UNIVERZITET U SARAJEVU
ELEKTROTEHNIČKI FAKULTET
ODSJEK ZA AUTOMATIKU I ELEKTRONIKU

# Upravljanje električnim vozilom

PROJEKTNI ZADATAK

- DRUGI CIKLUS STUDIJA -

**Student:**
**Vedad Halimić**

**Mentor:**
**V. prof. dr Senad Huseinbegović.**

Sarajevo, septembar 2021.

# Sadržaj

# Poglavlje 1

# Uvod

U ovom radu je predstavljeno upravljanje električnim vozilom (slika 1.1) sa pogonom na sva četiri točka. Proizvođač motora je kompanija *QSMOTOR*. Snaga motora je $8000W$, a standardni napon napajanja iznosi $72V$. Svaki od motora je spojen na odgovarajući pretvarač/invertor. Motori su trofazni i sadrže dva seta Hallovih senzora za određivanje brzine i pozicije. Datasheet motora je dat u prilogu A, a dio dokumentacije pretvarača *KLS7275H* u prilogu B. Razvoj upravljačkog prototipa će biti realiziran pomoću dSpace sistema.

## 1.1 Motor

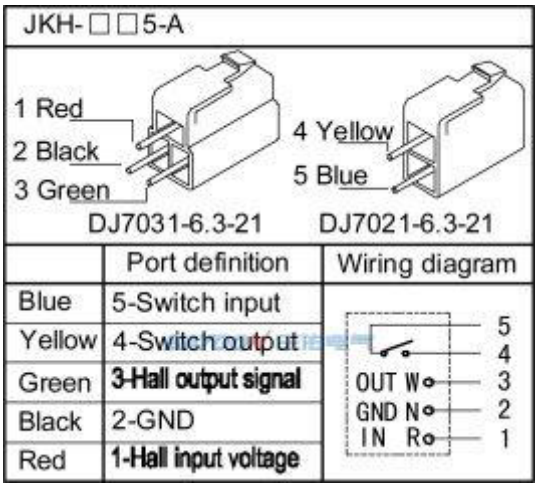
Motor je trofazni sa 16 pari polova, nominalne snage $8000W$. Za mjerenje brzine i pozicije motora, dostupna su dva seta Hallovih senzora. Moguće je mjeriti i temperaturu motora pomoću temperaturnog senzora $KTY83/122$. Motor sadrži dva konektora, čiji pinovi odgovaraju pinovima na *DJ7061Y-2.3-21* konektoru energetskog pretvarača. Svaki od konektora daje informacije sa Hallovog i temperaturnog senzora.

## 1.2 Papučica gasa

Brzinu motora je moguće zadavati pomoću papučice gasa. Model koji je odabran ima serijski broj *JKH-005-A-65*. Prema specifikaciji proizvođača *SAYOO*, datoj u prilogu C, dužina kabla spojenog na kočnicu iznosi $65cm$. U kablu se nalazi 5 žica raspoređenih na dva konektora - jedan sa tri, drugi sa četiri žice. Raspon ulaznog i izlaznog napona papučice gasa iznosi od 0 do $5V$. Ovaj element se konceptualno ponaša kao otpornik sa klizačem koji je spojen na napon napajanja. Izlazni napon otpornika ovisi o položaju klizača, odnosno u ovom slučaju - položaja papučice gasa. Pinovi, prikazani na slici (1.2), imaju funkcije date u nastavku.

- (1) - plus napon napajanja ($5V$)
- (2) - minus napon napajanja ($0V$, masa)
- (3) - izlazni napon
- (4) - izlazni kontakt prekidača
- (5) - ulazni kontakt prekidača

**Slika 1.1:** Električno 4*x*4 vozilo




**Slika 1.2:** Pinovi papučice gasa

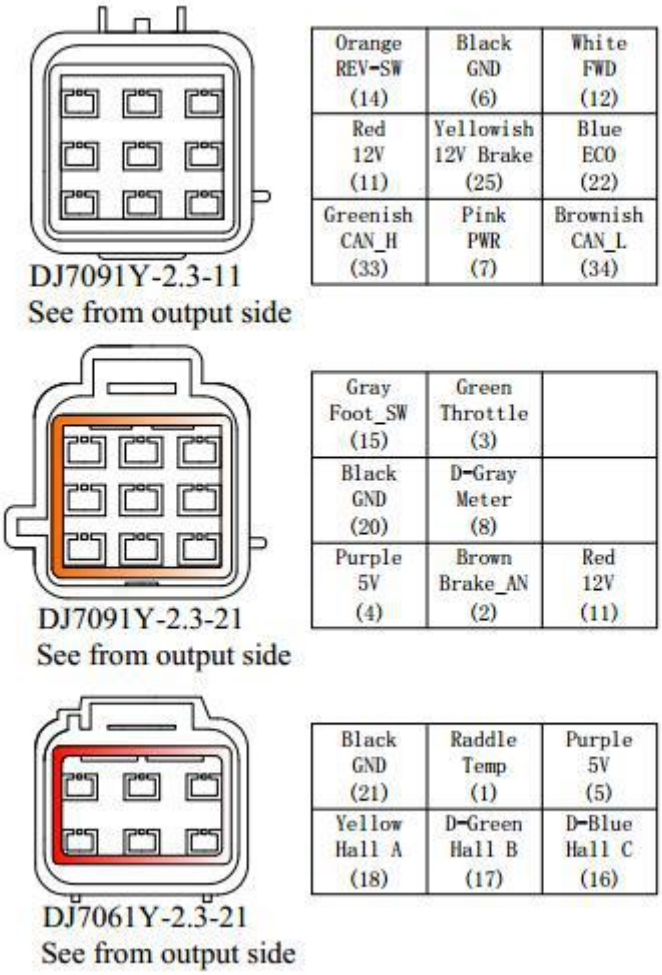
## 1.3 Pretvarač

Energetski pretvarač *KLS7275H* proizvođača *Kelly* sadrži 5 digitalnih ulaza: prekidače za gas i kočnicu, prekidače za kretanje naprijed i nazad, te prekidač za *boost* način rada. Dostupna su 3 analogna ulaza: gas, kočnica i temperatura motora. Opseg ulaznog napona može varirati od 0 do $5V$. Za upravljanje je moguće koristiti i palicu (*engl. joystick*), pri čemu pozicija palice određuje zadanu brzinu i smjer kretanja. *Cruise* režim rada, koji je također dostupan, podrazumijeva zadržavanje zadane brzine vrtnje motora sve dok se ne zada nova brzina ili aktivira kočnica. Pretvarač podržava povezivanje putem *CAN* mreže.

### 1.3.1 Pinovi energetskog pretvarača

*KLS7275H* kontroler posjeduje tri konektora prikazana na slici (1.3) i 22 pina. Pored standardnih pinova za napajanje, pretvarač posjeduje pinove za prikupljanje informacija sa motora (Hallov senzor i temperaturni senzor), kao i pinove za definiranje smjera i brzine vrtnje motora. Žica spojena na odgovarajući pin je označena jedinstvenom bojom i brojem. Funkcije pinova su date u nastavku.

