



BLDC DRIVER

## BLDC motor driver

### LBD-C2, RS232, 200watt

- Surface-mount technology
- Small size, low cost, easy
- Hall sensor commutation
- Set value speed : Volume(2.5Vdc), PWM, Analog(5Vdc)
- Slow start, slow stop
- Brake, Direction and Enable input
- RMS Current limit adjustable
- Motor lock detection : Blockage protection
- Alarm output function at time of error
- FG out

### General Description

The LBD series drivers are designed to drive 3-phase brushless DC motors at a high switching frequency.

Driver has enable, direction, and brake input.

In addition, rotation of the motor can be detected by logic output FG.

All models interface with digital controllers or can be used as stand-alone drives.

Driver require only a single regulated DC power supply and a red/green led indicates operating status.

### Electrical Data

DC supply voltage $V_m$
Absolute minimum supply voltage $V_{m \min}$
Absolute maximum supply voltage $V_{m \max}$
Max. output voltage
Peak. Current (1 sec. max., internally limited)
Max. continuous output current
Switching frequency of power stage
Power dissipation at cont. current

### LBD-C2

12 - 24 Vdc
12 Vdc
28 Vdc
$V_m - 0.5$
30 A
8 A
25 kHz
200 W

### Input

Set value speed

Enable

Brake

Direction

PWM : Open collector, TTL(3.3V) Input, 250Hz~1KHz  
Volume : 0~2.5Vdc analog input.

Open collector, TTL(3.3V) Input

Open collector, TTL(3.3V) Input

Open collector, TTL(3.3V) Input

### Output

FG

ALARM

Hall A

Hall B

Hall C

Open collector,  $V_{ce0} : 30Vdc$ ,  $I_c \max : 200mA$

Open collector,  $V_{ce0} : 30Vdc$ ,  $I_c \max : 200mA$

Open collector,  $V_{ce0} : 50Vdc$ ,  $I_c \max : 200mA$

Open collector,  $V_{ce0} : 50Vdc$ ,  $I_c \max : 200mA$

Open collector,  $V_{ce0} : 50Vdc$ ,  $I_c \max : 200mA$

### Voltage outputs

Hall sensor supply voltage  $V_{cc \text{ hall}}$

+5.8Vdc  $\pm 5\%$ , max. output current 20mA

### Indicator

RED LED blink (Driver on), RED LED on (Fault)

### Trim potentiometers

Set of motor acceleration time (slow start), deceleration time (slow stop).

### Protective function

RMS Current limit (OCP)

19A Typ, The set current limit is adjusted at volume.

Blockage protection

Detect a motor lock if motor shaft is blocked for longer than 3 sec.  
Set in communication mode.(2~5sec)

### Ambient temperature and humidity

Operation condition

Dry bulb temp:-10~+50 [°C], Relative humidity : 0 ~ 90 [%]

Storage condition

Dry bulb temp:-10~+60 [°C], Relative humidity : 10 ~ 90 [%]

**Mechanical data**

Weight	173g Typ
Dimension (L x W x H)	108 x 62 x 38 mm
Mounting threads	Flange for M3-screws

