

|                                       |         |                |
|---------------------------------------|---------|----------------|
| <b>SANYO</b>                          | No.3347 | <b>LB1689D</b> |
| <b>3-Phase Brushless Motor Driver</b> |         |                |

**Applications**

The LB1689D is a 3-phase brushless motor driver IC ideally suited for use in VTR capstan motor, drum motor drive applications.

**Features and Functions**

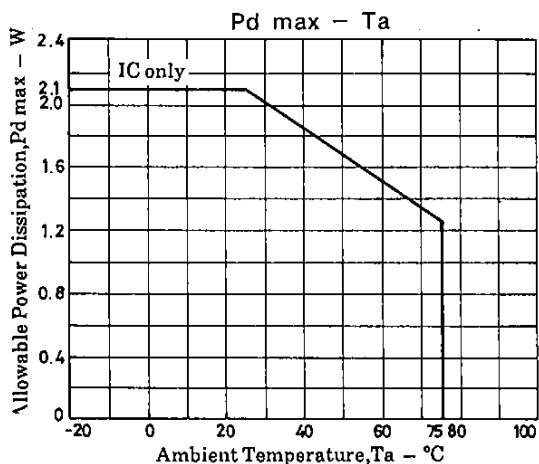
- (1) 120° voltage linear type
- (2) Soft switching type eliminating noises caused by current switching and making the values of external capacitors smaller (comparable to those of chip capacitors)
- (3) On-chip FG amplifier
- (4) On-chip thermal shutdown circuit
- (5) The FG signal can be used to detect the rotational speed of a motor so that the hall amp gain is changed in two steps, thus reducing torque ripple and noise.

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

|                             |                       |             | unit |
|-----------------------------|-----------------------|-------------|------|
| Maximum Supply Voltage      | V <sub>CC</sub> max1  | 20          | V    |
|                             | V <sub>CC</sub> max2  | 7.0         | V    |
| Output Supply Voltage       | V <sub>OUT.v.w.</sub> | 22          | V    |
| Output Current              | I <sub>OUT</sub>      | 1.5         | A    |
| Allowable Power Dissipation | Pd max                | 2.1         | W    |
| Operating Temperature       | T <sub>opr</sub>      | -20 to +75  | °C   |
| Storage Temperature         | T <sub>stg</sub>      | -55 to +125 | °C   |

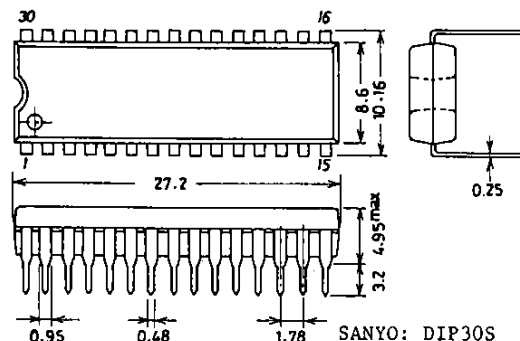
**Allowable Operating Conditions at Ta = 25°C**

|                |                   |            | unit |
|----------------|-------------------|------------|------|
| Supply Voltage | V <sub>CC</sub> 1 | 8.5 to 18  | V    |
|                | V <sub>CC</sub> 2 | 4.3 to 6.5 | V    |



**Package Dimensions 3061**

(unit: mm)



