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# LB1962MC

## Monolithic Digital IC For Fan Motor Single-Phase Full-Wave Driver

### Overview

Single-phase full-wave drive design and a compact package make these ICs optimal for small fans (especially CPU cooling fans). Low switching noise and effective motor drive are further advantages.

### Functions

- Support for 5V/12V dual power supply voltage
- Built-in regenerative circuit allows use of reverse connection protection diode
- Built-in Hall amplifier with hysteresis (supports core without auxiliary electrode)
- Built-in lockup protection and automatic recovery circuits
- Rotation detection output (FG)
- Hall bias pin and start/stop pin allow reduced current drain in standby mode
- Built-in thermal protection circuit

### Specifications

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

| Parameter                           | Symbol                | Conditions                     | Ratings     | Unit             |
|-------------------------------------|-----------------------|--------------------------------|-------------|------------------|
| Maximum supply voltage              | $V_{CC \text{ max}}$  |                                | 17          | V                |
| Maximum output current              | $I_{OUT \text{ max}}$ |                                | 0.5         | A                |
| Maximum output withstand voltage    | $V_{OUT \text{ max}}$ |                                | 17          | V                |
| FG maximum output withstand voltage | $V_{FG \text{ max}}$  |                                | 17          | V                |
| FG maximum output current           | $I_{FG \text{ max}}$  |                                | 5           | mA               |
| HB maximum output current           | $I_B \text{ max}$     |                                | 10          | mA               |
| ST maximum input voltage            | $V_{ST \text{ max}}$  |                                | 15          | V                |
| Allowable power dissipation         | $P_d \text{ max}$     | Mounted on a specified board * | 800         | mW               |
| Operating temperature               | $T_{opr}$             |                                | -30 to +90  | $^\circ\text{C}$ |
| Storage temperature                 | $T_{stg}$             |                                | -55 to +150 | $^\circ\text{C}$ |

\* Specified board: 114.3mm × 76.2mm × 1.6mm, glass epoxy board.

Caution 1) Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

Caution 2) Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

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 Conditions at Ta = 25°C

| Parameter                      | Symbol           | Conditions | Ratings                     | Unit |
|--------------------------------|------------------|------------|-----------------------------|------|
| Power supply voltage           | V <sub>CC</sub>  |            | 3.8 to 16.8                 | V    |
| ST input High level voltage    | ST <sub>H</sub>  |            | 3 to 14                     | V    |
| ST input Low level voltage     | ST <sub>L</sub>  |            | -0.3 to +0.4                | V    |
| Hall input common mode voltage | V <sub>ICM</sub> |            | 0.2 to V <sub>CC</sub> -1.5 | V    |

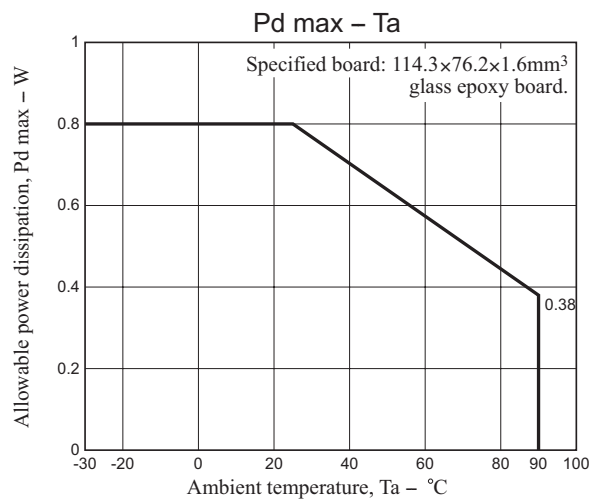
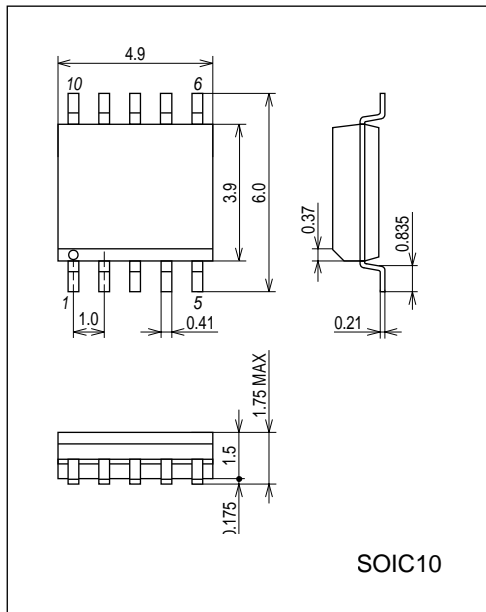
## Electrical Characteristics at Ta = 25°C, V<sub>CC</sub> = 5V

