

# Single-phase DC Brushless Motor Driver IC

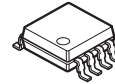
## ■ GENERAL DESCRIPTION

The NJU7357 is a single-phase DC brushless motor driver IC designed for small and high power fan-motor applications.

It provides a low operating current of 2mA (typ.) and low saturation output voltage at high output current operation, which offers high efficiency motor driving. It also has a high output current capability of 1000mA (peak) and 400mA (continuous).

The NJU7357 has useful functions such as a FG (frequency generator) output useful for various control systems, lock detect, auto-release (c-less type), thermal shutdown, linear driving which offers low noise motor driving and direct input of PWM signal for revolution speed control. The NJU7357 is available in a small and thin package of MSOP8 (TVSP8), which provides downsizing and thinning in motor applications.

## ■ PACKAGE OUTLINE



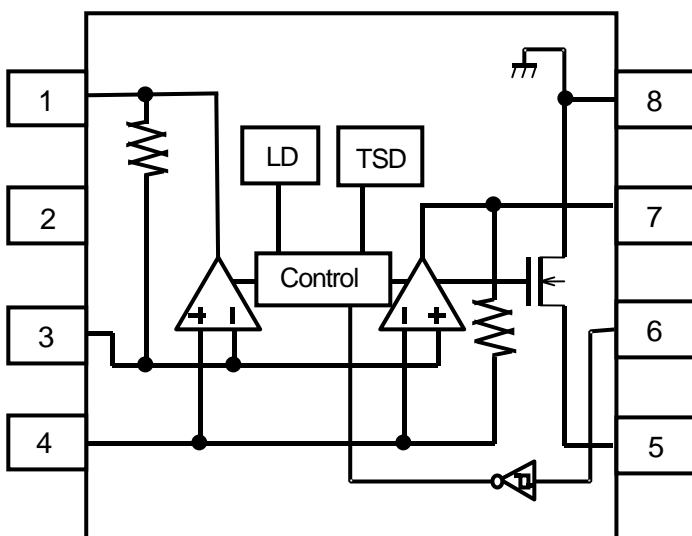
**NJU7357RB1**  
( MSOP8 (TVSP8) )

## ■ FEATURES

- Operating Voltage                    2.2 to 5.5V
- Low Operating Current             $I_{DD}=2mA$
- Low Saturation Output Voltage  
    $V_{sat}= \pm 0.2V @ I_o=\pm 400mA$
- Lock Detect / Auto Release Circuit (Condenser less type)
- Thermal Shutdown Circuit
- Frequency Generator Output
- CMOS Technology
- Package Outline                    MSOP8 (TVSP8)\*

\*MEET JEDEC MO-187-DA/ THIN TYPE

## ■ BLOCK DIAGRAM



## ■ PIN FUNCTION

- 1: OUT B
- 2: V<sub>DD</sub>
- 3: IN +
- 4: IN -
- 5: FG
- 6: PWM\_IN
- 7: OUT A
- 8: V<sub>SS</sub>

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## ■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	RATINGS	SYMBOL (unit)	NOTE
Supply Voltage	+7.0	V <sub>DD</sub> (V)	
Input Voltage	-0.3 to V <sub>DD</sub>	V <sub>ID</sub> (V)	(*1)
Output Current (Peak)	1000	I <sub>O PEAK</sub> (mA)	(*2)
Operating Temperature Range	-40 to +85	T <sub>opr</sub> (°C)	
Storage Temperature Range	-50 to +150	T <sub>stg</sub> (°C)	
Power Dissipation	400	P <sub>D</sub> (mW)	Device itself
Junction Temperature	150	T <sub>jmax</sub> (°C)	

(\*1). Input voltage is not to be over supply voltage to really use.

(\*2). This value is not to be over Pd.

