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# LB1868M

## Monolithic Digital IC 2-phase Brushless Fan Motor Driver

### Overview

The LB1868M is a 2-phase unipolar brushless motor driver. With only a few peripheral parts, lockup protection and automatic recovery can be implemented. The IC can be configured for 12V or 24V operation and a wide range of variations, from Low speed to H-High speed and from 60cm to 120cm square using the same PCB. This makes it easy to design highly reliable fan motor installations.

### Features

- Output protection Zener diode with variable withstand voltage
  - Z1, Z2 pins open:  $V_{OLM} = 57V$  (24V specification)
  - Z1, Z2 pins shorted:  $V_{OLM} = 32V$  (12V specification)
  - External Zener diode connected across Z1 – V<sub>CC</sub> pins: support for fans with large drive current
- External resistor allows configuration for 12V or 24V
- Direct Hall element connection possible (built-in Hall amplifier with hysteresis supports core without auxiliary electrode)
- Built-in output transistor with 1.0A output current (strengthened negative-current support for core without auxiliary electrode)
- Built-in rotation detection function: Low during rotation and High during stop
- Built-in lockup protection with automatic recovery
- ST pin for motor stop/drive (for standby mode of copiers etc.)
- BC pin for kickback noise reduction (with 2 external capacitors)
- FG output pin for rotation detection
- Built-in thermal shutdown

### Specifications

#### Absolute Maximum Ratings at T<sub>a</sub> = 25°C

| Parameter                      | Symbol               | Conditions                     | Ratings     | Unit |
|--------------------------------|----------------------|--------------------------------|-------------|------|
| Maximum input current          | I <sub>CC</sub> max  | t ≤ 20ms                       | 200         | mA   |
| Maximum applied output voltage | V <sub>OUT</sub> max |                                | Internal    | V    |
| Maximum output current         | I <sub>OUT</sub> max |                                | 1.0         | A    |
| Current flowing into RD, FG    | I <sub>RD</sub> max  |                                | 10          | mA   |
| RD, FG applied voltage         | V <sub>RD</sub> max  |                                | 30          | V    |
| ST applied voltage             | V <sub>ST</sub> max  |                                | 7.5         | V    |
| Allowable power dissipation    | P <sub>d</sub> max   | Mounted on a specified board * | 800         | mW   |
| Operating temperature          | T <sub>opr</sub>     |                                | -30 to +80  | °C   |
| Storage temperature            | T <sub>stg</sub>     |                                | -55 to +150 | °C   |

\* Specified board: 20mm × 15mm × 1.5mm, glass epoxy board.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

| Parameter                       | Symbol    | Conditions | Ratings             | Unit |
|---------------------------------|-----------|------------|---------------------|------|
| Input current range             | $I_{CC}$  |            | 6.0 to 50           | mA   |
| Common mode input voltage range | $V_{ICM}$ |            | 0.2 to $V_{IN}-1.5$ | V    |
| ST High voltage                 | $V_{STH}$ |            | 4.5 to 7.0          | V    |
| ST Low voltage                  | $V_{STL}$ |            | 0 to 0.5            | V    |

