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# LB11851FA

Monolithic Digital IC

## Microprocessor Fan Motor Interface Driver

### Overview

The LB11851FA provides an interface between a microcontroller motor control signal and external MOS transistors. This device can implement a microprocessor fan driver with a minimal number of external components. The LB11851FA is optimal for server and personal computer microprocessor fan drive in response to temperature or other external signals when high precision and high air flow are required.

### Features

- Fan motor interface driver function (FGIN)
  - ⇒ This IC accepts a signal from a microcontroller and interfaces to external power transistors (PMOS and NMOS) to provide high-efficiency low-power single-phase full-wave drive.
- Variable speed input pin (PWMIN)
  - ⇒ PMOS side PWM control
  - NMOS side current regeneration using slow decay is used to achieve quite high-speed control.
- Built-in kickback absorption circuit (OUT1P/2P)
  - ⇒ This circuit absorbs the kickback current that is generated at phase switching or power on/off to achieve smooth current regeneration and protect the external transistors against destruction or degradation.
- Built-in current limiter circuit (SENSE)
  - ⇒ This circuit implements a chopper-type current limiting control that operates at startup and during lock protection mode.
  - The current detection voltage is set to a fixed 0.2V internally.
- Built-in microcontroller power supply (5VREG)

## Specifications

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

| Parameter                         | Symbol                 | Conditions                                     | Ratings     | Unit |
|-----------------------------------|------------------------|------------------------------------------------|-------------|------|
| Maximum supply voltage            | V <sub>CC</sub> max    |                                                | 18          | V    |
| OUTN pin maximum output current   | IO <sub>UTN</sub> max  |                                                | 20          | mA   |
| OUTP pin maximum output current   | IO <sub>UTP</sub> max  |                                                | 20          | mA   |
| OUT pin voltage handling capacity | VO <sub>UT</sub> max   |                                                | 18          | V    |
| 5VREG maximum output current      | I <sub>5VREG</sub> max |                                                | 20          | mA   |
| Allowable power dissipation       | P <sub>d</sub> max     | When mounted on the specified circuit board *1 | 400         | mW   |
| Operating temperature             | T <sub>opr</sub>       | *2                                             | -40 to +90  | °C   |
| Storage temperature               | T <sub>stg</sub>       |                                                | -55 to +150 | °C   |

\*1 Specified substrate :20.0mm ×10.0mm ×0.8mm, Paper phenol board.

\*2 Do not exceed T<sub>j</sub> max = 150°C

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.

### Recommended Operating Ranges at Ta = 25°C

| Parameter                           | Symbol              | Conditions | Ratings    | Unit |
|-------------------------------------|---------------------|------------|------------|------|
| Supply voltage - V <sub>CC</sub>    | V <sub>CC</sub>     |            | 6 to 16    | V    |
| PWM high-level input voltage range  | VP <sub>WMINH</sub> |            | 2.1 to 5.0 | V    |
| PWM low-level input voltage range   | VP <sub>WMINL</sub> |            | 0 to 0.4   | V    |
| FGIN high-level input voltage range | V <sub>FGINH</sub>  |            | 2.1 to 5.0 | V    |
| FGIN low-level input voltage range  | V <sub>FGINL</sub>  |            | 0 to 0.3   | V    |
| SENSE input voltage range           | V <sub>SENop</sub>  |            | 0 to 5.0   | V    |

