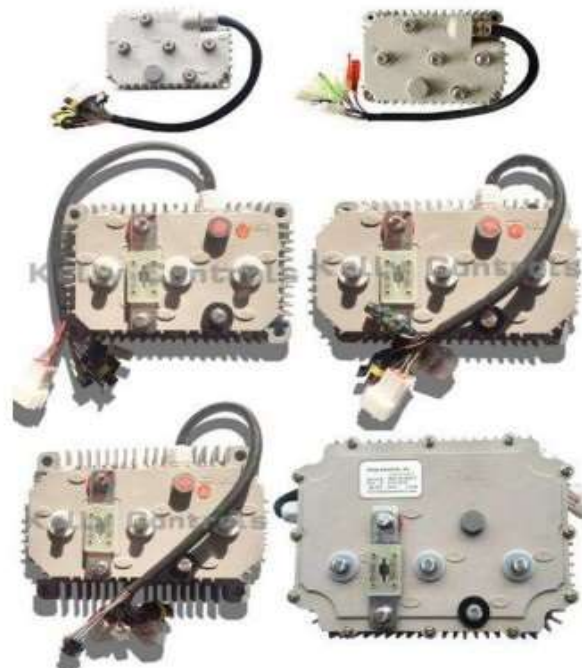|		
EMP ELECTRIC MOTOR POWER Pty. Ltd		ABN: 96 065 126 605
1/10 Newcastle Road, Bayswater 3153 Victoria, Australia Phone: (+61-3) 9720 6366		Web Page: www.emppl.com.au Email: sales@emppl.com.au

KLS-N Controller User's Manual
Brushless Motor

Devices Supported:

KLS2412N	KLS2415N	KLS2418N
KLS2430N	KLS2445N	KLS2412NX
KLS7212N	KLS7215N	KLS7218N
KLS7212NX	KLS6018N	KLS6030N
KLS7230N	KLS7245N	KLS7250N

CONTENTS

CHAPTER 1 - INTRODUCTION

1.1   OVERVIEW

The biggest difference is KLS-N is a waterproof-type controller by default. It is IP66 rating. This manual introduces the sinusoidal wave brushless BLDC motor controllers' features, installation instructions and maintenance. Read the manual carefully and thoroughly before using the controller. If you have any questions, please contact Electric Motor Power Pty Ltd.

These programmable motor controllers provide efficient, smooth and quiet controls for electric motorcycles, golf carts and go-carts, as well as industrial motor control. It is mainly supposed to solve noise problems of BLDC motor driving application. The KLS-N motor controller must be based on hall sensors type, as the KLS-N controller cannot support sensor-less brushless motor for now. Compared to the traditional trapezoidal waveform control technology, this technique based on sinusoidal wave driving technology to reduce the operation noise and 1/3 switching loss, well meets the noise reduction and efficiency requirements in the application of DC brushless motor. It uses high power MOSFETS and SVPWM and FOC to achieve efficiencies of up to 99% in most cases. A powerful microprocessor brings in comprehensive and precise control to the controllers. It also allows users to adjust parameters, conduct tests and obtain diagnostic information quickly and easily. People can program the KLS controller on PC software and Android APP. There is one more choice for customers to program KLS controller now: the APP software is based on Tablet and Android OS. Customers may add a Z-TEK USB to RS232 cable for programming KLS controller if they want to use Android Tablet.

Both PC software and Android APP can provide one screen to monitor the controller parameters. Sometimes people can use a small Android Tablet as display device. Customers can connect the KLS controller to Android APP in Android Phone if they order Bluetooth converter Kelly Controls directly.

KLS-N has a friendly "I/O" terminal for customers to hook up the batteries and motor easily.

Before running the motor, the operation angle needs to be identified. Do not connect the controller to the "User Program" while the motor is still running, let alone change the setting in "User Program" or Android APP. If you want to connect the controller to the "User Program" or try to do programming, stop the motor first. **This is very important.**

CHAPTER 2 - FEATURES & SPECIFICATIONS

2.1   GENERAL FUNCTIONS

1) Extended fault detection and protection. Customers can read the error message in PC software or Android APP also.
2) Monitoring battery voltage. It will stop driving if the battery voltage is too high and it will progressively cut back motor drive power as battery voltage drops until it cuts out altogether at the pre-set "Low Battery Voltage" setting.
3) Built-in current loop and over current protection.
4) Configurable motor temperature protection range.
5) Current cutback at low temperature and high temperature to protect battery and controller. The current begins to ramp down at 90°C case temperature, shutting down at 100°C.
6) The controller keeps monitoring battery recharging voltage during regenerating braking.
7) Maximum reverse speed and forward speed can be configured between 20% and 100% respectively and separately.
8) A 4-pin connector to RS232 port and a Z-TEK USB to RS232 cable allows for configuration, programming and software upgrades using the tablet which must be based on Android OS now. People can do the same things on PC software by using a standard USB to RS232 cable instead.
9) Provision of a +5V and +12V output to supply various kinds of hall sensors.
10) 5-switch inputs which are activated by connection to 12V. Default to throttle switch, brake switch, reversing switch, forward-switch and boost switch.
11) 3-analog 0-5V inputs that default to throttle input, brake analogue input and motor temperature input.
12) Copy signal of one of hall sensors.
13) Configurable boost switch. Enables the maximum output power achievable if the switch is turned on. The effect is the same as full throttle position even if you don't turn throttle at all.
14) 12V brake switch input used different port from motor temperature sensor. You can use both brake switch and motor temperature sensor functions at the same time on the latest version. Pin 25 is 12V brake switch input port. Pin 1 is motor temperature sensor input port.
15) Optional joystick throttle. A bi-symmetrical 0-5V signal for both forward and reversing.
16) Configurable motor over-temperature detection and protection with the recommended thermistor KTY84-130/150 or KTY83-122.
17) 3-hall position sensor inputs. Open collector, pull up provided.
18) Brake analogue regen mode. This regenerative mode doesn't need brake switch to support any more.

19) Enhanced regen brake function. A novel ABS technique provides powerful and smooth regen. The regen can happen at any speeds until zero speed.
20) KLS-N controller does not include the fuse and shunt on the case by default.
21) Cruise control can only be activated in forward direction.
22) KLS-N can support broadcast type CAN Bus function. It is 250Kbps. CAN bus is not included in KLS-N controller by default. CAN bus is only an optional function for the KLS-N.
23) Bluetooth function requires a small Bluetooth converter which needs to be purchased in addition from the Kelly website. This small converter is only useful for KLS controller.

2.2   FEATURES

1) Intelligence with powerful microprocessor.
2) Synchronous rectification, ultra-low drop, fast SVPWM and FOC to achieve very high efficiency.
3) Electronic reversing.
4) Voltage monitoring on 3-motor phases, bus, and power supply.
5) Voltage monitoring on voltage source 12V and 5V.
6) Current sense on all 3 motor phases.
7) Current control loop.
8) Hardware over current protection.
9) Hardware over voltage protection.
10) Configurable limit for motor current and battery current.
11) Low EMC.
12) Battery protection: current cutback warning and shutdown at configurable high and low battery voltage.
13) Aluminium based PCB board with heat sink plate on the bottom of controller.
14) Waterproof connectors for small signal.
15) Thermal protection: current cut back, warning and shutdown on high temperature.
16) Controller can do "auto-identification" angle for different degrees of hall sensors.
17) Configurable high pedal protection: the controller will not work if high throttle is detected at power on.
18) Current multiplication: take less current from battery, output more current to motor.
19) Easy installation: 3-wire potentiometer will work.
20) Standard PC/Laptop computer to do programming. There is one more choice for customers to program KLS controller. Standard tablet with Android OS to do programming. Need a Z-TEK USB to RS232 cable for connecting the controller to APP program in Tablet.
21) User program provided. Easy to use. No additional cost.
22) Support motors with any number of poles.
23) Up to 70,000 electric RPM standard (Electric RPM= Mechanical RPM*motor pole pairs; Motor pole pairs=Motor poles/2).
24) Dust and water protected under sealed condition IP66.

