V_{CC2} = 5\text{ V}$ ,  $V_{CC3} = 5\text{ V}$ ,  $V_S = 2\text{ V}$

Parameter		Symbol	Conditions	min	typ	max	Unit	Note
Current dissipation		$I_{CC1}$			18	23	mA	
		$I_{CC2}$	$I_O = 0.1\text{ A}$		1.5	6.0	mA	
		$I_{CC3}$	$V_{CC3} = 5\text{ V}$		1.3	2.5	mA	
$V_S$ current dissipation		$I_S$	$I_O = 0.1\text{ A}$		100		mA	
Output saturation voltage (high)		$V_{satH}$	$I_O = 0.4\text{ A}$		0.25	0.40	V	
Output saturation voltage (low)		$V_{satL}$	$I_O = 0.4\text{ A}$		0.25	0.40	V	
Reversing pin	High-level voltage	$V_{LRH}$		1			V	
	Low-level voltage	$V_{LRL}$				0.3	V	
	Input current	$I_{LR}$	$L/R = \text{GND}$		-50	-100	$\mu\text{A}$	
Start-up oscillator frequency		$F_{oscS}$	$R13 = 51\text{ k}\Omega$ , $C13 = 0.22\text{ }\mu\text{F}$		156		Hz	*
Trapezoidal wave amplitude	Start-up	$V_{pSS}$		320	360	400	mV	*
	Drive	$V_{pSD}$		180	200	220	mV	*
Restart cycle		$F_{oscR}$	$R23 = 56\text{ k}\Omega$ , $R24 = 390\text{ k}\Omega$ , $C24 = 683$		19.6		Hz	*
Current limiter amplifier	Common mode input voltage range	$V_{limCM}$		0		3	V	
	Input offset voltage	$V_{limOFF}$		-8		+8	mV	*
	Voltage gain	$V_{Glim}$		30			dB	*
TSD operating temperature		TSD		150	180	210	$^\circ\text{C}$	*
TSD hysteresis		TSDHIS			40		$^\circ\text{C}$	*

Note: Items marked with an asterisk are design targets, not measurements.

FG Amplifier Block at  $T_a = 25^\circ\text{C}$ ,  $V_{CC3} = 5\text{ V}$

Parameter	Symbol	Conditions	min	typ	max	Unit	Note
Input offset voltage	$V_{fgOFF}$		-8	$\pm 1$	+8	mV	*
Input bias current	$I_{fgB}$				250	nA	*
Common mode input voltage range	$V_{fgICM}$		1		4	V	*
Output current (sink)	$I_{fgOL}$				2.0	mA	
Output on voltage	$V_{fgOL}$			0.2	0.4	V	
Output off voltage	$V_{fgOH}$		4.8			V	
Hysteresis width	$V_{fgHIS}$			115		mV	*
Voltage gain	$V_{Gfg}$			80		dB	*

Note: Items marked with an asterisk are design targets, not measurements.

## PG Amplifier Block

Parameter	Symbol	Conditions	min	typ	max	Unit	Note
Input offset voltage	$V_{pgOFF}$		-8	$\pm 1$	+8	mV	*
Input bias current	$I_{pgB}$				500	nA	*
Common mode input voltage range	$V_{pgICM}$		1.0		4.0	V	*
Output current (sink)	$I_{pgOL}$				2.0	mA	
Output on voltage	$V_{pgOL}$			0.2	0.4	V	
Output off voltage	$V_{pgOH}$		4.8			V	
Schmitt amplifier hysteresis width	$V_{shHIS}$			20		mV	*

