Single-phase DC Brushless Motor Driver IC

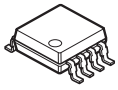
■ GENERAL DESCRIPTION

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



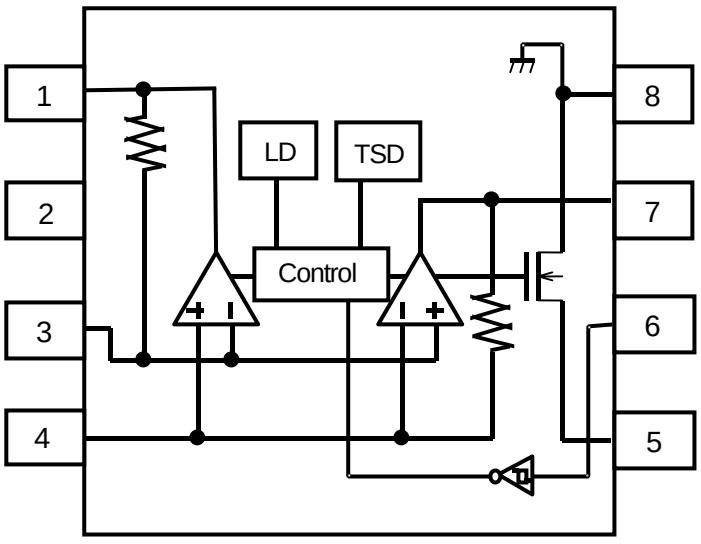
NJU7357RB1
(MSOP8 (TVSP8))

■ FEATURES

- Operating Voltage 2.2 to 5.5V
- Low Operating Current I_{DD}=2mA
- Low Saturation Output Voltage
  Vsat= ±0.2V @Io=±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_{DD}
3: IN +
4: IN -
5: FG
6: PWM_IN
7: OUT A
8: V_{SS}

■ **ABSOLUTE MAXIMUM RATINGS** (Ta=25°C)

PARAMETER	RATINGS	SYMBOL (unit)	NOTE
Supply Voltage	+7.0	V_{DD} (V)	
Input Voltage	-0.3 to V_{DD}	V_{ID}(V)	(*1)
Output Current (Peak)	1000	$I_{O\ PEAK}$ (mA)	(*2)
Operating Temperature Range	-40 to +85	Topr (°C)	
Storage Temperature Range	-50 to +150	Tstg (°C)	
Power Dissipation	400	P_D (mW)	Device itself
Junction Temperature	150	Tjmax(°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_{DD}	-	2.2	5.0	5.5	V

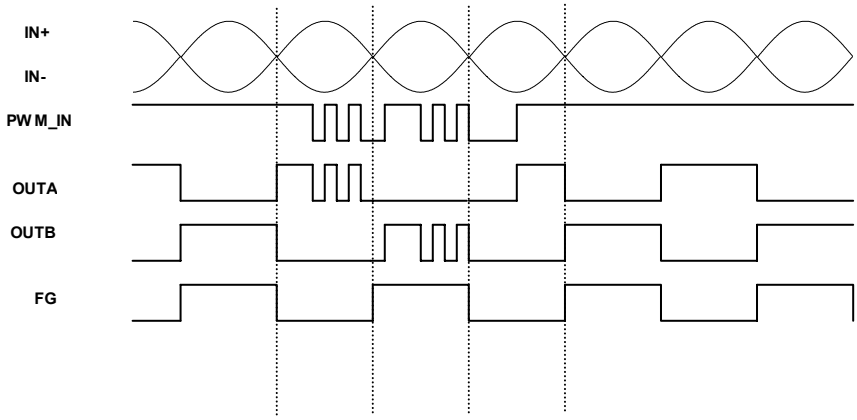
■ **ELECTRICAL CHARACTERISTICS** (V_{DD} =5V, Ta=25°C)