## LB1689D

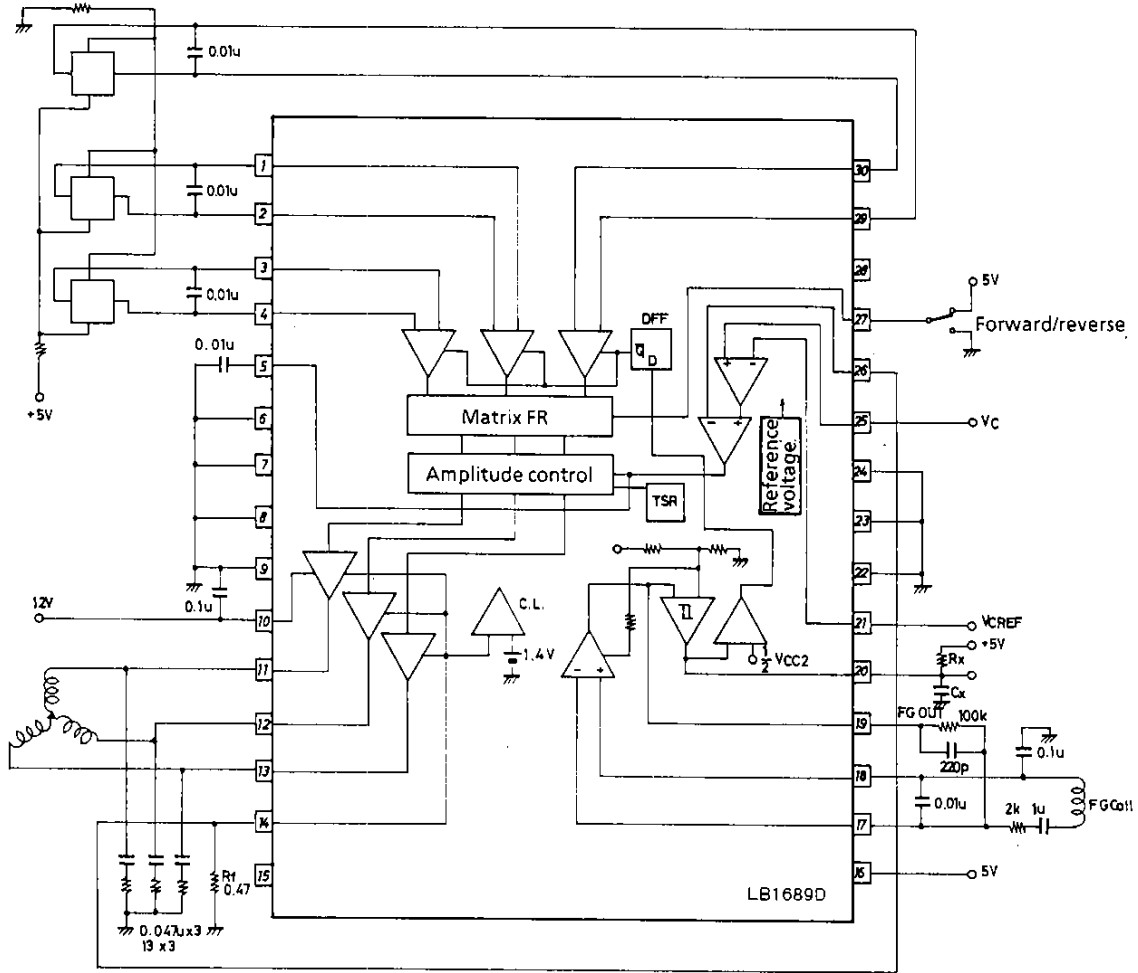
| Electrical Characteristics at $T_a = 25^\circ\text{C}$ , $V_{CC1} = 12\text{V}$ , $V_{CC2} = 5\text{V}$ |                  |   |  | min  | typ | max  | unit             |
|---|------------------|---|--|------|-----|------|------------------|
| [Power Supply]  |                  |   |  |      |     |      |                  |
| Supply Current 1  | $I_{CC1}$        | $V_C = 0, R_L = \infty$                 |  | 17   | 30  |      | mA               |
| Supply Current 2  | $I_{CC2}$        | $V_C = 0$                               |  | 6.5  | 9.5 |      | mA               |
| [Output]  |                  |   |  |      |     |      |                  |
| Output Saturation Voltage   | $V_{O(sat)1}$    | $I_{OUT} = 0.5\text{A}$ , sink + source |  | 1.6  | 2.2 |      | V                |
|   | $V_{O(sat)2}$    | $I_{OUT} = 1.0\text{A}$ , sink + source |  | 2.0  | 3.0 |      | V                |
| Output TRS Voltage  | $V_{O(sus)}$     | $I_{OUT} = 20\text{mA}$ (See note.)     |  | 20   |     |      | V                |
| Output Quiescent Voltage  | $V_{OQ}$         | $V_C = 0$                               |  | 5.8  | 6.1 | 6.4  | V                |
| [Hall Input-Output]   |                  |   |  |      |     |      |                  |
| Hall Amp Input Offset Voltage   | $V_H$ offset     |   |  | -5   |     | +5   | mV               |
| Hall Amp Input Bias Current   | $I_H$ bias       |   |  |      | 1   | 5    | $\mu\text{A}$    |
| Hall Amp Common-Mode  | $V_H$ ch         |   |  | 1.3  |     | 3.7  | V                |
| Input Voltage Range   |                  |   |  |      |     |      |                  |
| Hall Input-Output Voltage Gain  | $G_{VHO1}$       |   |  |      | 56  |      | dB               |
|   | $G_{VHO2}$       |   |  |      | 43  |      | dB               |
| [Control-Output]  |                  |   |  |      |     |      |                  |
| Control-Output Drive Gain   | $G_{VCO}$        |   |  | 38   | 41  | 44   | dB               |
| Control-Output CH Difference  | $\Delta G_{VCO}$ |   |  | -2   |     | +2   | dB               |
| [FG Amplifier]  |                  |   |  |      |     |      |                  |
| FG Amp Input Offset Voltage   | $V_{FG}$ offset  |   |  | -8   |     | +8   | mV               |
| Open-Loop Voltage Gain  | $G_{VFG}$        | $f = 1\text{kHz}$                       |  |      | 60  |      | dB               |
| Source Output Saturation Voltage  | $V_{FG OUT}$     | $I_O = 2\text{mA}$                      |  | 3.7  |     |      | V                |
| Sink Output Saturation Voltage  | $V_{FG OD}$      | $I_O = -2\text{mA}$                     |  |      |     | 1.3  | V                |
| Common-Mode Signal  | CHR              | (See note.)                             |  |      | 80  |      | dB               |
| Rejection Ratio   |                  |   |  |      |     |      |                  |
| FG Amp Common-Mode  | $V_{FG CH}$      |   |  | 0    |     | 3.5  | V                |
| Input Voltage Range   |                  |   |  |      |     |      |                  |
| Phase Margin  |                  | (See note.)                             |  |      | 30  |      | deg.             |
| [Motor Detection]   |                  |   |  |      |     |      |                  |
| Motor Detection Amp   |                  |   |  | 35   | 50  | 65   | mV               |
| Hysteresis Width  |                  |   |  |      |     |      |                  |
| CR Pin Threshold Voltage  |                  | $V_{CR}$ changes from LOW to HIGH.      |  | 2.35 | 2.5 | 2.65 | V                |
| Thermal Shutdown Temperature  | $T_{SD}$         | (See note.)                             |  | 150  | 180 | 210  | $^\circ\text{C}$ |
| Thermal Shutdown Hysteresis   | $\Delta T_{SD}$  | (See note.)                             |  |      | 15  |      | $^\circ\text{C}$ |