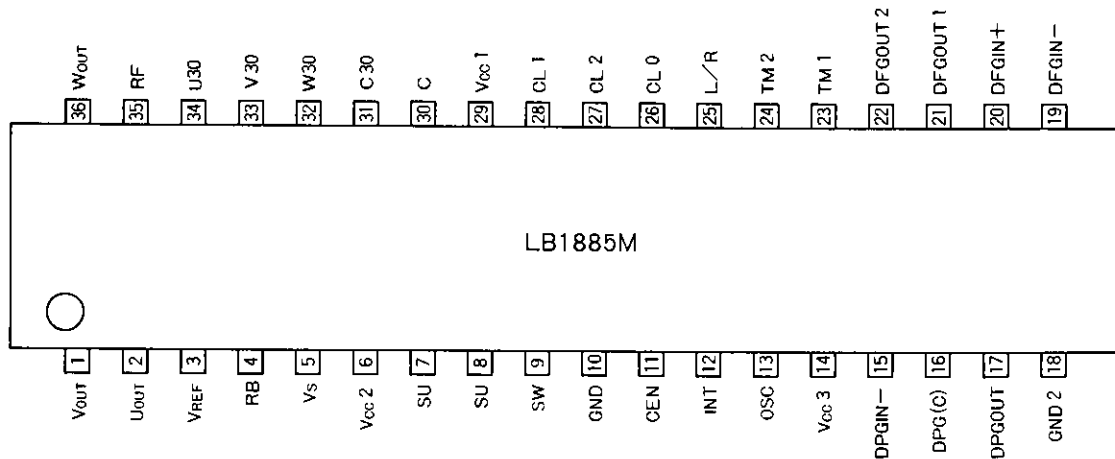
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## Amplification Ratios

Rank	Amplification ratio
A	130 to 240
B	200 to 300
C	240 to 380

# LB1885M

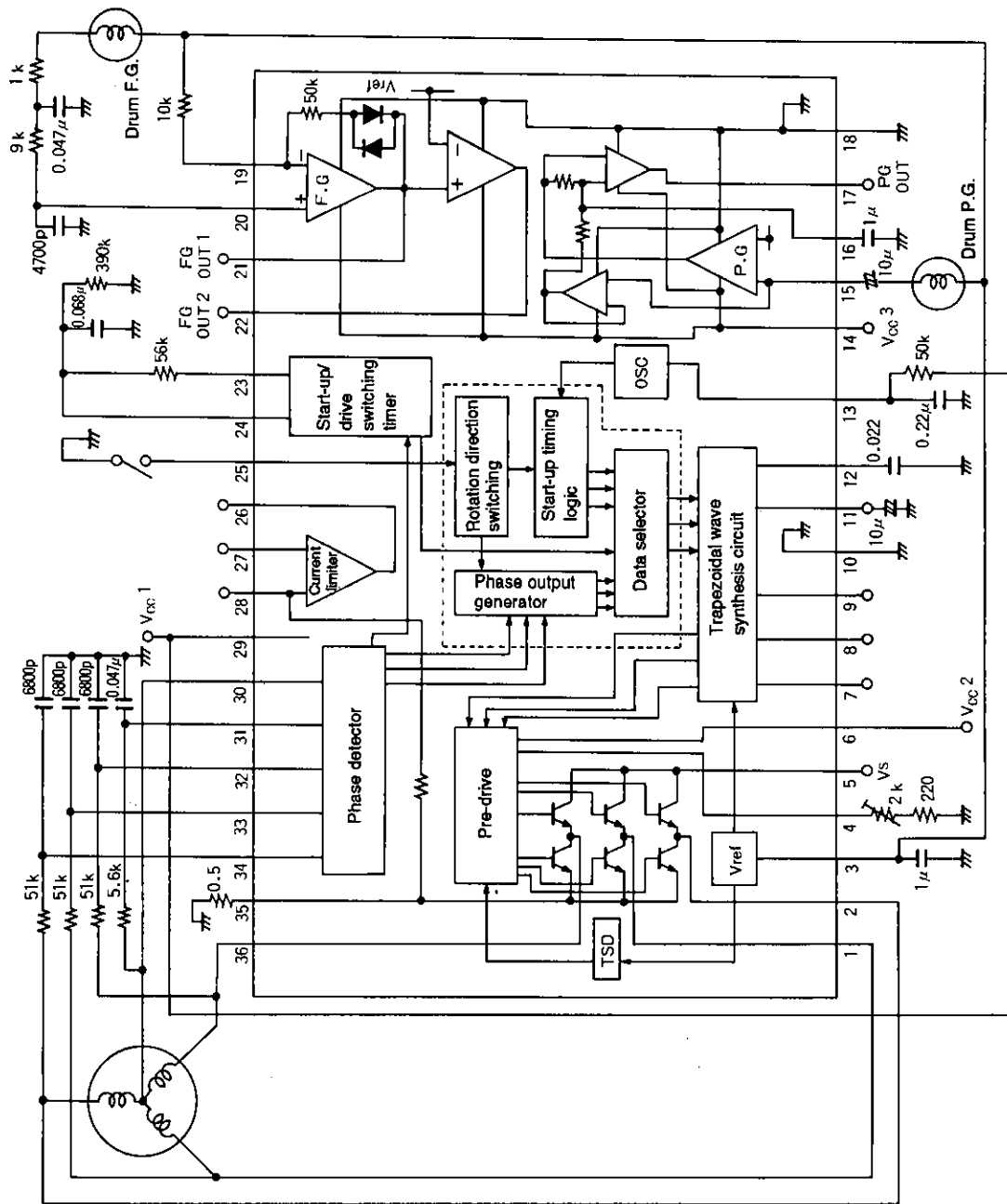
## Pin Assignment (top view)