| Parameter                                 | Symbol           | Conditions   | Ratings |      |      | Unit |
|---|------------------|--|---------|------|------|------|
|   |                  |  | min     | typ  | max  |      |
| Current drain                             | I <sub>CC</sub>  | In drive mode (CT = "L", ST = "L")                   |         | 6.5  | 9.1  | mA   |
|   |                  | In lockup protection mode (CT = "H", ST = "L")       |         | 2.2  | 3.1  | mA   |
|   |                  | In standby mode (ST = "H")                           |         | 110  | 150  | μA   |
| Lockup detection capacitor charge current | I <sub>CT1</sub> |  | 1.9     | 2.8  | 3.7  | μA   |
| Capacitor discharge current               | I <sub>CT2</sub> |  | 0.32    | 0.46 | 0.60 | μA   |
| Capacitor charge/discharge current ratio  | R <sub>CT</sub>  | R <sub>CT</sub> = I <sub>CT1</sub> /I <sub>CT2</sub> | 5.0     | 6.0  | 7.0  |      |
| CT charge voltage                         | V <sub>CT1</sub> |  | 2.55    | 2.75 | 2.95 | V    |
| CT discharge voltage                      | V <sub>CT2</sub> |  | 1.6     | 1.8  | 2.0  | V    |
| Output Low level voltage                  | V <sub>OL</sub>  | I <sub>O</sub> = 200mA                               |         | 0.2  | 0.3  | V    |
| Output High level voltage                 | V <sub>OH</sub>  | I <sub>O</sub> = 200mA                               | 3.9     | 4.1  |      | V    |
| Hall input sensitivity                    | V <sub>HN</sub>  | Zero peak value (Including offset and hysteresis)    |         | 7    | 15   | mV   |
| FG output pin Low voltage                 | V <sub>FG</sub>  | I <sub>FG</sub> = 5mA                                |         | 0.1  | 0.3  | V    |
| FG output pin leakage current             | I <sub>FGL</sub> | V <sub>FG</sub> = 15V                                |         |      | 30   | μA   |
| HB output Low voltage                     | V <sub>HBL</sub> | I <sub>HB</sub> = 5mA                                |         | 1.0  | 1.3  | V    |
| ST pin input current                      | I <sub>ST</sub>  | V <sub>ST</sub> = 5V                                 |         | 75   | 100  | μA   |

## Package Dimensions

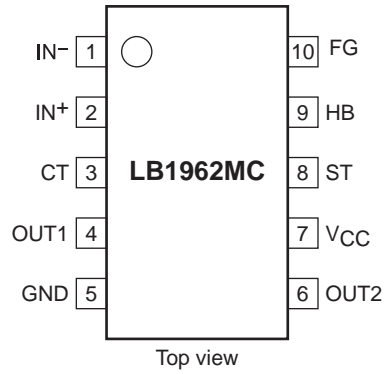
unit : mm (typ)