## Electrical Characteristics at $T_a = 25^\circ\text{C}$ , $I_{CC} = 10\text{mA}$

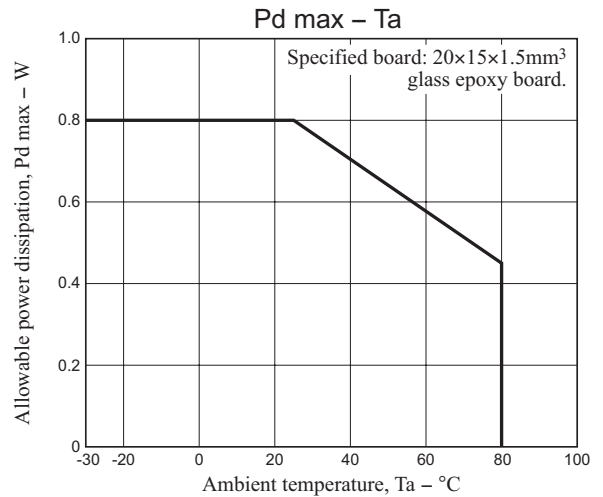
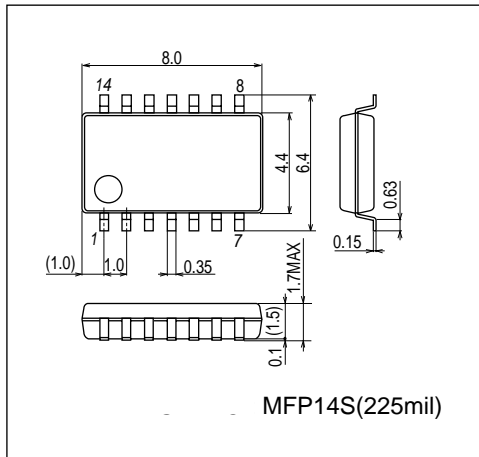
| Parameter                                | Symbol             | Conditions                      | Ratings |              |      | Unit             |
|--|--------------------|---------------------------------|---------|--------------|------|------------------|
|  |                    |                                 | min     | typ          | max  |                  |
| Output limiter withstand voltage         | $V_{OLM1}$         | Z1, Z2 open                     | 54      | 57           | 60   | V                |
|  | $V_{OLM2}$         | Z1, Z2 short                    | 31      | 33           | 35   | V                |
| Output saturation voltage                | $V_{Osat1}$        | $I_O = 0.5\text{A}$             |         | 0.95         | 1.2  | V                |
|  | $V_{Osat2}$        | $I_O = 1.0\text{A}$             |         | 1.15         | 1.5  | V                |
| $V_{IN}$ voltage                         | $V_{IN}$           | $I_{CC} = 7.0\text{mA}$         | 6.4     | 6.7          | 7.0  | V                |
| Hall input sensitivity (at zero peak)    | $V_{HN}$           | Including offset and hysteresis |         |              | 20   | mV               |
| RD, FG output saturation voltage         | $V_{RDSat}$        | $I_{RD} = 5\text{mA}$           |         | 0.1          | 0.3  | V                |
| CT drain current                         | IC1                | C = GND                         | 2.7     | 3.8          | 4.9  | $\mu\text{A}$    |
| CT discharge current                     | IC2                | C = $V_{IN}$                    | 0.19    | 0.30         | 0.41 | $\mu\text{A}$    |
| Comp input threshold voltage             | $V_{TH1}$          |                                 | 0.77    | $0.8V_{IN}$  | 0.83 | V                |
|  | $V_{TH2}$          |                                 | 0.42    | $0.45V_{IN}$ | 0.48 | V                |
| ST input current                         | $I_{ST}$           | $V_{ST} = 5\text{V}$            |         | 80           | 120  | $\mu\text{A}$    |
| Thermal protection operating temperature | TSD                | Design target value *           |         | 180          |      | $^\circ\text{C}$ |
| Thermal protection circuit hysteresis    | $\Delta\text{TSD}$ | Design target value *           |         | 40           |      | $^\circ\text{C}$ |

\* Design target value, Do not measurement.

## Package Dimensions

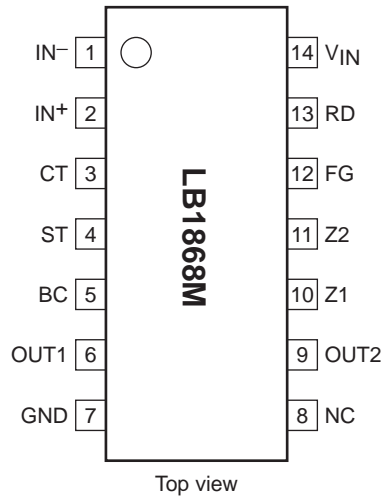
unit : mm (typ)

