Kelly High-current KLS-N series

High-current Sinusoidal BLDC Motor Controllers

User Manual

Devices Supported:

KLS4860NT	KLS4875N	KLS48100N	KLS48120N	
KLS7275NT	KLS7275N	KLSAA72100N	KLS72120N	KLS72150N
KLS8475N	KLS84100N	KLS84120N		

Rev. 2.1.2
Aug. 2025

Contents

Chapter 1 Introduction

1.1 Overview

The KLS-N HC is an upgraded version of the standard KLS-N model, providing significantly improved performance and a larger body, while still retaining the same IP66 protection rating.

This manual provides an overview of the features, installation, and maintenance procedures for the Kelly sinusoidal brushless DC (BLDC) motor controller. Please read this manual carefully before using the controller. If you have any questions, contact the Kelly Controls Support Center.

Kelly programmable motor controllers deliver efficient, smooth, and quiet performance for electric motorcycles, golf carts, go-karts, and industrial motor control applications.

The KLS-N series is specifically designed to address noise issues in BLDC motor drive systems. This controller must be used with Hall sensors and does not currently support sensorless brushless motors.

Compared with traditional trapezoidal control methods, the sinusoidal drive technology employed by the KLS-N reduces operating noise and switching losses by up to one-third, meeting stringent noise reduction and efficiency requirements for BLDC motor applications. Utilizing high-power MOSFETs, SVPWM, and FOC, the controller achieves efficiency levels of up to 99% in most scenarios. A powerful microprocessor provides comprehensive and precise control while enabling users to quickly adjust parameters, run diagnostics, and conduct testing.

The KLS controller can be programmed using either PC software or the Android app. User-friendly I/O terminals make it easy to connect the battery and motor.

Caution!

Before running the motor, perform the auto-identification procedure.

Do not attempt to connect the controller to the user program or change any settings in the PC software or Android app while the motor is running.

In other words, always stop the motor before connecting to the user program or attempting to adjust parameters. This is a mandatory safety step.

Chapter 2 Features and Specification

2.1 General functions

1. Extended fault detection and protection functions. Customers can view error information via PC software or Android application.
2. Constant monitoring of battery voltage. If the battery voltage is too high, the controller will stop driving. When the battery voltage is too low, the controller will gradually reduce the motor drive power as the battery voltage drops. The controller will also stop driving when the battery voltage reaches the preset “low battery voltage” threshold.
3. Built-in current loop and over current protection.
4. Configurable motor temperature protection range.
5. Low and high temperature current reduction function to protect the battery and controller. The current begins to decrease when the case temperature reaches 90°C and shuts down completely at 100°C.
6. During regenerative braking, the controller continuously monitors the battery charge voltage.
7. The maximum reverse speed and forward speed can be configured between 20% and 100% respectively.
8. The controller can be programmed and configured using the user program or Android app. For PC, please use Kelly USB cable or USB-RS232 converter to connect the controller and PC, and then you can use the user program. For Android, please use the Bluetooth Adapter purchased from us to connect the controller, and then use the configuration app on your Android device.
9. +5 V and +12 V outputs are provided to power various Hall sensors and switches.
10. Multiple switch inputs. By default, the switch input is valid when it is 12 V.
11. 3 analog inputs (signal range is 0-5 V), which are throttle analog input, brake analog input and motor temperature input by default.
12. The controller replicates the A-phase Hall sensor pulse signal for the pulse speedometer.
13. Configurable boost function. When the boost switch is turned on, the motor will get the maximum output power. Regardless of the throttle position, the effect is the same as full throttle.
14. Configurable joystick throttle. Both forward and reverse directions support dual symmetrical 0–5 V signals.
15. Configurable motor over-temperature detection and protection, recommended thermistor KTY84-130/150 or KTY83-122.
16. Only supports three-phase Hall position sensors. Open collector and pull-up resistors are provided.
17. In brake analog regeneration mode, the controller requires another analog input as brake input.
18. Enhanced regenerative braking function. Innovative ABS technology provides strong and smooth regeneration. Regeneration function can be activated at any speed.
19. Cruise control. Can only be activated when driving in forward direction.
20. Support Bluetooth. Bluetooth Adapter is required and needs to be purchased separately from our website. This adapter is only suitable for KLS controllers.
21. Support user-defined serial port communication.
22. CAN bus (optional), broadcast type, baud rate can be customized (default 250Khz). KLS-N controller does not include CAN bus by default.

23. Bidirectional anti-slip function (Optional), prevent the stationary vehicle from moving in the opposite direction. When this function is enabled, the controller detects if the motor starts turning in the opposite direction from a stationary state and applies braking force to stop or slow down the vehicle.The braking force can be set as needed.
24. Pedal assist system (optional) to provide assistance when the rider pedals.
25. Electromagnetic brake (optional).
26. Field weakening function (optional), to increase the max speed.
27. Anti-theft function (optional), requires an external alarm.
28. Built-in DC/DC module(Optional), to power external devices (13.5 V, 2A)
29. Other user-defined customizable functions.

Caution!

For safety reasons, regen must be used together with mechanical brakes.

2.2 Features

1. Intelligent control powered by a high-performance microprocessor.
2. Synchronous rectification, ultra-low voltage drop, fast SVPWM, and FOC for maximum efficiency.
3. Electronic commutation.
4. Monitoring of motor three phases, power bus, and supply voltage.
5. Monitoring of 12 V and 5 V voltage sources.
6. Detection of current in all three motor phases.
7. Current control loop for precise motor control.
8. Hardware overcurrent protection.
9. Hardware overvoltage protection.
10. Configurable limits for motor current and battery current.
11. Low EMC.
12. Battery protection with configurable current reduction, warnings, and shutdown at high or low voltage levels.
13. PCB mounted on an aluminum base plate with a heatsink integrated into the bottom of the controller.
14. Various connector sets supporting small signals; waterproof connector set provided by default.
15. Thermal protection: automatic current reduction, warnings, and shutdown at high temperatures.
16. Automatic identification of Hall sensors mounted at any angle.
17. Configurable high-throttle protection: prevents operation if a high throttle signal is detected at startup.
18. Current multiplication: draws less current from the battery while delivering higher current to the motor.
19. Easy installation: operates with only a 3-wire potentiometer.
20. Programming via standard PC or laptop; user program provided free of charge and easy to use.
21. Supports motors with any number of poles.
22. Supports electrical speeds up to 70,000 eRPM (electrical speed = mechanical speed × number of pole pairs; pole pairs = number of poles ÷ 2).
23. Dustproof and waterproof under sealed conditions (IP66 rating).

2.3 Specifications

1. Frequency of operation: 10 kHz, 16 kHz, 20 kHz (selectable).
2. Standby battery current: < 0.5 mA.
3. 5 V or 12 V sensor supply current: 40 mA max.
4. Supply (PWR) current: 30 mA (typical).
5. Battery voltage (B+) range: configurable.
6. Standard throttle input: 0–5 V (3-wire resistive potentiometer) or 1–4 V (active Hall throttle).
7. Full-power operating temperature range: 0 °C to 70 °C (MOSFET temperature).
8. Operating temperature range: −40 °C to 100 °C (MOSFET temperature).
9. Maximum battery current: configurable.
10. Maximum motor current: configurable.

2.4 Name Regulation

The name regulation of Kelly BLDC motor controllers:

For example: KLS7275NT.

KLS: Kelly BLDC motor controller based on sinusoidal waveform. Designed to work with BLDC motors equipped with three Hall sensors. All KLS controllers support regenerative braking by default.

72: 72 V battery pack.

N: Denotes a large housing, which allows for better current handling performance.

NT: Refers to a compact version of the large housing ("N"), offering a smaller and lighter design while providing standard current performance.