### Electrical Characteristics at Ta = 25°C, V<sub>DD</sub> = 12V

| Parameter                              | Symbol              | Conditions               | Ratings |      |      | Unit |
|----------------------------------------|---------------------|--------------------------|---------|------|------|------|
|                                        |                     |                          | min     | typ  | max  |      |
| Circuit current                        | I <sub>CC</sub> 1   | With no load             | 3.5     | 5    | 6.5  | mA   |
| 5VREG voltage                          | 5VREG               | 5VREG = 10mA             | 4.8     | 5    | 5.2  | V    |
| SENSE pin detection voltage            | V <sub>SENth</sub>  |                          | 0.15    | 0.19 | 0.23 | V    |
| FGIN high-level input current          | FGI <sub>hi</sub>   | V <sub>IN</sub> = 3V     | 60      | 80   | 100  | μA   |
| FGIN low-level input current           | FGI <sub>low</sub>  | V <sub>IN</sub> = 0V     | -27     | -21  | -15  | μA   |
| PWMIN high-level current               | PWMI <sub>hi</sub>  | V <sub>IN</sub> = 3V     | 35      | 45   | 55   | μA   |
| PWMIN low-level current                | PWMI <sub>low</sub> | V <sub>IN</sub> = 0V     | -27     | -21  | -14  | μA   |
| OUT1P, OUT2P high-level output voltage | V <sub>O12PH</sub>  | I <sub>O</sub> = 10mA *2 | 10      | 11   | 11.9 | V    |
|                                        |                     | I <sub>O</sub> = 1mA *2  | 11      | 11.3 |      | V    |
| OUT1P, OUT2P low-level output voltage  | V <sub>O12PL</sub>  | I <sub>O</sub> = 10mA *2 | 3       | 4    | 5    | V    |
|                                        |                     | I <sub>O</sub> = 1mA *2  |         | 1.2  | 1.5  | V    |
| OUT1N, OUT2N high-level output voltage | V <sub>O12NH</sub>  | I <sub>O</sub> = 10mA *1 | 9       | 10   | 11.9 | V    |
|                                        |                     | I <sub>O</sub> = 1mA *1  | 10.8    | 11.1 |      | V    |
| OUT1N, OUT2N low-level output voltage  | V <sub>O12NL</sub>  | I <sub>O</sub> = 10mA *1 | 0.1     | 1    | 2    | V    |
|                                        |                     | I <sub>O</sub> = 1mA *1  |         | 0.7  | 1    | V    |

\*1 : There is a built-in 100Ω gate protection resistor.

\*2 : There is a built-in 300Ω gate protection resistor.

### Truth Table

| FGIN | PWMIN | SENSE | OUT1P | OUT1N | OUT2P | OUT2N | Mode                                         |
|------|-------|-------|-------|-------|-------|-------|----------------------------------------------|
| L    | L     | L     | L     | L     | H     | H     | OUT1 → 2 drive                               |
| H    |       |       | H     | H     | L     | L     | OUT2 → 1 drive                               |
| L    | H     | L     | H     | L     | H     | H     | Regeneration mode<br>(low side regeneration) |
| H    |       |       | H     | H     | H     | L     |                                              |
| L    | L     | H     | H     | L     | H     | H     | Current limiter<br>(low side regeneration)   |
| H    |       |       | H     | H     | H     | L     |                                              |

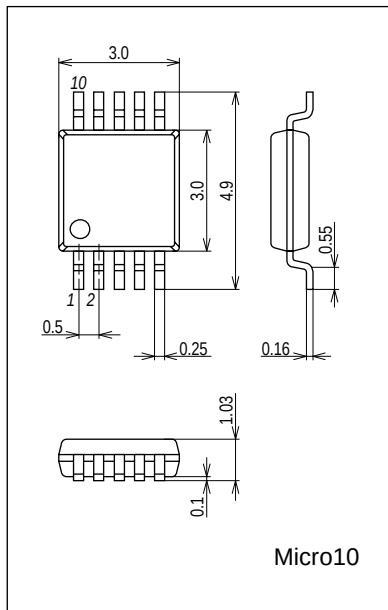
Note 1 : For the SENSE pin, the "H" state is 0.2V or higher.

Note 2 : The IC goes to regeneration mode (no motor drive applied) when the microcontroller is reset (the output high-impedance state).

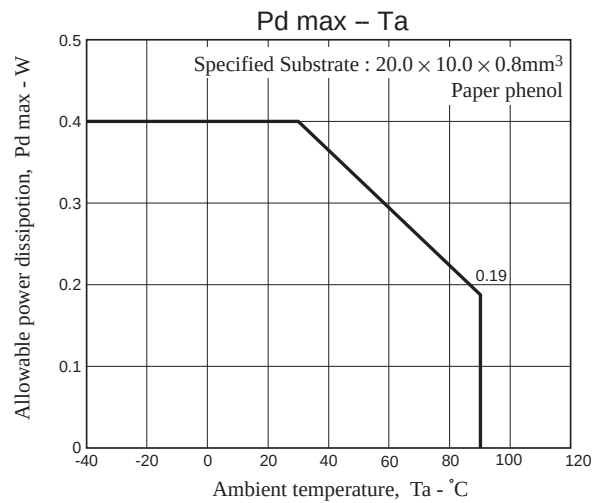
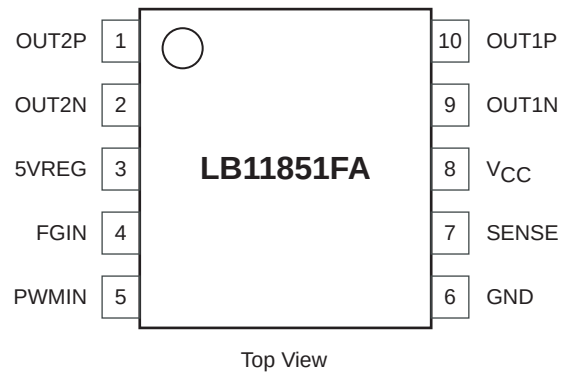
## Package Dimensions

unit : mm (typ)