**Terminals****Power, Motor**

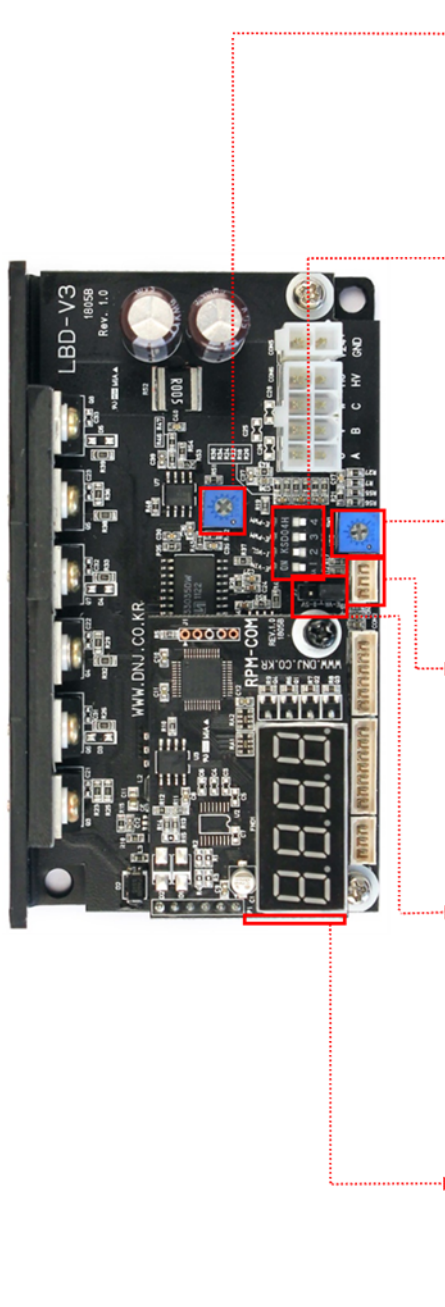
Male header (PCB) : MOLEX 5566 (4.20mm Pitch Mini-Fit Jr.™ Header, Dual Row)

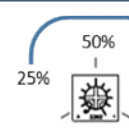
Suitable plug : MOLEX 5557

**Signal I/O**

Male header (PCB) : MOLEX 53014

Suitable plug : MOLEX 51004


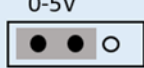
**Setting**


Vol 1	Function
<b>RMS Current limit</b>	 25% : 8.5 A 50% : 12 A 75% : 16,5 A 100% : 19 A

DIP S/W	Function (Control mode)
<b>External Volume</b>	<input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/> OFF <input type="checkbox"/> OFF
<b>Internal Volume</b>	<input type="checkbox"/> OFF <input checked="" type="checkbox"/> ON <input type="checkbox"/> OFF <input type="checkbox"/> OFF
<b>External PWM</b>	<input type="checkbox"/> OFF <input type="checkbox"/> OFF <input checked="" type="checkbox"/> ON <input checked="" type="checkbox"/> ON

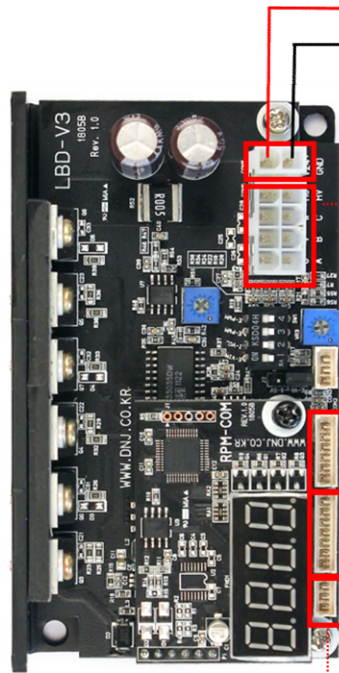
Vol 2	Function
<b>Internal Volume</b>	Controls motor speed with internal volume trimmer(10kΩ)

Vol 3	External speed
<b>External Volume</b>	+3.3 Vdc out 0~2.5Vdc input Input speed control with external volume (10kΩ) GND

Jumper	Motor speed Control mode
<b>E-VR</b> 	External volume input mode
<b>0-5V</b> 	External 0 ~ 5V input mode

Vol 4	Function
<b>ACC</b>	Acceleration time adjustment
<b>DEC</b>	Deceleration time adjustment

## Pin configuration



CON 1	Power
+PWR	+12 ~ 24 Vdc supply voltage input
PGND	Power grounded

CON 2		Motor			
Motor connection	Motor U	Motor V	Motor W	Hall GND	
	Hall A	Hall B	Hall C	Hall Vcc	

CON 3	Control Input
Speed in <5V>	Motor speed control input (0 ~ 5V)
Speed in <PWM>	Motor speed control input (PWM)
Enable	Motor ON/OFF control input
Direction	Motor rotation direction control input
Brake	Motor brake control input
GND	Signal grounded

