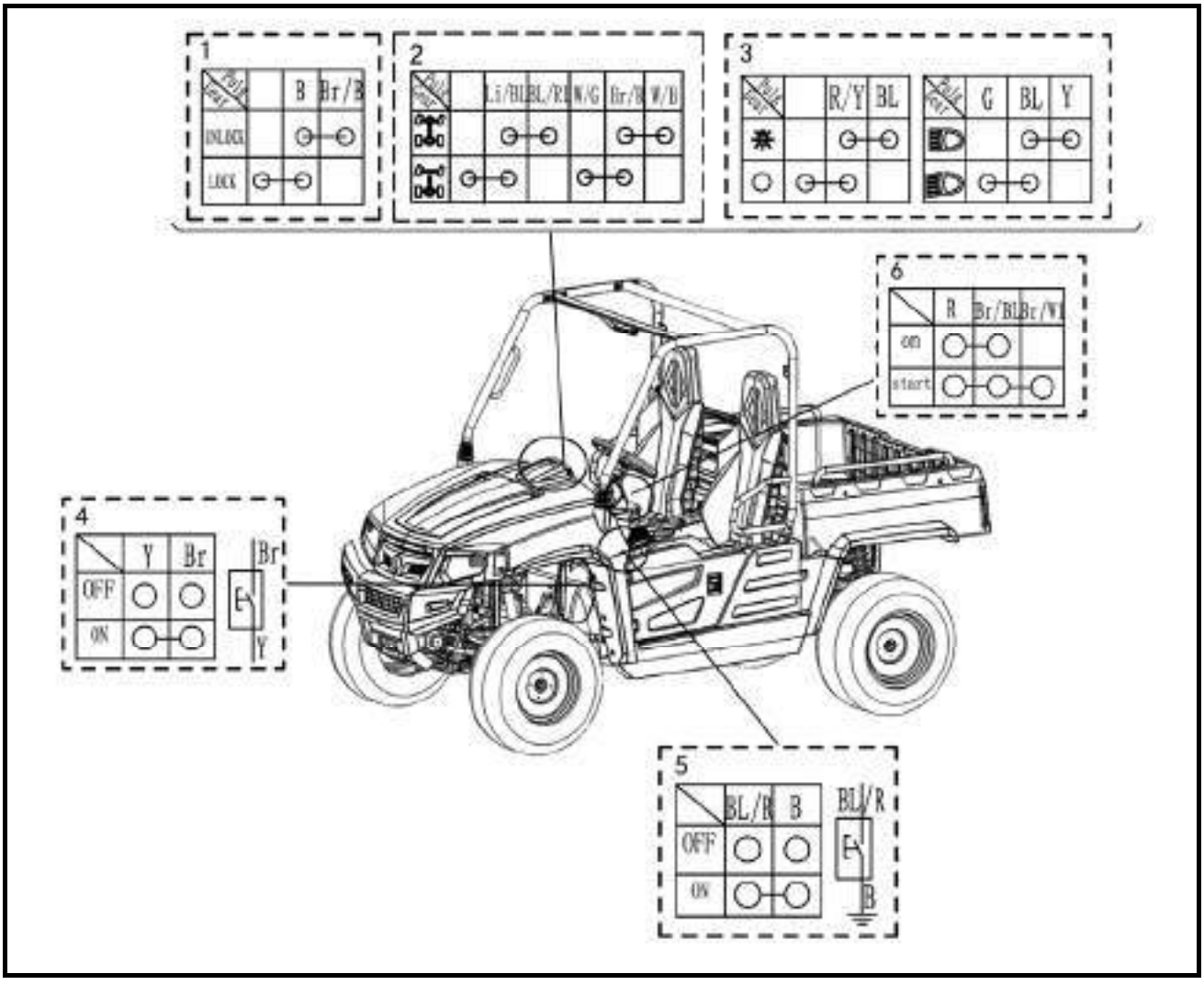
Checking the switch continuity(bucket)

Refer to “CHECKING THE SWITCH” and check for continuity between lead terminals. Poor connection, no continuity → Correct or replace.

* The coupler locations are circled.

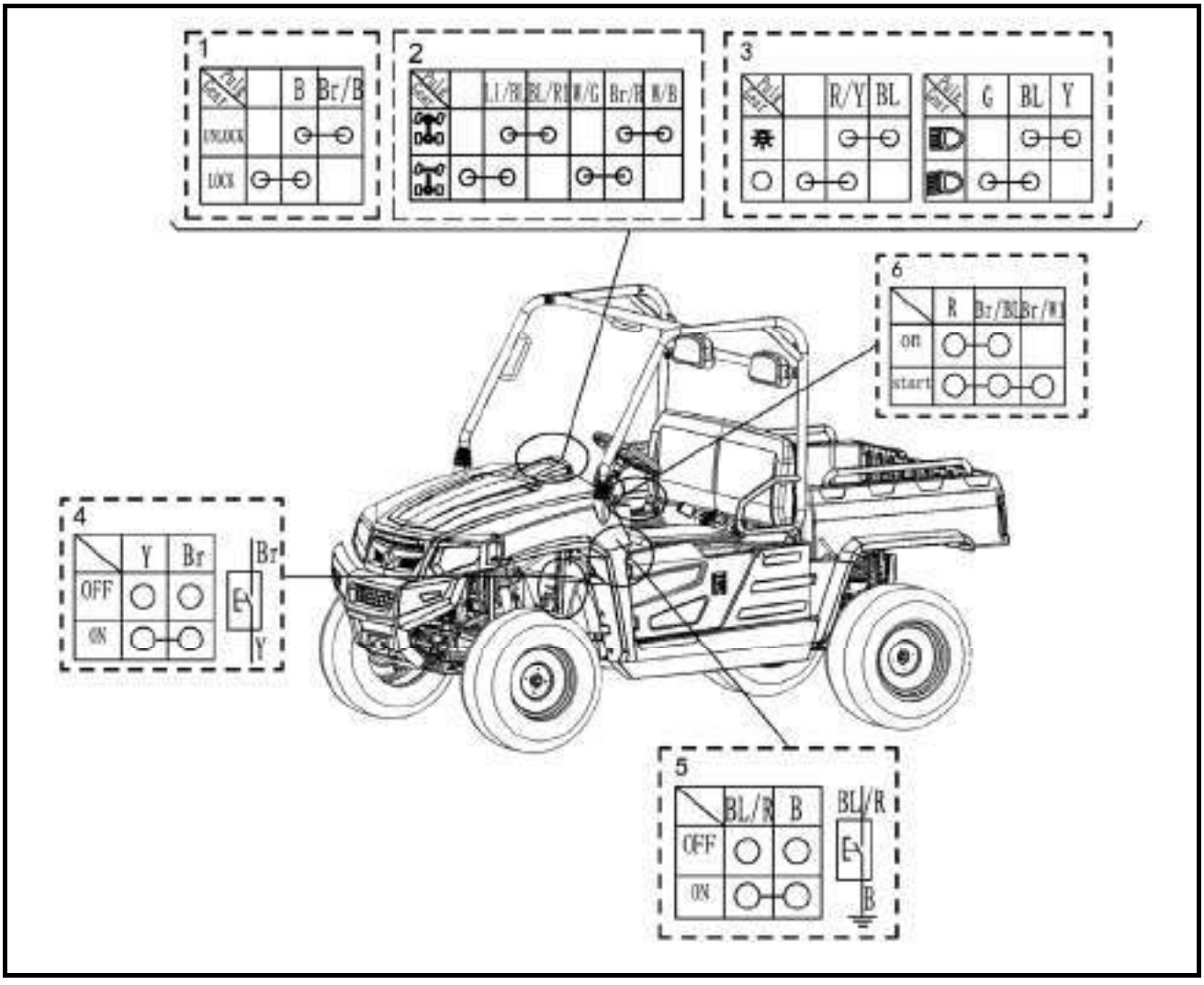


1. Rear bridge differential gear lock switch
2. Driven switch assy.
3. Light switch
4. Brake switch
5. Parking switch
6. Main switch

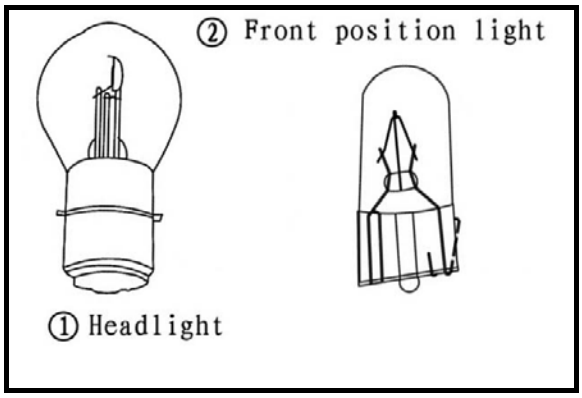
Checking the switch continuity(bench)

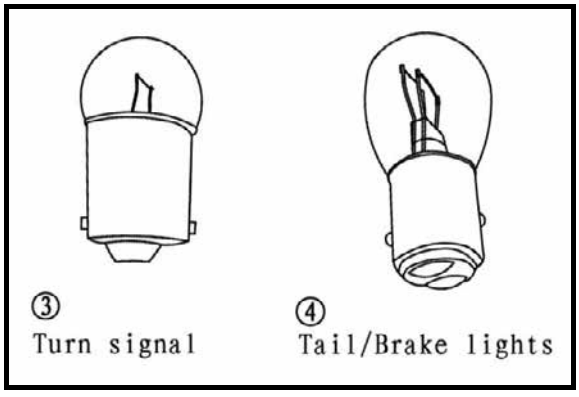
Refer to “CHECKING THE SWITCH” and check for continuity between lead terminals. Poor connection, no continuity → Correct or replace.

* The coupler locations are circled.



1. Rear bridge differential gear lock switch
2. Driven switch assy.
3. Light switch
4. Brake switch
5. Parking switch
6. Main switch





CHECKING THE BULBS AND BULB SOCKETS

Check each bulb and bulb socket for damage or wear, proper connections, and also for continuity between the terminals

Damage/wear → Repair or replace the bulb, bulb socket or both.

Improperly connected → Properly connect.

Incorrect continuity reading → Repair or replace the bulb, bulb socket or both.

WARNING:

Since the bulb gets extremely hot, keep flammable products and your hands away from the bulb until it has cooled down.

CAUTION:

- **Be sure to hold the socket firmly when removing the bulb. Never pull the lead, otherwise it may be pulled out of the terminal in the coupler.**
- **Avoid touching the glass part of the bulb to keep it free from oil, otherwise the transparency of the glass, the life of the bulb and the luminous flux will be adversely affected. If the bulb gets soiled, thoroughly clean it with a cloth moistened with alcohol or lacquer thinner.**

IGNITION SYSTEM

CIRCUIT DIAGRAM （see 373 page）

TROUBLESHOOTING

IF THE IGNITION SYSTEM FAILS TO OPERATE (NO SPARK OR INTERMITTENT SPARK):

Procedure

Check:

1. Fuses (main, ignition)
2. Battery
3. Spark plug
4. Ignition spark gap
5. Spark plug cap resistance
6. Ignition coil resistance
7. Main switch
8. Pickup coil resistance
9. Wiring connection (the entire ignition system)

NOTE:

1. **Cushion**
2. **Front frame**
3. **Front fender**

Check and repaire with following special tools.

1.Fuses (main, ignition)

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the fuse(s).

CONTINUITY ↓

2. Battery

- Check the battery condition. Refer to “CHECKING AND CHARGING THE BATTERY” in chapter 3.

Open-circuit voltage

12.8 V or more at 20 °C (68 °F)

INCORRECT →

- Clean the battery terminals.
- Recharge or replace the battery.

CORRECT ↓

3. Spark plug

- Check the spark plug condition.
- Check the spark plug type.
- Check the spark plug gap.

Refer to “CHECKING THE SPARK PLUG” in chapter 3.

4. Ignition spark gap

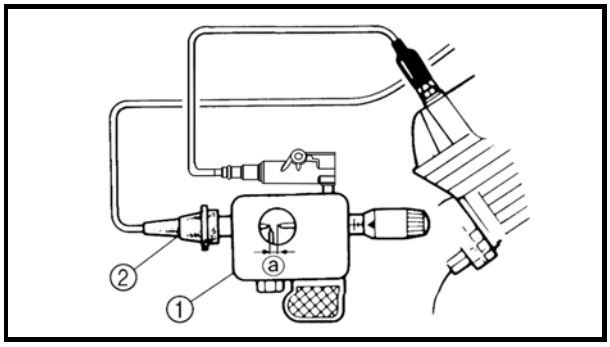
• Disconnect the spark plug cap from the spark plug.
• Connect the pulse ignition spark checker or ignition checker ① as shown.

② Spark plug cap
• Turn the main switch to "ON".
• Check the ignition spark gap ⓐ.

• Crank the engine by pushing the starter switch, and increase the spark gap until a misfiring occurs.

Minimum spark gap
6.0 mm (0.24 in)

INCORRECT → Repair or replace the spark plug.

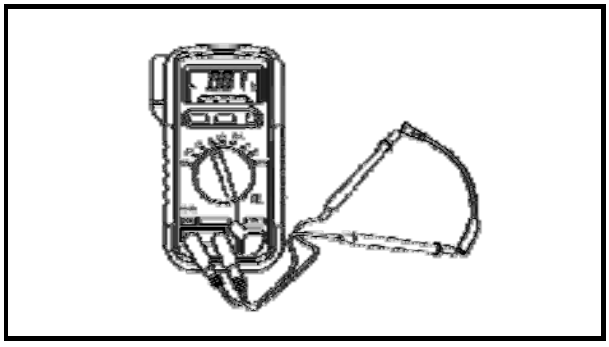


MEETS SPECIFICATION → The ignition system is not faulty.

OUT OF SPECIFICATION OR NO SPARK

5. Spark plug cap resistance

• Remove the spark plug cap.
• Connect the pocket tester (Ω × 1k) to the spark plug cap.
• Check that the spark plug cap has the specified resistance.
Spark plug cap resistance
10 kΩ at 20 °C (68 °F)

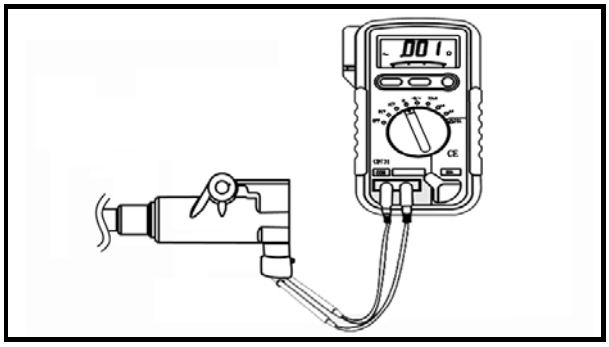


OUT OF SPECIFICATION → Replace the spark plug cap.

MEETS SPECIFICATION

6. Ignition coil resistance

• Disconnect the ignition coil connector from the wire harness
• Connect the pocket tester (Ω × 1) to the ignition coil.
Tester (+) lead → Orange lead terminal
Tester (–) lead → Ignition coil base
• Check that the primary coil has the specified



. resistance

Primary coil resistance

0.18 ~ 0.28 Ω at 20 °C (68 °F)

• Connect the pocket tester (Ω × 1k) to the ignition coil.

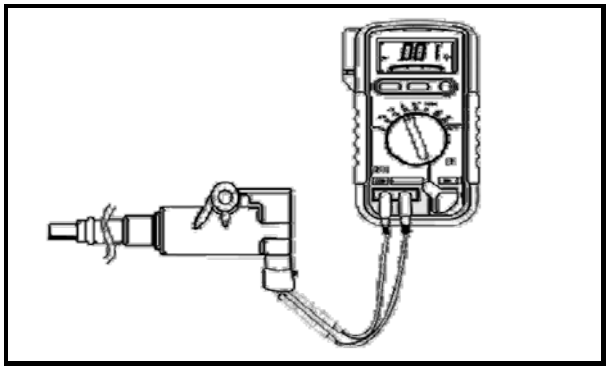
Tester (+) lead → Orange lead terminal

Tester (–) lead → Spark plug lead

• Check that the secondary coil has the specified resistance.

Secondary coil resistance

6.32 ~ 9.48 kΩ at 20 °C (68 °F)



OUT OF SPECIFICATION

Replace the ignition coil.

BOTH MEET SPECIFICATION

7. Main switch

Refer to “CHECKING THE SWITCH”

INCORRECT

Replace the main switch.

CORRECT

8. Pickup coil resistance

0• Disconnect the A.C. magneto coupler from the wire harness.

• Connect the pocket tester (Ω × 100) to the pickup coil terminal.

Tester (+) lead → White/ Blue terminal ①

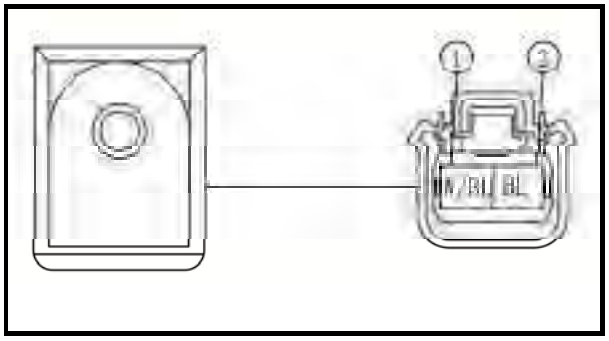
Tester (–) lead → Green terminal ②

• Check the pickup coil for the specified resistance.

