

Single-phase DC Brushless Motor Driver IC

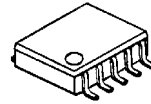
■ GENERAL DESCRIPTION

The NJU7343 is single-phase DC brushless motor driver IC designed for a small fan motor. Adopting the CMOS process, it can provide a low saturation output voltage that is effective in high current operation.

It has Lock Detect / Auto Reset and Thermal Shutdown Circuit for safety fan operation, and it has FG output function as useful function.

It is available in a small MSOP10 (VSP10) package, which makes motors thin and small. It is suitable for small and high output fan motor applications.

■ PACKAGE OUTLINE

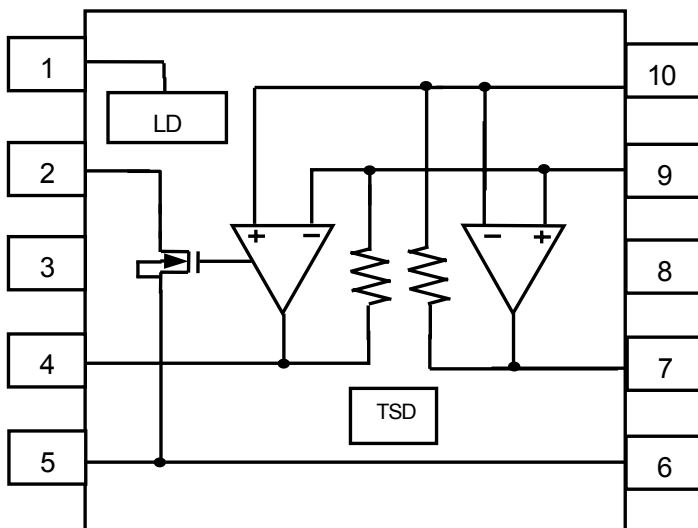


NJU7343R
(MSOP10 (VSP10))

■ FEATURES

- Operating Voltage 2.2 to 5.5V
- Lock Detect / Auto Release
- FG Output
- Thermal Shutdown Circuit
- Low Operating Current
- Low Saturation Output Voltage
- $V_{sat} = \pm 0.25V @ I_o = \pm 500mA$
- Input offset voltage $\pm 5mV$
- CMOS Technology
- Package Outline MSOP10 (VSP10)*
 *MEET JEDEC MO-187-DA

■ BLOCK DIAGRAM



■ PIN FUNCTION

- 1: Ct
- 2: FG
- 3: V_{DD}
- 4: OUT B
- 5: V_{SS}
- 6: V_{SS}
- 7: OUT A
- 8: V_{DD}
- 9: IN-
- 10: IN+

(Note)

All V_{DD} pins should be connected to the power supply and all V_{SS} pins should be connected to the ground respectively. Otherwise, the electrical characteristics may not satisfy specifications

NJU7343

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	RATINGS	SYMBOL (unit)	NOTE
Supply Voltage	+7.0	V _{DD} (V)	
Input Voltage	-0.3 ~ V _{DD} +0.3	V _{ID} (V)	
Output Current (Peak)	1000	I _{OPEAK} (mA)	
Operating Temperature Range	-40 ~ +85	Topr (°C)	
Junction Temperature Range	-40 ~+150	Toj (°C)	
Storage Temperature Range	-40 ~+150	Tstg (°C)	
Power Dissipation	400	P _D (mW)	Device itself

■ RECOMMENDED OPERATING CONDITIONS

(V_{DD} =5V, Ta=25°C)

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V _{DD}	Ct=0V	2.2	5.0	5.5	V
Junction Temperature Range	T _j	-	-40	-	125	°C
Input Common Mode Voltage Range	V _{ICM}	-	0.4	-	4.0	V
Output Current	I _O	-	-	-	500	mA

■ ELECTRICAL CHARACTERISTICS

($V_{DD}=5V, T_a=25^{\circ}C$)