Kelly KLS-N - Sinusoidal Brushless Permanent Magnet Motor Controller				
Model	Nominal Voltage	Max Operating Voltage	Peak Current 2 Minutes	Continuous Current
KLS4860NT	36-48V	27-60V	400A	160A-240A
KLS4875N	36-48V	27-60V	500A	200A-300A
KLS48100N	36-48V	27-60V	600A	240A-360A
KLS48120N	36-48V	27-60V	700A	280A-420A
KLS7275NT	48-72V	36-86V	450A	180A-270A
KLS7275N	48-72V	36-86V	500A	200A-300A
KLS72100N	48-72V	36-86V	600A	240A-360A
KLS72120N	48-72V	36-86V	700A	280A-420A
KLS72150N	48-72V	36-86V	800A	320A-480A
KLS8475N	48-84V	36-100V	500A	200A-300A
KLS84100N	48-84V	36-100V	600A	240A-360A
KLS84120N	48-84V	36-100V	700A	280A-420A

Chapter 3 Wiring and Installation

3.1 Mounting the Controller

The controller can be mounted in any location; however, it should be kept as clean and dry as possible. If necessary, use a protective cover to prevent water and contaminants from entering.

To ensure the controller delivers its full rated output power, it must be mounted on a clean, flat metal surface and secured using screws in all four mounting holes. Apply silicone grease or another thermally conductive material to the contact surfaces to improve thermal transfer and enhance cooling performance.

Adequate heat sinking and proper airflow are essential to achieve the controller’s maximum power capability.

The case outline and mounting holes’ dimensions are shown below.

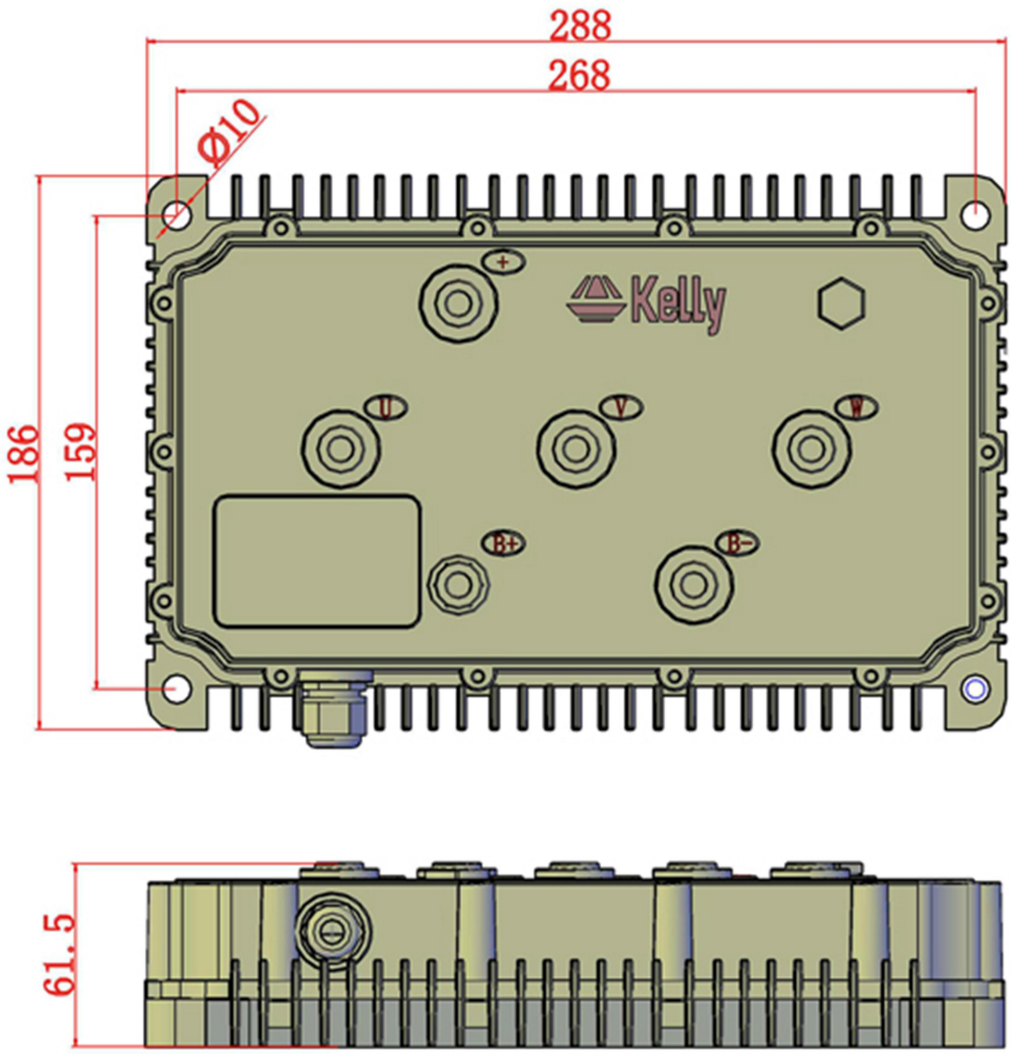
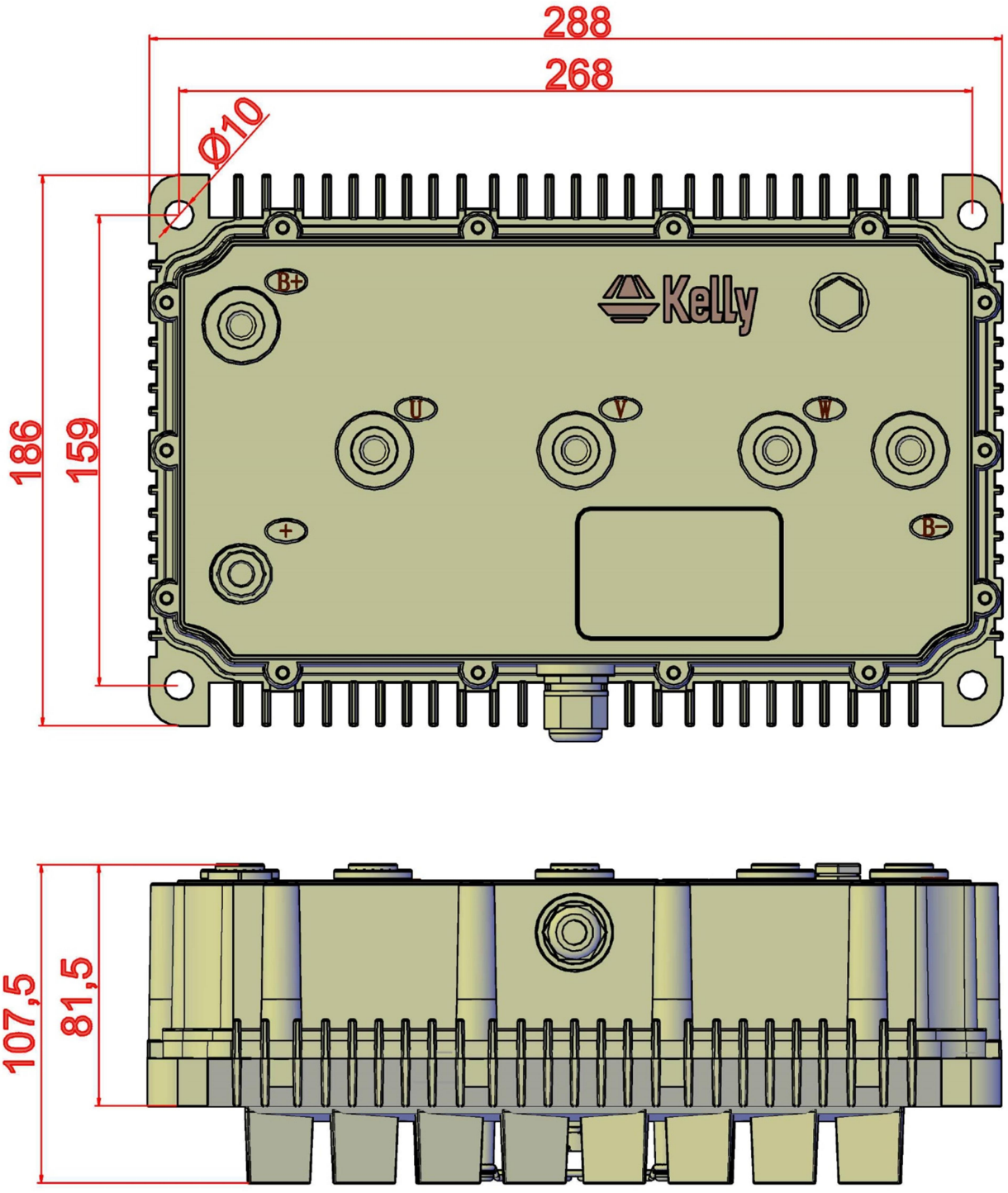