2.3   SPECIFICATIONS

- Frequency of Operation: 10KHz or 20KHz
- Standby Battery Current: <0.5mA
- 5V or 12V Sensor Supply Current: 40mA
- Controller supply voltage range: PWR, 40V or 90V for controllers rated equal or lower than 72V.
- KLS24V model: PWR 20V to 30V
- Supply current, PWR, 30mA Typical.
- Configurable battery voltage range, B+. Max operating range: 40V to 1.25*Nominal Voltage. KLS24V model: B+. Max operating range: 20V to 30V
- Standard Throttle Input: 0-5V (3-wire resistive pot), 1-4V (hall active throttle).
- Throttle Input: 0-5V can use 3-wire pot to produce 0-5V signal.
- Full Power Operating Temperature Range: 0°C to 70°C (MOSFET temperature).
- Operating Temperature Range: -40°C to 100°C (MOSFET temperature).
- Max Battery Current: Configurable.

2.4   NAME EXPLANATION (eg. KLS 72 18 N)

- ➤ **KLS:**   BLDC motor controller based on sinusoidal waveform which works with BLDC motor with three hall sensors. All KLS controllers can do regen brake function by default.
- ➤ **72**:   72V battery
- ➤ **N**:   The motor controller includes a plastic cover. KLS-N is IP66 rating without filling the silica gel by default. KLS-N used cast aluminium box as body protection.

Note: KLS7212N is the only KLS controller using solid flat aluminium plate as bottom of the controller. The thickness of the plate is 8mm.

KLS-N Brushless Motor Controller			
Model	30 seconds Current (A)	Continuous Current (A)	Voltage (V)
KLS2412N	140	60	20<Volt<30
KLS2415N	160	70	20<Volt<30
KLS2418N	220	80	20<Volt<30
KLS2430N	270	90	20<Volt<30
KLS2445N	350	100	20<Volt<30
KLS2412NX	200	75	20<Volt<30
KLS7212N	140	60	40<Volt<90
KLS7215N	160	70	40<Volt<90
KLS7218N	220	80	40<Volt<90
KLS6018N	220	80	40<Volt<80
KLS7212NX	200	75	40<Volt<90
KLS6030N	270	90	40<Volt<80
KLS7230N	270	90	40<Volt<90
KLS7245N	350	100	40<Volt<90

KLS7250N	380	140	40<Volt<90
24V model: range of batteries voltage is 20V-30V			
60V model: range of batteries voltage is 40V-80V			
72V model: range of batteries voltage is 40V-90V			

CHAPTER 3 - WIRING & INSTALLATION

3.1   MOUNTING THE CONTROLLER

The controller can be oriented in any position which should be as clean and dry as possible and, if necessary, shielded with a cover to protect it from water and contaminants.

To ensure full rated output power, the controller should be fastened to a clean, flat metal surface with four screws. Applying silicon grease or some other thermal conductive material to contact surface will enhance thermal performance.

Proper heat sinking and airflow are vital to achieve the full power capability of the controller. The case outline and mounting holes' dimensions are shown in Figure 1.
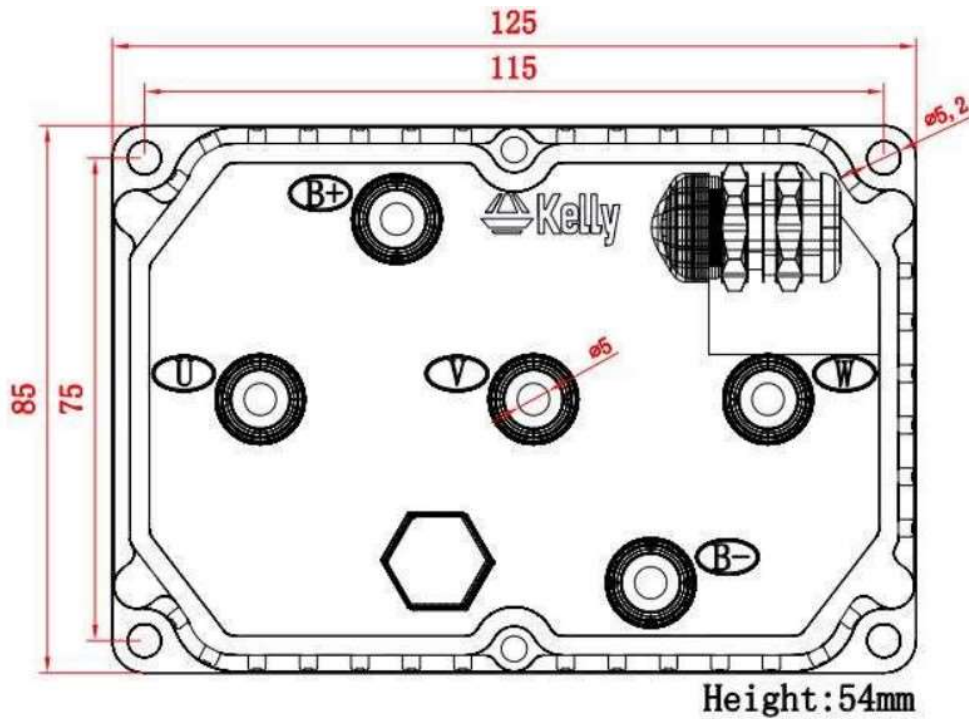

Figure 1: KLS2412N/NX, KLS7212N/NX mounting holes' dimensions
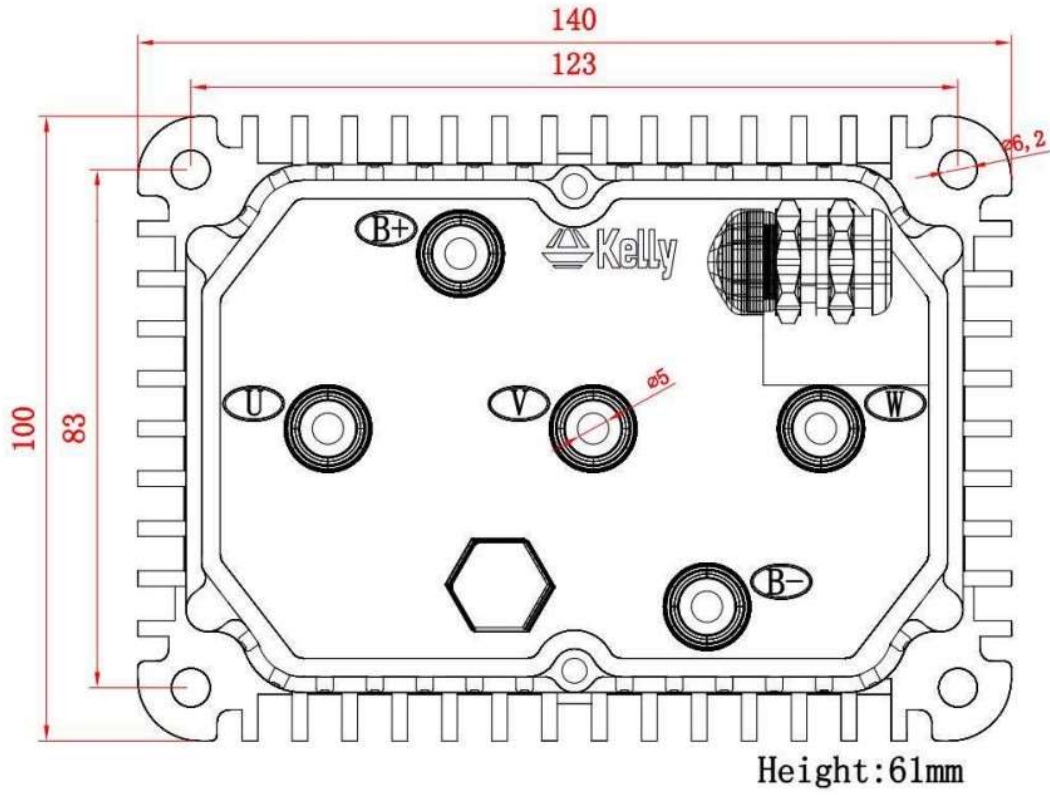(dimensions in millimeters)