## ■ RECOMMENDED OPERATING CONDITIONS

(Ta=25°C)

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V <sub>DD</sub>	-	2.2	5.0	5.5	V

## ■ ELECTRICAL CHARACTERISTICS

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

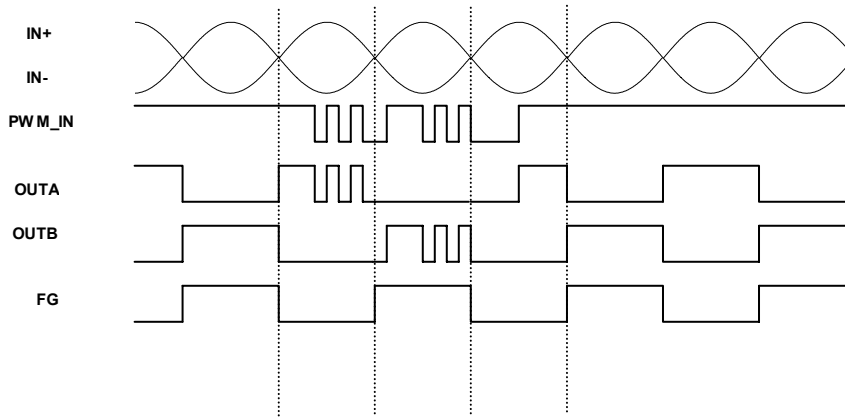
PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
<b>General</b>						
Operating Current	$I_{DD}$	-	-	2.0	5.0	mA
Thermal Shutdown Temperature	$T_{TSD}$	-	-	180	-	$^{\circ}C$
Thermal Shutdown Hysteresis	$T_{HYS}$	-	-	50	-	$^{\circ}C$
<b>Hall Amplifier</b>						
Input Offset Voltage	$V_{IO}$	-	-10	-	10	mV
Feedback Resistance	$R_F$	-	-	27.5	-	$k\Omega$
Open Loop Gain	$A_V$	-	-	70	-	dB
Input Common Mode Voltage Range	$V_{ICM}$	-	0.4	-	4.0	V
<b>Output</b>						
Maximum Output Voltage Range	$V_{OH}$	$I_o=+400mA$	4.65	4.80	-	V
	$V_{OL}$	$I_o=-400mA$	-	0.20	0.35	
Output Resistance	$R_{ONH}$	$I_o=+400mA$	-	0.5	-	$\Omega$
	$R_{ONL}$	$I_o=-400mA$	-	0.5	-	
FG L Output Voltage	$V_{FG}$	$IN+=5V, IN-=0V, RL=10\Omega$	-	-	0.3	V
FG H Leak Current	$I_{FG-LEAK}$	$IN+=0V, IN-=5V, FG=5V$	-	-	1.0	$\mu A$
<b>Lock Detect Circuit*</b>						
Lock Protect ON Time	$T_{ON}$	-	-	0.4	-	sec
Lock Protect OFF Time	$T_{OFF}$	-	-	2.8	-	sec
Detect Protection ON/OFF Ratio	$TV_{RATIO}$	-	-	1:7	-	-
<b>PWM Input</b>						
PWM Input Frequency Ratio	$F_{PWM}$	-	16	-	50	kHz
PWM pull-up Resistance	$R_{PWM}$	-	-	50	-	$k\Omega$
Input H Level Voltage	$V_{IHP}$	-	$0.7V_{DD}$	-	$V_{DD}$	V
Input L Level Voltage	$V_{ILP}$	-	-	-	$0.3V_{DD}$	V

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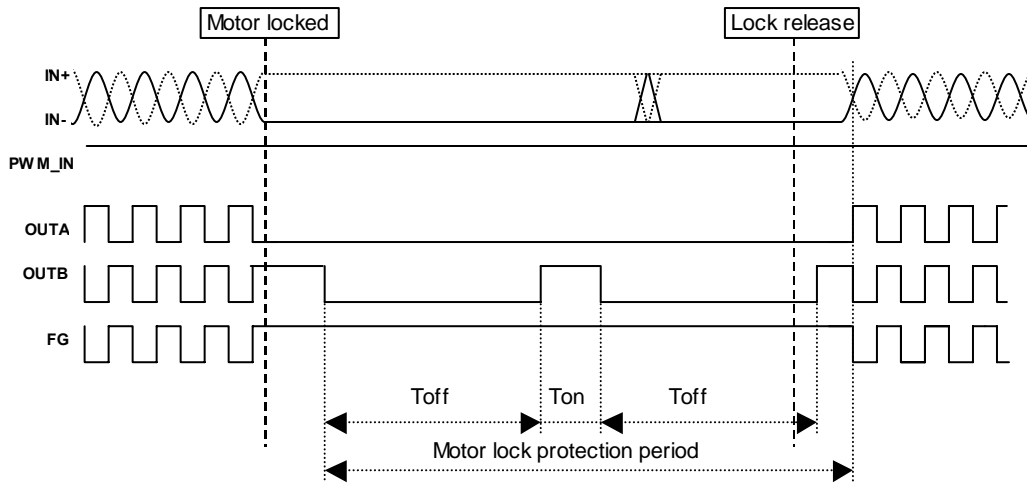
## ■ INPUT-OUTPUT TRUTH TABLE

