



SERVICE CENTER ELECTRICAL SYSTEM TROUBLESHOOTING AND TESTING GUIDE

## RYOBI RY48ZTR75/100 AND RY48140 RIDING MOWER







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**RYOBI**

**WARNING**



***THIS MATERIAL INTENDED ONLY FOR TECHNICIANS TRAINED IN ELECTRICAL REPAIR.***

***Technicians should wear personal protective equipment, such as rubber gloves and safety glasses.***

***Dangerous voltages /currents are present. Exercise caution at all times.***

This manual assumes knowledge of basic electrical equipment such as DMM (Digital Multi Meter) and clamping Amp Meter to measure voltage, current, resistance, continuity, and diodes.

The RYOBI ZTR riding mower is completely electrical, consisting of 4 *brushless* motors and a controller for each motor:

- A brushless motor and controller for each of the 2 blades
- A brushless motor/controller to drive each rear wheel. These *Drive Motor Controllers* also contains the “brains” that responds to various inputs such as the accelerators, seat switch, etc.



## BRUSHLESS MOTORS

Brushless motors operate quite differently than brushed motors, which you may be used to (i.e. a starter motor).

A brushed motor can be quickly tested by applying voltage to the two terminals.

***Brushless*** motors can be recognized by 3 wires. These 3 wires require a *controller* to operate them and to turn on these 3 phases in a precise fashion similar to spark plugs firing a 3-cylinder gas motor.

***Applying a voltage directly to these phases will cause damage.***



## USING THIS DOCUMENT

Any [blue text](#) can be clicked on to jump directly to the page of that topic. (This document is also printer-friendly, so you can have it in front of you while servicing the mower.) If you print this document, we recommend printing it in *landscape mode* and in **color**

A [Block Diagram](#) shows the general flow to visualize how the mower is connected and a chart shows general symptoms/solutions for repairs.

[Electronics tips](#), [Terminology](#) and [Using a Digital Multi-Meter \(DMM\)](#) are included for the technician familiar only with gas machines.



## TOOLS NEEDED

### Torx

**T27**

**T30**

**T40**

### Screwdrivers

**Cross tip**

**Flat blade**

### Sockets and Wrenches

**8 mm**

**10 mm**

**13 mm**

**14 mm**

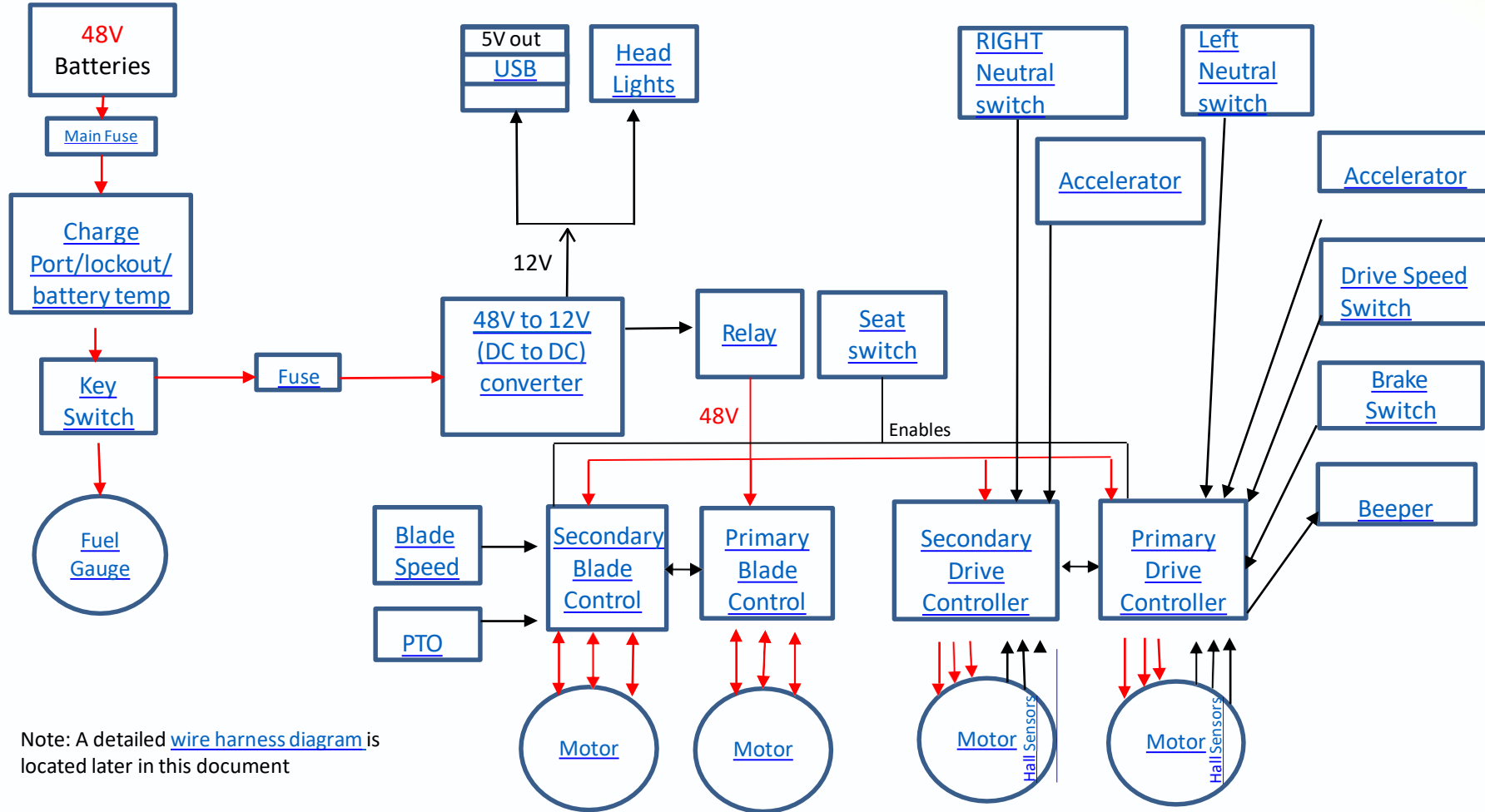
**15 mm**

**17 mm**

**19 mm**



# BLOCK DIAGRAM AND CONTROL FLOW



Note: A detailed [wire harness diagram](#) is located later in this document

**Important:** Primary and secondary have a communication link. If one blade motor or controller fails, BOTH will shut down.



- Follow the [Block Diagram](#) on the previous page.
- ***Check for loose/bad connections.***
- Test the easiest components first. (power, key switch, DC-DC converter)
- Mower should be fully charged (if possible)
- *Before* disassembly:
  - Attempt to charge mower (note any error LED indications)
  - Check for voltage at charge port.
  - Check [USB Indicator](#) and [Headlights](#) are functional (this tests the 48V- 12V converter)
- Remove [Instrument Panel](#) cover
  - [Test Key Switch](#)
  - Check all other connections while panel is removed.



# TROUBLESHOOTING: DETAILED

Use the [block diagram](#) as a guide

Also refer to the [beep diagnostic code chart](#)

1. Verify the battery charger is functional by plugging it into the charge port on the back of the mower and let the mower fully charge.
2. If necessary, further test the [charger](#) and [charge port](#). Replace as needed. [Charge port](#), [Interlock](#), and [temperature sensor](#) *should be replaced together*.
3. [Test the key switch](#) by operating it, making sure it has a tactile “click” when turned on or off. Replace if necessary
4. [Test and replace main relay](#) and [diode](#) as necessary. (Note: when you turn the mower on, you should hear the relay click)
5. Check the [main fuse](#). *If it is blown, check the system for signs of a short circuit before replacing the main fuse*
6. If the fuel gauge has power, but no display or malfunctions, [replace the fuel gauge](#)
7. If ONLY the fuel gage works when the key is turned on, [test/replace the 48-to-12V DC converter](#) and [5A fuse](#) as necessary Note: this fuse is a common part available at any automotive store

8. If the mower will not drive
  - a. Make sure the [seat switch](#) is functional and activated.
  - b. Test the [angular transducers](#). Replace if necessary.
  - c. Test the [neutral switches](#). Replace if necessary.
  - d. Test the [brake switch](#). Replace if necessary.
  - e. If the mower still will not drive, [test the Drive Motor controllers](#). Replace if necessary.
  - f. Test the [drive motors](#) and [Hall sensors](#), replace as necessary
9. Test the blade operation by pulling up on the PTO switch
  - a. Make sure the [seat switch](#) is functional and activated.
  - b. [Test the primary and secondary motors](#). Replace as a pair if found bad
  - c. [Test the primary blade](#) and [secondary blade controllers](#). Replace as a pair if found bad.
  - d. If the mower blades still will not operate, [replace the Drive motor controllers](#) (same as step 8e above)
10. If the mower works except for the headlights, [test the headlight switch](#) and [headlights](#). Replace as necessary

## DIGITAL MULTIMETER (DMM)



Typical DMM (Fluke 87). Note the dial is set to the “DIODE” function. this function will be used in many of the following procedures.

Also note where the **red** and **black** jacks of the test leads are connected to the DMM.