Pickup coil resistance

459 ~ 561 Ω at 20 °C (68 °F)

(White/Red – White/Green)

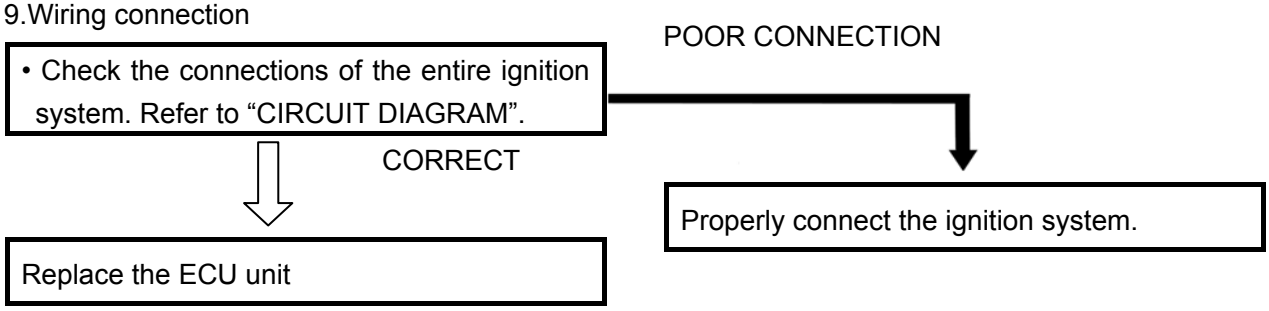


OUT OF SPECIFICATION

Replace the pickup coil/stator assembly.

MEETS SPECIFICATION

9.Wiring connection



ELECTRIC STARTING SYSTEM

CIRCUIT DIAGRAM（see 374 page）

TROUBLESHOOTING

IF THE STARTER MOTOR FAILS TO OPERATE:

Procedure

Check:

1. Fuses (main, ignition, signaling system)
2. Battery
3. Starter motor
4. Starter relay
5. Main switch
6. Gear position switch
7. Brake light switch
8. Diode 1
9. Wiring connection (the entire starting system)

NOTE:

- **Remove the following part(s) before troubleshooting:**

1. Console
2. Front frame
3. Front fender

- **Use the following special tool(s) for troubleshooting.**

1. Fuses (main, ignition, signaling system) Refer to "CHECKING THE SWITCH"

NO CONTINUITY → Replace the fuse(s).

CONTINUITY ↓

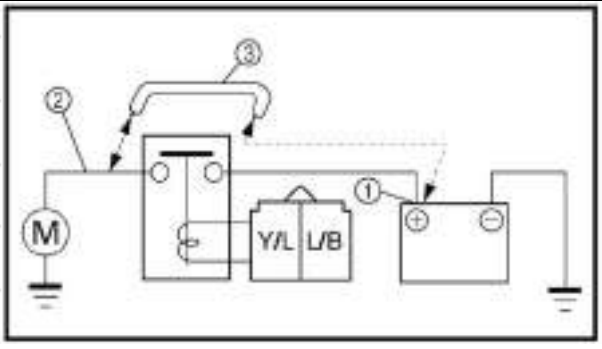
2. Battery
- Check the battery condition. Refer to "CHECKING AND CHARGING THE BATTERY" in chapter 3.

Open-circuit voltage
12.8 V or more at 20 °C (68 °F)

INCORRECT →
- Clean the battery terminals.
- Recharge or replace the battery.

CORRECT ↓

3. Starter motor
- Connect the battery (+) terminal ① and starter motor cable ② using a jumper lead③
- Check the operation of the starter motor.



WARNING:

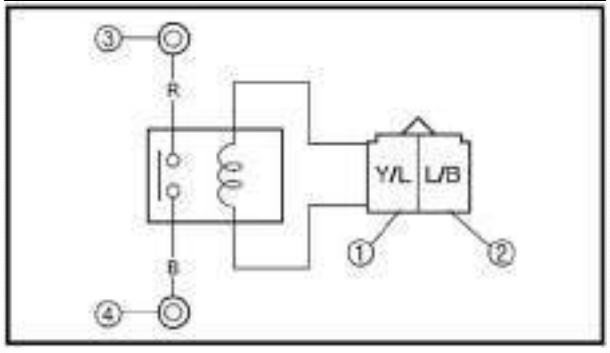
- **A wire that is used as a jumper lead must have the equivalent capacity or more as that of the battery lead, otherwise the jumper lead may burn.**
- **This check is likely to produce sparks, so be sure that no flammable gas or fluid is in the vicinity.**

DOSE NOT TURN ↓

TURNS

4. Starter relay
• Remove the starter relay from the wire harness.
• Connect the pocket tester (Ω × 1) and the battery (12 V) to the starter relay terminals.
Battery (+) terminal → Yellow/Blue terminal ①
Battery (–) terminal → Blue/Black terminal ②
Tester (+) lead → Red terminal ③
Tester (–) lead → Black terminal ④
• Check the starter relay for continuity.

Repair or replace the starter motor.
Small testers and battery and (12V) and start relay terminal connection
Check continuity of the start relay



CONTINUITY

NO CONTINUITY

5. Main switch Refer to “CHECKING THE SWITCH”.

Replace the starter relay.

CORRECT

6. Gear position switch Refer to “CHECKING THE SWITCH”.

INCORRECT

CORRECT

Replace the main switch.

7. Brake light switch Refer to “CHECKING THE SWITCH”.

INCORRECT

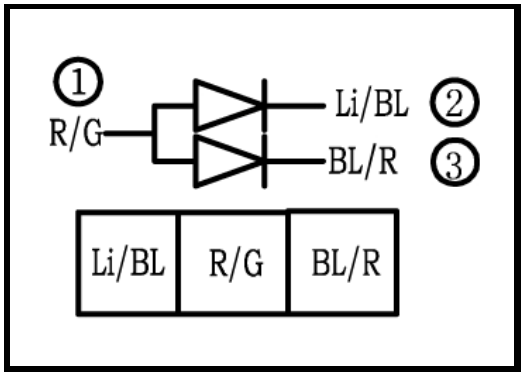
CORRECT

Replace the gear position switch.

8. Diode 1
㈠nnect multimeter positive to Yellow/Red green terminal (1)
Connect multimeter negative to Black/Light blue②or blue red ③terminal (2)

INCORRECT

Replace the brake light switch.
Removed from the coupling diodes
Small diode Tester connection terminals, As shown in the figure
Check the diode continuity

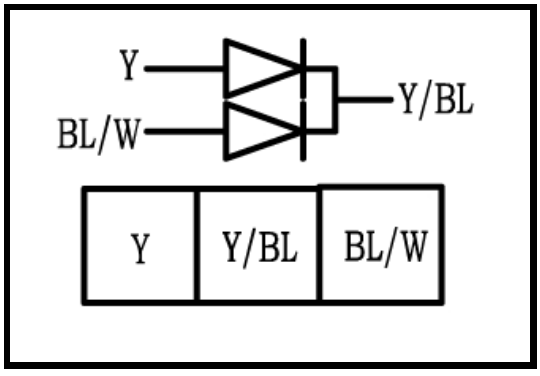


NOTE:

1.When you switch the tester's positive and negative probes, the readings in the left chart will be reversed.

㈢Connect multimeter positive to Red/Bule white terminal (1)

Connect multimeter negative to Yellow/Bule terminal (2)



NOTE:

2.When you switch the tester's positive and negative probes, the readings in the left chart will be reversed.

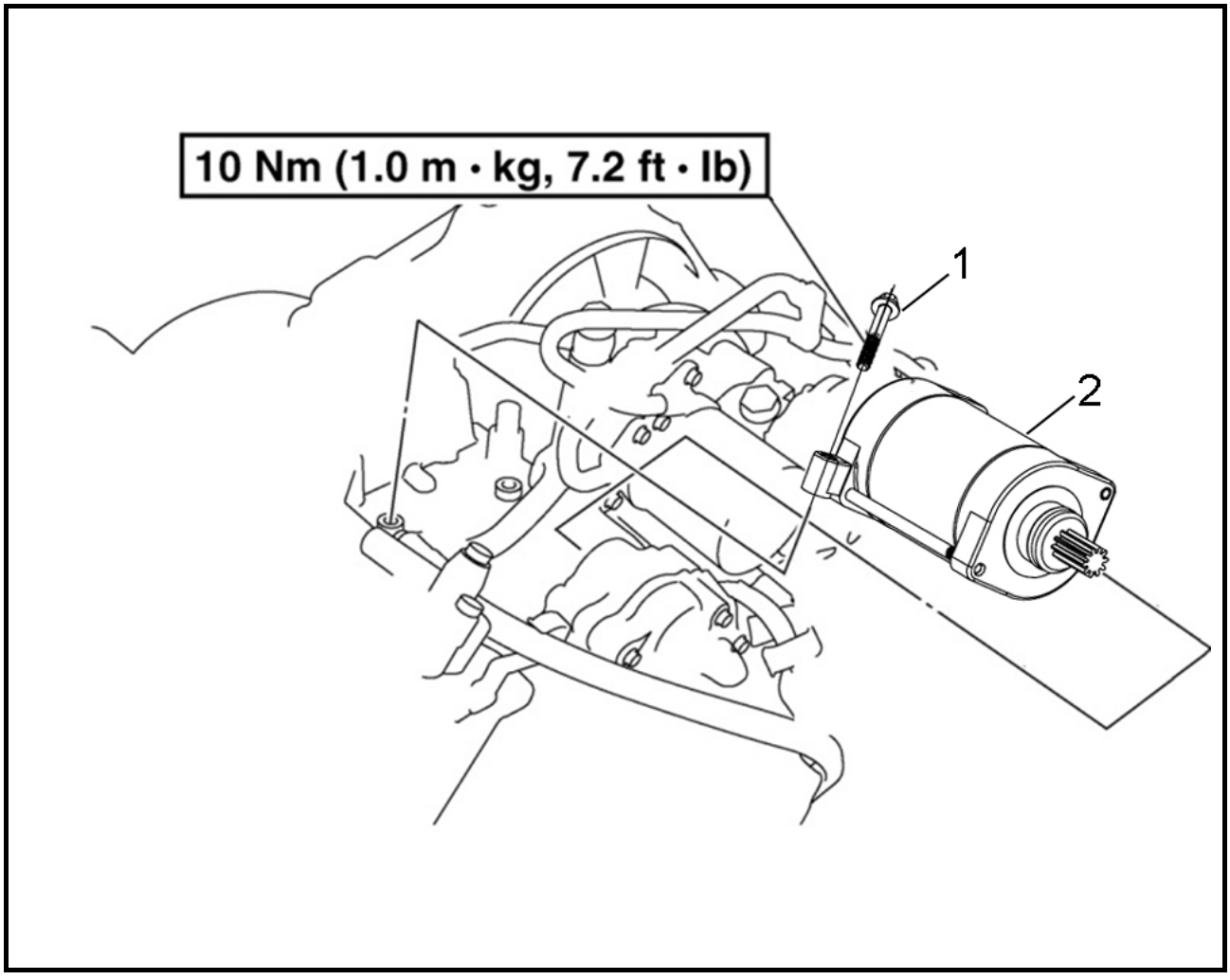
⇩ CORRECT

9. Wiring connection
• Check the connections of the entire starting system. Refer to "CIRCUIT DIAGRAM".

POOR CONNECTION ⇩

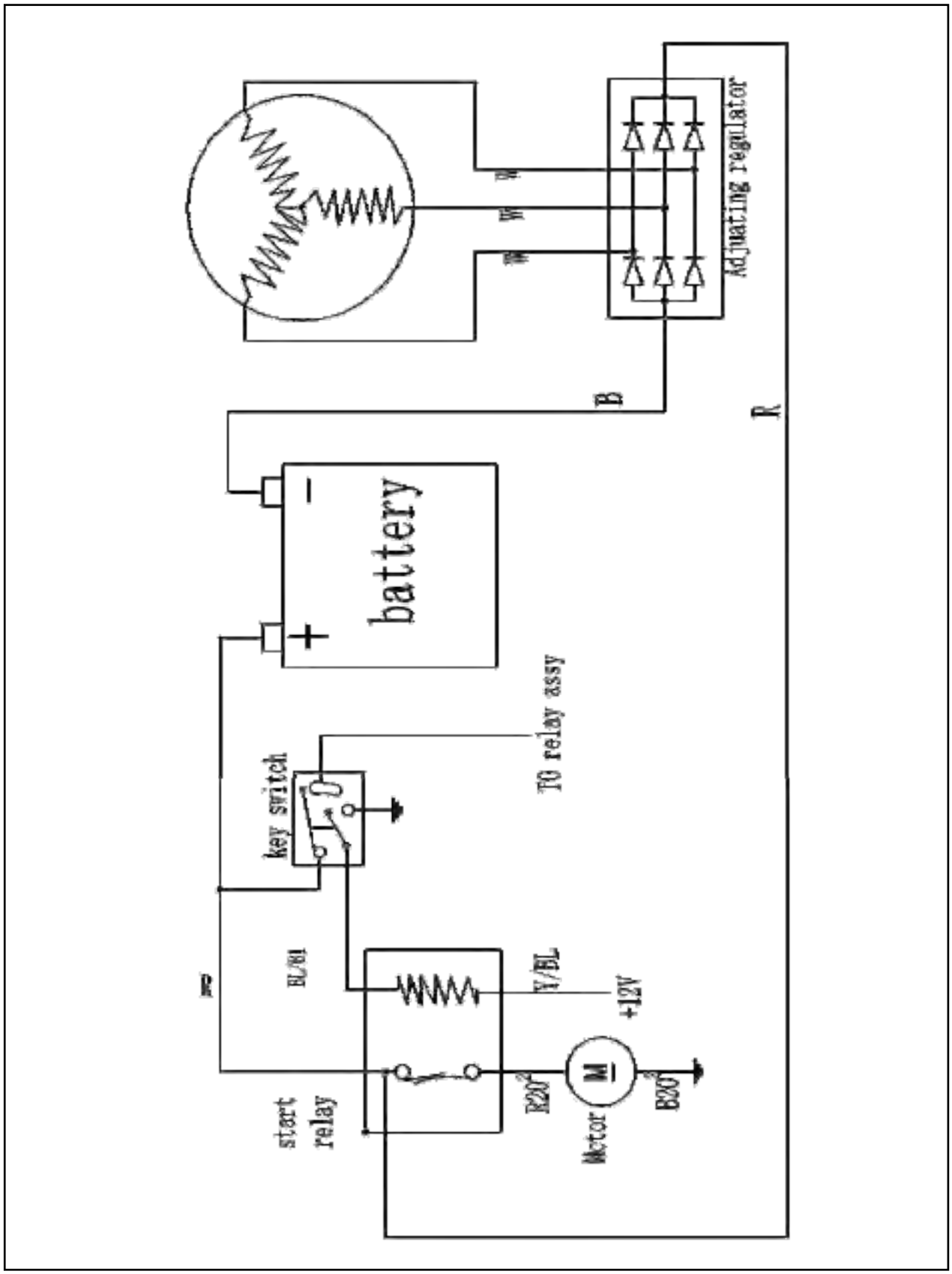
Properly connect the starting system.

STARTER MOTOR



No.	Part Name	Qty	Remarks	The performance parameters
	Removing the starter motor	1	Remove the parts in the order listed	1、no-load：12V/300W 2、Load：12V/1400W 3、The load torque:1.2N.m
1	Flange bolt			
2	Starter motor assy.			

CHARGING SYSTEM
CIRCUIT DIAGRAM



TROUBLESHOOTING

IF THE BATTERY IS NOT CHARGED:

1. Fuse (main)
2. Battery
3. Charging voltage
4. Charging coil resistance
5. Wiring connections(the entire charging system)

NOTE:

Remove some parts before maintenance

1. Cushion

Repair with following special toolings

1. Fuse (main)

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the fuse.

CONTINUITY ↓

2.Battery

- Check the battery condition. Refer to “CHECKING AND CHARGING THE BATTERY in chapter 3.

Open-circuit voltage

12.8 V or more at 20 °C (68 °F)

INCORRECT →

- Clean the battery terminals.
- Recharge or replace the battery.

CORRECT ↓

3. Charging voltage

- Connect the engine tachometer to the spark plug lead.
- Connect the pocket tester (DC 20 V) to the battery.

Tester (+) lead → Battery (+) terminal

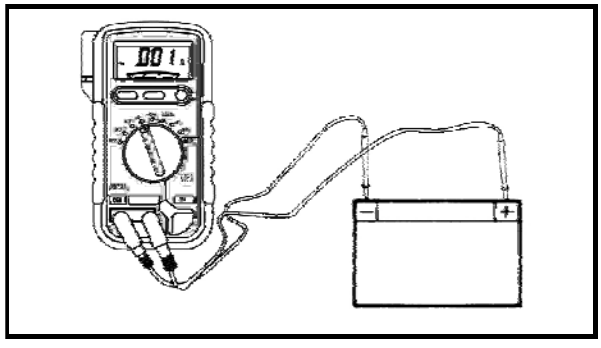
Tester (–) lead → Battery (–) terminal

- Start the engine and accelerate to about 1,000 r/min.

Charging voltage 14 V at 1,450 r/min

NOTE:

Use a fully charged battery.



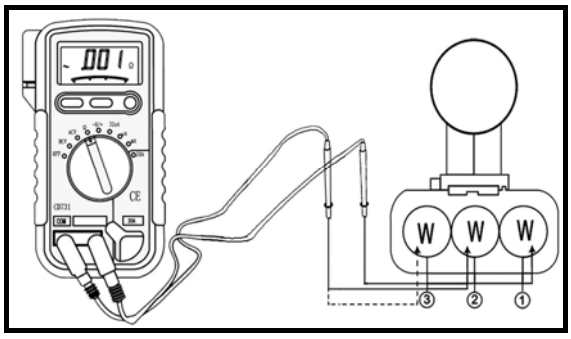
MEETS SPECIFICATION →

The charging circuit is not faulty.

OUT OF SPECIFICATION ↓

4. Charging coil resistance

• Disconnect the A.C. magneto coupler from the wire harness.
• Connect the pocket tester (Ω × 1) to the charging coils.
Tester (+) lead → White terminal ①
Tester (–) lead → White terminal ②
Tester (+) lead → White terminal ①
Tester (–) lead → White terminal ③
• Measure the charging coil resistance.
Charging coil resistance
0.32 ~ 0.43 Ω at 20 °C (68 °F)



OUT OF SPECIFICATION → Replace the pickup coil/stator assembly.

MEETS SPECIFICATION

5. Wiring connections

• Check the connections of the entire charging system. Refer to “CIRCUIT DIAGRAM”.

POOR CONNECTION → Properly connect the charging system.

CORRECT → Replace the rectifier/regulator.

