

**ATO-BLD-50A / BLD-100A BLDC Controller
User Manual**

Brushless

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Preamble

Brief description

Thank you for purchasing DB series of DC brushless drivers.

BLD series DC brushless driver is a low-voltage DC brushless platform driver, which is a general-purpose low-voltage DC brushless driver with small size and wide voltage input range, a safety and high performance driver.

The power range 0.75kW~7.5kW of this series products, supports CANBUS communication, which can form a network system with multiple brushless drivers. This series of products with the latest easy-to-use functions driver, Hall sensors integrated low-voltage DC brushless motors, which makes the brushless motor control simple and easy to use.

Low-voltage DC brushless drivers are equipped with superior heat dissipation performance, which drive low-voltage DC brushless motors with high efficiency. The driver supports DC wide voltage input with built-in mechanic brake output function, makes the low-voltage brushless drive safer. These all secure the equipment to produce a safety production.

This series of brushless drivers are suitable for the automation equipment in logistics, new energy, AGV and other industries, realizing fast and accurate speed and torque control with high power, high performance, and safer and more universal solutions.

This manual describes the functions and parameters of the product, including an overview of the functions, basic functions, adjustments and parameter descriptions.

Version Change Log

Revision date	Release Version	Changes
2024-11	A00	First release of the manual

Warranty Statements

Under normal use, the product malfunction or damage, provide warranty service within the warranty period (please refer to the order form for details of the product warranty period). Beyond the warranty period, repair costs will be charged.

During the warranty period, repair costs will be charged for damage to the product caused by the following conditions

Damage to the product caused by not operating the product as specified in the manual.

Fire, flood, abnormal voltage, resulting in damage to the product.

Product damage caused by using the product for abnormal functions.

Damage to the product caused by exceeding the scope of use specified for the product.

Force majeure (natural disasters, earthquakes, lightning strikes) factors caused by secondary damage to the product.

The relevant service costs are calculated according to the manufacturer's uniform standards, and if there is a contract, the contract will be handled on a priority basis. Please refer to the Product Warranty Card for detailed warranty description.

Safety Caution

Security Statement

- ※ This chapter explains the safety precautions that you need to pay attention to in order to use this product properly. Before using this product, read the instruction manual and correctly understand the information regarding the safety precautions. Failure to observe the matters agreed upon in the safety precautions may result in death or serious injury, or damage to the equipment.
- ※ The DANGERS, WARNINGS, and CAUTIONS in this manual do not represent the full range of safety precautions to be observed, but are intended to be in addition to the full range of safety precautions.
- ※ This product should be used in an environment that complies with the design specifications, otherwise it may cause malfunctions. Abnormal functioning or damage to parts, etc. caused by failure to comply with the relevant regulations are not covered by the product quality warranty.
- ※ We will not be held legally responsible for any personal safety accidents, property damage, etc. caused by failure to comply with the contents of this book or illegal operation of the product.

Definition of Security Levels



Indicates death or serious bodily injury if not followed.



Indicates that if not followed, death or serious bodily injury may result.



Indicates that minor bodily injury or equipment damage may result if not followed.

Safety Precautions

- ※ The illustrations of the product in this manual are sometimes intended to show the detailed parts of the product, and the product is in the state of removing the outer cover or safety cover. When using the product, be sure to attach the outer cover or cover as specified and follow the instructions for use.
- ※ The product illustrations in this manual are examples only and may differ slightly from the product you ordered, so please refer to the actual product you ordered.
- ※ Operators must take mechanical protective measures to protect their personal safety, please wear and wear the necessary protective equipment, such as wearing anti-smash shoes, safety clothing, safety goggles, protective gloves and cuffs.

1 Model Definition

BLD	48D	50	RS	M	DK
①	②	③	④	⑤	⑥
①	DS: Servo DB: Brushless BLD: Brushless(without IP65)				
②	Maximum voltage: 12V / 24V / 48V / 72V / 96V / 220V / 310V / 380V / 510V A: AC D: DC				
③	Rated current: 7A 15A 30A 50A 100A 150A 200A 300A				
④	Control Method: C: CAN RS: 485 HP: High-speed pulse P: Pulse A: Analog				
⑤	Braking Resistors				
⑥	Inner Code				

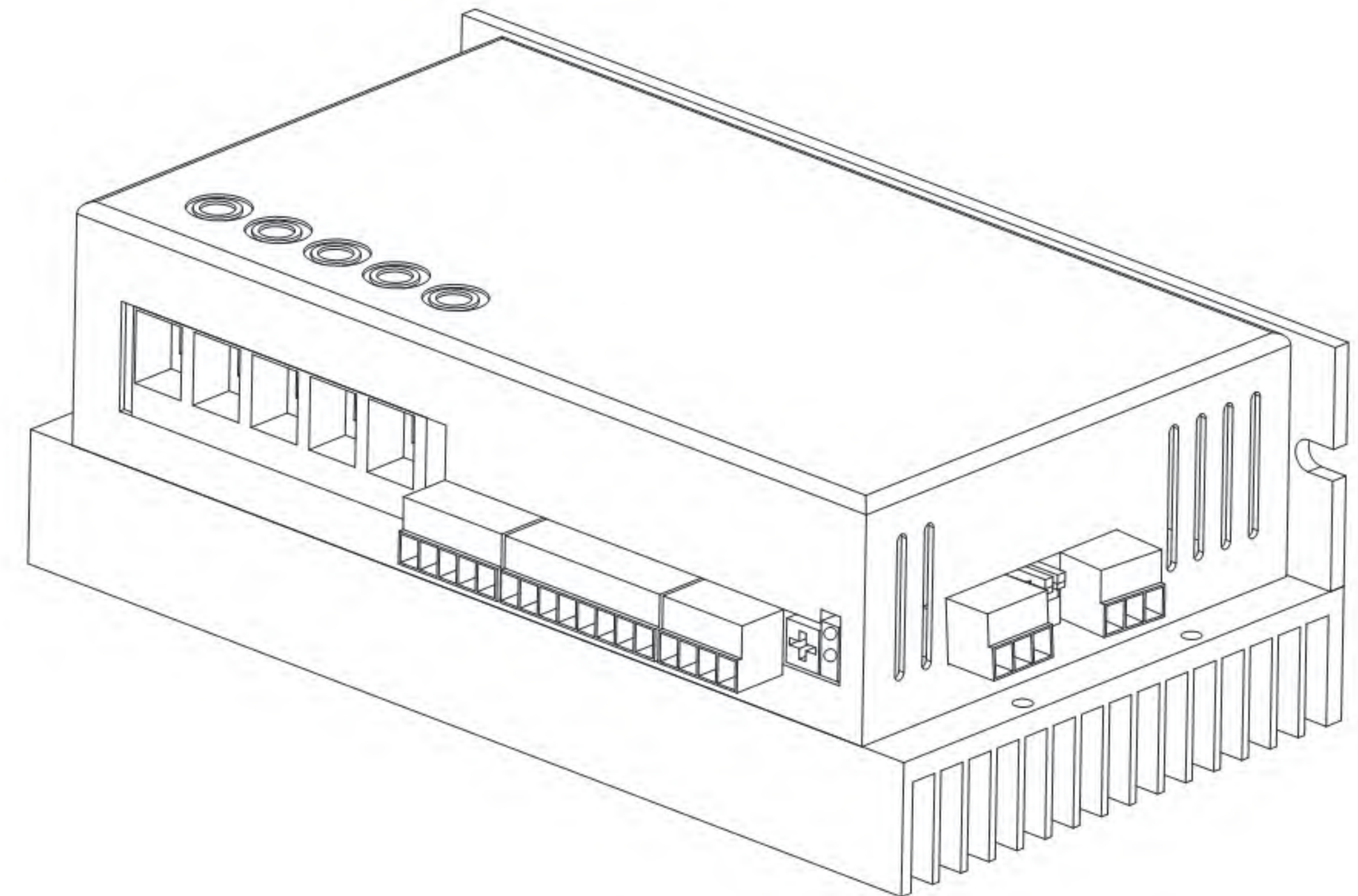
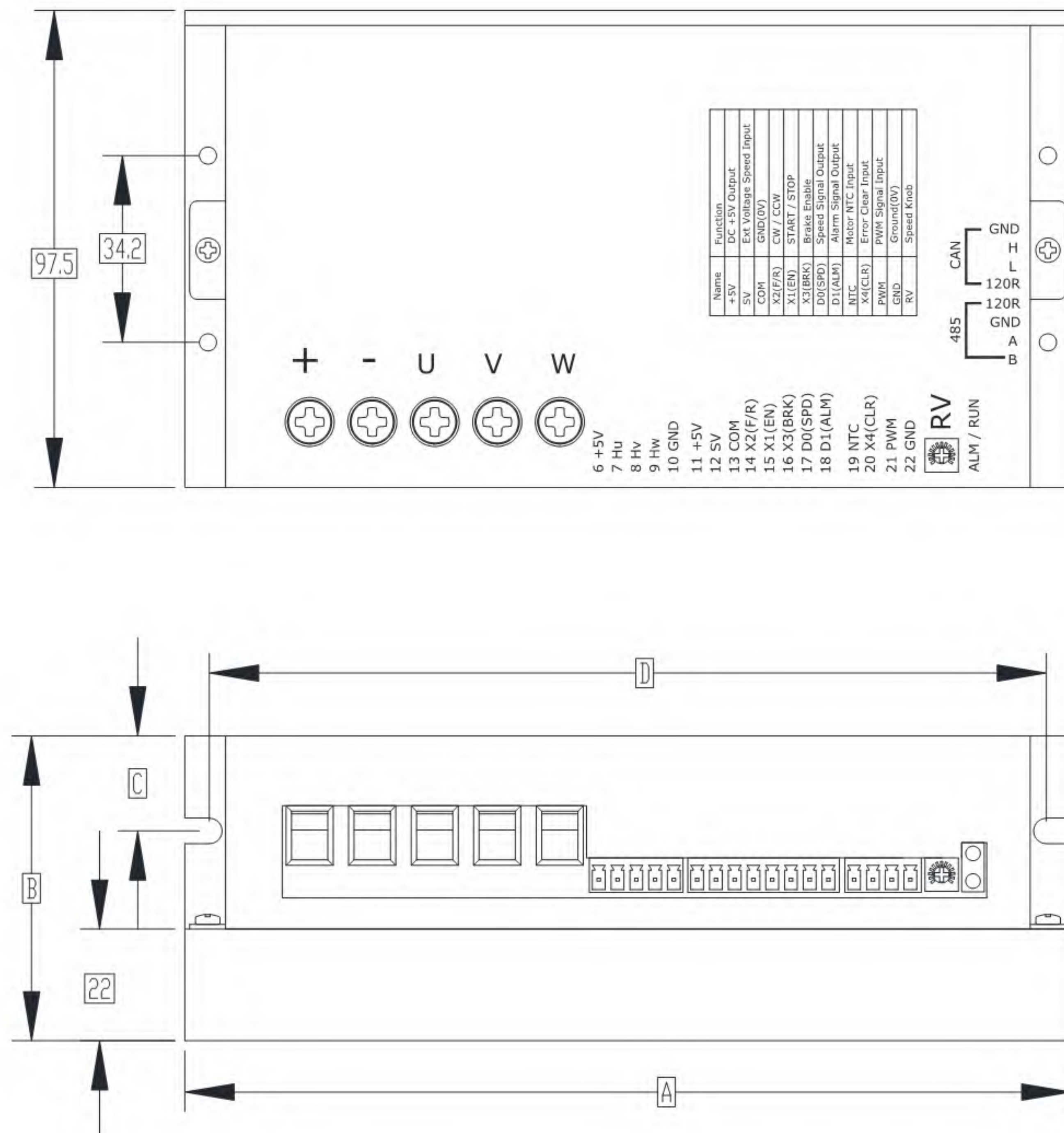
Clarification

The driver can overload 150% of the rated current, the overload alarm time is related to the amount of overload, the higher value of current makes the faster to alarm.