If you are unfamiliar with a DMM, please read the section [Electronics Tips for the Mechanical Small Engine Technician](#)





# COMPONENT LOCATIONS

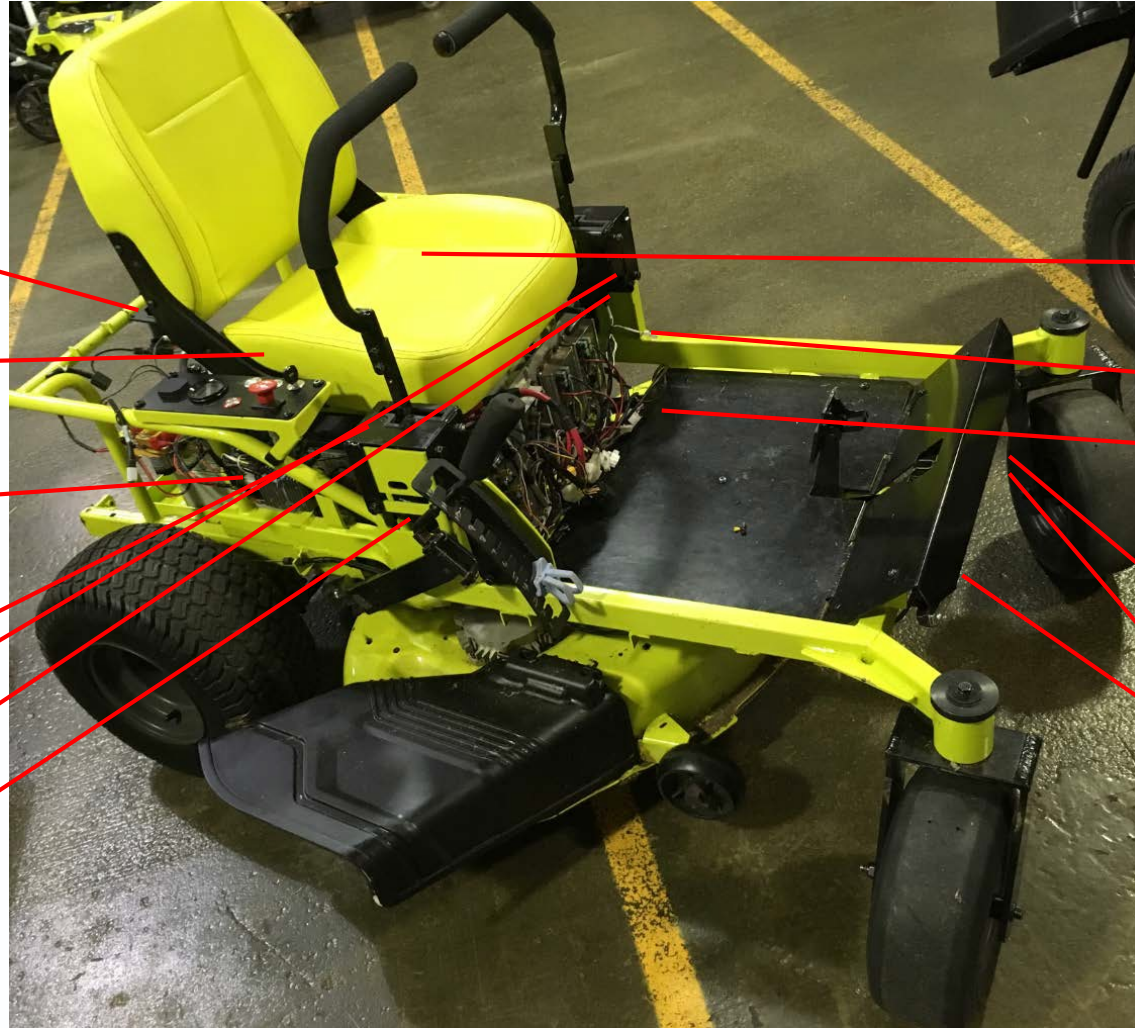
Charge port

Access panel  
(under seat)

DC-DC  
converter

Neutral "zero"  
Switches

Accelerator  
transducers



Seat  
Switch

Beeper

Controllers

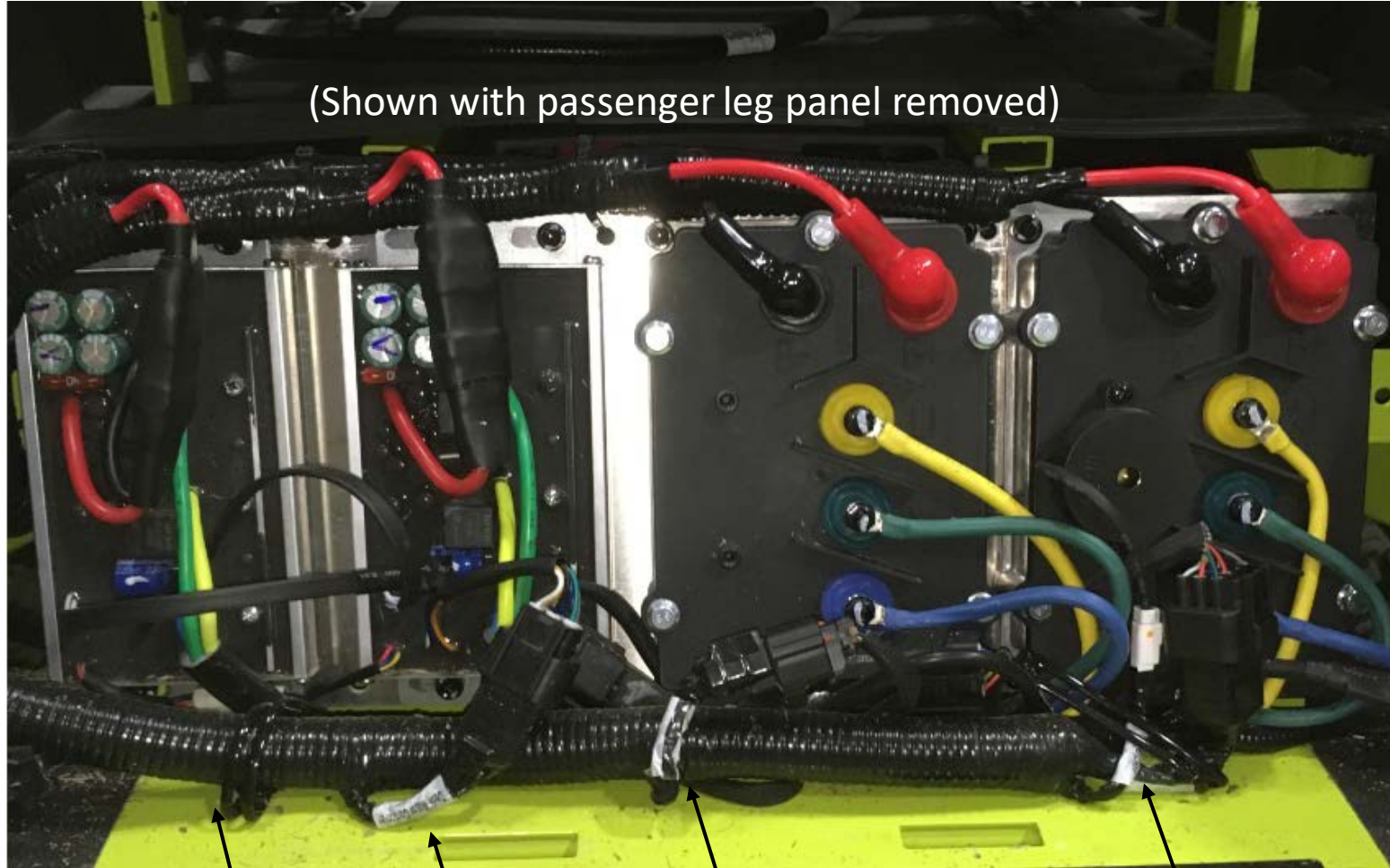
Brake Switch

Headlights



# CONTROLLERS AND LABEL LOCATIONS

As a note the RY48140 will have 3 deck motor controllers with 2 being Secondary and 1 as a Primary

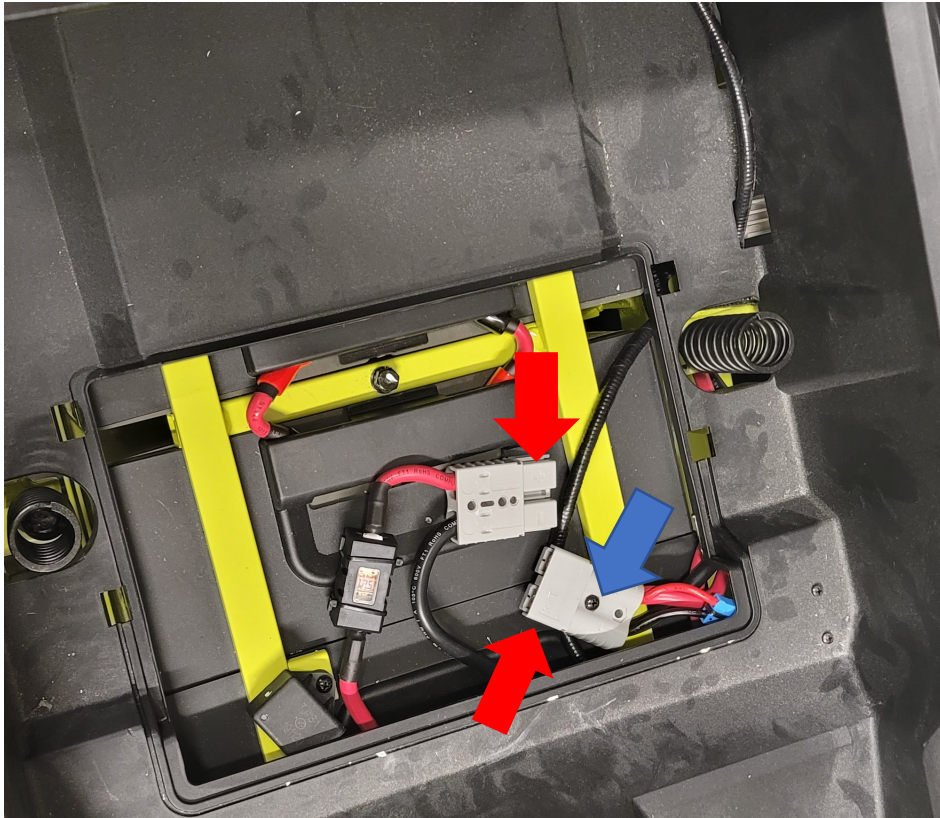


“Deck Motor Controller” “Deck Motor Controller” “Drive Motor Controller 2” “Drive Motor Controller”





## MAIN BATTERY CONNECTION



The main battery disconnect is located directly under the seat access cover. It may take considerable pressure to separate the halves.