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
General						
Operating Current	I_{DD}	-	-	2.0	5.0	mA
Thermal Shutdown Temperature	T_{TSD}	-	-	180	-	°C
Thermal Shutdown Hysteresis	T_{HYS}	-	-	50	-	°C
Hall Amplifier						
Input Offset Voltage	V_{IO}	-	-10	-	10	mV
Feedback Resistance	R_F	-	-	27.5	-	kΩ
Open Loop Gain	A_V	-	-	70	-	dB
Input Common Mode Voltage Range	V_{ICM}	-	0.4	-	4.0	V
Output						
Maximum Output Voltage Range	V_{OH}	Io=+400mA	4.65	4.80	-	V
	V_{OL}	Io= -400mA	-	0.20	0.35	
Output Resistance	R_{ONH}	Io=+400mA	-	0.5	-	Ω
	R_{ONL}	Io=-400mA	-	0.5	-	
FG L Output Voltage	V_{FG}	IN+=5V, IN-=0V, RL=10Ω	-	-	0.3	V
FG H Leak Current	$I_{FG-LEAK}$	IN+=0V, IN-=5V, FG=5V	-	-	1.0	μA
Lock Detect Circuit*						
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	-	-
PWM Input						
PWM Input Frequency Ratio	F_{PWM}	-	16	-	50	kHz
PWM pull-up Resistance	R_{PWM}	-	-	50	-	kΩ
Input H Level Voltage	V_{IHP}	-	$0.7V_{DD}$	-	V_{DD}	V
Input L Level Voltage	V_{ILP}	-	-	-	$0.3V_{DD}$	V

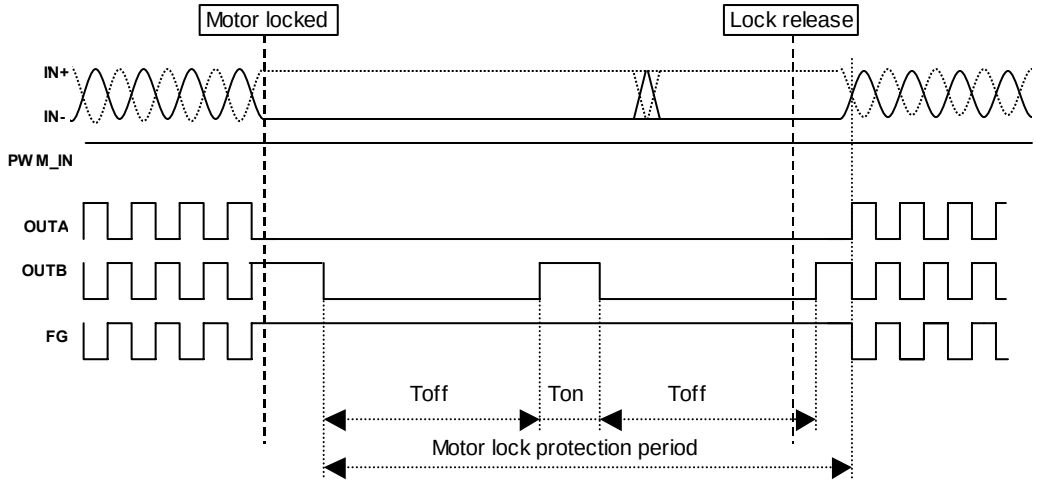
■ INPUT-OUTPUT TRUTH TABLE

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)

