Single-phase DC Brushless Motor Driver IC

■ GENERAL DESCRIPTION

The NJU7356 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 a high efficiency motor driving. It also has a high output current capability of 1000mA (peak) and 400mA (continuous).

The NJU7356 has useful functions such as a FG (frequency generator) output useful for various control systems, lock detect, auto-release (c-less type), thermal shutdown and linear driving which offers low noise motor driving. The NJU7356 is available in a small and thin package of MSOP8 (TVSP8), which provides downsizing and thinning in motor applications.

■ PACKAGE OUTLINE

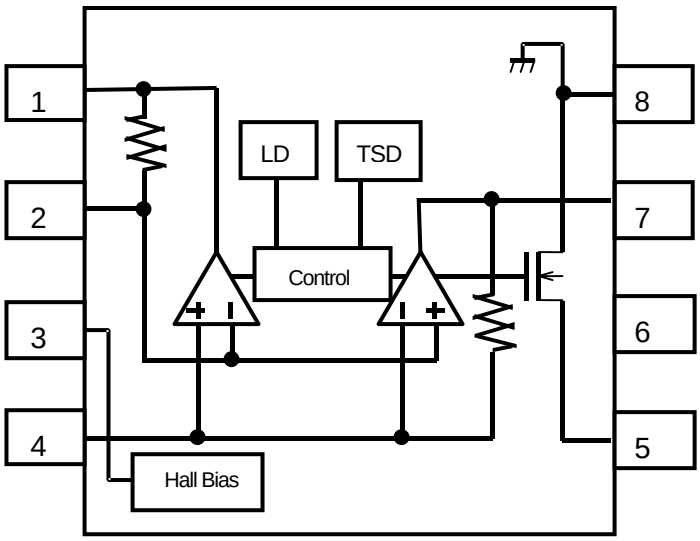
NJU7356RB1
(MSOP8 (TVSP8))

■ 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
- Thermal Shutdown Circuit
- Frequency Generator Output
- Hall Bias Terminal
- CMOS Technology
- Package Outline MSOP8 (TVSP8)*

*MEET JEDEC MO-187-DA / THIN TYPE

■ BLOCK DIAGRAM



■ PIN FUNCTION

1: OUT B
2: IN +
3: HB
4: IN -
5: FG
6: V_{DD}
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)	
Output Current (Continuance)	400	I_O (mA)	Note1
Output Current (Peak)	1000	$I_{O\ PEAK}$ (mA)	Note2
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)	

Note1 : This value is not to be over Pd.

Note2 : Input voltage is not to be over supply voltage to really use.

■ **RECOMMENDED OPERATING CONDITIONS** (Ta=25°C)

PARAMETER	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	V_{DD}	Ct=0	2.2	5.0	5.5	V

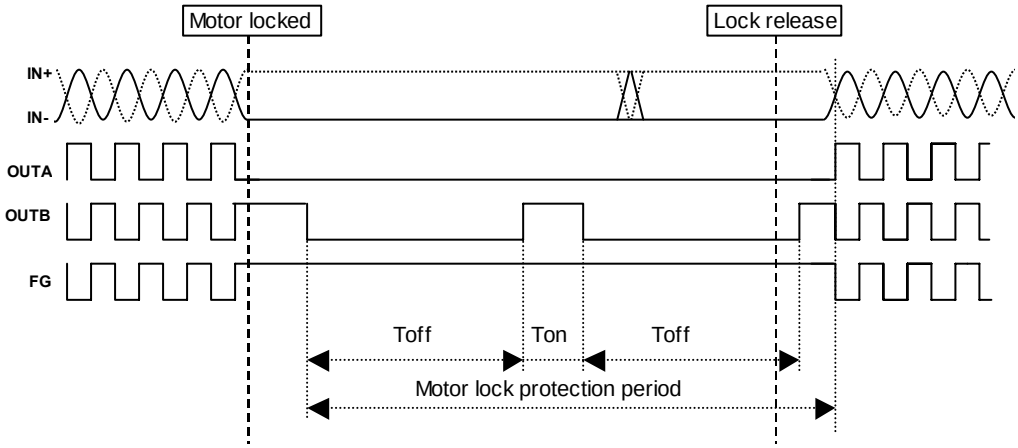
■ **ELECTRICAL CHARACTERISTICS** (V_{DD} =5V, Ta=25°C)