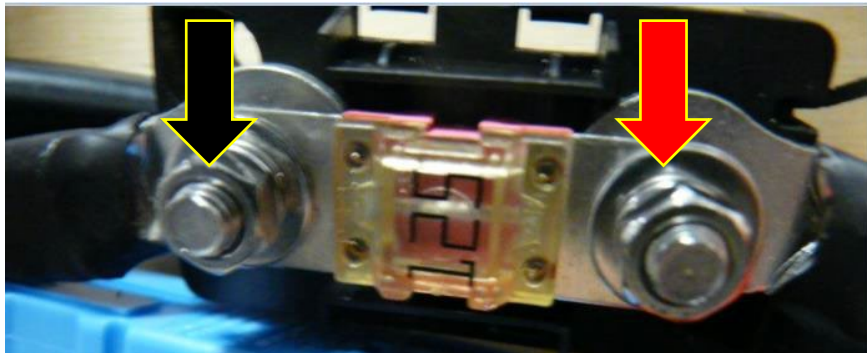
If you can not separate by hand, you may need a blunt instrument to push in the hole in the direction indicated.

**NOTE THAT ONE HALF OF THE CONNECTOR IS SCREWED TO THE FRAME AND WILL NOT MOVE. BE CAREFUL NOT TO DAMAGE THE CONNECTOR.**

**IMPORTANT:** *If the main fuse is blown, find the source of problem before replacing fuse*



Where probes go



### 1. **Disconnect main battery connection**

2. Open the plastic box to access main fuse.
3. Set DMM to **Resistance  $\Omega$  symbol on DMM**
  - Measure were indicated to the left.
  - Ensure the nuts are tight, but not overtightened, as this can cause the fuse to twist and break.

If fuse is blown,  
**Replace only with the same physical size and same Amperage.**



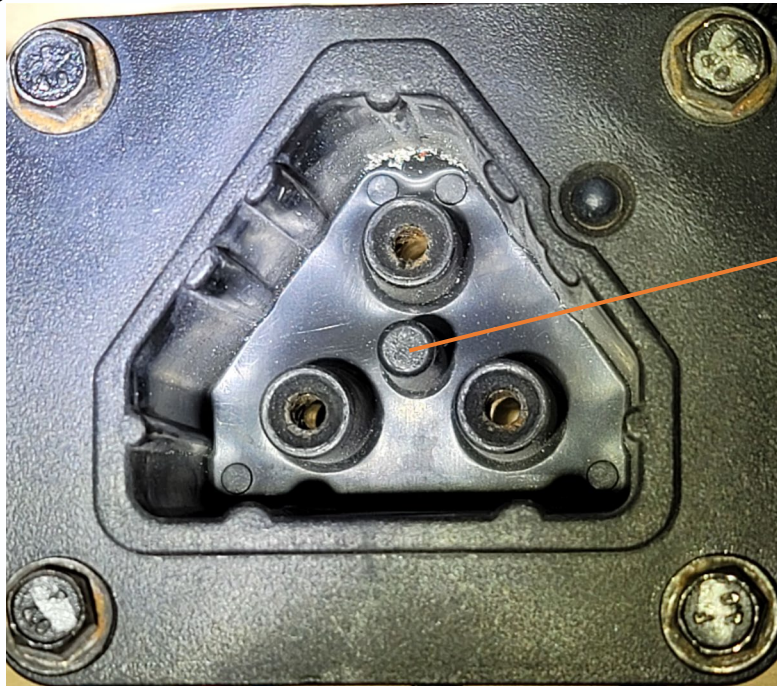




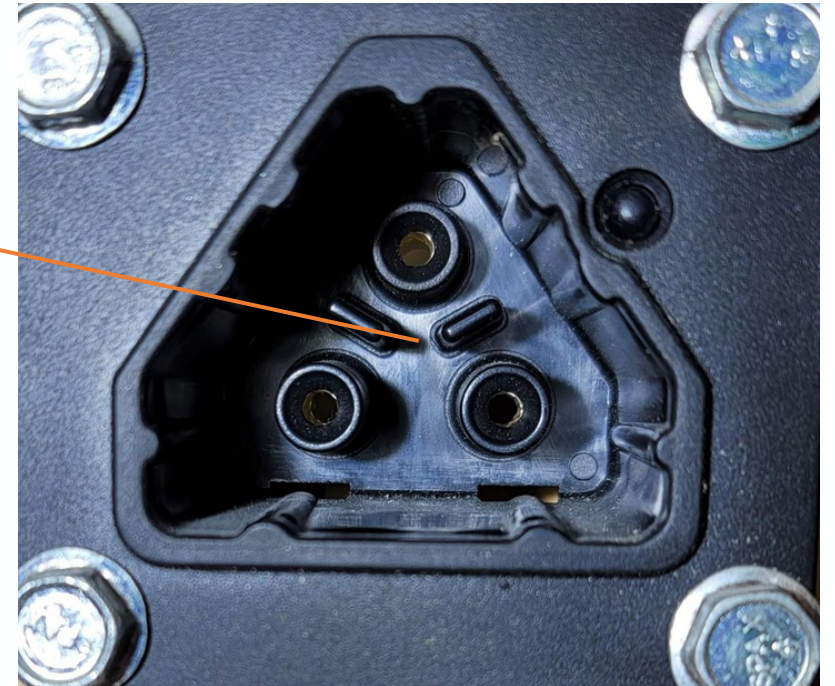
# CHARGING PORT

## Two Different Charging Ports

The Charging port on the Left is the Gen 1 charger.



The Charging port on the Right is the Gen 2 charger.

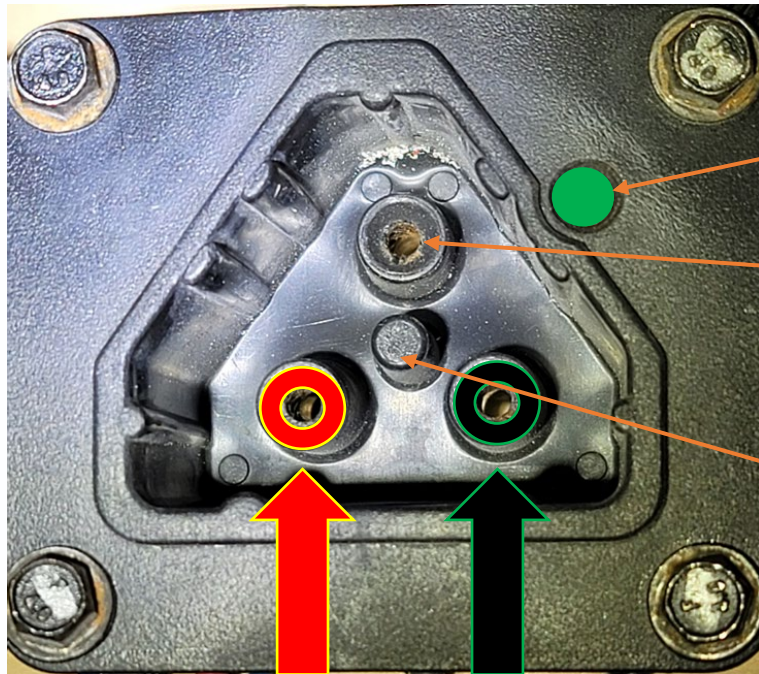


Note the Different indexing plugs.

Make sure when ordering charging port or charger they are the same type.

## BATTERY VOLTAGE TEST

1. Set DMM to “**DC Volt**” mode.
2. Turn mower on.
3. Pull PTO switch up (Power Take Off/Blade Engage knob) to load the battery for more accurate measurement.
4. Place **RED** DMM probes indicated by red arrow, **BLACK** probe by black arrow



Charge Indicator LED (LED should blink in similar pattern to charger when charger is connected)

Charger Interlock

*Note: New mowers have a different pattern of Indexing pin. When requesting repair parts, send a picture of this connector to ensure proper parts For the charger and charge port*

Note: If a valid voltage cannot be read, the electronics built into the charge port may be bad. In this event, find the blue connector which connects directly to the batteries. Disconnect it, and measure battery voltage

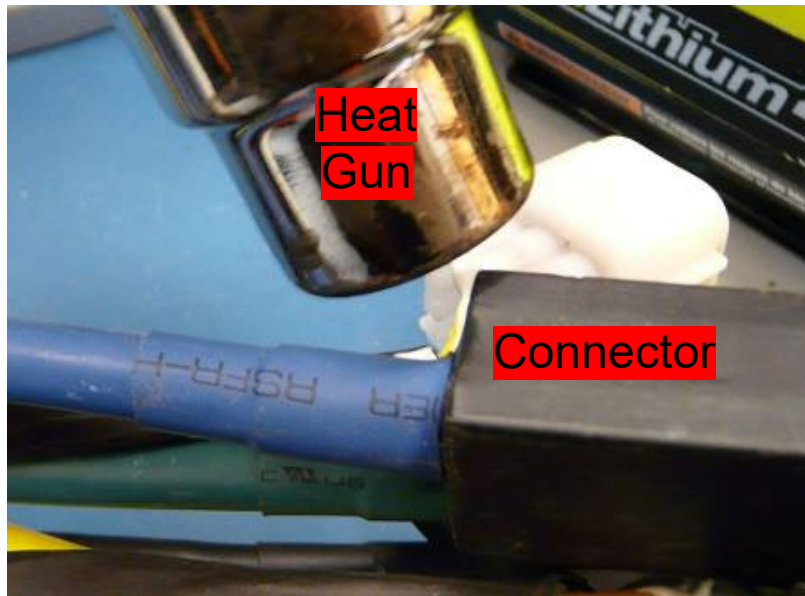






# SEPARATING CONNECTORS

Many of the connectors are sealed together with heat shrink tubing. To separate the connectors, soften the heat shrink with a heat gun, then peel the heat shrink tubing off with pliers as shown.