IN+	IN -	PWM	OUTA	OUTB	FG
H	L	H	H	L	L (Output Transistor ON)
L	H	H	L	H	Z (Output Transistor OFF)
H	L	L	L	L	L (Output Transistor ON)
L	H	L	L	L	Z (Output Transistor OFF)

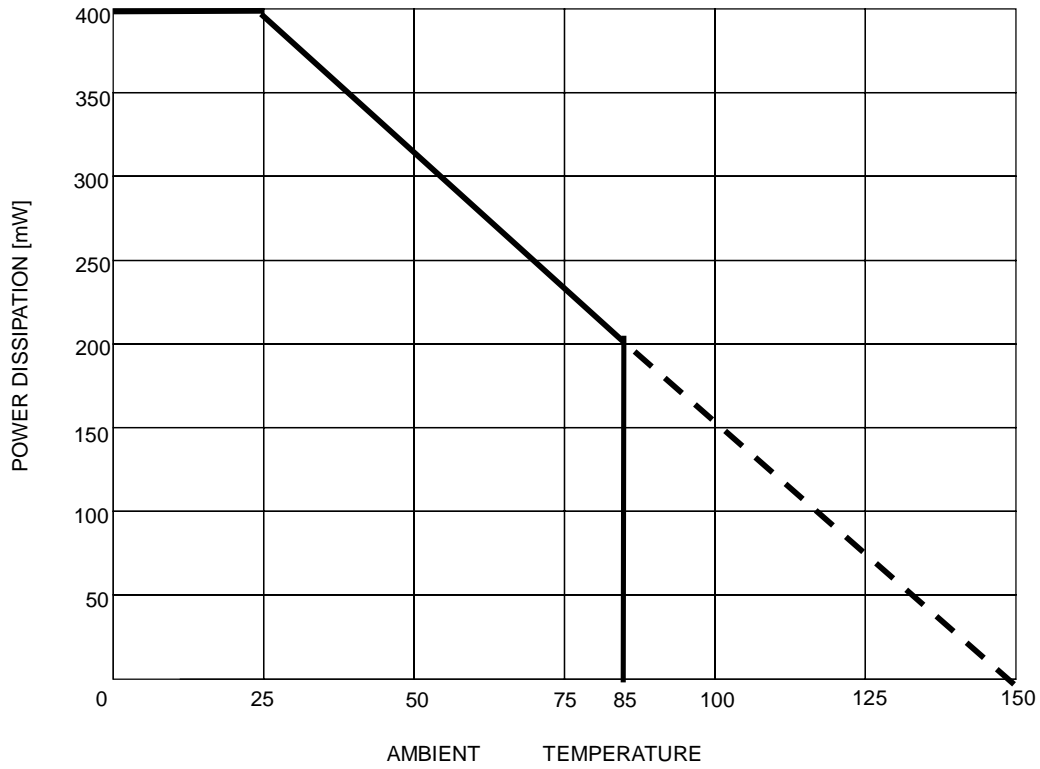
## ■ PWM TIMING CHART



## ■ FG TIMING CHART

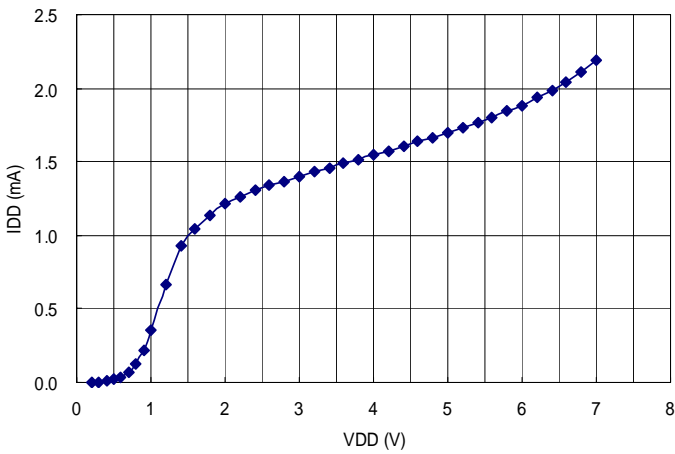