Figure 2: KLS2415N, KLS7215N mounting holes' dimensions
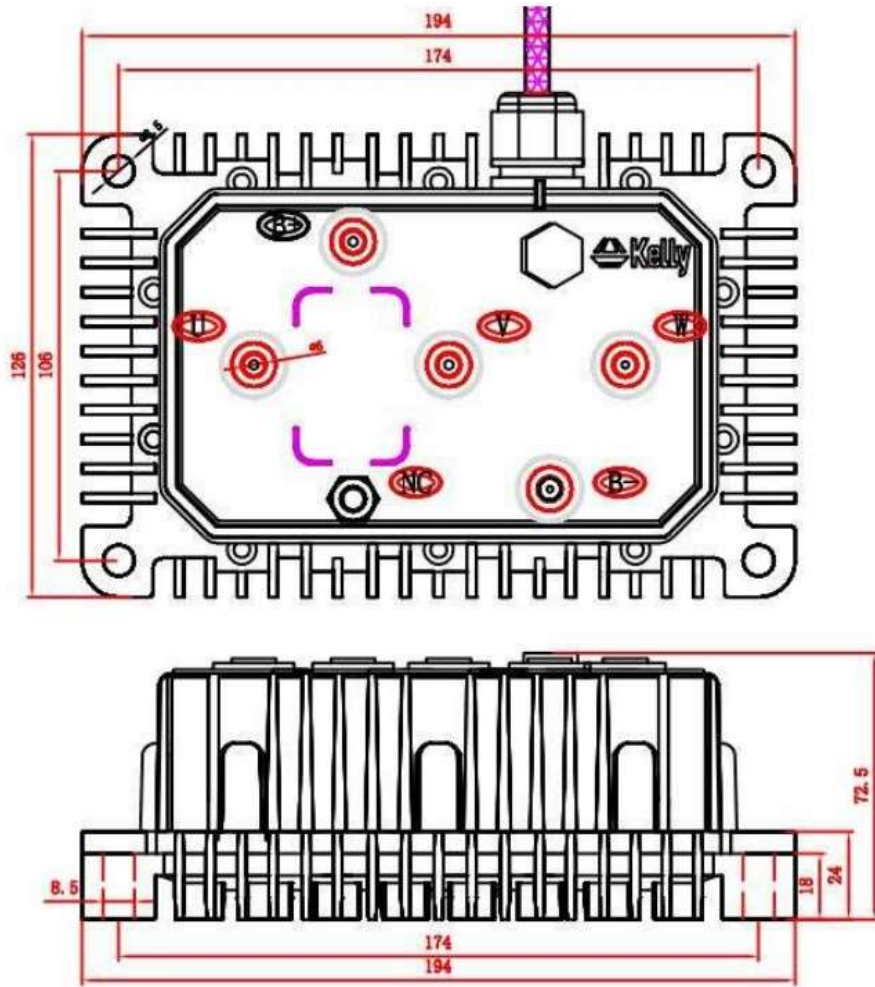(dimensions in millimeters)

Figure 3: KLS2418N, KLS6018N, KLS7218N mounting holes' dimensions
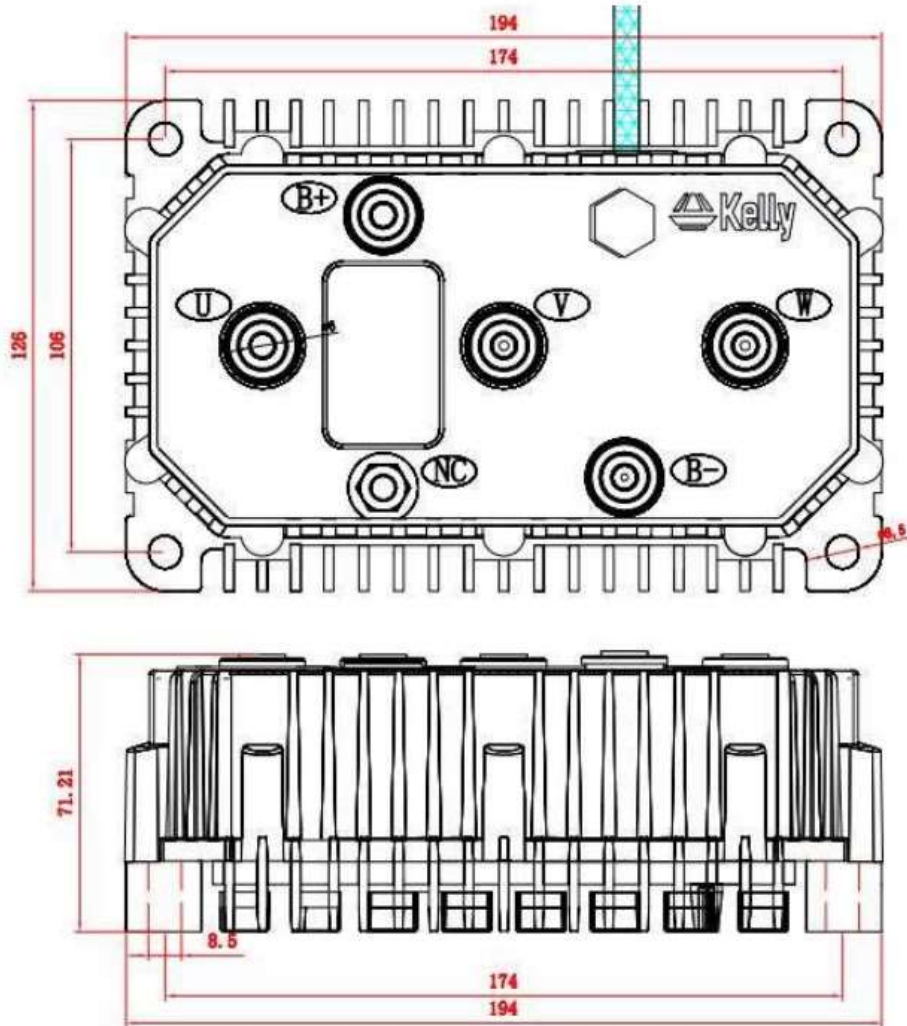(dimensions in millimeters)

Figure 4: KLSxx30N mounting holes' dimensions
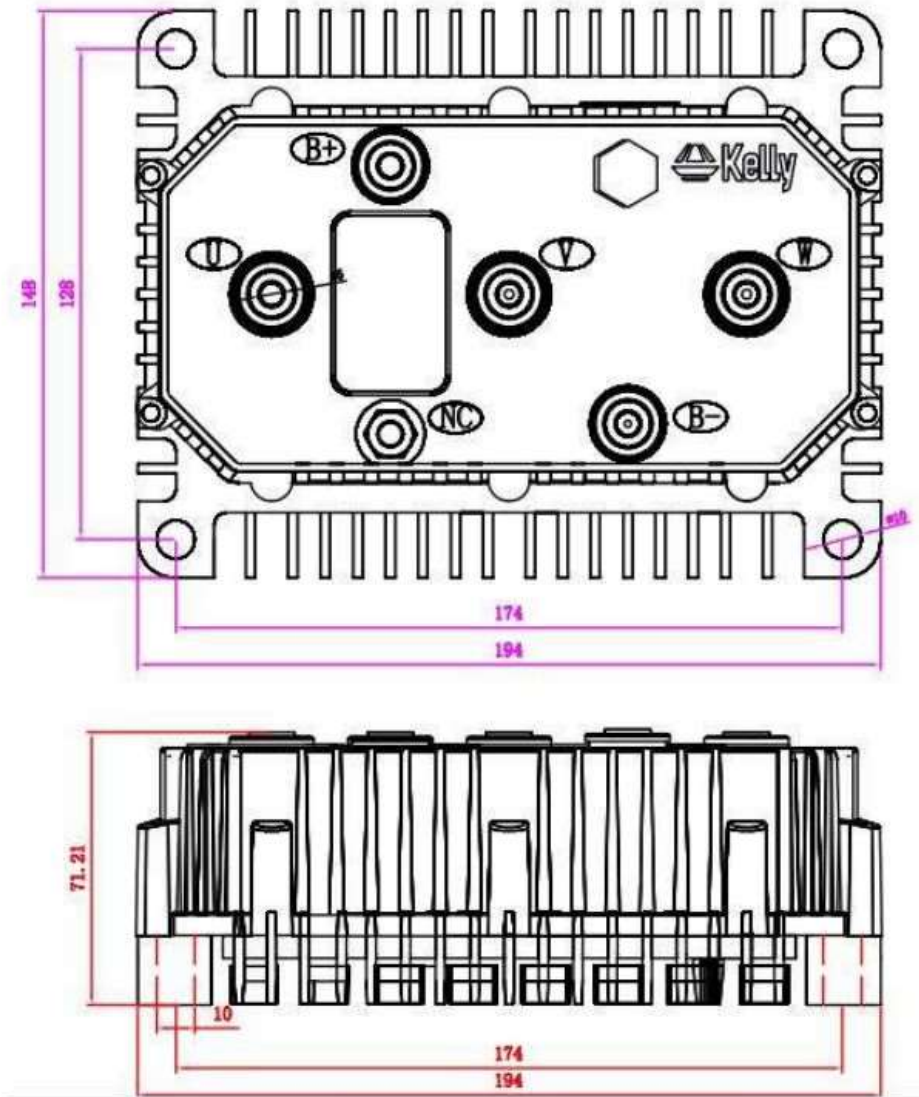(dimensions in millimeters)