When reassembling connectors, be sure to apply new heat shrink tubing and shrink with a heat gun to protect against elements and hold the connections together.

***Extra care is needed to avoid damaging surrounding parts by the heat. Be careful of the batteries.***



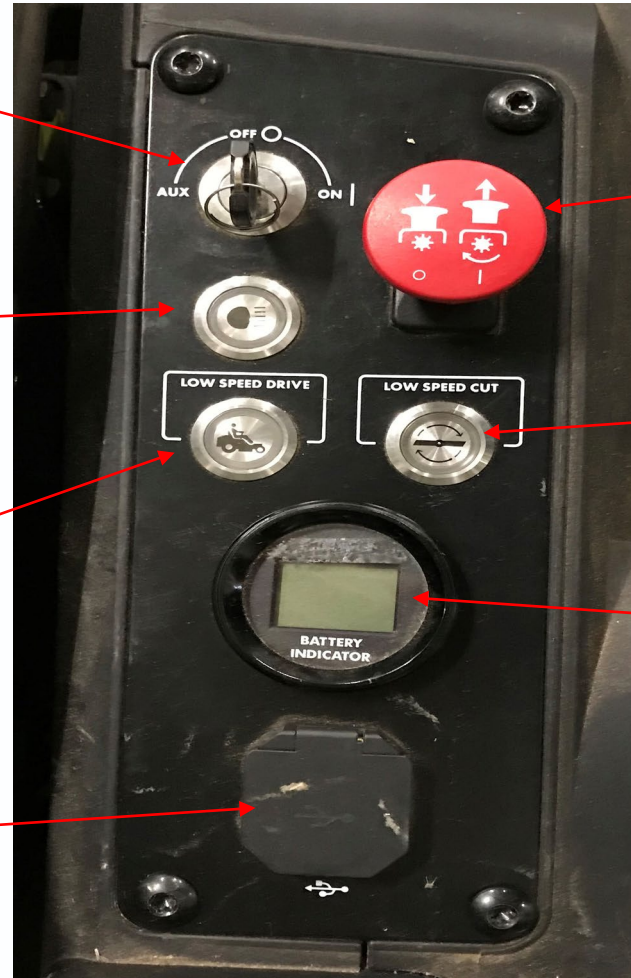
# CONTROL PANEL

Main Power Key Switch

Headlight switch

Low Speed Button

USB Charger



PTO  
(Power Take Off)

Low Speed Cut Button

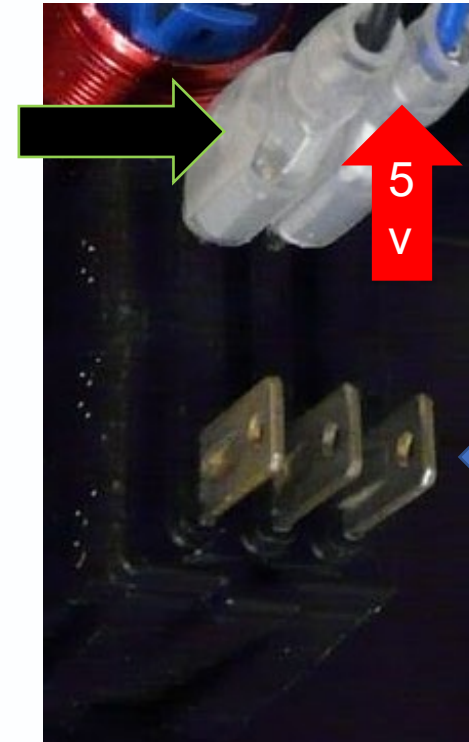
Fuel Gauge/ Hour Meter



1. **Mower Power OFF**
2. DMM set to measure **Resistance**
3. Insert DMM probes where indicated. When red button is **PULLED OUT**, the switch is **CLOSED** (very LOW resistance or continuity)



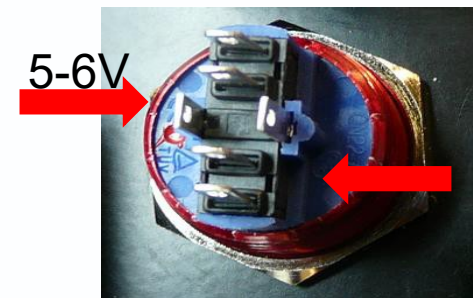
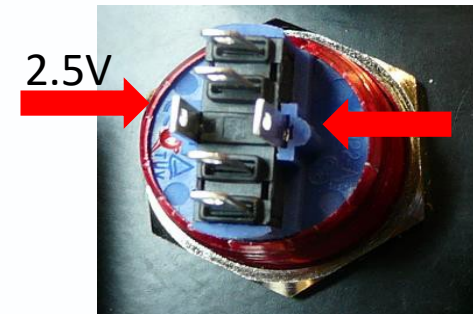
4. When red button is **PUSHED IN**, the switch is **OPEN** (very HIGH resistance or no continuity)



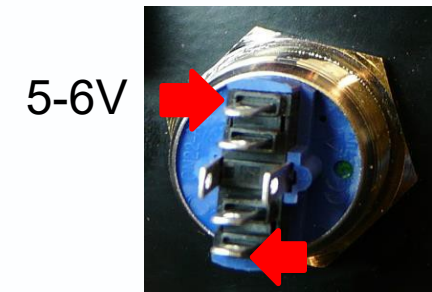
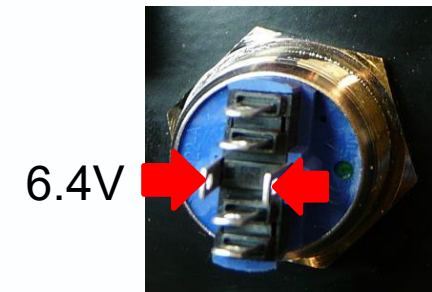
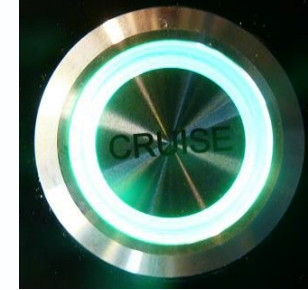
Note: Make sure spade plugs are secure. They should be locked in place and should not come loose if the wires are pulled on.

Note: these terminals are not used

1. **DISCONNECT MAIN POWER FROM MOWER.**
2. Set DMM to "**Diode**" mode.
3. Touch leads where indicated. LED should light (polarity of probes does not matter).
4. Set DMM to "**Resistance**" mode. Switch is normally open (N.O.). Measure continuity when button held in. Measure high resistance when released.

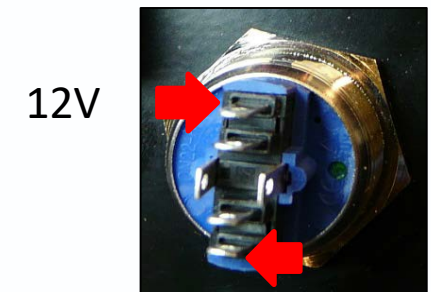
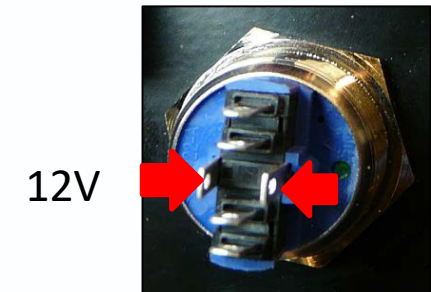
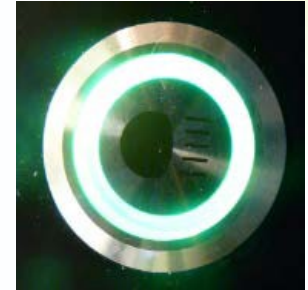


1. **Disconnect Main Power from Mower.**
2. DMM set to "**Diode**" mode.
3. Touch the leads where indicated. LED should light
4. Set DMM to **Resistance** mode. This is a *latching* switch. Pressing the buttons alternates between open and closed.





1. Disconnect Main Power from Mower.
2. DMM set to "Diode" mode.
3. Touch the leads where indicated. LED should light
4. Set DMM to **Resistance** mode. This is a latching switch. Pressing the buttons alternates between open and closed.





- This test procedure is the same as the headlight switch procedure.
- The only difference is these switches are momentary.
- When the button is held in, the switch is closed.
- When the button is released, the switch is open.