The rated operating currents are all values corresponding to 48V input bus voltage. If the input voltage exceeds 60V, the current is calculated by the output power. If the power of 50A is 2500W, the current can only go up to about 34A when working under 72V bus voltage.

2 Mechanical Installation

2.1 Size



Model	A	B	C	D
BLD-30A	150	52.5	15	139
BLD-50A	180	62	19	170
BLD-100A	208	70	27	195

Fixing Screws: 2*M8, recommended locking torque: 0.55N.m.

2.2 Preparation of mounting options

Fuse

In order to comply with the safety standards for CE certification, be sure to connect a fuse on the input side to prevent accidents caused by short circuits in the internal circuit.

EMC Filters

The filter should be mounted close to the input terminals of the driver, and the connecting cable between them should be less than 30 cm. The ground terminal of the filter and the ground terminal of the driver should be connected together, and make sure that the filter and the driver are mounted on the same conductive mounting plane, which is connected to the main ground of the cabinet.

2.3 Cable Preparation

For the driver to connect properly, the power supply cable, phase power cable, sensor cable, control cable and communication cable need to be used together at the same time.

If you are making your own cable or have a specific cable length requirement, please contact technical support.

2.4 Security tips

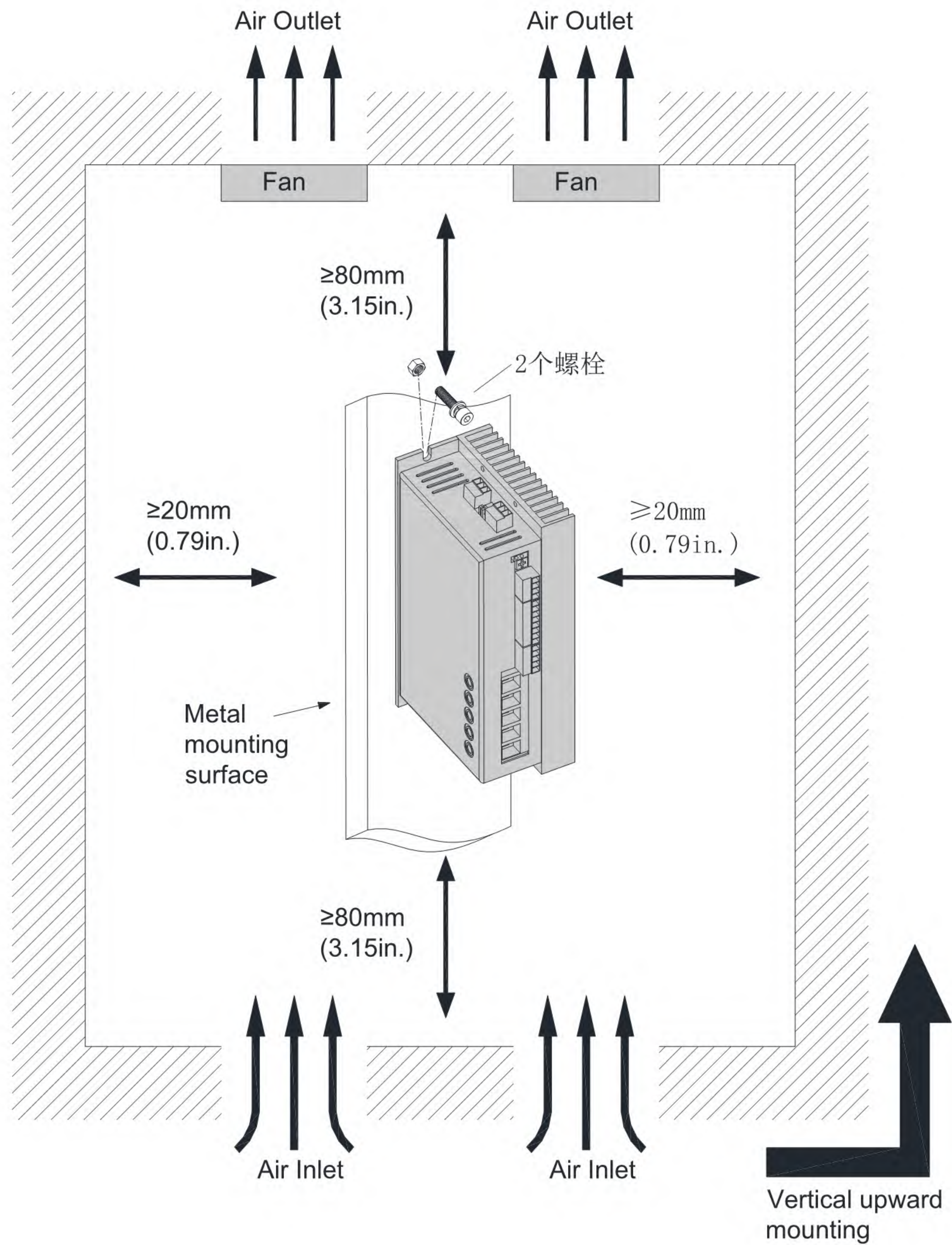
Item	Description
Installation	<p>Please install the product vertically upwards to facilitate heat dissipation upwards. If there are many products in the cabinet, install them side by side. If the product is to be mounted up or down, install a heat-insulating deflector.</p> <p>Make sure the mounting direction is perpendicular to the wall. Use natural convection or a fan to cool the drive. Securely fasten the driver to the mounting surface through 2 ~ 4 (number of mounting holes varies depending on capacity) mounting holes.</p> <p>When installing, face the front of the driver (the actual mounting surface for the operator) toward the operator and keep it perpendicular to the wall.</p> <p>If a mounting bracket is required, be sure to use a flame-retardant material for the mounting bracket.</p>
Cooling	To ensure cooling by fan and natural convection, leave enough space for heat dissipation around the driver and take into account the heat dissipation of other devices in the cabinet. Install a cooling fan on the upper part of the driver, and keep the temperature inside the cabinet uniform so that the ambient temperature of the driver is not locally too high.
Ground	Be sure to ground the ground terminal, otherwise there may be a risk of electric shock or interference resulting in malfunction.
Layout	<p>When wiring the driver, route the cables downward to avoid flowing into the driver along the cables if there is liquid attached to the cables in the field.</p> <p>Power, motor phase cable should not be tied together with the signal and communication cable, to layout them separately.</p>

2.5 Pre-installation inspection

SN	Checking Items	Appr.
1	The product received is the same model as the product ordered.	<input type="checkbox"/>
2	The product shell is free of deformation and cracks.	<input type="checkbox"/>
3	There are no loose or stripped screws on the product.	<input type="checkbox"/>
4	Signal terminals are free of cracks, foreign objects, and skew.	<input type="checkbox"/>

2.6 Installation of driver

Retaining the mounting distance, the driver heatsink contact surface is metal, and the thermal performance is required.



2.7 Installation inspection

SN	Checking Items	Appr.
1	Terminal screws are locked and marked to the specified torque.	<input type="checkbox"/>
2	The driver and external braking resistor are not placed on combustible objects.	<input type="checkbox"/>
3	There are no foreign objects such as wire tips or metal shavings inside or outside the driver that could cause short circuits in the signal and power cables.	<input type="checkbox"/>
4	The motor mounting, shaft and mechanical connections must be reliable.	<input type="checkbox"/>
5	The motor and connected machinery must be in operable condition.	<input type="checkbox"/>
6	The main electrical wiring is securely installed.	<input type="checkbox"/>

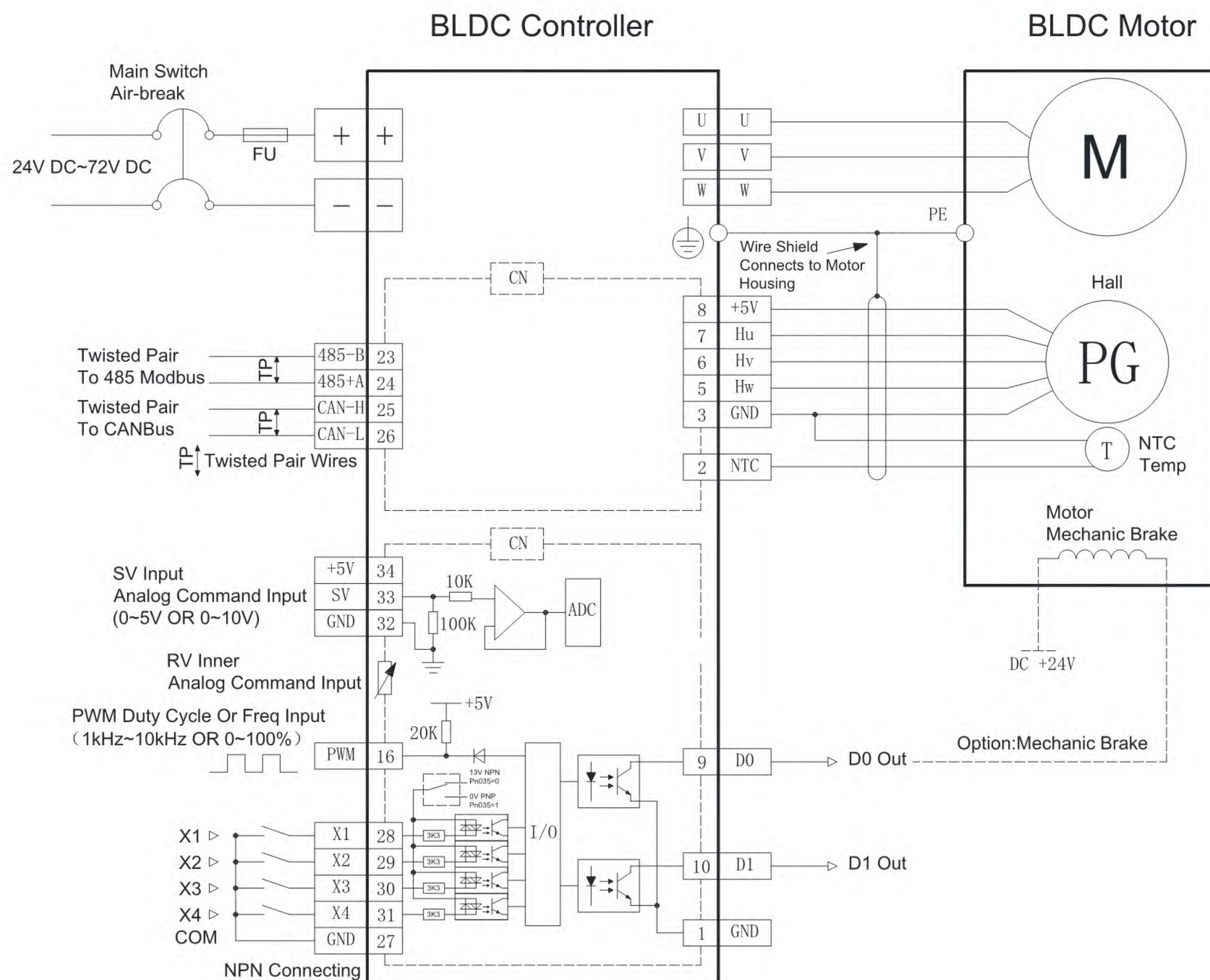
3 Electrical Installation

3.1 Installation Tips

Observe the following precautions when wiring the power supply and main circuit:

- If the main circuit terminals are connectors, remove the connectors from the driver before wiring.
- One of the connector's cord sockets is capable of inserting only one cord.
- When inserting wires, do not short-circuit the burrs of the core wire to neighboring wires.
- Insulate the power terminal connections, otherwise electric shock may result.
- Safety devices such as circuit breakers are provided to prevent fires that may result from short-circuiting of external wiring.
- It is strictly prohibited to place the cable under heavy objects or drag it vigorously, as this may result in damage to the cable and electric shock.
- Use a power filter to minimize the effects of electromagnetic interference, which can cause interference with electronic equipment near the drive.

3.2 Electrical Diagram



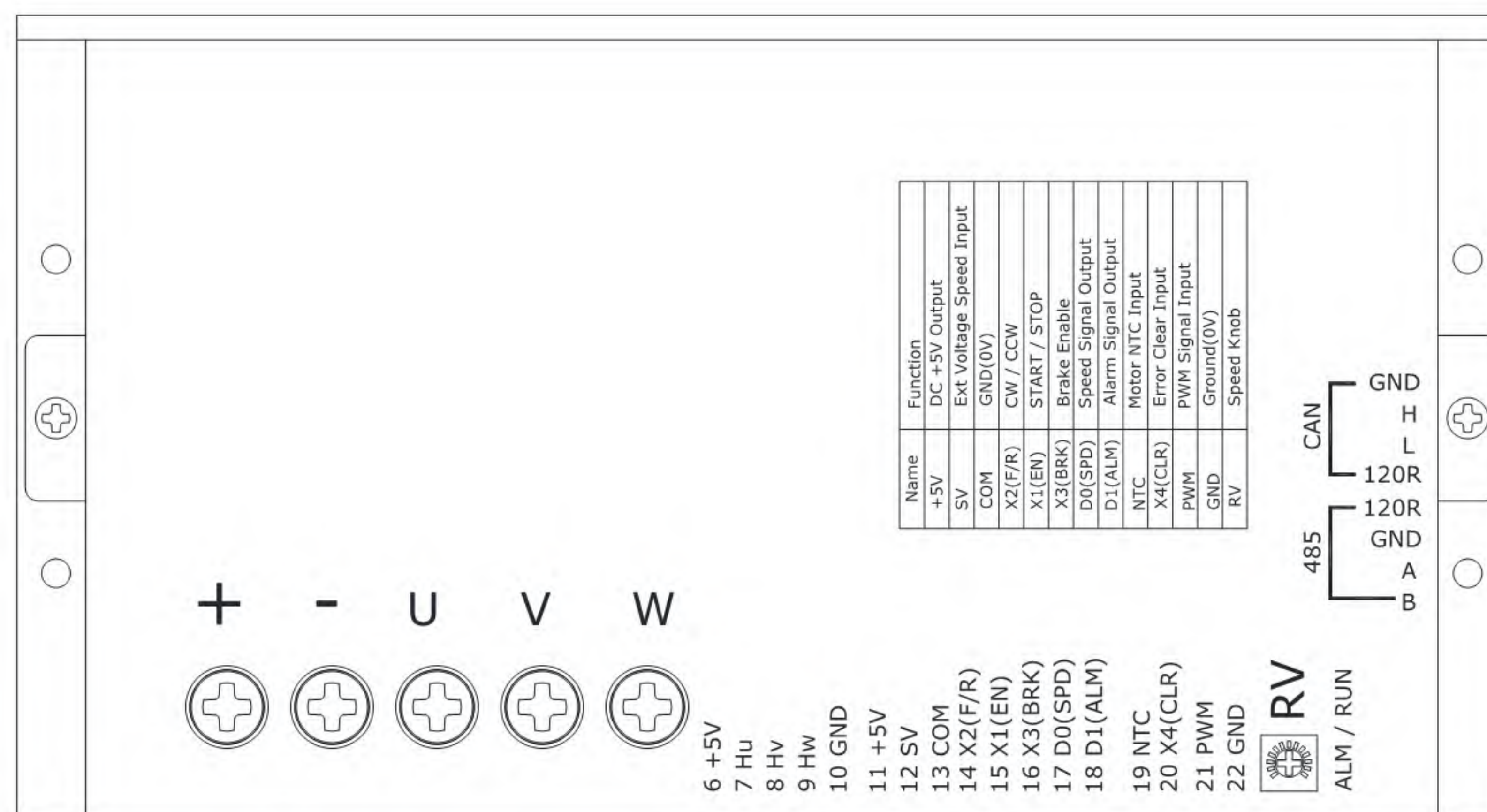
Clarification

Where the power supply +, - is prohibited from being reversed to prevent damage to the driver.

When making cable connections, the U, V, and W phase order must not be connected incorrectly, otherwise there is a risk of wrong running.

The PE wire from the motor is connected to the driver mounting bolts and connected to the equipment earth ground.

3.3 Cable pin definition



Note: "Pin No." maybe different according to each model, please refer to "Name".

Pin No.	Name	Color	Description
Power & Phase	+	-	DC 24V~72V input
	-	-	
	U	-	Motor phase line outputs
	V	-	
	W	-	
22	GND	Black	Digital GND
19	NTC	-	NTC Sensors
10	GND	Black	Analog GND
9	HW	Yellow	Hall Sensor Input
8	HV	Green	
7	HU	Blue	
6	5V	Red	5V Output
17	D0	-	Open-drain NPN output
18	D1	-	Voltage: 30V, Current: 500mA
21	PWM	-	Frequency range: 1~10kHz (50% duty cycle) Duty cycle range: 0~100% (100Hz~1000Hz) Signal voltage: DC 5~24V
--	485+A	-	485 communication port
--	485-B	-	
--	485-GND		
--	485-120R		485 120Ω Terminating Resistor Switch
--	CAN-H	-	CAN communication port
--	CAN-L	-	
--	CAN-GND		
--	CAN-120R		CAN 120Ω Terminating Resistor Switch
15	X1_IN	-	Support NPN, PNP NPN: 0V is low, 5~24V is high, current 20mA PNP: output is 13V high, low to GND
14	X2_IN	-	
16	X3_IN	-	
20	X4_IN	-	
13	GND	Black	GND
12	SV	-	DC 0~5V range DC 0~10V ange Deadband voltage adjustment range 0.2~1.0V Input internal resistance: 100kOhm
11	+5V	Red	5V Output

2.2 Check after wiring

SN	Checking Items	Appr.
1	The power input terminals (V+, V-) must be properly connected.	<input type="checkbox"/>
2	The driver output terminals (U, V, W) and motor phase cables (U, V,W) are in phase and properly connected.	<input type="checkbox"/>
3	The power input terminals (V+, V-) and phase output terminals (U, V, W) of the driver are not shorted.	<input type="checkbox"/>
4	All cables are stressed within specified limits.	<input type="checkbox"/>
5	The driver and motor must be reliably grounded.	<input type="checkbox"/>
6	Wiring terminals are insulated.	<input type="checkbox"/>

4 Function summary

The following is a list of the functions of the DC brushless driver. For details of each function, please refer to the specific descriptions in each chapter.

Function	Contents
Speed control mode	The brushless driver operates in speed control mode.
Torque control mode	The brushless driver operates in torque control mode.
IO+SV input control	The brushless driver works through IO switching and SV analog input commands.
IO + Duty Cycle Input Control	The brushless driver works through IO switching and PWM duty cycle input commands.
IO + frequency input control	The brushless driver operates via IO switching and PWM frequency input commands.
IO+485 communication input control	The brushless driver works through IO switching and 485 communication data input commands.
Segment speed input control	The brushless driver works through segment speed input commands.
ModBus communication control	The brushless driver works by inputting commands via ModBus communication.
CANBus communication control	The brushless driver works by inputting commands via CANBus communication.
Synchronous rectification [1]	The brushless driver can respond to application scenarios that require more rigidity by turning on this control.
Temperature Sensor Input	A specified temperature sensor can be accessed to monitor the motor temperature.
Input signal selection	Input functions such as motor start enable can be defined to the corresponding pins.
Output signal forced output	Realize forced output with brushless driver status signal, which can be used to detect the wiring of the output signal.
status display	The main circuit power indicator and fault indicator show the current status of the brushless driver.
External I/O Display	Displays the ON/OFF status of external I/O signals.
Alarm history	The last 10 alarms can be recorded and the alarm history can also be cleared.
Alarm code output	Outputs a 2-digit length alarm code when an alarm occurs.
black box function	The data before and after the occurrence of a fault alarm are captured and saved in the brushless driver, and these data are read with the background software for further analysis and research use.
Built-in holding brake function	Built-in holding brake as standard, real-time monitoring of the status of the holding brake.
JOG mode	Run brushless motors directly through the brushless driver APP without inputting a physical signal for trial operation.
Driver Debugging Platform	Using a personal computer, you can perform operations such as parameter setting, trial operation, and status display.

Clarification

[1]: Synchronous rectification can be enabled only for power requirements less than 1kW.