Figure 7: KLS4860NT KLS7275NT
mounting holes' dimensions
(dimensions in millimeters) +/B+/B-/U/V/W:M8


288
268
Ø10
186
159
B+
Kelly
U
V
W
+
B-
107,5
81,5

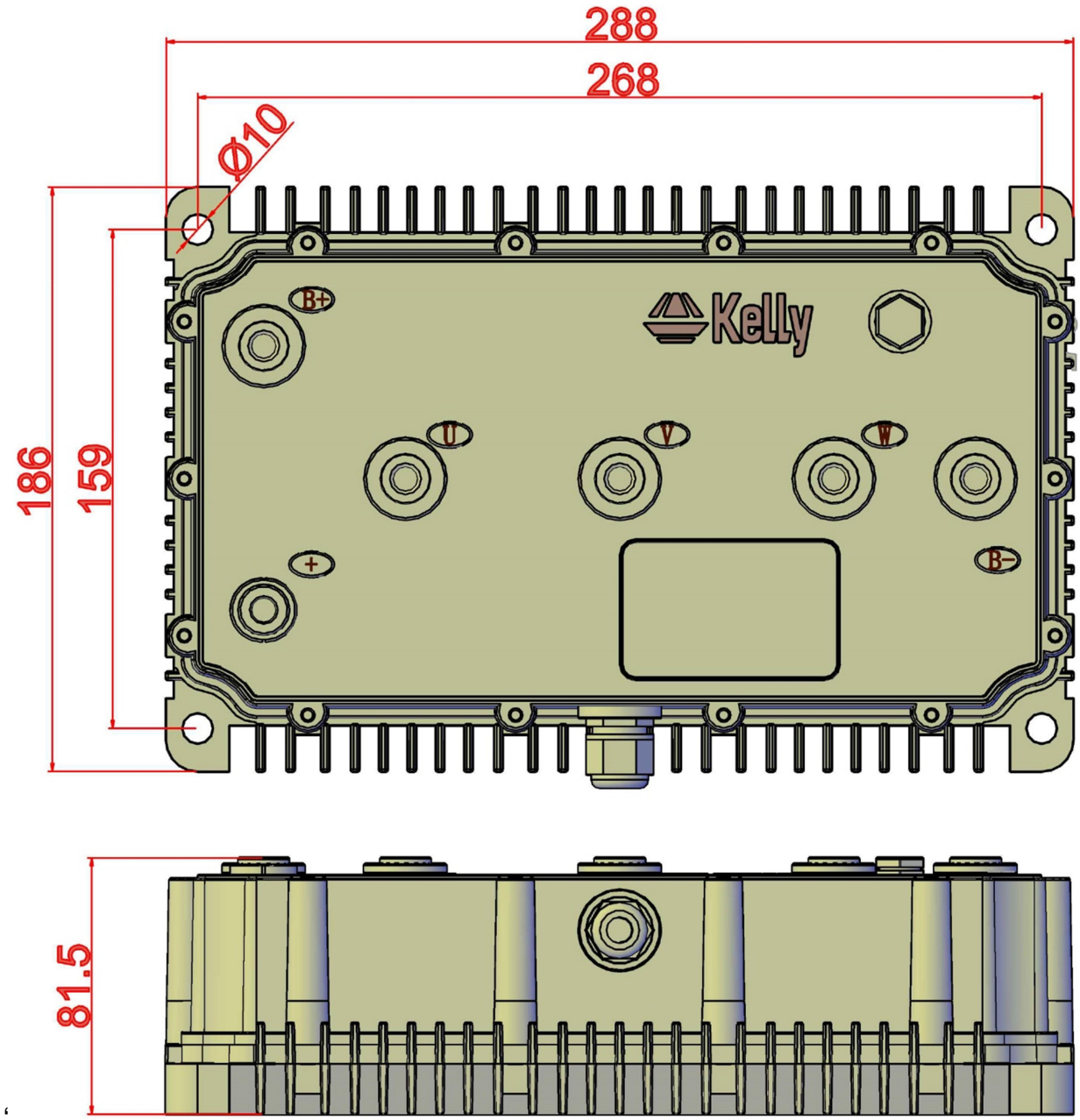


Figure 9: KLS-N Series
mounting holes' dimensions
(dimensions in millimeters) +/B+/B-/U/V/W:M8

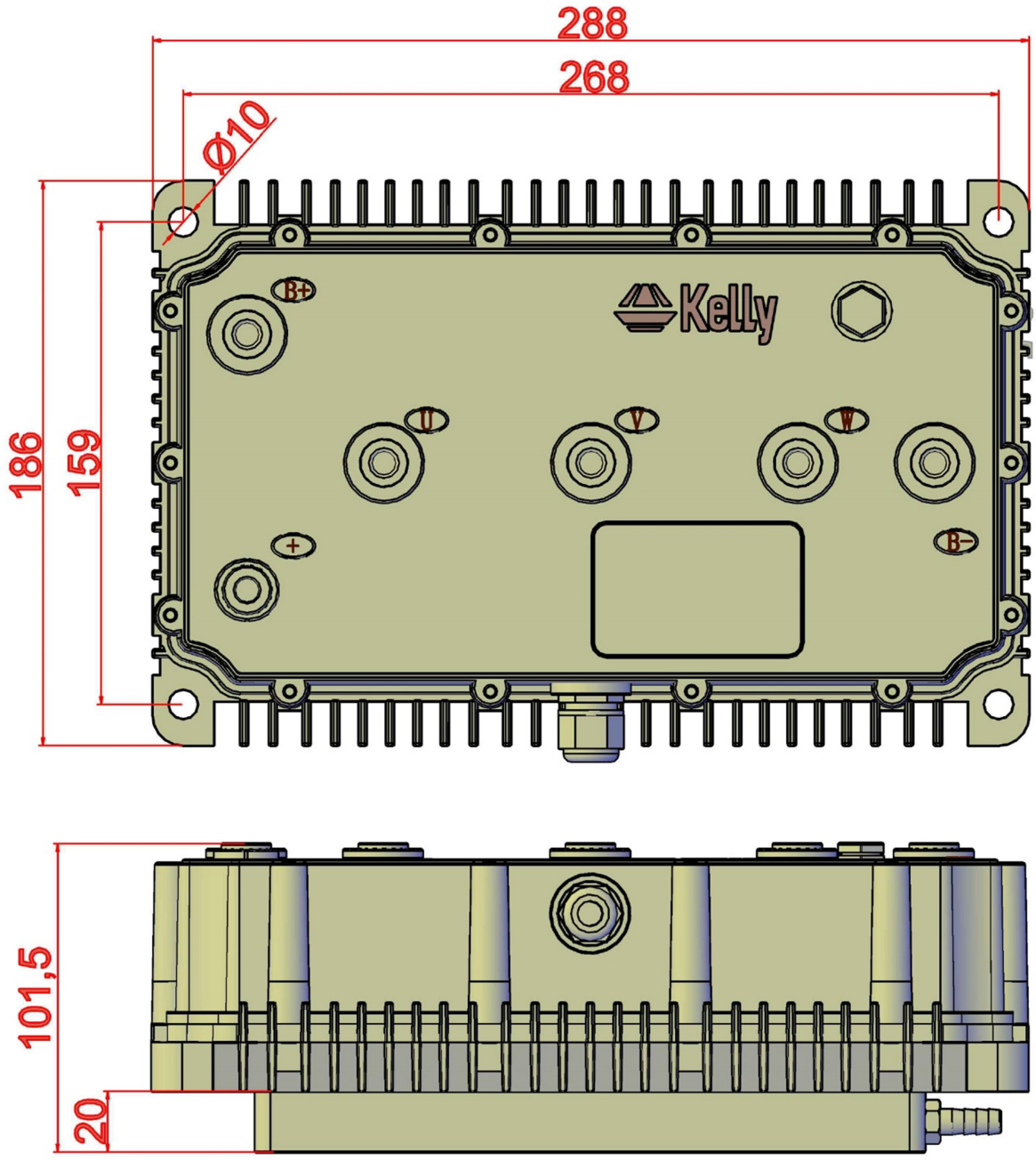
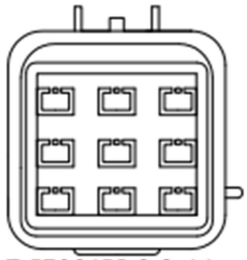