3426A

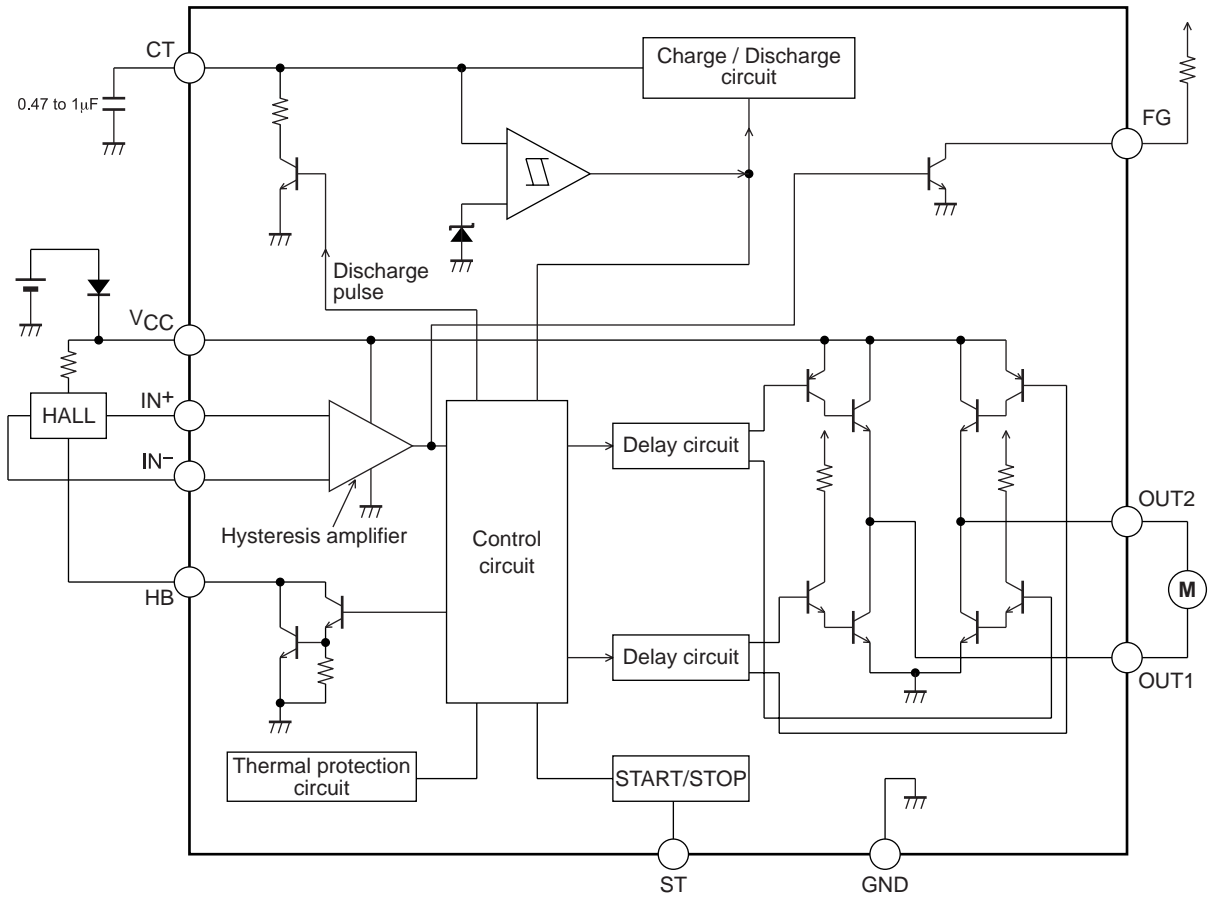


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## Pin Assignment



## Block Diagram

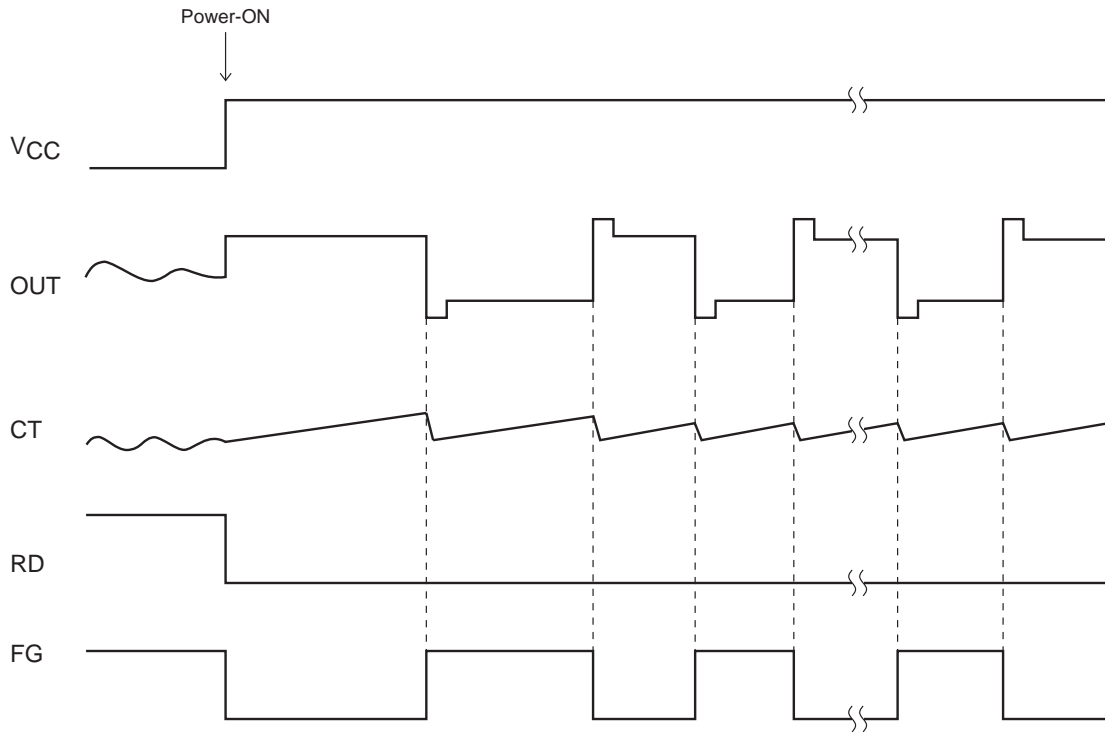


## Truth Table

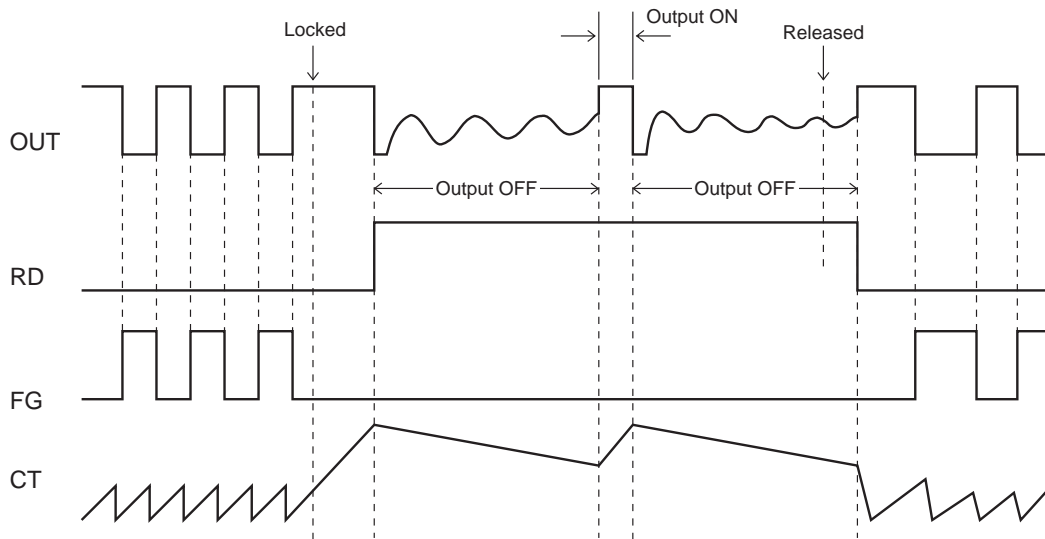
| ST | IN- | IN+ | CT | OUT1 | OUT2 | FG  | HB  | Mode                        |
|----|-----|-----|----|------|------|-----|-----|-----------------------------|
| H  | -   | -   | -  | OFF  | OFF  | OFF | OFF | Standby                     |