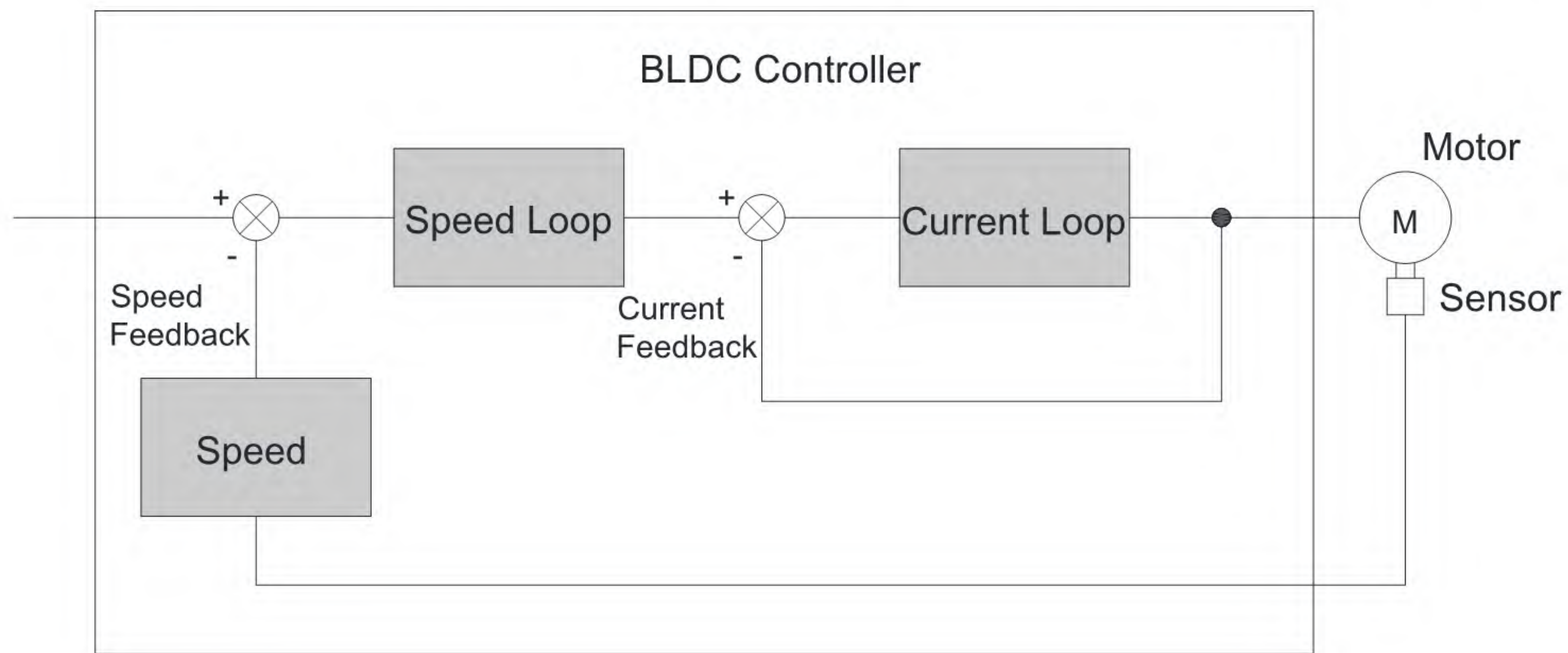
5 Technical specification

The following is a list of technical specifications for brushless DC drives.

Item	Specification
Rated Input Voltage Range	DC +24~+72V
Rated Watt	DB48D30xxxxx: 1.5kW DB48D50xxxxx: 2.5kW DB48D100xxxxx: 4.5kW DB48D200xxxxx: 10.0kW
Operating Temperature Range	-40~+80°C
IO input	Supports NPN, PNP NPN: 0V is low, 5~24V is high, current 20mA PNP: 13V high output, low to ground
IO output	Open Drain NPN Output Voltage: not exceed 30V, Current: 500mA
SV Input Characteristics	DC 0~5V range or DC 0~10V range Deadband voltage adjustment range 0.2~1.0V Input internal resistance: 100k
PWM Input Characteristics	Frequency range: 1~10kHz (50% duty cycle) Duty cycle range: 0~100%(100Hz~1000Hz) Signal voltage: DC 5~24V
Carrier Frequency	10~20kHz
485 Communication Parameters	ID: 1~255 Baud rate: 9600 / 19200 / 38400 / 57600 / 115200 bps
CAN Communication Parameters	ID: 0~255 Baud rate: 125 / 250 / 500 kbps
Load	150% of rated current Overload duration: 30~1s (at 150% rated)
External Temperature Sensor	Customizable ntc= mf52-103f-3435-55l
Control Method	Torque Loop (Open Loop) Speed Loop (Close Loop)
Acceleration And Deceleration Times	0.5~16s motor without load
Overheating Protection	Inside the driver: +85°C
Protection Class	IP65(DB series only)
Debugging Software	Universal Brushless Motor Control APP
Certification	

6 Control mode

- The brushless system consists of three main components: the driver, the motor and the sensor.



The driver is the control core of the DC brushless control system. By processing the input signal and feedback signal, the brushless driver can provide accurate speed and torque control of the brushless motor, i.e., speed and torque control mode. Among them, speed control is the most important and commonly used control mode of the system.

Each control mode is described below:

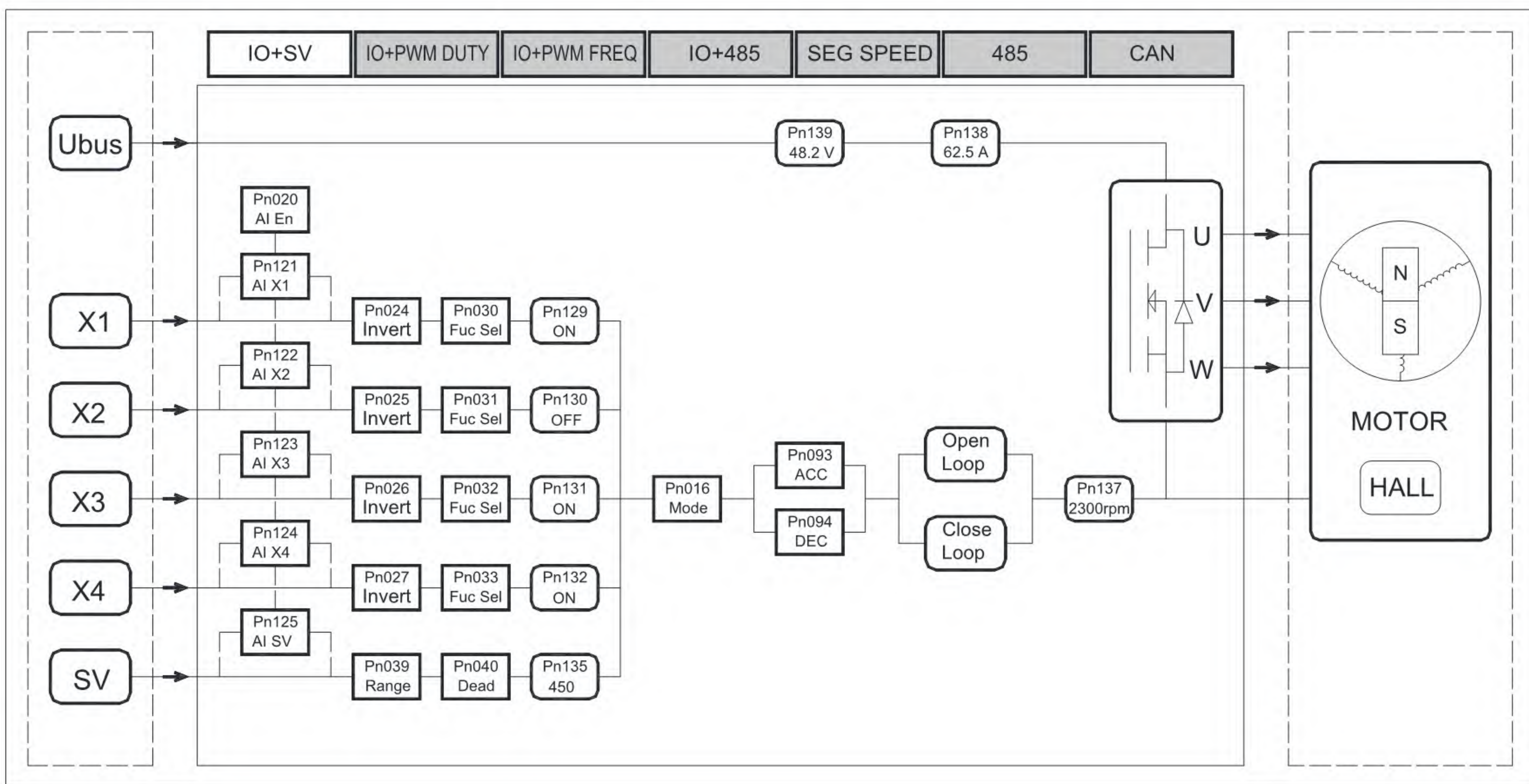
- Speed control refers to controlling the speed of a motor through a speed command. By communicating a given speed command, the driver is able to achieve fast and accurate control of the motor speed. Therefore, the speed control mode is mainly used in applications where the speed is controlled or where the output of the host computer is used as the speed command input to the driver, such as belt transfer equipment.
- The current and torque of a brushless motor are linearly related, so the control of the current realizes the control of the torque. Torque control means to control the output torque of the motor by torque command. The torque command can be given through communication. The torque control mode is mainly used in installations that do not require an accurate speed, such as applications with wind or liquid loads.
- By changing Pn016: =1 for torque control mode, =2 for speed control mode.

6.1 IO+SV control

Control by IO switching and SV analog inputs as commands, the parameters are set as follows:

Pn	HEX	Min	Max	Default	Unit	Name	Attr.	Description
14	000Eh	1	6	1	-	Data Channel	Reboot	SV input as a data source
15	000Fh	1	4	1	-	Ctrl Channel	Reboot	IO switching as a control source
30	001Eh	0	4	0	-	X1 Function	Immediate	X1 as start/stop control
31	001Fh	0	4	1	-	X2 Function	Immediate	X2 as direction control
32	0020h	0	4	2	-	X3 Function	Immediate	X3 as brake control
33	0021h	0	4	3	-	X4 Function	Immediate	X4 as fault clearing control
39	0027h	0	1	0	-	SV Range	Immediate	0~5V as data command
40	0028h	100	1000	500	mV	SV Start Voltage	Immediate	Deadband voltage = 0.5V

The control block diagram is shown below:



In this control mode, the switching inputs of X1~X4 are used as motor start/stop, brake and direction change control.

The analog voltage of the SV is used as the speed RPM input, and this voltage range can be selected via Pn039.

