

**LB11988N****Fan Motor Driver for Refrigerator Fans****Overview**

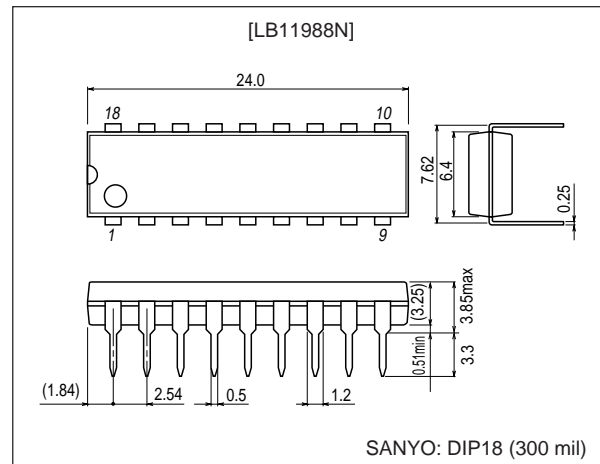
The LB11988N is a fan motor driver IC that is optimal for driving the fans used in refrigerators.

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 Ta = 25°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	°C
Storage temperature	T _{stg}		-55 to +150	°C

Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V _S		5 to 22	V
	V _{CC}		7 to 22	
	V _S conditions		V _S ≤ V _{CC}	
Hall input amplitude	V _{HALL}	Between the Hall inputs	±30 to ±80	mV _{o-p}

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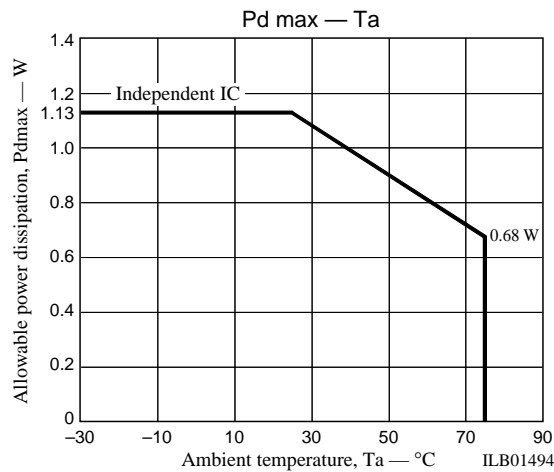
90503TN (OT) No. 7118-1/6

LB11988N

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_{IN} , W_{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.



LB11988N

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).

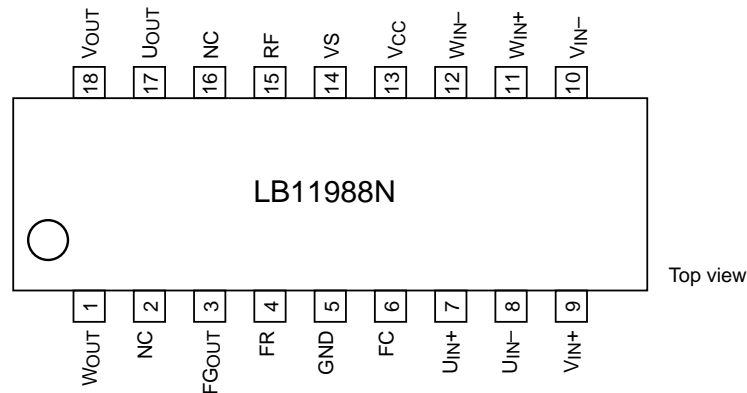
Note: For the Hall inputs, the input "H" state means the state in which the (+) input for that phase is at least 0.01 V higher than the (-) input for that phase. Similarly, the "L" state means the state in which the (+) input for that phase is at least 0.01 V lower than the (-) input for the that phase.

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.

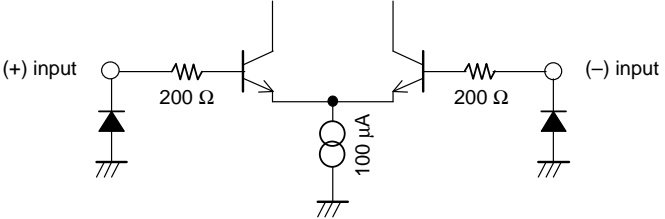
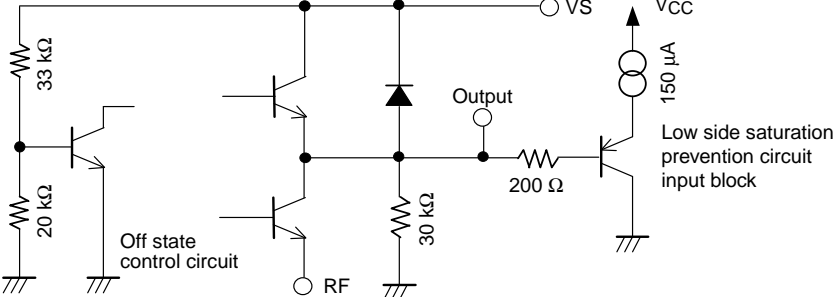
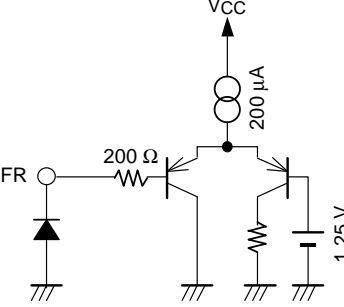
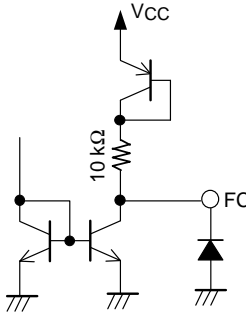
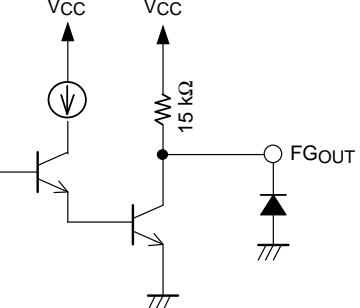
Pin Functions