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, R_L=10kΩ	-	-	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}	-	-	0.5	-	sec
Lock Protect OFF Time	T_{OFF}	-	-	3.5	-	sec
Detect Protection ON/OFF Ratio	T_{RATIO}	-	-	1:7	-	-
Hall Bias						
Hall Bias Voltage	V_{HB}	-	1.1	1.3	1.5	V

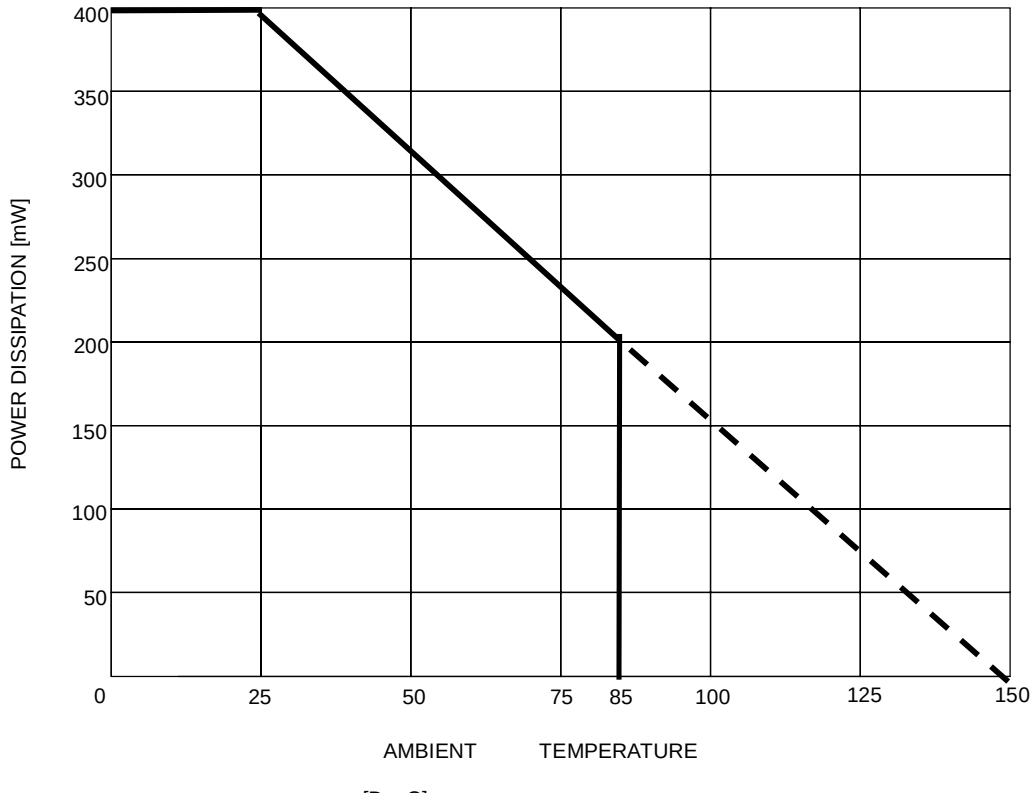
■ INPUT-OUTPUT TRUTH TABLE

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

■ TIMING CHART

