

**SANYO**

No.3323

**LB1619M****3-Phase Brushless Motor Driver****Applications**

The LB1619M is a 3-phase brushless motor driver IC ideally suited for use in VTR capstan motor driver, drum motor driver applications.

**Features**

- 120° voltage linear type
- Speed control based on motor voltage control
- Soft switching type eliminating noises caused by current switching and making the values of external capacitors smaller (comparable to those of chip capacitors)
- On-chip torque ripple compensation circuit
- On-chip thermal shutdown circuit

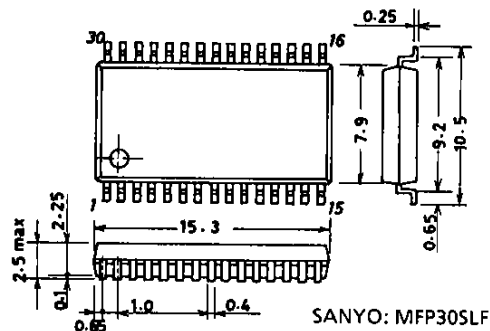
**Absolute Maximum Ratings at Ta = 25°C**

			unit
Maximum Supply Voltage	V <sub>CC</sub> max	16	V
Maximum Supply Voltage	V <sub>S</sub> max	V <sub>CC</sub>	V
Output Current	I <sub>O</sub>	1.5	A
Hall Supply Current	I <sub>H</sub>	20	mA
Allowable Power Dissipation	P <sub>d</sub> max	1.0	W
Operating Temperature	T <sub>opr</sub>	-20 to +75	°C
Storage Temperature	T <sub>stg</sub>	-55 to +125	°C

**Allowable Operating Conditions at Ta = 25°C**

			unit
Supply Voltage	V <sub>CC</sub>	6 to 16	V

(Design Notes) It should be noted that dielectric breakdown is liable to occur between pin 11 and other pins.

**Package Dimensions 3073A-M30IC**  
(unit: mm)

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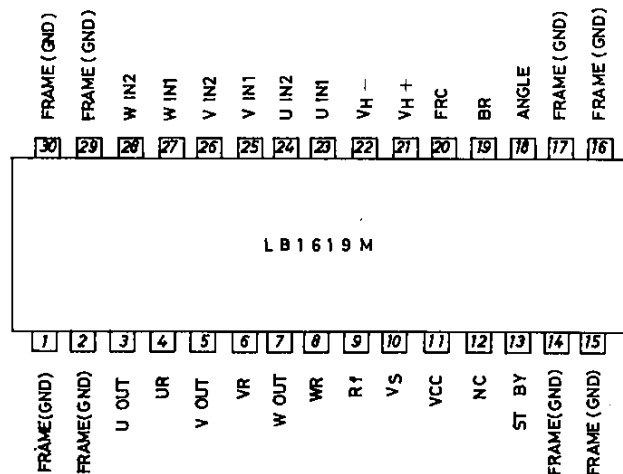
3270YT,TS No.3323-1/6

## LB1619M

Electrical Characteristics at $T_a = 25^\circ\text{C}, V_{CC} = 12\text{V}, V_S = 3\text{V}$				min	typ	max	unit
Supply Current 1	$I_{CC}$	$V_{BR} = 5\text{V}$			18	23	mA
Supply Current 2	$I_S$	$V_{BR} = 5\text{V}$			5.0	7.0	mA
Supply Standby Current	$I_{CCOQ}$	$V_{STBY} = 0\text{V}$				180	$\mu\text{A}$
Output Saturation Voltage	$V_{O(sat)}$	$I_{OUT} = 1.0\text{A}, \text{sink} + \text{source}$				2.3	V
Output Transistor	$V_{O(sus)}$	$I_{OUT} = 20\text{mA}^*$			16		V
Breakdown Voltage							
Output Standby Voltage	$V_{OQ}$	$V_{BR} = 5\text{V}$		1.43	1.53	1.63	V
Hall Amp Input Offset Voltage	$V_{HOFFset}$	*		-5		+5	mV
Hall Amp Common-Mode	$V_{HCOM}$			1.4		2.8	V
Input Voltage Range							
Hall Input-Output Voltage Gain	$G_{VHO}$	Under specified circuit conditions		31.5	34.5	37.5	dB
Brake Pin 'H'-Level Voltage				2.0			V
Brake Pin 'L'-Level Voltage						0.8	V
Brake Pin Input Current						100	$\mu\text{A}$
Brake Pin Leak Current						-30	$\mu\text{A}$
FRC Pin 'H'-Level Voltage				2.8			V
FRC Pin 'L'-Level Voltage						1.2	V
FRC Pin Input Current						100	$\mu\text{A}$
FRC Pin Leak Current						-30	$\mu\text{A}$
Hall Supply Voltage	$V_H$	$I_H = 10\text{mA}, V_H^{(+)} - V_H^{(-)}$		0.8	1.0	1.5	V
Upper Residual Voltage	$V_{XH}$	$I_{OUT} = 100\text{mA}$		0.40	0.6	0.75	V
Lower Residual Voltage	$V_{XL}$	$I_{OUT} = 100\text{mA}$		0.5	0.6	0.7	V
Residual Voltage Inflection Point					2.0		V
Overlap Amount		$V_{CC} = 12\text{V}, V_S = 3.5\text{V}$		60	70	80	%
Operating Temperature of Thermal Shutdown Circuit		*		150	180	210	$^\circ\text{C}$
Hysteresis of Thermal Shutdown Circuit		*			15		$^\circ\text{C}$
Standby Operating Voltage						0.1	V
Standby Bias Current		Pin GND				10	$\mu\text{A}$
$V_S$ OFF-State IC Flow-out/in Current		Number of revolutions : 1260rpm				0.8	A

