

Smart brushless motor driver

BLD-24V04A-D, brushless, digital, 90watt



BLDC DRIVER

- Surface-mount technology
- Small size, low cost, easy
- Hall sensor commutation
- Digital(PWM) speed control
- Slow start, slow stop
- Brake, Direction and Enable input
- Maximum current limit adjustable (PWM current limit)
- Motor lock detection : Blockage protection
- Aluminium housing
- Alarm output function at time of error
- FG out

General Description

The BLD24V04A series drivers are designed to drive 3-phase brushless DC motors at a high switching frequency.

They are fully protected against overvoltage, undervoltage, overcurrent.

This is provided with functions of PWM electric current control to limit inrush electric current, and of overheat shutdown, etc.

Driver is designed with N-channel high-power MOSFETs and is ready for motor power voltage of up to 30V.

Phase is switched by hall elements arranged at an interval of 120°

Driver has enable, direction, and brake input, and can control electric current by internal PWM.

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 unregulated DC power supply and a single red/green led indicates operating status.

Electrical Data

BLD-24V04A-D

DC supply voltage V_m	8 - 30 Vdc
Absolute minimum supply voltage V_m min	6.5 Vdc
Absolute maximum supply voltage V_m max	28 Vdc
Max. output voltage	$V_m - 0.5$
Peak. Current (1 sec. max., internally limited)	8 A
Max. continuous output current	4 A
Switching frequency of power stage	25 kHz
Power dissipation at cont. current	90 W

Input

Set value speed	0~5V, Pulse Width Modulated Digital Input, Frequency : 1kHz
Enable	<Enable> : Set to GND or input voltage < 0.8 Vdc <Disable> : Input open or input voltage , 2.4 ~ 5 Vdc
Brake	<Brake function not active> : Set to GND or input voltage < 0.8 Vdc <Brake function active> : Input open or input voltage , 2.4 ~ 5 Vdc
Direction	<Clockwise> : Input open or input voltage , 2.4 ~ 5 Vdc <Counter-clockwise> : Set to GND or input voltage < 0.8 Vdc
Hall sensor signals	<Hall sensor A>, <Hall sensor B>, <Hall sensor C>, 120° phase

Output

FG	Open collector, V_{max} : 30Vdc, $V_{ce(sat)}$: 0.3V, I_c max : 50mA
ALARM	Open collector, V_{max} : 30Vdc, $V_{ce(sat)}$: 0.3V, I_c max : 50mA
Hall sensor signals	Schmitt trigger TTL Level 5Vdc, Hall A, B, C

Voltage outputs

Hall sensor supply voltage V_{cc} hall	+5Vdc \pm 5%, max. output current 30mA
For Customer use, V_{cc} 5Vdc	+5Vdc \pm 5%, max. output current 250mA

Indicator

Operating(green) and fault(red) display LED

Trim potentiometers

Current limit

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

Protective function

Current limit (OCP)	3.7A Typ, The set current limit is adjusted at Vol 3 (potentiometer).
Blockage protection	Detect a motor lock if motor shaft is blocked for longer than 3 sec.
Thermal shutdown	160±10 [°C], IC temperature/design specification.
Undervoltage shutdown	Shutdown if $V_m < 6.5Vdc$

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 [%]
Non condensating	20 ~ 80%

Mechanical data

Weight	154 g Typ
Dimension (L x W x H)	97 x 62 x 34.5 mm
Mounting threads	Flange for M3-screws