- Konektor *DJ7091Y-2.3-11*
  - (14) REV-SW - prekidač za kretanje nazad
  - (6) GND - minus napona napajanja, povratni signal, masa
  - (12) FWD - prekidač za kretanje naprijed
  - (11) 12V - naponski izvor od $12V$
  - (25) 12V Brake - ručna kočnica
  - (22) ECO - prekidač za štedljivi način rada
  - (33) CAN-H - *high* pin za CAN komunikaciju
  - (7) PWR - plus napona napajanja pretvarača
  - (34) CAN-L - *low* pin za CAN komunikaciju
- Konektor *DJ7091Y-2.3-21*
  - (15) FOOT-SW - prekidač za gas
  - (3) Throttle - analogni ulaz za gas $(0-5V)$
  - (20) GND - minus napon napajanja, povratni signal, masa
  - (8) Meter - kopija signala sa Hallovog senzora
  - (4) 5V - naponski izvor od $5V$
  - (2) Brake-AN - *boost* funkcija ili analogni ulaz za regenerativni tip kočenja
  - (11) 12V - naponski izvor od $12V$
- Konektor *DJ7061Y-2.3-21*
  - (21) GND - minus napon napajanja, povratni signal, masa
  - (1) Temp - temperatura motora
  - (5) 5V - naponski izvor od $5V$




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

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

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

**Slika 1.3:** Pinovi *Kelly KLS7275H* pretvarača

- (18) Hall A - signal Hallovog senzora za fazu A
- (17) Hall B - signal Hallovog senzora za fazu B
- (16) Hall C - signal Hallovog senzora za fazu C

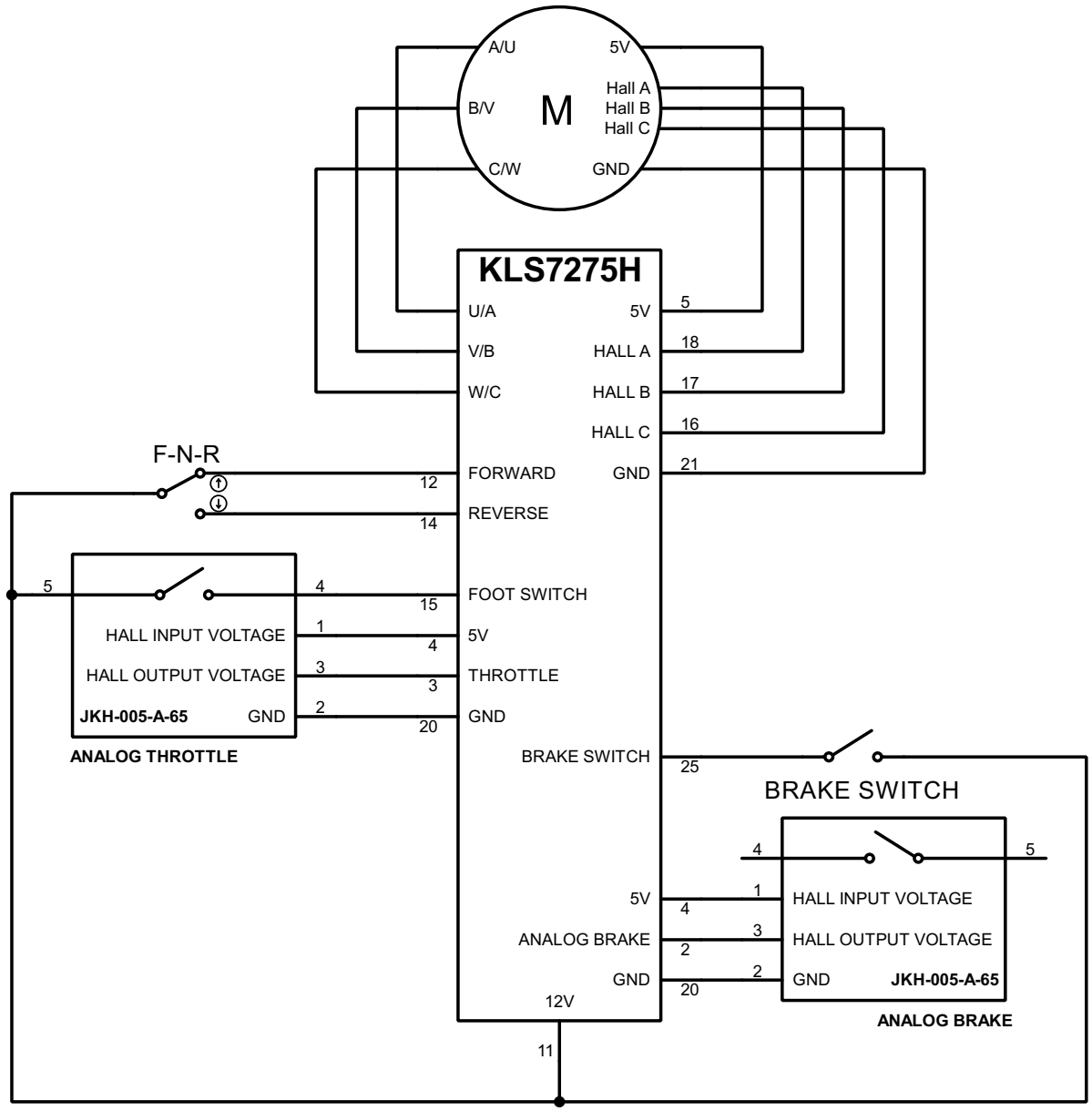
## 1.4 Upravljanje motorom

Energetski pretvarač/kontroler koristi vektorsku modulaciju (*engl. space-vector modulation*) za upravljanje trofaznim motorom. Za upravljanje cjelokupnim sistemom vozila, potrebno je uključiti dodatni sloj upravljanja, koji će upravljati paralelno sa svim pretvaračima koji su povezani sa motorima.

Za sada će konceptualno biti razmotreno upravljanje jednim motorom. Shema upravljanja je data na sljedećoj strani. Osnovna ideja upravljanja se zasniva na tome da se na pin (3) *KLS7275H* pretvarača dovodi signal u rasponu od 0 do $5V$, koji će proporcionalno svojoj vrijednosti - određivati željenu brzinu vrtnje motora. Izvor signala gasa može biti potenciometar ili nožna papučica, što se također mora uzeti u obzir prilikom konfiguracije samog pretvarača. U prikazanoj konfiguraciji je potrebno obezbjediti signal koji će na pinu (15) davati informaciju

o stanju papučice gasa. Funkcija analognog regenerativnog kočenja se može realizirati na sličan način, pri čemu za razliku od gasa, nije potrebna infromacija da li je papučica aktivirana. Na pinu (25) je moguće realizirati $12V$ ručnu kočnicu.

Korisnik može mijenjati smjer vrtnje motora, odnosno smjer kretanja vozila (naprijed ili nazad) dovođenjem odgovarajuće kombinacije signala na pinove (12) i (14). Na osnovu ulaznih signala, energetski pretvarač pokreće trofazni DC motor bez četkica. Pinovi (16), (17) i (18) služe za prikupljanje signala sa Hallovog senzora na samom motoru. Napajanje Hallovog senzora iznosi $5V$.




