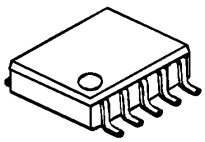
Single-phase DC Brushless Motor Driver IC

■ GENERAL DESCRIPTION

The NJU7327 is a single-phase DC brushless motor driver IC for small fan-motor and high power applications. It features MOS-FET driver circuit for better saturation characteristics. Slew late of amplifiers and feedback resistors are optimized to achieve low-noise motor operation. The NJU7327 also includes frequency generator (FG) output for various control needs.

■ PACKAGE OUTLINE

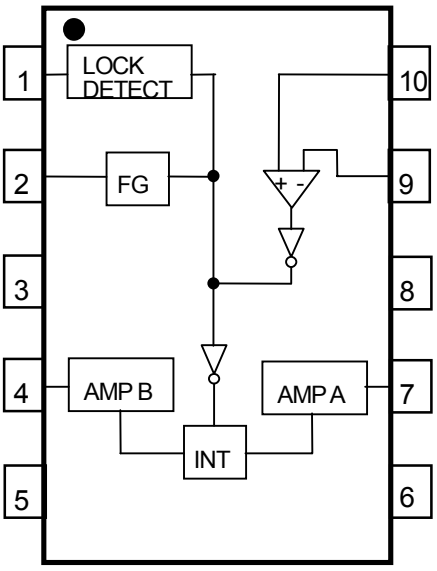


NJU7327R

■ FEATURES

- Operating Voltage V_{DD}=3.5 ~ 15V
- FG Output
- Internal Lock Detect
- Low Operating Current
- Low Saturation Output Voltage
  Vsat=±0.35V @Io=±200mA
- C-MOS Technology
- Package Outline VSP10

■ BLOCK DIAGLAM



■ PIN FUNCTION

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

■ ABUSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	RATINGS	SYMBOL (unit)	NOTE
Supply Voltage	+18	V_{DD} (V)	
Input Voltage	-0.3 ~ V_{DD}+0.3	V_{ID}(V)	
Operating Temperature Range	-40 ~ +85	Topr (°C)	
Storage Temperature Range	-50 ~ +150	Tstg (°C)	
Power Dissipation	400	P_D (mW)	Device itself