Figure 11: With Aluminum Liquid Cooling Heatsink at the bottom
mounting holes' dimensions
(dimensions in millimeters) +/B+/B-/U/V/W:M8

3.2 Connections

3.2.1 Pin definition of KLS-N Controller

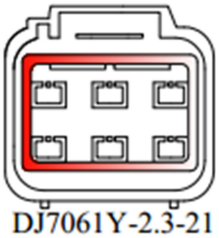


DJ7091Y-2.3-11
See from output side

Orange REV-SW (14)	Black GND (6)	White FWD (12)
Red 12V (11)	Yellowish 12V Brake (25)	Blue ECO (22)
Greenish CAN_H (33)	Pink PWR (7)	Brownish CAN_L (34)

DJ7091Y-2.3-21
See from output side

Gray Foot_SW (15)	Green Throttle (3)	
Black GND (20)	D-Gray Meter (8)	
Purple 5V (4)	Brown Brake_AN (2)	Red 12V (11)



DJ7061Y-2.3-21
See from output side

Black GND (21)	Raddle Temp (1)	Purple 5V (5)
Yellow Hall A (18)	D-Green Hall B (17)	D-Blue Hall C (16)

Figure 10: waterproof connector

DJ7091Y-2.3-11 Pin Definition

1. **REV_SW(Pin 14): Reverse switch input. ※Orange**
2. **GND(Pin 6): Signal return or power supply return. ※Black**
3. **FWD(Pin 12): Forward switch or can be enabled as High speed switch function. ※White**
4. **12 V(Pin 11): 12 V Supply. ※Red**
5. **12 V (Pin 25): brake switch. ※Yellowish**
6. **ECO(Pin 22): Low speed switch. ※Blue**
7. **CAN-H(Pin 33): (Optional function). ※Greenish**
8. **PWR(Pin 7): Controller power supply (input). ※Pink**
9. **CAN-L(Pin 34): (Optional function). ※Brownish**

DJ7091Y-2.3-21 Pin Definition

1. **Foot_SW(Pin 15): Throttle switch input. ※Gray**
2. **Throttle(Pin 3): Throttle analog input, 0-5 V. ※ Green**

3. **GND(Pin 20): Signal return. ※Black**
4. **Meter(Pin 8): Copied signal of hall-A sensor. ※Dark Gray**
5. **5 V(Pin 4): 5 V Supply, <40mA. ※Purple**
6. **Brake_AN(Pin 2): Brake variable regen or Boost function. ※Brown**
7. **12 V(Pin 11): 12 V Supply. ※Red**

DJ7061Y-2.3-21 Pin Definition

1. **GND(Pin 21): Signal return. ※Black**
2. **Temp(Pin 1): Motor temperature sensor input. ※Raddle.**
3. **5 V(Pin 5): 5 V Supply, <40mA. ※Purple**
4. **Hall A(Pin 18): Hall sensor signal of phase-A. ※Yellow**
5. **Hall B(Pin 17): Hall sensor signal of phase-B. ※Dark Green**
6. **Hall C(Pin 16): Hall sensor signal of phase-C. ※Dark Blue**

Notes:

1. All GND pins are internally connected.
2. The Meter function outputs the Hall-A sensor signal.
3. By default, the three-gear and three-speed functions cannot be used simultaneously, as both use the same pin (FWD, Pin 12) for control.
4. Switch signals are valid at 12 V.
5. The 12 V output (Pin 11) is intended only for switch signals, with a total current not exceeding 40 mA.
6. CAN bus functionality is not included in KLS-N controllers by default.
7. The Boost and Brake Analog Regen functions share the same port (Brake_AN, Pin 2). When Boost is disabled in the user program, Pin 2 serves as Brake Analog Regen. When Boost is enabled, Pin 2 is used for the Boost function. Due to this port conflict, both functions cannot operate simultaneously on the same port.

3.2.2 KLS-N Controller Standard Wiring

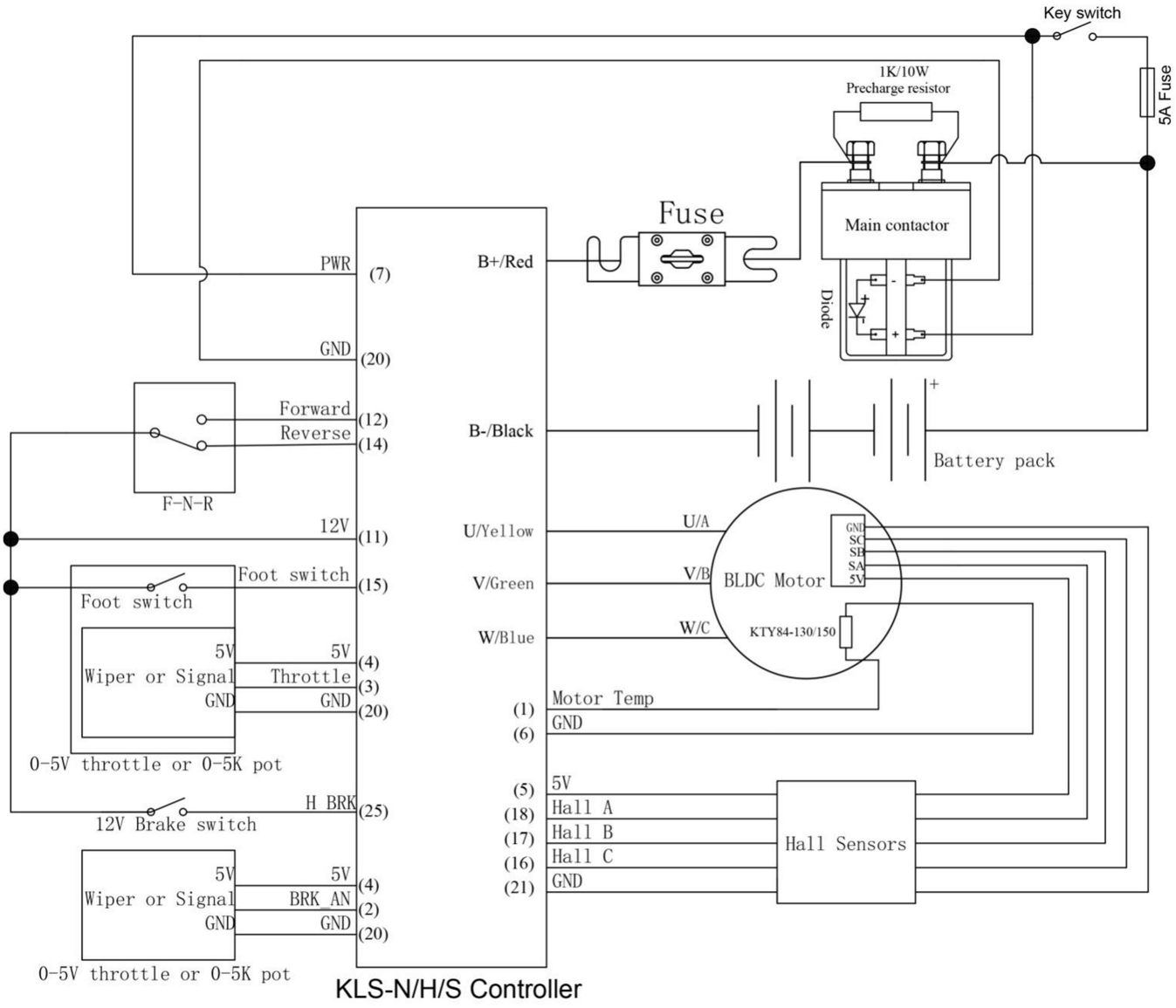


Figure 11: KLS-N controller standard wiring
(Battery is also used as controller's power supply)

Caution!