| | |
|---|---|
| FILE NAME: | Upravljanje.pdsprj |
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| PATH: | C:\Users\VedadNedzad\My Drive\Master Zavrsni Rad\Electric Car-C |
| BY: @AUTHOR | REV:@REV |
| DATE: | 30-Sep-21 |
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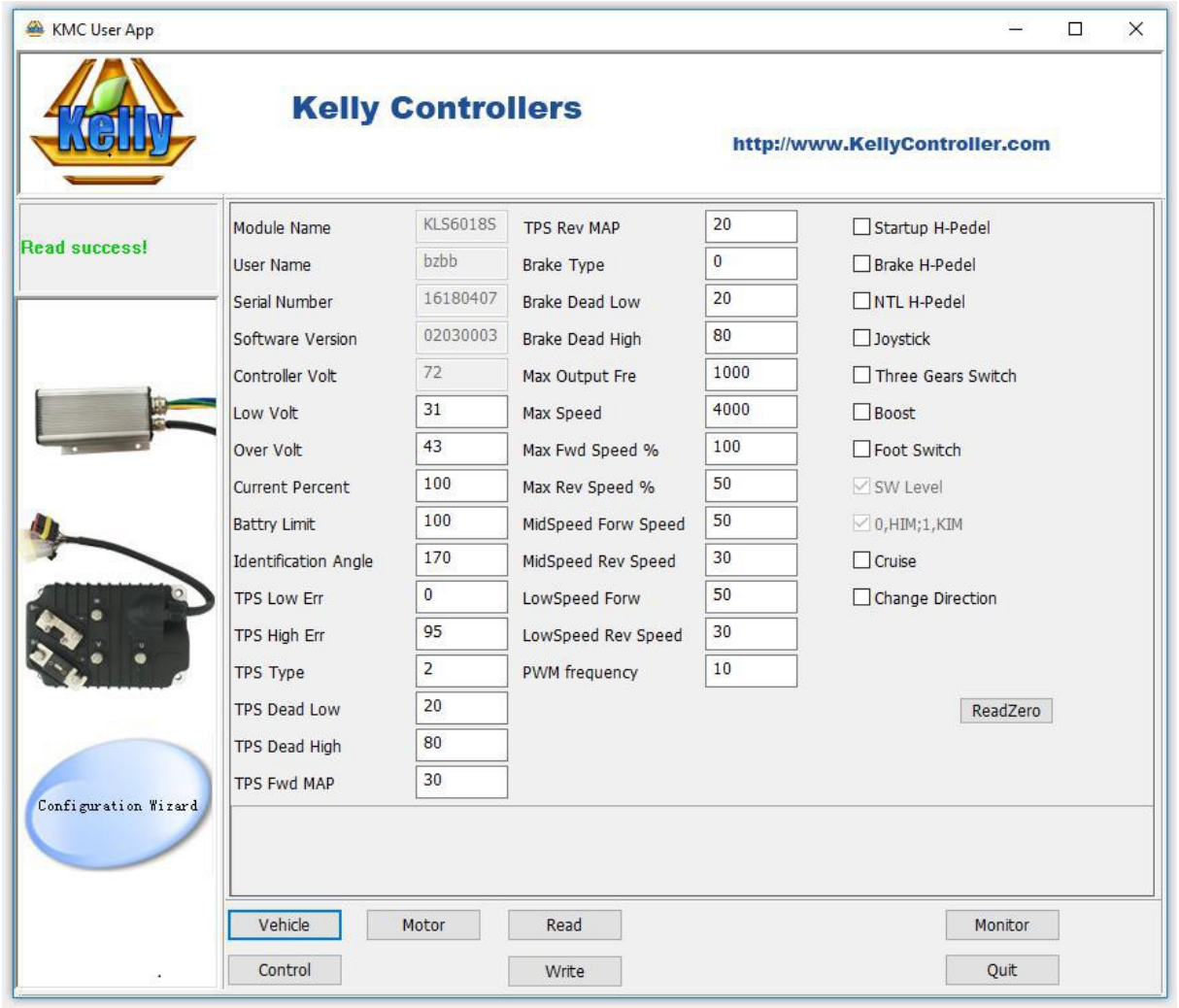



**Slika 1.4:** Program za konfiguraciju energetskog pretvarača

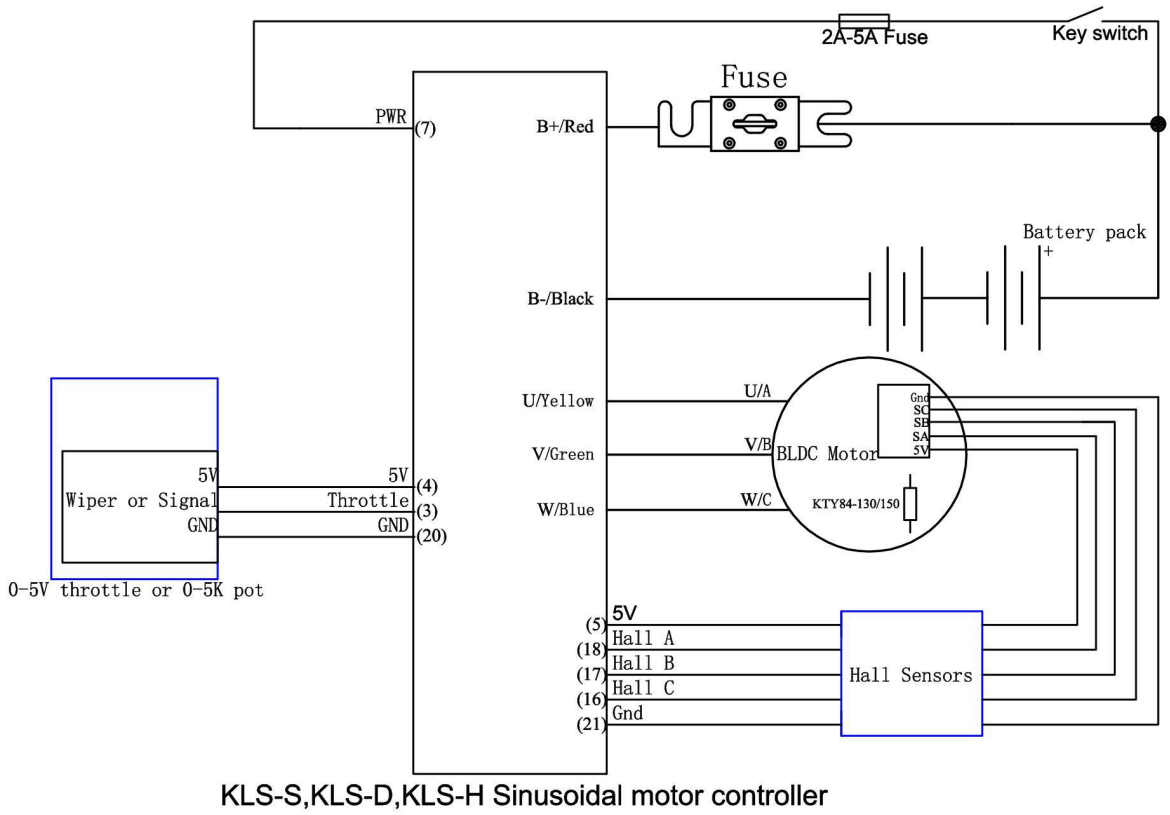
## 1.5 Konfiguracija parametara pretvarača

Parametre *KLS7275H* kontrolera je moguće podešavati pomoću PC ili Android uređaja. Veza sa PC uređajem se ostvaruje preko *USB-RS232* konektora. Softver za konfiguraciju je dostupan na zvaničnoj stranici proizvođača. Dijaloški okvir programa je prikazan na slici (1.4). Podešavanja vezana za motor i samo vozilo koje će motor pogoniti kao dio sistema su odvojena. Informacije kao što su ime modula, serijski broj, verzija softvera i napon pretvarača su dostupna samo za čitanje.

## 1.6 Operacija identifikacije ugla

Prije puštanja određenog motora u rad, potrebno izvršiti proceduru *identifikacije ugla*. Ova operacija se izvršava korištenjem aplikacije na računaru koji je povezan sa energetskim pretvaračem preko *USB-RS232* konektora. Shema spajanja je data na slici (1.5). Pretvarač je spojen na motor sa tri faze, a sa motora se prenosi signal sa Hallovog senzora. Vanjski element za zadavanje gasa također treba povezati sa pretvaračem, pri čemu taj element može jednostavno biti potenciometar ili papučica gasa.