■ RECOMMENDED OPERATING CONDITIONS

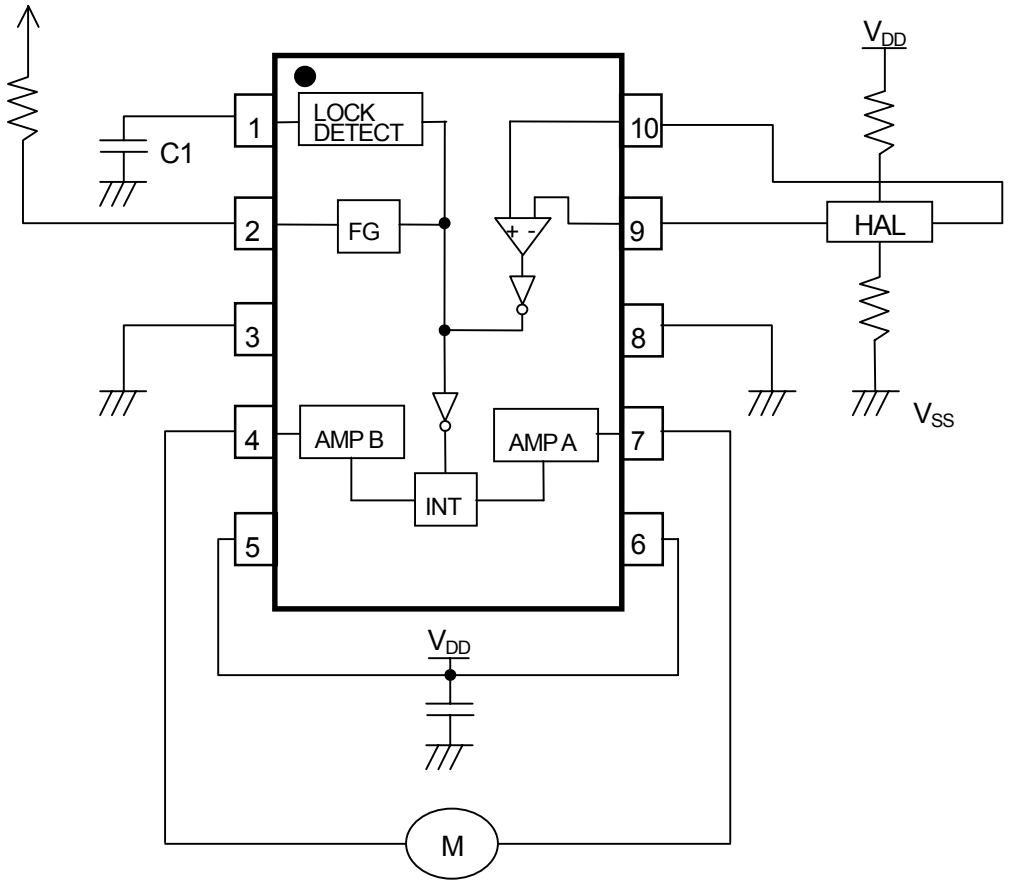
V_{DD}=3.5V~15.0V

■ ELECTRICAL CHARACTERISTICS

(V_{DD}=12V, Ta=25°C)

PARAMETER	SYSMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Current	I_{DD}	No load	-	3.0	4.0	mA
Input Offset Voltage	V_{IO}	1V bias	-15	-	15	mV
Input Common Mode Voltage Range	V_{ICM}	-	0.2	-	8.0	V
Maximum Output Voltage Range	V_{OM}	Io=+200mA	11.55	11.70	-	V
		Io= -200mA	-	0.30	0.45	
Slew Rate	SR	RL=58.6Ω	46.2	60.0	85.7	mV/μS
Lock Detect Charge Current	I_{CH}	-	0.70	1.25	2.25	μA
Lock Detect Discharge Current	I_{DIS}	-	0.20	0.40	0.80	μA
Clamp Voltage	V_{CL}	-	2.5	2.6	2.7	V
Detect Voltage	V_{LD}	-	0.54	0.60	0.66	V
FG H Leak Current	I_{FGLEAK}	IN+=12V,IN-=0V, R_P=10kΩ	-	-	1.0	μA
FG L Voltage	V_{FGL}	IN+=0V,IN-=12V,R_P=10kΩ	-	-	0.3	V

■ APPLICATION CIRCUIT

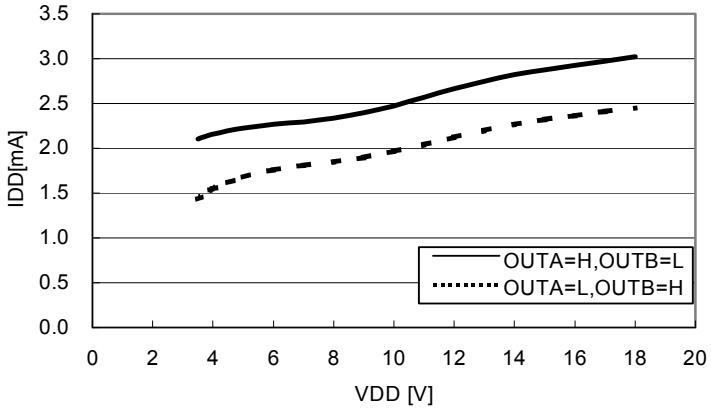


• Connect the decoupling capacitor between V_{DD} and V_{SS}.