## Motor Driver Block Pin Functions

Pin No.	Symbol	Pin description
1	V <sub>OUT</sub>	Motor connection pin (V phase)
2	U <sub>OUT</sub>	Motor connection pin (U phase)
3	V <sub>REF</sub>	Reference voltage pin (Also functions as the I <sub>LL</sub> injector power supply for the 2.2 V output voltage. Also used as the reference voltage for the current limiter and the thermal shutdown function.)
4	R <sub>B</sub>	Pin for the resistor that determines the drive current by comparison with RF.
5	V <sub>S</sub>	Motor supply voltage pin
6	V <sub>CC2</sub>	Driver state supply voltage pin. Set to at least 1 V higher than V <sub>S</sub> .
7	SU	U phase drive signal pin. (The trapezoidal wave amplitude can be adjusted (reduced) by inserting a resistor between this pin and CEN.)
8	SV	V phase drive signal pin. (The trapezoidal wave amplitude can be adjusted (reduced) by inserting a resistor between this pin and CEN.)
9	SW	W phase drive signal pin. (The trapezoidal wave amplitude can be adjusted (reduced) by inserting a resistor between this pin and CEN.)
10	GND	Motor driver block ground
11	CEN	The trapezoidal wave is formed with this potential (about 2.2 V) as its midpoint.
12	INT	Capacitor connection pin for the integration circuit that generates the triangle wave used in trapezoidal wave synthesis
13	OSC	Start-up oscillator capacitor connection pin. The capacitor is charged and discharged by the fixed current supplied by this pin.
14	V <sub>CC3</sub>	Power supply for the FG and PG amplifier systems
15	DP G <sub>IN</sub> -	PG amplifier input pin
16	DP G(C)	Peak hold capacitor connection pin
17	DP G OUT	PG amplifier output pin
18	GND 2	FG and PG amplifier system GND
19	DF G <sub>IN</sub> -	FG amplifier - input pin
20	DF G <sub>IN</sub> +	FG amplifier + input pin
21	DF G OUT1	FG amplifier output pin 1
22	DF G OUT2	FG amplifier output pin 2
23	TM1	Start-up/drive switching timer charging pin
24	TM2	Start-up/drive switching timer discharging pin
25	L/R	Start-up/drive switching timer discharging pin
26	CL0	Current limiter output pin (NPN open collector)
27	CL2	Current limiter + input pin
28	CL1	Current limiter - input pin (connected to RF internally)
29	V <sub>CC1</sub>	Trapezoidal wave synthesis circuit, reference voltage circuit
30	C	Motor midpoint connection pin
31	C30	Midpoint 30° filter output pin
32	W30	W point 30° filter output pin
33	V30	V point 30° filter output pin
34	U30	U point 30° filter output pin
35	RF	Current feedback resistor connection pin
36	W <sub>OUT</sub>	Motor connection pin (W phase)