CON 4	Control Output
Hall A out	Hall sensor U signal out
Hall B out	Hall sensor V signal out
Hall C out	Hall sensor W signal out
Alarm out	Fault out
FG out	1FG signal out
3.3V out	For customer use. Auxiliary voltage out +3.3Vdc
GND	Signal grounded

CON 5	RS485 Communication
Tx	RS232(Tx)
Rx	RS232(Rx)
GND	Signal grounded

## Speed control mode <Dip switch>

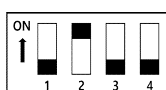
Setting of motor speed control mode

No	DIP switch	Function	Discription
1		I-VOL	Internal volume control mode - Controlled by internal volume control
2		E-VIN	External volume control mode - Controlled by external volume input - Controlled by external 5V input
3		E-PWM	External pwm control mode - Controlled by external pwm input

## Internal Volume input <I-VOL>

Motor speed control input

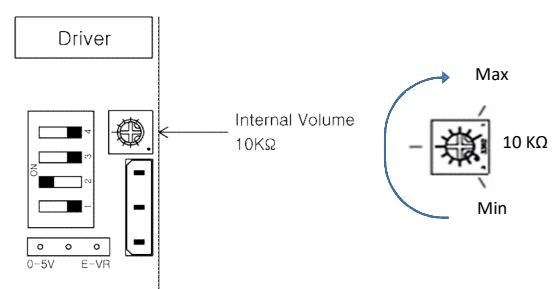
Dip-switch no. 2 is turned on.



The motor speed is controlled by a 1-turn potentiometers.(10kΩ)

Left end stop of potentiometers : Motor speed is minimum

Right end stop of potentiometers : Motor speed is maximum

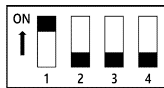


**External Volume input <E-VIN>**

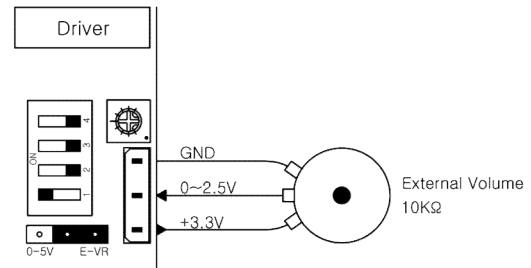
Motor speed control input

Dip-switch no. 1 is turned on.

Jumper pin header <E-VR>



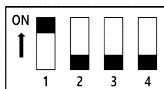
E-VR

**External Ref 5V input <E-VIN>**

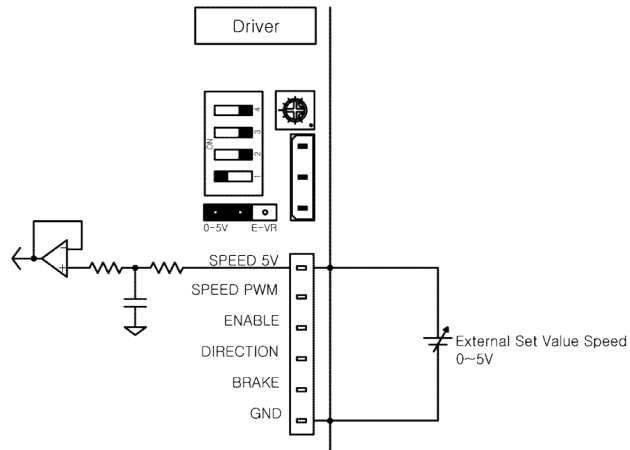
Motor speed control input

Dip-switch no. 1 is turned on.

