

**SANYO**

## Overview

The LB1662D, 1662M are 2-phase brushless motor drivers operated from 5 V power supply. Motor Lock protection and automatic return can be provided with a minimum number of external parts.

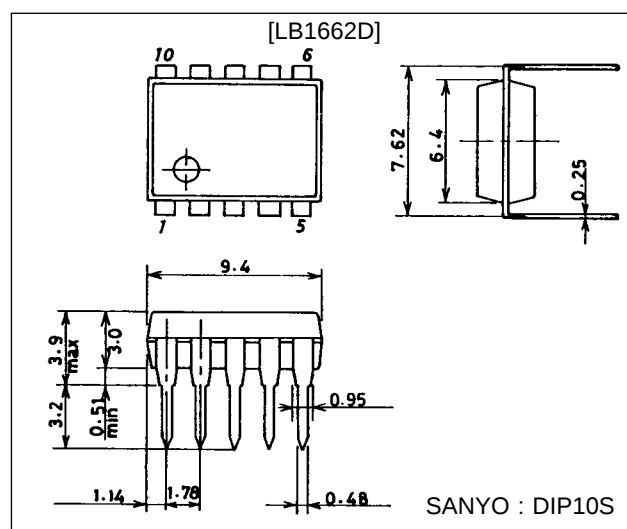
## Features and Functions

- Designed to be operated from 5 V power supply, making stable operation possible at a reduced voltage.
- Direct connection to a Hall element possible.
- Built-in output transistors with output current 1.5 A
- Built-in rotation detect function (Drive mode: "L", Stop mode: "H")
- Built-in motor lock protector and automatic return function
- With radio noise reduction pin

## Package Dimensions

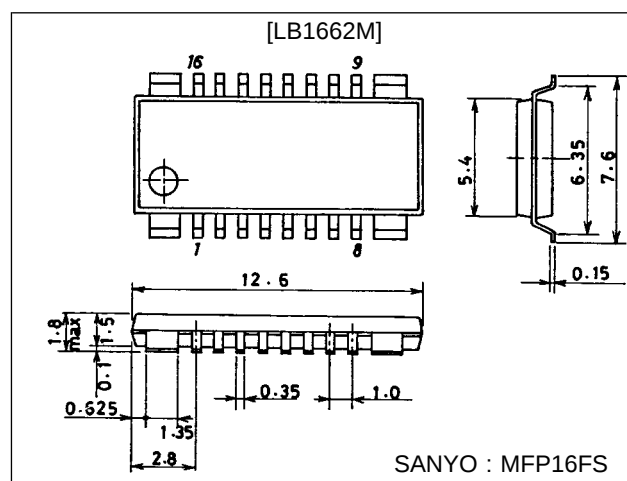
unit : mm

### 3098B-DIP10S



unit : mm

### 3097-MFP16FS



## Specifications

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

| Parameter                   | Symbol              | Conditions                    | Ratings     | Unit               |
|-----------------------------|---------------------|-------------------------------|-------------|--------------------|
| Maximum supply voltage      | $V_{IN\text{ max}}$ |                               | 7           | V                  |
| Output voltage              | $V_{OUT}$           |                               | -0.3 to +85 | V                  |
| Output current              | $I_{OUT}$           |                               | 1.5         | A                  |
| RD flow-in current          | $I_{RD}$            |                               | 10          | mA                 |
| RD voltage                  | $V_{RD}$            |                               | 50          | V                  |
| Allowable power dissipation | $P_d\text{ max}$    | LB1662D                       | 1.2         | W                  |
|                             |                     | LB1662M (Independent IC)      | 0.9         | W                  |
|                             |                     | LB1662M with Specified board* | 1.2         | W                  |
| Operating temperature       | $T_{opr}$           |                               | -40 to +80  | $^{\circ}\text{C}$ |
| Storage temperature         | $T_{stg}$           |                               | -55 to +125 | $^{\circ}\text{C}$ |

\* Specified board ( $20 \times 30 \times 1.5\text{ mm}^3$  glass epoxy resin)