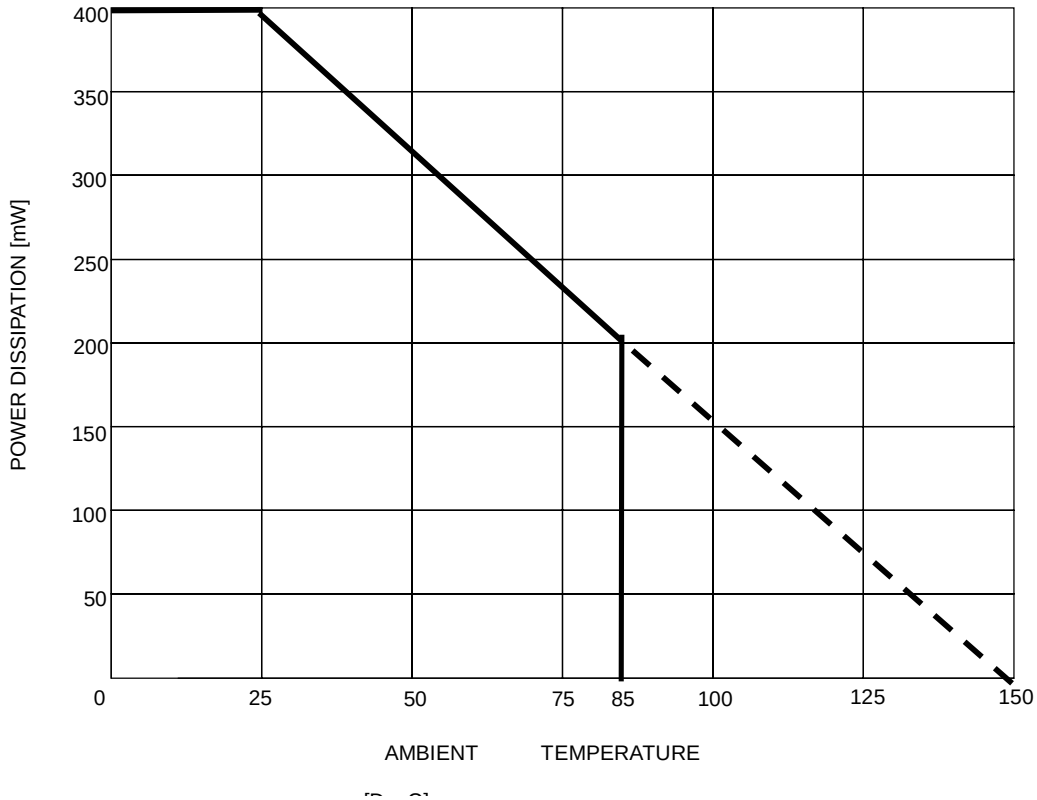
■ PWM TIMING CHART



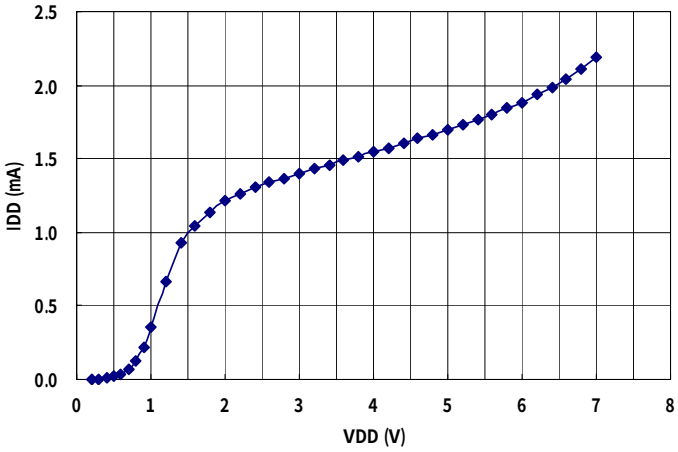
■ FG TIMING CHART

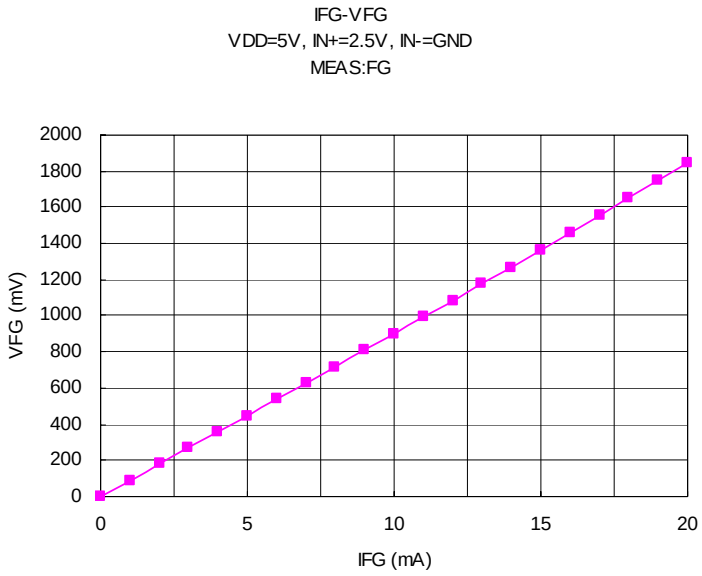


■ POWER DISSIPATION



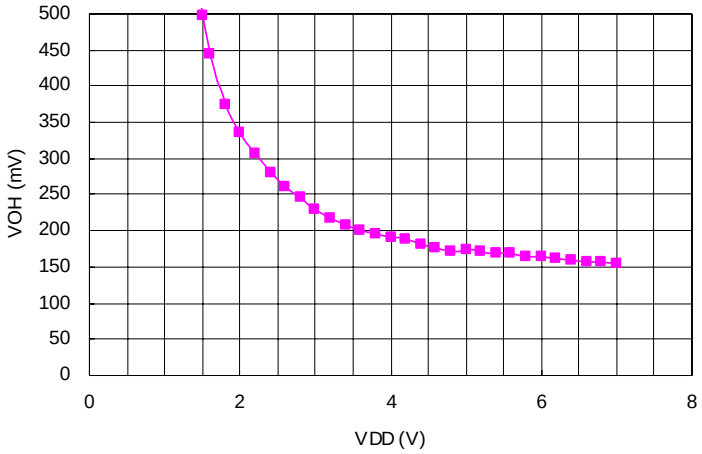