Komponenta koja se može koristiti u tu svrhu je *Controller Control Box*, prikazana na slici




**Slika 1.5:** Shema spajanja za operaciju identifikacije ugla

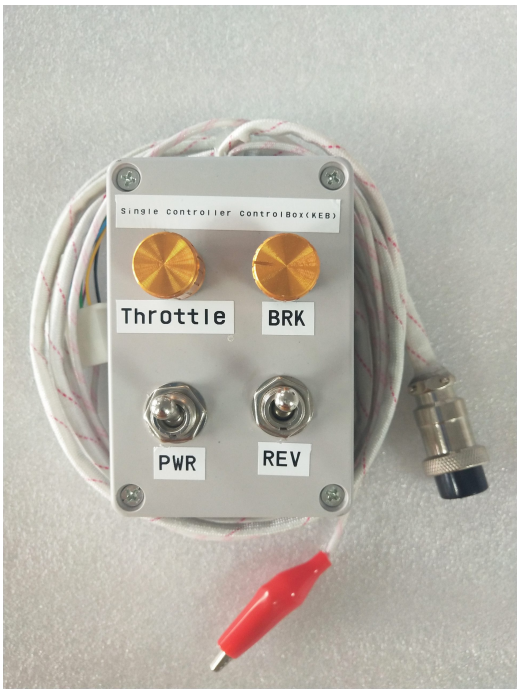
(1.6). Shema spajanja sa kontrolerom preko 14-pinskog konektora je data u prilogu D, pri čemu je za realizaciju identifikacije ugla dovoljno koristiti opciju u kojoj se *PWR* prekidač na kontrolnoj kutiji koristi za *Key switch* na slici (1.5) i konfiguracija *Throttle* potenciometra kao element zadavanja gasa.

Pri povezivanju svih elemenata potrebno je da *PWR* prekidač, odnosno*Key switch* bude u otvorenom stanju. Nakon što se preuzme softver za konfiguraciju i instalira na PC, prekidač za napajanje je potrebno zatvoriti i pokrenuti instalirani softver. Kada se otvori dijaloški prozor programa (slika 1.4), potrebno je kliknuti na opciju *Read*, kako bi se učitali trenutni podaci kontrolera.

Parametri koje je potrebno konfigurirati prije procesa identifikacije ugla se nalaze unutar grupe *Motor*, a odnose se na broj polova motora, tip senzora brzine i iznos struje koja se koristi za identifikaciju. Unutar grupe *Vehicle* potrebno je podesiti parametre: *TPS Type* (način zadavanja gasa), *Max Output Frequency* (maksimalna vrijednost frekvencije za faze motora), *Max Speed* (maksimalna brzina motora, izražena u obrtajima po minuti) i *PWM frequency* (frekvencija širinsko-impulsne modulacije, odnosno metode kojom pretvarač upravlja motorima). Treba napomenuti da brzina rotacije motora, prema specifikaciji proizvođača datoj u prilogu A, brzina rotacije motora iznosi od 550 do 1200 RPM.

Naredni korak u postupku identifikacije ugla je upisivanje broja **170** u parametar *Identification Angle* i odabir opcije *Write*. Zatim je potrebno izaći iz programa za konfiguraciju. Isključivanjem dovoda napajanja na nekoliko sekundi i ponovnim spuštanjem *PWR* prekidača, motor započinje kretanje nasumično u oba smjera. Proces identifikacije traje od 2 do 3 minute.

Kada se proces završi, pretvarač će dati $3-2$ kod greške - zujalica (*engl. buzzer*) će najprije dati 3, a zatim 2 brza zvučna signala. Zatim je potrebno opet na nekoliko sekundi isključiti




**Slika 1.6:** Controller Control Box

napajanje kontrolera. Nakon ponovnog pokretanja korisničkog sučelja za konfiguraciju kontrolera, potrebno je provjeriti *Identification Angle* parametar, ukoliko je proces identifikacije uspješno izvršen - parametar ima vrijednost 85.

Iako se u procesu identifikacije ugla nije koristio potenciometar za davanje gasa, ovaj element služi za provjeru da li se motor kreće u željenom smjeru. Ukoliko to nije slučaj, potrebno je označiti (*engl. check*) opciju *Change Direction* u programu za konfiguraciju. Da bi se promjena sačuvala potrebno je kliknuti na dugme *Write* i resetirati napajanje.

# Prilozi

# Prilog A

# 8000W DC Brushless Car Motor Datasheet

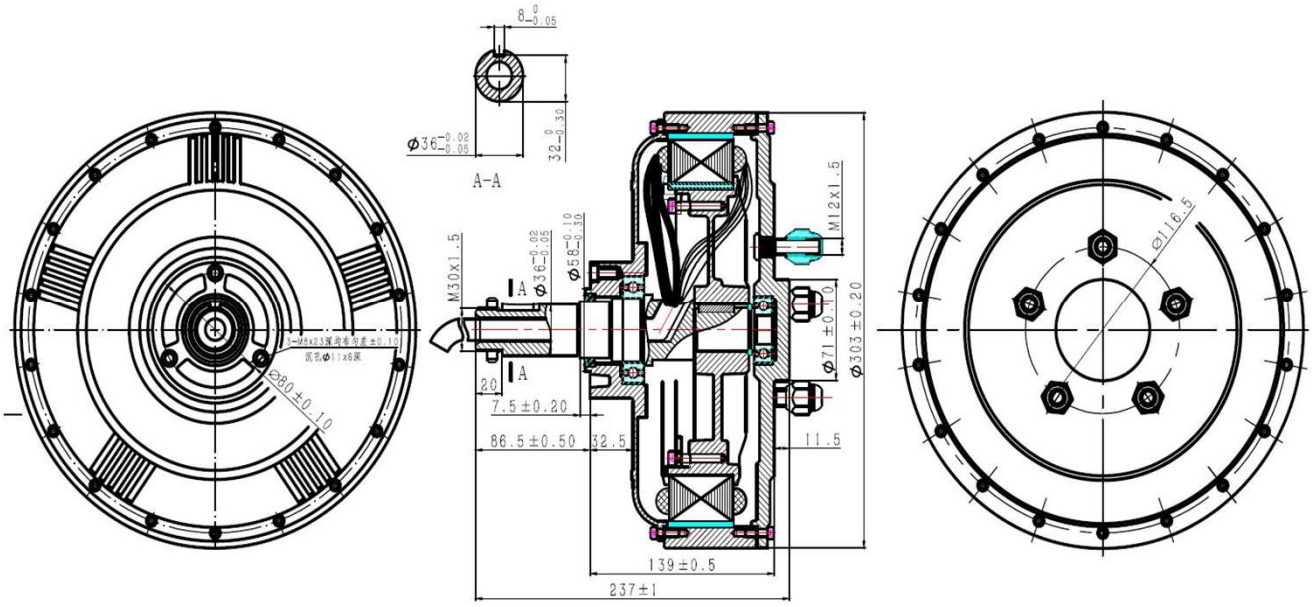
# QS MOTOR LTD

Phone: +86-188-0166-2699
Email: sales@qsmotor.com
Website: www.qsmotor.com
Contact: Harry Zhou