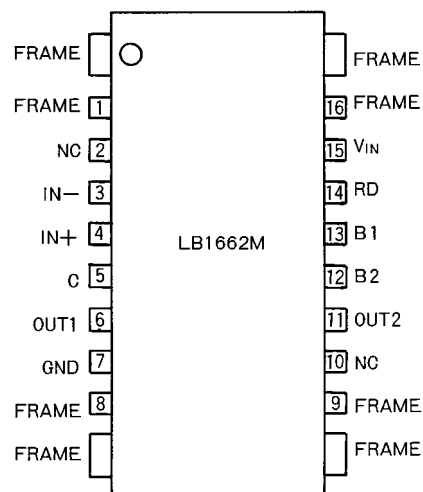
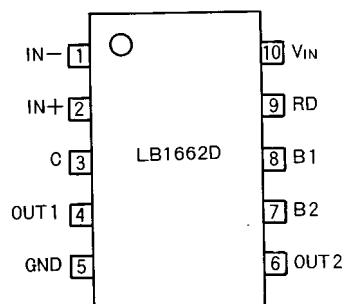
### Allowable Operating Ranges at $T_a = 25\text{ }^{\circ}\text{C}$

| Parameter                       | Symbol    | Conditions | Ratings             | Unit |
|---------------------------------|-----------|------------|---------------------|------|
| Supply voltage range            | $V_{IN}$  |            | 3.8 to 6.0          | V    |
| Common-mode input voltage range | $V_{ICM}$ |            | 0 to $V_{IN} - 1.5$ | V    |

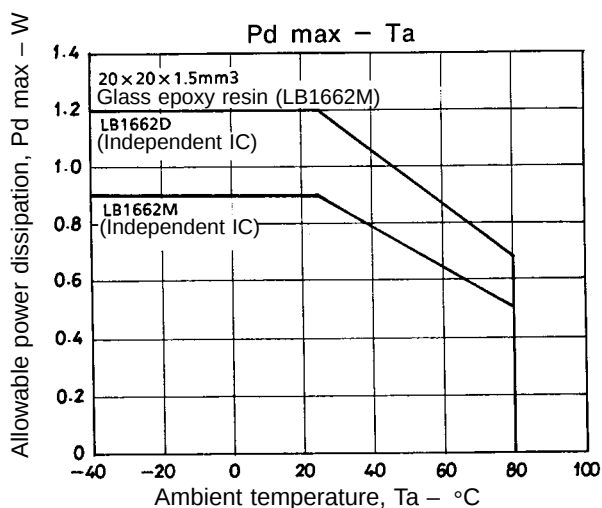
### Electrical Characteristics at $T_a = 25\text{ }^{\circ}\text{C}$ , $V_{IN} = 4.3\text{ V}$

| Parameter                          | Symbol                | Conditions                                     | min  | typ          | max  | Unit          |
|------------------------------------|-----------------------|------------------------------------------------|------|--------------|------|---------------|
| Output withstand voltage 1         | $V_{OR}$              |                                                | 80   |              |      | V             |
| Output withstand voltage 2         | $V_{O(SUS)}$          | $I_O = 0.1$                                    | 65   |              |      | V             |
| Output saturation voltage          | $V_O\text{ sat 1}$    | $I_O = 0.5\text{ A}$                           |      | 0.95         | 1.2  | V             |
|                                    | $V_O\text{ sat 2}$    | $I_O = 1.0\text{ A}$                           |      | 1.15         | 1.5  | V             |
|                                    | $V_O\text{ sat 3}$    | $I_O = 1.5\text{ A}$ , $V_{IN} = 4.8\text{ V}$ |      | 1.4          | 2.0  | V             |
| $V_{IN}$ flow-in range             | $I_{IN}$              |                                                | 1.4  | 2.5          | 3.7  | mA            |
| Amp input offset voltage           | $V_{OFF}$             |                                                | -7   | 0            | 7.0  | mV            |
| Amp input bias current             | $I_{BA}$              |                                                | -250 |              |      | nA            |
| RD output saturation voltage       | $V_{RD}\text{ (sat)}$ | $I_{RD} = 5\text{ mA}$                         |      | 0.1          | 0.2  | V             |
| C flow-out current                 | $I_C\text{ 1}$        |                                                | 1.5  | 2.8          | 4.1  | $\mu\text{A}$ |
| C discharge current                | $I_C\text{ 2}$        |                                                | 0.21 | 0.38         | 0.61 | $\mu\text{A}$ |
| Comparator input threshold voltage | $V_{TH}\text{ 1}$     |                                                | 0.67 | $0.7V_{IN}$  | 0.73 | V             |
|                                    | $V_{TH}\text{ 2}$     |                                                | 0.34 | $0.38V_{IN}$ | 0.42 | V             |