LIGHTING SYSTEM

CIRCUIT DIAGRAM（see 375 page）

TROUBLESHOOTING

IF THE HEADLIGHT AND/OR TAILLIGHT FAIL TO COME ON:

Procedure

Check

1. Fuses (main, lighting system)
2. Battery
3. Main switch
4. Light switch
5. Wiring connections(the entire lighting system)

NOTE:

- **Remove the following part(s) before troubleshooting:**
  1. **Console**
  2. **Front luggage carrir**
  3. **Front covering parts**
- **Use special tool(s) for troubleshooting**.

1. Fuses (main, lighting system)

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the fuse(s).

CONTINUITY ⇩

2. Battery

- Check the battery condition. Refer to “CHECKING AND CHARGING THE BATTERY” in chapter 3.

Open-circuit voltage

12.8 V or more at 20 °C (68 °F)

INCORRECT →
- Clean the battery terminals.
- Recharge or replace the battery

CORRECT ⇩

3. Main switch

Refer to “CHECKING THE SWITCH”.

INCORRECT → Replace the main switch.

CORRECT ⇩

4.Light switch

Refer to “CHECKING THE SWITCH”.

INCORRECT → Replace the light switch.

CORRECT ⇩

5. Wiring connection

- Check the connections of the entire lighting system. Refer to “CIRCUIT DIAGRAM”.

POOR CONNECTION → Properly connect the lighting system.

CORRECT ⇩

Check the condition of each of the lighting system’s circuits. Refer to “CHECKING THE LIGHTING SYSTEM”.

CHECKING THE LIGHTING SYSTEM

1. If the headlights fail to come on:

(1). Bulb and bulb socket

- Check the bulb and bulb socket for continuity.

NO CONTINUITY → Replace the bulb and/or bulb socket.

CONTINUITY ⇩

(2). Voltage

- Connect the pocket tester (DC 20 V) to the headlight couplers.

Tester (+) lead → Black terminal ① or Yellow terminal ②

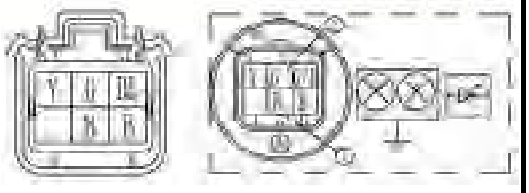
Tester (–) lead → Green terminal ③

Ⓐ When the light switch is on "".

Ⓑ When the light switch is on ""

- Turn the main switch to "ON".
- Turn the light switch to "" or "".
- Check the voltage (12 V) of the "Green" and "Yellow" leads on the bulb socket connector.

A



B

OUT OF SPECIFICATION → The wiring circuit from the main switch to the bulb socket connector is faulty, repair it.

MEETS SPECIFICATION ⇩

This circuit is not faulty.

2. If the taillights fail to come on:

(1). Bulb and bulb socket

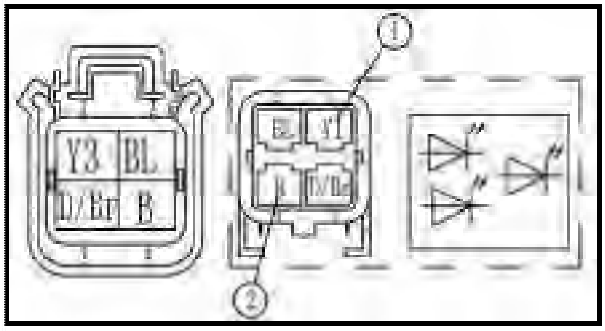
• Check the bulb and bulb socket for continuity.

NO CONTINUITY → Replace the bulb and/or bulb socket.

CONTINUITY ⇩

(2) . Voltage

• Connect the pocket tester (DC 20 V) to the tail/brake light couplers.
Tester (+) lead → Yellow1 lead terminal ①
Tester (–) lead → Black lead terminal ②



• Turn the main switch to “ON”.
• Turn the light switch to“ ” or “ ”.

• Check the voltage (12 V) of the “Blue” lead on the bulb socket connector.

OUT OF SPECIFICATION → The wiring circuit from the main switch to the bulb socket connector is faulty, repair it.

MEETS SPECIFICATION ⇩

This circuit is not faulty.

SIGNALING SYSTEM
CIRCUIT DIAGRAM（see 376 page）

TROUBLESHOOTING

IF A BRAKE LIGHT, AN INDICATOR LIGHT, OR THE WARNING LIGHT FAILS TO COME ON:

Procedure

Check:

1. Fuses (main, signaling system)
2. Battery
3. Main switch
4. Wiring connections (the entire signal system)

NOTE:

- **Remove the following part(s) before troubleshooting:**
  1. **Console**
  2. **Front frame**
  3. **Front pedal**
- **Use special tool(s) for troubleshooting.**

1. Fuses (main, signaling system)

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the fuse(s).

CONTINUITY ⇩

2. Battery

- Check the battery condition. Refer to “CHECKING AND CHARGING THE BATTERY” in chapter 3.

Open-circuit voltage

12.8 V or more at 20 °C (68 °F)

INCORRECT →
- Clean the battery terminals.
- Recharge or replace the battery.

CORRECT ⇩

3.Main switch

Refer to “CHECKING THE SWITCH”.

INCORRECT → Replace the main switch

CORRECT ⇩

4. Wiring connections

- Check the connections of the entire signal system. Refer to “CIRCUIT DIAGRAM”.

POOR CONNECTION → Properly connect the signal system.

CORRECT ⇩

Check the condition of each of the signal system’s circuits. Refer to “CHECKING THE SIGNAL SYSTEM”.

CHECKING THE SIGNAL SYSTEM

1. If the brake lights fail to come on:

(1). Bulb and bulb socket

- Check the bulb and bulb socket for continuity.

NO CONTINUITY → Replace the bulb and/or bulb socket.

CONTINUITY ↓

(2). Bake light switch

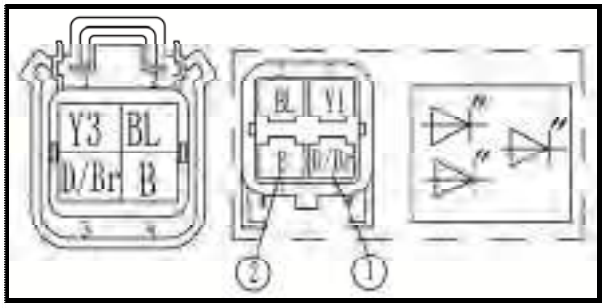
Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the brake light switch.

CONTINUITY ↓

(3). Voltage

- Connect the pocket tester (DC 20 V) to the bulb socket connector.
  Tester (+) lead → Dark/Brown terminal ①
  Tester (–) lead → Black terminal ②
- Turn the main switch to “ON”.
- Turn the light switch to “⇦” or “⇨”.
- Check the voltage (12 V) of the “Yellow” lead on the bulb socket connector.



OUT OF SPECIFICATION → The wiring circuit from the main switch to the bulb socket connector is faulty, repair it.

MEETS SPECIFICATION ↓

This circuit is not faulty.

2. If L, H, N, R, light is not bright

(1). Gear position switch

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the gear position switch

CONTINUITY ↓

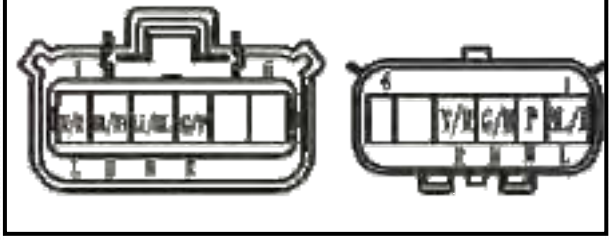
(2). Wire connection

Check the main beam connected to the gear switch connector is strong

NO CONTINUITY → Repair the main beam connection with gear switch connector

CONNECTION IS FIRM ↓

This circuit is not faulty.



3. If the parking brake indicator light fails to come on:

(1). Brake switch

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the parking brake switch

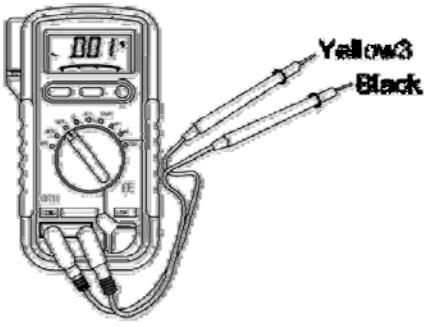
CONTINUITY ↓

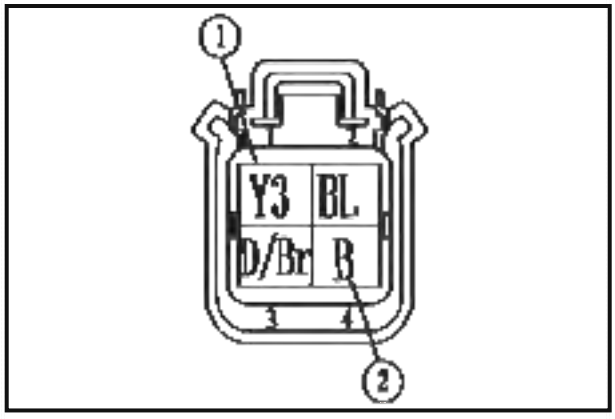
(2). Voltage

Set the multimeter to DC12V, test the brake lamp voltage at both ends

Yellow3 power meter pens → ①

Black power meter pens → ②





NO VOLATGE DISPLAY → Replace the fuse F2

DISPLAY +12V ↓

This circuit is not faulty.

4. If the reverse indicator light fails to come on:

(1). Directional signal switch

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the Reverse switch

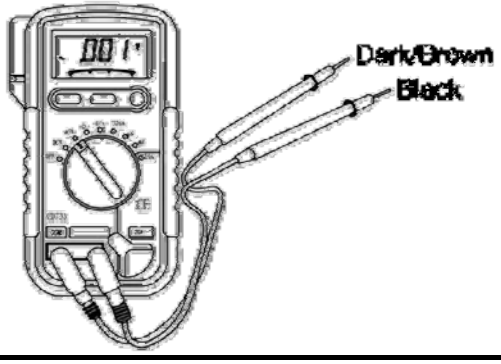
CONTINUITY ⇩

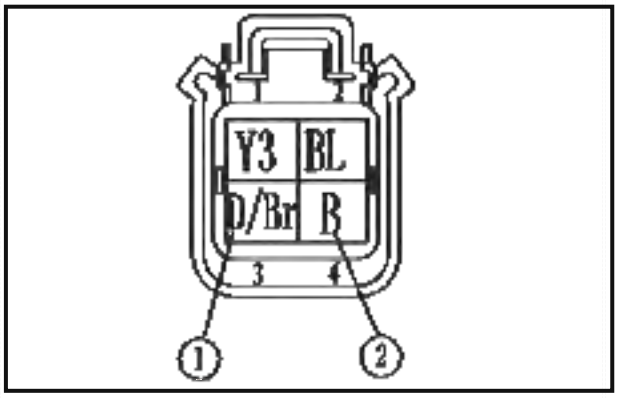
(2). Voltage

Set the multimeter to DC12V, test the direction lamp voltage at both ends

Dark/Brown power meter pens ⟶ ①

Black power meter pens ⟶ ②





NO VOLATGE DISPLAY → Replace the fuse F2

DISPLAY +12V ⇩

This circuit is not faulty.

5. If the coolant temperature warning light does not come on when the main switch to "ON", or if the coolant temperature warning light does not come on when the temperature is high (more than 117 ~ 123 °C (242.6 ~ 253.4 °F):

(1). Bulb and bulb socket

- Check the bulb and bulb socket for continuity.

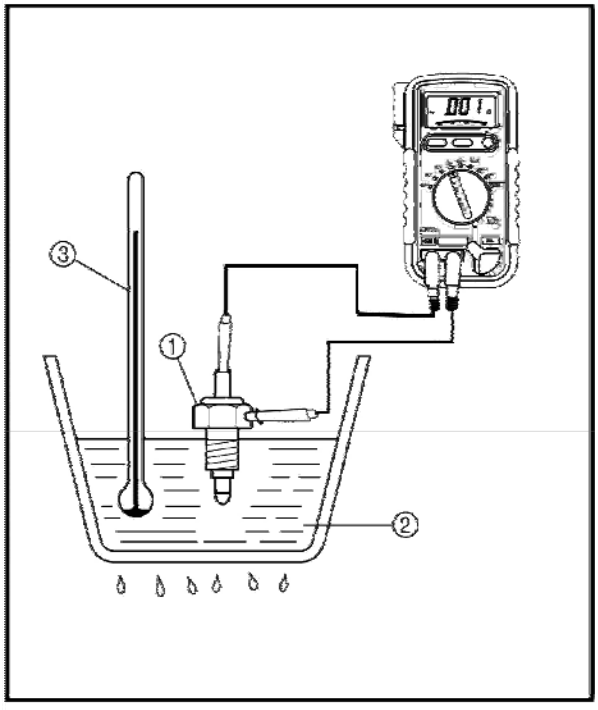
NO CONTINUITY → Replace the bulb and/or bulb socket.

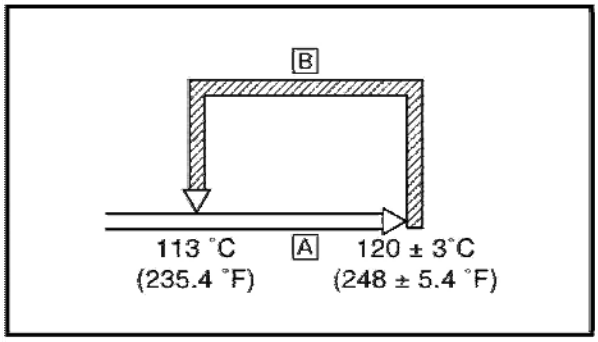
CONTINUITY ↓

(2). Thermo switch 1

- Remove the thermo switch 1 from the cylinder head.
- Connect the pocket tester (Ω × 1) to the thermo switch 1 ①.
- Immerse the thermo switch 1 in coolant ②.
- Check the thermo switch 1 for continuity.
  While heating the coolant use a thermometer ③ to record the temperatures.
  Ⓐ The thermo switch 1 circuit is open and the coolant temperature warning light is off.
  Ⓑ The thermo switch 1 circuit is closed and the coolant temperature warning light is on.

Test step	Coolant temperature	Continuity
1	Less than 120 ± 3 °C (248 ± 5.4 °F)	No
2	More than 120 ± 3 °C (248 ± 5.4 °F)	Yes
3	More than 113 °C (235.4 °F)	Yes
4	Less than 113 °C (235.4 °F)	No





Test steps 1 & 2: Heating phase
Test steps 3 & 4: Cooling phase

WARNING:

Handle the thermo switch 1 with special care.
Never subject it to a strong shock or allow it to be dropped. Should it be dropped, it must be replaced.

BAD CONDITION → Replace the thermo switch 1

6. If the four-wheel drive and front bridge differential lock indicator light fails to come on：

(1). **Check the driver combination switch and front axle differential switch**

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the to drive the combination switch.

CONTINUITY ⇩

(2). Wire connection detection

Detection front axle and transfer line 2 raider controller cable to connect is complete.

NOT CONNECTED WELL → Will check two connector connect with device.

CONNECTED WELL ⇩

(3). Voltage

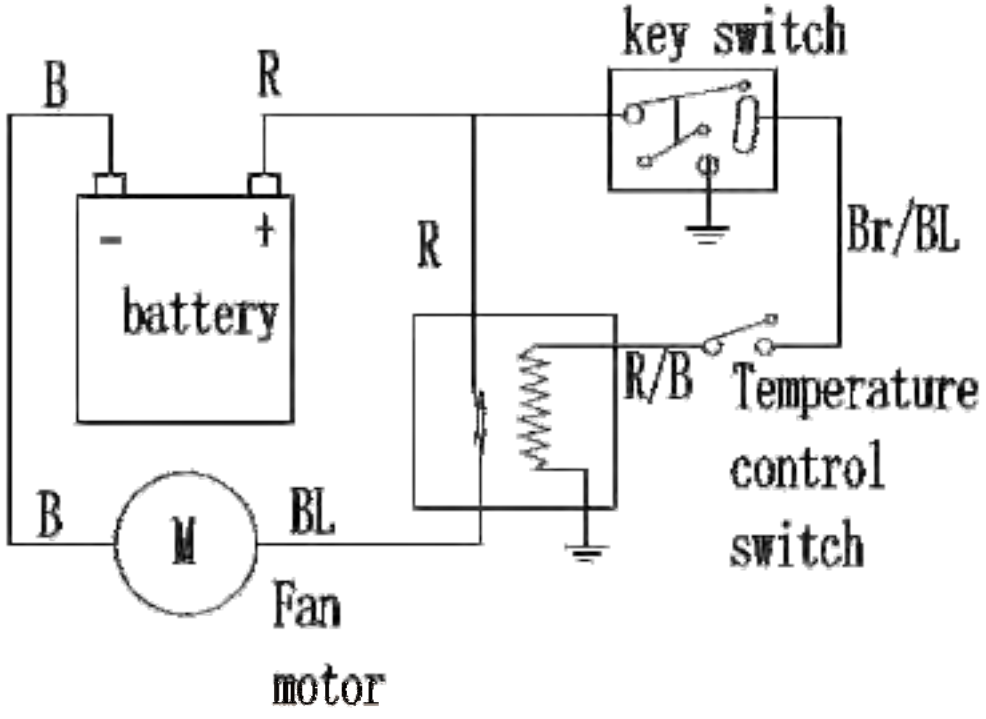
Will the multimeter to DC 12 V, test drive switch and 2WD/4WD controller “Br/R” if there are +12V voltage.

NO +12V VOLATGE DISPLAY → Replace the fuse F3.

+12V VOLATGE DISPLAY ⇩

Replace two all-wheel-drive controller or front axle thansfer.

COOLING SYSTEM
CIRCUIT DIAGRAM



TROUBLESHOOTING

IF THE FAN MOTOR DOES NOT MOVE:

Procedure

Check:

1. Fuse (main)
2. Battery
3. Main switch
4. Radiator fan motor
5. Thermo switch 3
6. Wiring connection(the entire cooling system)

NOTE:

- **Remove the following part(s) before troubleshooting.**

1. Console
2. Front frame
3. Front pedal

- **Use special tool(s) for troubleshooting**.