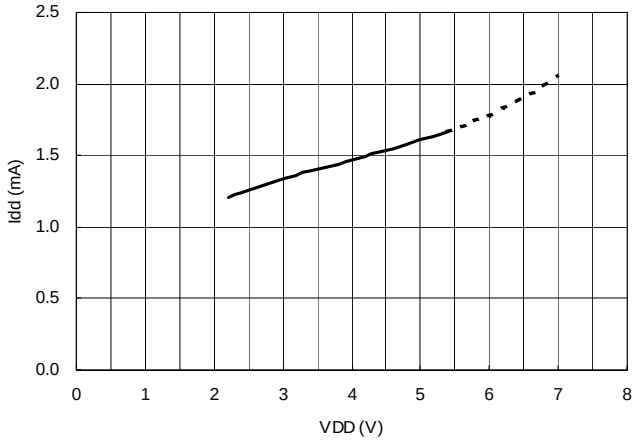


■ POWER DISSIPATION

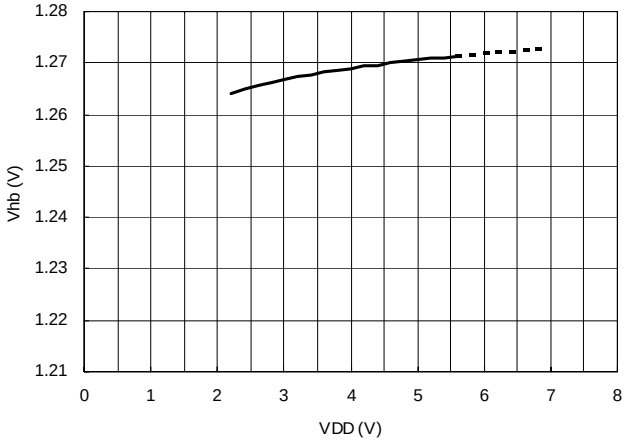


■ TYPICAL CHARACTERISTICS

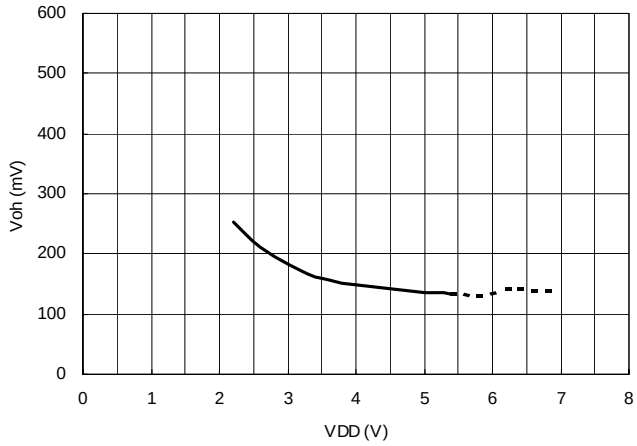
VDD-Idd
IN+=VDD, IN-=GND



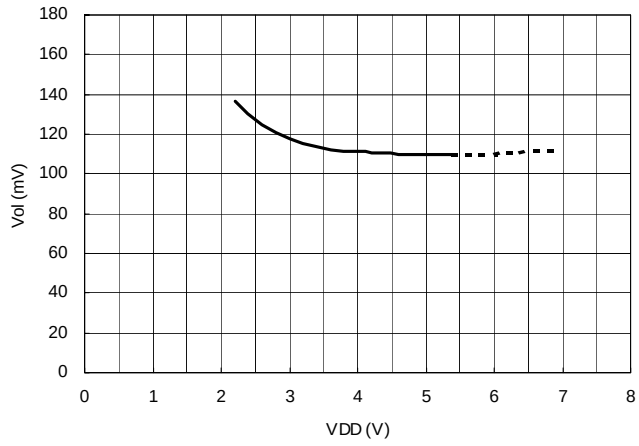
VDD-Vhb
VDD=5V, IN+=2.5V, IN-=GND
(Io=5mA)



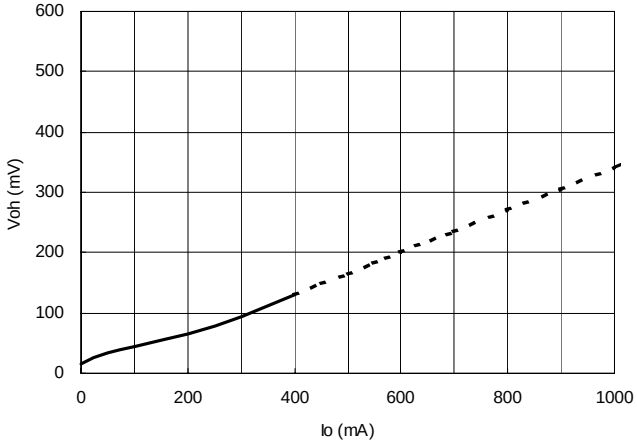
VDD-Voh
VDD=5V, IN+=2.5V, IN-=GND
(Io=400mA)



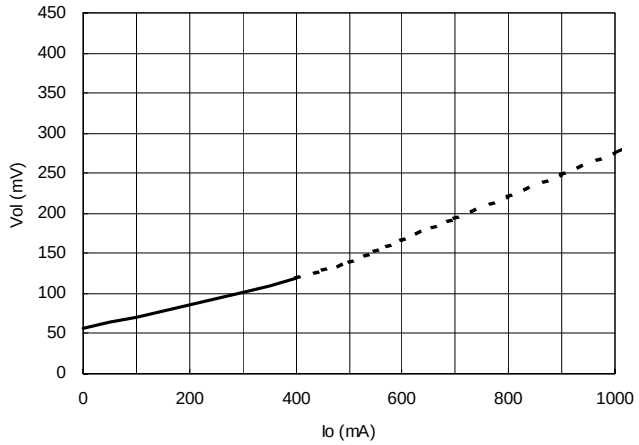
VDD-Vol
VDD=5V, IN-=2.5V, IN+=GND
(Io=400mA)