Note : Values shown are design targets only. No measurements have been taken.

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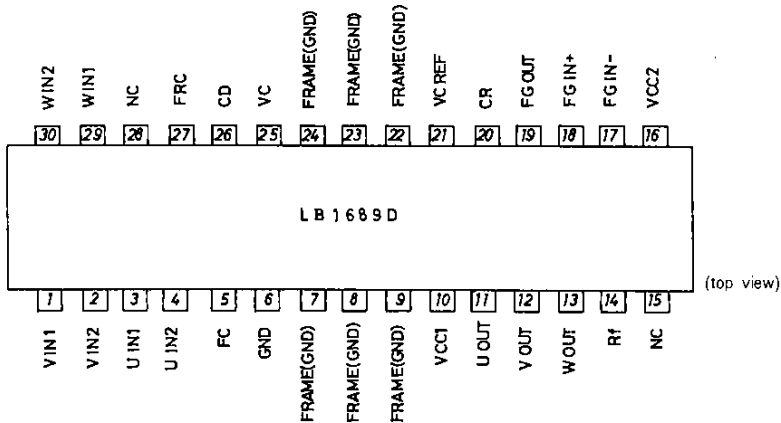
# LB1689D

## Equivalent Circuit Block Diagram



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

## Pin Assignment



Note : All FRAME pins are connected to GND.

