



LB11988N

Fan Motor Driver for Refrigerator Fans

Overview

The LB11988N is a fan motor driver IC that is optimal for driving the fans used in refrigerators.

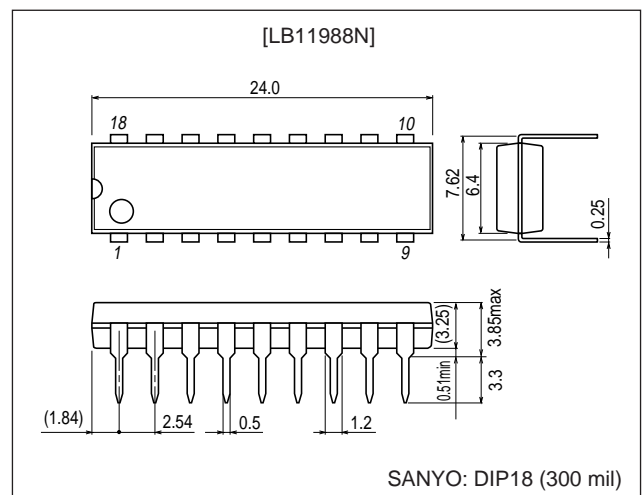
Functions

- Three-phase full-wave current linear drive
- Built-in current control circuit
- Output stage high side and low side saturation prevention circuit
- Forward/reverse direction setting circuit
- Built-in FG comparator
- Thermal shutdown circuit

Package Dimensions

unit: mm

3007B-DIP18 (300 mil)



Specifications

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

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------------------------|--------------|----------------|-------------|------------------|
| Maximum supply voltage | V_{CC} max | | 24 | V |
| | V_S max | | 24 | V |
| Maximum output current | I_O max | | 1.3 | A |
| Allowable power dissipation | P_d max | Independent IC | 1.13 | W |
| Operating temperature | T_{opr} | | -30 to +75 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -55 to +150 | $^\circ\text{C}$ |

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

| Parameter | Symbol | Conditions | Ratings | Unit |
|----------------------|------------------|-------------------------|----------------------|-------|
| Supply voltage | V_S | | 5 to 22 | V |
| | V_{CC} | | 7 to 22 | |
| | V_S conditions | | $V_S \leq V_{CC}$ | |
| Hall input amplitude | V_{HALL} | Between the Hall inputs | ± 30 to ± 80 | mVo-p |

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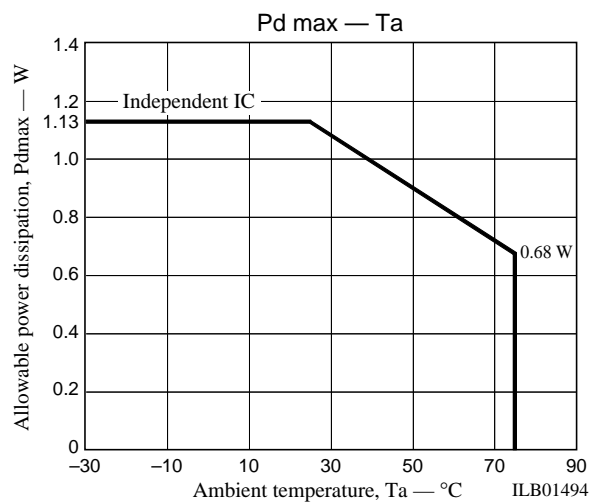
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Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = 12\text{ V}$, $V_S = 12\text{ V}$