1. Fuse (main)

Refer to “CHECKING THE SWITCH”.

NO CONTINUITY → Replace the fuse.

CONTINUITY ↓

2. Battery

- Check the battery condition. Refer to “CHECKING AND CHARGING THE BATTERY” in chapter 3。

Open-circuit voltage:
12.8 V or more at 20 °C (68 °F)

INCORRECT →
- Clean the battery terminals.
- Recharge or replace the battery

CORRECT ↓

3. Main switch

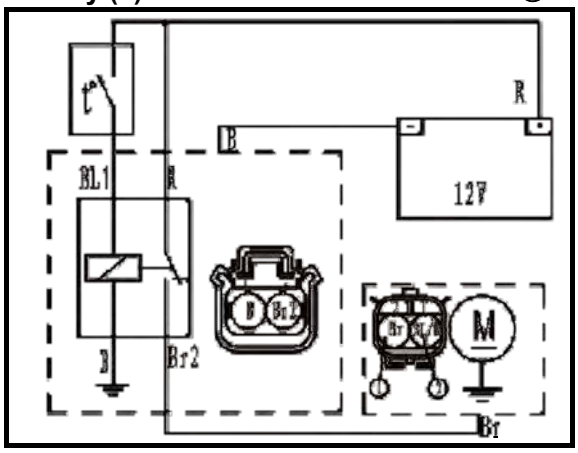
Refer to “CHECKING THE SWITCH”.

INCORRECT → Replace the main switch.

CORRECT ↓

4.Radiator fan motor

• Disconnect the radiator fan motor coupler.
• Connect the battery (12 V) as shown.
Battery (+) lead → Brown terminal ①
Battery (–) lead → Blue/Red terminal ②



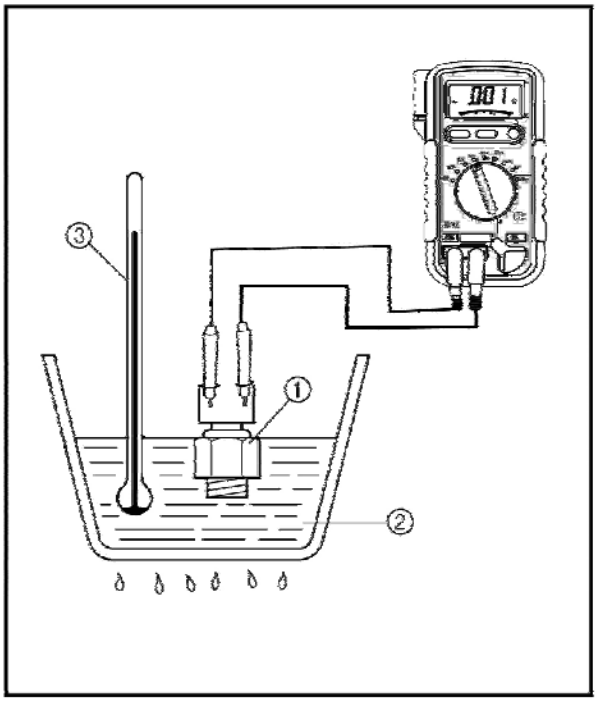
• Check the operation of the radiator fan motor.

DOES NOT TURN

Replace the radiator fan motor.

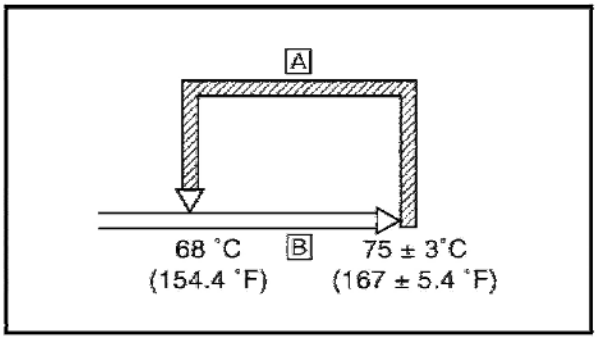
5.Thermo switch 3

• Remove the thermo switch 3 from the radiator.
• Connect the pocket tester (Ω × 1) to the thermo switch 3 ①.
• Immerse the thermo switch 3 in coolant ②.
• Check the thermo switch 3 for continuity.
While heating the coolant use a thermometer ③ to record the temperatures.
Ⓐ The thermo switch 3 circuit is closed.
Ⓑ The thermo switch 3 circuit is open.



Test step	Coolant temperature	Continuity
1	Less than 75±3 °C (167 ± 5.4 °F)	No
2	More than 75 ± 3 °C (167 ± 5.4 °F)	Yes
3	More than 68 °C (154.4 °F)	Yes
4	Less than 68 °C (154.4 °F)	No

Test steps 1 & 2: Heating phase
Test steps 3 & 4: Cooling phase



WARNING:

Handle the thermo switch 3 with special care.

Never subject it to a strong shock or allow it to be dropped. Should it be dropped, it must be replaced.

Thermo switch 3

28 Nm (2.8 m · kg, 20 ft · lb)

BAD CONDITION → Replace the thermo switch 3

GOOD CONDITION

6. Wiring connection

• Check the connections of the entire starting system. Refer to “CIRCUIT DIAGRAM”

POOR CONNECTION → Properly connect the cooling system.

CORRECT

This circuit is not faulty.

2WD/4WD SELECTING SYSTEM

CIRCUIT DIAGRAM（see 377 page）

TROUBLESHOOTING

1. Check if the 2/4WD switch is working.

a. Turn on the switch, put the gear to position N; keep front and rear wheel off the ground , and then roll the front wheel to see if the rear wheel is moving together with it or if it is rotatable.

b. After the actions above being done, and the wheels are rotatable, please check the electricity with multimeter, if has no electricity, please check the fuse.

2. Check if the rear differential is working.

a. Check the sound. When the switch is turned on, the magneto valve will make s sound ‘TA’ to show that it is working and the rear wheel won’t be able to rotatable at the same direction.

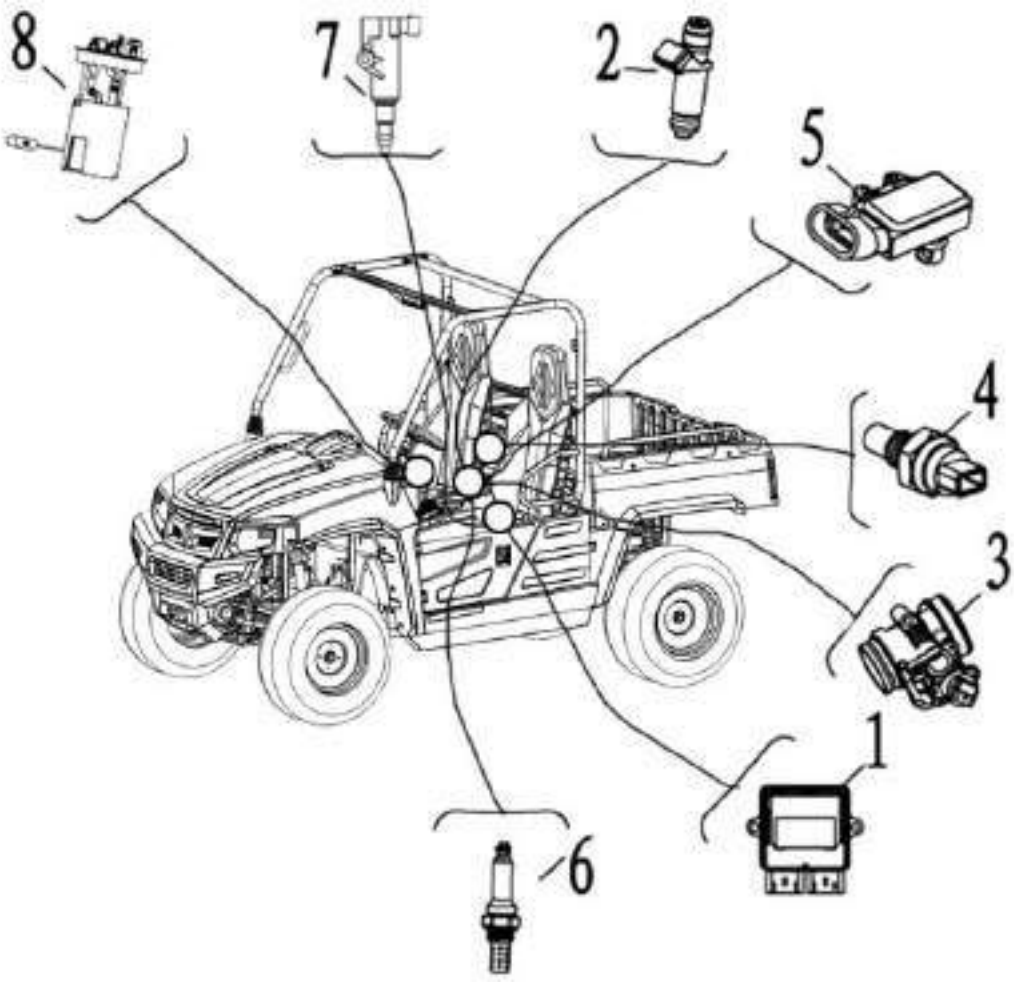
b. If no sound is made, check if the controller of magnetic valve has a output of 12V electricity, and check if the magnetic valve has a input of 12V electricity,if it has the input, it means the valve doesn't work, please change for a new one ; if not , please check if the input end of controller has a input, if it has, change for a new controller, if not , check the fuse.

INTRODUCTION

EMS (Engine Management System)

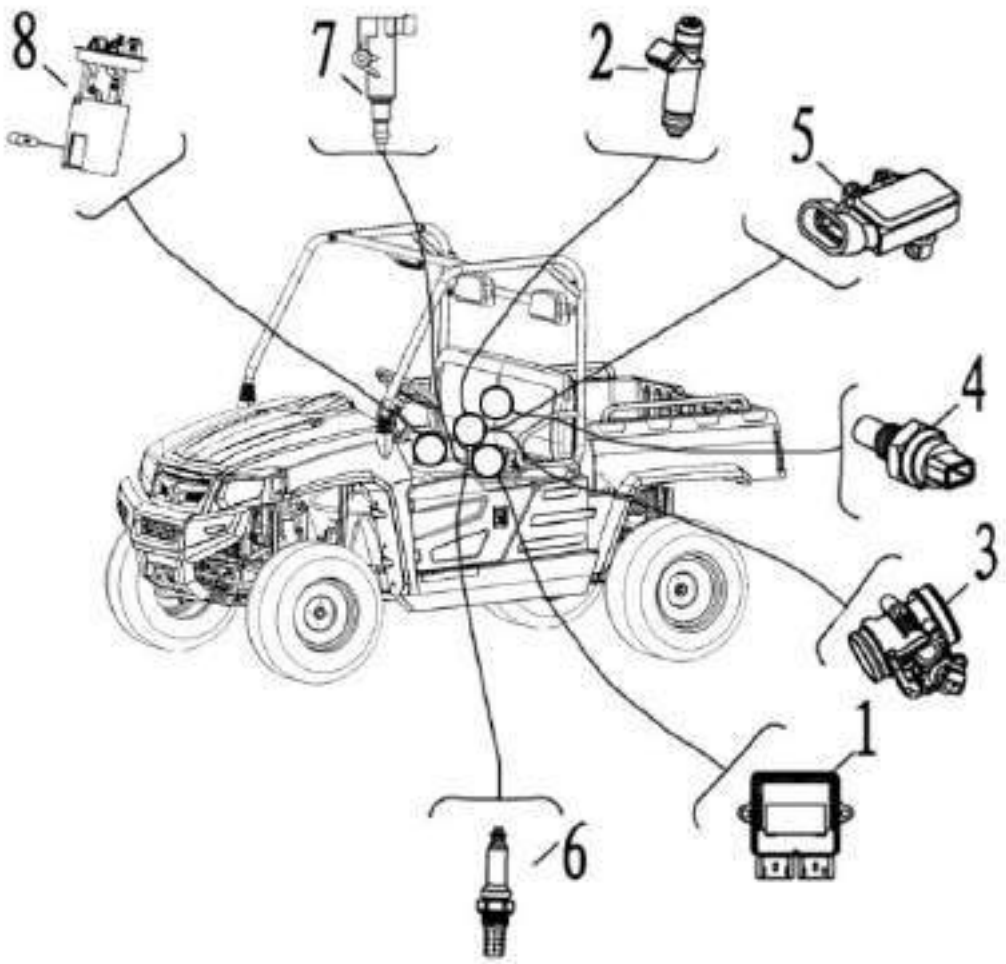
EMS is a self contained set of components including a custom built computer and sensors and actuators which control the operation of an engine by monitoring the engine speed, load and temperature and providing the ignition spark at the right time for the prevailing conditions and metering the fuel to the engine in the exact quantity required.

Typical Components Of EMS(Bucket seat)



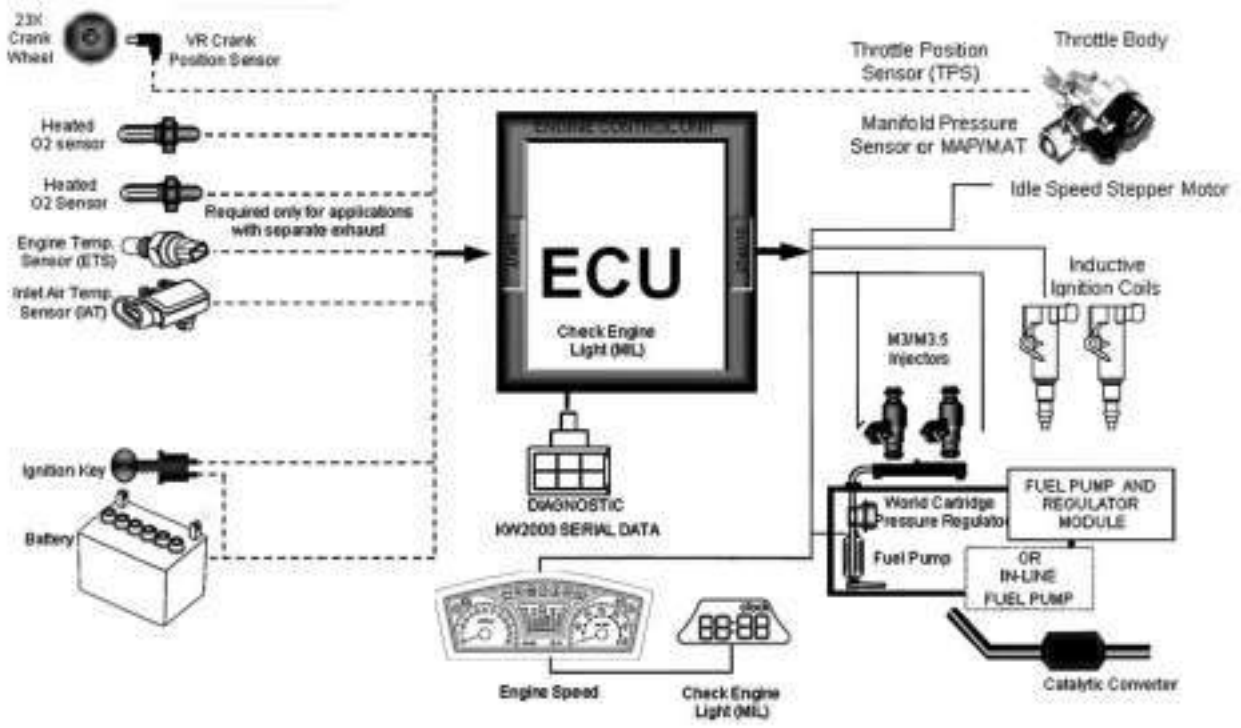
1. Electronic Control Unit
2. Multec 3.5 Injectors
3.Throttle Body Assembly(with stepper motor)
4. Engine Coolant Temperature Sensor
5. Intake Air Pressure and Temperature Sensor
6. Oxygen Sensor
7. Ignition Coil
8. Fuel Pump Module

Typical Components Of EMS(Bench seat)



1. Electronic Control Unit
2. Multec 3.5 Injectors
3.Throttle Body Assembly(with stepper motor)
4. Engine Coolant Temperature Sensor
5. Intake Air Pressure and Temperature Sensor
6. Oxygen Sensor
7. Ignition Coil
8. Fuel Pump Module

Layout of EMS Components



Legend:	
– – – – – – –	Dotted line indicates inputs
———————	Solid line indicates outputs

COMPONENTS OF EMS

Electronic Control Unit

1. Description & Working Principle

The ECU continuously monitors the operating conditions of the engine through the system sensors. It also provides the necessary computation, adaptability, and output control in order to minimize the tailpipe emissions and fuel consumption, while optimizing vehicle drivability for all operating conditions. The ECU also provides diagnosis when system malfunctions occur.

2. Handling – DOs & DONTs

ECU Handing	
ACTION	**REASON**
DO NOT: Place the ECU close to the exhaust pipe or Engine when removed	High temperature might reduce the life of the ECU and also can damage the ECU
DO NOT: Place the ECU close to or pour water, oil or any other liquids.	ECU is susceptible to water and liquids
DO NOT: Allow mud or other debris to accumulate on the surface of the ECU	Having mud or debris accumulated on the ECU casing reduces its heat dissipation efficiency.
DO NOT: Apply any voltage relative to any point to the ECU	Drastically affects the performance of the ECU and may lead to ECU damage
DO NOT: Clean ECU with any solvent or any corrosive liquid	Can damage the housing of the ECU
DO: Take extreme care that water droplets or excess moisture should not fall on ECU connectors	ECU connectors can get short and may lead to ECU damage
DO: Clean the ECU with a moist cloth and keep it dry	Prevents ECU damage

3. Installation requirements

The ECU shall be mounted using M5 machined screws with a torque of 3.9Nm ± 10%. The mounting surface should also be flat to avoid subjecting the base plate to unnecessary force and warping the PCB.