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 Rf 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 Rf is reduced excessively.
U_{OUT}	17	U phase output } (Spark killer diodes are built in the output circuits.)
V_{OUT}	18	
W_{OUT}	1	

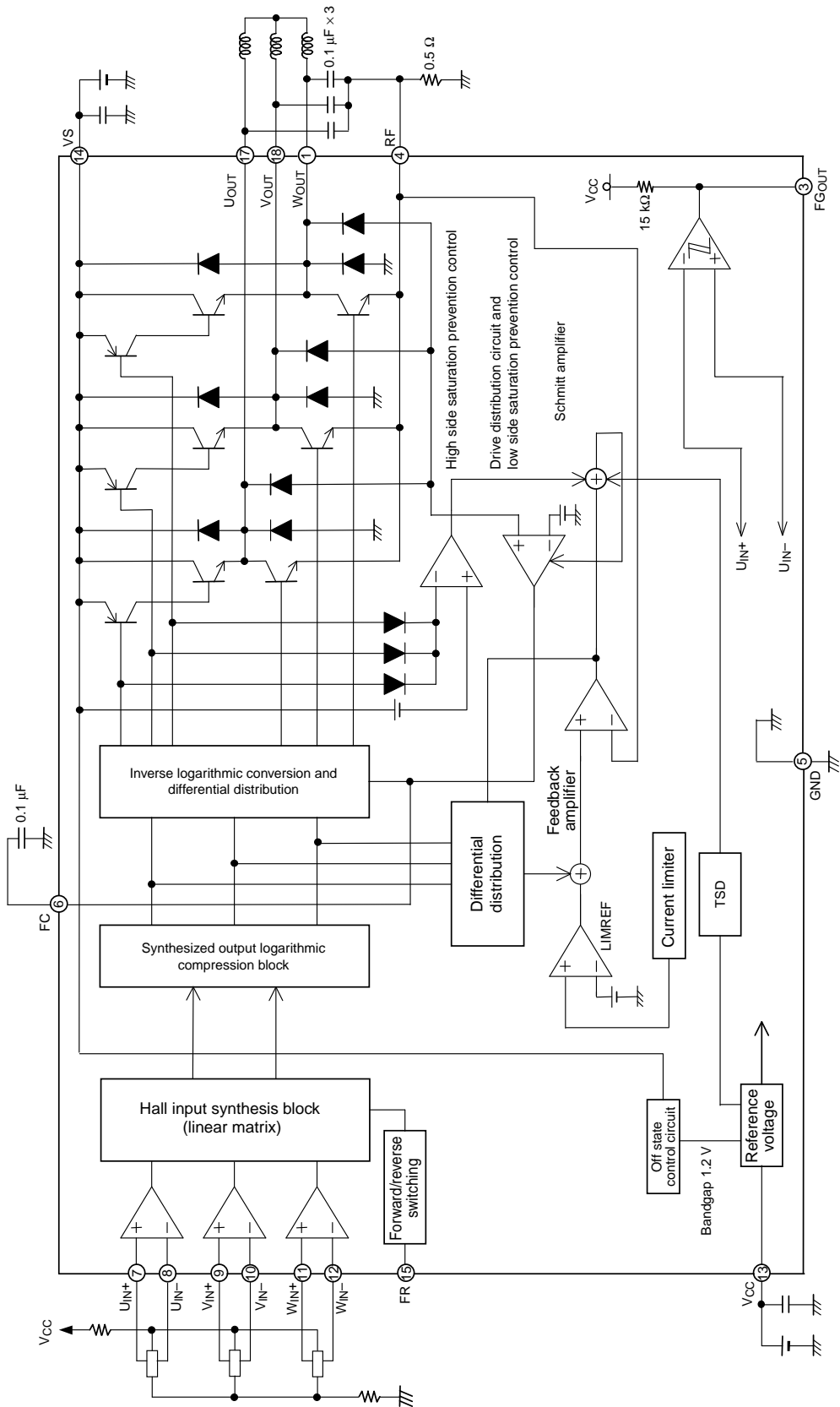
Pin Assignments



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>33 kΩ 20 kΩ</p> <p>Off state control circuit</p> <p>RF</p> <p>30 kΩ</p> <p>Output</p> <p>200 Ω</p> <p>VS</p> <p>V_{CC}</p> <p>150 μA</p> <p>Low side saturation prevention circuit input block</p>
<p>FR</p>	 <p>V_{CC}</p> <p>200 μA</p> <p>FR</p> <p>200 Ω</p> <p>1.25 V</p>
<p>FC</p>	 <p>V_{CC}</p> <p>10 kΩ</p> <p>FC</p>
<p>FG_{OUT}</p>	 <p>V_{CC} V_{CC}</p> <p>15 kΩ</p> <p>FG_{OUT}</p>

Block Diagram



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