| L  | H   | L   | L  | H    | L    | L   | L   | Rotating                    |
|    | L   | H   |    | L    | H    | H   |     |                             |
| -  | -   | -   | H  | OFF  | OFF  | -   | L   | Lockup protection activated |

Latch-type RD output is Low during rotation and High during stop.

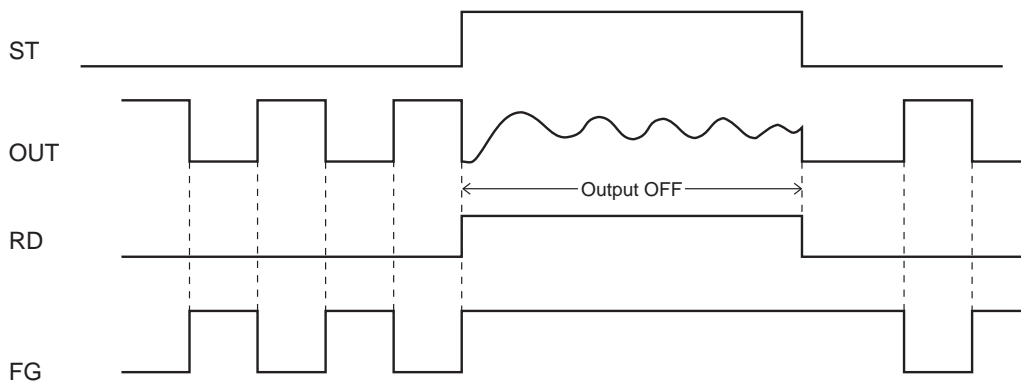
Startup



Lockup protection/automatic recovery



Start/stop



## Design Reference

(1) V<sub>CC</sub> pin

Power supply pin for control block and motor drive.