4. Maintenance service and Repair

ECU is a non-serviceable part. Once there are problems, it's important to first determine if the problem is caused by software/calibration. If it is caused by software/calibration, please refer to software/calibration reflashing procedure. In the event of ECU hardware failure or malfunction (during warranty period only) the ECU should be sent back to the vehicle manufacturer giving complete details of the ECU Part No, Serial number, Vehicle Model & Make, manufacturing Date, Total kms run on the vehicle, Location of use, Vehicle No, Date of return.

Multec 3.5 Injectors

1. Description and Working Principle

The Multec 3.5 Fuel Injector is an electromechanical device. A magnetic field is generated as voltage is applied to the solenoid coil. The resulting magnetic force lifts the core assembly, overcoming manifold vacuum, spring force, and fuel pressure, allowing fuel to pass through the ball and seat interface to the director. As the fuel passes through the director, an atomized spray is developed. The injector closes when the voltage is removed, cutting off the fuel flow.

2. Handling - DOs & DONTs

3.5 FUEL INJECTOR HANDLING	
ACTION	**REASON**
DO NOT: Re-use injector seal rings if at all possible. If no other choice exists, take extra care in inspecting the seal rings for damage.	Leakage.
DO NOT: Dip injector tips into lubricants.	Can plug injector spray orifices.
DO NOT: Cycle injector repeatedly without fuel pressure.	Damage to internal mechanical components.
DO NOT: Pulse (actuate) a suspected high leak rate injector (leak >50 sccm air).	Can dislodge internal contamination if present and preclude root cause analysis.
DO NOT: Allow water to enter fuel system from air lines, etc. during leak checks.	Can damage injectors.
DO NOT: Contact or apply load to the injector tip for installation.	Apply load to 45 deg angle on nylon over mold see
DO NOT: Pound injectors into manifold during assembly to engine.	Can damage injectors or seal rings.
DO NOT: Apply excessive side loads to electrical connectors.	May cause loss of electrical continuity.
DO NOT: Use any dropped unit.	Internal damage may have occurred.
DONOT:Store injectors, rails, or subassemblies including engines on which the injectors have been installed in an unprotected environment.	External contamination can damage the injector electrically and/or mechanically.
DO NOT: Use the injector as a handle.	Do not use the injector to lift assemblies
DO NOT: Rack, stage, or handle parts in a manner that allows contact between parts.	Damage will occur.
DO NOT: Remove packing in a way that allows contact between parts.	Damage could occur due ton contact between parts.
DO NOT: Tap on fuel injectors to correct any malfunction.	Can damage injector.
DO NOT: Replace the injector with other part number not recommended for this application	Will severely affect the performance of the injector
DO: Take extra care when installing new fuel seal ring over injector inlet flange.	Prevent tearing seal ring during installation.

DO: Use proper lubricants on seal ring surfaces to install injector in engine. Minimize time between applying lubricant and inserting injector / rail.	Avoid damage to seal ring during installation. Avoid contamination at seal.
DO: Pulse (actuate) stuck closed or tip-leak suspected injector (Actuate consists of one pulse <5 sec duration at 9 to 15V).	To verify the injector failure
DO: Pulse (actuate) injectors prior to a dry fuel system leak test at engine/vehicle assembly to reseat injector valves.	Injector valves may not reseat without fuel after shipping and handling resulting in false leakage.
DO: Avoid any liquid contamination in the injector area.	Coil could short circuit.
DO: Use care during connection of harness to injector.	Avoid terminal damage.
DO: Use recommended terminal lubricant on mating connector.	Minimize potential for terminal fretting corrosion.
DO: Return any dropped, damaged, or suspect material with a tag that describes the problem.	Ensure fast and correct diagnosis of root cause.

3. Installation guidelines

Follow these guidelines to prevent damage to the injector and its electrical interface during the replacement or re-installation process.

- Lubrication: Apply a light coating of lubricant to the lower injector seal ring. ISO 10 light mineral oil or equivalent is recommended.
- The preferred technique is to apply the lubricant to the sockets the injectors are being installed into, rather than directly to the seal ring itself. This will help minimize the possibility of injector contamination.
- Avoid applying lubricant over the director plate holes – this may restrict injector flow. Do not dip the injector tip in lubricant.
- Multec 3.5 injectors come from the factory with the seal rings attached. The re-use of seal rings is not preferred when replacing an injector. If an injector is to be re-used, and no new seal rings are available, take care to inspect each seal ring for signs of damage. Even minor defects in the seal ring can lead to leakage. Take extra care in installing seal ring over flange of injector inlet.
- Carefully installing the harness connector will prevent terminal damage. Listen for a positive audible click from the connector retention device — this ensures that it is fully engaged. Shut off ignition.
- Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.
- Disconnect the electrical connector from the injector wiring harness.
- Relieve fuel pressure
- Remove the retaining clip from the fuel injector.

- Remove the fuel line connection from the injector
- Carefully clean debris from the interface surfaces. Do not damage seal mating surfaces.
- Remove the injector from the manifold
- Apply a light coating of a lubricant to both the upper and lower injector seal ring of the replacement injector.
- Install the new injector into the manifold. Check that the injector is installed in the original orientation to maintain proper spray targeting, and that the retaining clip is properly seated on the injector and the fuel line
- Install the retaining clip after connecting the fuel line
- Tighten the injector mounting to the desired torque as mentioned in the manufacturer manual
- Tighten the fuel line
- Re-install the injector electrical connector
- Check for fuel leaks with the key “on” and the engine “off”
- Start engine and verify proper operation.
- or spray pattern, do not rotate the injector in the fuel rail assembly to install the injector electrical connector. This may dislodge the retaining clip, and result in improper spray orientation

4. Replacement Techniques

WARNING:

The injector and all associated hardware may be extremely hot.

- Shut off ignition.
- Disconnect negative battery cable to avoid possible fuel discharge if an accidental attempt is made to start the engine.
- Disconnect the electrical connector from the injector wiring harness.
- Relieve fuel pressure
- Remove the retaining clip from the fuel injector.
- Remove the fuel line connection from the injector
- Carefully clean debris from the interface surfaces. Do not damage seal mating surfaces.
- Remove the injector from the manifold
- Apply a light coating of a lubricant to both the upper and lower injector seal ring of the replacement injector.
- Install the new injector into the manifold. Check that the injector is installed in the original orientation to maintain proper spray targeting, and that the retaining clip is properly seated on the injector and the fuel line
- Install the retaining clip after connecting the fuel line
- Tighten the injector mounting to the desired torque as mentioned in the manufacturer manual
- Tighten the fuel line
- Re-install the injector electrical connector
- Check for fuel leaks with the key “on” and the engine “off”
- Start engine and verify proper operation.

5. Plugging

Fuel deposits cause plugging resulting in flow shifts over the life of the injector. Fuel varnish or gumming, a type of injector deposit, is created when certain types of fuel are heated by high injector tip temperatures at soak (no fuel flow). Deposit build up in the director holes causes the flow shifts

- Plugging can cause flow restrictions, frictional changes and the collection of other particles attracted by the tacky surface. The flow restrictions can degrade emissions and drivability.
- Other fuel and environmental conditions may cause crystal or corrosion growth in the injector and cause a flow shift.
- Oxidation stability of the gasoline affects the potential for deposit formation and must be controlled by the fuel supplier.
- Increased levels of detergent additives reduce the rate of injector plugging.
- Incase of plugging of injector follow the injector cleaning procedure mentioned in the section below

6. Cleaning Procedure

- Electrically disable the fuel pump by removing the fuel pump connection.
- Relieve the fuel pressure in the system and disconnect the fuel connection at the injector. Plug the fuel feed line.
- Injector cleaner with the specific ratio of the cleaner and gasoline to be mixed in the Injector cleaning tank.
- Connect the injector-cleaning tank to injector in the vehicle.
- Pressurize the injector-cleaning tank to system pressure.
- Start and idle the engine for 15- 20 minutes.
- Disconnect the injector-cleaning tank from the system and install the fuel pump connections. Connect the fuel feed line to injector.
- Start and idle the vehicle for an additional 2 minutes to ensure the residual injector cleaner is flushed from system.

Throttle Body Assembly(with stepper motor)

1. Description and Working Principle

The Throttle Body Assembly is an interactive system comprised of the following subsystems: the main casting body, bearing system, shaft and valve system, return spring system, cable interface system, throttle position sensing system, and the bypass air control system. The subsystems interact and support each other to provide all the functional requirements, which are mentioned below -

- Control intake air flow
- Control idle air flow
- Sense throttle position - Provide position feedback to Engine Controller
- Provide reactionary force to the throttle

2. Handling – DOs and DONTs

THROTTLE BODY ASSEMBLY HANDLING	
ACTION	**REASON**
DO: Use care during assembly of harness to throttle body.	Avoid terminal damage.
DO: Avoid any liquid contamination in the throttle body area.	Ensure proper operation.
DO: Unload and install units one at a time from packing trays.	Damage may be done to critical components.
DO: Return any dropped, damaged, or suspect material with a tag that describes the problem. (Only warranty cases)	Ensure fast and correct diagnosis of root
DO: Remove and discard protective caps just before assembling mating components.	Protects system from contamination, which can prevent proper operation.
DO: clean the by pass passage after removing bottom cover	To ensure good idle stability
DO NOT: Use any dropped or impacted unit.	Internal damage may have occurred or emissions settings may have been upset.
DO NOT: Store units without protective caps in place.	Contamination may impair correct operation.
DO NOT: Ship or store near saltwater without protection.	Corrosion buildup may impact proper operation.
DO NOT: Exposed to environmental conditions (Moisture) prior to complete vehicle installation.	Corrosion buildup may impact proper operation.
DO NOT: Apply any voltage other than system voltage for testing.	Damage could occur.
DO NOT: Apply excessive band clamp loading	Damage could occur.
DO NOT: Remove packing in a way that allows contact between parts.	Minimum air leakage could be affected and/or other damage could occur.
DO NOT: Release the throttle cam abruptly from any position without the throttle linkage attached.	Damage could occur.
DO NOT: Let the by pass holes be blocked by dirt or foreign particles.	This could effect idle stability
DO NOT: Rake, stage, or handle parts in a manner that allows contact between parts.	Damage will occur.

3. Throttle Body Removal

- Disconnect negative terminal of the battery
- Disconnect electric lead wire of throttle position sensor coupler, stepper motor coupler and MAP/MAT sensor coupler (if this sensor is mounted on the throttle body)
- Disconnect accelerator cable from throttle body

- Remove air cleaner outlet hose and throttle body outlet hose

4. Cleaning Procedure

If there is cover on the bottom, it may be removed and cleaned using carburetor cleaner (3M make recommended). Once the throttle body cover is removed, spray the throttle-body cleaner inside the shipping air passage, and use the brushes to gently dislodge the dirt, gum and varnish that are present. Do not let the bye pass holes be blocked by dirt or foreign particles.

5. Throttle Body Installation

- Reverse the procedure for installation noting the following:
- Adjust accelerator cable play
- Check to ensure that all removed parts are back in place.Reinstall any necessary part which have not been reinstalled

6. Precautions

- Do not submerge TPS in any cleaning fluid.
- Always open the throttle valve using the throttle cable or lever.
- Do not hold the valve at opening position by inserting tools or any sticks into the bore. The valve may be warped and the bore may be scratched. This type of damage may keep the throttle from opening easily or fully closing.

Engine Coolant Temperature Sensor

1. Description and Working Principle

This sensor is used in water cooled engines. It provides a resistance that varies as a function of temperature within prescribed tolerance limits. The sensor has a negative temperature coefficient of resistance. This is a non-serviceable part.

2. Installation Requirements

- Dynamic Torque Requirement: The sensor shall be hand into the application and then driven by a driver with a maximum no load speed of 400 rpm or installed to the desired torque by a hand torque wrench (5/8” hex). The recommended installation torque is:
  Minimum: 20 N·m
  Maximum: 25 N·m
- Static Torque Requirement: The torque required to remove the sensor from the mating hole shall be within 200% of the installation torque mentioned above.

3. Sample Cleaning

- When necessary the samples may be cleaned in isopropyl alcohol for one minute with mating connectors in place and then air-dried

Intake Air Pressure and Temperature Sensor

1. Description and Working Principle

This sensor has two functions. The first is the intake manifold air temperature, it provides a resistance that varies as a function of temperature within prescribed tolerance limits. The second is the intake manifold air pressure; it provides a voltage varies as the intake air pressure.

2. Sample Cleaning

- When necessary the samples may be cleaned in isopropyl alcohol or gasoline for one minute with mating connectors in place and then air-dried

Oxygen Sensor

1. Description and Working Principle

This sensor is a device for monitoring the residual oxygen in the exhaust of an internal combustion engine. It consists of the wide range sensor and stoichiometric sensor. Usually we use stoichiometric sensor on the small engine. It is the feedback element for engine closed loop control.

2. Installation Requirements

- Mounting Angle with Level: ⩾10 degree
- Tightening Torque Requirement: 40-60 Nm

Ignition Coil

1. Description and Working Principle

This coil provides energy to the spark plug in the combustion chamber. The coil itself doesn't have a driver. The high voltage tower of the coil is connected to the spark plug using a high voltage cable assembly. This is a non-serviceable component.

2. Installation requirements

- The vehicle frame provides the mounting surface and mounting holes.
- Mount coil close to the spark plug and keep the plug wire length very short (less than 6 ").
- Mount coil away from any pick coil device. Especially, a VR type Crank / Cam sensor. Keep a Min distance of 150 mm (around 6") between coil and any VR sensor device.
- Never route the coil C- wire with the same bundle as the Crank sensor wires. There is around 200 V peak potential between C- wire and engine ground. This voltage potential could cause a noise on sensor cables.

3. DOs and DONTs

Ignition Coil Handing	
Action	**Reason**
DO NOT: Install the low voltage connectors with the power applied	This might cause an unwanted secondary firing, possibly leading to personal injury

DO NOT: Use a screw driver to asset in removing secondary boots from the secondary tower. Use tools designed for secondary removal.	It is possible to damage a secondary lead in such a manner that creates an electrical path to outside the system permitting improper system operation misfire, or even possible personal injury if arcing occurs.
DO NOT: Use parts that have been dropped or display physical damage	Damaged components can lead to premature failure.
DO NOT: Scratch or apply any non approved material to the surface of the high voltage tower which mates with the high voltage secondary leads.	This can jeopardize the seal integrity of the mating surfaces which in turn can create a secondary high voltage leak path.
DO NOT: Strike any part of the ignition system with a tool or other object.	This can lead to physical damage which can cause a system malfunction or failure.
DO NOT: Permit paint or other sprayed materials to be sprayed onto the electrical connectors.	Insulating type sprays can create a high resistance or open connection. And, a conductive type spray can create an electrical short condition.
DO NOT: Support the ignition system by the wiring harness or plug wire.	These leads are not designed to support the weight of the ignition system. It can create a poor electrical connection Or become disconnected allowing the system to fall and be subjected to physical damage
DO NOT: Pierce or probe the secondary leads.	This creates an electrical path to outside the system permitting improper system operation, misfire, or even possible personal injury if arcing occurs.
DO NOT: Operate without the spark plug attached.	If a technician or mechanic comes in contact with the high voltage generated during operation, personal injury may occur. Or, if the engine is operated under this condition, unburned fuel may fill the converter area creating a potential hazard
DO NOT: Share ignition component wiring with other components, Dedicated wiring is required.	This prevents electrical cross talking between components which can lead to component malfunction.
DO NOT: Apply voltage to the ignition system other than vehicle system voltage for testing purposes.	This can cause reduced performance or an electrical malfunction of the ignition system.
DO NOT: Use high impact tools to apply the spark plug boot to the ignition secondary towers. Installation of the high voltage secondary leads by hand is preferred.	Damage to the coil tower, secondary boot, or mating connection surfaces might occur.