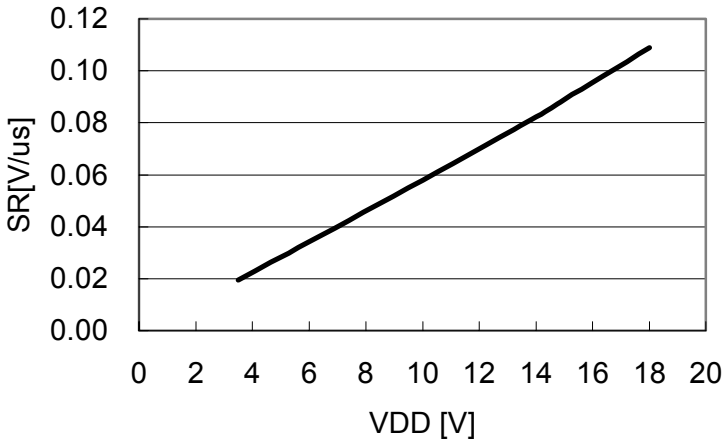
■ TYPICAL CHARACTERISTICS

IDD - VDD

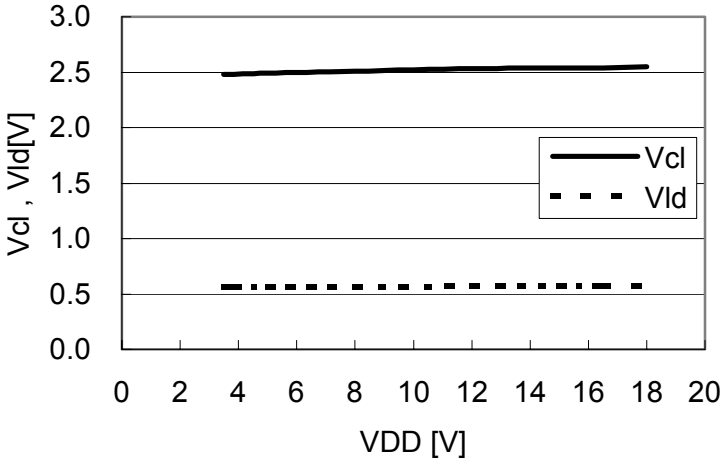
No Load LD=VSS FG:OPEN



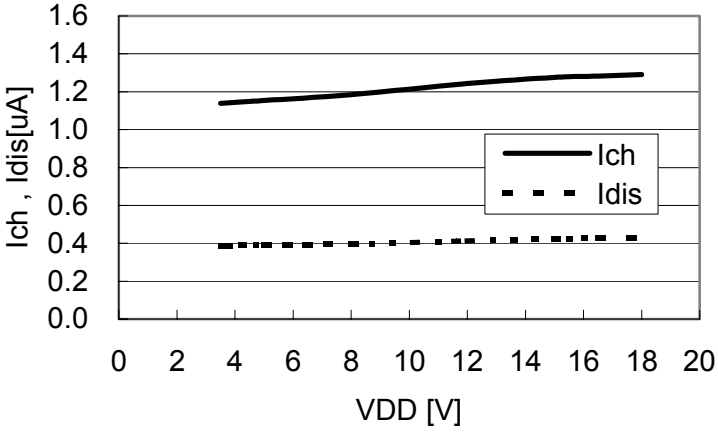
SR - VDD



Vcl , Vld - VDD

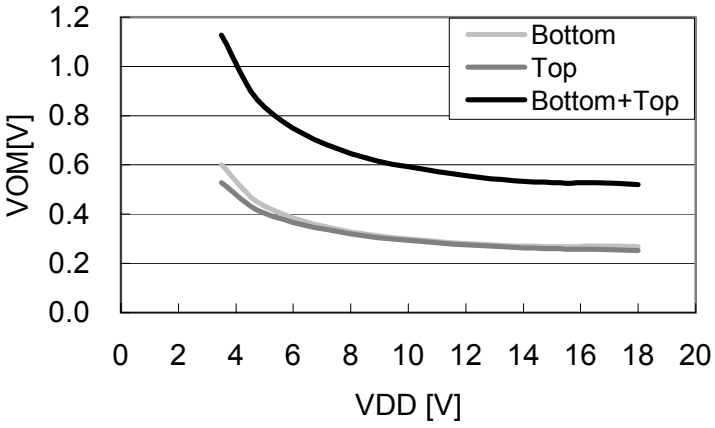


Ich , Idis - VDD



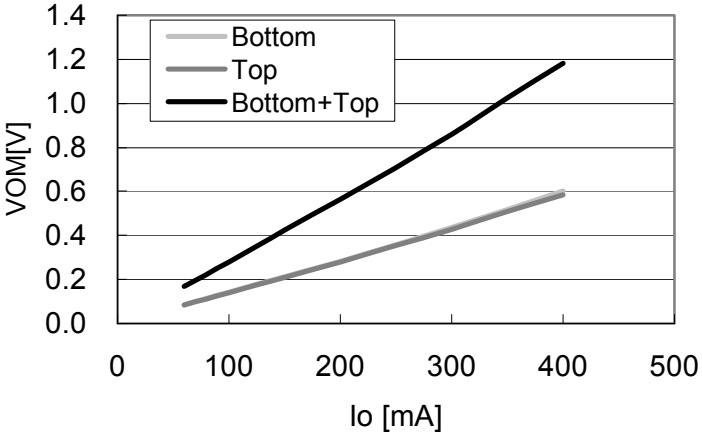
VOM - VDD

Io=200mA



VOM - Io

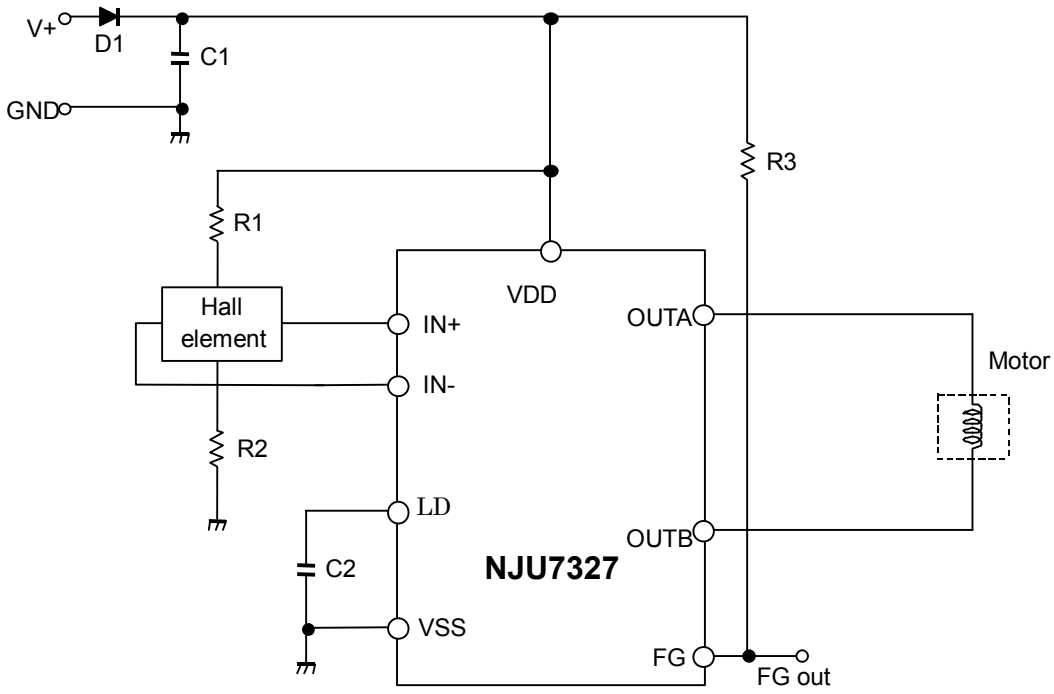
VDD=12V



■ APPLICATION NOTE

The NJU7327 is a single-phase DC brushless motor driver IC in small VSP-10 package.
With minimal external components, it can drive up to 200mA of motor current for small fan application.

[Application Circuit Example]



[Design Notes]

Above application example is designed for 12V operation with motor current of 200mA. 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 f or safety operation. A value of C2 determines Lock detection time () and Auto Resume Time (Toff).