1 **Verify all controller wiring before powering on.** Double-check connections, especially the B+ and B- terminals. Incorrect wiring can cause severe damage to the controller.

2 Ensure the **B-** connection is secure and properly tightened before applying power.The system contactor or circuit breaker should be connected **in series with the B+ line**.

3 Important: Any contactors installed in the B+ line must have a diode placed across their coils. This diode acts as a freewheeling (flyback) diode to protect the controller's power module.

4 Failure to install this diode may result in serious damage to the controller.

5 Refer to the KLS-N controller standard wiring diagram for proper diode installation.

3.2.3 Communication Port

A 4pin connector is provided to communicate with host for calibration and configuration.

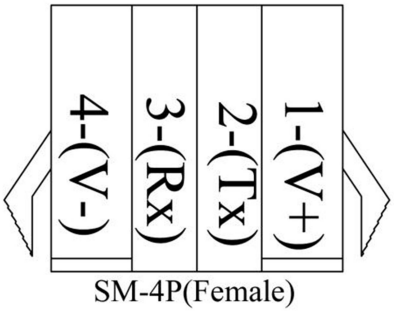


Figure 12: SM-4P connector

3.3 Installation Check List

1. **Conduct a visual inspection** to ensure all components—such as mounting holes, wiring, and sealing rings—are intact and undamaged.
2. **Check the connection between the battery B+ and NC.**
   a) For controllers without a fuse, check the connection between the battery B+ and the controller B+ instead of NC.
3. **Check the connection between the battery B- and the controller B-.** Ensure the connection is secure and properly tightened.
4. **Verify all signal wire connections.** Ensure that PWR and GND are properly isolated from each other.
5. **Inspect the motor Hall wire connections.** Confirm that the 5 V and GND wires align correctly with the motor's interface.
6. **Inspect the throttle wire connections.** Confirm that the 5 V and GND wires align correctly with the throttle's interface.
7. **Check the gear wire connections.** By default, the switch signal is valid at 12 V.

Chapter 4 Configuration Program

The **KLS Configuration Program** enables users to adjust various parameters to suit specific applications, allowing the motor to achieve optimal performance.

The default parameters may not be suitable for all use cases. Ensure all parameters are properly configured **before testing** to prevent potential hazards.
Users can program the controller using either:
The **PC configuration software** (requires Kelly USB cable, or RS232-USB cable and SM-4P adapter).
The **Android configuration app** (requires a Bluetooth Adapter).

Before operating the motor, you **must perform an automatic identification process** to ensure the controller properly detects and configures the motor parameters.

During this process:

- Connect the controller to the **battery**, **motor**, and **throttle**.
- Ensure **PWR (Pin 7)** is connected to **battery B+** to supply power to the controller.
- Follow the detailed instructions in **Chapter 4.2: Automatic Identification Guide**.

Notes

1. When configuring parameters in the PC program or Android app, ensure the controller is disconnected from the motor, or at least stop the motor before making changes.

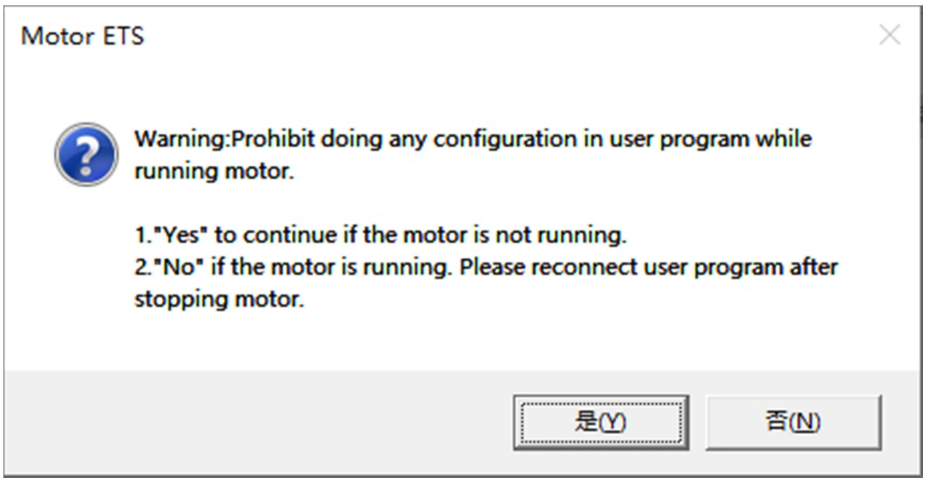


Figure 13 Warning window

1. The controller may display fault codes while adjusting parameters. This will **not affect programming or configuration**, but these codes **must be cleared before performing the automatic identification process**.
2. To connect to a PC Configuration Program:

    - Use Kelly USB cable, or RS232-USB cable and SM-4P adapter provided by Kelly.
    - During operation, the controller's PWR must be supplied with > +18 V (for 24 V controllers, supply > +8 V).
    - Connect GND to battery B-.

3. To connect to an Android device, use a **Bluetooth Adapter** (sold separately).

4.1 Connecting to upper host.

You have three ways to connect the controller to host computers or Android devices:

1. **Using the Kelly USB cable**, connect the SM-4P (Female) from the controller to the USB port on the computer. You may download the Kelly USB Cable driver from our website.(https://media.kellycontroller.com/new/CH341SER.zip)

Figure 14: Kelly USB Cable

2. **Using an RS232-USB cable** along with the SM-4Pin adapter, connect the SM-4Pin (Female) from the controller to the USB port on the computer. You may download the USB-RS232 driver from our website. (https://media.kellycontroller.com/new/USB-CONVERTER-RS232-Win10.zip)

Figure 15: RS232-USB (left) and SM 4-Pin (right) adapter

3. **Using a Bluetooth Adapter**, connect it to the SM-4P (Female) and then connect the controller to Android devices through Bluetooth. This Bluetooth Adapter can be purchased from our website. (https://kellycontroller.com/shop/usb-adapter)

Figure 16: Bluetooth Adapter

How to Use Auto-Identification

Here is a brief overview of the automatic identification process:

1. Connect the controller and the motor according to the standard wiring diagram (Figure 11). Please make sure there is no load on the motor shaft before starting the programming.
2. Connect the controller to the PC using a Kelly USB cable or a USB to RS232 set. For Android devices, please use the Bluetooth Adapter to connect the controller.
3. Download the corresponding USB drivers and the user program from our website. Only one driver can be installed; two drivers installed at the same time are incompatible. After the USB driver is successfully installed, please restart your PC.
4. Turn the key switch to supply power to the controller from B+/B- and PIN7, then open the user program on your device. Click the 'READ' button to open the initial interface, as shown in the figure below. Please check whether the value of **Identification_Angle** is 85. An angle value of 85 means that this controller has already completed the automatic identification operation with the motor at the factory. However, it is still necessary to run the automatic identification operation before proceeding.