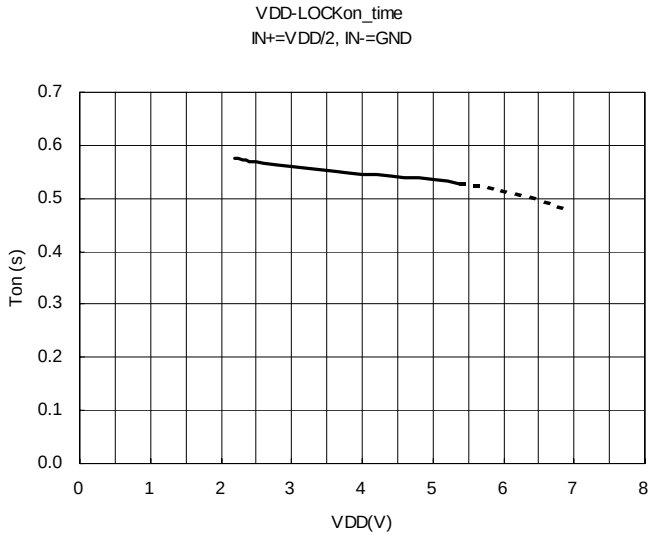
Io-Voh
VDD=5V, IN+=2.5V, IN-=GND
(Io=400mA)

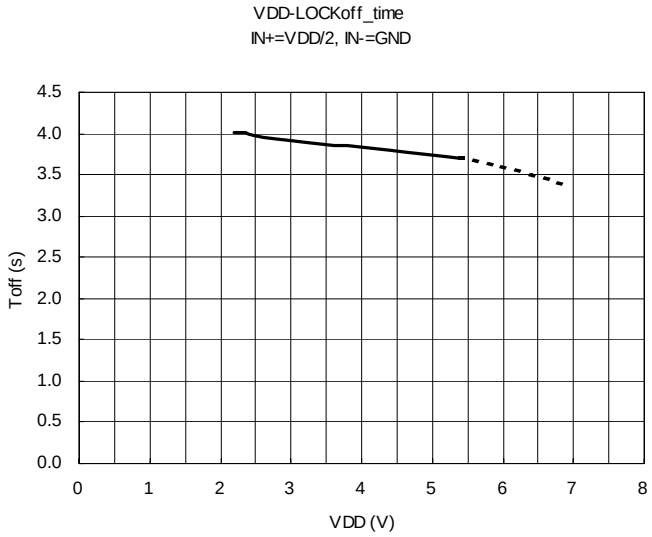


Io-Vol
VDD=5V, IN-=2.5V, IN+=GND
(Io=400mA)