# TESTING FUEL GAUGE/ HOUR METER

Percent Charge remaining

Approximate charge remaining



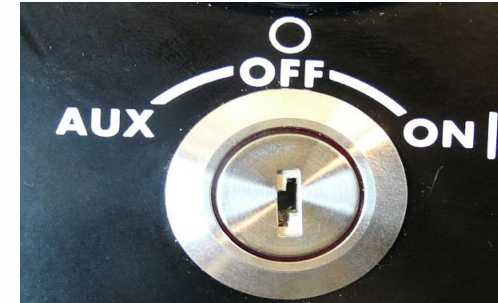
Total hours of use  
(mower must be on  
Continuously for a minimum  
of 6 minutes for time to change)

1. Turn Mower switch ON.
2. Set Volt meter to "DC VOLTS".
3. Measure battery voltage between **Red** and **Black** wire (below, left)
4. Measure battery voltage between **Black** and **Blue** wires (below, right) Approximately 51V fully charges, no load





1. Set DMM to DC Volts
2. With Power switch OFF, measure battery voltage where indicated
3. With Power ON, measure approx. 0V where indicated



Note this switch operates at **48V DC**

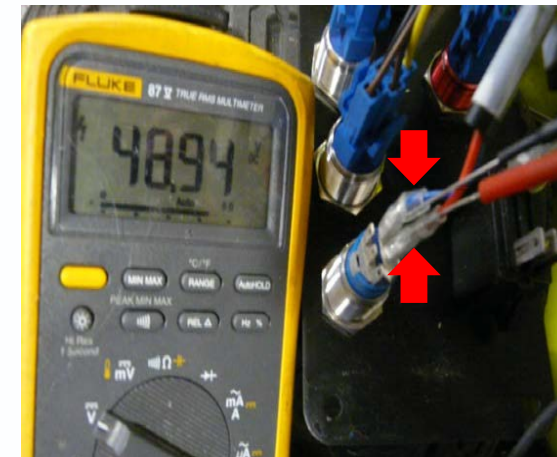
**To measure Switch with wires disconnected:**

***Set DMM to measure continuity***

**OFF** position: No continuity between green and red wire.

**ON** position: Continuity between green and red wire.

**AUX** position: Not used at time of this writing.

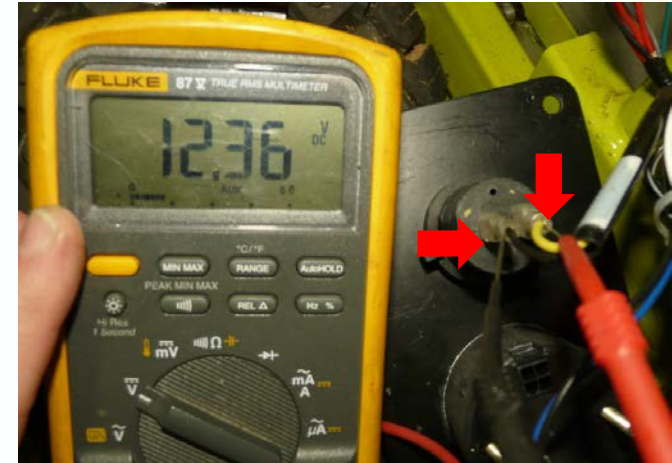




The USB port is marked "+" (yellow wire) and "-" (black wire).

1. Power ON Mower.
2. Set DMM to measure **DC Volts**.
3. Connect a scrap USB cord with one end removed.
4. Measure 5V between the red and black wire

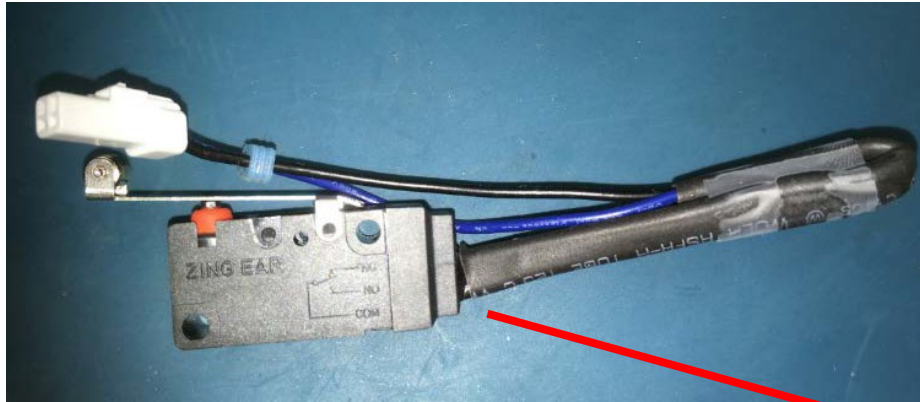
USB power indicator LED\*  
Measure 12V where indicated below. If LED indicator is not on, USB port is bad.



Note: The "+" spade lug is larger than the "-" lug

\*USB operated 11.5v-12.5V nominal power IN, 5V OUT. The LED indicates there is power IN, But **does not guarantee the USB 5V out is working.**

## TESTING THE ZERO SWITCHES



A zero switch is located at the base of each steering arm

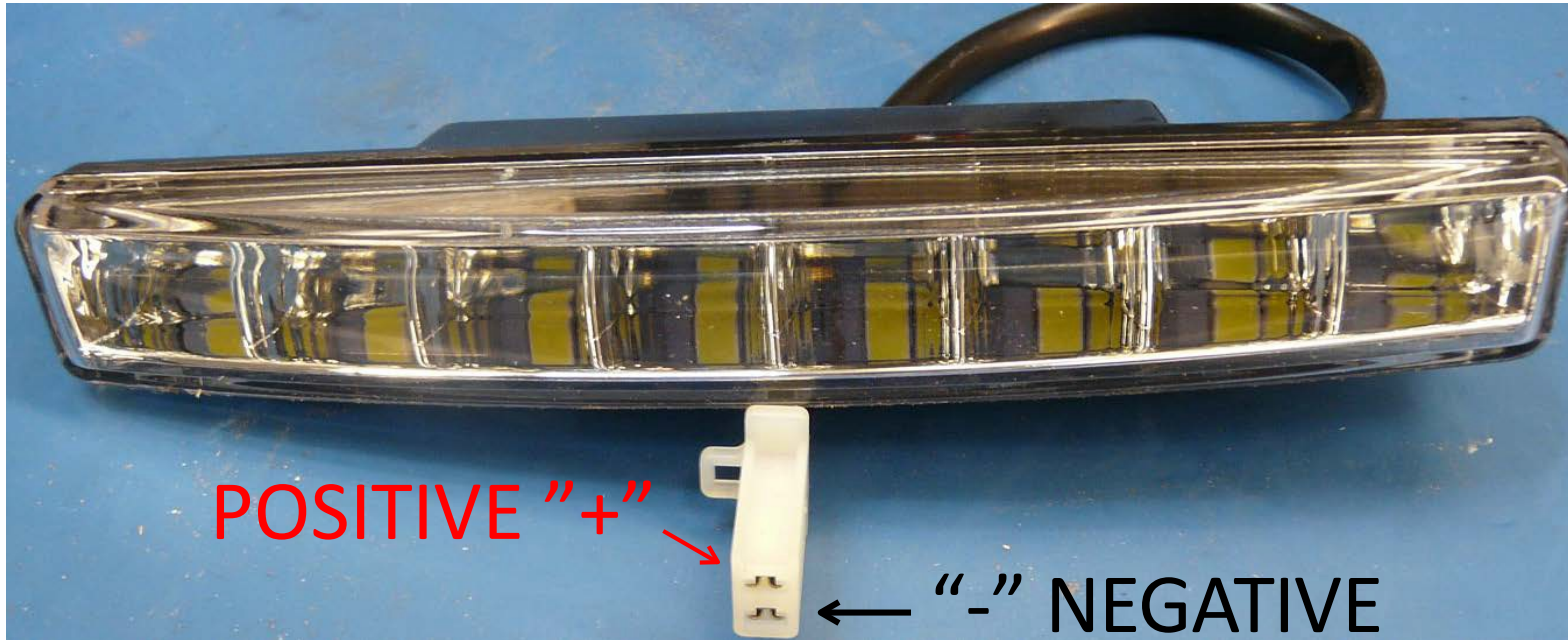


## TESTING THE NEUTRAL SWITCHES



1. Set meter to measure continuity and connect probes
  2. With switch NOT pressed, measure **No** continuity
  3. With switch pressed, measure continuity
  4. Make sure wires and connector are in good shape and wires don't pull loose
- Note: the switches are pressed when the steering arms are in the out position

## TESTING HEAD LIGHT ASSEMBLY

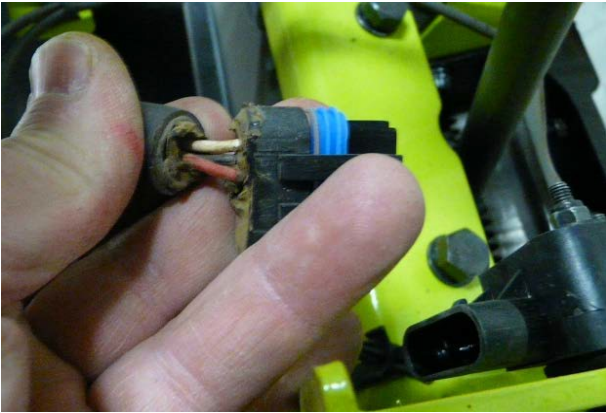


1. Power on Mower.
2. Turn on Headlights.
3. Set DMM to measure **DC Volts.**
4. Measure for 12V at harness.

### To test Headlight module independently:

1. Disconnect Headlight from wire harness.
2. Supply 12V to the connector as shown above.

*Nominal current: 275mA*



## Test for Voltage at Harness

1. Set DMM to measure DC Volts.
2. Disconnect Accelerator connector.
3. Turn mower on.
4. Measure 4-5V between red and black wires on *harness*.

4.25V typical



## To Test Transducer Independently:

1. Set DMM to measure DC Volts.
2. Connect 5V power to pin that mates with Red wire on harness and ground to pin that mates with black wire to harness.
3. Place probes on White (signal wire) and black (ground).
4. Slowly turn the accelerator with a coin. Voltage should change gradually between 0V and approx. 4.7V.