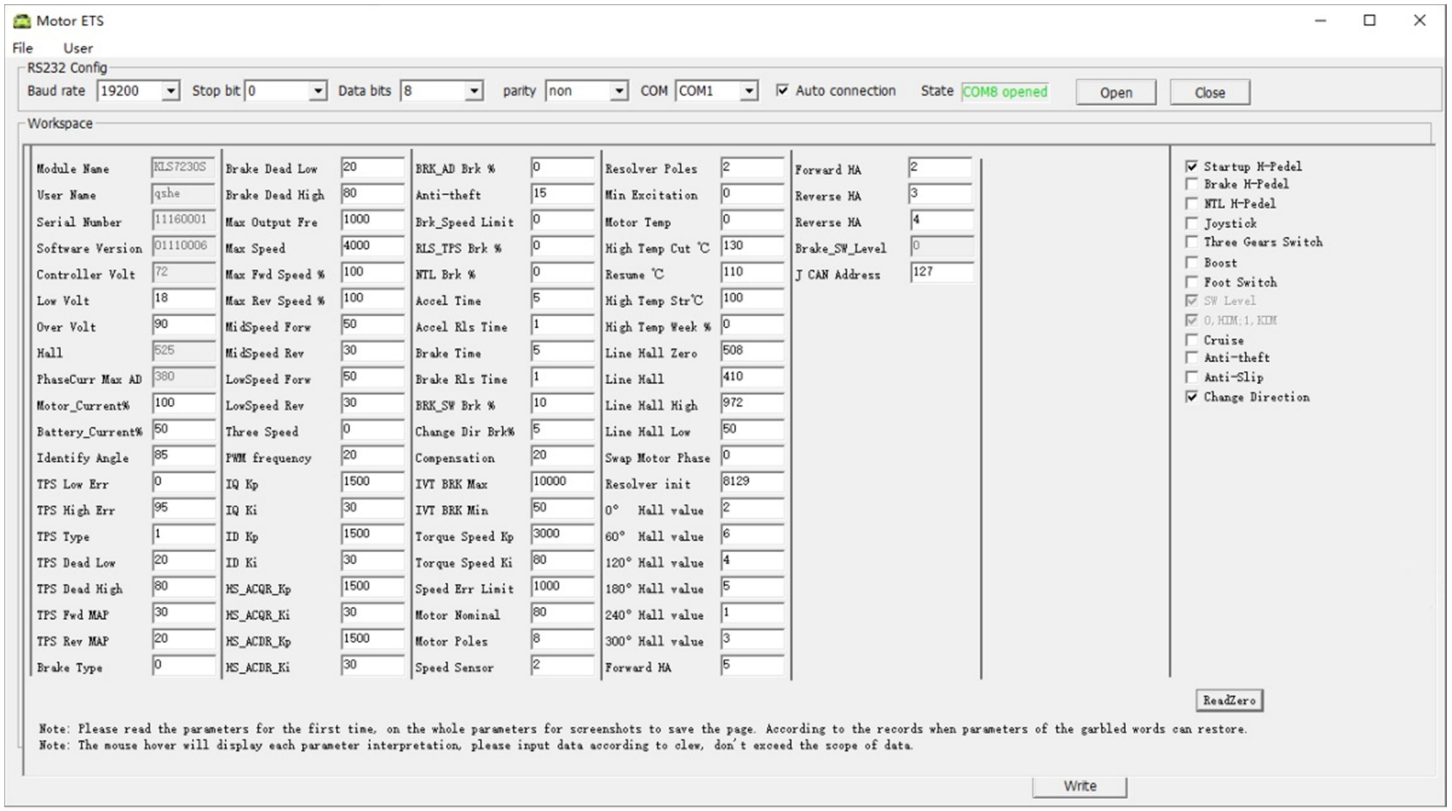


Figure 17: User program initial interface

5. Enter 170 in the **Identification_Angle** value, then click the "Write" button. The user program will display a pop-up window indicating that the Write operation succeeded. Then exit from the user program and turn off the power supply.
6. Wait for a few seconds before turning the power supply back on. The motor shaft will attempt to run in random directions. This is a normal operating phenomenon.
7. Wait for about 2-3 minutes.
8. The beeper will sound with error code 3-2, indicating that the automatic identification operation has completed successfully. You will also see a reset error message on the user program’s monitor screen.
9. Turn off the power supply again, then wait for a few seconds before turning it back on.
10. Connect the controller to the user program. You will see 85 in the **Identification_Angle**, which means the controller's auto-identification operation was successful and the motor is ready to run.
11. If the **Identification_Angle** value is 170, it means the auto-identification process is still ongoing.
12. If no error code is triggered, please do not manually set the **Identification_Angle** to 85 or restart the power supply.
13. If a constant beep sound lasts for more than 5 minutes and there are other error codes (such as Identify error, hall error, etc.), please return to the initial interface of the user program and manually set **Identification_Angle** to 85.
14. Before turning off the power supply, make sure that **Identification_Angle** is not set to 170. Otherwise, the controller will continue attempting identification after the power supply is turned on again. If error codes occur, please exit the user program and try step 6 again.
15. After successful identification, make sure that **Identification_Angle** is not set to 170. Then, you may turn on the power supply.
16. If the direction of the motor is not what you expected, there is no need to repeat the process. Simply check the "Change Direction" option in the last part of the initial interface, then click the "Write" button and reset. The motor will run in the opposite direction.

4.3 Program parameters and value

On program's initial interface, these items are listed:

Number	Parameter	Possible Value	Default Value	Description	Source of Value*
1	Model Name			Controller Model.	Default
2	User Name			User code, to identify controller variants.	Default
3	Serial Number			Serial Number.	Default
4	Software Version			Software Version.	Default
5	Controller Volt	0-144		Controller Voltage(V).	Default
6	Low Volt	18-180		Minimum normal voltage(V), In order to protect the battery, if the battery voltage is lower than this value, the controller will not work.	User Configuration
7	Over Volt	18-180		Maximum normal voltage(V), In order to protect the battery, if the battery voltage is high1er than this value, the controller will not work.	User Configuration
8	Hall	0-1000		Hall Galvanometer Rate(A).	Default
9	PhaseCurr Max AD	409-2048		The Max AD value of phase current.	Default
10	Motor_Current	20-100%	100%	The ratio range of the motor phase current to the controller peak current.	User Configuration
11	Battery_Current	20-100%	50%	Maximum battery current. Used to set the upper limit of battery current to protect the battery. A lower value will limit the battery output current more and protect the battery more effectively. However, if this value is too low, it will affect acceleration.	User Configuration
12	Identify Angle	85 / 170	85	Status of identification: 85:normal operation. 170: A reboot is required to automatically identify the sensor angle. Once identification is complete, this value will be reset to 85.	Auto
13	TPS Low Err	0-20%	0%	Hall pedal parameter, only valid when TPS type is set to 2. When the actual value is lower than this value, the controller will report a TPS type error, 20%*5 V=1V	User Configuration
14	TPS High Err	80-100%	95%	Hall pedal parameter, only valid when TPS type is set to 2. When the actual value is higher than this value, the controller will report a TPS type error, 80%*5 V=4V	User Configuration

15	TPS Type	1 / 2	1	Throttle Type, 1: 0-5K,resistance pedal; 2: 0,5 V,Hall active pedal;	User Configuration
16	TPS Dead Low	0-60%	20%	Throttle Dead Zone Lower Limit, 20%*5 V=1V.	User Configuration
17	TPS Dead High	60-95%	80%	Throttle Dead Zone Higher Limit, 80%*5 V=4V.	User Configuration
18	TPS Fwd MAP	0-100%	30%	When moving forward , the MAP value corresponding to throttle midpoint, to adjust throttle response amplitude.	User Configuration
19	TPS Rev MAP	0-100%	20%	When moving backward , the MAP value corresponding to throttle midpoint , to adjust throttle response amplitude.	User Configuration
20	Brake Type	0 /1 / 2	0	Regen braking mode 0: Switch regen mode. 1:0-5K, resistance pedal regen. 2:0-5 V, hall active pedal regen.	User Configuration
21	Brake Dead Low	5-40%	20%	Brake Dead Zone Lower Limit, 20%*5 V=1V.	User Configuration
22	Brake Dead High	60-95%	80%	Brake Dead Zone Upper Limit, 80%*5 V=4V.	User Configuration
23	Max Output Fre	50-1200	1000	Max output Frequency(Hz).	User Configuration
24	Max Speed	0-16000	4000	Motor max speed (RPM).	User Configuration
25	Max Fwd Speed	0-100%	100%	Maximum forward speed to the motor max speed .	User Configuration
26	Max Rev Speed	0-100%	100%	Maximum reverse speed to the motor max speed.	User Configuration
27	MidSpeed Forw Speed	0-100%	50%	Maximum forward speed in the middle speed gear .	User Configuration
28	MidSpeed Rev Speed	0-100%	30%	Maximum reverse speed in the middle speed gear .	User Configuration
29	LowSpeed Forw Speed	0-100%	50%	Maximum forward speed in the low speed gear .	User Configuration
30	LowSpeed Rev Speed%	0-100%	30%	Maximum reverse speed in the low speed gear .	User Configuration
31	Three Speed	0 / 1 / 2	0	Number of speed modes: 0: one speed mode: maximum speed mode. 1:two speed modes: middle speed mode and maximum speed mode . 2:three speed modes:low speed mode, middle speed mode and maximum speed mode.	User Configuration