Note) \* : Values shown are design targets only. No measurements have been taken.  
 Overlap amount : Value measured at the time of shipment

### Pin Assignment



Note : All FRAME pins are connected to GND.

Truth Table

	Source	Sink	Input			Forward/Reverse Control
			U	V	W	
1	W phase	→ V phase	H	H	L	L
	V phase	→ W phase				H
2	W phase	→ U phase	H	L	L	L
	U phase	→ W phase				H
3	V phase	→ W phase	L	L	H	L
	W phase	→ V phase				H
4	U phase	→ V phase	L	H	L	L
	V phase	→ U phase				H
5	V phase	→ U phase	H	L	H	L
	U phase	→ V phase				H
6	U phase	→ W phase	L	H	H	L
	W phase	→ U phase				H

Input:

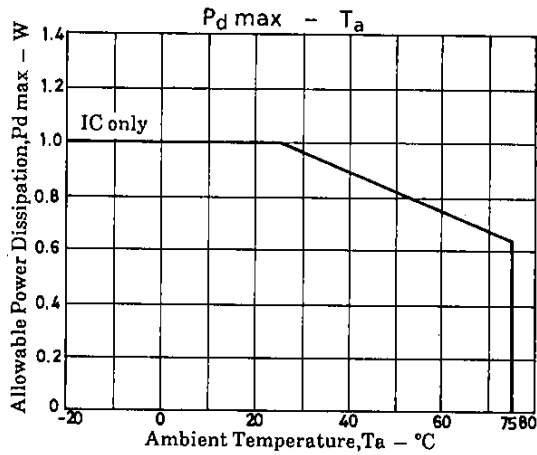
H: High level. One of the inputs should have a potential at least 0.2V higher than the other.

L: Low level. One of the inputs should have a potential at least 0.2V lower than the other.

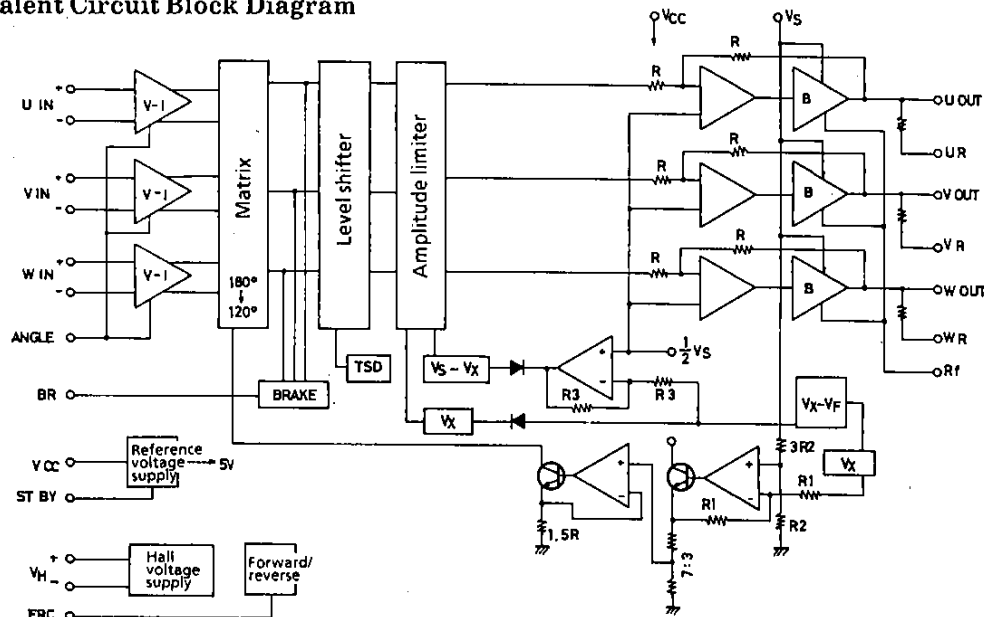
Forward/reverse control:

H: 2.8 to 5V

L: 0 to 1.2V

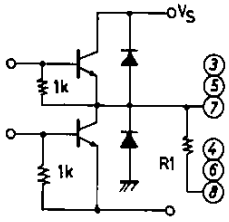
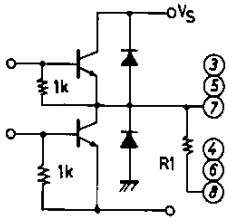
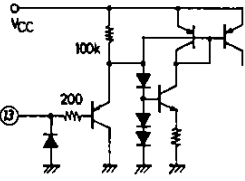
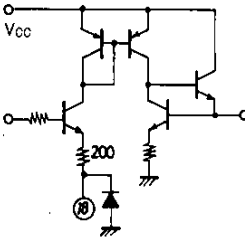
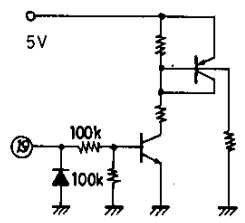


Equivalent Circuit Block Diagram



Pin Description

Unit (resistance:  $\Omega$ )

Pin No.	Pin Symbol	Pin Voltage	Equivalent Circuit	Pin Function
1,2 14,15 16,17 29,30	FRAME (GND)			GND for other than output
3 5 7	$U_{out}$ $V_{out}$ $W_{out}$			Output pins
4 6 8	$U_R$ $V_R$ $W_R$			Output pins with resistor of $2\Omega$
9	$R_f$			GND for output transistor
10	$V_S$	$< V_{CC2}$		Power supply pin for fixing the output amplitude. Must be lower than $V_{CC2}$ voltage.
11	$V_{CC}$			Power supply pin for power amp circuit other than motor driver transistor.
13	ST, BY	L: 0.1V max H: 2.0V min		When this pin is grounded, all the circuitry stops operating. In this case, the supply current is approximately $100\mu A$ . In the normal operation mode, this pin is left open or made to be at a potential of more than 2V.
18	ANGLE			The hall input-output gain (slope of motor waveform) can be changed by changing the resistance connected across this pin and GND. $\cong 10k\Omega$
19	BR	H: 2.0V min L: 0.8V max		Pin for stopping the motor L level : Motor drive (Less than 0.8V) H level : Motor stop (More than 2.0V)

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LB1619M

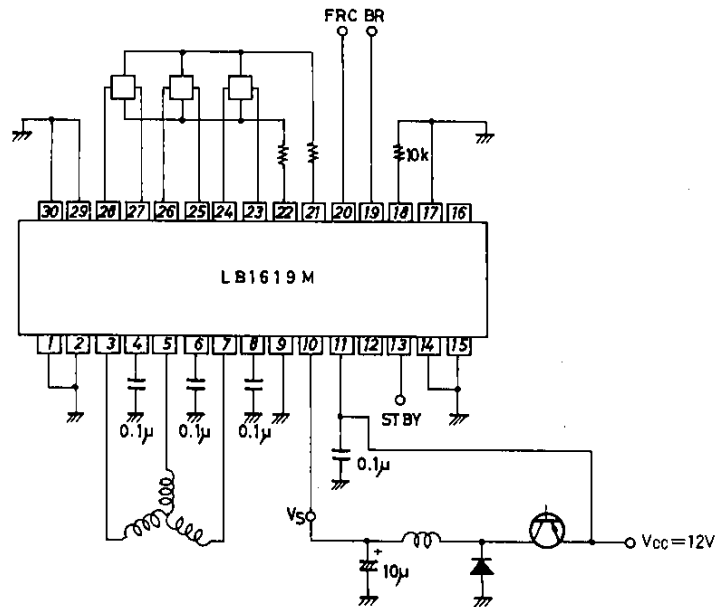
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Unit (resistance:  $\Omega$ )