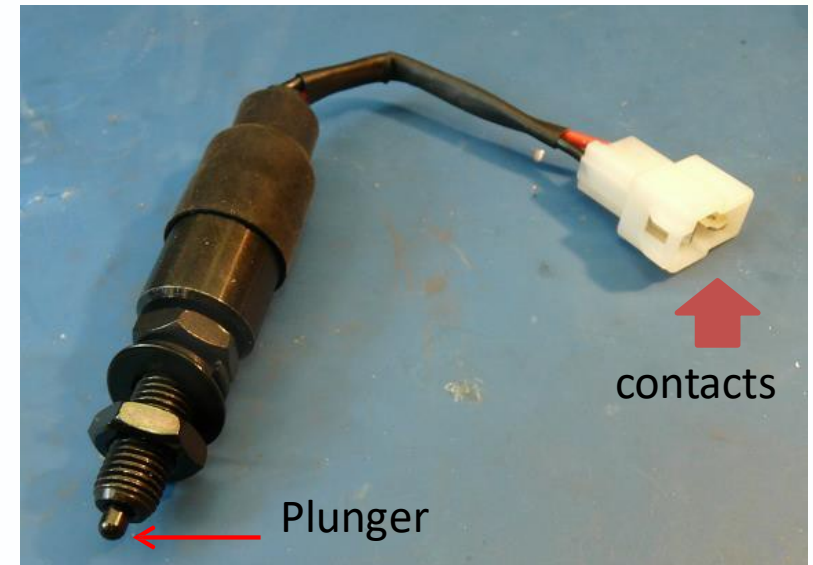
1. Turn Power Off.
2. Disconnect brake switch connector.
3. Measure voltage at the contacts.

**To test brake switch independently:**

1. **Power OFF Mower.**
2. Set DMM to measure **Resistance.**
3. Connect DMM leads to black and red contacts.

Continuity when plunger is NOT pressed.  
High resistance when plunger pressed.

5.4V nominal when plunger depressed



## TESTING THE BEEPER

Test by disconnecting connector and connecting 12V “+” to red wire and “-” to black ground wire of beeper.

Or put mower in Reverse.

This should cause beeper to activate.



### To measure the voltage at the harness:

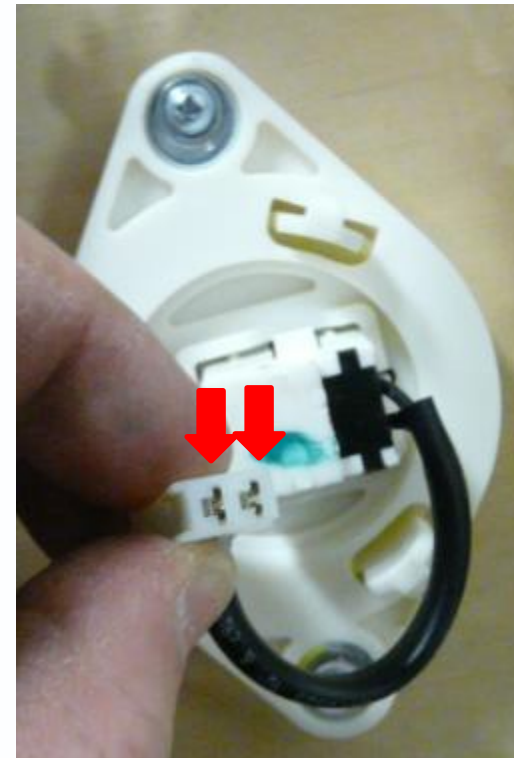
1. Set DMM to measure voltage.
2. Set mower to REVERSE.
3. Place probes in harness socket.
4. Measurement display should alternate between 0 and 12V.

1. **Power Mower OFF.**
2. Set DMM to measure **Resistance**.
3. Disconnect seat switch connectors.
4. Measure continuity when switch is pressed.
5. Measure very high resistance when switch is released.

0-2 Ohms nominal continuity when pressed

### **To Measure the harness:**

1. Turn ON the mower.
2. Set DMM to **Volts**.
3. Measure 5VDC between the 2 pins on the harness.

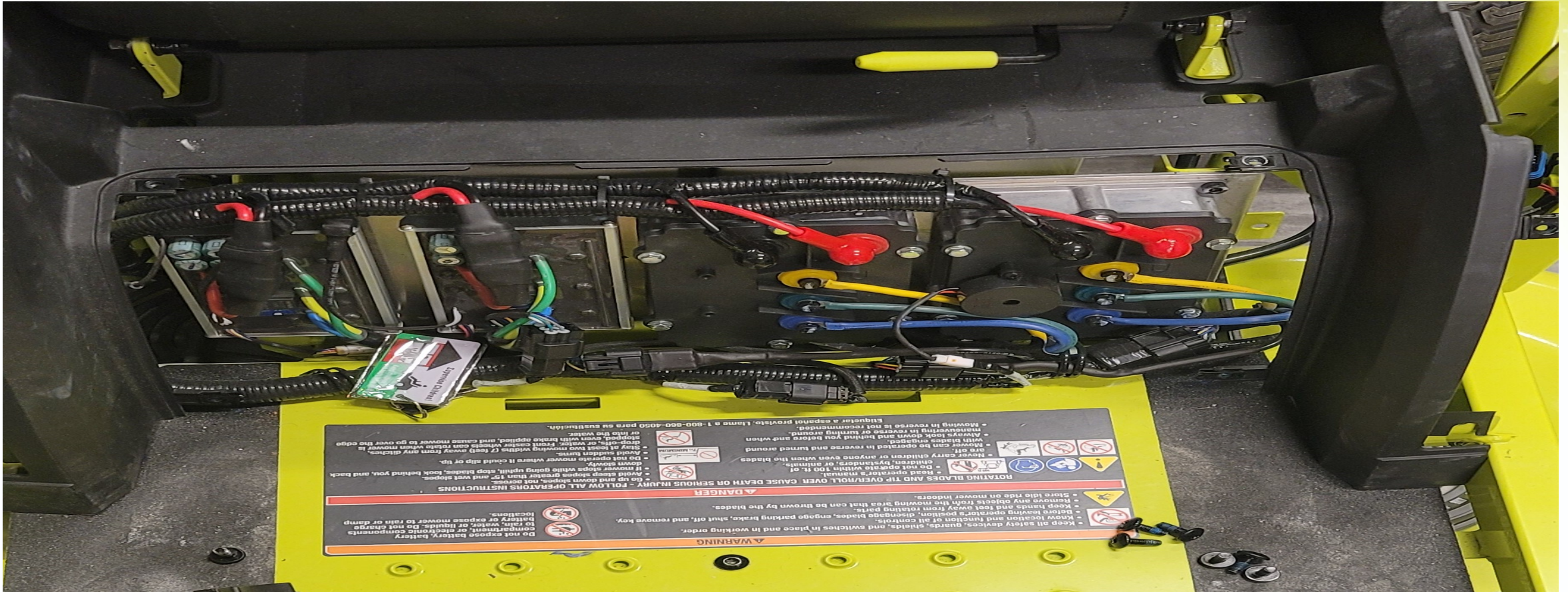


Note: this switch operates at 5V.





# CONTROLLER LOCATION



The only difference between the RY48ZTR's and the RY48140 is that there are 3 deck controllers  
One primary and two secondary controllers



## TESTING PRIMARY BLADE CONTROLLER

### Test for short circuit:

1. Disconnect all connectors to Primary Controller.
2. Temporarily touch a wire between “+” and “-” wires to drain capacitance.
3. Set meter to ***Resistance Mode***.
4. Connect DMM probes to heavy red wire (power) and heavy black (ground) wire to check for short circuit

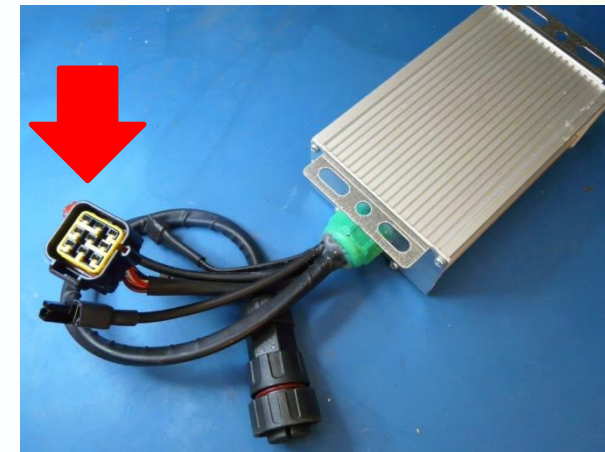
Typical resistance: 1.46M

### Check resistance of controller output:

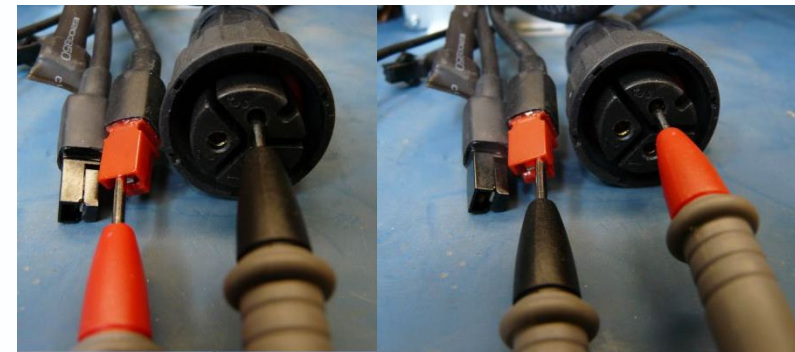
1. Set DMM to ***Resistance*** Mode.
2. Check continuity between any two terminals .
3. Check continuity between other terminals.
4. Both measurements should be nearly identical.

### Test Power and Ground to output circuitry

1. Set DMM to ***Diode*** mode
2. Connect black lead of DMM to heavy black wire (ground).
3. Sequentially connect the red probe wire to each pin shown above.
4. Meter should read “Open” for each pin.
5. Connect black lead of DMM to heavy RED wire (ground).
6. Sequentially connect the red probe to each pin.  
DMM should measure approx .48V for each pin (indicating diode good).



Note: ***Primary*** Controller is identified by additional large square connector as shown above.  
***Secondary*** Controller does ***not*** have this connector



### Test for short circuit:

1. Disconnect all connectors to Secondary Controller.
2. Temporarily touch a wire between “+” and “-” wires to drain capacitance.
3. Set meter to **Resistance Mode**.
4. Connect DMM probes to heavy red wire (power) and heavy black (ground) wire to check for short circuit.