## Pin Assignments



Top view



## Pin Functions

| Pin No. | Pin name        | Function                                                                                                                                                                                                                                                                                                                                        |
|---------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1<br>2  | IN-<br>IN+      | Input pins for hall element outputs.<br>Common-mode input voltage range is 0 to $V_{IN}-1.5 \text{ V}$ , offset voltage is $\pm 7 \text{ mV}$                                                                                                                                                                                                   |
| 3       | C               | Capacitor pin (1 to 10 $\mu\text{F}$ ) that forms automatic return circuit.<br>When rotation is stopped due to overload, the pin voltage increases and output stops.<br>After proper load adjustment, the output returns from "stop" mode to "drive" mode automatically.<br>The lock detect time can be set by changing the capacitor constant. |
| 4<br>6  | OUT1<br>OUT2    | Output pins. The output transistor is Darlington connected.<br>Connect either an external capacitor or an external Zener diode for output transistor protection.                                                                                                                                                                                |
| 5       | GND             | Ground pin.                                                                                                                                                                                                                                                                                                                                     |
| 8<br>7  | B1<br>B2        | Base pins for Darlington connected output transistors.<br>If radio noise is a problem, add a capacitor (0.01 to 0.1 $\mu\text{F}$ ).                                                                                                                                                                                                            |
| 9       | RD              | Open collector output. Drive mode: "L", Stop mode: "H"                                                                                                                                                                                                                                                                                          |
| 10      | V <sub>IN</sub> | Insert a limiting resistor between $V_{CC}$ and $V_{IN}$ and use the voltage applied between $V_{IN}$ and ground in a range from 3.8 to 6.0 V.<br>In this case, the current consumption $I_{CC}$ at the $V_{IN}$ pin is 1.4 to 3.7 mA (when $V_{IN} = 4.3 \text{ V}$ ).                                                                         |

## Truth Table

| IN+ | IN- | C | OUT1 | OUT2 |
|-----|-----|---|------|------|
| H   | L   | L | H    | L    |
| L   | H   | L | L    | H    |
| H   | L   | H | H    | H    |
| L   | H   | H | H    | H    |

## Usage Notes

(See the Sample Application Circuits.)

### (1) Supply voltage ( $V_{IN}$ pin)

Use these ICs with the voltage applied between  $V_{IN}$  and ground in the range from 3.8 to 6.0 V. The current consumption,  $I_{CC}$ , at the  $V_{IN}$  pin is from 1.4 to 3.7 mA (when  $V_{IN} = 4.3$  V). Insert diode D1 to keep coil kickback out of the power line. This diode also prevents breakdown due to reverse connections. Also, inserting R1 limits the reverse connection current flowing into ground and  $V_{IN}$ . These ICs have a reverse connection withstand current,  $I_{CC} = 200$  mA. Check R1 around the range from 50 to 200  $\Omega$ .

### (2) Hall input pin voltage (IN- and IN+ pins)

Set the voltage levels of the input pin for the Hall element output and the Hall element output voltage to within the range of 0 V to  $V_{IN}-1.5$  V.

The gain between the Hall input pin and the output pin is 100 dB or greater. The offset voltage of the Hall input amp is  $\pm 7$  mV. Therefore, the Hall element output must be set with the offset voltage ( $\pm 7$  mV) considered.

### (3) Output transistors (OUT1 and OUT2 pins)

Output current  $I_O = 1.5$  A max.

Output saturation voltage  $V_O \text{ sat} = 1.15$  V/1.0 A (typ.)

The LB1662D, 1662M requires one of the three types of output protection.

- ① When external capacitors are connected between OUT and ground, the capacitance should not exceed 10  $\mu\text{F}$ . Use capacitance that will hold kickback voltage and back voltage to 80 V or less.
- ② When external Zener diodes are connected, use one that will have a cutoff voltage of 65 V or less. If radio noise is a problem, insert a 0.01  $\mu\text{F}$  to 0.1  $\mu\text{F}$  capacitor between B1 and B2.
- ③ When external capacitors are connected between OUT and B, use one that will hold kickback voltage to 65 V or less. If it oscillates, insert resistance in series with the capacitor.

### (4) Output protection function (C pin)

Capacitor pin used in forming an automatic return circuit.

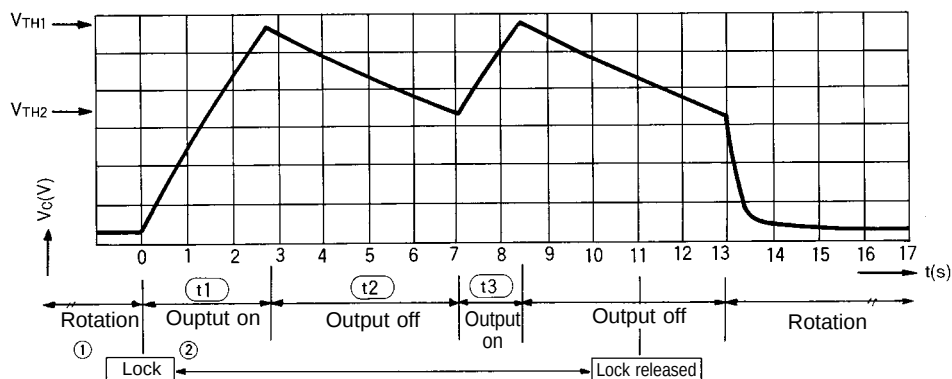
If rotation is stopped due to overload, the pin voltage increases and then forces the output to become inactive. In this case, after proper load adjustment, the output returns to the 'drive' mode from the 'stop' mode automatically. By changing the capacitor value, the lock detect time period can be set.