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--|-------------------------------|---|---------|----------|--------------|------------------|
| | | | min | typ | max | |
| V_{CC} supply current | I_{CC} | V_S open | | 20 | 150 | μA |
| [Outputs] | | | | | | |
| Output saturation voltage | $V_{O\text{sat}1}$ | $I_O = 500\text{ mA}$, $R_f = 0.5\ \Omega$, Sink + Source (with saturation prevention) | | 2.1 | 2.6 | V |
| | $V_{O\text{sat}2}$ | $I_O = 1.0\text{ A}$, $R_f = 0\ \Omega$, Sink + Source (with saturation prevention) | | 2.6 | 3.5 | V |
| Output leakage current | $I_{O\text{leak}}$ | | | | 1.0 | mA |
| [Hall amplifier] | | | | | | |
| Input offset voltage | $V_{\text{off}}(\text{HALL})$ | | -6 | | +6 | mV |
| Input bias current | $I_b(\text{HALL})$ | $V_{\text{IN}}, W_{\text{IN}}$ | | 1 | 3 | μA |
| Common-mode input voltage | $V_{\text{cm}}(\text{HALL})$ | | 3 | | $V_{CC} - 3$ | V |
| [FR] | | | | | | |
| Threshold voltage | V_{FRTH} | | 1 | | 2 | V |
| Input bias current | $I_b(\text{FR})$ | | -5 | | | μA |
| [Current limiter] | | | | | | |
| LIM pin current limiter level | I_{LIM} | $R_f = 0.5\ \Omega$, with the Hall input logic state held fixed (U, V, W = H, H, L) | | 1 | | A |
| [Saturation] | | | | | | |
| Saturation prevention circuit low side voltage setting | $V_{O\text{sat}}(\text{DET})$ | $R_L = 560\ \Omega$ (Y), $R_f = 0.5\ \Omega$ The voltage between each OUT/RF pair. | | 0.28 | | V |
| [FG comparator] | | | | | | |
| Hysteresis | V_{hys} | | ± 8 | ± 18 | ± 28 | mV |
| Thermal shutdown circuit operating temperature | T_{TSD} | Design target value* | | 170 | | $^\circ\text{C}$ |

*: This is a design target value and is not measured.



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Truth Table and Control Function

| | Source → sink | Hall input | | | FR |
|---|---------------|------------|---|---|----|
| | | U | V | W | |
| 1 | V → W | H | H | L | H |
| | W → V | | | | L |
| 2 | U → W | H | L | L | H |
| | W → U | | | | L |
| 3 | U → V | H | L | H | H |
| | V → U | | | | L |
| 4 | W → V | L | L | H | H |
| | V → W | | | | L |
| 5 | W → U | L | H | H | H |
| | U → W | | | | L |
| 6 | V → U | L | H | L | H |
| | U → V | | | | L |

Note: The "H" state for FR is defined as a voltage of 8 V or higher, and the "L" state for FR is defined as a voltage of 4 V or lower (when V_{CC} is 12 V).

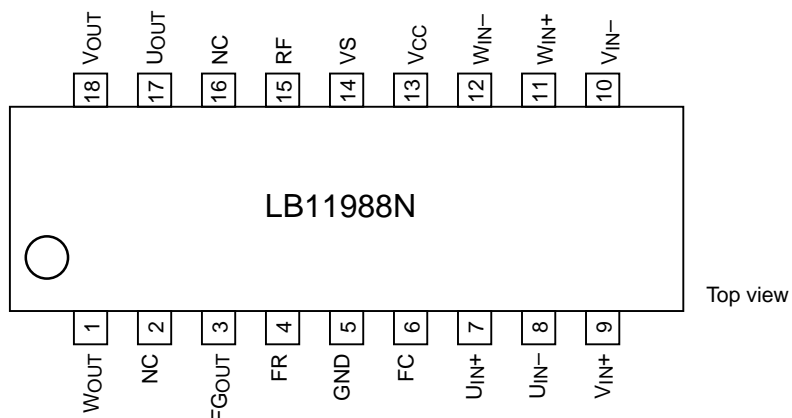
Note: For the Hall inputs, the input "H" state means the state in which the (+) input for that phase is at least 0.01 V higher than the (-) input for that phase. Similarly, the "L" state means the state in which the (+) input for that phase is at least 0.01 V lower than the (-) input for the that phase.

Note: Since this drive system adopts a 180° current application technique, phases other than the sink and source phase will not necessarily go to the off state.