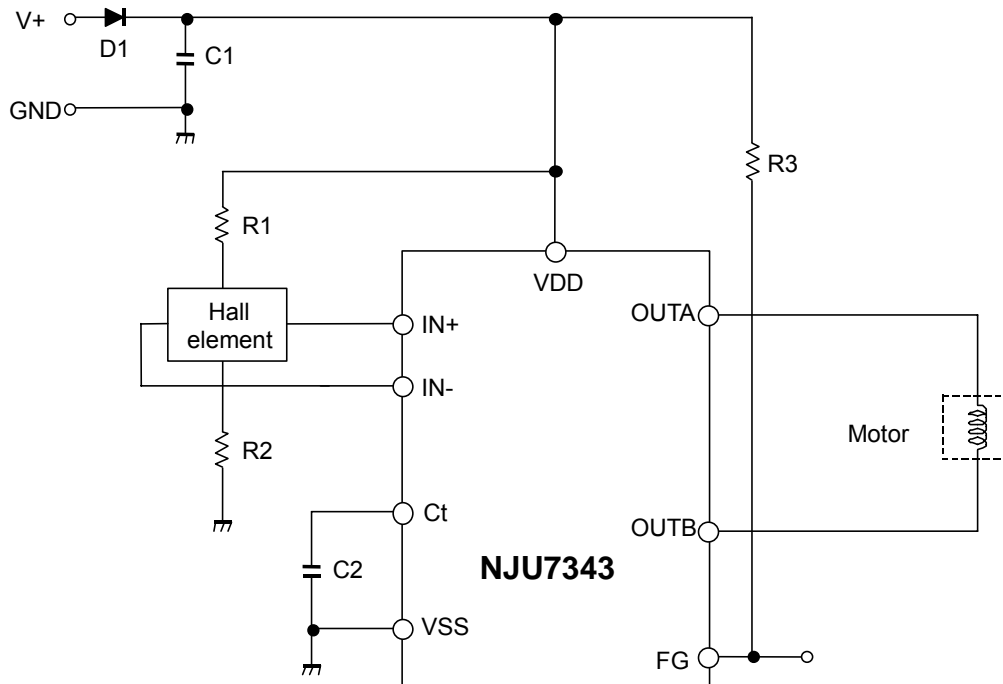
PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
General						
Operating Current	I_{DD}	-	-	3.0	4.0	mA
Thermal Shutdown Temperature	T_{TSD}	-	-	180	-	$^{\circ}C$
Thermal Shutdown Hysteresis	T_{HYS}	-	-	50	-	$^{\circ}C$
Hall Amplifier						
Input Offset Voltage	V_{IO}	-	-5	-	5	mV
Feedback Resistance	R_F	-	22.0	27.5	33.0	$k\Omega$
Open Loop Gain	A_V	-	-	80	-	dB
Input Common Mode Voltage Range	V_{ICM}	-	0.4 to 4.0	-	-	V
Motor Output						
Maximum Output Voltage Range	V_{OH}	$I_o=+350mA$	4.65	4.75	-	V
	V_{OL}	$I_o=-350mA$	-	0.25	0.35	
Output Resistance	R_{ONH}	$I_o=+500mA$	-	0.5	-	Ω
	R_{ONL}	$I_o=-500mA$	-	0.5	-	
Lock Detect Circuit						
Lock Detect Charge Current	I_{CHG}	-	-	0.6	-	μA
Lock Detect Discharge Current	I_{DCHG}	-	-	0.1	-	μA
Clamp Voltage	V_{CL}	-	-	2.8	-	V
Detect Voltage	V_{ID}	-	-	0.8	-	V
Rotation Detect Output						
FG L Output Voltage	V_{FG}	$IN+(10pin)=0V, IN-(9pin)=5V, R_F=10k\Omega$	-	-	0.3	V
FG H Leak Current	$I_{FG-LEAK}$	$IN+(10pin)=5V, IN-(9pin)=0V, R_F=10k\Omega$	-	-	1.0	μA

NJU7343

APPLICATION NOTE

The NJU7343 is single-phase DC brushless motor driver ICs in a small MSOP10 (VSP10) package. With minimal external components, that can drive up to 500mA of motor current for small fan application.

[Application Circuit Example]



[Design Notes]

Above application example is designed for 5V operation with motor current of 500mA. It uses the following components:

Hall elements: HW101A (AKE)

1. Selection of C1 and D1:

C1 is used for a noise reduction purpose. A typical value is 0.1uF.

Optimize the value in actual operating conditions if necessary. D1 is a diode for protection against reverse voltage supply. Silicon rectifier diode is appropriate.

2. Lock Protection Function (Design of C2 value):

Lock Protection Function, consists of Motor Lock Detection and Auto Resume Function, is a safety feature to protect a motor and a driver circuit from fatal destruction in case of motor halt.

Motor Lock Detection detects motor halt due to irregular load conditions and then cuts motor driving current for safety operation. A value of C2 determines Lock detection time (T_{on}) and Auto Resume Time (T_{off}).