■ TYPICAL CHARACTERISTICS



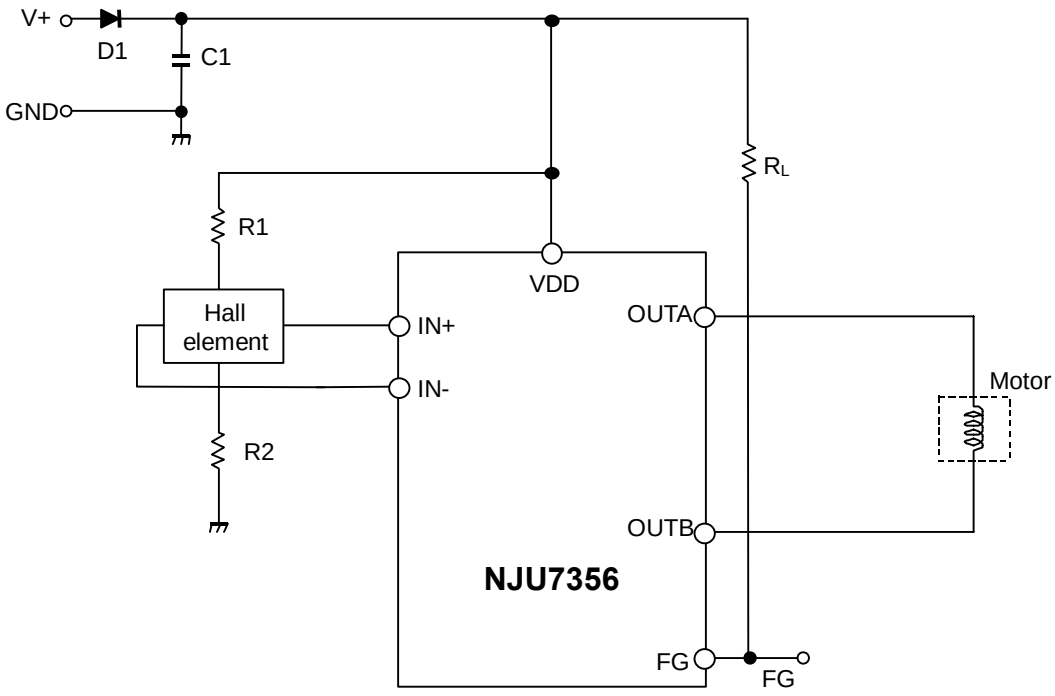


■ APPLICATION NOTE

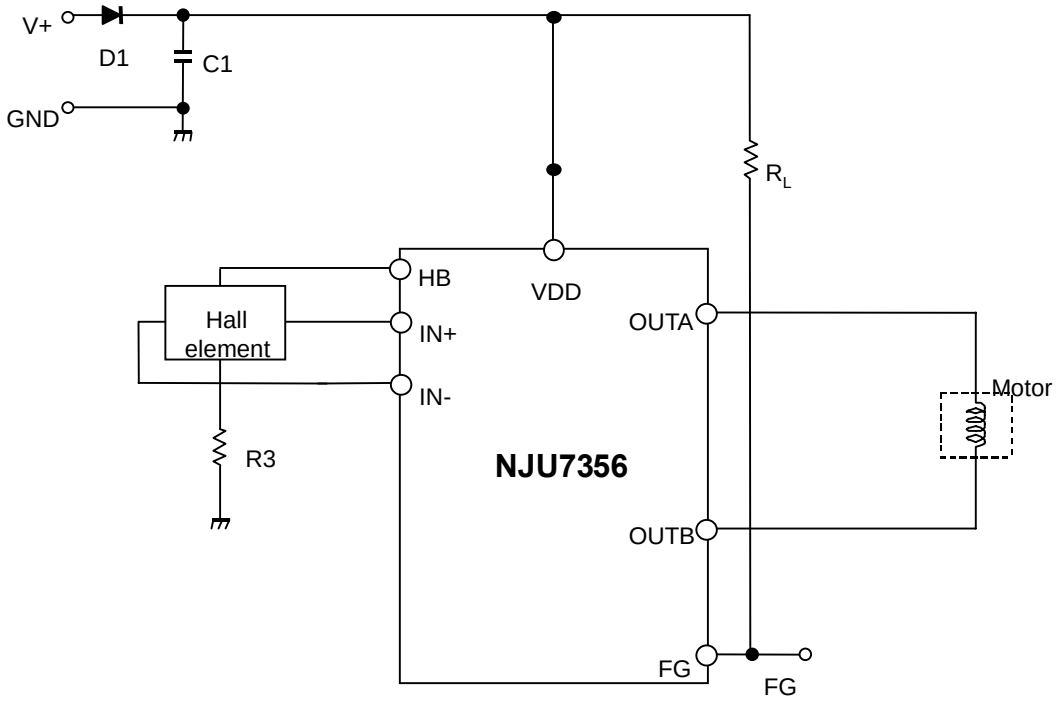
The NJU7356 is a single-phase DC brushless motor driver IC in small MSOP8 (TVSP8) package.
With minimal external components, that can drive up to 400mA of motor current for small fan application.

[Application Circuit Example]

1) Hall Bias unused application circuit



2) Hall bias used application circuit



[Design Notes]

Above application example is designed for 5V operation with motor current of 400mA. 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. Position Detection Circuit Hall Device

2-1. When using V_{DD} (**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 NJU7356 is 100mVp-p and higher. With such input voltage, the highest efficiency can be obtained.

2-2. When using HB (**R3** design)

By connecting a Hall device to the Hall bias terminal (HB), a constant Hall output amplitude that has good temperature characteristics is obtained, resulting in stable linear drive. If it is necessary to adjust the Hall output amplitude, perform adjustment with R3.

3. Design of FG output resistance ($\mathbf{R_L}$)

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.