## Automatic return circuit C pin voltage

For 1  $\mu\text{F}$  lock detection time about 1 seconds

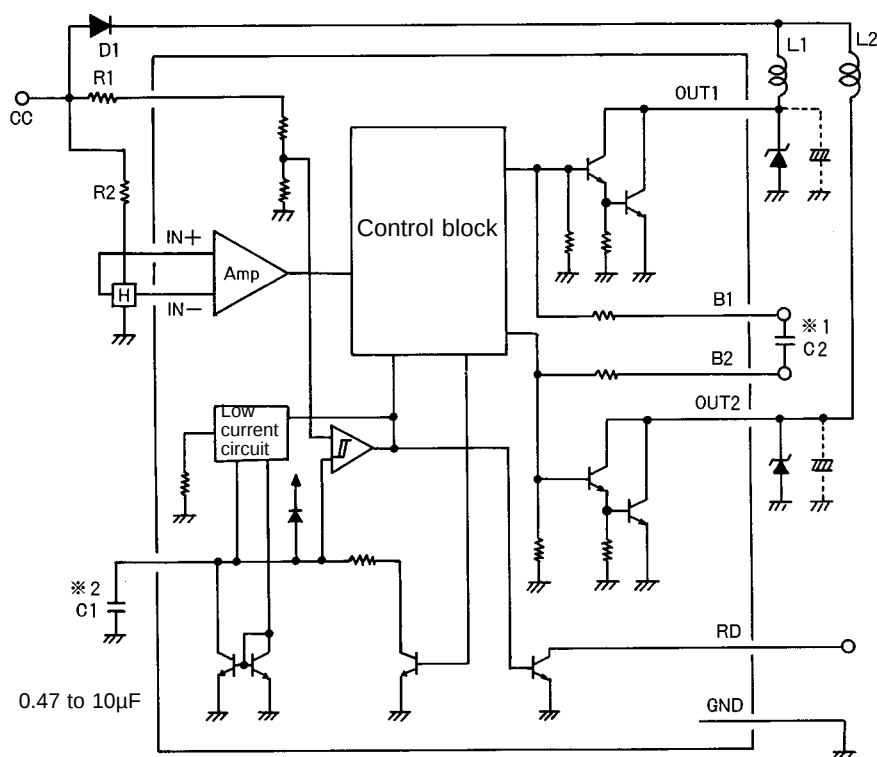
lock protection time (output ON) about 0.5 second

(output OFF) about 3.5 seconds



- ① When a fan is rotating, the capacitor is charge at 2.8  $\mu\text{A}$  (typ) and discharged through the C with pulses according to the rotational speed.
  - ② When a fan is locked, no discharge occurs through the C and the C voltage rises, turning OFF the output at  $V_{\text{TH1}}$  ( $0.7 \times V_{\text{IN}}$ ).
  - ③ When the output is turned OFF, discharge occurs through the C at 0.38  $\mu\text{A}$  (typ). If the lock is not released when the C voltage drops to  $V_{\text{TH2}}$  ( $0.38 \times V_{\text{IN}}$ ), the capacitor is charged to  $V_{\text{TH1}}$  again. (At this moment, the output is turned ON.) These operations ② and ③ repeated at a cycle of approximately  $t_{\text{ON}} : t_{\text{OFF}} = 1 : 7$  protect a motor.
  - ④ If the lock is released when the C voltage drops to  $V_{\text{TH2}}$ , the output is turned ON, starting rotation.
- (5) Rotation detect signal (RD pin)  
Open collector output (Drive mode: "L", Stop mode: "H")
- (6) Radio noise reducing (B1 and B2 pins)  
These are the base pins for Darlington connected output transistors. If radio noise is a problem, add a capacitor of approximately 0.01 to 0.1  $\mu\text{F}$  between B1 and B2, or 0.001  $\mu\text{F}$  to 0.01  $\mu\text{F}$  between OUT and B.

### Block Diagram and Sample Application Circuit – ①



\*1 Use (10,000 to 100,000 pF) if radio noise is a problem.

\*2 Use a Zener diode or capacitor for output stage protection.