Figure 5: KLSxx45N mounting holes' dimensions
(dimensions in millimeters)
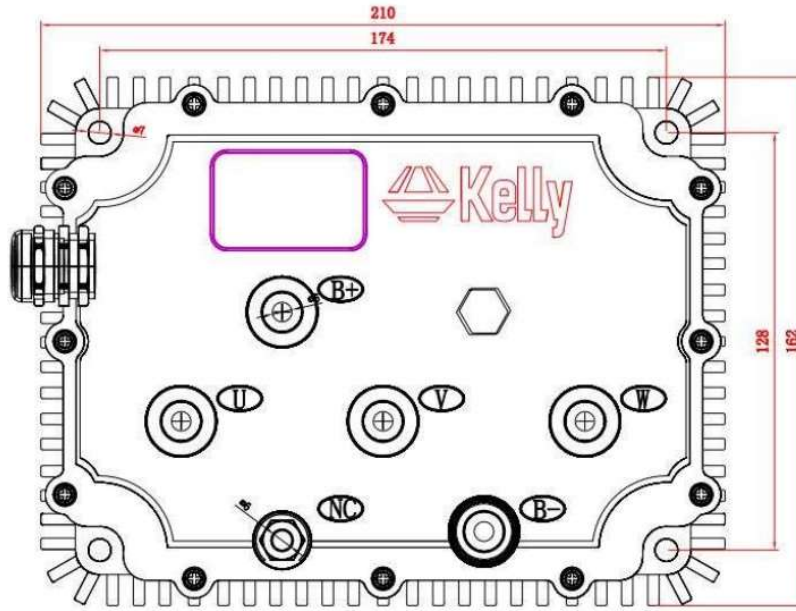
Height:87.5mm with heat sink

Figure 6: KLS7250N mounting holes' dimensions
(dimensions in millimeters)

3.2   CONNECTIONS

3.2.1   PIN Definition of KLS-N/NX 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 7: waterproof connector

1. The switch signal is valid to 12V
2. 12V only can be used for LED or switch signals.
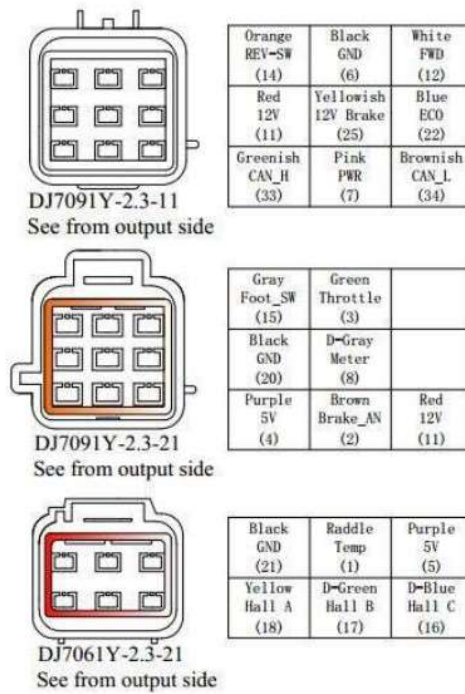3. Boost and brake analogue regen use the same port on Pin2.
4. CAN bus is not included in KLS-N controller by default.

When boost is disabled in User Program, Pin2 is used as brake analogue regen mode. When boost is enabled, Pin2 is used for boost function.

You may not use two functions at the same time.

DJ7091Y-2.3-11 Pin Definition

(14)	REV_SW:	Reverse switch input	Orange
(6)	RTN:	Signal return or power supply return	Black
(12)	FWD:	Forward switch or can be enabled as High-Speed Function	White
(11)	12V:	12V Source	Red
(25)	12V	Brake Switch	Yellow
(22)	ECO:	Low speed switch function	Blue
(33)	CAN-H:	Optional function	Green
(7)	PWR:	Controller power supply (input)	Pink
(34)	CAN-L:	Optional function	Brown

DJ7091Y-2.3-21 Pin Definition

(15)	Micro_SW:	Throttle switch input	Grey
(3)	Throttle:	Throttle analogue input, 0-5V	Dark Green
(20)	RTN:	Signal return	Black
(8)	Meter:	Copy signal of hall sensors	Dark Grey
(4)	5V:	5V Supply output <40mA	Purple
(2)	Brake_AN:	Brake variable regen or boost function	Brown

DJ7061Y-2.3-21 Pin Definition

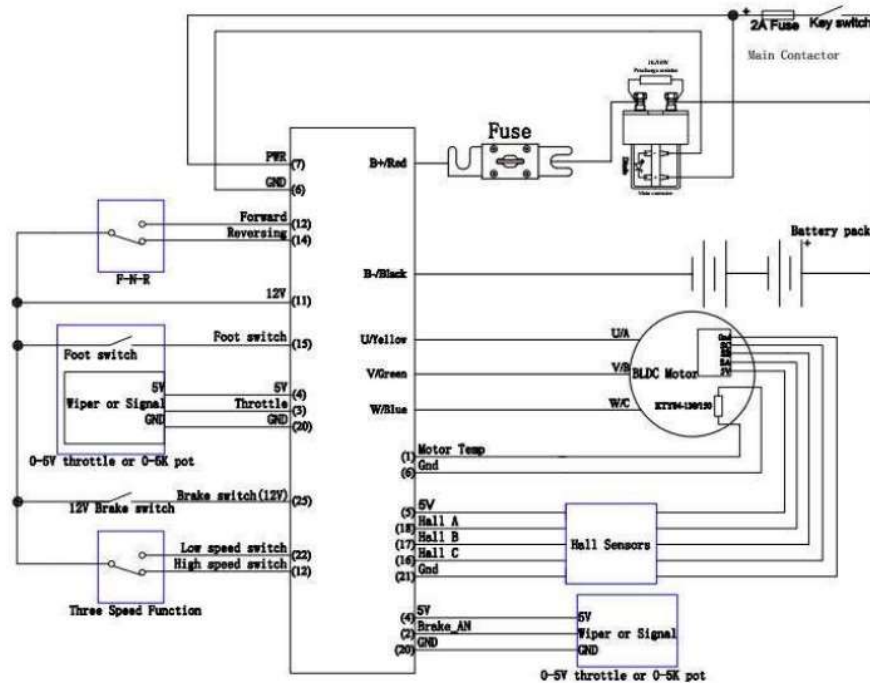| (21)	RTN:	Signal return	Black
(1)	Temp:	Motor temperature sensor input	Raddle
(5)	5V:	5V supply output <40mA	Purple
(18)	Hall A:	Hall phase A	Yellow
(17)	Hall B:	Hall phase B	Dark Green
(16)	Hall C:	Hall phase C	Dark Blue

Notes:
1. All RTN pins are internally connected
2. Meter function is to copy either of hall sensors
3. Switch to 12V is active. Open switch is inactive
4. F-N-R control and three speed function cannot be used at the same time as both use the same pin (Pin12=FWD)

CAUTION:
- Do not apply power until you are certain the controller wiring is correct and has been double checked. Wiring faults will damage the controller.
- Ensure that the B- wiring is securely and properly connected before applying power.
- The preferred connection of the system contactor or circuit breaker is in series with the B+ line.
- All contactors or circuit breakers in the B+ line must have pre-charge resistors across their contacts. Lack of even one of these pre-charge resistors may severely damage the controller at switch-on.