## 8000W DC Brushless Car Motor (50H 273 V3)

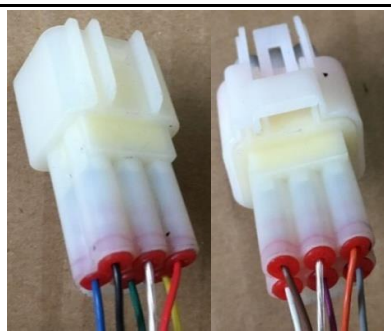
| | | |
|---|---|---|
| Motor Size | Motor Diameter | 303mm |
| | Recommendation Hub | 14 inch or more than 14 inch rim |
| | Axle | Single Shaft |
| | PCD | 5x117mm (Customizable 100-117mm) |
| | CB | 71mm (or Customizable 60-80mm) |
| Motor Phase | Number of Motor Phase | 3 |
| | Cross Section of Cable | 16 Square Millimeter |
| Motor Power | Rated Power | 8000W |
| | Max. Power | 12800W (peak 16000W) |
| | Rated Voltage | 72V (option 84V, 96V, 108V, 120V) |
| | Continuous Current | 127A |
| | Peak Current | 190A (peak 300A less than 5 seconds) |
| | Magnet Height | 50mm |
| | Number of Pole Pairs | 16 Pairs |
| | Max. Torque | 90 - 302N.m |
| | Max. Efficiency | 91% |
| | Rotating Speed | 550 - 1200rmp |
| | Max. Speed of Scooter | 30 - 110km/h |
| Motor Hall Sensor | Hall Sensor | 2 sets (1 for use and 1 for backup) |
| | Hall Working Votalge | 5V (option 12V) |
| Motor Brake System | Brake Type | Disc Brake |
| | Disc Size | 220mm |
| Remark | Waterproof Grade | IP54 |
| | Max. Working Temperature | 70 ℃ (peak 120℃ in 5 - 10 second) |
| | Temperature Sensor | KTY83-122 |
| | Color | Black |
| | Weight | 26kgs |
| | Unit Packing | 43x43x41cm/carton |
| Option | Temperature Sensor | KTY83-122 |

# Drawing of Car Motor 273



# QS MOTOR LTD

55 Shugang Ave, Luqiao, Taizhou 318057, Zhejiang, China
Phone: +86-188-0166-2699 Email: sales@qsmotor.com

| **Motor has 3 Phase Cables and 2 sets Hall Sensor Plugs** | |
|---|---|
| 3 Phase Cables | 2 Sets Hall Sensor Plugs |
|  |  |
| Motor Phase Cable | |
| Motor's YELLOW Cable (big cable), A, U phase. | |
| Motor's GREEN Cable (big cable), B, V phase. | |
| Motor's BLUE Cable (big cable), C, W phase. | |
| | |
| The Hall Sensor Plug Set 1. | |
| The Hall Sensor's YELLOW Cable (small cable, hall A). | |
| The Hall Sensor's GREEN Cable (small cable, hall B). | |
| The Hall Sensor's BLUE Cable (small cable, hall C). | |
| The Hall Sensor's RED Cable (small cable, +5V DC). | |
| The Hall Sensor's BLACK Cable (small cable, GND). | |
| The Hall Sensor's Transparent/Crystal Cable (Temperature Sensor). | |
| | |
| The Hall Sensor Plug Set 2. | |
| The Hall Sensor's GRAY Cable (small cable, hall A). | |
| The Hall Sensor's PURPLE Cable (small cable, hall B). | |
| The Hall Sensor's WHITE Cable (small cable, hall C). | |
| The Hall Sensor's ORANGE Cable (small cable, +5V DC). | |
| The Hall Sensor's BROWN Cable (small cable, GND). | |
| The Hall Sensor's Transparent/Crystal Cable (Temperature Sensor). | |
| | |
| **Important Notice.** | |
| 1. The function of 2 sets hall sensors are same. We use 1 set Hall Sensor Plug and the other 1 set for backup. Please note never try to connect 2 set hall sensor plugs to controller at same time. | |
| 2. Please change the hall plug of controller if the hall plugs do not match with motor. The static electricity may damage the hall sensor of motor if you change the plug of motor. | |

# Prilog B

# Kelly KLS-H Brushless Motor Controller User's Manual

# Chapter 2 Features and 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 preset "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℃ case temperature, shutting down at 100℃.
(6) The controller keeps monitoring battery recharging voltage during regen braking.
(7) Maximum reverse speed and forward speed can be configured between 20% and 100% respectively and separately.
(8) A 4pin 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 +5 volt and +12 volt 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 analog 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.Pin1 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 analog regen mode.This regen mode doesn't need brake switch to support any more.Only available from software version 0106 or advanced version.
(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-H controller included the fuse on the case.Not shunt is attached.
(21) Cruise control.Only can be activated in forward direction.
(22) KLS-H can support Broadcast type CAN Bus function.It is 250Kbps.CAN bus is not included in KLS-H controller by default.CAN bus is only an optional function for KLS-H.

CAN ID can be changed in the latest user program also.

(23)Bluetooth function.Required a small Bluetooth converter which needs to be purchased in addition from our website.This small converter is only useful for KLS controller.

(24)Can support three speed function on the latest version.

***Caution!*** *The regen is not a safe function.Usually you may use the mechanical brake.*

## 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) Rugged aluminum housing for maximum heat dissipation and harsh environment.
14) Rugged high current terminals, and rugged aviation 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 cost to customers.
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) KLS-H:Dust and water protected under sealed condition,IP66
25) KLS-8080H.The protection rating is IP54.

## 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 to 90V for controllers rated equal or lower than 72V.KLS24V model:PWR,20V to 30V
The PWR can be 96V batteries for KLS96xxx-8080H model.So All KLS-H and KLS-8080H model are non isolated type controllers.
•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: 0-5 Volts(3-wire resistive pot), 1-4 Volts(hall active throttle).
•Throttle Input: 0-5 Volts. Can use 3-wire pot to produce 0-5V signal.
•Full Power Operating Temperature Range: 0℃ to 70℃(MOSFET temperature).
•Operating Temperature Range: -40℃to 100℃ (MOSFET temperature).
•Max Battery Current :Configurable.

## 2.4 Name Regulation

The name regulation of Kelly BLDC motor controllers:

**KLS 72 30H**
**KLS:Kelly BLDC motor controller based on sinusoidal waveform which is supposed to work with BLDC motor with three hall sensors.All KLS controllers can do regen brake function by default.**
**72:72V batteries.**
**H:The motor controller included a plastic cover with a fuse.And KLS-H is IP66 rating without filling the silica gel by default.But KLS-8080H is IP54 rating.**
**C:BroadCast type CAN bus protocol.**

| Kelly KLSH Brushless Motor Controller | | | |
|---|---|---|---|
| Model | 30 seconds Current(Amp) | Continuous Current(Amp) | Voltage(Volt) |
| KLS2422H | 220 | 88 | 20<Volt<30 |
| KLS2430H | 350 | 120 | 20<Volt<30 |
| KLS2445H | 350 | 140 | 20<Volt<30 |
| KLS2475H | 500 | 200 | 20<Volt<30 |
| KLS6022H | 220 | 88 | 40<Volt<80 |
| KLS6030H | 350 | 120 | 40<Volt<80 |
| KLS7218H | 200 | 80 | 40<Volt<90 |
| KLS7230H | 300 | 100 | 40<Volt<90 |
| KLS7245H | 350 | 140 | 40<Volt<90 |
| KLS7275H | 500 | 200 | 40<Volt<90 |

| | | | |
|---|---|---|---|
| KLS8422H | 220 | 80 | 40<Volt<105 |
| KLS8430H | 300 | 100 | 40<Volt<105 |
| KLS72501-8080H | 500 | 200 | 20<Volt<90 |
| KLS72601-8080H | 600 | 240 | 20<Volt<90 |
| KLS72701-8080H | 700 | 280 | 20<Volt<90 |
| KLS84701-8080H | 700 | 280 | 20<Volt<105 |
| KLS96301-8080H | 300 | 120 | 20<Volt<120 |
| KLS96401-8080H | 400 | 160 | 20<Volt<120 |
| KLS96501-8080H | 500 | 200 | 20<Volt<120 |
| KLS96601-8080H | 600 | 240 | 20<Volt<120 |
| | | | |