Jumper pin header <0-5V>



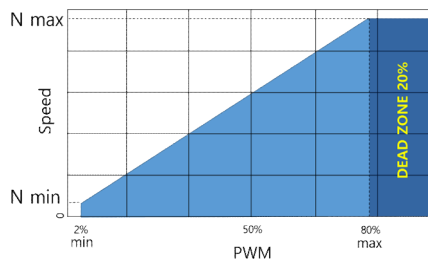
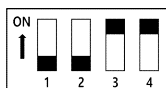
0-5V

**External PWM input <E-PWM>**

Motor speed control input

Pulse Width Modulated input

Dip-switch no. 3 and 4 is turned on.



Input	Open-collector, TTL(3.3V) Input	
Frequency	PWM frequency range is 250Hz (between 0.2 ~ 1 [kHz])	
Set value input	Speed setting for speed control via PWM duty 0~80%	
Interface		

**Inputs and outputs****Control input ON/OFF <ENABLE>**

Enables or disables the power stage.

If the <ENABLE> input contacts ground potential, the driver is activated.

If the <ENABLE> input is open, mosfets on the bridge drive turns off and the motor shaft freewheels slows down

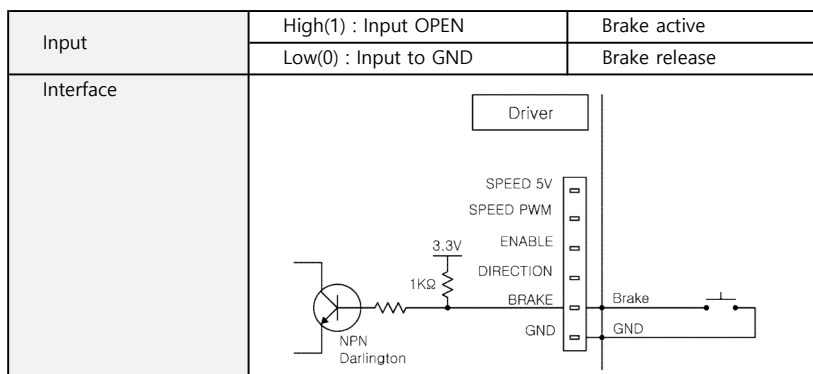
Open-collector, TTL(3.3V) Input

Input	High(1) : Input OPEN	Power stage switched off
	Low(0) : Input to GND	Motor power on
Interface		

**Control input brake <BRAKE>**

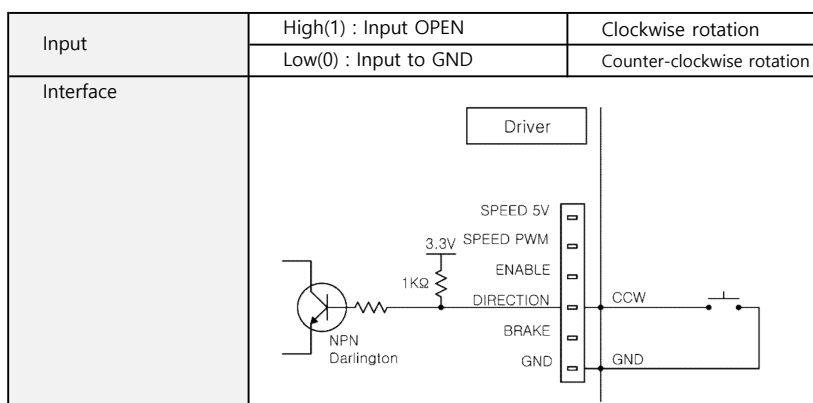
The motor shaft slows down in an uncontrolled fashion to a standstill by short-circuiting the motor windings.

Open-collector, TTL(3.3V) Input

**Control input direction <CCW>**

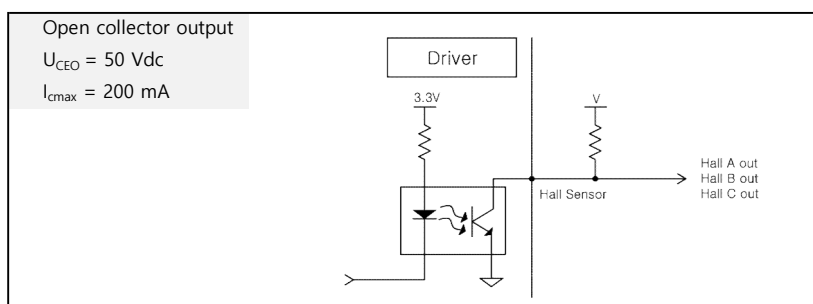
When the level changes, the motor shaft slows down in an uncontrolled fashion to a standstill by short-circuiting the motor windings, and accelerates in the opposite direction, until the nominal speed reaches again.