Nominal resistance: 1.45M Ohms

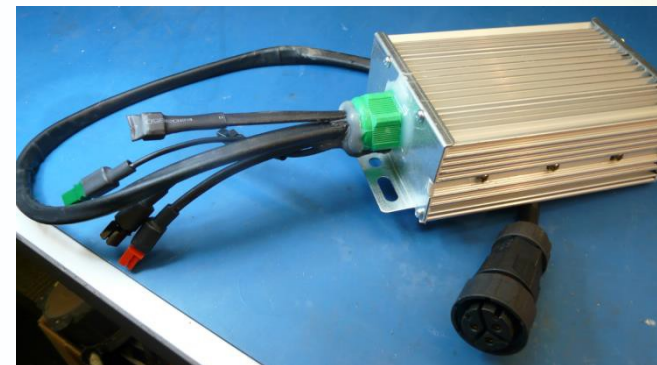
### Check for resistance controller output:

1. Set DMM to **Resistance** Mode.
2. Check continuity between any two terminals.
3. Check continuity between two other terminals.

Nominal resistance: 18K Ohms

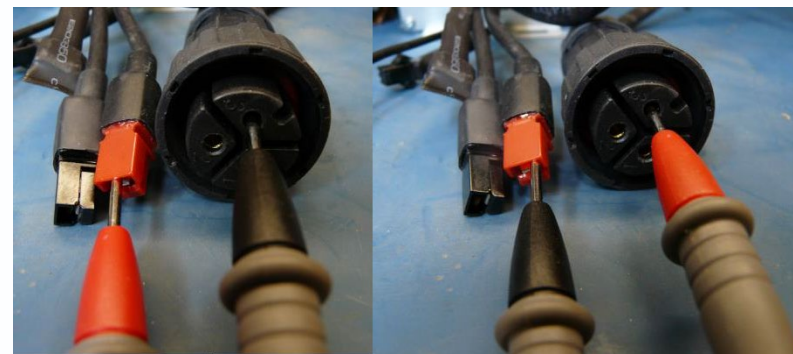
### Test Power and Ground to output circuitry

1. SET DMM to **“DIODE”**
2. Connect black lead of DMM to heavy black wire (ground).
3. Sequentially connect the red probe wire to each pin. Meter should measure “open”.
4. Connect black lead of DMM to heavy RED wire (ground).
5. Sequentially connect the red probe to each pin (diode test .4V).
6. Meter should measure approximately .48V.



Note: **Primary** Controller is identified by large square connector (see previous page).

**Secondary** Controller does **not** have this connector.







# TESTING DRIVE CONTROLLER

## Test for short circuit:

1. Set meter to **Resistance** Mode.
2. Connect DMM probes to heavy red wire (power) and heavy black (ground) wire to check for short circuit.

Nominal resistance: 750K Ohms

## Check resistance in controller output:

1. Set DMM to **Resistance** Mode.
2. Check continuity between any two terminals (heavy Yellow and heavy green for example).
3. Check continuity between two other terminals (2 and 3 for example).
4. The 2 measurements should be nearly identical.

Nominal resistance: 20K Ohms

## Test Power and Ground Resistance at output circuitry

1. Connect black lead of DMM to heavy black wire (ground).
2. Sequentially connect the red probe wire to each pin.
3. The measurements should be nearly identical.

Nominal resistance : open circuit

1. Connect black lead of DMM to heavy RED wire (ground).
2. Sequentially connect the red probe to each pin.
3. The measurements should be nearly identical.

Nominal resistance 10k Ohms



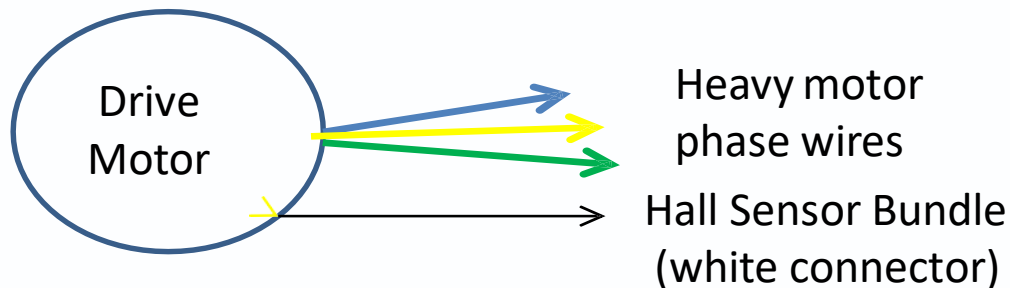
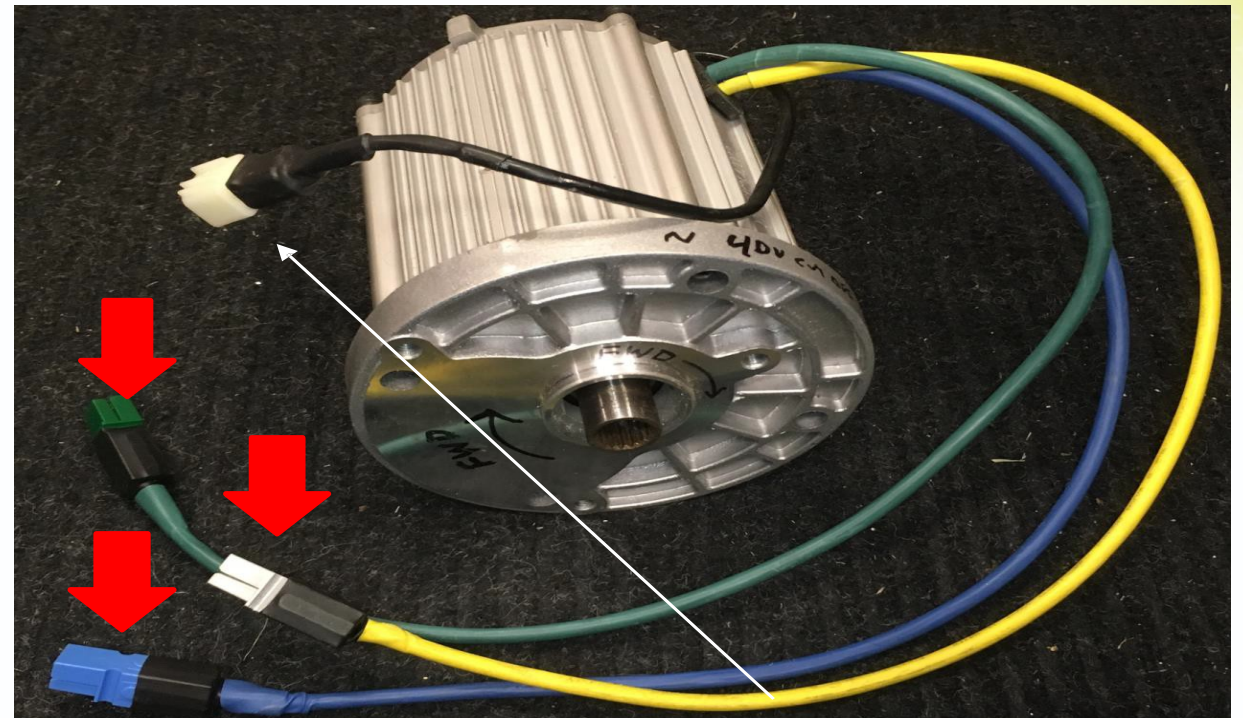


1. Disconnect Motor from controller.
2. Set DMM to Resistance mode.
3. Measure between any 2 pins.
4. Measure between other pins.
5. Measurements should be nearly identical.

Nominal resistance .1 Ohm

1. Set DMM to **Resistance** mode
2. Measure resistance between heavy green and heavy yellow wire.
3. Measure resistance between heavy green and heavy blue wire.
4. Measurements should be nearly identical.

Nominal resistance: 0.1 Ohm



Hall sensors



## TESTING DRIVE MOTOR HALL SENSORS IN MOWER

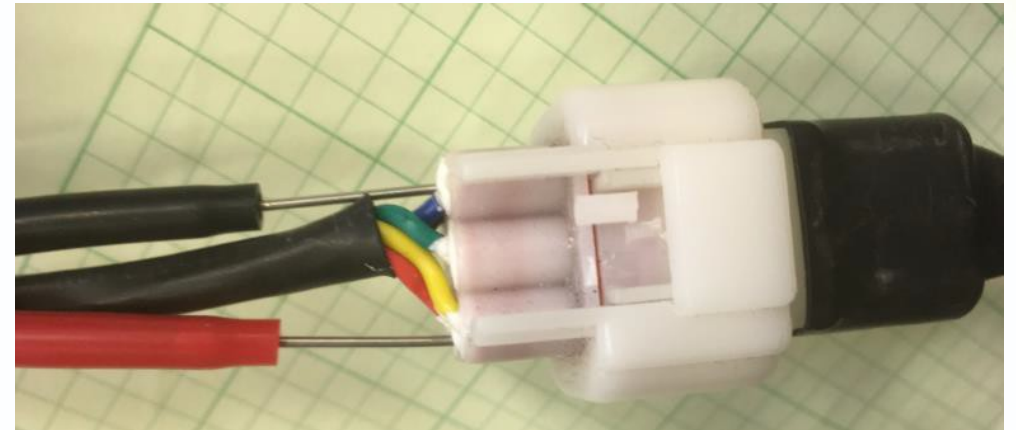
Note: power should be ON, and rear wheels raised so they can be rotated by hand.