# Chapter 3 Wiring and 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 1,2,3,4.

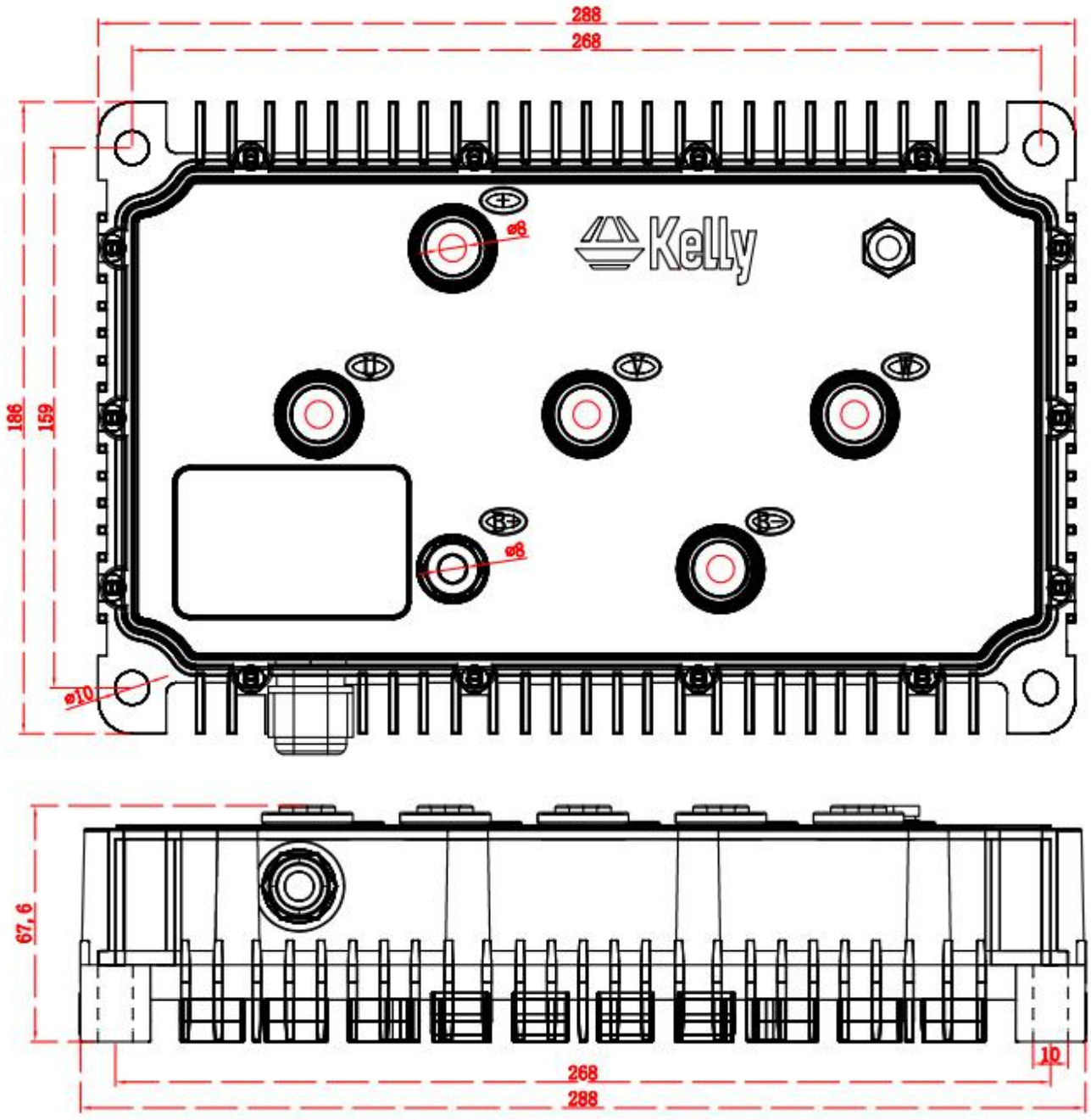
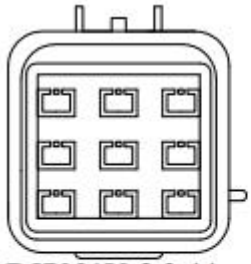



**Figure 3: KLS2475H KLS7275H** mounting holes' dimensions (dimensions in millimeters)

# 3.2 Connections

### 3.2.1 Pin definition of KLS-H Controller



DJ7091Y-2.3-11
See from output side

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

DJ7091Y-2.3-21
See from output side

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

DJ7061Y-2.3-21
See from output side

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

1,The switch signal is valid to 12V on pin11
2,12V capacity is low.This 12V only can be used for LED or switch signals.
3,Boost and Brake analog regeneration mode used the same pin as pin2.
When Boost is disabled in the user program,the pin2 can be used as brake variable regen mode.When Boost is enabled,the brake analog regen mode is inactivated automatically.Both Boost and Brake variable regen mode can not be used at the same time.

**Figure 5:** waterproof connector

## 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 White**
**(11) 12V:12V Source Red**
**(25) 12V brake switch. Yellowish**

（22）ECO: Low speed input switch function. Blue
(33)CAN-H:Green(Optional function)
(7) PWR: Controller power supply (input). Pink
(34)CAN-L:Dark Gray(Optional function)

## DJ7091Y-2.3-21 Pin Definition

(15) Micro_SW: Throttle switch input. Gray
(3) Throttle: Throttle analog input, 0-5V. Dark Green
(20) RTN: Signal return. Black
(8) Meter: Copy signal of hall sensors. Dark Blue
(4) 5V: 5V supply output, <40mA. Purple
(2) Brake_AN：Brake variable regen or Boost function. Brown
(11) 12V:12V Source Red

## DJ7061Y-2.3-21 Pin Definition

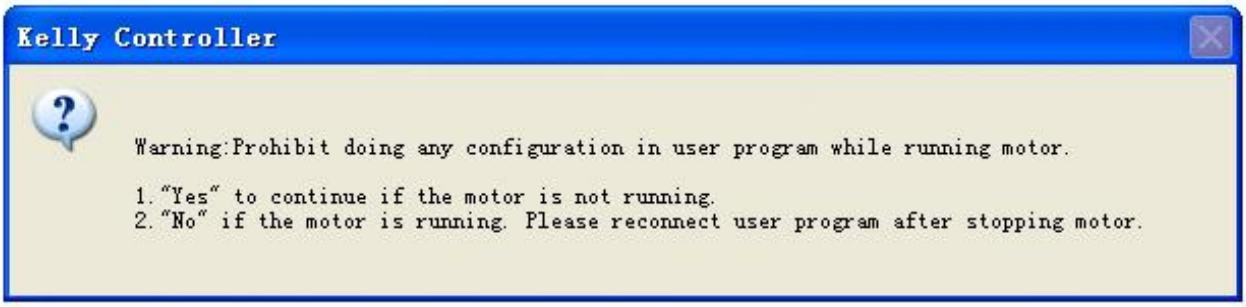
(21) RTN:Signal return. Black
(1) Temp: Motor temperature sensor input. Raddle
(5) 5V: 5V supply output,<40mA.Purple
(18) Hall A: Hall phase A. Yellow
(17) Hall B: Hall phase B. Dark Green
(16) Hall C: Hall phase C. Dark Blue

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.