KLS-N Controller

Warning:Prohibit doing any configuration in user program while running motor.

1. "Yes" to continue if the motor is not running.
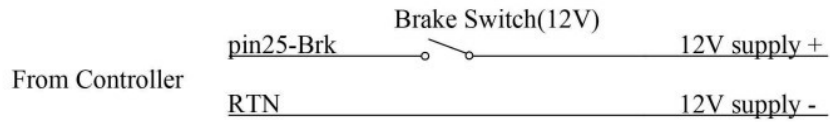2. "No" if the motor is running. Please reconnect user program after stopping motor.

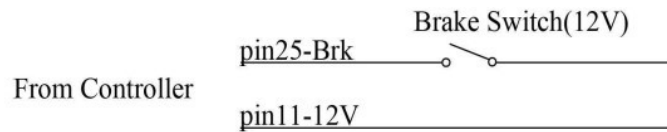### 3.2.2 Standard Wiring of KLS-N Controller

Figure 8: KLS-N controller standard wiring
(Battery voltage can be used for controller supply)

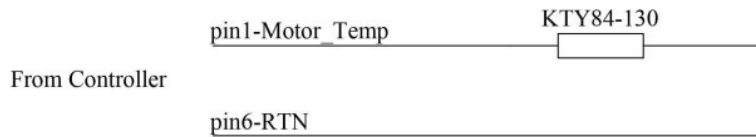### 3.2.3   Optional Wiring of KLS-N Controller

The 12V input signal of the Pin supplies the second braking function of the controller.

Figure 9: Wiring of brake switch(12V): 12V is provided by external source.

Figure 10:   Wiring of brake switch(12V): 12V is provided by KLS-N controller on pin11
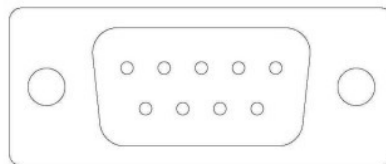

Figure 11: Wiring diagram for motor temperature sensor

Note: KLS Controller can support KTY84-130/150 and KTY83-122 thermistors.
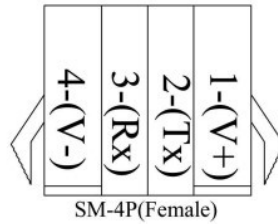
3.2.4   Communication Port

A 4-pin connector to RS232 port is provided to communicate with host computer for calibration and configuration.

Figure 12: RS232 Interface on 4pin connector to RS232 converter

Figure 13: SM-4P connector for communication interface on KLS-N controller

3.3   INSTALLATION CHECK LIST

Before operating the vehicle, complete the following check procedure. Use buzzer code as a reference and as listed in Table 1.

CAUTION:
  ➢ Put the vehicle up on blocks to get the drive wheels off the ground before beginning these tests.
  ➢ Do not allow anyone to stand directly in front of or behind the vehicle during the checkout.
  ➢ Make sure the PWR switch and the brake is OFF.
  ➢ Use well insulated tools.

- Ensure wire is connected correctly.
- Turn the PWR switch ON
- The fault code will be detected automatically at restart.
- With the brake switch "Open", select direction and operate the throttle. The motor should spin the selected direction. If it does not, verify wiring or voltage and the fuse. The motor should run faster with increasing throttle. If not, refer to Table 1 code and correct the fault as determined by the fault code.

Take vehicle off the blocks and drive in a clear area. It should have smooth acceleration and good power.

CHAPTER 4 – PROGRAMMABLE PARAMETERS

KLS configuration program allows user to set parameters according to the vehicle actual working environment to be at its best.

The default parameters of the controller are not recommended for all applications. Make sure to set the proper parameters before making any test to avoid danger.

Customers can do program on PC software or Android APP. The Android Tablet is preferred. The "Identification Angle" will need to be identified for KLS controller before running the motor. The controller needs to be connected to batteries, motor and throttle before identification operation. It is simply not enough to connect only the power supply (PWR=Pin7) to batteries for "Identification Angle" operation.

On how to use "Identification Angle" function, please download the instruction from our website www.kellycontroller.com/support.php

4.1   STEP 1

(1)   Low Volt (The min voltage of reporting this fault - Range 20~90)
        Controller will not operate when battery voltage is near the value to protect battery.
        Recommendation: Set according to the practical situation. Default set at 20V.
(2)   Over Volt (The max voltage of reporting this fault – Range 20~90)
        Controller will not operate when battery voltage is higher than the value so to protect battery and controller.
        Recommendation: Set according to the practical situation. Default set at 90V for 72V controller.

Controller Rated Voltage	Under Voltage Range (V)	Over Voltage Range (V)
24V	20~30	20~30
60V	40~80	40~80
72V	40~90	40~90

Figure 4.1

(3)   Current Percent (Phase current percent – Range 20~100)
        The max motor current is (The Value * Peak Current of the Controller)
        Recommendation: Factory default is 100%.
(4)   Battery Limit (Battery limit current – Range 20~100)
        Set max battery current to protect battery. A lower value means a lower battery output current and better protective effect. However, excessively low value will affect acceleration.

: Factory default is 100%.

(5)   Identification Angle

Please download the instruction from www.kellycontroller.com/support.php

If you can read "85" in Identification Angle item, the system is stable and normal. Fill in "170" for Identification Angle item in User Program. Then click "Write" button in User Program. Wait a few seconds before restarting the power supply. You will see some info on monitor screen after power is reset. If you see "Reset Error" on the monitor screen, that is to say, the auto_identification is finished. You can see 85 in the "Identification Angle" item again and the controller will blink error code. This is normal. Please reset the power supply again, then everything will be fine. The motor is ready to be driven by the KLS controller. Range 85~170.

(6)   TPS Low Err

Hall active pedal, if lower than value, report fault of TPS type.   Range 0~20.

(7)   TPS High Err

Hall active pedal, if higher than value, report the fault of TPS type. Range: 80~100. Output of hall throttle is appx. 0.86V to 4.2V. Controller will report 3.3 error code if the output of hall throttle is below 0.5V or above 4.5V by default. Controller will assume hall throttle is shorted or damaged if output is beyond range from 0.5V to 4.5V. You can adjust threshold voltage below or above 0.5V. Controller will report the 3.3 code to protect the system according to different types of hall throttle. Due to the number of hall throttle suppliers in the market, the initial output cannot always be in the range of 0.5V to 4.5V. Choosing a 0~5V or 3-wire pot for the throttle type will not be an issue as these two settings are only useful for hall active throttle or pedal when you choose throttle type at 2. It is also valid to adjust the high threshold voltage above 4.5V or below 4.5V. Normally the hall output voltage is 4.2V max however, If adjusted to lower value which is near 4.2V it may trigger the error code in normal way.

(8)   TPS Type: (1) 0-5V 3-wire 0-5K pot, 5K is normal, 2K-20K can be used; (2) Hall active throttle or pedal. Range 1~2.

(9)   TPS Dead Low: Range 5~40. Set throttle effective starting point.

: Set according to the practical situation, factory default is 20%*5V=1.0V.

(10)   TPS Dead High: Range 60~95. Set throttle effective ending point.

: Set according to the practical situation, factory default is 80%*5V=4.0V

(11)   Brake Sensor Type: For brake variable regen mode (1) 0-5V 3-wire 0-5K pot, 5K is normal, 2K-20K can be used; (2) Hall active throttle or pedal. Range: 1-2.