DO: Install the secondary leads before connecting the primary leads.	In the event the low voltage connection has been made and the power applied, unwanted secondary output might occur possibly resulting
	in injury, damage the ignition component, and test equipment
DO: Take care when working around the ignition system.	The high voltage produced by the coil secondary circuit can cause personal injury and/or damage test equipment
DO: Proper handling and shipping methods need to be in place to reduce the risk of damage due to impact, moisture, or contamination	Damaged components can lead to premature failure.
DO: Avoid unnecessary disconnecting and connecting of the electrical components.	The electrical connections are not designed for repeated connection and disconnection.
DO: Insure the low voltage connectors are entirely seated and the locking mechanism is engaged.	This prevents intermittent electrical connections leading to an improper ignition system operation.
DO: Use approved connector breakouts when testing the ignition system.	Connector and/or component damage may occur.
DO: Insure the appropriate seals are included in the connector system.	Liquid intrusion into the terminal connection area might occur causing an electrical intermittent or short condition. In the event of severe terminal corrosion, an open condition might occur.
DO: Operate with gasoline based internal combustion engines.	Other fuels or combustion designs may require additional design considerations.
DO:The power feed line should be fused.	This could protect the system in the event of an electrical short
DO: The module heat sink and back plate must not be used as a connection point when jump starting the engine	The high level of voltage and current which the module could be subjected to, could cause module performance degradation or failure.
DO: Connection of the module back plate to vehicle ground is desirable whenever possible	This greatly reduce potential ground loops and acts as a heat transfer source from the module.
DO: The ignition system ground wire should be kept as short as possible. And, when permissible, should be grounded at the same engine block position as the engine controller	This would greatly reduce the possible of unwanted electrical ground loops.
DO: The electrical wiring to the ignition system should be routed so that the conductors are protected from excessive heat, damage, and wear.	Helps prevent electrical intermittent, open or shorted operating conditions.
DO: Ignition secondary leads should not be routed with the ignition primary harness or any other electrical harness.	Voltage spikes can be transmitted from the secondary cables into other leads which are in close. This could create a component performance degradation or failure condition

DO: Spark plug wires(secondary leads) & primary wiring: - must not contact sharp surface - must not be under tension between fixed points - must be clear of moving parts (belts, fan, etc…) - must be protected from or kept at least 125 mm away from radiant heat source exceeding 400 F. - must be protected from environmental damage (dirt, splash, oils, fluids, etc….) - must be retained, secured or insulated to prevent pinching, mis-routing, rattles, and squeaks	- Spark plug wires carry very high voltage (30,000 volt). If the secondary lead loses its dielectric characteristics thru being nicked, cut , chaffed, then an arc thru to a near by ground could take place. This kind of condition could lead to misfire, no start, or premature failure of ignition system.
DO: Not all fasteners are designed for repeat use. Beware of fastener specifications. All harnesses should be supported within 6" of a mating connection.	Adequate retention force might not be achieved if the fastener is not designed to be reused. Mating connections are not designed to support the weight of the harness assembly.
DO: For removing spark plugs follow the following steps: 1- Grasp the spark plug boot and gently 2- rotate 90°; and then pull the spark plug boot and cable away from the spark plug 3- Before removing spark plug, brush or air blast dirt away from the well areas 4- Use correct size deep socket wrench to loosen each spark plug one or two turns	To remove spark plugs from Aluminum heads, allow the engine to cool. The heat of the engine, in combination with a spark plug that is still hot, may cause the spark plug threads to strip the cylinder head upon removal Use goggles to protect eyes from dirt when applying compressed air to spark plug wells
DO: Cleaning a spark plug could be done as follow: 1- wipe all spark plug surfaces clean….remove oil, water, dirt and moist residues. 2- If the firing end of spark plug has oily or wet deposit, brush the spark plug in an approved, non-flammable and non-toxic solvent. Then dry the spark plug thoroughly with compressed air 3- Use a propane torch to dry wet-fuel fouled plugs. Allow the torch flame to enter up the center electrode insulator. Allow plug to cool down 4- If the spark plug threads have carbon & scale deposits, clean with wire brush, taking care not to injure the electrode or the insulator tip	-Cleaning a spark plug will reduce the voltage required for an electrical arc(spark) across the electrodes -Cleaning & re-gapping will not restore a used spark plug to a new condition. It may be more economical and efficient to replace used spark plugs with new plugs instead of cleaning. -Sooted plugs should be replaced -Do not cool by using water or any liquid -Clean threads permit easier installation and proper seating which will maximize transfer heat away from the plug

DO: Regap spark plugs to the exact measurement specified by the engine	-Too wide a gap could cause the plug to misfire(higher required ignition voltage).
manufacturer to keep the best fuel economy and proper engine performance - Use round wire-type gauge for an accurate measure of gap on all used spark plugs - when gapping a spark plug only the side electrode is moved. The center electrode must not be moved	-Too narrow of a gap could affect idle stability -A flat gauge can't accurately measure the spark plug on used plugs
DO: When replacing spark plugs with new ones, always use equivalent plugs with same heat range, thread, size, etc.…	-Higher heat range plug(hotter plug) could lead to pre-ignition & possible piston damage -Lower heat range (colder plug) could lead to cold fouling & emission problem
DO: For installing spark plugs follow the following steps: 1- make sure the cylinder head threads and spark plug threads are clean. Make sure the spark plug thread is free of dings and burrs. If necessary, use a thread chaser and seat cleaning tool. 2- Make sure the spark plug gasket seat is clean, then thread the gasket to fit flush against the gasket seat. Tapered seat plugs do not require gaskets 3- Screw the spark plugs finger-tight into the cylinder head. Then, use a torque wrench to tighten spark plugs following manufacturer's recommendation). Torque is different for various plug type & cylinder head material	-If the thread is damage, it prevents a good heat transform from the shell to the cylinder head -Do not use any type of anti-seize compound on spark plug threads. Doing this will decrease the amount of friction between the threads. The result of the lowered friction is that when the spark plug is torqued to the proper specification, the spark plug is turned too far into the cylinder head. This increases the likelihood of pulling or stripping the threads in the cylinder head -Over-tightening of a spark plug can cause stretching of the spark plug shell and could allow blowby to pass thru the gasket seal between the shell and insulator. Over-tightening also results in extremely difficult removal

Fuel Pump Module

1. Description and Working Principle

Fuel Pump Module supplies fuel to engine at system pressure. Fuel Pump Module is mounted to fuel tank at bottom and supplies fuel to engine through hoses.

Fuel Pump module consists of Fuel Pump to generate the fuel flow and pressure regulator to regulate the fuel pressure.

Fuel Pump

When power is supplied to fuel pump, motor in pump assembly rotates the impeller. Impeller in turn draws the fuel from strainer and pumps the flow to generate the system pressure.

Pressure Regulator

Pressure Regulator is a diaphragm type mechanical device. Fuel flow from filter enters in the inlet of pressure regulator. Pressure regulator regulates the fuel pressure at a set pressure by releasing the excessive fuel flow to fuel tank.

2. Service Procedure:

Precautions:

Before attempting any service on fuel system, following cautions should be always followed for personal safety and to avoid system damages.

- Disconnect negative cable at battery.
- DO NOT smoke, and place 'No SMOKING" sign near work area
- Make sure to have fire extinguisher handy.
- Make sure to perform work in well ventilated area and away from any open fire/flames.
- Wear Safety glasses
- To relieve fuel vapor pressure in fuel tank, remove fuel filler cap fuel filler neck and then reinstall it.
- As fuel lines are at high pressures when the engine is stopped, loosening or disconnecting fuel line will cause dangerous spout of fuel. Before loosening/ disconnecting fuel lines, please follow the "Fuel Pressure Relief Procedure" described in this section.
- Small amount of fuel may drip after the fuel lines are disconnected. In order to reduce the risk of personal injury, cover the pipe/ hose ends with suitable blind with no rust or contamination.
- After servicing, make sure that the fuel hoses and clamps are connected according to the hose fitment instructions given in vehicle instruction manual.
- After servicing, please follow the 'Fuel Leakage Check Procedure' described in this section.
- After servicing make sure to fill at least 3 liters gasoline before pump is primed (ignition key should be turned on only after ensuring there is minimum 3 liters of fuel in the fuel tank)

Fuel Module Diagnosis:

Step	Action	Yes	No
1	Switch on Ignition key. Fuel Pump primes for 3 seconds when the ignition key is ON. Check for fuel pump running noise for 3 seconds after ignition key is ON.	If fuel pump running noise can be heard, go to step 4.	If fuel pump running noise can not be heard, go to step 2.
2	Disconnect fuel module coupler. Check voltage at harness coupler. Is the voltage within 10-14V	Go to step 3	Check the electrical circuit from Ignition to fuel module.

3	Connect 12V DC power supply (battery) to fuel module. Make sure that enough fuel available in fuel tank to avoid fuel pump running dry.Is the fuel pump running	1. Check electrical circuit from fuel module to ECU 2. Check ECU	1. Check Fuel Pump Harness integrity 2. Check Fuel Pump
4	Check fuel system pressure at Injector inlet (with a T-joint) while engine is running in idle condition. Is the pressure between 220 ~ 270kPa?	Fuel Module Operation Normal	Go to Step 5
5	Is the Pressure below 220kPa?	1. Check for leakages from hoses, hose joints 2. Check Fuel Pump 3. Check Pressure Regulator	1. Clogged Filter 2. Kink/ Blockage in Fuel Hoses 3. Check Regulator

3. Fuel Module Removal:

- Relieve fuel pressure in fuel lines referring to the 'Fuel Pressure Relief Procedure' provided in this section.
- Disconnect negative cable at battery.
- Disconnect fuel module wire coupler.
- Drain the fuel in fuel tank thru fuel filler with help of hand pump (siphon). Collect the fuel in approved container for contamination and safety.
- Disconnect the fuel hoses from fuel module by using standard tools
- Remove the fuel tank from vehicle.
- Place the fuel tank with bottom up condition. Care to be taken not to cause any scratches/ damages on fuel tank.
- Open the fuel module mounting bolts.
- Take out fuel module assembly from fuel tank with care
- Care to be taken not to damage the strainer while removing fuel module from tank.

4. Fuel Module Installation:

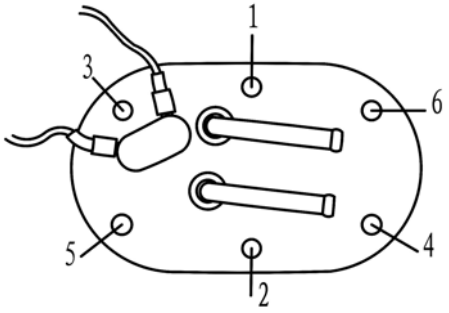
- Replace the fuel module gasket in fuel module assembly with a new one. Old/ used gaskets can cause leakages.
- Fold strainer towards fuel pump and insert fuel module in tank opening with care. Care should be taken not to cause any damages on strainer.

NOTE

Fuel Module Orientation: Fuel module bolts not symmetrical and can be mounted only in the intended direction. Regulator side should be facing the Fuel Tank rear side.Make sure that the fuel tank surface at module mounting area is clean and free of surface defects.

- Place the bolts on module cover and tighten the bolts gradually in star pattern sequence to apply equal compression on gasket. It is shown in figure as below. Bolt Tightening Torque: 3~4 Nm.

  Fuel module is installed with special bolts (step bolts). Use designated bolts only. Follow the tightening torque and tightening sequence instruction.Over torque and miss-sequence can cause unequal compression of gasket and leakage.
- Install the fuel tank to vehicle.
- Connect for fuel hoses with suitable hose clamps.
- Connect fuel module coupler.
- Follow “Fuel Leakage Check Procedure’ to check any leakage before the engine is started。



Mounting Bolts – Star Tightening Pattern

5. Pressure Regulator Assembly Replacement:

- Remove the regulator retainer from module.
- Apply gradual pull force on retainer to avoid any personal injury due to spring action of retainer.
- Take out the pressure regulator assembly from module.
- Do not hit/ damage on the regulator dome and crimping portion.
- Lubricate the O-rings in new pressure regulator assembly with recommended lubrication oils as mentioned in Table no: 3. Lubrication oil is applied only for ease of regulator assembly.
- Make sure that 2 O-rings (one is bigger diameter the other is smaller diameter) are assembled in pressure regulator.
- Place the pressure regulator on module at regulator pod. Push the regulator gently in the pod.
- Do not hit/ damage on the regulator dome and crimping portion. This will disturb the pressure setting.
- Assemble the retainer on the regulator pod
- Replace the gasket, module with new gasket provided in the kit.

6. Fuel Pressure Relief Procedure:

NOTE

This work must not be done when engine is hot. If done so, it may cause adverse effect to catalyst (if equipped)

After making sure that engine is cold, relieve fuel pressure as follows.

- Place vehicle gear in 'Neutral'.
- Disconnect fuel module electrical coupler from vehicle harness.
- Start engine and run till it stops due to lack of fuel. Repeat ignition key ON and OFF for 2 ~ 3 times of about 3 seconds each time to relieve fuel pressure in lines. Fuel Connections are now safe for servicing.
- Upon the completion of servicing, Connect Fuel Module Connector to Vehicle Harness.

7. Fuel Leakage Check Procedure:

After performing any service on fuel system, check to make sure that there are no fuel leakages as below.

- Fill about 3 ~ 5 liters of fuel in tank.
- Turn Ignition key to ON position for 3 seconds (to operate fuel pump) and then turn to OFF position. Repeat this for 3 ~ 4 times to apply fuel pressure in fuel lines.
- In this state, check to see that there are no fuel leakage from any part of fuel system (Fuel Tank, Hoses, Hose Joints, etc)

8. Handling – DOs and DONTs:

FUEL MODULE HANDLING	
ACTION	**REASON**
DO NOT: Drop Fuel Module on Floor	Could cause internal damage to Fuel Pump.
DO NOT: Run Fuel Pump Dry (without fuel at pump inlet/ strainer) ensure atleast 3 litres of gasoline is present in the fuel tank	Caused internal damage to Fuel Pump
DO NOT: Damage the strainer during servicing, insertion of fuel module in fuel tank	Contamination enters fuel pump thru damaged strainer damages the Fuel Pump
DO NOT: Disassemble Fuel Pump and regulator internal parts out side Delphi premises. **DO NOT:** Do any adjustments on pressure regulator and pump except for replacement.	Warranty void.
DO NOT: Use module harness for hold/ carry fuel module. **DO NOT:** Pull Wiring Harness in vertical direction to module cover	Wiring Harness Breakage/ Fuel Pump Power disconnection
DO NOT: Use damaged/ distorted hose clamps.	Can cause fuel seepage/ leakage.

DO NOT: Use Fuel Module if the strainer with excessive damage/ cut.	Contamination enters fuel pump thru damaged strainer damages the Fuel Pump
DO NOT: Use Fuel Pump for draining duel in fuel tank.	Not intended function of fuel module.
DO NOT: Use module mounting bolts for mounting other components.	Affects fuel module sealing.
DO NOT: Damage fuel pump harness while servicing fuel module.	Damaged terminals will cause intermittent/ No contact for power supply.
DO NOT: Force hand pump towards fuel module while draining fuel from tank.	To avoid any damages on fuel module.
DO : Ensure that there are no damages to fuel pipes while servicing fuel module	Can cause fuel seepage/ leakage.
DO: Use genuine module gasket only.	Spurious gaskets can cause leakages.
DO: Use designated hose clamps.	To ensure no leakages/ seepages thru hose joint.
DO: Clamp fuel module harness to vehicle chassis	Clamp provides mechanical support for wiring harness in vibrations.
DO: Use only standard gasoline for operating vehicle/ module.	Fuel Module is intended to run in standard gasoline. Adulterated fuel can cause fuel module premature failures which are not covered under warranty.
DO: Change the fuel filter at recommended intervals.	Clogged fuel filter will cause restriction in fuel flow and can cause flow reduction.
DO: Use fuel filters supplied/ recommended fuel filters only.	Spurious fuel filters causes damages to injector, regulator and fuel pump performance.
DO: Ensure that the hoses are routed properly and there are no kinks / rubbing with other components.	Improper routing, kinks and fouling of hoses with other components causes hose damage
DO: Ensure that always sufficient fuel till the strainer height	Avoids Pump running in dry
DO: Replace two O-rings along with replacement/ re-installation of pressure regulator.	For proper functioning of regulator.
DO: Use care during connection of harness to module coupler.	Avoid terminal damage.
DO: Return any dropped, damaged, or suspect material with a tag that describes the problem.	Ensure fast and correct diagnosis of root cause.

EMS FAULT DIAGNOSIS

EME Fault Diagnosis

When fault comes up, the odometer's clock will turn into a number， which is a fault code, find out the cause with this numbe;press clock button,then it will turn back to clock mode, and five second later,the fault code will show again.

Fault code list

System or Component	DTC Number	DTC Description	Related Calibration
Manifold Absolute Pressure Sensor (MAP)	0107	MAP Circuit Low Voltage or Open	KsDGDM_MAP_ShortLow
	0108	MAP Circuit High Voltage	KsDGDM_MAP_ShortHigh
Intake Air Temperature Sensor (IAT)	0112	IAT Circuit Low Voltage	KsDGDM_IAT_ShortLow
	0113	IAT Circuit High Voltage or Open	KsDGDM_IAT_ShortHigh
Coolant/Oil Sensor	0117	Coolant/Oil Temperature Sensor Circuit Low Voltage	KsDGDM_CoolantShortLow
	0118	Coolant/Oil Temperature Sensor Circuit High Voltage or Open	KsDGDM_CoolantShortHigh
Throttle Position Sensor (TPS)	0122	TPS Circuit Low Voltage or Open	KsDGDM_TPS_ShortLow
	0123	TPS Circuit High Voltage	KsDGDM_TPS_ShortHigh
Oxygen Sensor	0131	O2S 1 Circuit Low Voltage	KsDGDM_O2_1_ShortLow
	0132	O2S 1 Circuit High Voltage	KsDGDM_O2_1_ShortHigh
Oxygen Sensor Heater	0031	O2S Heater Circuit High Voltage	KsDGDM_O2_HeaterShortHigh
	0032	O2S Heater Circuit Low Voltage	KsDGDM_O2_HeaterShortLow
Fuel Injector	0201	Injector 1 Circuit Malfunction	KsDGDM_INJ_CYL_A_Fault
	0202	Injector 2 Circuit Malfunction	KsDGDM_INJ_CYL_B_Fault
Fuel Pump Relay (FPR)	0230	FPR Coil Circuit Low Voltage or Open	KsDGDM_FPP_CircuitShortLow
	0232	FPR Coil Circuit High Voltage	KsDGDM_FPP_CircuitShortHigh
Crankshaft Position	0336	CKP Sensor Noisy Signal	KsDGDM_CrankNoisySignal
Sensor (CKP)	0337	CKP Sensor No Signal	KsDGDM_CrankNoSignal
Ignition Coil	0351	Cylinder 1 Ignition Coil Malfunction	KsDGDM_EST_A_Fault
	0352	Cylinder 2 Ignition Coil Malfunction	KsDGDM_EST_B_Fault
Idle Control System	0505	Idle Speed Control Error	KsDGDM_IdleControl

System Voltage	0562	System Voltage Low	KsDGDM_SysVoltLow
	0563	System Voltage High	KsDGDM_SysVoltHigh
MIL	0650	MIL Circuit Malfunction	KsDGDM_MIL_Circuit
Tachometer	1693	Tachometer Circuit Low Voltage	KsDGDM_TAC_Circuit_Low
	1694	Tachometer Circuit High Voltage	KsDGDM_TAC_Circuit_High
Oxygen Sensor 2	0137	O2S 2 Circuit Low Voltage	KsDGDM_O2_2_ShortLow
	0138	O2S 2 Circuit High Voltage	KsDGDM_O2_2_ShortHigh
Oxygen Sensor Heater 2	0038	O2S Heater 2 Circuit High Voltage	KsDGDM_O2_HeaterShortHigh
	0037	O2S Heater 2 Circuit Low Voltage	KsDGDM_O2_HeaterShortLow
Vehicle Speed Sensor	0500	VSS No Signal	KsDGDM_VSS_NoSignal
Park Neutral Switch Diag	0850	Park Neutral Switch Error	KsDGDM_ParkNeutralSwitch
CCP	0445	CCP short to high	KsDGDM_CCP_CircuitShortHigh
	0444	CCP short to low/open	KsDGDM_CCP_CircuitShortLow
BLM MaxAdapt	0171	BLM Max Adapt(Kohler Special)	KsFDIAG_BLM_MaxAdapt
BLM MinAdapt	0172	BLM Min Adapt(Kohler Special)	KsFDIAG_BLM_MinAdapt
PE system Lean	P0174	PE syst Lean(Kohler Special)	KsFDIAG_PESystLean

NOTE:

The following trouble, not including all possible troubles, is a help for trouble guide. Please refer to relevent contents for the inspection, adjustment and replacement of part.

