

Single-phase DC Brushless Motor Driver IC

■ GENERAL DESCRIPTION

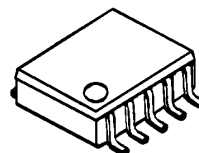
The NJU7343/ 44/ 45 are single-phase DC brushless motor driver IC. That features MOS-FET driver circuit for better output characteristics.

The drivers includes Lock Detect and Thermal Shutdown Circuit. Each of the drivers includes FG output (NJU7343), Half FG output (NJU7344), and RD output (NJU7345).

Maximum output current is 500mA and Input offset voltage is $\pm 7\text{mV}$.

It is suitable for 5V high current small fan-motor applications.

■ PACKAGE OUTLINE

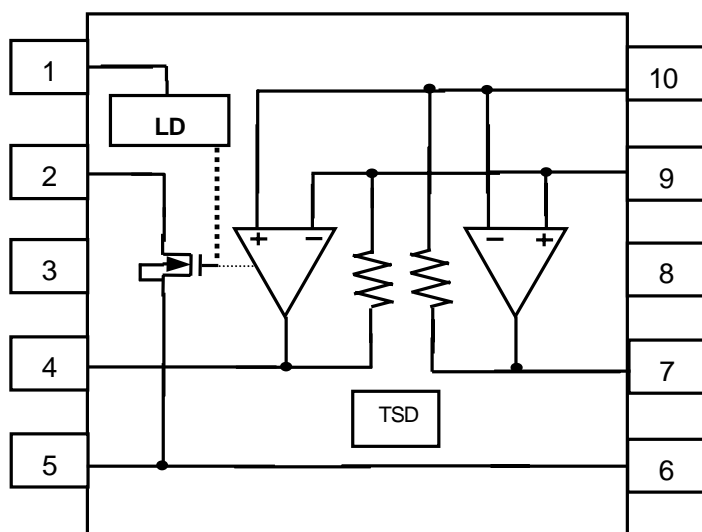


NJU7343R/44R/45R

■ FEATURES

- Operating Voltage 2.2 to 5.5V
- Lock Detect / Auto Release
- Control Output Terminal
 - NJU7343:FG(Frequency Generator)
 - NJU7344:Half FG
 - NJU7345:RD(Rotation Detect)
- Thermal Shutdown Circuit
- Low Operating Current
- Low Saturation Output Voltage
- $V_{\text{sat}} = \pm 0.25\text{V}$ @ $I_o = \pm 500\text{mA}$
- Input offset voltage $\pm 5\text{mV}$
- CMOS Technology
- Package Outline VSP10

■ BLOCK DIAGRAM



..... NJU7343(FG), NJU7344(Half FG)
 NJU7345(RD)

■ PIN FUNCTION

- 1: Ct
- 2: FG(NJU7343), Half FG(NJU7344), RD(NJU7345)
- 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} and V_{SS} pins should be connected the power supply and the ground respectively. Otherwise, the electrical characteristic may not satisfy specifications

■ 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	$I_{O\ PEAK}$ (mA)	
Operating Temperature Range	-40 ~ +85	T_{opr} (°C)	
Storage Temperature Range	-50 ~ +150	T_{stg} (°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=0	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

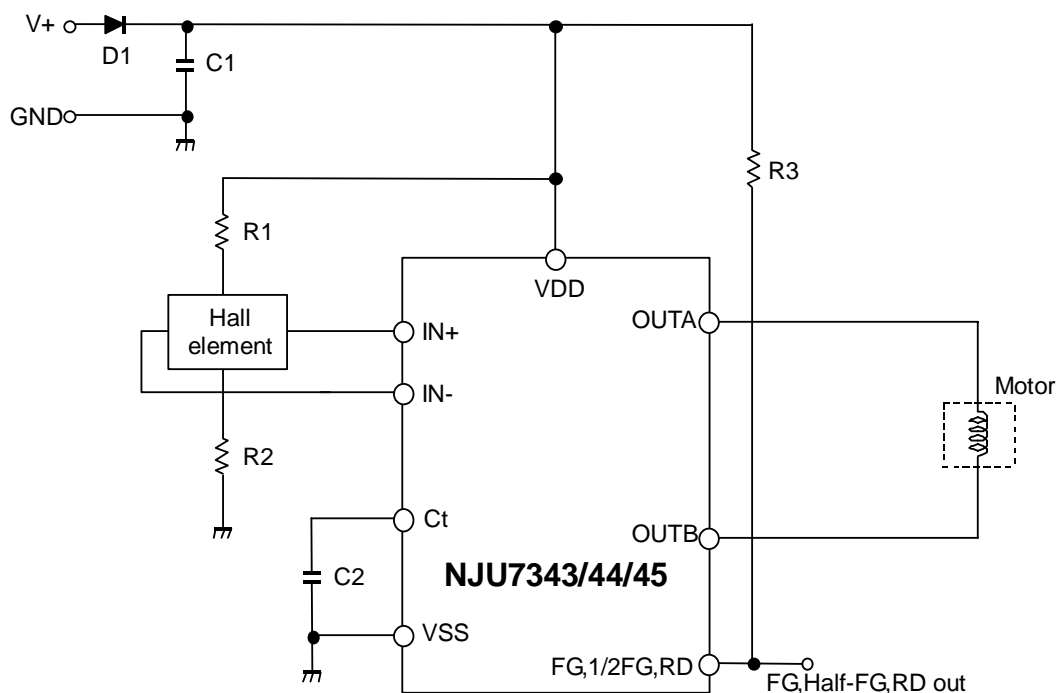
($V_{DD}=5V$, $T_a=25^{\circ}C$)