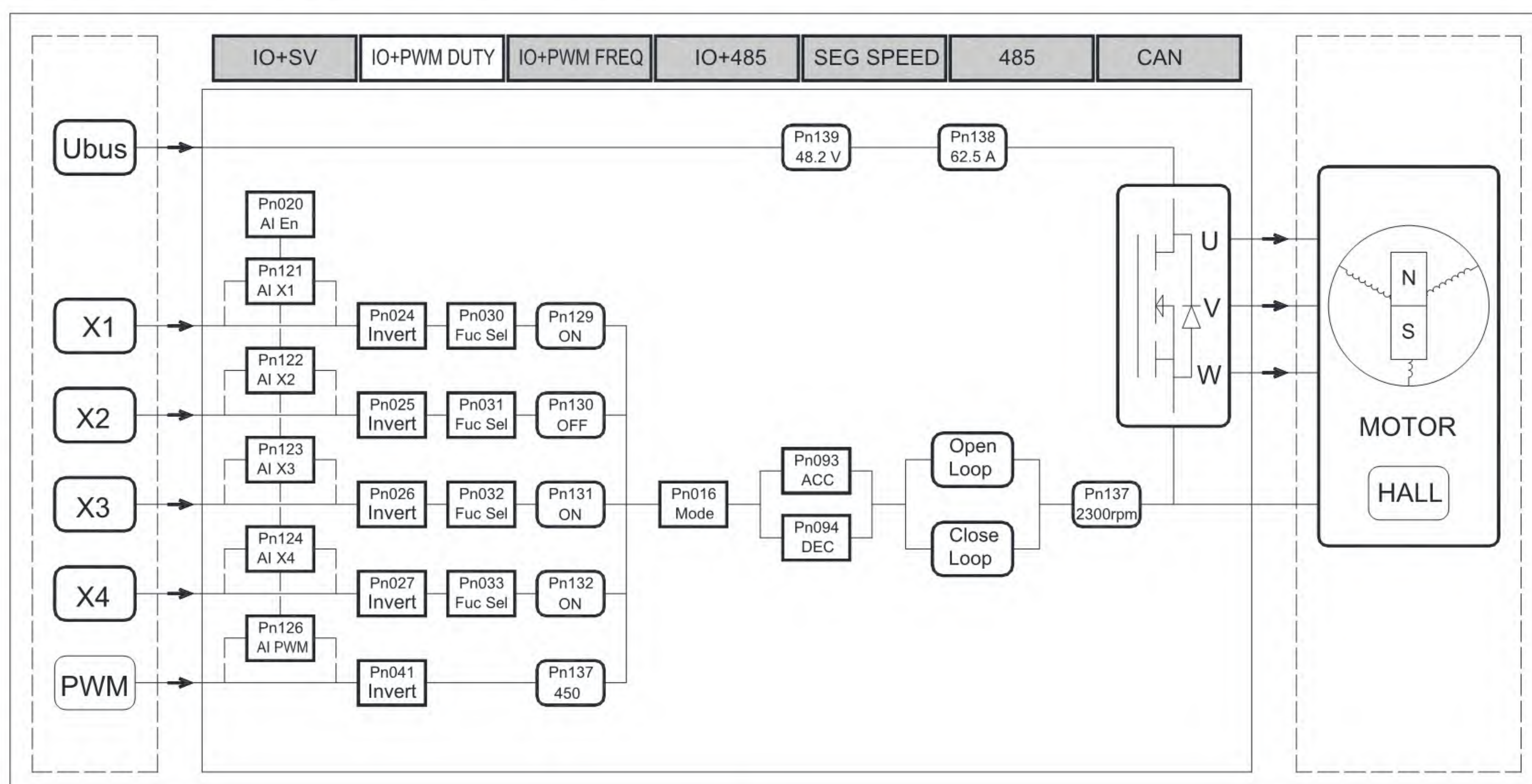
In the debugging stage, by setting the Pn020 virtual enable, virtual data can be used to replace the actual physical signals, thus realizing the debugging of the control system for JOG mode without connecting any control cables.

6.2 IO+PWM duty cycle control

Control by IO switching and PWM duty cycle inputs as commands, the parameters are set as follows:

Pn	HEX	Min	Max	Default	Unit	Name	Attr.	Description
14	000Eh	1	6	4	-	Data Channel	Reboot	SV input as a data source
15	000Fh	1	4	1	-	Ctrl Channel	Reboot	IO switching as a control source
30	001Eh	0	4	0	-	X1 Function	Immediate	X1 as start/stop control
31	001Fh	0	4	1	-	X2 Function	Immediate	X2 as direction control
32	0020h	0	4	2	-	X3 Function	Immediate	X3 as brake control
33	0021h	0	4	3	-	X4 Function	Immediate	X4 as fault clearing control

The control block diagram is shown below:



In this control mode, the switching inputs of X1~X4 are used as motor start/stop, brake and direction change control.

The PWM input duty cycle is used as speed input, and the frequency range of PWM is 100~1000 Hz. It is recommended to use a low frequency signal so that the duty cycle data will be more accurate.

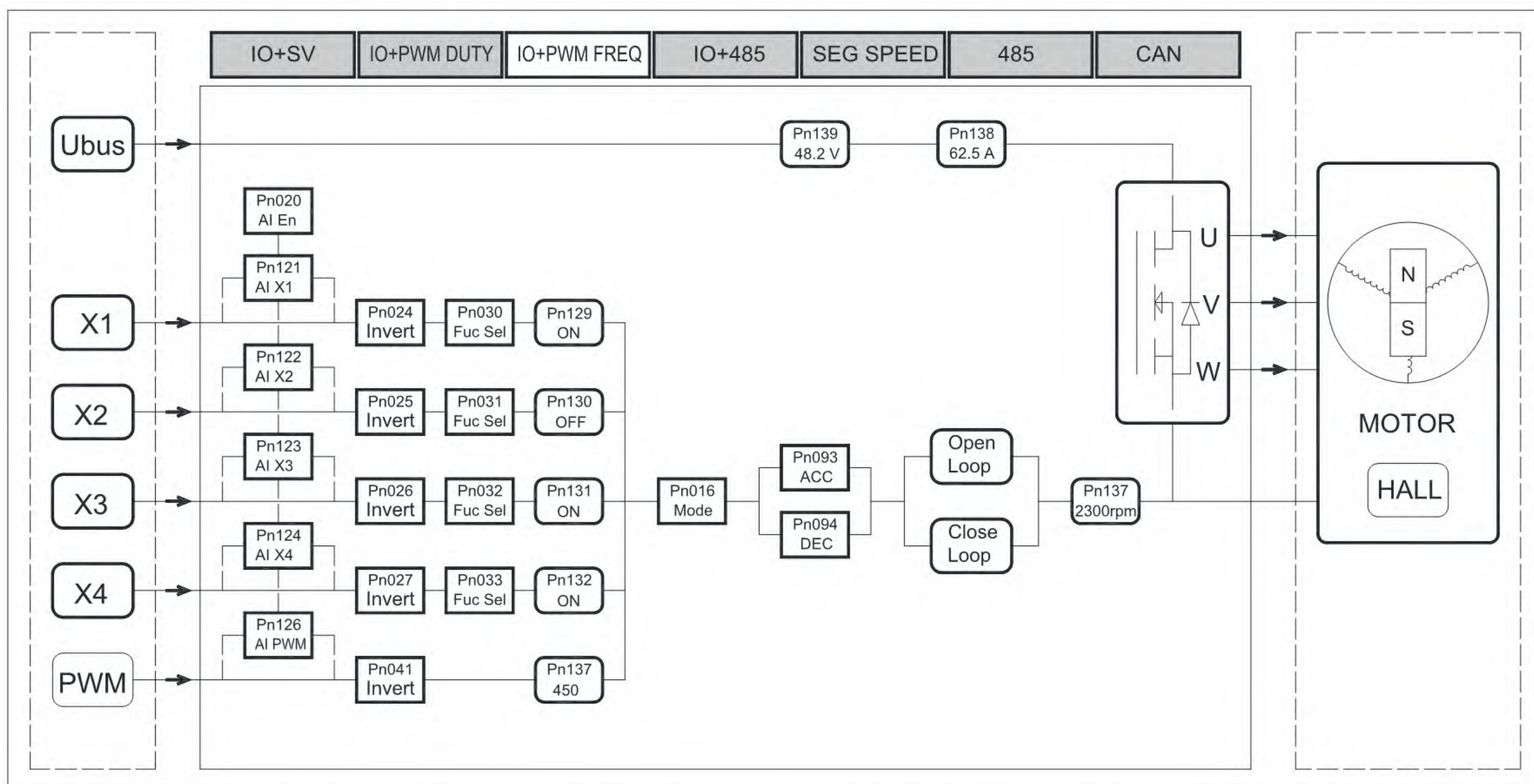
In the debugging stage, by setting the Pn020 virtual enable, virtual data can be used to replace the actual physical signals, thus realizing the debugging of the control system for JOG mode without connecting any control cables.

6.3 IO+PWM frequency modulation control

Control by IO switching and PWM frequency inputs as commands, the parameters are set as follows:

Pn	HEX	Min	Max	Default	Unit	Name	Attr.	Description
14	000Eh	1	6	5	-	Data Channel	Reboot	SV input as a data source
15	000Fh	1	4	1	-	Ctrl Channel	Reboot	IO switching as a control source
30	001Eh	0	4	0	-	X1 Function	Immediate	X1 as start/stop control
31	001Fh	0	4	1	-	X2 Function	Immediate	X2 as direction control
32	0020h	0	4	2	-	X3 Function	Immediate	X3 as brake control
33	0021h	0	4	3	-	X4 Function	Immediate	X4 as fault clearing control

The control block diagram is shown below:



In this control mode, the switching inputs of X1~X4 are used as motor start/stop, brake and direction change control.

The PWM frequency input is used as the speed input, and the PWM speed regulation frequency range is 1kHz to 10kHz (the signal duty cycle is set to 50%).

In the debugging stage, by setting the Pn020 virtual enable, virtual data can be used to replace the actual physical signals, thus realizing the debugging of the control system for JOG mode without connecting any control cables.