32	PWM frequency	10 / 16 / 20	16	PWM modulation frequency (Khz)	User Configuration
33	IQ *Kp*	0-32767	500	*Kp* of Q-ring, the proportional gain in Q-ring current loop, is mainly effective at speeds below 400 RPM. Increasing this value will accelerate the response speed but will increase startup jitter; decreasing this value will reduce startup jitter but will also decrease the response speed.	User Configuration
34	IQ *Ki*	0-32767	10	Ki of Q-ring, the integral gain in Q-ring current loop, is mainly effective at speeds below 400 RPM. Increasing this value will improve current accuracy but will increase startup jitter and instability. Decreasing this value will enhance stability and reduce startup jitter but will also lower current accuracy.	User Configuration
35	ID *Kp*	0-32767	1500	Kp of D-ring, the proportional gain in D-ring speed loop, is mainly effective at speeds below 400 RPM. Increasing this value will accelerate the response speed but will increase high-speed jitter; decreasing this value will reduce high-speed jitter but will also decrease the response speed.	User Configuration
36	ID *Ki*	0-32767	30	Ki of D-ring, the integral gain in D-ring current loop, is mainly effective at speeds below 400 RPM. Increasing this value will improve speed accuracy but will increase high-speed jitter and instability. Decreasing this value will enhance stability and reduce high-speed jitter but will also lower speed accuracy.	User Configuration
37	HS_ACQR_*Kp*	0-32767	2000	*Kp* of Q-ring, the proportional gain in Q-ring current loop, is mainly effective at speeds above 400 RPM. Increasing this value will accelerate the response speed but will increase startup jitter; decreasing this value will reduce startup jitter but will also decrease the response speed.	User Configuration
38	HS_ACQR_*Ki*	0-32767	60	Ki of Q-ring, the integral gain in Q-ring current loop, is mainly effective at speeds above 400 RPM. Increasing this value will improve current accuracy but will increase startup jitter and instability. Decreasing this value will enhance stability and reduce startup jitter but will also lower current accuracy.	User Configuration
39	HS_ACDR_*Kp*	0-32767	5000	Kp of D-ring, the proportional gain in D-ring speed loop, is mainly effective at speeds above 400 RPM. Increasing this value will accelerate the response speed but will increase high-speed jitter; decreasing this value will reduce high-speed jitter but will also decrease the response speed.	User Configuration
40	HS_ACDR_*Ki*	0-32767	100	Ki of D-ring, the integral gain in D-ring current loop, is mainly effective at speeds above 400 RPM. Increasing this value will improve speed accuracy but will increase high-speed jitter and instability. Decreasing this value will enhance stability and reduce high-speed jitter but will also lower speed accuracy.	User Configuration

41	BRK_AD Brk	0-50%	0%	Brake pedal regen's regen strength, 0= no regen.	User Configuration
42	Anti-theft	0-30%	15%	When the anti-theft function is activated, the percentage of the motor's locking current to the maximum current.	User Configuration
43	Brk_Speed Limit	0-500	0	Minimum motor speed to activate regen brake (RPM), RPM below this value will exit regen.	User Configuration
44	RLS_TPS Brk	0-50%	0%	Pedal releasing regen 's regen strength, 0= no regen.	User Configuration
45	NTL Brk	0-50%	0%	Neutral gear regen 's regen strength, 0= no regen.	User Configuration
46	Accel Time	1-250	5	Torque mode accelerate Time, the time of torque from 0 to max,(X0.1second)	User Configuration
47	Accel Rls Time	1-250	1	Torque mode accelerate release delay Time, the time of torque from max to 0,(X0.1second)	User Configuration
48	Brake Time	1-250	5	Torque mode Brake Time, the time of Brake Torque from 0 to max,(X0.1second)	User Configuration
49	Brake Rls Time	1-250	1	Torque mode Brake release Time, the time of Brake Torque from max to 0,(X0.1second)	User Configuration
50	BRK_SW Brk	0-50%	10%	Switch regen 's regen strength. 0= no Switch regen.	User Configuration
51	Change Dir Brk	0-50%	5%	Change direction regen's regen strength. 0= no Change direction regen.	User Configuration
52	Compensation	0-100%	20%	Compensation current of anti-slip function.	User Configuration
53	IVT BRK Max	0-10000	10000	Maximum motor speed for enable Change direction regen(RPM)	User Configuration
54	IVT BRK Min	0-5000	50	Minimum motor speed for enable Change direction regen (RPM)	User Configuration
55	Torque Speed *Kp*	0-10000	3000	*Kp* of Q-ring **in torque mode**, the proportional gain in Q-ring current loop, is mainly effective at speeds below 400 RPM. Increasing this value will accelerate the response speed but will increase startup jitter; decreasing this value will reduce startup jitter but will also decrease the response speed.	User Configuration
56	Torque Speed *Ki*	0-500	80	Ki of Q-ring **in torque mode** the integral gain in Q-ring current loop, is mainly effective at speeds below 400 RPM. Increasing this value will improve current accuracy but will increase startup jitter and instability. Decreasing this value will enhance stability and reduce startup jitter but will also lower current accuracy.	User Configuration

57	Speed Err Limit	50-4000	1000	Limit of *Kp* and *Ki* in torque mode, need to be adjusted at same time when adjusting *Kp* and *Ki* in torque mode.	User Configuration
58	Motor Poles	0-1000	80	Motor Current when identification(A)	User Configuration
59	Motor Poles	2-128	8	Number of motor poles, equal to 2* pole pairs. When used for hub motors, reducing this value by multiples, such as from 8 to 4, can improve the speed measurement accuracy.	User Configuration
60	Speed Sensor Type	2 /3/ 4	2	Sensor Type: 2. Hall sensor 3. Magnetic encoder. 4. Linear Hall sensor（sine/cosine sensors）	User Configuration
61	Resolver Poles	2-32		Reserved.	User Configuration
62	Min Excitation	0-100	0	Minimum excitation coefficient (A) This value affects the current and maximum speed of the motor when the field weakening function is enabled. When this value = 0, the field weakening function has no actual effect	User Configuration
63	Motor Temp	0 / 1 / 2	0	Temperature sensor type, 0:none. 1: KTY84-130 and KTY84-150 2: KTY83-122	User Configuration
64	High Temp Cut °C	60-170	150	Temperature for triggering the motor's high temperature cut off.	User Configuration
65	Resume °C	60-170	110	When the temperature drops back to this value, high temperature resume will be triggered.	User Configuration
66	High Temp Str°C	0-170	100	starting temperature for high-temperature weakening. (°C)	User Configuration
67	High Temp weak	0-100%	50%	The strength of high-temperature weakening (%)	User Configuration
68	Line Hall Zero	1-1023		Zero point of sine/cosine sensor signal, this value / 1024 * 5 = actual voltage value (Volts). Available for sine/cosine sensor	User Configuration
69	Linear Hall Amplitude	1-1024		Signal amplitude of sine/cosine sensor signal. this value / 1024 * 5 = actual voltage value (Volts). When this value is below 153.6 or above 256,the signal voltage is error. Available for sine/cosine sensor	User Configuration