Sample Application Circuit



Unit (Resistance: Ω, Capacitance: F)

The LB1885M functions differ from those of the LB1880M only in the following point. In the LB1885M, the function that forcibly switches the system to start-up mode when  $V_s$  falls to 0.7 V or lower has been removed.

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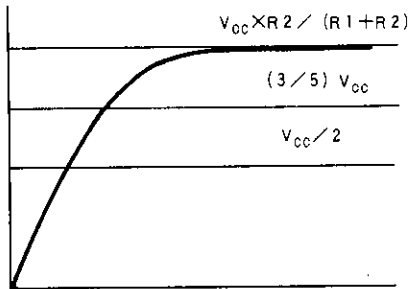
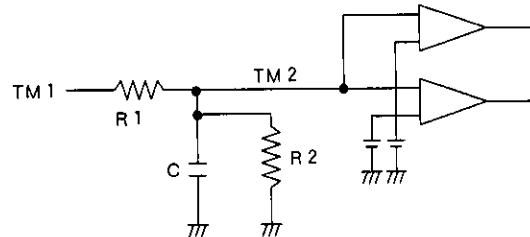
**External Component Constants**

1. Vref  
Capacitor (to GND)  
1 μF
2. RB  
Resistor (to GND)  
Specified for each rank:  
A: 560 Ω  
B: 820 Ω  
C: 1 kΩ
3. SU, SV, SW  
Capacitor (to GND)
4. INT  
Capacitor (to GND)
5. OSC  
Resistor (to V<sub>CC</sub>)  
Capacitor (to GND)
6. TM1, TM2  
R1 (inter-pin)  
R2 (to GND)  
C (to GND)

If a value larger than the specified value is used, the drive capacity will become insufficient, and the motor speed will not increase even if V<sub>S</sub> is increased. Inversely, if the value is too small, invalid currents will increase when V<sub>S</sub> is raised. Also, the motor speed will not increase.

If noise or oscillations appear in the output voltage, these components are effective to stop noise or oscillation.

Creates a clean triangle wave corresponding to the motor speed. If too small, the top of the waveform will be clipped, and if too large, the triangle wave will become smaller.



The TM1 output is generated by taking the logical exclusive OR of three signals generated by comparing the IC output voltages U, V and W with 3/5 of V<sub>S</sub>. During normal rotation, C is charged by the pulses generated by the iteration of high, medium and low levels on the U, V and W output. Therefore the TM2 pin voltage rises until it reaches  $5 \times R2 / (R1 + R2) V$ .

While the threshold level between start-up mode and drive mode is V<sub>CC</sub>/2, the threshold from drive mode to start-up mode has a hysteresis of about 0.64 V (typical).

The condition for entering restart is:

$$R2 \times 1b \times 1.5 < 0.64$$

$$\text{At that time: } R2 < 520 \text{ k}\Omega.$$

The threshold for changing the amplitude of the trapezoidal wave is:

$$(3/5) V_{CC}$$

Therefore, resistor values such that

$$R2 / (R1 + R2) > 3/5$$

must be chosen.

7. U30, V30, W30  
These are computed at  $f = \sqrt{3} / (3 \times 2 \pi CR)$ .
8. C30  
R must be 20 kΩ or less. (This is to maintain the back voltage detection sensitivity.)  
Otherwise the comparator offset will become large and the circuit will be unable to detect the back voltage.