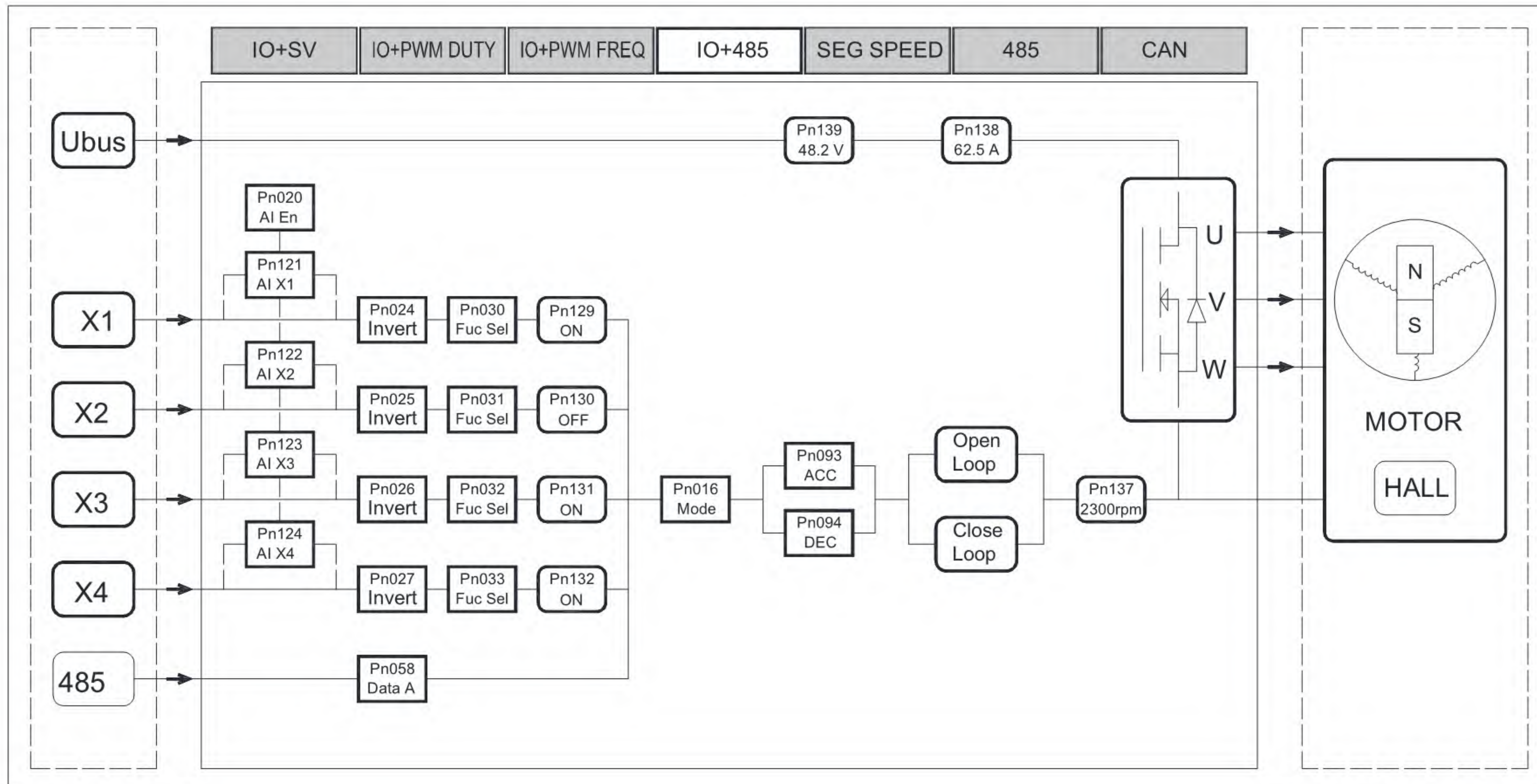
6.4 IO+485 modbus control

Control by IO switching and 485 modbus inputs as commands, the parameters are set as follows:

Pn	HEX	Min	Max	Default	Unit	Name	Attr.	Description
14	000Eh	1	6	2	-	Data Channel	Reboot	SV input as a data source

15	000Fh	1	4	1	-	Ctrl Channel	Reboot	IO switching as a control source
30	001Eh	0	4	0	-	X1 Function	Immediate	X1 as start/stop control
31	001Fh	0	4	1	-	X2 Function	Immediate	X2 as direction control
32	0020h	0	4	2	-	X3 Function	Immediate	X3 as brake control
33	0021h	0	4	3	-	X4 Function	Immediate	X4 as fault clearing control
58	003Ah	0	0xFFFF	0	rpm	Data A	Immediate	485 Data A

The control block diagram is shown below:



In this control mode, the switching inputs of X1~X4 are used as motor start/stop, brake and direction change control.

The speed data is set via 485. This control method is suitable for application scenarios where the speed is constant and the motor operation is controlled only by switching.

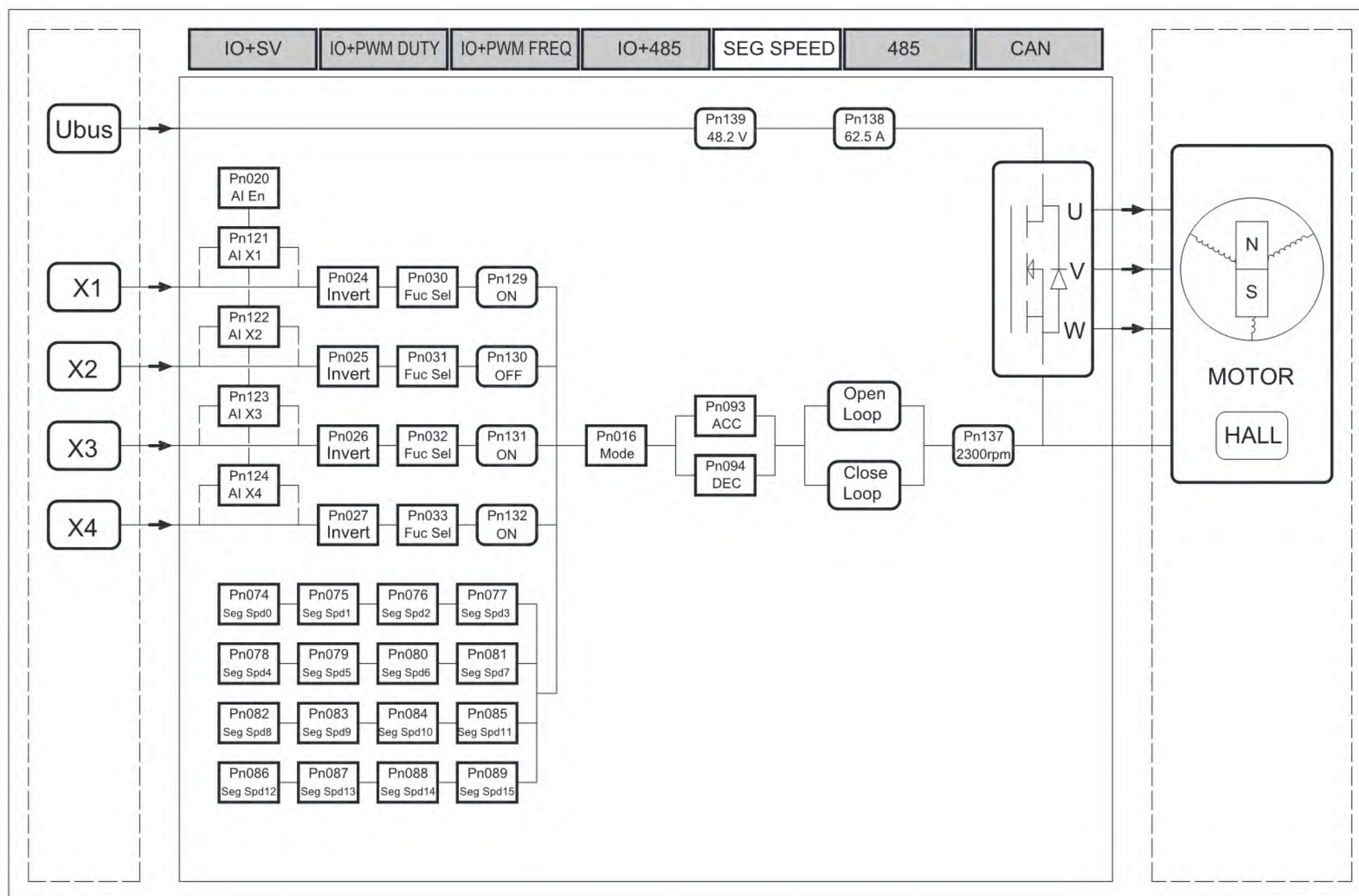
In the debugging stage, by setting the Pn020 virtual enable, virtual data can be used to replace the actual physical signals, thus realizing the debugging of the control system for JOG mode without connecting any control cables.

6.5 Segment speed control

Control by segment speed input as commands, the parameters are set as follows:

Pn	HEX	Min	Max	Default	Unit	Name	Attr.	Description
14	000Eh	1	6	6	-	Data Channel	Reboot	SV input as a data source
15	000Fh	1	4	4	-	Ctrl Channel	Reboot	IO switching as a control source
30	001Eh	0	4	4	-	X1 Function	Immediate	X1 as start/stop control
31	001Fh	0	4	4	-	X2 Function	Immediate	X2 as direction control
32	0020h	0	4	4	-	X3 Function	Immediate	X3 as brake control
33	0021h	0	4	4	-	X4 Function	Immediate	X4 as fault clearing control

The control block diagram is shown below:



In this control mode, the switching inputs of X1~X4 are used as the control inputs for segment speeds, and the 16 states of the 4 inputs correspond to the 16 speeds in the parameters Pn074~Pn089 respectively.

It is also possible to select only 1 input, 2 inputs, or 3 inputs of the X1~X4 inputs as segment speed inputs, then the corresponding 2, 4, or 8 speeds are controlled.

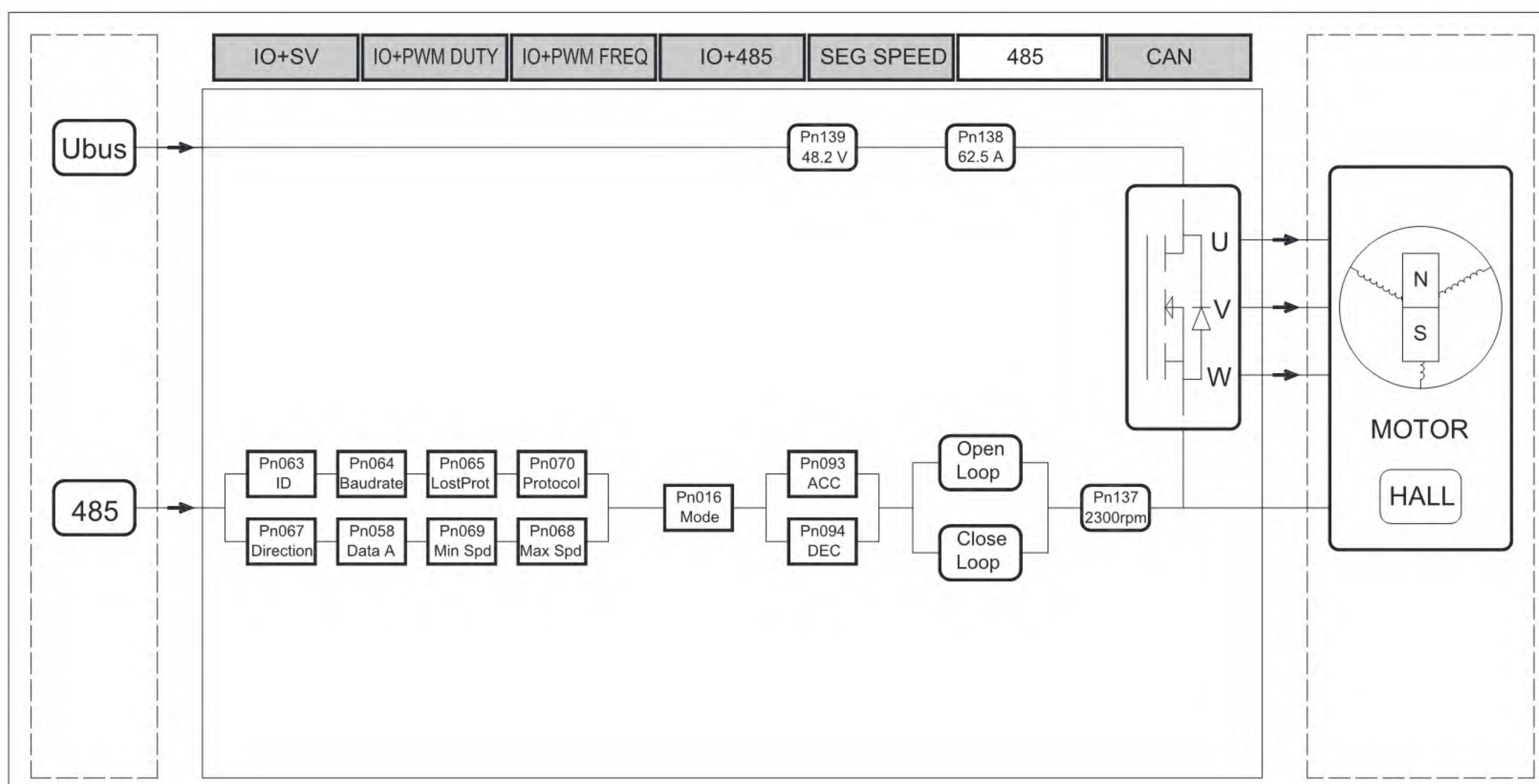
In the debugging stage, by setting the Pn020 virtual enable, virtual data can be used to replace the actual physical signals, thus realizing the debugging of the control system for JOG mode without connecting any control cables.