Lock detection time (Ton) is given by:

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

Where C2 is 0.47uF:

$$T_{ON} = 0.47\times10^{-6}\times\frac{2.6-0.6}{1.26\times10^{-6}} = 0.76[\text{sec}]$$

Auto Resume Time (Toff) is given by:

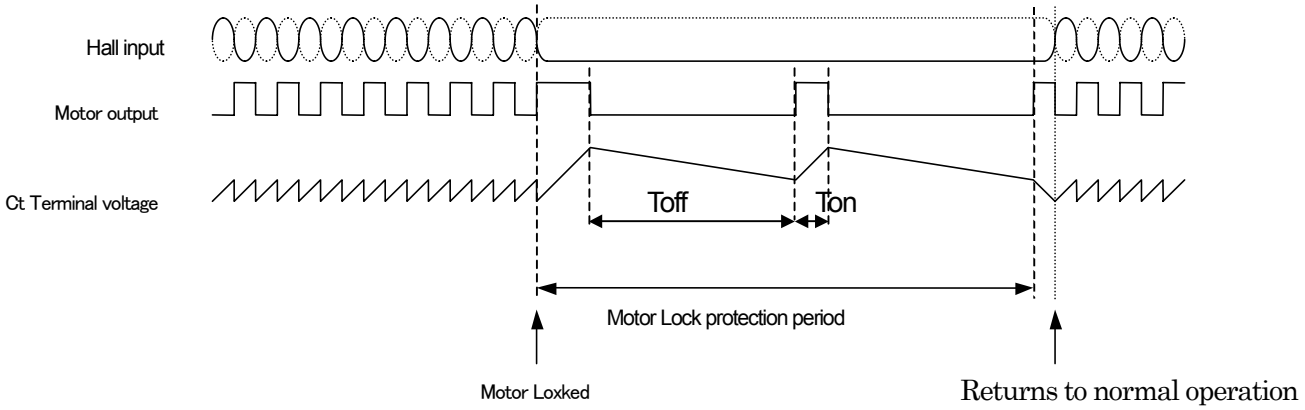
$$T_{OFF} = C2\frac{V_{CL} - V_{ID}}{Idis}[\text{sec}]$$

Where C2 is 0.47uF:

$$T_{OFF} = 0.47\times10^{-6}\times\frac{2.6-0.6}{0.42\times10^{-6}} = 2.33[\text{sec}]$$

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 0.47uF or 1uF depending on a motor.



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 VDD-1V and the input signal must be within the range.
Non-excitation hall bias voltage is to be set at a half of VDD 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:

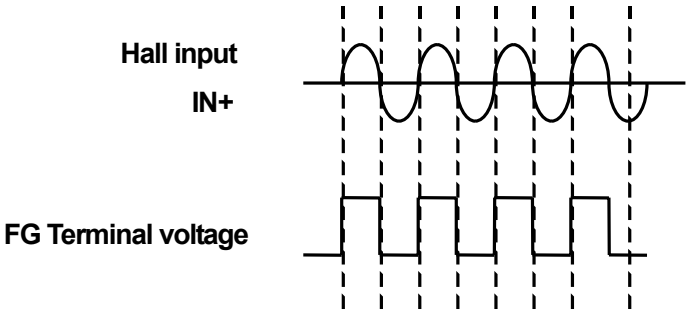
$$R1 + R2 + Rin = \frac{VDD}{Ihbias} = \frac{12}{5 \times 10^{-3}} = 2.4k\Omega$$

$$R1 = R2 = 1k\Omega$$

The output voltage of hall elements is influenced by the bias current and magnetic flux density of hall elements.
The optimum input voltage of NJU7327 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: Pin8) is an open drain output and R3 is a pull up register. A typical value of R3 is 10kΩ.
The timing chart of FG Out is as follows.
Note that the pull up resistance shall be connected to below supply voltage.



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Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:
moschip.ru
moschip.ru_4
moschip.ru_6
moschip.ru_9