Terminals

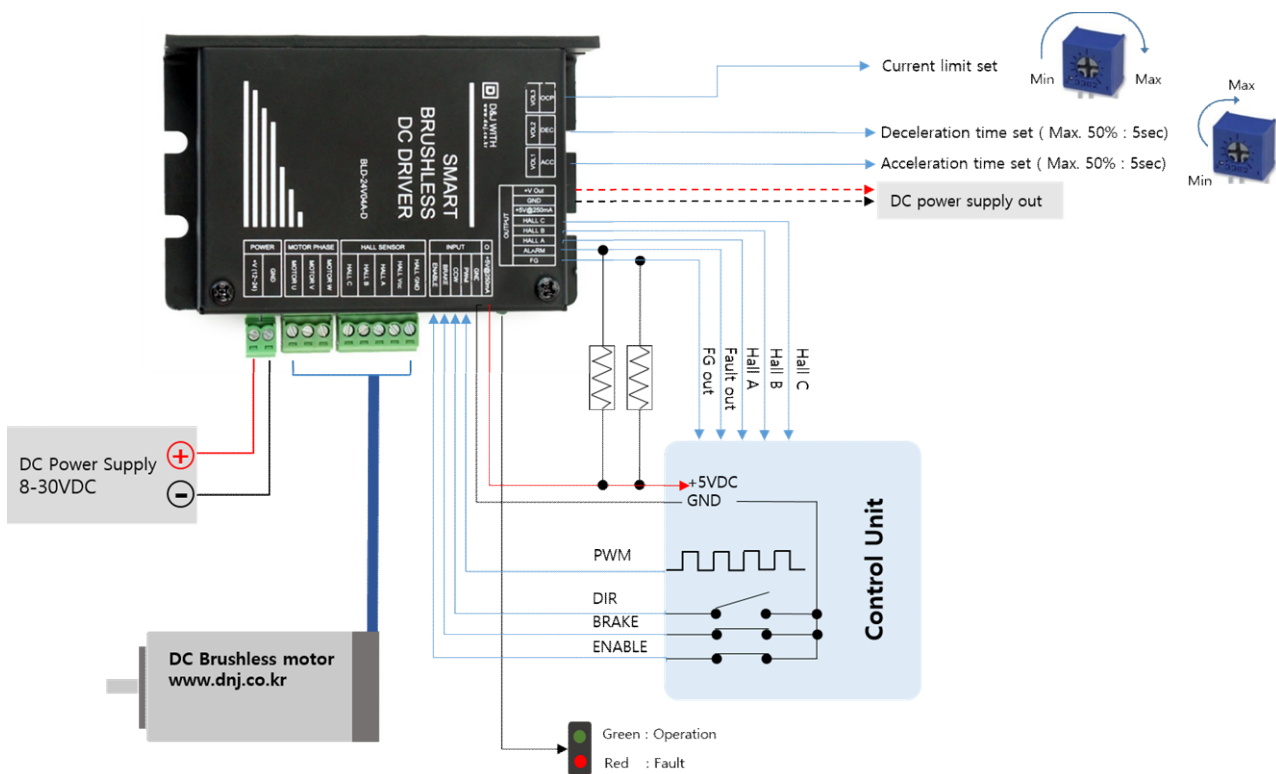
Power, Motor and Hall sensors

Male header PCB : ECH350R, 1 row, Pitch : 3.5 mm
 Suitable plug : EC350V
 Suitable for wire cross section : AWG#22 UL1007 (Power, motor)
 AWG#26 UL1007 (Hall sensors)

Signal I/O

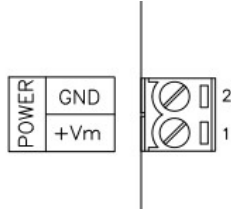
Male header (PCB) : MOLEX 53014, 1 row, Pitch : 2 mm
 Suitable plug : MOLEX 51004
 Suitable for wire cross section : AWG#26 UL1007

Wiring diagram



Pin configuration

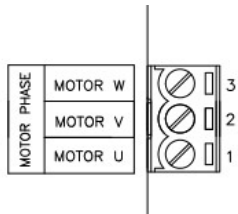
Power



PIN	NAME	DESCRIPTION / NOTES	I/O
1	+Vm	DC power input	I
2	GND	Power ground	PGND

ITEM	PART No.	TYPE
Male header(PCB)	ECH350R-02P	any
Plug	EC350V-02P	any

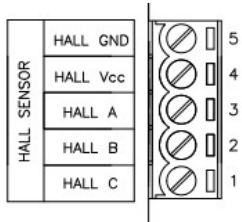
Motor



PIN	NAME	DESCRIPTION / NOTES	I/O
1	Motor U	Motor winding U phase connection	O
2	Motor V	Motor winding V phase connection	O
3	Motor W	Motor winding W phase connection	O

ITEM	PART No.	TYPE
Male header(PCB)	ECH350R-03P	any
Plug	EC350V-03P	any

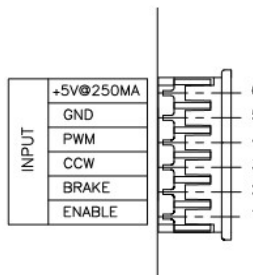
Hall sensor



PIN	NAME	DESCRIPTION / NOTES	I/O
1	Hall sensor C	Hall sensor W	I
2	Hall sensor B	Hall sensor V	I
3	Hall sensor A	Hall sensor U	I
4	Hall Vcc	Hall sensor voltage +5Vdc / 30mA	O
5	Hall GND	Hall signal ground	SGND