(12)   Brake Sensor Dead Low: Range 5~40. Set throttle effective starting point

: Set according to the practical situation, factory default is 20%*5V=1.0V.

(13)   Brake Sensor Dead High: Range 60~95. Set throttle effective ending point.

: Set according to the practical situation, factory default is 80%*5V=4.0V.

(14)   Max Output Frequency: Unit Hz. It will affect the top speed of the motor.

Set according to the practical situation, factory default is 1000Hz. **DO NOT** set above 1000Hz.

(15) Max Speed (rpm): Range: 0-15000. It is set at 4000 by default. Software version 0109 can support 15000rpm settings in user program.

(16) Max Fwd Speed %: The forward speed of the percentage of maximum speed. Range 20~100. It is set at 100% by default.

(17) Max Rev Speed %: The reverse speed of the percentage of maximum speed. Range: 20~100. It is set at 100% by default.
Midspeed Frw Speed, Midspeed Rev Speed, Lowspeed Frw Speed and Lowspeed Rev Speed range: 20~100. It is set at 100% by default. Both F-N-R control and three speed function use the same Pin12. Needless to say, we cannot use both function at the same time. Three Gears switch is supposed to enable F-N-R control. When this item is disable, we can use three speed function, vice versa. Pin22 is low speed switch input port, while Pin12 is high speed switch input port. When both Pin22 and Pin12 are disconnected from Pin11 the controller is driving with medium speed mode. Three Speed: This item is used to enable or disable three speed function. It is set at 0 by default. "0"=three speed function is disabled; "1"=Two speed function; "2"=Three speed function is enabled.

(18) PWM Frequency (KHz): 20KHz is better for hub motor with strict quiet control.
Recommendation: Set according to the practical situation, factory default is 20KHz. **DO NOT** set above 20KHz. Value range: 10KHz or 10KHz.

(19) Start-up H-Pedal (Enable & Disable): If enabled, the controller will detect the current pedal status at power up. If throttle got effective output, the controller will report fault and not operate.
Recommendation: Set according to the practical situation. Factory default is "Enable".

(20) Brake H-Pedal (Enable & Disable) – Releasing Brake High Pedal Disable: If enabled, the controller will detect the current pedal status when release the brake. If throttle got effective output, the controller will report fault and not operate.
Recommendation: Set according to the practical situation. Factory default is "Disable".

(21) NTL H-Pedal (Neutral Position High Pedal) Disable: Only use when three gears switch function is enabled. If enabled, the controller will detect the current pedal position or signal when the switch is in neutral position. If the throttle got effective output signal, the controller will not operate and report fault code.
Recommendation: set according to the practical situation. Factory default is "Disable".

(22) Joystick Function:
If enable, the controller can drive the motor on two directions without using any reversing switch. Just one single throttle can drive the motor on forward and reverse direction. The stick shift throttle firmware can be called "wig-wag" or "joystick operation". It is only a software function. It is usually useful for electric boat project. You still can use the common 0-5K pot or 0-5V throttle for the controller. If you don't choose the joystick, you operated the throttle in this way. The motor speed will increase when the throttle is from 0V to 5V.
If you enable joystick for this controller in "User Program" you will start the motor from 2.5V position. 2.6V to 5V is "Forward", 2.4V to 0V is "Reverse".
2.4V to 2.6V is the "throttle dead zone". Customers can adjust the throttle dead zone in "User Program" also.

Note: The common throttle will spring back to original position if you release the throttle.

Recommendation: Factory default is "Disable".

(23)   Three Gears Switch: It is used for function of F-N-R control. Check wiring diagram in the manual for F-N-R control.

Recommendation: Set according to practical situation. Factory default is "Disable".

(20-A) Three Gears Switch: Value range "Enable" and "Disable". If enabled, the Forward switch will be activated. Please see Figure 4.1.

Recommendation: Set according to the practical situation. Factory default is "Disable".

(20-B) Foot Switch: Value range "Enable" and "Disable". If enabled, the foot switch will be activated. The controller will not accept the throttle signal if the foot switch is turned off. Please see Figure 4.1.

Recommendation: set according to practical situation. Factory default is "Disable".

Configuration		Pin Status			Running Status
Forward Switch	Foot Switch	FWD_SW (12)	REV_SW (14)	Foot (15)	
Enable	Disable	OFF	OFF	x	Neutral
		OFF	ON	x	Reverse
		ON	OFF	x	Forward
		ON	ON	x	Neutral
Disable	Enable	x	OFF	OFF	Can't operate
		x	ON	OFF	Can't operate
		x	ON	ON	Reverse
		x	OFF	ON	Forward
Disable	Disable	x	OFF	x	Forward
		x	ON	x	Reverse

Note: X means can be on or off

Figure 4.2

(24)   Boost: If enabled, the controller will output max power for a while. Boost function is just full throttle position when you turn on boost switch even if the throttle is not operated at all. The boost function is still based on limiting of the motor current and battery current settings in "User Program". If disabled, the controller can provide brake sensor regen mode on the same pin as Pin2. In simple terms, boost and brake analogue regen use the same pin as Pin2.

Recommendation: Set according to practical situation. Factory default is "Disable", in other words, the default function is brake variable regen mode.

(25)   Foot switch: It is used for microswitch. If enabled, the controller will only accept the throttle signal after received the valid foot switch signal. If there is no foot switch signal, the controller will ignore the throttle signal.

Recommendation: Set according to practical situation. Factory default is "Disable".

(26)   Cruise Control: Value range "Enable" and "Disable".
If "Enable" and hold throttle at certain position for about 5 seconds, the controller will go into Cruise Control. The Cruise function cannot be activated in reversing direction. If the motor speed is below 500rpm, the Cruise control cannot be

activated. Release throttle and turn the throttle again or turn on the brake switch will make the Cruise Control quit.
Recommendation: Factory default is "Disable".

(27)   Anti-Slip: If enabled, the controller will try to prevent the vehicle rolling backwards faster and faster. If the ratio of gearbox is high, it can try to help the motor stop on the downhill, but usually this function only helps motor stop rolling back too fast.
Recommendation: Factory default is "Disable".

(28)   Change Direction: If the direction is not what you expected after completing the "Identification Angle" operation, select "Change Direction" item. Click right button to activate "Change Direction" function. The motor direction will be what you expected after the power supply is reset.
Recommendation: Factory default is "Disable".

4.2   STEP 2

(1)   Motor Nominal Curr: When the controller is doing "Identification Angle" operation without load on the motor shaft, there is a current requirement for identification operation. If the motor rated power is very high, please increase this parameter to a higher value. Otherwise keep it at 80 by default. If the motor power is very low such as hundreds of watts, reduce this parameter to lower value to match the low power motor for "Identification Angle" operation.

(2)   Motor Poles: Pair pole number 2. Range 2~128.
Recommendation: Set according to the real motor poles on the nameplate of the motor. Factory default is "8".

(3)   Speed Sensor Type: 2=Hall, 3=Resolver, 4=Line Hall. Range 2~4. Different sensor types, however, factory default is set at "2".
If you have a motor with 5V Sin/Cosin, GND speed sensors, select it at "4" and enquire as to which KLS-8080IPS model before ordering.

(4)   Resolver Poles: The pair pole number*2. Range 2~32. It is only used for the "Resolver" sensor type.

(5)   Motor Temp Sensor: "0"=None, 1=KTY84-130 or 150, 2=KTY83-122. Range 0-2.
High Temp Cut-Out (°C): Nominal value 130°C. Range: 60~170
Resume Motor High Temp (°C): Nominal value 110°C. The controller will resume work when the motor temp is at 110°C inside. Range 60~170.

(6)   Line Hall Zero: It is only useful when the speed sensor is at 4. Not required for KLS-N model.

4.3   STEP 3

(1)   RLS_TPS Brk %: The % of releasing pedal BRK in max braking. Range 0~50. Used to adjust the regen current of releasing throttle regen mode type. The regen will happen as long as the throttle is released completely. Factory set is "0".