## POWER DISSIPATION

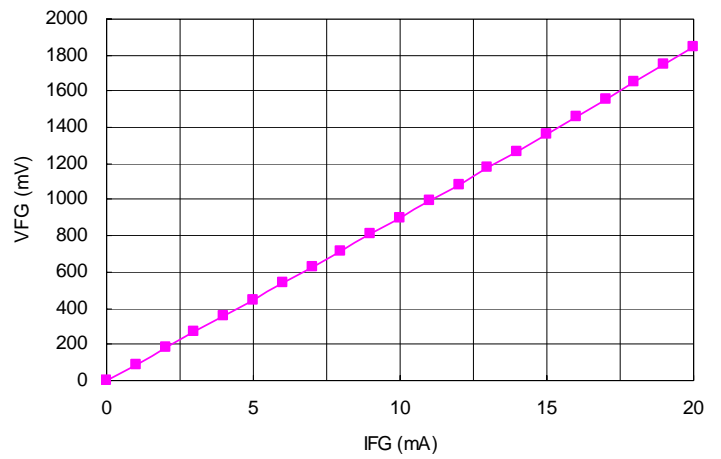


## TYPICAL CHARACTERISTICS

VDD-IDD  
IN+=VDD, IN-=GND  
MEAS:IDD

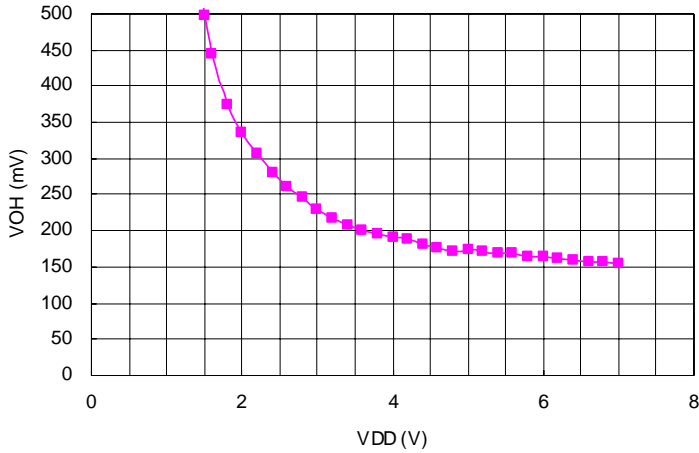


IFG-VFG  
VDD=5V, IN+=2.5V, IN-=GND  
MEAS:FG

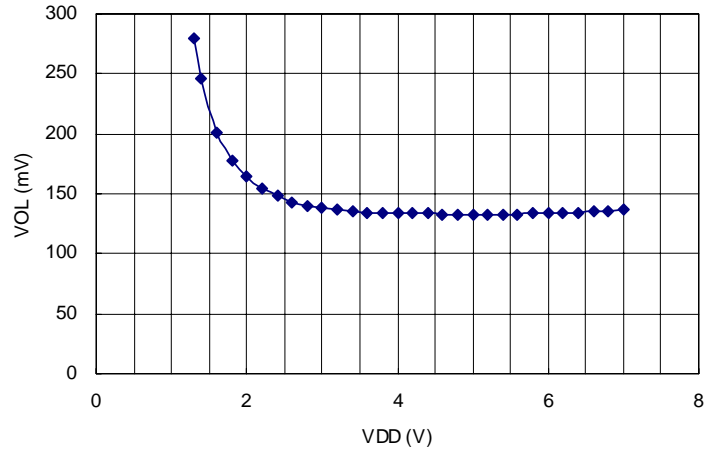


## TYPICAL CHARACTERISTICS

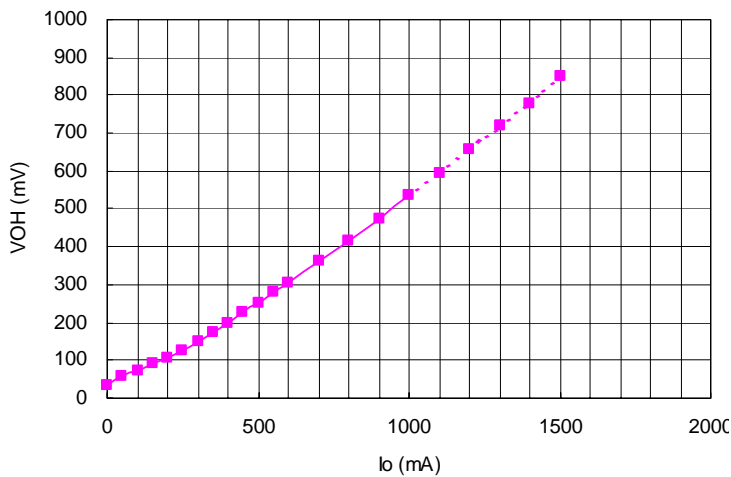
VDD-VOH  