6.6 485 modbus control

Control by 485 modbus inputs as commands, the parameters are set as follows:

Pn	HEX	Min	Max	Default	Unit	Name	Attr.	Description
14	000Eh	1	6	2	-	Data Channel	Reboot	SV input as a data source
15	000Fh	1	4	2	-	Ctrl Channel	Reboot	IO switching as a control source
58	003Ah	0	0xFFFF	0	rpm	Data A	Immediate	485 Data A

The control block diagram is shown below:



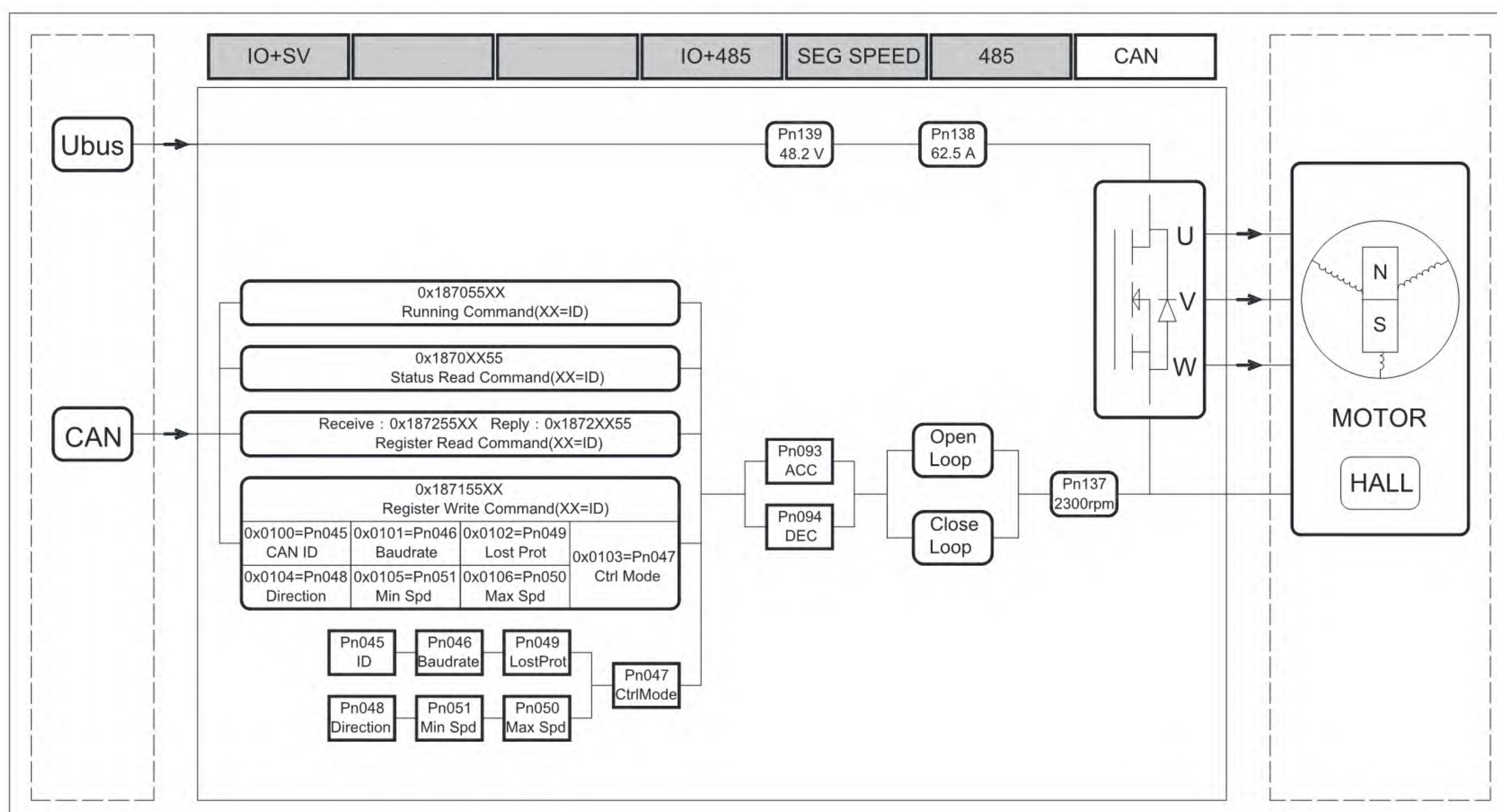
In this control mode, the control of the system can be realized only through the 485 communication port, and the communication protocol is standard ModBus.

6.7 CAN Control

Control by CANBUS inputs as commands, the parameters are set as follows :

Pn	HEX	Min	Max	Default	Unit	Name	Attr.	Description
14	000Eh	1	6	3	-	Data Channel	Reboot	SV input as a data source
15	000Fh	1	4	3	-	Ctrl Channel	Reboot	IO switching as a control source
45	002Dh	0	255	0	-	CAN ID	Reboot	
46	002Eh	0	2	2	-	Baud rate	Reboot	0=125k, 1=250k, 2=500k
49	0031h	0	0xFFFF	1000	mS	Heart Beat Protection	Immediate	0=Disable , NOT 0=Heart beat interval
50	0032h	0	0xFFFF	3000	rpm	Max Speed	Immediate	Exceeding this value is considered to be this value
51	0033h	0	0xFFFF	200	rpm	Min Speed	Immediate	A value below this is considered to be this value

The control block diagram is shown below:



In this control mode, the control of the system can be realized only through the CAN communication port, and the communication protocol is customized CAN protocol.

7 Special Application

7.1 Synchronous rectification

The synchronous rectification function can be turned on by setting parameter.

The synchronous rectification function is generally used in application scenarios that require a faster response to speed regulation.

Turning on the synchronous rectifier will limit the maximum output current rating of the system to 20A.

After starting the synchronous rectifier, be aware of the problem of BEMF(Back Electromotive Force). If the system is battery powered and the battery can be recharged during output ports, the electricity generated by the motor will be absorbed by the power supply battery.

If the system is powered by a switching power supply and the system will become a reverse engine power generation due to motor inertia or passive rotation, it is recommended that a braking resistor control unit be added to the power supply side to prevent high voltage shocks to the entire system from excessive supply voltage.

7.2 Phase order Adjustment

The power line output sequence can be changed by setting the value of Pn019.

This function can be used to find the correct order by adjusting on the parameters when the order of the matched brushless motor power line UVW is not known.

Each half HEX bit of the parameter represents a phase, with 1, 2, and 3 representing U, V, and W, respectively.

For example, 0x0132, indicates that the current output order of the drive is: U, W, V. If the parameter is not set accurately, the driver will default to the order in which the output is UVW.

7.3 Motor temperature

The sensor for motor temperature detection can be selected by setting the value of Pn101.

The driver is equipped with a temperature sensor input interface, if the system needs to monitor the motor temperature, you can access the sensor models in the list and set the parameters to the corresponding values.

The sensor models that can be accessed are listed. You can contact the driver manufacturer to upgrade the firmware to match different sensor models, only NTC 100k type temperature sensors are supported.

7.4 Virtual(AI) input

The virtual input can be enabled by setting the value of Pn120, for JOG running mode.

When this function is enabled, all physical quantity inputs can be replaced by 485 communication application data. This makes it easy for the user to run the system without connecting any wiring harnesses or switches to make the system working.

The virtual physical quantity inputs include: X1~X4 switch inputs, SV analog voltage inputs, PWM data inputs.

7.5 Current control

The driver contains several key current parameters, from minimum to maximum:

① Pn003 Current Rating: defined as the current on the bus input at which the system can keep operating within this current.

- ② Overload current: automatically formed. Equal to 1~1.5 times the rated current of Pn003, i.e., in this current interval, the driver will perform overload timing, the higher the overload current, the faster the timing. Greater than 1~1.5 times rated current corresponds to 30~1 seconds overload allowed working time.
- ③ Pn013 Rated Current Limit: The upper limit of current on the bus that the control will limit the system from operating above.
- ④ Pn012 Rated overcurrent alarm value: the current alarm value on the bus, when the current on the bus reaches this value, the control will alarm and stop working.
- ⑤ Pn010 Peak current alarm value: defined as the instantaneous current alarm value on the phase line.
- ⑥ Hardware overcurrent alarm value: defined as the maximum tolerance value allowed by the hardware, hardware design value, and it cannot be set.

In general, the Pn003 rated current is set according to the rated power of the matched motor. Regarding the overload current, this overload protection can be turned off with Pn021, depending on the application scenario. When turned off, Pn013 automatically equals the value of Pn003. This application is suitable for long time high torque output scenarios.

7.6 Mechanic brake output

Both outputs D0 and D1 of the driver can be set as holding brake outputs with Pn036 and Pn037. When this function is set, the output can be connected to the mechanical holding brake of the motor for control.

The rotational speed associated with the holding brake output can be set via Pn099.

This function can be used in application scenarios where the motor needs to be held in the system to realize mechanical holding after motor stopped or power off.

8 Fault process

When the driver detects a fault, the fault RED light will flash, and the number of flashes corresponds to the corresponding fault.

The fault type can also be determined by reading the Pn140 parameter.

The fault can be cleared by setting one of the X1~X4 inputs to the fault clear function. The current fault can also be cleared by setting Pn103, and the driver will restart when the fault is cleared by the command.

The driver has a black box function that records data to be saved to memory for analysis while detecting faults.

