Monolithic Digital IC

No.3323

SANYO

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

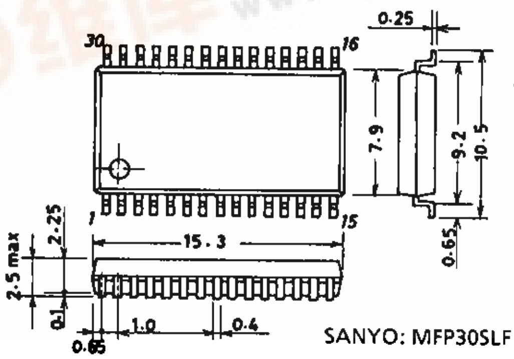
			unit
Maximum Supply Voltage	V_{CC} max	16	V
Maximum Supply Voltage	V_S max	V_{CC}	V
Output Current	I_O	1.5	A
Hall Supply Current	I_H	20	mA
Allowable Power Dissipation	Pd max	1.0	W
Operating Temperature	Topr	−20 to +75	°C
Storage Temperature	Tstg	−55 to +125	°C

Allowable Operating Conditions at Ta = 25°C

			unit
Supply Voltage	V_{CC}	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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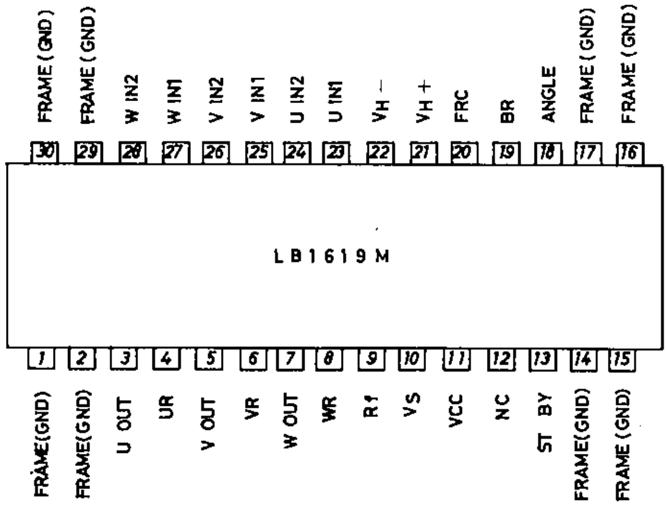
Electrical Characteristics at $Ta = 25°C, V_{CC} = 12V, V_S = 3V$

Parameter	Symbol	Conditions	min	typ	max	unit
Supply Current 1	I_{CC}	$V_{BR} = 5V$		18	23	mA
Supply Current 2	I_S	$V_{BR} = 5V$		5.0	7.0	mA
Supply Standby Current	I_{CCOQ}	$V_{STBY} = 0V$			180	μA
Output Saturation Voltage	$V_{O(sat)}$	$I_{OUT} = 1.0A$, sink + source			2.3	V
Output Transistor Breakdown Voltage	$V_{O(sus)}$	$I_{OUT} = 20mA$ ※	16			V
Output Standby Voltage	V_{OQ}	$V_{BR} = 5V$	1.43	1.53	1.63	V
Hall Amp Input Offset Voltage	$V_{HOFFset}$	※	−5		+5	mV
Hall Amp Common-Mode Input Voltage Range	V_{HCOM}		1.4		2.8	V
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	μA
Brake Pin Leak Current					−30	μA
FRC Pin 'H'-Level Voltage			2.8			V
FRC Pin 'L'-Level Voltage					1.2	V
FRC Pin Input Current					100	μA
FRC Pin Leak Current					−30	μA
Hall Supply Voltage	V_H	$I_H = 10mA\ V_H^{(+)} - V_H^{(-)}$	0.8	1.0	1.5	V
Upper Residual Voltage	V_{XH}	$I_{OUT} = 100mA$	0.40	0.6	0.75	V
Lower Residual Voltage	V_{XL}	$I_{OUT} = 100mA$	0.5	0.6	0.7	V
Residual Voltage Inflection Point				2.0		V
Overlap Amount		$V_{CC} = 12V, V_S = 3.5V$	60	70	80	%
Operating Temperature of Thermal Shutdown Circuit		※	150	180	210	°C
Hysteresis of Thermal Shutdown Circuit		※		15		°C
Standby Operating Voltage					0.1	V
Standby Bias Current		Pin GND			10	μA
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



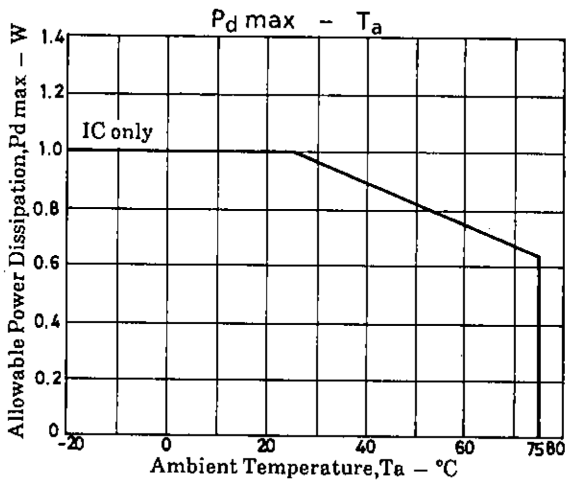
Note : All FRAME pins are connected to GND.