ITEM	PART No.	TYPE
Male header(PCB)	ECH350R-05P	any
Plug	EC350V-05P	any

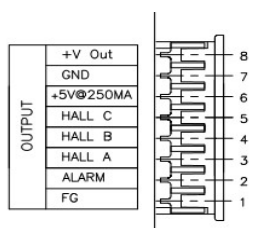
Signal (INPUT)



PIN	NAME	DESCRIPTION / NOTES	I/O
1	ENABLE	Motor enable/disable	I
2	BRAKE	Brake active/not active	I
3	CCW	Direction of rotation	I
4	PWM	Set value speed reference : PWM input	I
5	GND	Reference ground	SGND
6	+5Vdc@250mA	For customer use. Auxiliary voltage out +5Vdc	O

ITEM	PART No.	TYPE
Male header(PCB)	53014-0610	MOLEX
Plug	510040600	MOLEX

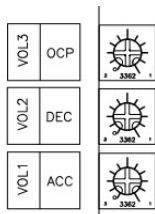
Signal (OUTPUT)



PIN	NAME	DESCRIPTION / NOTES	I/O
1	FG	1FG signal out	O
2	ALARM	Fault out (LED red)	O
3	HALL A	Hall U signal out	O
4	HALL B	Hall V signal out	O
5	HALL C	Hall W signal out	O
6	+5V@250mA	For customer use. Auxiliary voltage out +5Vdc	O
7	GND	Reference ground	SGND
8	+V OUT	Supply voltage +Vm out	O

ITEM	PART No.	TYPE
Male header(PCB)	53014-0810	MOLEX
Plug	510040800	MOLEX

Potentiometer



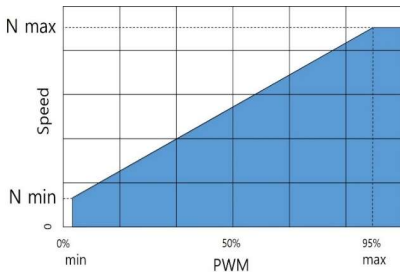
NAME	DESCRIPTION / NOTES	turning CW
Vol 1	Slow start : motor acceleration time set	Increases
Vol 2	Slow stop : motor deceleration time set.	Increases
Vol 3	Current limit.	Increases

Inputs and outputs

PWM

Set value speed

Pulse Width Modulated input, opto-coupled



Input voltage range	High(1) : 4 to 5 V or Input OPEN	Motor OFF
	Low(0) : 0 to 0.8 V or Input to GND	Motor ON
Frequency	PWM frequency range is 1kHz (between 10 ~ 3 [kHz])	
Set value input	Speed setting for speed control via PWM duty 0~95%	
Interface		

Control input enable <ENA>

Enables or disables the power stage.

If the voltage applied to ENA is higher than 2.4V or opened, MOSFETs on the bridge drive turns off and the motor shaft freewheels slows down.

If the voltage applied to ENA is lower than 0.8V or ground potential, the driver is activated.

You should connect a Schottky Barrier Diode between each signal line to ground to prevent

Input voltage range	High(1) : 2.4 to 5 V or Input OPEN	Power stage switched off
	Low(0) : 0 to 0.8V or Input to GND	Motor running
Interface		

Control input brake <BLK>

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

Input voltage range	High(1) : 2.4 to 5 V or Input OPEN	Brake active
	Low(0) : 0 to 0.8 V or Input to GND	Brake not active
Interface		

Control input rotation <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.

Input voltage range	High(1) : 2.4 to 5 V or Input OPEN	Clockwise rotation
	Low(0) : 0 to 0.8 V or Input to GND	Counter-clockwise rotation
Interface		

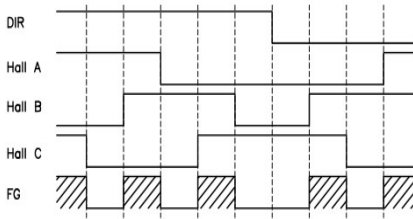
Hall sensor input

Hall sensors need for detecting rotor position and actual speed.