3111A



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## Pin Assignment



## Pin Function

| Pin No. | Pin name        | Function   |
|---------|-----------------|--|
| 1       | IN <sup>-</sup> | Hall input + pin. Hysteresis amplifier   |
| 2       | IN <sup>+</sup> | Hall input – pin. Hysteresis amplifier   |
| 3       | CT              | Lockup protection time setting capacitor pin (0.47 to 4.7μF).  |
| 4       | ST              | Start/stop pin.  |
| 5       | BC              | Output transistor common base pin.   |
| 6       | OUT1            | Output 1 pin.  |
| 9       | OUT2            | Output 2 pin.  |
| 7       | GND             | GND pin.   |
| 10      | Z1              | External Zener diode pin (external Zener diode to be connected between power supply and Z1).                   |
| 11      | Z2              | Kickback absorption voltage alteration pin (shorted to Z1: 12V operation).                                     |
| 12      | FG              | Rotation frequency detector pin.   |
| 13      | RD              | Lockup detection pin (latch type).   |
| 14      | V <sub>IN</sub> | Regulated power supply input pin (limiting resistor to be inserted between power supply and V <sub>IN</sub> ). |

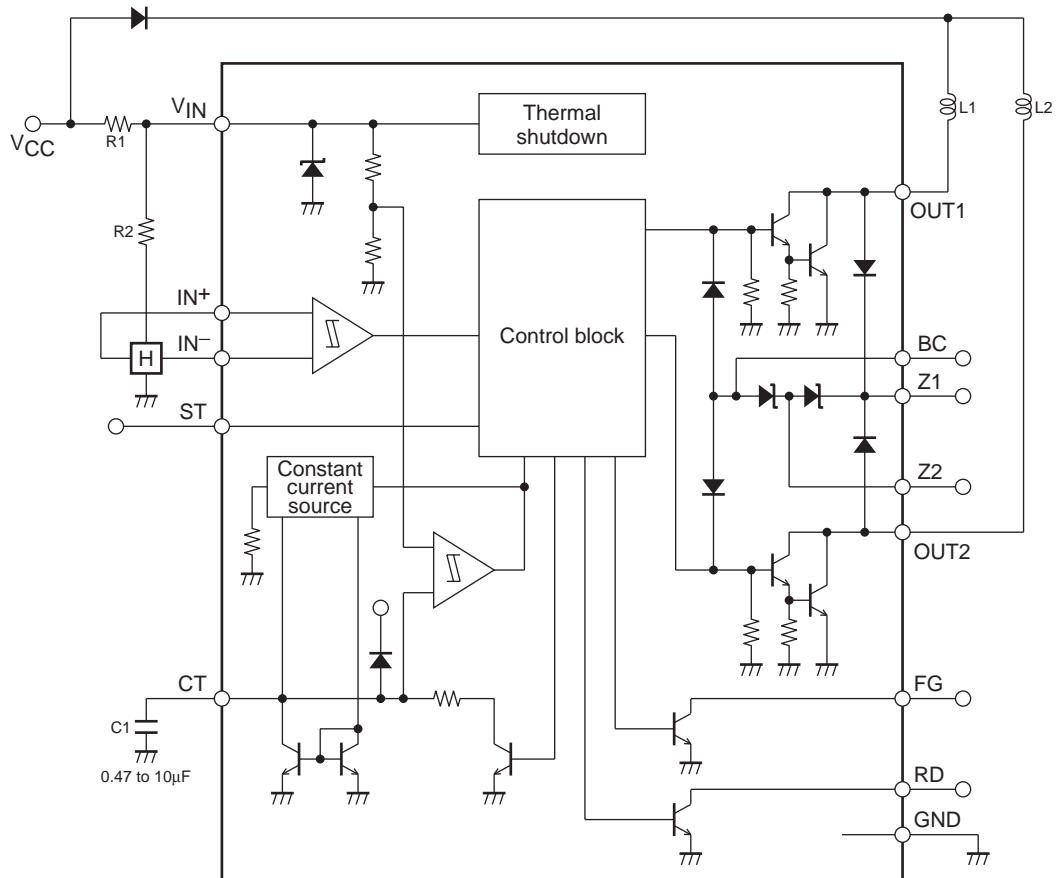
## Truth Table

| ST              | IN <sup>+</sup> | IN <sup>-</sup> | CT | OUT1 | OUT2 | RD | FG |
|-----------------|-----------------|-----------------|----|------|------|----|----|
| H               | H               | L               | L  | H    | H    | L  | L  |
|                 | L               | H               | L  | H    | H    | L  | H  |
| L<br>or<br>OPEN | H               | L               | L  | H    | L    | L  | L  |
|                 | L               | H               | L  | L    | H    | L  | H  |
|                 | H               | L               | H  | H    | H    | H  | L  |
|                 | L               | H               | H  | H    | H    | H  | H  |