■ TYPICAL CHARACTERISTICS



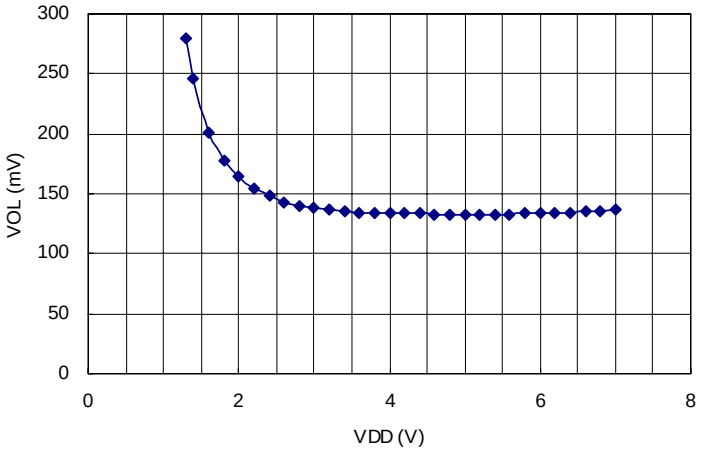


■ TYPICAL CHARACTERISTICS

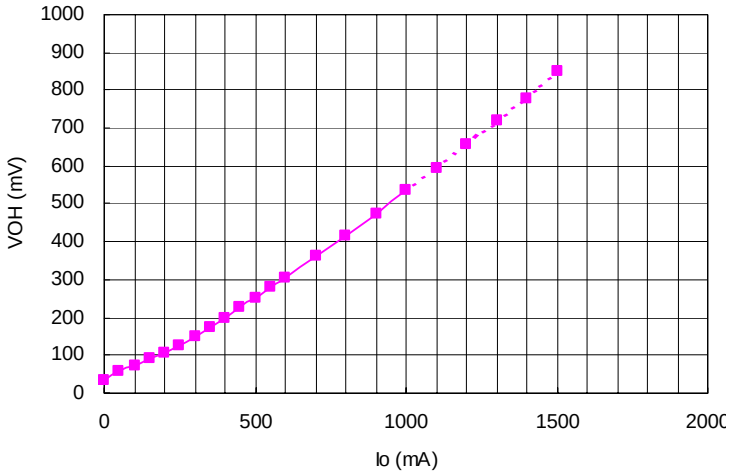
VDD-VOH
VDD=5V, IN+=2.5V, IN-=GND
MEAS:OUTA (Io=400mA)