VDD=5V, IN+=2.5V, IN-=GND  
MEAS:OUTA (Io=400mA)



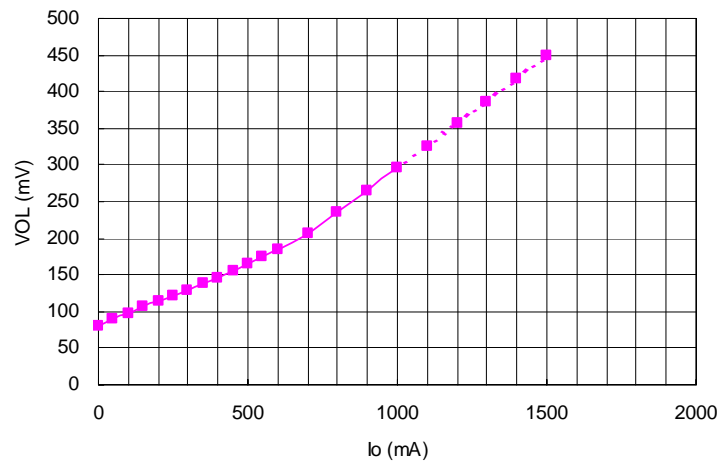
VDD-VOL  
VDD=5V, IN+=2.5V, IN-=GND  
MEAS:OUTA (Io=400mA)



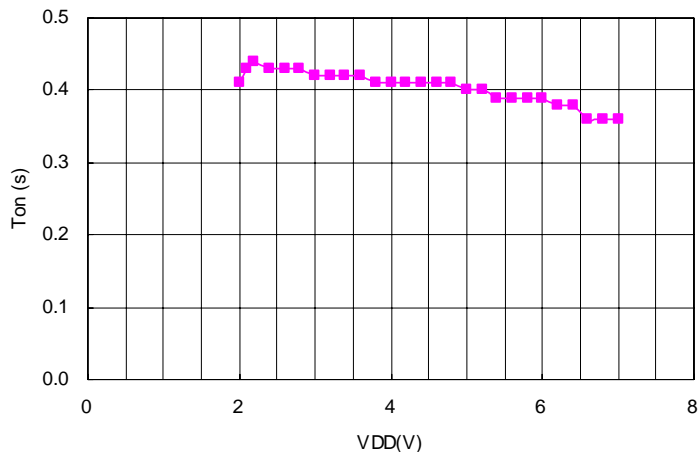
Io-VOH  
VDD=5V, IN+=2.5V, IN-=GND  
MEAS:OUTA



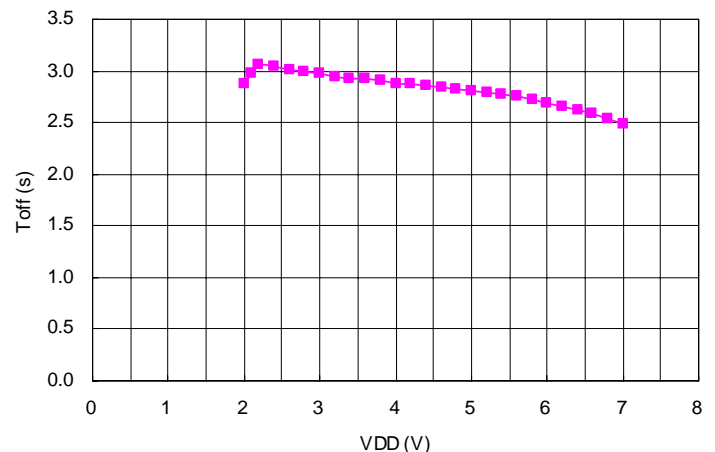
Io-VOL  
VDD=5V, IN+=2.5V, IN-=GND  
MEAS:OUTA