**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 precharge resistors across their contacts. Lack of even one of these precharge resistors may severely damage the controller at switch-on.




### 3.2.2 Standard Wiring of KLS-H Controller

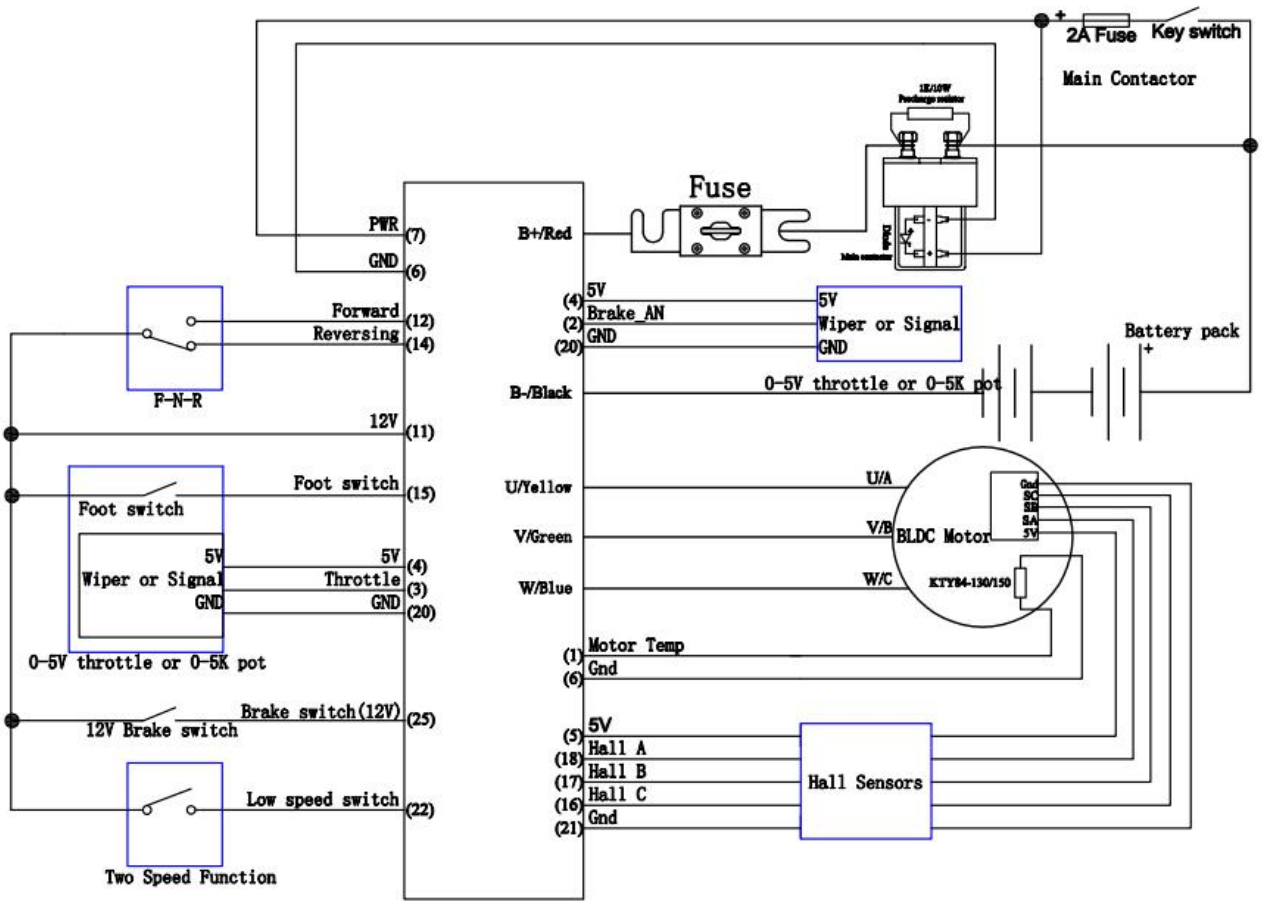



**Figure 6: KLS-H** controller standard wiring
(Battery voltage can be used for controller supply)

# Prilog C

# JKH Foot Throttle

# Switches and Accessories

## JKH Foot Throttle

## USES

Foot speed control for electric vehicles, electric tricycles, trucks, recreational vehicles, classic cars, brick cars, solar boats

## SAYOON MODEL IMPLICATION

JKH - □ □ □ - □ - □

- Wire length(cm)
- Plug type:A,B,C
- The total number of wires:2, 3, 4, 5, 6, 7
- Hall output voltage range type
  0: 0-5V, 1: 1-4V, 4: 4-1V; 5: 5-0V; 6: 0-10V;9:other voltage
- Hall input voltage type
  0:5V, 1:12V/15V， 2:24V±50%, 3:36V±50%,
  4:48V±50%, 6:60V±50%, 7:72V±50%,
  8:84V±50%, 9:96V±50%
- Product type: Hall type of foot throttle

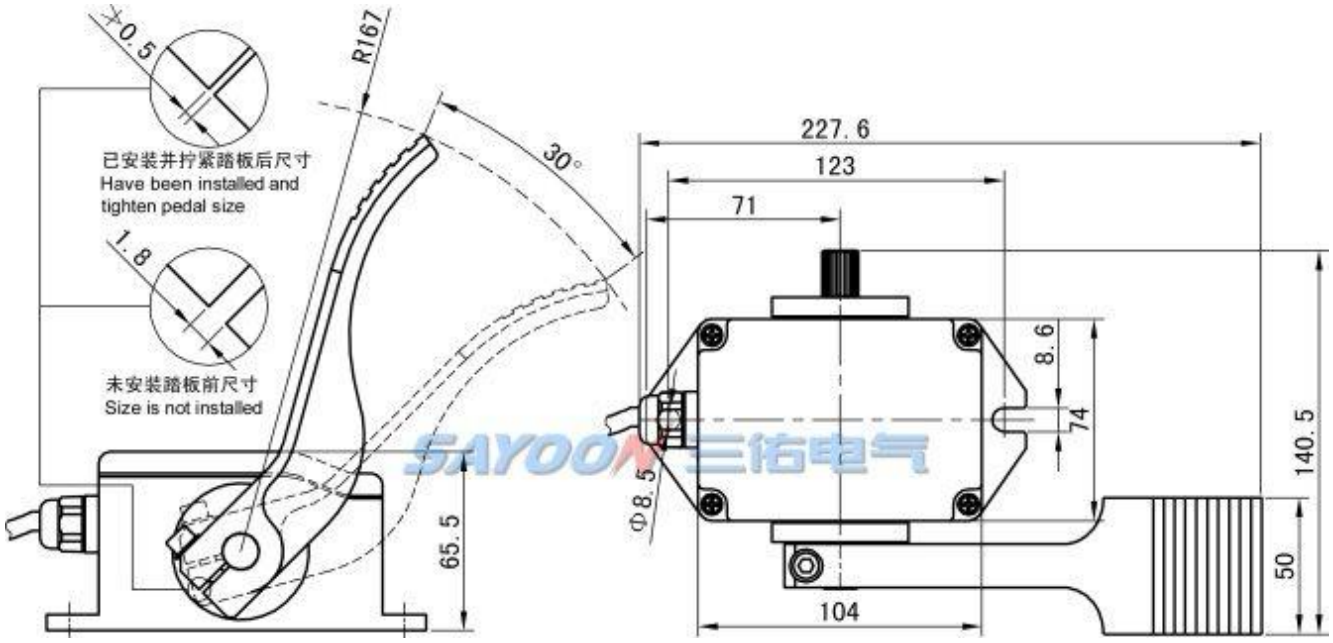
## USE OF THE ENVIRONMENT

| | |
|---|---|
| Ambient temperature | -30~+85℃ |
| Relative humidity | +20℃ 98% |
| the vibration frequency of the | 3G, 1 ~ 50Hz 0.5mm amplitude |
| Altitude | 2000m |
| Installation direction | Random |
| International protection | IP68 |