(2)   NTL Brk %: The % of Neutral Braking in max braking. Range 0~50. Only useful when you enable "Three gears" switch in "User Program". The regen will happen when you turn F-N-R switch from Forward or Reverse to Neutral position. Factory set is "0".

(3)   Accel Time: The time of TPS torque from 0 to max. Accuracy 0.1s. 5 is equal to 0.5s. Range 1~250. Factory set is "0".

(4)   Accel Rls Time: The time of TPS torque from max to 0. Accuracy 0.1s. Range 1~250. Factory set is "1".

(5)   Brake Time: the time of brake torque from 0 to max. Accuracy 0.1s. Range 1~250. Factory set is "15".

(6)   Brake Rls Time: The time of brake torque from max to 0. Accuracy 0.1s. Range 1~250. Factory set is "1".

(7)   BRK_SW Brk%: The % of BRK_SW in max braking. Range 0~50. The brake switch regen mode: you have to turn on the brake switch after the throttle is released for the regen to occur. Factory set is "10".

(8)   BRK_AD Brk%: It is used to adjust the max regen % of brake variable regen mode. This regen mode does not need brake switch to support any more for KLS controller.

(9)   Torque Speed KP (Speed % Kp in torque mode): Range 0~1000. Factory set is "3000".
Torque Speed KI (Speed integral Ki in torque mode): Range 0~500. Factory set is "80".
Speed Err Limit (speed error limit in torque mode): Range 50~4000. Factory set is "1000".
These three parameters are used for PID adjustment. If you think the acceleration performance is very-very strong, adjust them to a lower value respectively.

(10)   Change Dir Brake: Range "Enable" and "Disable". It is only useful when you "Enable" the joystick function. If you want to get swift direction changing by using joystick function, you may enable "Change Dir Brake" item in "User Program". It will help the motor change the direction of motor quickly after you shift throttle from 0V to 5V or from 5V to 0V.
Recommendation: Factory default is "Disable".

(11)   Compensation Per%: Tried to increase the current usage during "Anti-Slip" operation.

(12)   VT BRK MAX and IVT BRK MIN: These two items are only useful when joystick function is enabled in the "User Program". When you wan to use "Change Dire Brake" to reduce the delay time when you shift the direction under joystick operation, there is a RPM limitation to use "Change Dir Brake" function which is only activated when the motor RPM is between IVT BRK MIN and IVT BRK MAX.
Recommendation: Factory default is "Disable".

(13)   Torque Speed Kp: 3000
Torqure Speed Ki: 80
Speed Err Limit: 1000
These parameters are used for PID adjustment. If the acceleration is too aggressive, reduce these three parameters at the same time, vice versa. Change the Torque Speed Kp every 1000 units, Torque speed Ki every 100 units and Speed Err Limit every 500 units.
Note: Thermistor is optional. Default to KTY84-130/150 or KTY83/122. When controller temp item shows 246 on monitor screen of "User Program", it is normal. This item is only useful for internal calculation for MCU.246 is about 11 degrees in environment.

4.4   STEP 4

"Identification Angle" operation must be conducted before running motor for all KLS controllers. The "Identification Angle" operation can be done in PC program or Android APP (tablet or cell phone). KLS-N controller is designed for BLDC motor with three hall sensors. By default the speed sensor type is set at "2" from factory.

Speed Sensor Type	2

1.   Hook up the controller for "Identification Angle" operation according to the wiring diagram below. Ensure there is no load on the motor shaft before starting the programming.

KLS-S,KLS-D,KLS-H,KLS-N Sinusoidal motor controller
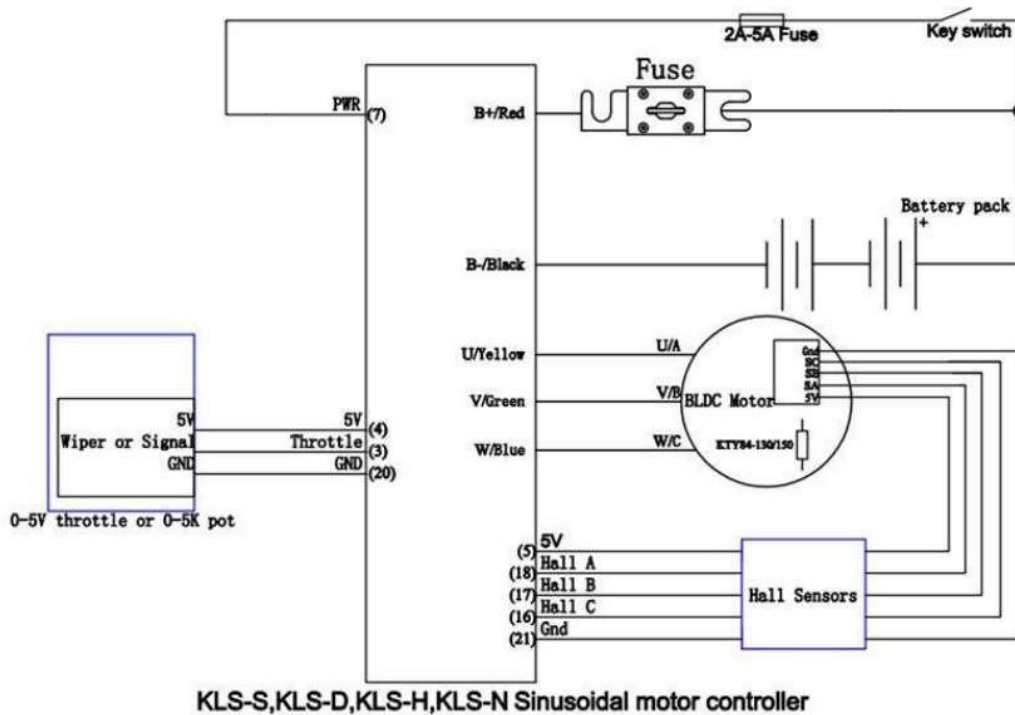
2.   Connect the controller to "User Program" by using a USB to RS232 cable and SM-4A DB9 (RS232) converter.

Customers can use a Z-TEK USB to RS232 cable and SM-4A DB9 (RS232) converter to connect the controller to an Android Tablet.

Another option is for customers to buy a Bluetooth converter to connect the controller to Android phone. If using a Bluetooth converter you do not have to use SM-4A to DB9 (RS232) converter for programming the controller.

3.   To install the "User Program" on your computer, tablet or phone, download for free the controller "User Program" from www.kellycontroller.com/support/php

4.   Turn on the key switch so that the controller can get power supply from B+/B- and Pin7. Try to open the "User Program" in your computer or other device. You may then try to click "Read" button in "User Program" on APP. You will see the first image of "User Program".
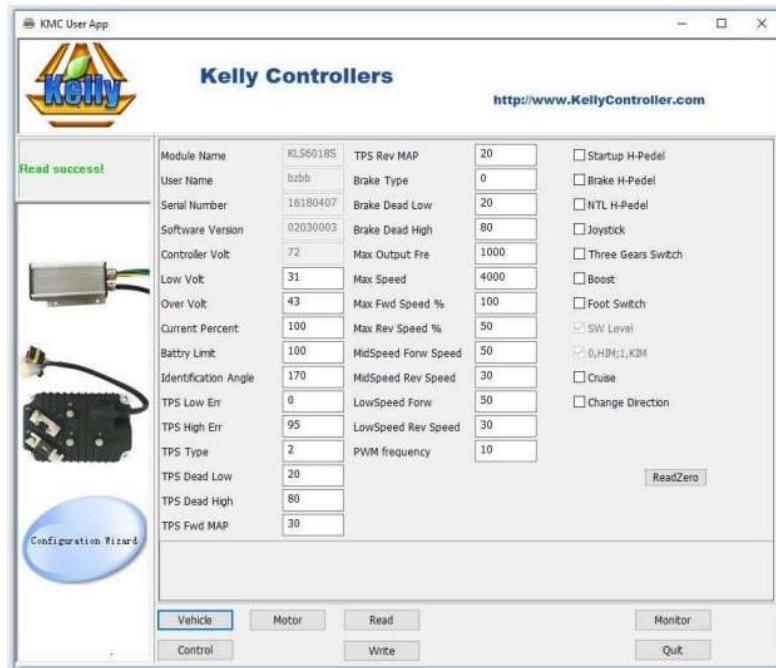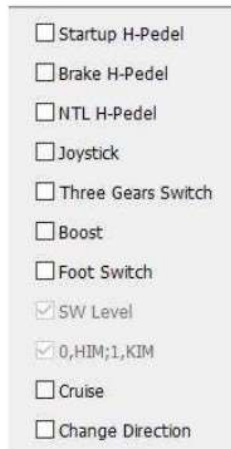
Check whether the "Identification Angle" item is at correct setting of 85. This simply means the controller finished the "Identification Angle" operation with the motor in factory before shipment, however, customers still need to run "Identification Angle" operation before driving as customer's motor is different from the one the controller was tested with.