Lock detection time (T_{on}) is given by:

$$T_{ON} = C2 \frac{V_{CL} - V_{ID}}{I_{ch}} [\text{sec}]$$

Where C2 is 0.15uF:

$$T_{ON} = 0.15 \times 10^{-6} \times \frac{2.8 - 0.8}{0.6 \times 10^{-6}} = 0.49[\text{sec}]$$

Auto Resume Time (Toff) is given by:

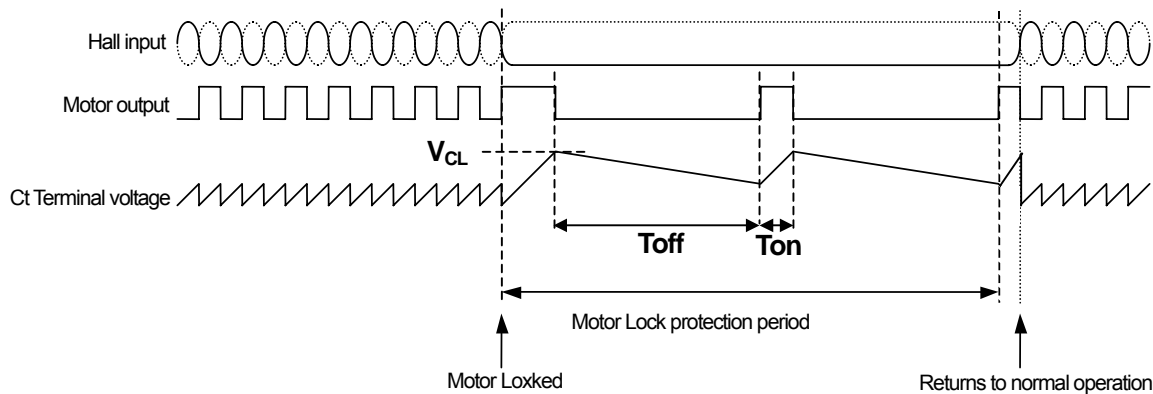
$$T_{OFF} = C2 \frac{V_{CL} - V_{ID}}{I_{dis}} [\text{sec}]$$

Where C2 is 0.15uF:

$$T_{OFF} = 0.15 \times 10^{-6} \times \frac{2.8 - 0.8}{0.1 \times 10^{-6}} = 3.00[\text{sec}]$$

In actual application, Lock detection time (Ton) is affected by the mechanical time constant of a motor. Therefore, constant start up must be confirmed in actual evaluation taking operating variations (i.e. Temperature, Voltage change and so on) in consideration.

A typical value of C2 is either from 0.1uF to 0.47uF depending on a motor.



*Remarks : When V_{DD} becomes lower than 4V, the Clamp Voltage (V_{CL}) becomes lower accordingly. This makes Ton and Toff shorter and may cause issues associated with the restarting of the motor from the lock protection state. Therefore, careful evaluation is necessary with actual motors.

3. Design of hall element bias resistance (R1 and R2)

Hall amplifier is a differential amplifier.

The common-mode input voltage is between 0.4V and V_{DD}-1V and the input signal must be within the range.

Non-excitation hall bias voltage is to be set at a half of V_{DD} for effective use of common-mode input voltage range. Therefore the same value of hall bias resistors is selected for R1 and R2.

Given that the bias current is set to be 5mA by HW101A datasheet, R1 and R2 can be determined as follows:

$$R1 + R2 + R_{in} = \frac{V_{DD}}{I_{hbias}} = \frac{5}{5 \times 10^{-3}} = 1.0k\Omega$$

$$R1 = R2 = 300\Omega$$

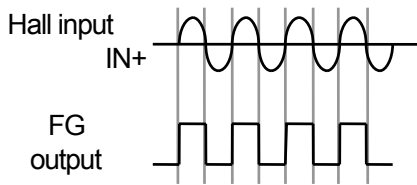
The output voltage of hall elements is influenced by the bias current and magnetic flux density of hall elements.

The optimum input voltage of NJU7343 is 100mVp-p and higher. With such input voltage, the highest efficiency can be obtained.

4. Design of FG output resistance (R3)

FG Out (FG: Pin2) is an open drain output and R3 is a pull up register. A typical value of R3 is 10kΩ.

The timing chart is as follows.



[CAUTION]
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