70	Line Hall High	1-1023		An error will be reported when the amplitude of the sine/cosine sensor signal exceeds this value. this value / 1024 * 5 = actual voltage value (Volts). Available for sine/cosine sensor	User Configuration
71	Line Hall Low	1-1023		An error will be reported when the amplitude of the sine/cosine sensor signal is below this value. this value / 1024 * 5 = actual voltage value (Volts). Available for sine/cosine sensor	User Configuration
72	Swap Motor Phase	0 / 1 /255	0	Swap phase function status 0: disabled 1: enabled, 255: error. Available for sine/cosine sensor	Default
73	Synchro Initial Angle	0-65535	8192	Synchro Initial Angle , defines the reference point of the position when sensor type is set to 4. Available for sine/cosine sensor	Default
74	0° Hall value	0-7	2	Hall sensor sequence value at motor electrical angle 0°.	Auto
75	60° Hall value	0-7	6	Hall sensor sequence value at motor electrical angle 60°	Auto
76	120°Hall value	0-7	4	Hall sensor sequence value at motor electrical angle 120°	Auto
77	180°Hall value	0-7	5	Hall sensor sequence value at motor electrical angle 180°	Auto
78	240°Hall value	0-7	1	Hall sensor sequence value at motor electrical angle 240°	Auto
79	300°Hall value	0-7	3	Hall sensor sequence value at motor electrical angle 300°	Auto
80	Forward HA Rising edge	0-7	6	Forward Hall-A Rising edge sequence value	Auto
81	Forward HA Falling edge	0-7	1	Forward Hall-A Falling edge sequence value	Auto
82	Reverse HA Rising edge	0-7	5	Reverse Hall-A Rising edge sequence value	Auto
83	Reverse HA Falling edge	0-7	2	Reverse Hall-A Falling edge sequence value	Auto
84	Brake_SW_Level	0-255		Brake_SW_Level	Default
85	J CAN Address	0-255	5	CAN Address, when there are multiple CANs, different addresses need to be set	User Configuration
86	Startup H-Pedal	checked/ unchecked	checked	Startup High pedal function , Checked: From powerup, when the first time throttle being pressed, the controller will report a high pedal error to prevent accidental starting, need to step on the pedal again to start.	User Configuration
87	Brake H-Pedal	checked/ unchecked	unchecked	Brake High-pedal function Checked: When press the brake and throttle at the same time, he controller will report a high pedal error to stop running.	User Configuration

88	NTL H-Pedal	checked/ unchecked	unchecked	Neutral High-pedal function Checked: the first time throttle being pressed after switching gears, the controller will report a high pedal error to prevent accidental starting, need to step on the pedal again to start.	User Configuration
89	Joystick	checked/ unchecked	unchecked	Joystick throttle Checked: enable joystick throttle, Its range: 0-2.5 V: forward 2.5 V: neutral 2.5 V-5 V: backward. Has same range of dead zone as TPS dead zone.	User Configuration
90	Three Gears Switch	checked/ unchecked	unchecked	Three-gear function Check: Enable three operating gears: Forward, Neutral, Reverse. Uncheck: Forward only.	User Configuration
91	Boost	checked/ unchecked	unchecked	Boost function, Checked: enable boost switch, Connect Brake_AN (PIN2) to 12 V to start boost. Unchecked: Connect Brake_AN (PIN2) to 12 V to start switch regen.	User Configuration
92	Foot Switch	checked/ unchecked	unchecked	Thorttle switch Checked: Connect Foot_SW to 12 V to enable throttle, so motor can start.	User Configuration
93	SW Level	checked/ unchecked	checked	Defining which is the effective level of the switch. Checked: high level=enable. Unchecked: low level=enable.	Default
94	0,HIM;1,KIM	checked/ unchecked	checked	Controller type Checked: KIM. Unchecked: HIM.	Default
95	Cruise	checked/ unchecked	unchecked	Cruise function Check: Enable the cruise function. Press and hold the accelerator for more than 3 seconds to enter the cruise mode. If the eRPM is lower than 4000, the controller will automatically exit the cruise mode.	User Configuration
96	Anti-theft	checked/ unchecked	unchecked	Anti-theft function Checked: enable anti-theft function, Need to connect to external anti-theft device. When the alarm is triggered, the motor will resist being turned.	User Configuration

97	Anti-Slip	checked/ unchecked	unchecked	Anti-Slip function Checked: enable anti-slip function, The motor will resist rotation to prevent the vehicle from moving due to external forces.	User Configuration
98	Change Direction	checked/ unchecked	unchecked	Change Direction function Checked: Swap the forward and backward directions. Unchecked: no swap. Used to correct the motor from moving opposite direction after identification	User Configuration

Source of Value *:

- **User**: Users should modify these values to adjust the controller.
- **Auto**: These values are generated by the sensor or the controller's program, and users can affect the operation of the controller by modifying these values.
- **Default**: These values are factory presets or sensor readings and cannot be modified by the user program.

Chapter 5 Maintenance

Caution!
There are no user-serviceable parts inside the controller. Do not attempt to open the controller on your own, as this will void your warranty.
The exterior of the controller should be cleaned periodically.
The controller is a high-powered device. When working with any battery-powered vehicle, proper safety precautions should be taken, including, but not limited to, proper training, wearing eye protection, avoiding loose clothing, hair, and jewelry, and using insulated tools.

Although the controller virtually requires no maintenance after proper installation, it is recommended to follow these steps during use:

1. Disconnect the battery, starting with the positive terminal, to cut off the power.
2. Discharge the capacitors in the controller by connecting a load (such as a contactor coil, resistor, or horn) across the controller’s B+ and B- terminals.
3. Regularly remove any dirt or corrosion from the bus bar area. Wipe the controller with a moist rag and ensure it is completely dry before reconnecting the battery.
4. Make sure the connections to the bus bars are tight. To avoid physically stressing the bus bars, use two well-insulated wrenches for the operation.
5. For fanned models, routine fan maintenance is required, including ensuring the fan rotates normally and cleaning the dust from the fan.

Table 1: Error Codes

Buzzer Error Codes

Error code		Explanation	Solution
1, 1	¤ ¤	Auto-Identification failed	1. Check Phase line or Hall line. 2. Check Hall power line(+5 V and GND). 3. The motor load maybe too high. Please unload the motor before proceeding with identification.
1, 2	¤ ¤¤	Over voltage error	1. Battery voltage is too high for the controller. Check battery volts and controller configuration. 2. Regeneration over-voltage. Controller will limit regen or stop regen. please reduce the regen ratio in configuration.
1, 3	¤ ¤¤¤	Low voltage error	Battery voltage is too low, please check the battery and recharge. When the battery voltage continuously exceeds the low voltage cut-off value for 5 seconds, the controller will resume normal operation.
1, 4	¤ ¤¤¤¤	The controller did not receive CAN commands	Resend CAN commands from VCU.
2, 1	¤¤ ¤	Motor stall	The motor did not reach 25eRPM within 2 seconds of starting. Please check the Hall signal lines and the phase line connections.
2, 2	¤¤ ¤¤	Internal voltage error	1. Check the connection between PWR and B+(For 8080N series, check connection between PWR and +12 V; GND and -12 V). 2. The load on the 5 V or 12 V power supply could be too heavy, ensure that the measured voltage of the 5 V power supply is not less than 4V and the voltage of the 12 V power supply is not less than 8V. The lower these values are, the heavier the load on the power supply. 3. If none of the above issues are present, the internal power module of the controller may be damaged. The controller needs to be sent back to the factory.
2, 3	¤¤ ¤¤¤	Over temperature	The controller temperature is too high, about to stop. Please wait until it restore to 80°C.
2, 4	¤¤ ¤¤¤¤	Throttle error at power on	Throttle signal is higher than the value of “TPS_dead_low”at power-on. Release the throttle and press again or adjust the TPS_dead_low value. If still can’t fix the issue, check if the throttle is functioning properly.

3, 1	¤¤¤ ¤	Reserved	
3, 2	¤¤¤ ¤¤	Internal reset error	Current is too high or current fluctuations are too large. Reduce the phase current and check if the 5 V and 12 V power supplies are normal.
3, 3	¤¤¤ ¤¤¤	Hall throttle is open or short-circuit	May occur after TPS_Type being set to 2. 1. The throttle might have an internal short circuit or the ground wire might be disconnected. 2. Set TPS_High_Err to 95 , check the throttle and its wiring, then restart to fix the issue.
3, 4	¤¤¤ ¤¤¤¤	Angle sensor error	1. Speed sensor type error,customers may set the correct sensor type through user program or App. 2. Incorrect wiring. 3. Speed sensor is damaged or defective. Or feedback signal is erratic.
4, 1	¤¤¤¤ ¤	Switch-direction error	1. Throttle is not at 0 when switching motor direction. 2. Motor rotation speed is above 50RPM.
4, 2	¤¤¤¤ ¤¤	Reserved	
4, 3	¤¤¤¤ ¤¤¤	Motor over-temperature	May occur after motor temp being set to 1 or 2. The Motor temperature has exceeded the configured maximum value. The controller will shut down until the motor temperature cools down.
4, 4	¤¤¤¤ ¤¤¤¤	Hall Galvanometer sensor error	Hall galvanometer inside the controller is damaged.
Error codes can be read through PC software or Android app.			

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