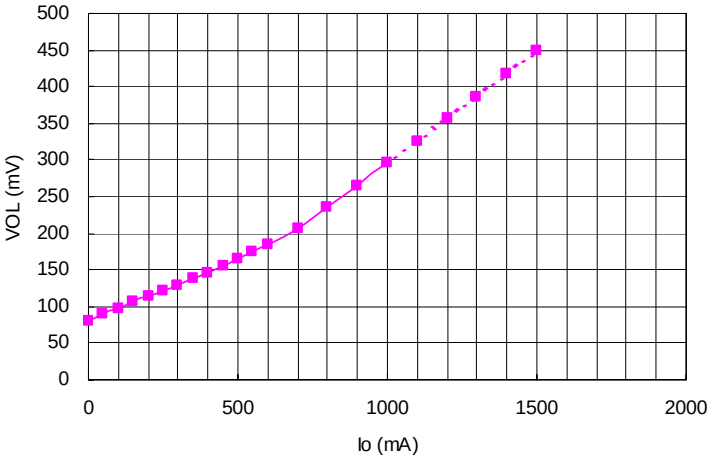
VDD-VOL
VDD=5V, IN-=2.5V, IN+=GND
MEAS:OUTA (Io=400mA)



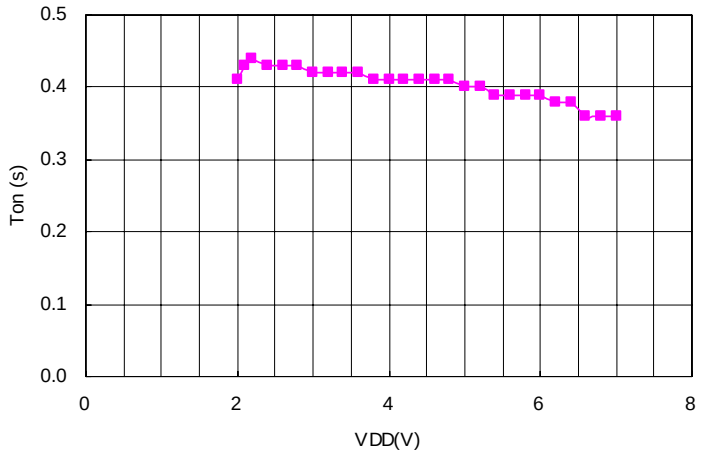
Io-VOH
VDD=5V, IN+=2.5V, IN-=GND
MEAS:OUTA



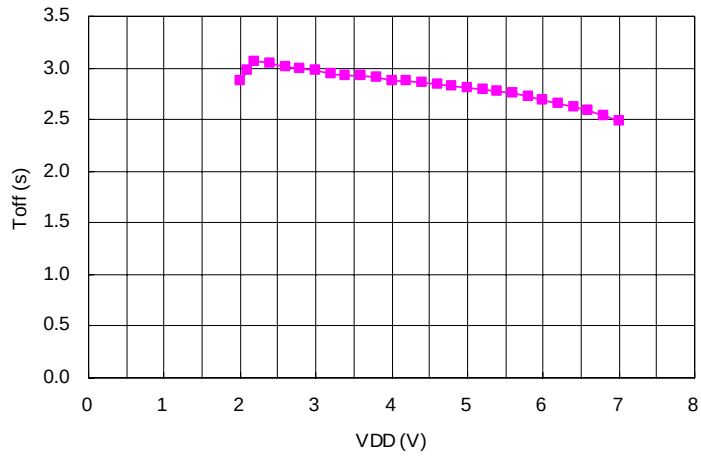
Io-VOL
VDD=5V, IN-=2.5V, IN+=GND
MEAS:OUTA