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 Ω
Open Loop Gain	A_V	-	-	80	-	dB
Input Common Mode Voltage Range	V_{ICM}	-	0.4-4.0	-	-	V
Output						
Maximum Output Voltage Range	V_{OH}	$I_O=+350mA$	4.65	4.80	-	V
	V_{OL}	$I_O=-350mA$	-	0.20	0.35	
Output Resistance	R_{ONH}	$I_O=+500mA$	-	0.5	-	Ω
	R_{ONL}	$I_O=-500mA$	-	0.5	-	
FG(RD) L Output Voltage	V_{FG}	9pin=0V, 10pin=5V, $R_3=10k\Omega$	-	-	0.3	V
FG(RD) H Leak Current	$I_{FG-LEAK}$	9pin=5V, 10pin=0V, $R_3=10k\Omega$	-	-	1.0	μA
Lock Detect Circuit*						
Lock Protect Operation Voltage	V_{LOP}	-	4.0	-	-	V
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

■ APPLICATION NOTE

The NJU7343/44/45 are single-phase DC brushless motor driver IC in small VSP-10 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 (WO3C, 10D1 and equivalent) 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:

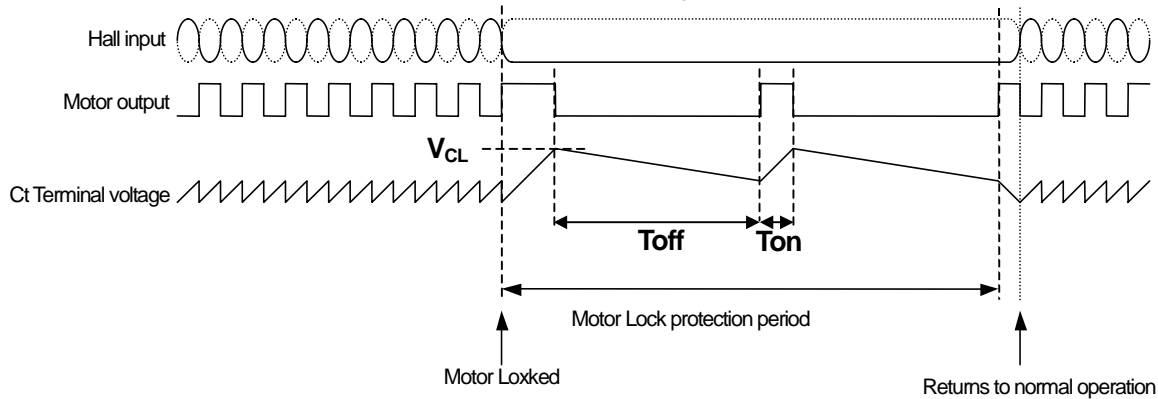
$$T_{OFF} = C2 \frac{V_{CL} - V_{ID}}{I_{dis}} [\text{sec}]$$

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.

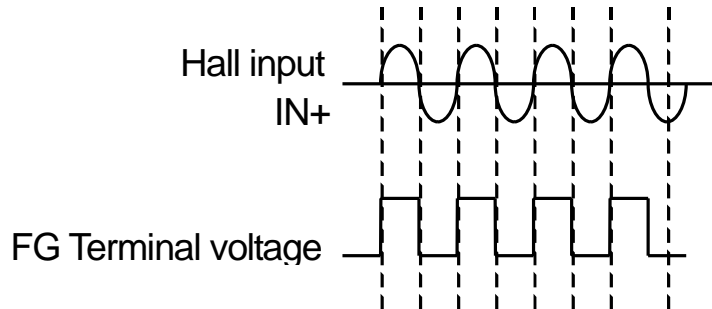
The optimum input voltage of NJU7343/44/45 are 100mVp-p and higher. With such input voltage, the highest efficiency can be obtained.

4. Design of FG output resistance (**R3**)

FG Out (FG: Pin8) is an open drain output and R3 is a pull up register. A typical value of R3 is 10k Ω .

The timing chart of FG Out (Half-FG, RD) is as follows.

Note that the pull up resistance shall be connected to below supply voltage.



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