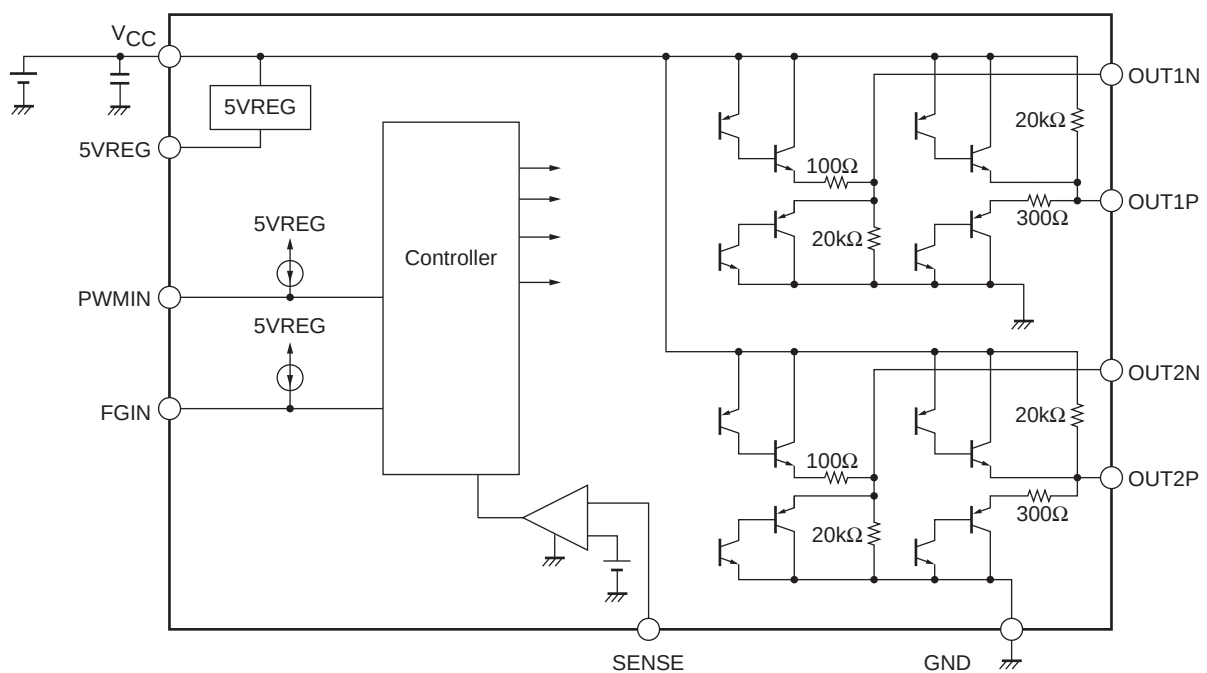
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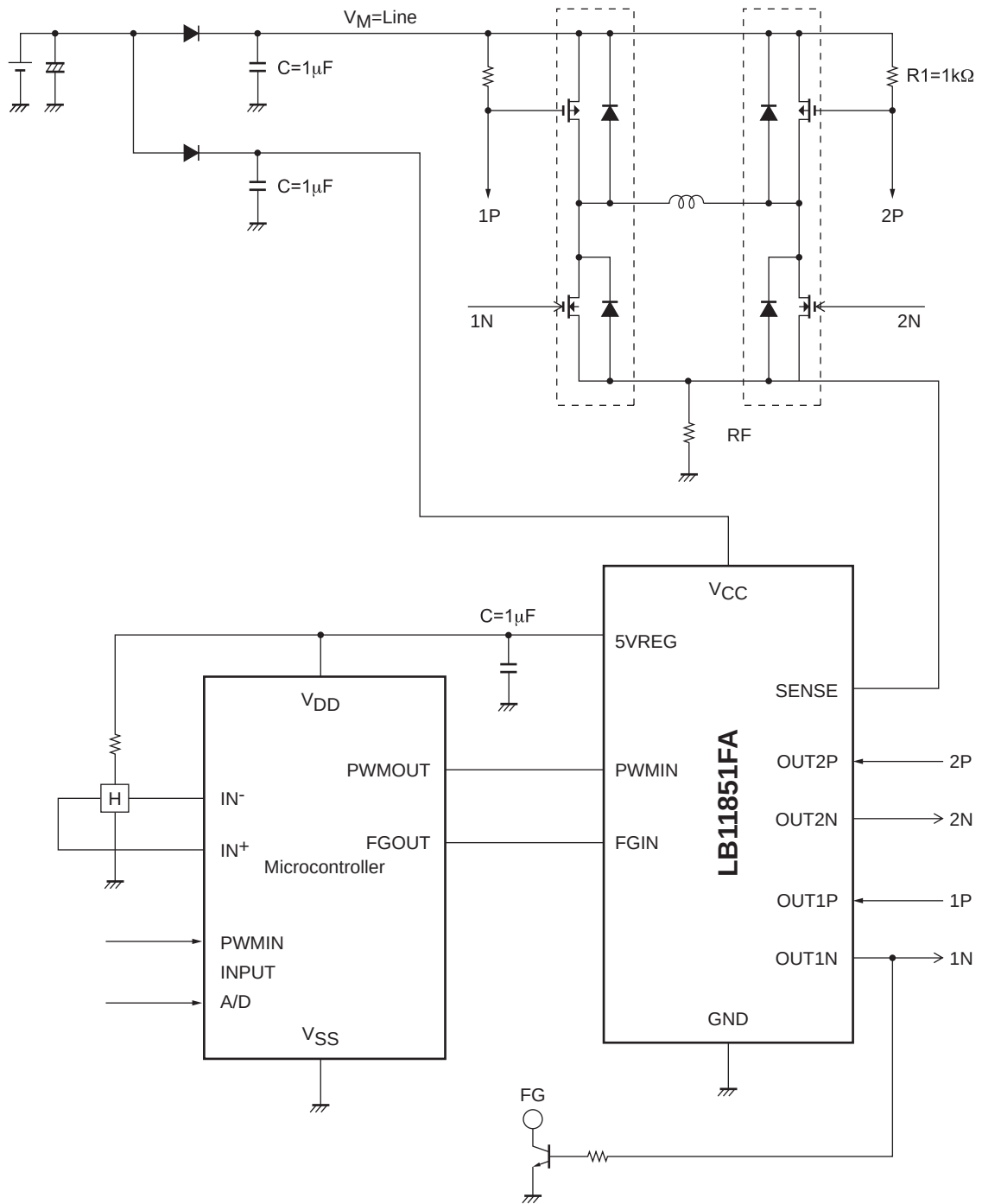
## Pin Assignment