VDD-LOCKon\_time  
IN+=Vdd/2, IN-=GND  
MEAS:OUTA



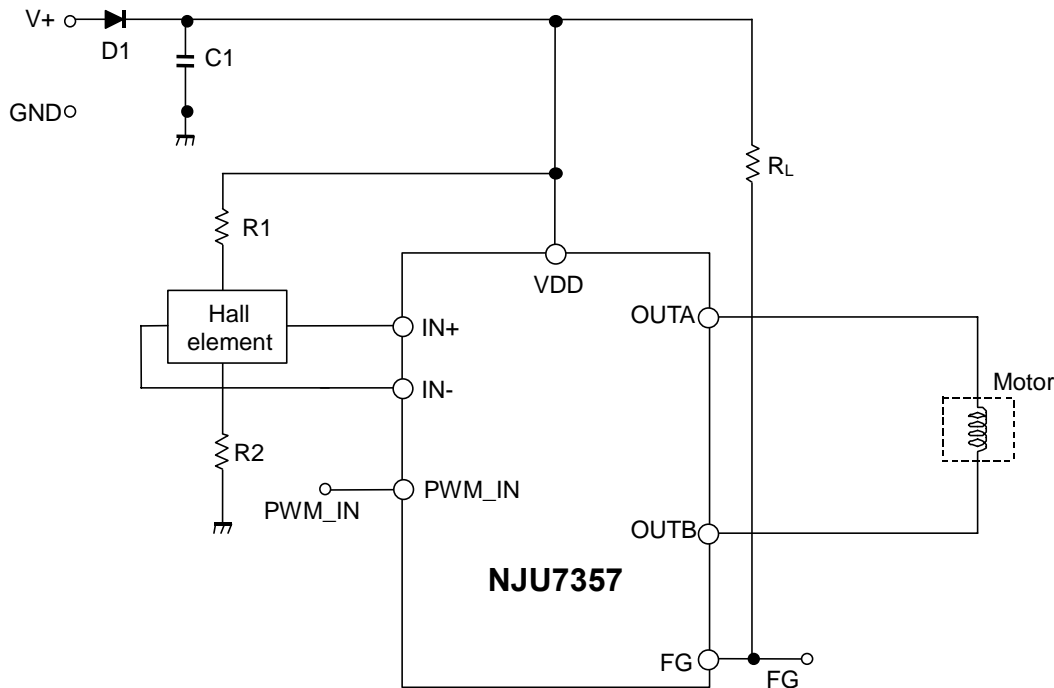
VDD-LOCKoff\_time  
IN+=Vdd/2, IN-=GND  
MEAS:OUTA



## ■ APPLICATION NOTE

The NJU7357 is a single-phase DC brushless motor driver IC in a small MSOP8 (TVSP8) 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. 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:

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

$$R1 = R2 = 300\Omega$$

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

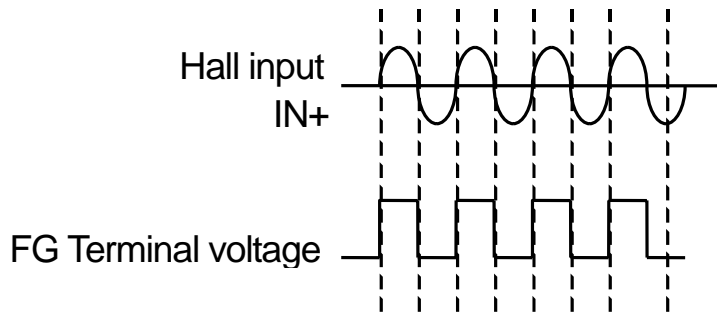
The optimum input voltage of NJU7357 are 100mVp-p and higher. With such input voltage, the highest efficiency can be obtained.

#### 4. Design of FG output resistance ( $R_L$ )

FG Out (FG: Pin5) is an open drain output and  $R_L$  is a pull up register. A typical value of  $R_L$  is 10k $\Omega$ .

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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