Pin Functions

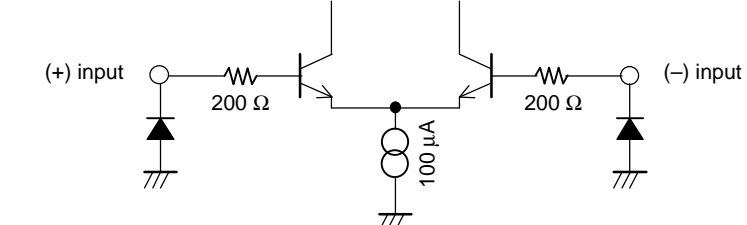
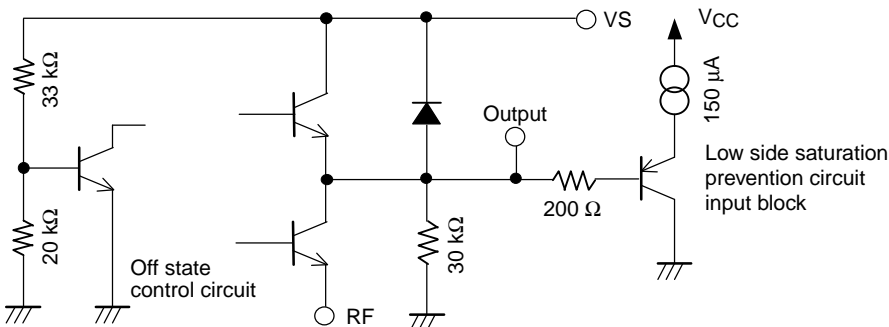
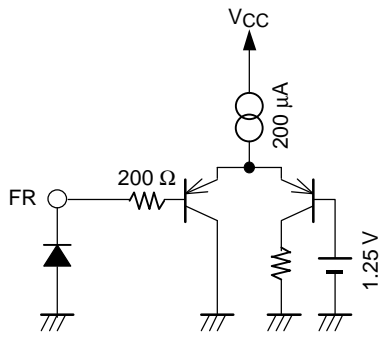
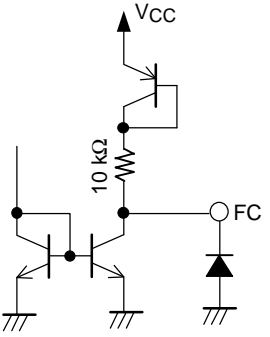
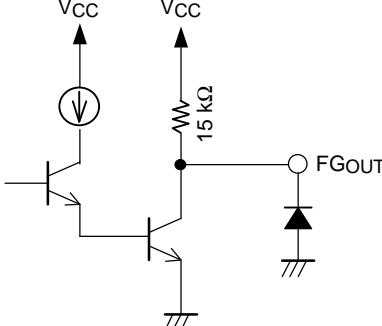
| Pin | Pin No. | Pin function |
|-------------------------------------|---------------|--|
| GND | 5 | Ground for circuits other than the output transistors. The lowest potential of the output transistors will be that of the RF pin. |
| FG-OUT | 3 | FG comparator output |
| FR | 4 | Forward/reverse direction switching input |
| FC | 6 | Corrects the frequency characteristics of the saturation prevention circuit and the current limiter circuit. |
| U_{IN+} , U_{IN-} | 7, 8 | U phase Hall element input. The logic high level indicates the state $IN+ > IN-$. |
| V_{IN+} , V_{IN-} | 9, 10 | V phase Hall element input. The logic high level indicates the state $IN+ > IN-$. |
| W_{IN+} , W_{IN-} | 11, 12 | W phase Hall element input. The logic high level indicates the state $IN+ > IN-$. |
| V_{CC} | 13 | Power supply for IC internal circuits other than the output block. This voltage must be stabilized so that ripple and noise do not enter the IC. |
| V_S | 14 | Output block power supply |
| Rf | 15 | Output current detection. The current limiter circuit operates using the resistor R_f connected between this pin and ground. The lower side saturation prevention circuit operates according to the voltage that appears on this pin. Since the saturation prevention level is set with this voltage, the operation of the low side saturation prevention circuit will become less sensitive if the value of the resistor R_f is reduced excessively. |
| U_{OUT} V_{OUT} W_{OUT} | 17 18 1 | U phase output V phase output W phase output } (Spark killer diodes are built in the output circuits.) |