5. Please fill 170 in the "Identification Angle" item and click the write button. The "User Program" will give a pop-up window which shows the "Write" operation is successful. Please quit from the "User Program" and turn off the power supply.

6. Turn on the power supply after the power supply has been switched off for a few seconds. The motor shaft will try to run on directions randomly. It is normal because the controller is doing "Identification Angle" operation.

7. Wait about 2-3 minutes.

8. If the "Identification Angle" operation is finished, the beeper will show an error code 3-2 and will note a reset error message in the monitor screen of "User Program".

9. Turn off the power supply again, wait a few seconds before turning the power supply back on.

10. Try to connect the controller to "User Program" again. You will see 85 in the "Identification Angle" item. It means the controller "Identification Angle" operation is successful and can use KLS-N controller to drive the motor.

11. So long as it is not "reset" error code, the value in "Identification Angle" will not go back to 85. The value is always at 170 and the controller is still in the processing of identification operation.

12. Do not try to write 85 in the "Identification Angle" or reset the power supply if you do not see any error codes.

13. If the constant beep sound lasts above 5 minutes and there are other error codes such as "Identify Error", "Hall Err", etc., return to the first picture of "User Program". Write 85 instead in "Identification Angle" by manual. If there are no error codes you cannot write back to 85 by manual. Wait longer time until the error codes occur. Do

not keep 170 in the "Identification Angle" item when you want to turn off the power supply as the controller will try to keep doing identification operation all the time as long you turn on power supply again. When error codes occur, quit "User Program" and try again from step 6.

14.   Do not keep 170 in "Identification Angle" item before power supply is turned on after the identification operation is successful

15.   If the direction of the motor is not what you expected, do not try to do "Identification Angle" operation again. You need to enable "Change Direction" item in the first picture of "User Program". Click "Write" button and reset the power supply to activate the setting, then the motor will run in the expected direction.

☐ Startup H-Pedel

☐ Brake H-Pedel

☐ NTL H-Pedel

☐ Joystick

☐ Three Gears Switch

☐ Boost

☐ Foot Switch

☑ SW Level

☑ 0,HIM;1,KIM

☐ Cruise

☐ Change Direction

CHAPTER 5 – MAINTENANCE

There are no user-serviceable parts inside the controllers. Do not attempt to open the controller as this will void your warranty, however, periodic exterior cleaning of the controller should be carried out.

The controller is a high-powered device. When working with any battery-powered vehicle, proper safety precautions should be taken that include – but are not limited to – proper training, wearing eye protection, avoidance of loose clothing, hair and jewlery. Always use insulated tools.

5.1   CLEANING

Although the controller requires virtually no maintenance after properly installed, the following minor maintenance is recommended in certain applications:
* Remove power by disconnecting the battery, starting with battery positive.
* Discharge the capacitors in the controller by connecting a load (such as a contactor coil, resistor or a horn) across the controller's B+ and B- terminals.
* Remove any dirt or corrosion from the BUS bar area. The controller should be wiped with a moist rag. Make sure that the controller is dry before reconnecting the battery.
* Make sure the connections to the BUS bars, if fitted are tight. To avoid physically stressing the BUS bars use two well-insulated wrenches.

5.2   CONFIGURATION

You can configure the controller with a host computer through either an RS232 or USB port.
* Disconnect motor wiring from controller for configuring existing parameters in the "User Program" or Android APP. If this operation is too much extra work, ensure the motor is stopped before programming.
* The controller may display fault code, but it does not affect programming or configuration, but it will affect the "Identification Angle" operation. Try to eliminate the error codes before "Identification Angle" operation.
* Use a straight through RS232 cable or USB converter provided by Kelly to connect to a host computer. Provide >+18V to PWR (for a 24V controller provide >+8V). Wire power supply return (supply negative) to any RTN pin.
* KLS controller requires a 4-pin connector to Kelly RS232 converter to support the communication. Customers may need a Z-TEK USB cable for table with Android OS.

Customers may download PC software or Android APP to program the controller before running the motor. You may do "Identification Angle" for brushless motor with hall sensors after running the software or Android APP. Every item in the configuration program can show the explanation automatically when you click it.

CAUTION:

- Make certain that the motor is connected before trying to run "Identification Angle" function in the configuration software. The controller needs to be connected to batteries, motor and throttle before identification operation. It is not enough to connect only power supply (PWR=Pin7) to batteries for "Identification Angle" operation.
- Configuration software will be regularly updated and published on the website. Please update your configuration software regularly. You must uninstall the older version before updating.
- Try to use "Identify Function" for motor and hall sensors in the "User Program".

Kelly Controller

? Warning:Prohibit doing any configuration in user program while running motor.

1. "Yes" to continue if the motor is not running.
2. "No" if the motor is running. Please reconnect user program after stopping motor.

TABLE 1 – ERROR CODES

Buzzer Error Codes

Code		Explanation	Solution
1.1		Automatic Error Identification	1.Wrong wiring of motor phase line or hall. Please suspend the motor when enable "Auto-Identify" function.
1.2		Over voltage error	2.Battery voltage is too high for the controller. Check battery volts and configuration. 3. Regeneration over-voltage. Controller will have cut-back or stopped regen. 4.This only accurate to ±2% upon Overvoltage setting.
1.3		Low voltage error	1.The controller will clear after 5 seconds if battery volts returns to normal. 2.Check battery volts and recharge if required.
1.4		Reserved	
2.1		Motor did not start	Motor did not reach 25 electrical rpm within 2 seconds of start-up. Hall sensor or phase wiring problem.
2.2		Internal volts fault	1.Measure that B+ & PWR are correct when measured to B- or RTN. 2.There may be excessive load on the +5V supply caused by too low and value of Regen or throttle potentiometers or incorrect wiring. 3.Controller is damaged. Contact Kelly about a warranty repair. 4.If this error code occurs, the relay function on Pin9 will be deactivated.
2.3		Over temperature	The controller temperature has exceeded 100°C. The controller will be stopped but will restart when temperature falls below 80°C.
2.4		Throttle error at power-up	Throttle signal is higher than the pre-set "dead zone" at Power-on. Fault clears when throttle is released.
3.1		Reserved	
3.2		Internal reset	May be caused by some transient fault condition like a temporary over-current, momentarily high or low battery voltage. This can happen during normal operation.
3.3		Hall throttle is open or short-circuit	When the throttle is repaired, a restart will clear the fault.
3.4		Angle sensor error	1.Speed sensor type error, customers may set the correct sensor type through "User Program" or APP. Download how to use "Identification" function instruction from our website. 2.Incorrect wiring. 3.Speed sensor is damaged or defective, or feedback signal is erratic.

4.1		Reserved	
4.2		Reserved	
4.3		Motor over temperature	Motor temperature has exceeded the configured maximum. The controller will shut down until the motor temperature cools down.
4.4		Hall Galvanometer Sensor Error	1.Hall galvanometer device is damaged inside the controller. 2.This error code is only valid for KLS-8080I controller.
Customers may read error codes in PC software or Android Tablet			

Contact Us:

Kelly Controls

Home Page:
http://www.KellyController.com

Download user manual, instructions and user program:
www.kellycontroller.com/support.php

E-mail:
Sales@Kelly-Controls.com

Phone:
(01) 224 637 5092