Truth Table

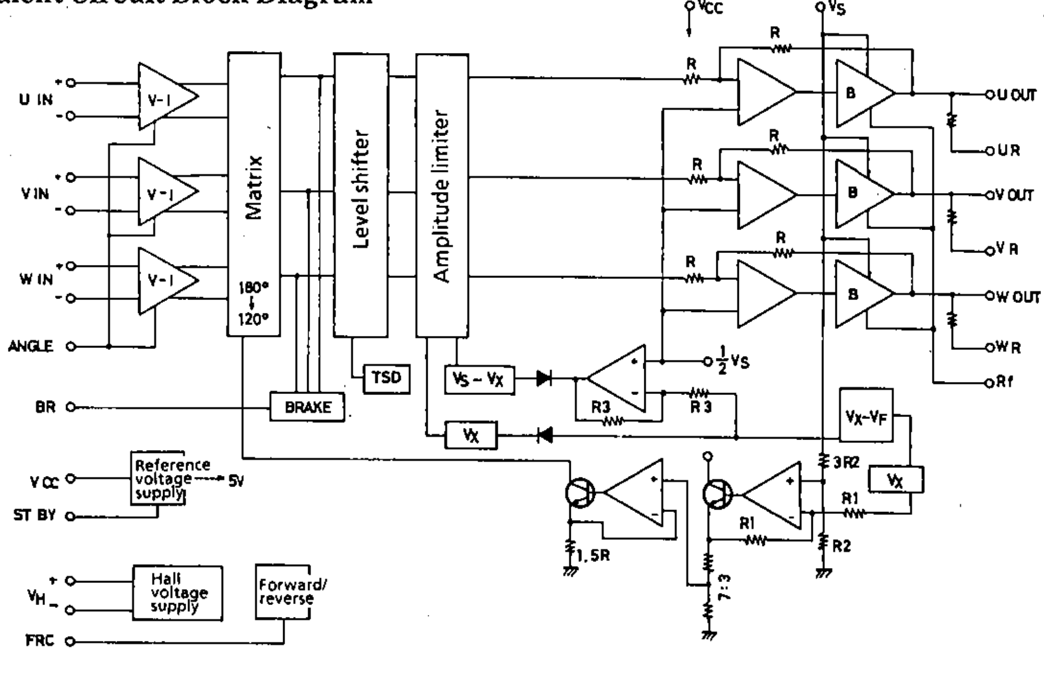
	Source		Sink	Input U	Input V	Input W	Forward/Reverse Control
1	W phase	→	V phase	H	H	L	L
	V phase	→	W phase				H
2	W phase	→	U phase	H	L	L	L
	U phase	→	W phase				H
3	V phase	→	W phase	L	L	H	L
	W phase	→	V phase				H
4	U phase	→	V phase	L	H	L	L
	V phase	→	U phase				H
5	V phase	→	U phase	H	L	H	L
	U phase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

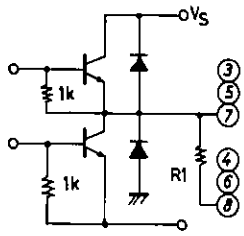
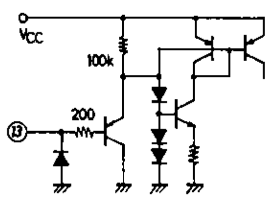
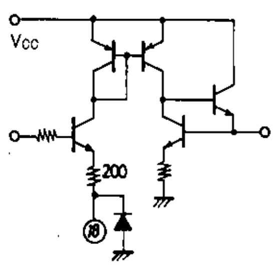
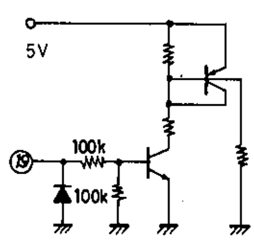


Equivalent Circuit Block Diagram



Pin Description

Unit (resistance: Ω)