## Block Diagram



Application Circuit Example (12V)



1. Power supply ( $V_{CC}$  and  $V_M$ ) and ground

The wiring is separated into the control IC side ( $V_{CC}$  line) and the motor output side ( $V_M$  line) by the diode DI, which protects the IC from destruction on reverse connection. The application circuit uses  $1\mu F$  capacitors to prevent line oscillation when kickback occurs. Similarly,  $1\mu F$  capacitors are also used on the  $V_{CC}$  line for power supply line stabilization.

2. PWMIN

The LB11851M accepts an open-drain output signal from the microcontroller with this pin and controls the on/off states of the PMOS transistor (OUT1P and OUT2P) outputs accordingly. A constant-current bias is provided from 5VREG internally to the IC.

3. FGIN

The LB11851M accepts a CMOS output from the microcontroller with this pin and determines the drive phase output (OUT1P, OUT2P, OUT1N, or OUT2N).

4. 5VREG

This is the power supply for the microcontroller, Hall effect sensors, and other circuits. A capacitor with a value of  $1\mu F$  is used for output stabilization. This pin has an output current capacity of 20mA.

5. SENSE

A sensing resistor is used for current detection. If the SENSE pin voltage exceeds 0.2V, the PMOS transistors are turned off and only low side regeneration is performed.

\*<OUT1, 2P output H voltage / OUT1, 2N output L voltage>

Output L voltage of OUT1 and 2 sticks in GND when FET is put up outside like the example of applied circuit by internal pull-down resistor ( $20k\Omega$ ), and there is no what turns on FET.

Output H voltage of OUT1 and 2 sticks in VCC with internal pull-up resistor ( $20k\Omega$ ) as the Pch side is also similar.

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