Pin No.	Pin Symbol	Pin Voltage	Equivalent Circuit	Pin Function
20	FRC	H: 2.8V min L: 1.2V max		Pin for forward/reverse control of motor L level : Forward (Less than 1.2V) H level : Reverse (More than 2.8V)
21 22	$V_H^+$ $V_H^-$			Pin for supplying the hall bias current A voltage of approximately 1V is developed across ( $V_H^+$ ) and ( $V_H^-$ ).
23 24 25 26 27 28	$U_{IN1}$ $U_{IN2}$ $V_{IN1}$ $V_{IN2}$ $W_{IN1}$ $W_{IN2}$	1.4V min 2.8V max		U phase hall element input pin Logic "H" : $U_{IN1} > U_{IN2}$ V phase hall element input pin Logic "H" : $V_{IN1} > V_{IN2}$ W phase hall element input pin Logic "H" : $W_{IN1} > W_{IN2}$

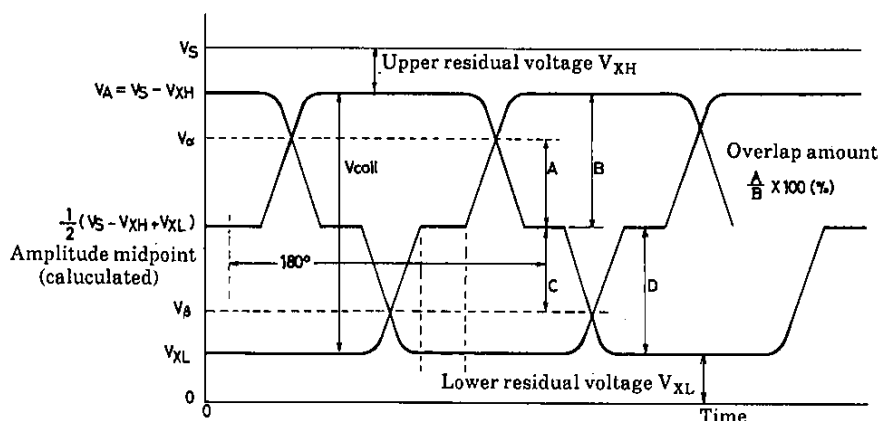
Note) Pin 12 (NC pin) must be left open.

Sample Application Circuit



Unit (resistance:  $\Omega$ , capacitance: F)

## Output Voltage Waveform



$$\text{Upper overlap} = (2V_\alpha - V_A - V_{XL}) / (V_A - V_{XL}) \times 100[\%]$$

$$\text{Lower overlap} = (V_A + V_{XL} - 2V_\beta) / (V_A - V_{XL}) \times 100[\%]$$

## 1. Upper overlap

DC voltage of upper amplitude :  $V_S - V_{XH} = V_A$

DC voltage of lower amplitude :  $V_{XL}$

Let the DC voltage at the intersection of two phases of the upper waveform be  $V_\alpha$  :

From the drawing shown above

At upper overlap amount =  $A/B \times 100[\%]$

$$A = V_\alpha - \frac{1}{2}(V_S - V_{XH} + V_{XL}) = V_\alpha - \frac{1}{2}(V_A + V_{XL})$$

$$B = (V_S - V_{XH}) - \frac{1}{2}(V_S - V_{XH} + V_{XL}) = \frac{1}{2}(V_A + V_{XL})$$

※ Upper overlap

$$= (2V_\alpha - V_A - V_{XL}) / (V_A - V_{XL}) \times 100[\%]$$

## 2. Lower overlap

DC voltage of upper amplitude :  $V_S - V_{XH} = V_A$

DC voltage of lower amplitude :  $V_{XL}$

Let the DC voltage at the intersection of two phases of the upper waveform be  $V_\beta$  :

From the drawing shown above

At lower overlap amount =  $C/D \times 100[\%]$

$$C = \frac{1}{2}(V_S - V_{XH} + V_{XL}) - V_\beta = \frac{1}{2}(V_A + V_{XL}) - V_\beta$$

$$D = \frac{1}{2}(V_S - V_{XH} + V_{XL}) - V_{XL} = \frac{1}{2}(V_A - V_{XL})$$

※ Lower overlap

$$= (V_A + V_{XL} - 2V_\beta) / (V_A - V_{XL}) \times 100[\%]$$

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