Accepts a wide operation voltage range from 3.8 to 16.8V, for 5V/12V dual power supply support.

(2) OUT1, OUT2 pins

Single-phase coil output pins.

Bipolar drive output with upper side inverted and lower side single output. Built-in regenerative circuit regenerates kickback current between lower side NPN outputs when a diode is used for protection against reverse connection.

(3) IN<sup>-</sup>, IN<sup>+</sup> pins

Hall input signal pins

The Hall signal is amplified into a square wave by the Hall amplifier with hysteresis characteristics of  $\pm 3.5\text{mV}$  (typ.).

The Hall input signal amplitude should be 70mV or more.

(4) CT pin

This pin serves for connecting a capacitor between CT and GND.

The capacitor determines the characteristics of the built-in lockup protection circuit for preventing coil burnout in the case of motor restraint. Once normal motor load is restored, the automatic recovery circuit resets itself.

Changing the capacitance alters the lockup detection time.

When a 0.47 mF capacitor is connected between CT and GND

Lockup detection time : approx. 0.5s

Lockup protection time/automatic recovery time : approx. 0.16s (output ON)

approx. 1s (output OFF)

When not using lockup protection function, this pin should be connected to ground.

(5) FG pin

Open-collector output pin for rotation frequency detection.

When IN<sup>-</sup> = High and IN<sup>+</sup> = Low, then FG = Low

When IN<sup>-</sup> = Low and IN<sup>+</sup> = High, then FG = High

(6) ST pin and HB pin

ST pin : When input to this pin is High, motor drive is stopped (OUT is high impedance).

At this time, RD output indicates lockup protection mode OFF.

HB pin : Hall bias switching pin. At ST pin High input, Hall bias is switched to reduce current drain in fan standby mode.