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 2Ω
9	R_f			GND for output transistor
10	V_S	$<V_{CC}2$		Power supply pin for fixing the output amplitude. Must be lower than $V_{CC}2$ 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 100μA. 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. ≒10kΩ
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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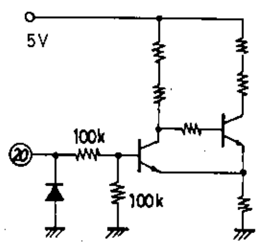
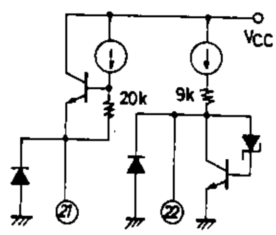
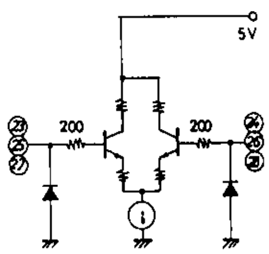
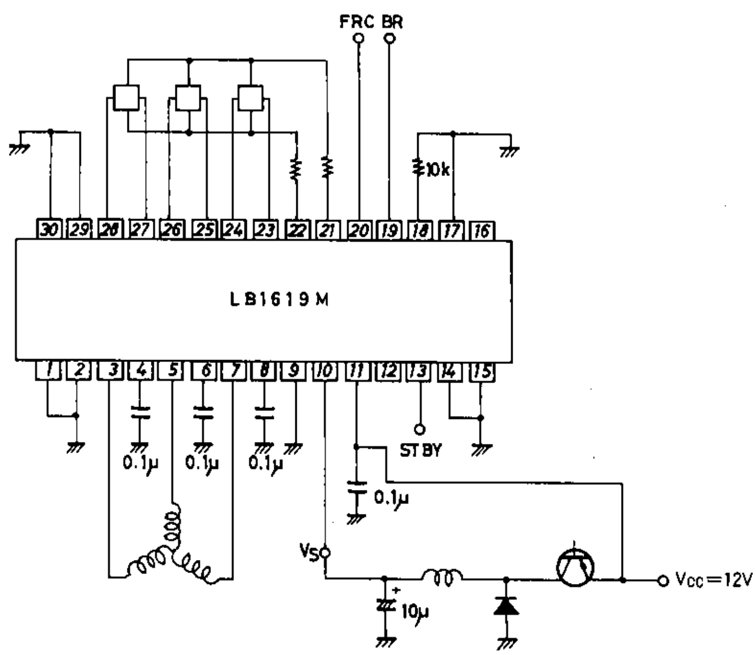
Unit (resistance: Ω)

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	$U_{IN}1$ $U_{IN}2$ $V_{IN}1$ $V_{IN}2$ $W_{IN}1$ $W_{IN}2$	1.4V min 2.8V max		U phase hall element input pin Logic "H" : $U_{IN}1 > U_{IN}2$ V phase hall element input pin Logic "H" : $V_{IN}1 > V_{IN}2$ W phase hall element input pin Logic "H" : $W_{IN}1 > W_{IN}2$

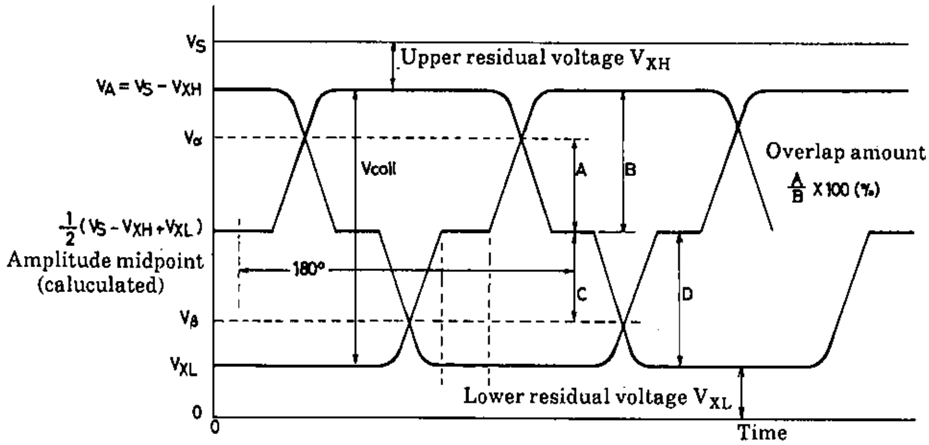
Note) Pin 12 (NC pin) must be left open.

Sample Application Circuit



Unit (resistance: Ω, capacitance: F)

Output Voltage Waveform



Upper overlap $= (2V_\alpha - V_A - V_{XL}) / (V_A - V_{XL}) \times 100[\%]$
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 $= A/B \times 100[\%]$
   $A = V\alpha - 1/2\,(V_S - V_{XH} + V_{XL}) = V\alpha - 1/2\,(V_A + V_{XL})$
   $B = (V_S - V_{XH}) - 1/2\,(V_S - V_{XH} + V_{XL}) = 1/2\,(V_A + V_{XL})$
   ※ 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 $= C/D \times 100[\%]$
   $C = 1/2\,(V_S - V_{XH} + V_{XL}) - V\beta = 1/2\,(V_A + V_{XL}) - V\beta$
   $D = 1/2\,(V_S - V_{XH} + V_{XL}) - V_{XL} = 1/2\,(V_A - V_{XL})$
   ※ Lower overlap
   $= (V_A + V_{XL} - 2V\beta) / (V_A - V_{XL}) \times 100[\%]$