STARTING FAILURE/HARD STARTING

FUEL SYSTEM	
Fuel tank	1、No oil 2、Fuel filter is clogged 3、Fuel pump filter net is clogged 4、Breather tube is clogged 5、Fuel is deteriorated or polluted
Fuel pump	1、Clogged fuel hose 2、Damaged vacuum hose
Air filter	Clogged air filter element
Gasoline filter	Block up
ELECTRICAL SYSTEM	
Spark plug	1、Improper plug gap 2、Worn electrodes 3、Wire between terminals broken 4、Wrong Spark plug heat value 5、Faulty spark plug cap 6. High voltage wires strapped on frame cause shortage of high pressure ignition energy
EFI system	1、 Broken ECU 2、 Clogged nozzle or the rupture the line from nozzle to ECU 3、 Damage of engine speed signal sensor 4、 Rupture of the line from engine speed signal sensor to ECU 5、 Broken inlet pressure or temperature sensor or damaged line to ECU 6、 Broken air throttle or damage line to ECU. 7、Broken vice line (cable) of electrical injection
Switches and wires	1、 Broken main cable 2、 Broken main switch

Starter motor	1、Faulty starter motor 2、Faulty starter relay 3、Faulty overrunning clutch in engine 4、Broken main switch 5、Broken main fuse
Battery	1、Low battery voltage 2、Faulty battery
COMPRESSION SYSTEM	
Cylinder and cylinder head	1、Loose spark plug 2、Loose cylinder head or cylinder 3、Broken cylinder head gasket 4、Broken cylinder gasket 5、Worn, damaged or seized cylinder
Piston and piston rings	1、Improperly installed piston ring 2、Worn, fatigued or broken piston ring 3、Seized piston ring 4、Seized or damaged piston
Valve, camshaft and crankshaft	1、Improperly sealed valve 2、Improperly contacted valve and valve seat 3、Improper valve timing 4、Broken valve spring 5、Seized camshaft
Crankcase and crankshaft	1、Improperly seated crankcase 2、Seized crankshaft
Valve train	1、Improperly adjusted valve clearance 2、Improperly adjusted valve timing

POOR IDLE SPEED PERFORMANCE

POOR IDLE SPEED PERFORMANCE	
EFI system	1、Broken ECU 2、Clogged nozzle or the rupture the line from nozzle to ECU 3、Damage of engine speed signal sensor 4、Rupture of the line from engine speed signal sensor to ECU 5、Broken inlet pressure or temperature sensor or damaged line to ECU 6、Broken air throttle or damage line to ECU. 7、Broken vice line (cable) of electrical injection

Electrical system	1、Faulty ignition plug 2、The performace of speed sensor become poor 3、Faulty ignition coil
Valve train	Improperly adjusted valve clearance
Air filter	Clogged air filter element

POOR MEDIUM AND HIGH-SPEED PERFORMANCE

POOR MEDIUM AND HIGH-SPEED PERFORMANCE	
EFI system	1、Broken ECU 2、The performance of speed signal sensor become poor 3、The main nozzle clog or loose 4、Spoiled or pollute oil 5、Broken inlet pressure / temperature sensor 6、Air throttle position sensor loose
Air filter	Clogged air filter element
Muffler	Clogged muffler
Set out	The reverse signal error trigger

FAULTY GEAR SHIFTING

SHIFT LEVER DOES NOT MOVE	
Shift drum, shift forks	1、Groove jammed with impurities 2、Seized shift fork 3、Bent shift fork guide bar 4、Broken shift guide
Transmission	1、Seized transmission gear 2、Incorrectly assembled transmission
Shift guide	1、Broken shift guide mechanism 2、Broken shift flexible shaft
JUMPS OUT OF GEAR	
Shift forks	Worn shift fork
Shift drum	1、Improper thrust play 2、Worn shift drum groove
Transmission	Worn gear dog

ENGINE OVERHEATING

OVERHEATING	
Ignition system	1、Improper spark plug gap 2、Improper spark plug heat range
Fuel system	1、Improper fuel level 2、Clogged air filter element
Compression system	Heavy carbon deposit
Engine oil	1、Improper oil level 2、Improper oil viscosity 3、Inferior oil quality
Brake	Brake drag
Cooling system	1、Low coolant level 2、Clogged or damaged radiator 3、Damaged or faulty water pump 4、Faulty fan motor 5、Faulty thermo switch
Oil cooling system	Clogged or damaged oil cooler

FAULTY BRAKE

POOR BRAKING EFFECT	
Disc brake	1、Worn brake pads 2、Worn disc 3、Air in brake fluid 4、Leaking brake fluid 5、Faulty master cylinder kit cup 6、Faulty caliper kit sea 7、Loose union bolt 8、Broken brake hose and pipe 9、Oily or greasy disc/brake pads 10、Improper brake fluid level

SHOCK ABSORBER MALFUNCTION

Loss of damping function	
Shock absorber	1、Bent or damaged damper rod 2、Damaged oil seal lip 3、Fatigued shock absorber spring

UNSTABLE HANDLING

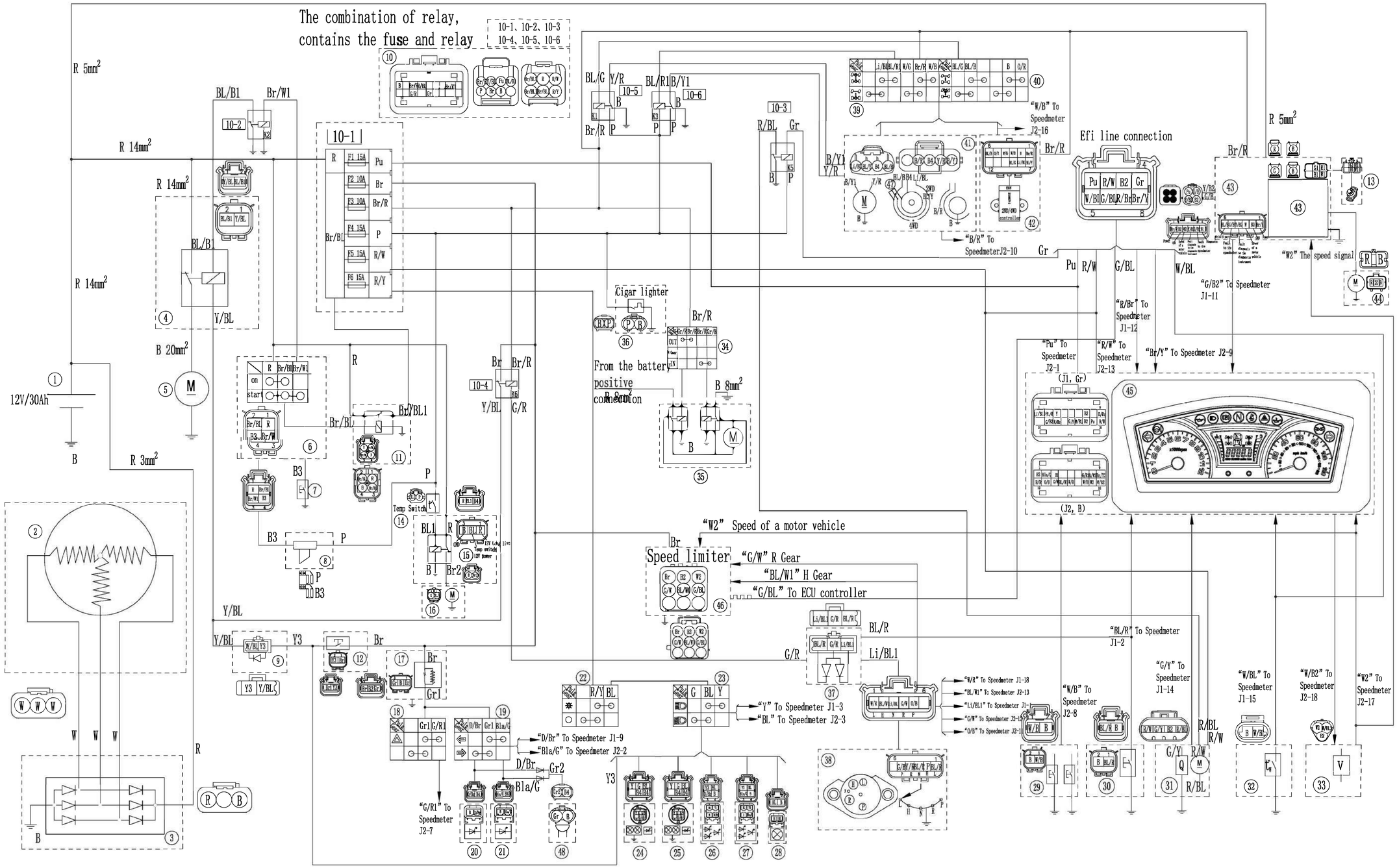
UNSTABLE HANDLING	
Steering column	Improperly installed or bent
Steering	1、Incorrect toe-in 2、Bent steering shaft 3、Improperly installed steering shaft 4、Damaged bearing 5、Bent tie-rods
Tires	1、Uneven tire pressures on both sides 2、Incorrect tire pressure 3、Uneven tire wear
Rim	1、Deformed wheel 2、Loose bearing 3、Bent or loose wheel axle
Frame	1、Bent 2、Damaged frame
Suspension	1、 Over worn or loosen main knuckle ball stud 2、 Bent rocker 3、 Broken shock absorber 4、 Broken buffer rubber of rocker shaft

LIGHTING SYSTEM

HEAD LIGHT IS OUT OF WORK	
Head light is out of work	1、Improper bulb 2、Too many electric accessories 3、Hard charging(broken stator coil and/or faulty rectifier/regulator) 4、Incorrect connection 5、Improperly grounded 6、Bulb life expired

BULB BURNT OUT	
Bulb burnt out	1、Improper bulb 2、Faulty battery 3、Faulty rectifier/regulator 4、Improperly grounded 5、Faulty main and/or lights switch 6、Bulb life expired
ERROR DISPLAY OF METER	
Wrong Speed	1、 Then sensor on rear axle is damaged or polluted by iron powder 2、 The connection between sensor to meter is wrong. 3、 Broken meter

WIRING DIAGRAM

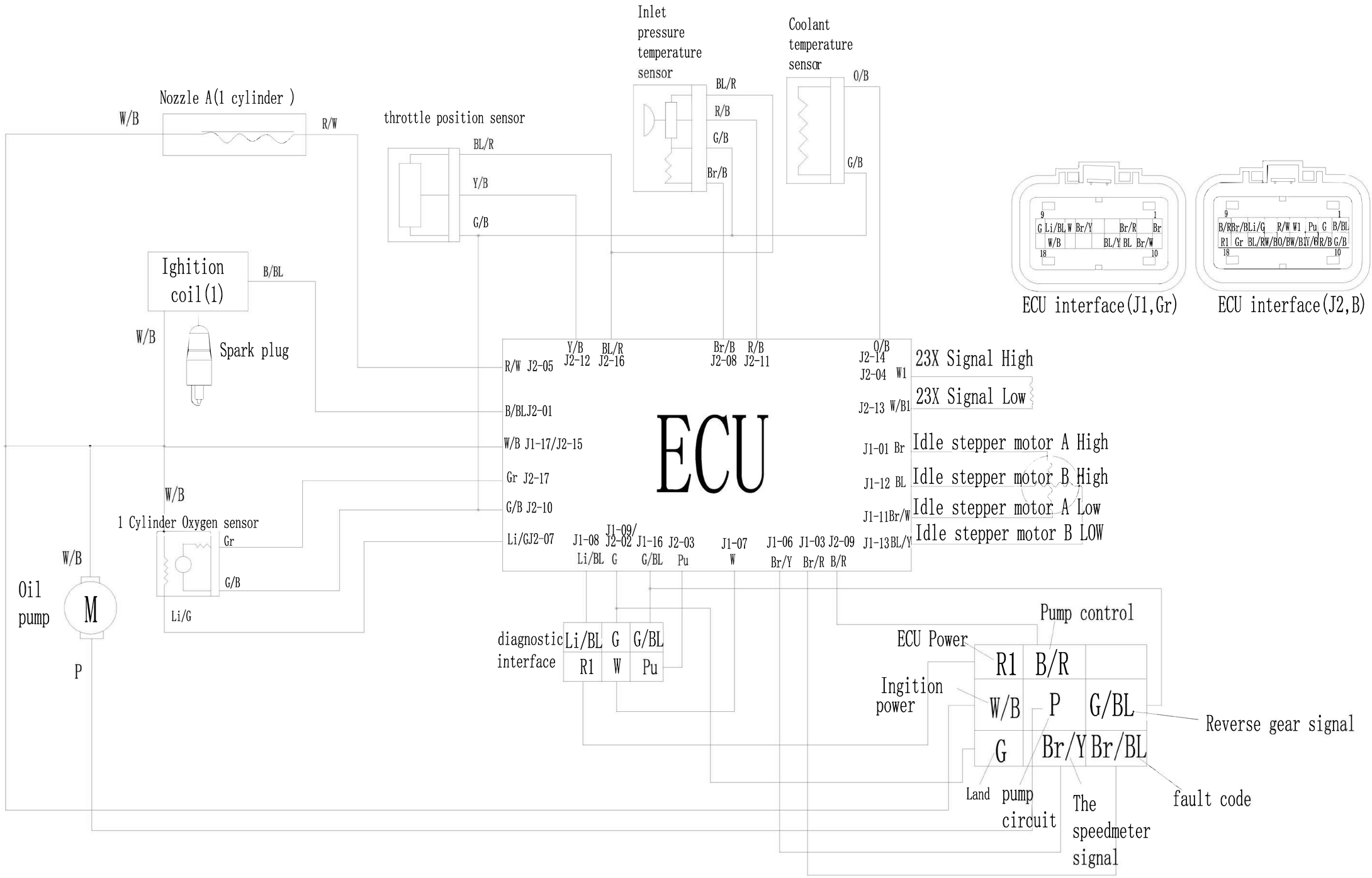


1、Battery parts
2、Magnetic motor
3、Rectifier/regulator
4、Starter relay
5、Starte motor
6、Ignition switch parts
7、Horn patr switch
8、Horn patrs
9、Brake start dilde
10、Relay as^{8}y.
10-1、Fuse
10-2、Ignition relay
10-3、Oil pump relay
10-4、N gear、parking ignition relay
10-5、Front axle 2/4WD control relay
10-6、Front axle differential lock control relay
11、The main relay assy.
12、Brake switch
13、Torque sensor
14、Fan temperature control switch
15、Fan controller
16、Fan motor
17、Flasher
18、Emergency lamp switch
19、Turn light convert switch
20、Front turn signal light assy. (L)
21、Front turn signal light assy. (R)
22、Lighting switch assy.
23、Low(hight beam)convert switch
24、Head light assy. (L)
25、Head light assy. (R)
26、Rear brake light assy. (L)
27、Rear brake light assy. (R)
28、Rear registration plate lamp assy.
29、Safety belt lock catch switch
30、Parking final motion switch
31、Fuel punp parts
32、Water temperature sensor
33、Speed sensor parts
34、Windlass controller switch
35、Windlass relay assy.
36、DC socket assy.
37、N gear、parking start dilde
38、Documents show assy.
39、Driven switch assy.
40、The front axle differential switch
41、Front axle thansfer
42、2/4WD control relay
43、Power steering controller
44、Power steering motors
45、Speedmeter part
46、Speed limiter
47、Differential unlock
48、Buzzer

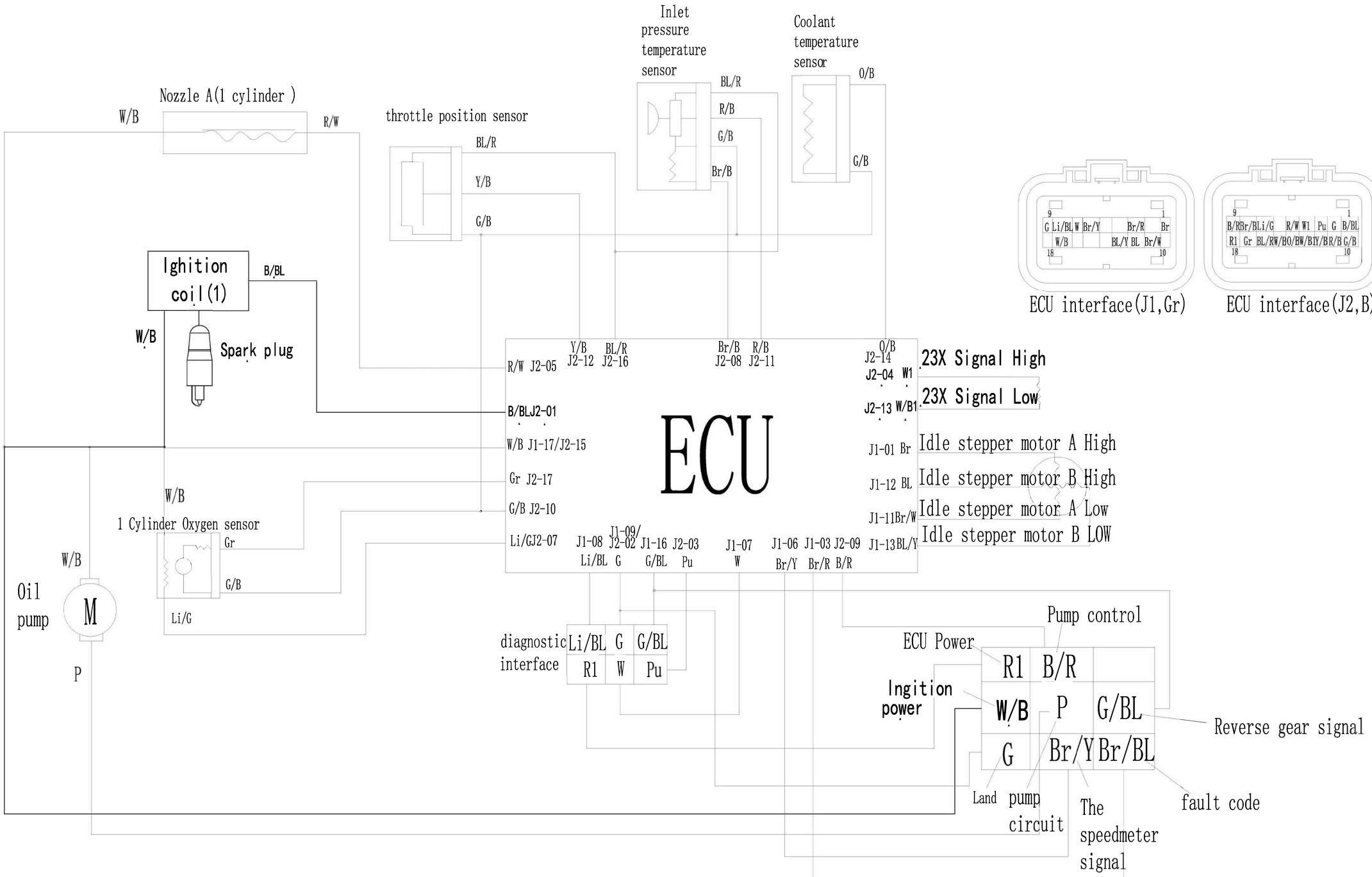
Note:

R-Red	Pu-Purple	Li-Light	W-White	D-Dark	Bla-Blackish
Br-Brown	Y-Yellow	BL-Blue	B-Black	Gr-Grey	P-Pink
O-Orange	G-Green				

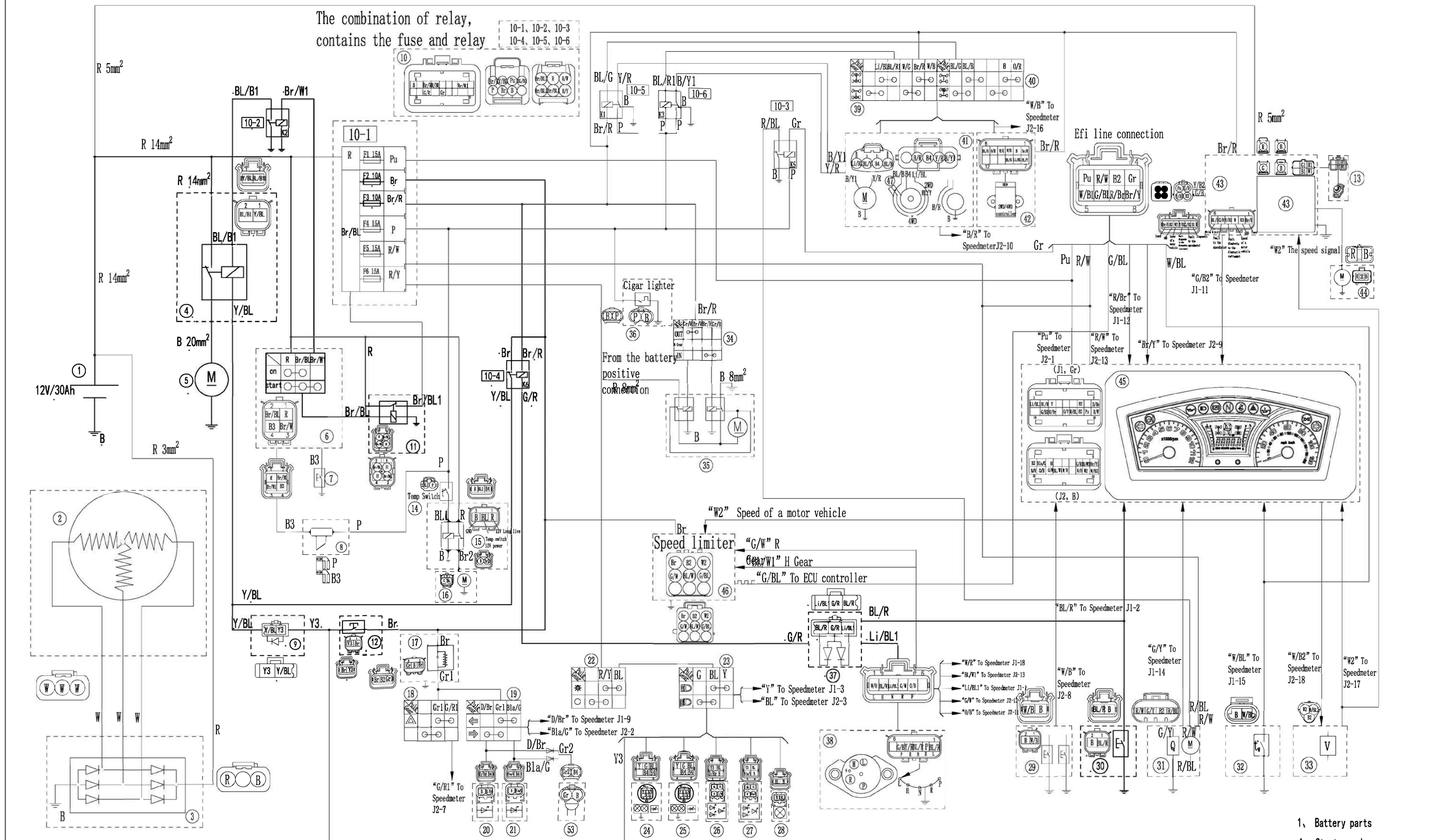
WIRING ECU DIAGRAM



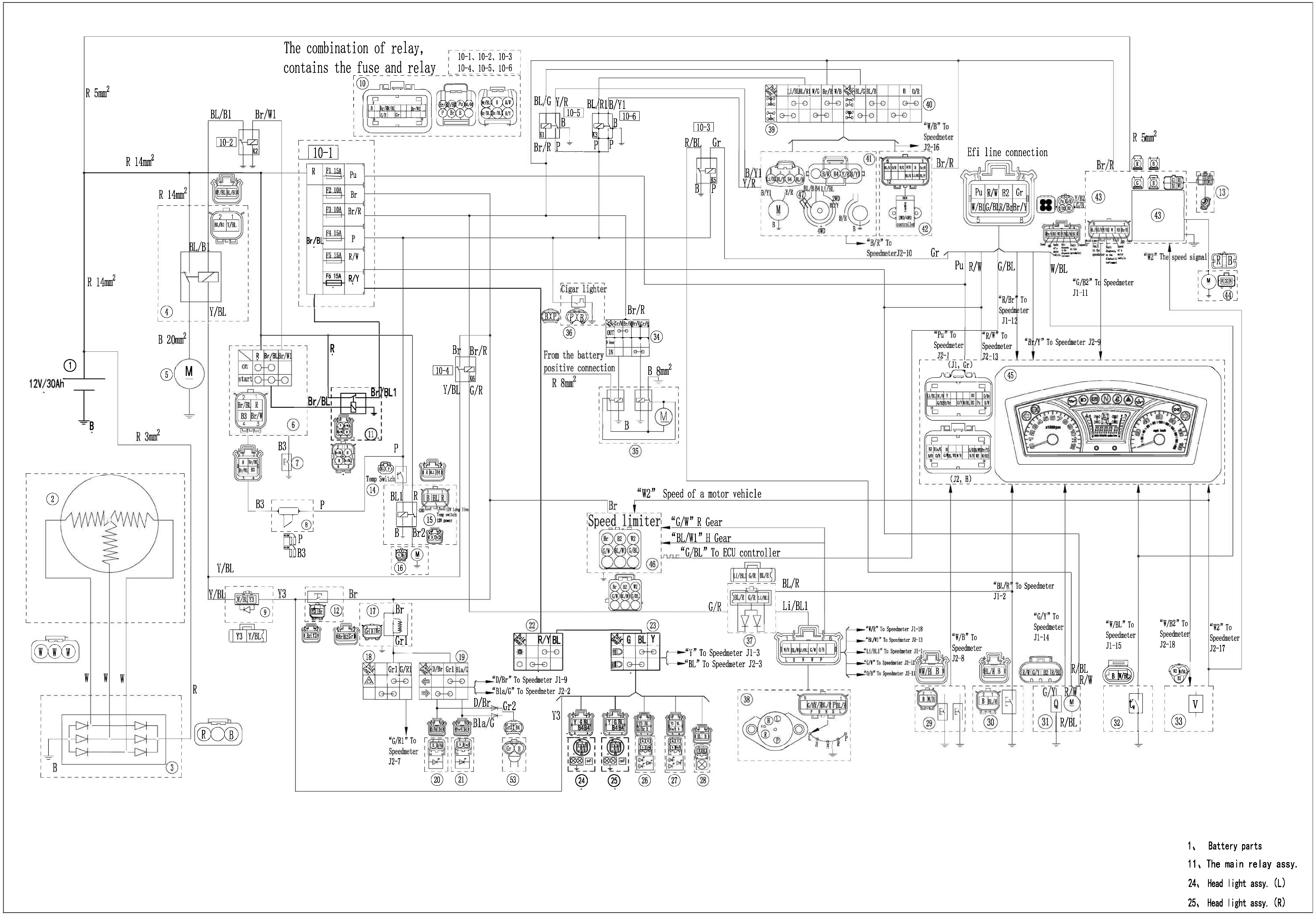
IGNITION SYSTEM CIRCUIT DIAGRAM



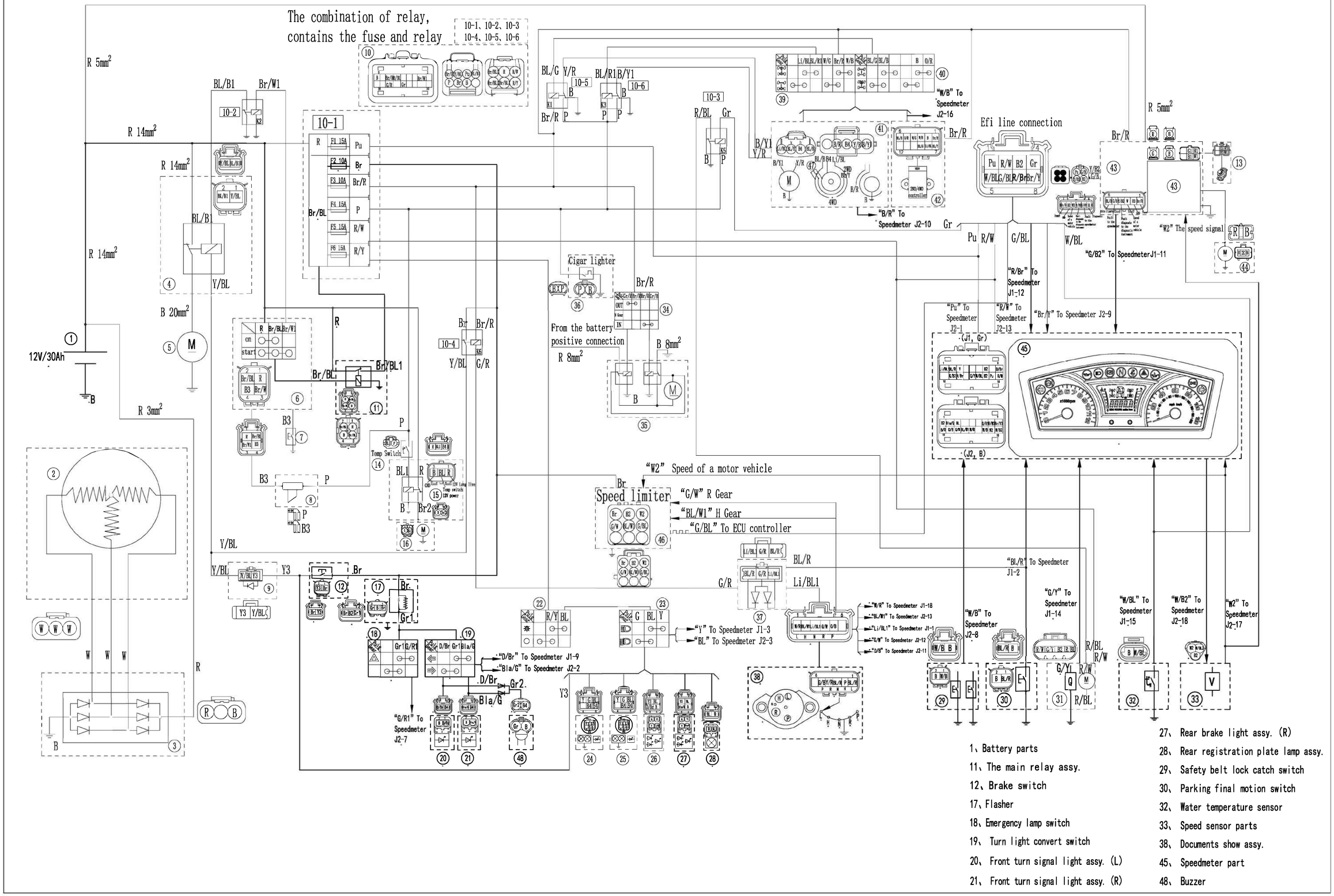
ELECTRIC STARTING SYSTEM CIRCUIT DIAGRAM



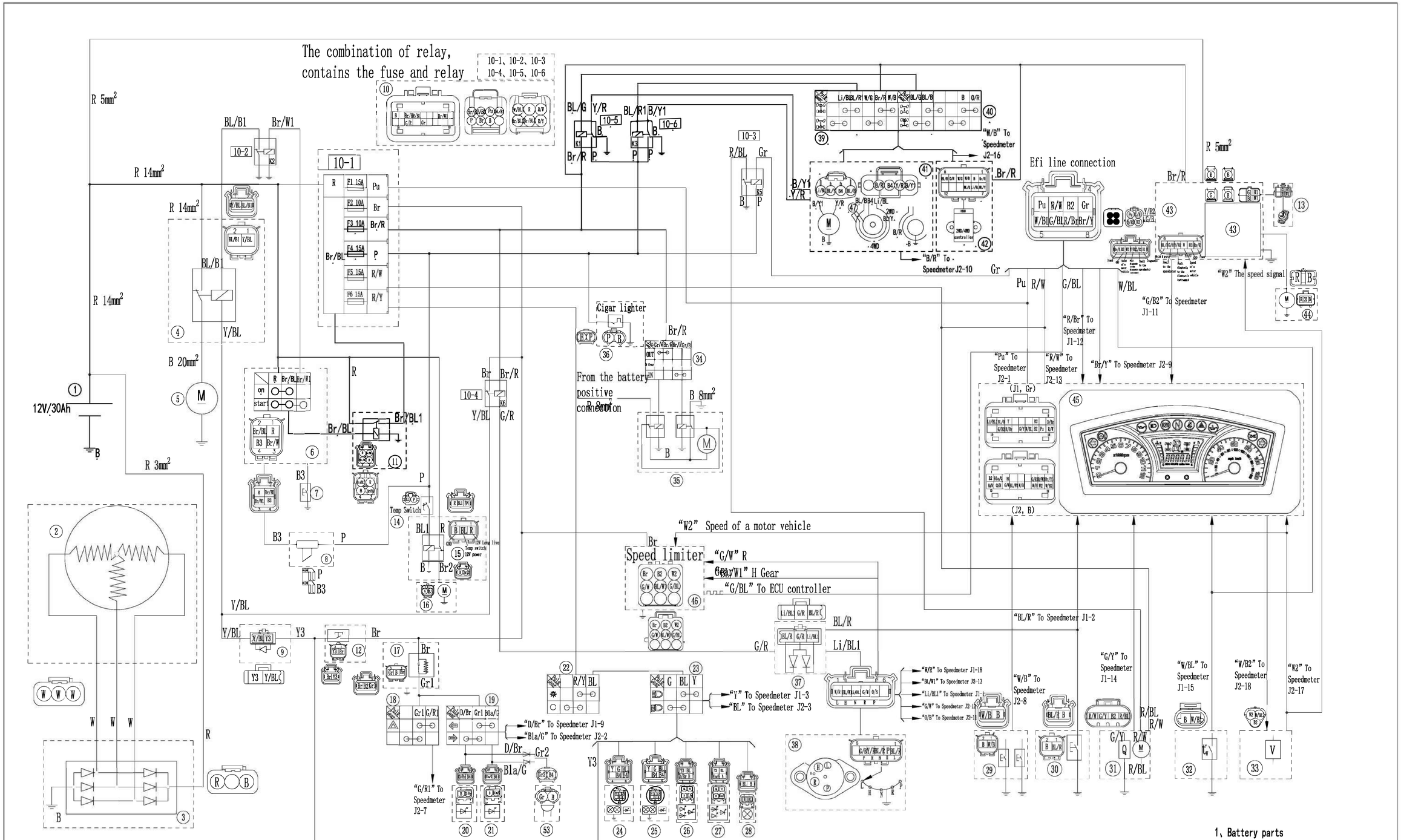
LIGHTING SYSTEM CIRCUIT DIAGRAM



SIGNALING SYSTEM CIRCUIT DIAGRAM



2WD/4WD SELECTING SYSTEM CIRCUIT DIAGRAM



1、Battery parts

11、The main relay assy

39、Driven switch assy.

40、The front axle differential switch

41、Front axle thansfer

42、2/4WD control relay

47、Differential unlock

⚠ WARNING

Improper use can result in SEVERE INJURY or DEATH

ALWAYS USE AN APPROVED HELMET AND PROTECTIVE GEAR

NEVER USE ON PUBLIC ROADS

NEVER USE WITH DRUGS OR ALCOHOL

NEVER operate:

- without proper training or instruction
- at speeds too fast for your skills or the conditions
- on public roads - a collision can occur with another vehicle
- with a passenger - passengers affect balance and steering and increase risk of losing control

ALWAYS:

- use proper riding techniques to avoid vehicle overturns on hills and rough terrain and in turns
- avoid paved surfaces - pavement may seriously affect handling and control

LOCATE AND READ OWNER'S MANUAL.
FOLLOW ALL INSTRUCTIONS AND WARNINGS.