Open-collector, TTL(3.3V) Input

**<Hall sensor signal> out**

Open collector

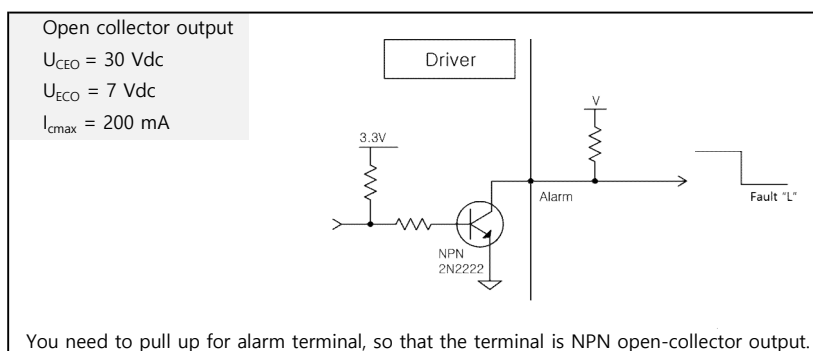
Hall A, Hall B, Hall C

**<ALARM> out**

Driver fault output.

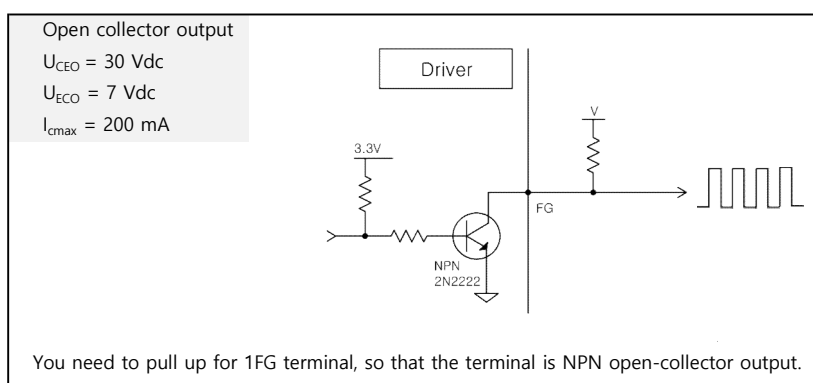
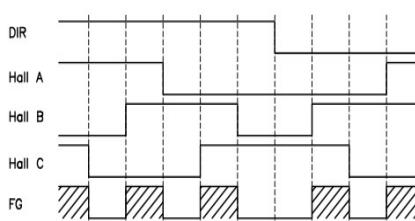
This open collector output is active low during one or more of the following conditions :  
 Invalid Sensor input code, Enable input at logic 0, over current, motor rock detection, and Thermal shutdown.

\* Reset : Speed in 0, Enable, Power off

**<FG> out**

1FG is put into toggle-operation in which the logic reverses every time when excitation phase is switched by hall input.

\*  $SPEED = (Pole - Pairs) \times 3$



## Hall Sensor

### Hall sensor voltage out

+5.8Vdc @ 20mA

### Hall A, Hall B, Hall C

An internal voltage of +5.8 Vdc is provided for powering the hall sensors.

Output voltage 5.8 Vdc  $\pm$  5%

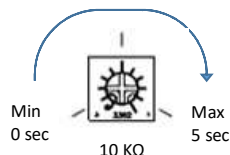
Max. output current 20mA (short-circuit protection)

Hall sensor inputs, logic levels, internal 1K $\Omega$  pull-up.