## ORDER INSTRUCTION

| | |
|---|---|
| U.N.W. | 1000g |
| Package QTY. | 40 PCS |

## INSTALLATION DIAGRAM




## TECHNICAL PARAMETERS

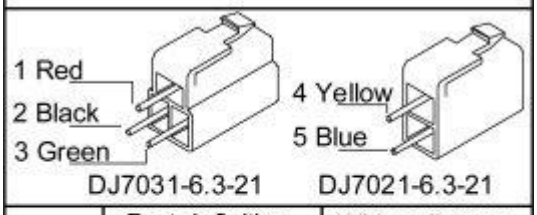
| | |
|---|---|
| Input voltage | 5V,10V,12V,24V,36V-84V,96V, Any voltage |
| Output | 0.8-4.2v;0-5V;5-0V;4.2V-0.8V;0-10V;10-0V |
| Output rated load current | 10mA |
| Output type | Voltage |
| Wire length | 650 mm |
| Pedal rotation angle | 30 degrees |
| Micro Switch resistive load current | 2A |
| Micro Switch Inductive load current | 1A |
| Accelerate the operating voltage of the switch | 0-96V |
| Pedal position | Vertical or suspension |
| Installation form | Vertical or suspension |
| Testing organization certification | CE |

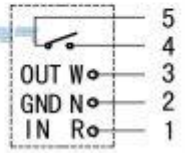
## FEATURES

Pedal accelerator pedal device is through one of the most important components of motor controller management operation, its quality determines the user driving reliability and comfort. The company accelerator has the following characteristics:1 Mechanical and electronic signal, logic signal, to prevent runaway.2 double torsion spring design, reasonable structure, prevent speed, high safety.3 waterproof and anti vibration, suitable for a variety of vehicle environment.4 imported sensitive components, the temperature drift is small, the work is stable.5 non contact type induction work, no wear, long life.6 the output curve is reasonable, the vehicle control freely.

## WIRING DIAGRAM

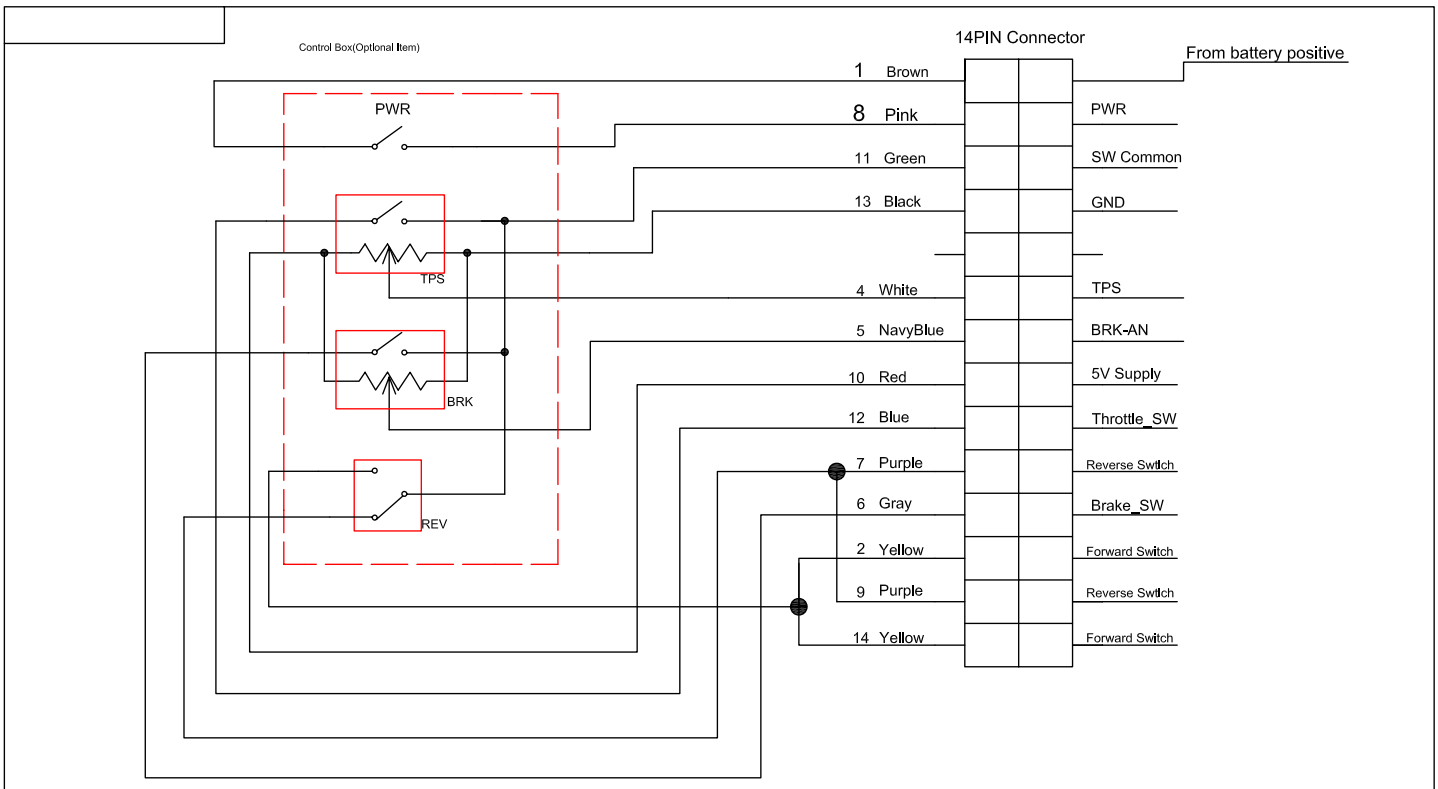
JKH-□□5-A




| | Port definition | Wiring diagram |
|---|---|---|
| Blue | 5-Switch input |  |
| Yellow | 4-Switch output | |
| Green | 3-Hall output signal | |
| Black | 2-GND | |
| Red | 1-Hall input voltage | |

# Prilog D

# Control Box




# Control Box for Brushed and Brushless

See From Front Side

| 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| Purple | Gray | NavyBlue | White | | Yellow | **Brown** |
| Reverse SW | Brake SW | Brake AN | TPS | | Forward SW | **From battery** |
| 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| Yellow | Black | Blue | Green | **Red** | Purple | **Pink** |
| Forward SW | **RTN** | Throttle SW | **SW Common** | **5V output** | Reverse SW | **PWR** |

14pin connector

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | KELLY CONTROLS, LLC |
| Mark | | Subarea | Signatory | | Date | 05/29/2009 | | |
| Design | | | Stand | | | modification | Number | Proportion |
| Assessor | | | | | | | | |
| Technics | | | Authorize | | | | | V1.0 |
| | | | | | | Sum | | |