Input voltage range	High(1) : 2.4 to 5 V
	Low(0) : 0 to 0.8 V
Input impedance	10kΩ pull-up resistor +5V
Interface	<p>Suitable for Hall effect sensors IC using Schmitt trigger and open collector output.</p>

FG out

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

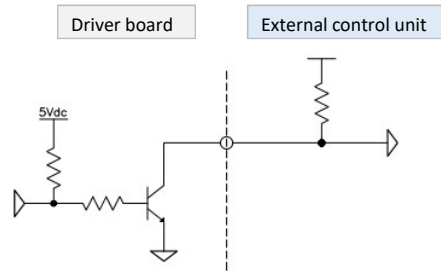


Open collector

$U_{ext. max} = 30 V$

$U_{ce(sat)} = 0.3 V$

$I_{cm max} = 50 mA$



You need to pull up for 1FG terminal, so that the terminal is open-collector output.

Alarm out

Driver fault output.

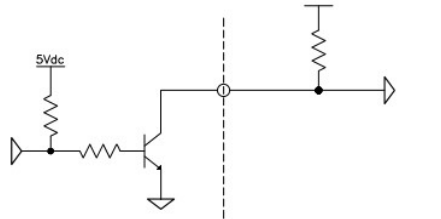
Output transistor turns on and becomes high during low voltage, overvoltage, overcurrent motor lock detection, thermal shutdown, and during power-up reset.

Open collector

$U_{ext. max} = 30 V$

$U_{ce(sat)} = 0.3 V$

$I_{cm max} = 50 mA$



You need to pull up for alarm terminal, so that the terminal is open-collector output.

Hall sensor voltage out

+5Vdc @ 30mA

An internal voltage of +5 Vdc is provided for powering the hall sensors.

Output voltage 5 Vdc ± 5%

Max. output current 30mA (short-circuit protection)

Auxiliary voltage out

+5Vdc @ 250mA

For customer use.

An internal auxiliary voltage of +5 Vdc is provided.

The total current should not exceed 250 mA

Used as reference voltage :

- For external set value potentiometers(recommended value:10kΩ) ; BLD24V04A-A
- Supply power to user controllers

Hall sensor signal out

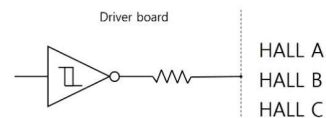
Logic levels.

Hall A, Hall B, Hall C

Schmitt trigger.

High (1) 2.4 to 5 V

Low (0) 0 to 0.8 V



Adjusting the potentiometers

Current limit, motor acceleration time, deceleration time can be adjusted using 1-turn potentiometers.

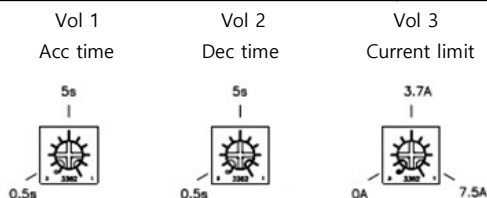
Can be used to reduce the factory preset maximum current limit.

Pre-adjustment

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

Pre-adjustment of potentiometers

Vol 1	Set the acceleration time of the motor. (5 sec max.)	50%	5 sec
Vol 2	Set the deceleration time of the motor. (5 sec max.)	50%	5 sec
Vol 3	Current limit. This potentiometer adjusts both the continuous and peak current limit while maintaining a selected ratio. Adjusting the max. continuous current in the 0.1~8 A range.	50%	3.7A
<p style="color: red;">Notice : If the current limit is set to 4A or more, the driver will be damaged.</p>			



Left end stop of potentiometers : Minimal value

Right end stop of potentiometers : Maximum value

Driver protection

No	Item	Specification	Note
1	Current limit	3.7 [A] Typ	
2	Thermal shutdown	160±10 [°C]	When the driver IC reaches the defined temperature, the motor current automatically cuts off. The highest rating temperature of IC is 160 [°C] 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.
3	Motor lock detection	3 sec	When the motor locks, the motor current automatically cuts off within the defined time. The motor restarts by power supply reset. If the motor shaft is blocked for longer than 3 sec, the current limit is set at 3.7A, provided the current limit was not set lower via Icont potentiometer.

Control sequence timing chart



Dimension Drawing

Dimensions in [mm]