## Pin Description

| Pin Name  | Pin No.                | Description  |
|---|------------------------|--|
| U <sub>IN1</sub> , U <sub>IN2</sub><br>V <sub>IN1</sub> , V <sub>IN2</sub><br>W <sub>IN1</sub> , W <sub>IN2</sub> | 3, 4<br>1, 2<br>29, 30 | U phase hall element input pin. 'H' of logic : V <sub>IN1</sub> > V <sub>IN2</sub><br>V phase hall element input pin. 'H' of logic : V <sub>IN1</sub> > V <sub>IN2</sub><br>W phase hall element input pin. 'H' of logic : V <sub>IN1</sub> > V <sub>IN2</sub> |
| U <sub>OUT</sub><br>V <sub>OUT</sub><br>W <sub>OUT</sub>  | 11<br>12<br>13         | U phase output pin<br>V phase output pin<br>W phase output pin   |
| V <sub>CC1</sub>  | 10                     | Power supply pin for applying output   |
| V <sub>CC2</sub>  | 16                     | Power supply pin for applying voltage to each section other than output section.<br>This voltage must be stabilized to be free from ripple, noise, etc.  |
| R <sub>f</sub>  | 14                     | Output current detect pin. By connecting R <sub>f</sub> across this pin and GND pin, output current is detected as voltage.<br>The result is used to control the overcurrent protection circuit.   |
| CD  | 26                     | Pin for fetching current (voltage) detected with R <sub>f</sub> .<br>Takes feedback from R <sub>f</sub> to reduce output voltage gain. Ground when not in use.   |
| FC  | 5                      | Frequency characteristic correction  |
| V <sub>C</sub>  | 25                     | Speed-phase control pin<br>Control is of voltage-controlled type that controls output voltage.   |
| V <sub>CREF</sub>   | 21                     | Control reference voltage  |
| GND   | 6                      | GND for other than output<br>Minimum potential of output transistor is at R <sub>f</sub> pin.  |
| F/R <sub>C</sub>  | 27                     | Forward/reverse control pin<br>By setting this pin to 'H' (more than 2.0V)/'L' (less than 0.3V), truth value is changed to perform forward/reverse rotation.   |
| FG <sub>in-</sub> , FG <sub>in+</sub>   | 17, 18                 | FG signal input pin  |
| FG <sub>OUT</sub>   | 19                     | FG amp output pin  |
| CR  | 20                     | This pin voltage can be used to change the hall input-output gain. Connection of an external resistor and capacitor makes it possible to detect the rotational speed of a motor and change the hall input gain in two steps.                                   |

## Truth Table

|   | Source            | Input |   |   | Forward/Reverse Control<br>F/R <sub>C</sub> |
|---|-------------------|-------|---|---|---|
|   |                   | U     | V | W |   |
| 1 | W phase → V phase | H     | H | L | L   |
|   | V phase → W phase | H     | H | L | H   |
| 2 | W phase → U phase | H     | L | L | L   |
|   | U phase → W phase | H     | L | L | H   |
| 3 | V phase → W phase | L     | L | H | L   |
|   | W phase → V phase | L     | L | H | H   |
| 4 | U phase → V phase | L     | H | L | L   |
|   | V phase → U phase | L     | H | L | H   |
| 5 | V phase → U phase | H     | L | H | L   |
|   | U phase → V phase | H     | L | H | H   |
| 6 | U phase → W phase | L     | H | H | L   |
|   | W phase → U phase | L     | H | H | 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: 2.0 to V<sub>CC2</sub>

L: 0 to 0.3V