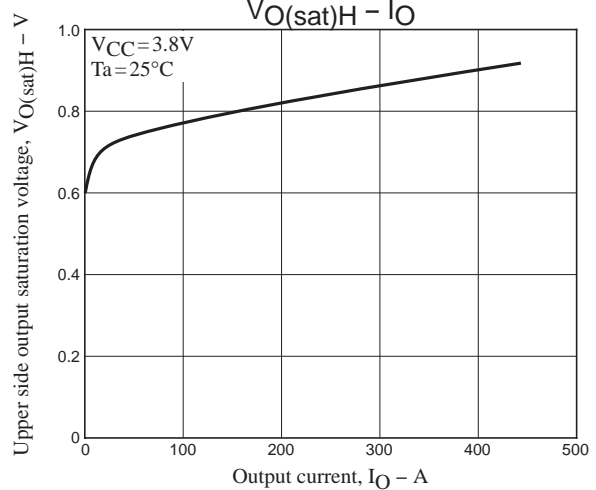
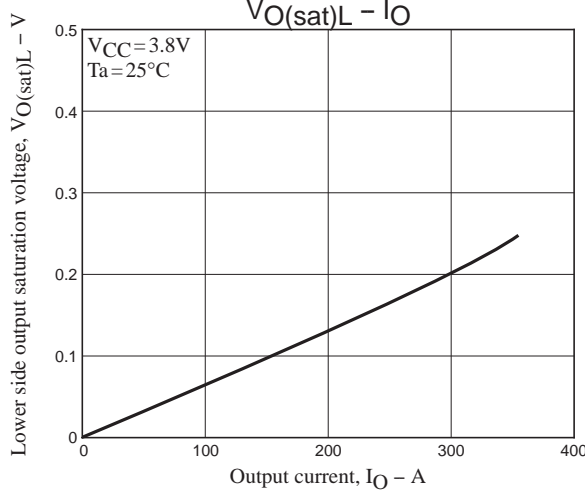
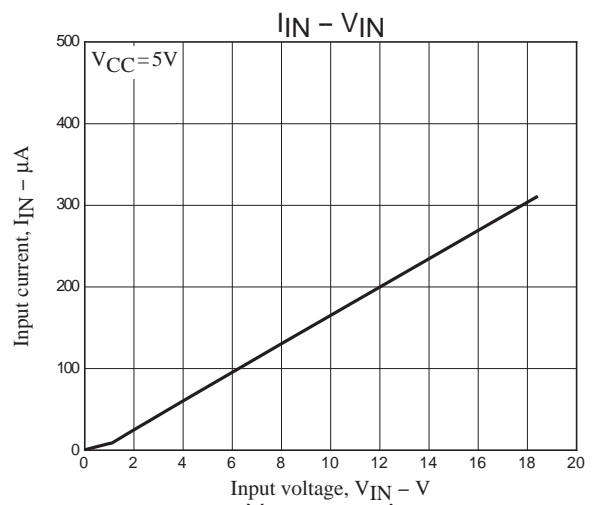
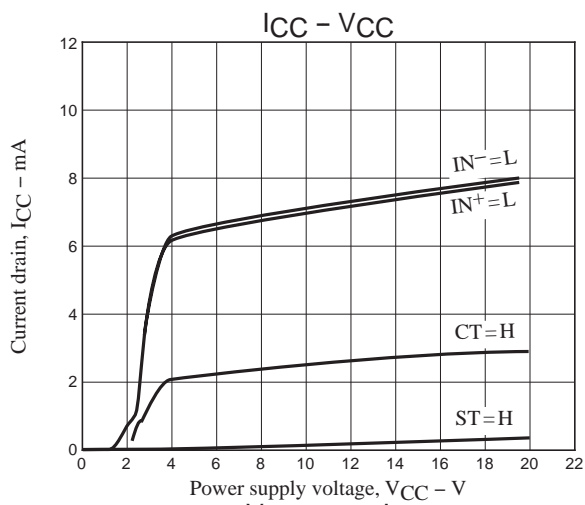
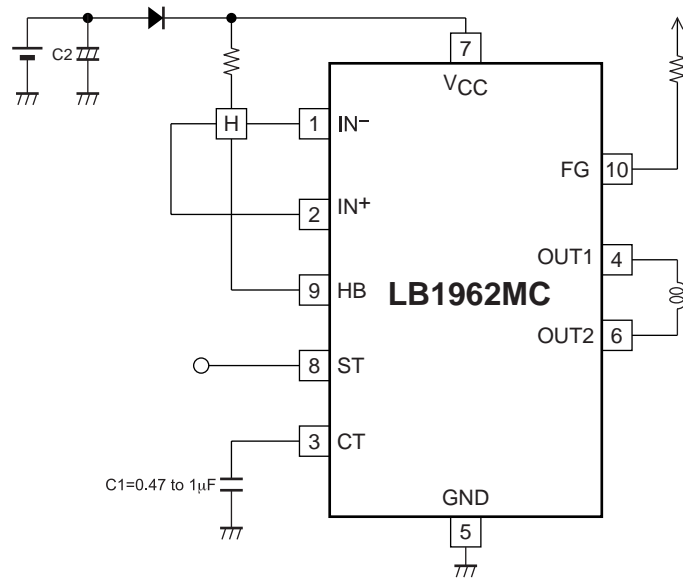
If not used, both pins should be open.

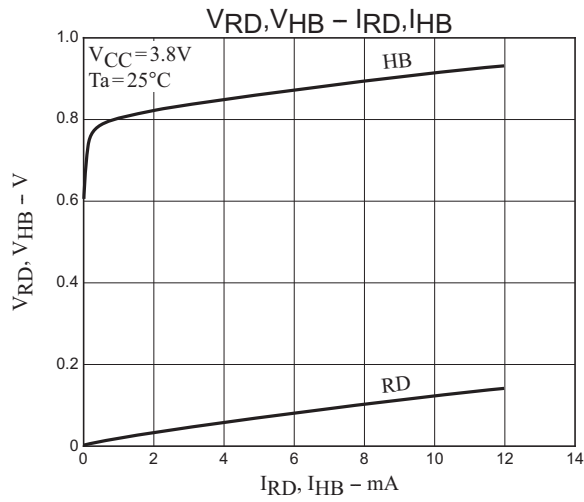
(7) Thermal protection circuit

When internal temperature T<sub>j</sub> of IC reaches 180°C, output current limiter is activated to protect against damage.

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## Application Circuit Example





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