Pin Assignments

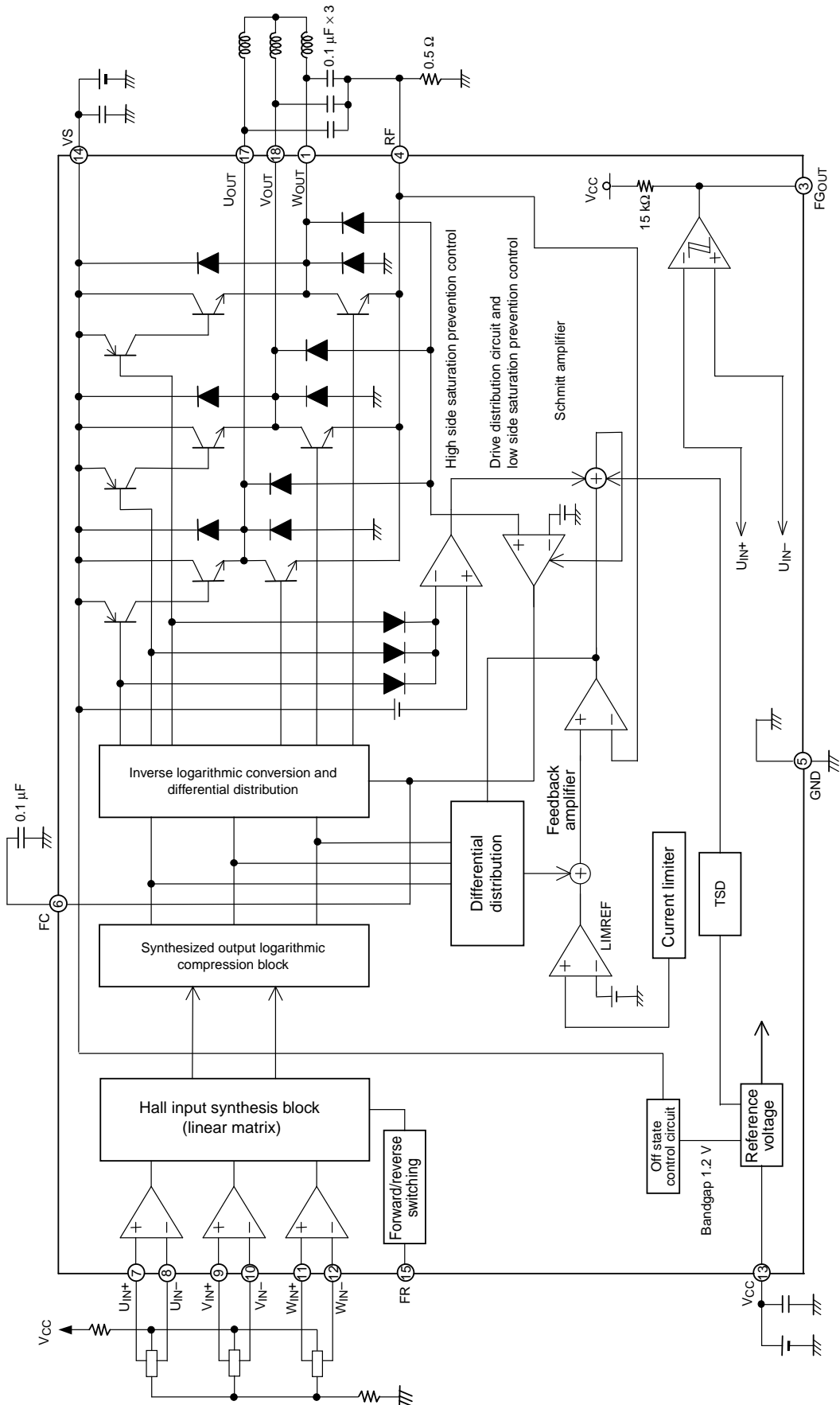


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Pin I/O Equivalent Circuits

| Pin | I/O equivalent circuit |
|--|--|
| <p>U_{IN} (+) U_{IN} (-) V_{IN} (+) V_{IN} (-) W_{IN} (+) W_{IN} (-)</p> |  <p>(+) input (-) input</p> <p>200 Ω 200 Ω</p> <p>100 μA</p> |
| <p>U-OUT V-OUT W-OUT RF VS</p> |  <p>VS Vcc</p> <p>33 kΩ 150 μA</p> <p>20 kΩ 200 Ω</p> <p>30 kΩ</p> <p>Output</p> <p>Off state control circuit</p> <p>RF</p> <p>Low side saturation prevention circuit input block</p> |
| <p>FR</p> |  <p>Vcc</p> <p>200 μA</p> <p>200 Ω</p> <p>FR</p> <p>1.25 V</p> |
| <p>FC</p> |  <p>Vcc</p> <p>10 kΩ</p> <p>FC</p> |
| <p>FGOUT</p> |  <p>Vcc Vcc</p> <p>15 kΩ</p> <p>FGOUT</p> |

Block Diagram



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