\* RD is a latch type output

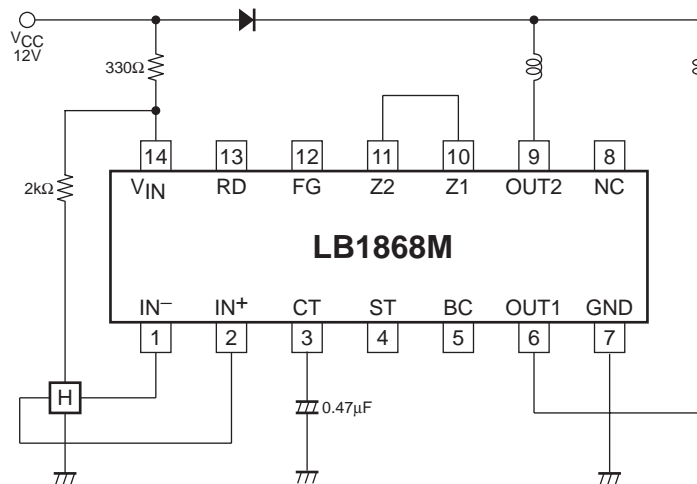
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## Block Diagram



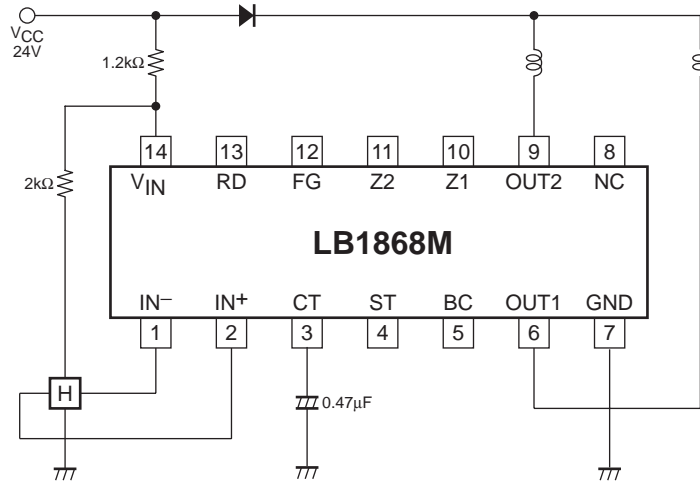
## Application Circuit Example

(1) 12V supply voltage

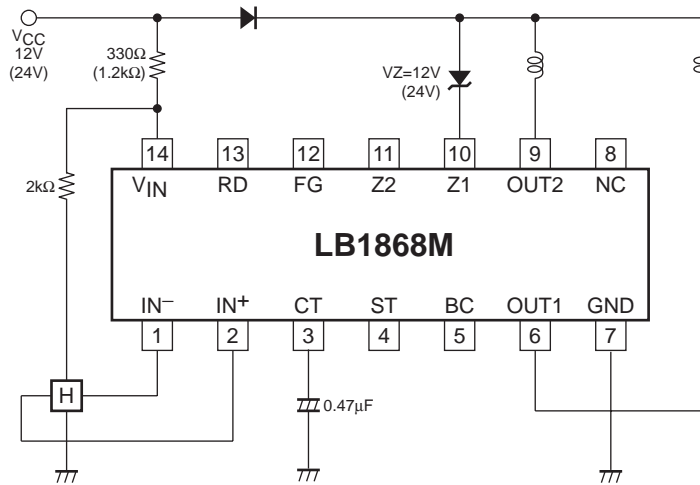


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## (2) 24V supply voltage





## (3) High-Power Fan (120mm-HH-Speed)



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