Maximum low level input is 1V, Minimum high level input is 3.5V.

## Adjusting the potentiometers

Motor acceleration time, deceleration time can be adjusted using 1-turn potentiometers.



Pre-adjustment

With pre-adjustment, the potentiometers are set in a preferred position.

### Pre-adjustment of potentiometers

ACC	Set the acceleration time of the motor. (0 or 1~5 sec)
DEC	Set the deceleration time of the motor. (0 or 1~5 sec)

## RPM Display

Led 4 channel 7 segment display

Default : 4 pole BLDC

The speed of the 4-pole, 3-phase BLDC motor is displayed as a 4-digit, 7-segment.

In order to display the motor speeds of other poles, it is possible to change in the communication mode.

- It is possible to directly change the number of motor for RS485 communication of LBD-C2 products.

Above 10,000 RPM, the decimal point is displayed in place of 1.

Ex) Motor speed : 14,000 rpm

Display indication: 1400(1400 \* 10 = 14,000 with 14,400\*10=14,000)

rpm : 3,500 rpm



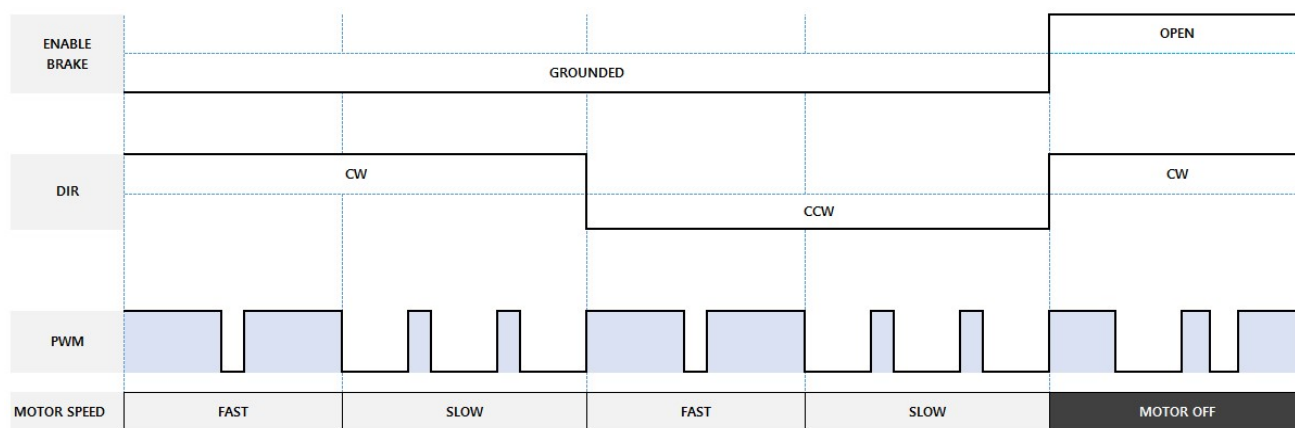
rpm : 14,000 rpm



## Driver protection

No	Item	Specification	Note
1	RMS Current limit	19 [A] Typ	<p>The RMS continuous current limit level can be set using internal volume (Vol 1).</p> <p>Vol 25% : 8.5A Vol 50% : 12A Vol 75% : 16.5A Vol 100% : 19A</p>
2	Thermal shutdown	160 $\pm$ 10 [°C]	<p>When the driver IC reaches the defined temperature, the motor current automatically cuts off. The highest rating temperature of IC is 160 [°C]</p> <p>Component reliability can't be ensured when motor is used in exceeded 160 [°C]. There is no guarantee of proper operation when thermal shutdown motor is reused.</p>
3	Motor lock detection	3 sec	<p>When the motor locks, the motor current automatically cuts off within the defined time.</p> <p>You can set the lock detection time using RS485 communication (2 ~ 60 seconds).</p>

## Control sequence timing chart



## Dimension Drawing

[mm]