VDD-LOCKon_time
IN+=Vdd/2, IN-=GND
MEAS:OUTA



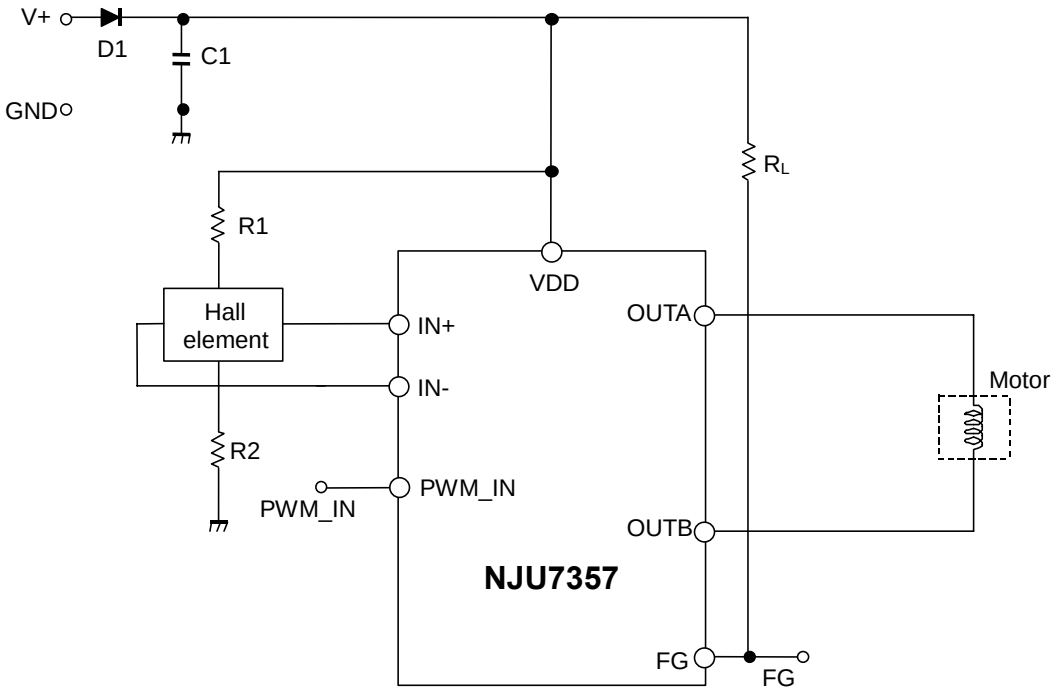
VDD-LOCKoff_time
IN+=Vdd/2, IN-=GND
MEAS:OUTA



■ 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:

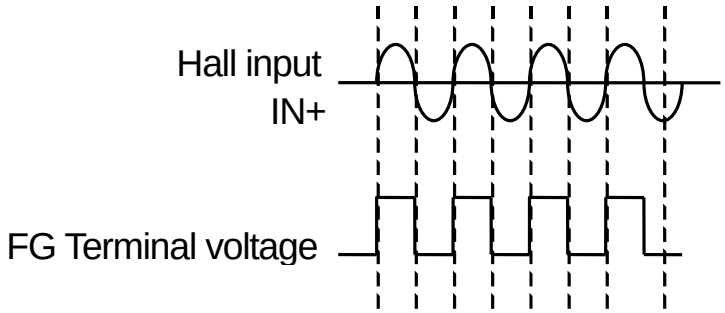
$$R1 + R2 + Rin = \frac{VDD}{Ihbias} = \frac{5}{5 \times 10^{-3}} = 1.0k\Omega$$

$$R1 = R2 = 300\Omega$$

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