SN	Fault	Possible Reason
1	Stall	1, Power phase wire or hall sensor wiring error or omission, resulting in a normal start motor running under the command, the motor does not turn to produce this fault. Check the wiring to ensure that the correct wiring. 2, The motor load is too large, resulting in the motor not running, that will produce this fault, and try to reduce the load. 3, The motor 3-phase has a bad phase, resulting in the motor not running properly, that will result in this fault.
2	Overcurrent(H)	1. When the motor is not in running, this fault occurs, that means the hardware is failure and the repair is needed. 2, In the start of the motor running resulting this fault you can reduce the starting acceleration. Reduce the starting current can avoid this fault. 3, In the normal operation of the motor in the process of generating this fault, then the possible causes are the motor load suddenly become large, or phase line has a short-circuit condition.
3	Overcurrent(S)	1, In the start of the motor operation found in this fault, you can reduce the starting ACC. Reducing the starting current can avoid this fault. 2, In the normal operation of the motor in the process of generating this fault, then the possible causes are that the motor load suddenly become large, or phase line has a short-circuit condition.
4	Overcurrent Bus	Same as Overcurrent(S) fault.
5	Hall Error	1, When power on without running the motor producing this fault, check the wiring. 2, This fault occurs occasionally during operation, then the possible cause is hall signal interference. If hall lines are too long, it may produce this fault, or hall lines are not shielded and the power line tie with them together, the interference may cause this fault. 3, Once the motor is running producing this fault, it may be caused by the motor of the hall sensor position not accurate.
6	Under Voltage	1, When power on the motor without running causing this fault, the supply voltage may be too low. 2, When this fault occurs during operation, it may be the output current of the power supply equipment insufficient, that results in the voltage reduced to the alarm value. After the voltage is restored, the fault will disappear. checking the fault history.
7	Over Voltage	1, When power on without running the motor, produce this fault. The supply voltage may be too high. 2, during the operation resulting this fault, it may be due to that the motor becomes a generator generated by BEMF(Back Electromotive Force) resulting in the supply voltage rises. This situation generally occurs in the switching power supply system.
8	Over Speed	1. Under open-loop operation, this fault is generated. It may be caused by the motor running with a small load and the speed exceeding the set value at full speed. 2. Closed loop operation, this fault occurs. It may be because the power line sequence is connected wrongly, and the speed is out of control during operation.
9	Sample Base Error	When power on producing this fault, it is hardware failure, return for service.

10	Over Load	The driver has been running over its rated power for a long time, that will cause this fault.
11	Under Temperature	Driver detects low temperature
12	Over Temperature	The driver detects high temperatures and the system needs a better cooling environment.
13	PWM Input Signal Error	The PWM input signal frequency exceeds 1kHz to 10kHz range.
14	EERPROM Error	Data storage errors can be resolved by trying to upgrade the firmware.

9 RS485 communication

9.1 RS485 Protocol

(1) Protocol format: Modbus RTU protocol

The MODBUS bus of this system adopts and supports the communication mode of RTU mode. For the use of MODBUS communication protocol, please refer to the MODBUS official website <http://www.modbus.org> for the most authoritative information.

(2) Baud rate: 9600/19200/38400/57600/115200 (default 38400)

Data bits: 8 bits

Parity bit: None

Stop bit: 1 bit

Checksum method: ModBus CRC16

9.2 Protocol Command Structure

Name	ID	WR	Address	Data	CRC16
byte(s)	1	1	2	2	2
Description	Device ID	0x03: Read 0x06: Write	HEX Address PnXXX	Data	Modbus CRC16
Sample	0x01	0x06	0x00 0x25	0x00 0x01	0x59 0xC1
	Set the parameter Pn37 (address is 0x0025) value 0x0001 (Pn037=1)				

10 CAN

The default communication rate is: 500Kbps The bus communication ID address is: 32-bit . The CAN bus communication cable is a shielded twisted pair and utilizes the CAN 2.0 standard protocol.

For multi-node inline use, the final node requires an additional 120 ohm terminating resistor. The node ID can be set according to the actual operation, 0x00 is the permanent ID.

10.1 Running Command

Driver receives run command data: (ECU, BCM, and other master control units →→ Driver)

Name	Interval	ID	Bytes	Bits	Description
Running	100mS	0x187055?? ??=CAN ID	Byte1		Target Data High Byte 【Note1】
			Byte2		Target Data Low Byte 【Note1】
			Byte3		Reserved
			Byte4		Reserved
			Byte5		Heart Beat High Byte 【Note2】
			Byte6		Heart Beat Low Byte 【Note2】
			Byte7		Byte1-6 Checksum High Byte 【Note3】
			Byte8		Byte1-6 Checksum Low Byte 【Note3】

【Note 1】

This motor target data Bit0-13, is the motor target speed data. Data Bit14-15 = bin00 for motor stop.

Data Bit14-15=bin01 for motor forward rotation. Data Bit14-15=bin10, for motor backward rotation. Data Bit14-15=bin11, for motor braking.

In the speed closed loop mode, Bit0-13 represents the target speed, if the absolute value of the set speed is less than the minimum speed of motor operation (default is 200rpm), the motor will not run. If the absolute value of the set speed is more than the maximum speed of motor operation (default is 4000rpm), the motor will run at the maximum speed of 4000rpm.

In the torq open loop mode, Bit0-13 represents the target regulation, valid range is 0-200, if the set regulation is greater than 200, it will operate according to the maximum regulation.

【Note 2】

Heartbeat number to prevent the host side of the ECU, BCM, etc. from dying and sending repetitive data without autonomous, if the heartbeat number of the command frame sent by the host side is unchanged from the previous command frame, this command is regarded as an invalid command frame.

【Note 3】

To prevent data transmission errors, Byte7 and Byte8 are the summation check digits for [Data1- Data6] data.

10.2 Status Data

Status data sent by the driver: (Driver →→ ECU, BCM, and other master control units):

Name	Interval	ID	Bytes	Bits	Description	
Status	100ms	0x1870??55 ??=CAN ID	Byte1		Bus Voltage 【Note4】	
			Byte2		Bus Current 【Note5】	
			Byte3		Driver Temperature 【Note6】	
			Byte4		Motor Speed High Byte 【Note7】	
			Byte5		Motor Speed Low Byte 【Note7】	
			Byte6	Bit0		Bus Over Voltage 【Note8】
				Bit1		Bus Under Voltage 【Note8】
				Bit2		Controller Over Temp 【Note8】
				Bit3		Controller Low Temp 【Note8】
				Bit4		Over Current 【Note 8】
				Bit5		Over Load 【Note 8】
				Bit6		Hall Error 【Note 8】
			Bit7		Stall 【Note 8】	
Byte7		Byte1-6 Checksum High Byte 【Note9】				
Byte8		Byte1-6 Checksum Low Byte 【Note9】				

[Note 4] Driver bus voltage: Unit V, 1:1 data.

[Note 5] Driver working current: Unit A, 1:1 data.

[Note 6] Driver temperature: 1:1 data in °C with an offset of -40, e.g. a value of 30 means -10 °C.

[Note 7] Actual motor speed: 1:1 data in rpm.

[Note 8: Fault status: 1 means the corresponding fault exists, 0 means the corresponding fault does not exist.

[Note 9] To prevent data transmission errors, Byte7 and Byte8 are checksum check digits for [Data1-Data6] data.

10.3 Register

CAN special function register settings (ECU, BCM, and other master control units→→Driver):

Name	Interval	ID	Bytes	Bits	Description
			Byte1		Address High Byte
			Byte2		Address Low Byte

SFR Setting	0x187155?? ??=CAN ID	Byte3	Data High Byte
		Byte4	Data Low Byte
		Byte5	Reserved
		Byte6	Reserved
		Byte7	Byte1-6 Checksum High Byte
		Byte8	Byte1-6 Checksum Low Byte

SFR explain:

Name	Add	Default Value
CAN ID	0x0100	0x0000
Baud rate	0x0101	0x0001
Heart Beat Interval	0x0102	0x0000
Work Mode	0x0103	0x0000
Direction	0x0104	0x0101
Max Speed Limit	0x0105	0x0FA0
Min Speed Limit	0x0106	0x00C8
Factory Setting	0x0F00	-

Device Node ID, default value: 0x0000

The range of setting value is 0~255, otherwise it is invalid.

0x00 is the permanent ID and the other set IDs are feature IDs. the ID code of the communication frame must match either the feature ID code or the permanent ID code.

Communication baud rate, default value: 0x0002 [500Kbps]

0x0000 corresponds to 125Kbps

0x0001 corresponds to 250Kbps

0x0002 corresponds to 500Kbps

Other values are invalid.

Communication heart beat Interval, default value: 0x0000 [unit ms]

A communication abnormality means that the master control unit does not transmit a run command or that the heartbeat number of the run command does not change. When using CAN to control motor operation, the driver automatically stops the motor when the communication abnormality time exceeds the value set in this data to protect the system from stopping due to CAN communication abnormality.

Note: When this register is 0, the communication abnormality protection function is turned off.

Work mode, Register address 0x0103, register default value 0x0000

High byte for operating mode:

0x00 for speed open loop mode;

0x01 is the speed closed loop mode. .

Other values are invalid.

The low byte is the control channel:

0x03 is CAN control path

0x00 is physical signal control path (SV for RPM, CW/CCW for direction).

Other error values may introduce control disturbances.

Running Direction and Feedback Direction, Register address 0x0104, register default value 0x0101

The high byte is the setting value for the motor running direction polarity.

≠0 is positive polarity,

=0 is negative polarity.

The low byte is the setting value for motor feedback direction polarity. ≠0 is positive polarity, =0 is negative polarity.

When the motor running direction is found to be reversed, or the feedback motor direction is reversed, polarity reversal switching can be done by the corresponding byte of this register.

Maximum speed limit value, default value: 0x0FA0 [unit RPM]

Minimum speed limit value, default value: 0x00C8 [in RPM].

Restore Factory Settings.

Write operation to this register restores the factory setting regardless of the value set.

10.4 Special Register Read

Read SFR : (ECU, BCM, and other master control units →→ Driver)

Name	Interval	ID	Bytes	Bits	Description
SFR Read		0x187255?? ??=CAN ID	Byte1		Address High Byte
			Byte2		Address Low Byte
			Byte3		Data High Byte
			Byte4		Data Low Byte
			Byte5		Reserved
			Byte6		Reserved
			Byte7		Byte1-6 Checksum High Byte
			Byte8		Byte1-6 Checksum Low Byte

Read reply: (Driver →→ECU, BCM control center)

Name	Interval	ID	Bytes	Bits	Description
			Byte1		Address High Byte
			Byte2		Address Low Byte
			Byte3		Data High Byte

SFR Reply		0x1872??55 ??=CAN ID			
			Byte4		Data Low Byte
			Byte5		Reserved
			Byte6		Reserved
			Byte7		Byte1-6 Checksum High Byte
Byte8		Byte1-6 Checksum Low Byte			

SFR definition:

Name	Add	Description
Bus Voltage	0x0200	【Note4】
Bus Current	0x0201	【Note 5】
Driver Temp	0x0202	【Note 6】
Speed	0x0203	【Note 7】
Status	0x0204	0x0000=STOP, 0x0001=CW, 0x0002=CCW, 0x0003=BRAKE
Error Code	0x0205	【Note 8】
Position	0x0206	Electronic Signal Turns Count Value = Motor round * Motor Pole Pairs. The register value range -32768~32767, if the number of electronic revolutions has reached the register counting limit, it will not continue to accumulate. This register can be assigned with the 0x187155? instruction to assign a value to this register.