Set DMM to “**DC Volts**”

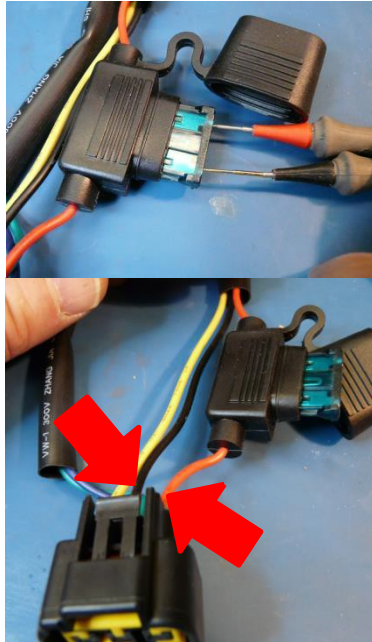
1. Touch red probe to red wire.
2. Black probe to black wire.
3. Should measure 4-5V.

*Leave black probe connected to black wire.*

1. Touch red probe to yellow wire Slowly rotate motor. Voltage should Jump between 0V and 4-5V.
2. Repeat with green wire.
3. Repeat with blue wire.



## TESTING 48V TO 12V (DC-DC) CONVERTER



### Testing Converter Fuse:

1. **DISCONNECT MAIN POWER.**
2. Check continuity of fuse.
3. If fuse is bad, replace only with same type and Amperage.

### Testing Converter:

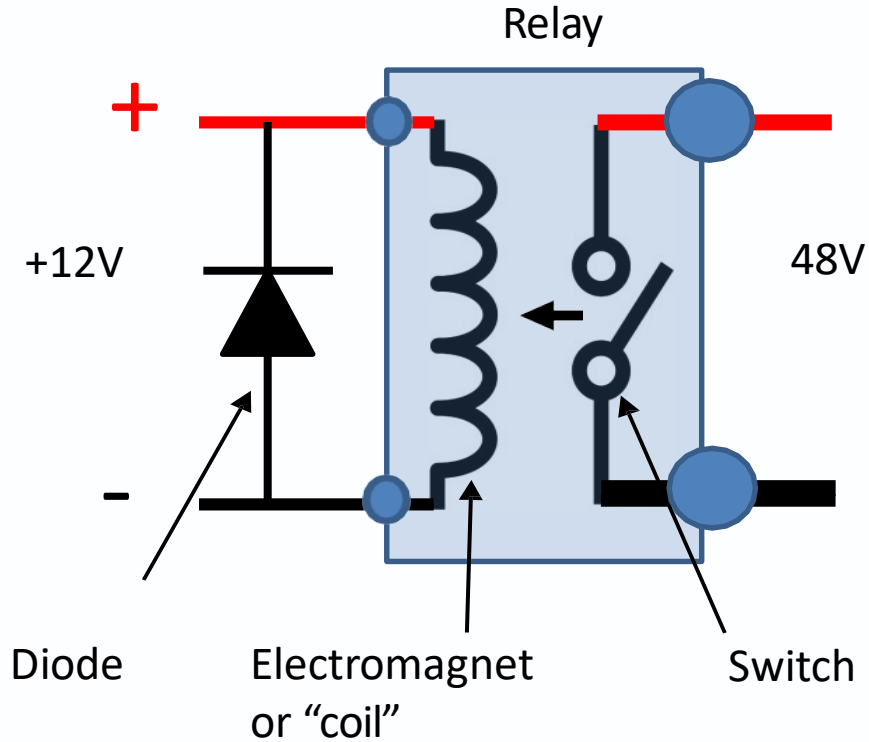
1. Turn mower on. Set DMM to “Volts”
2. Measure ~48V between Red and black wire as indicated.
3. Check for 12V output at blue and yellow wire.

### To test Converter Module Independently:

1. Apply 48V “+” to Red AND Yellow wire.
2. Apply “-” to black wire.
3. Check for 12V output at blue and green wire.

Note: Red and Black are 48V input Blue and green are 12V output  
Yellow is a control wire (48V) to turn on the output



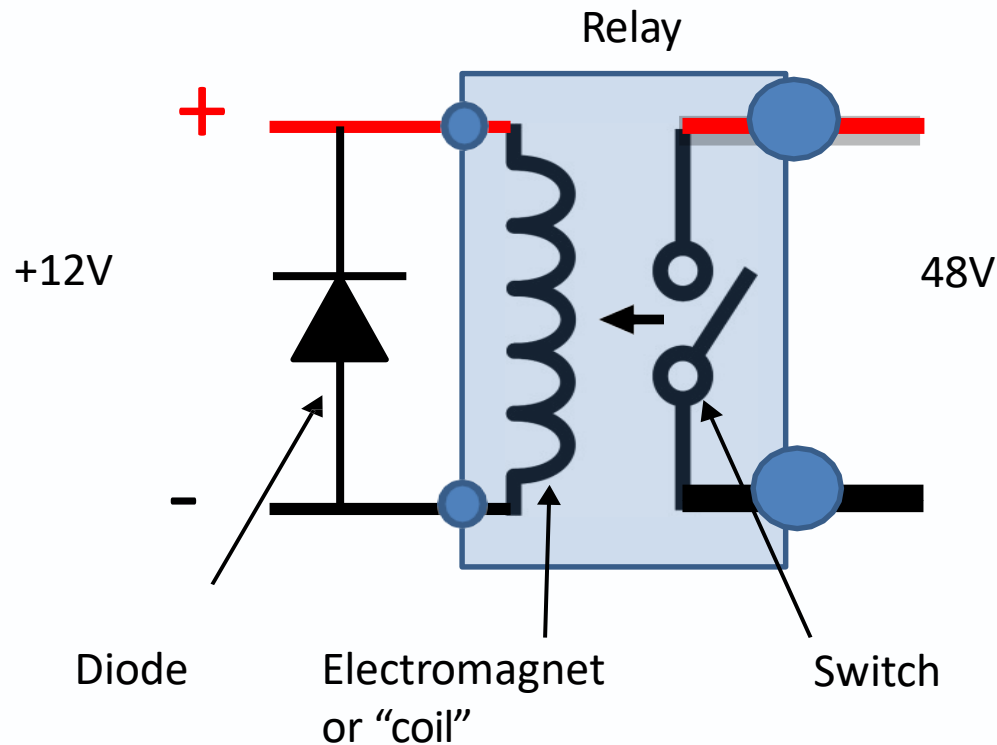


A relay consists of an **electromagnet** and a **switch**, controlled by the electromagnet, within a single package

When 12V is supplied to the two small terminals on the left of the relay, it causes the switch to close and supply 48V to the mower.

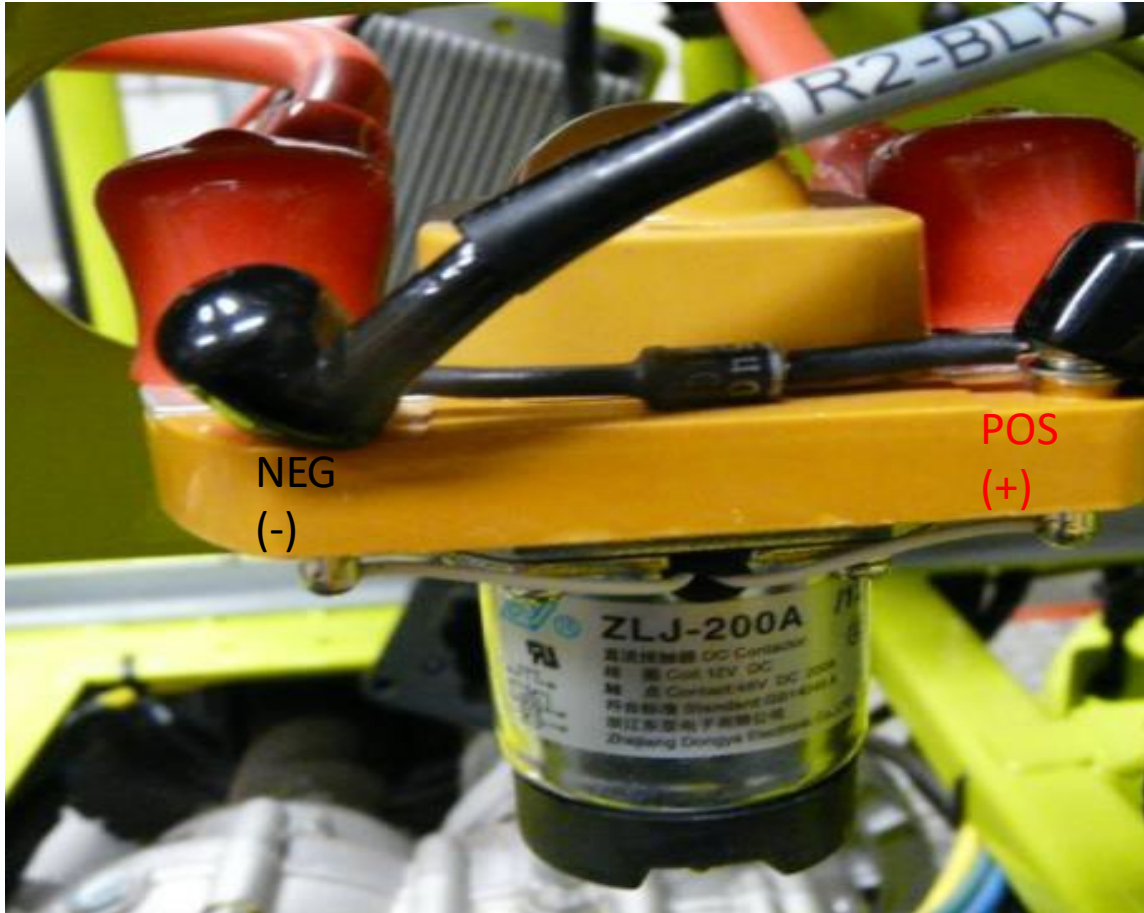
It is standard practice to add a **diode** across the electromagnet to suppress spikes. **It is very Important to connect the diode in the correct orientation!**





General rules of thumb:

1. When you turn on mower, you should hear a "clunk" when the relay engages. and also when you turn off the mower and the relay disengages.
2. If headlights work, the relay is good
3. If the relay "chatters", ensure all nuts are securely tightened on the relay



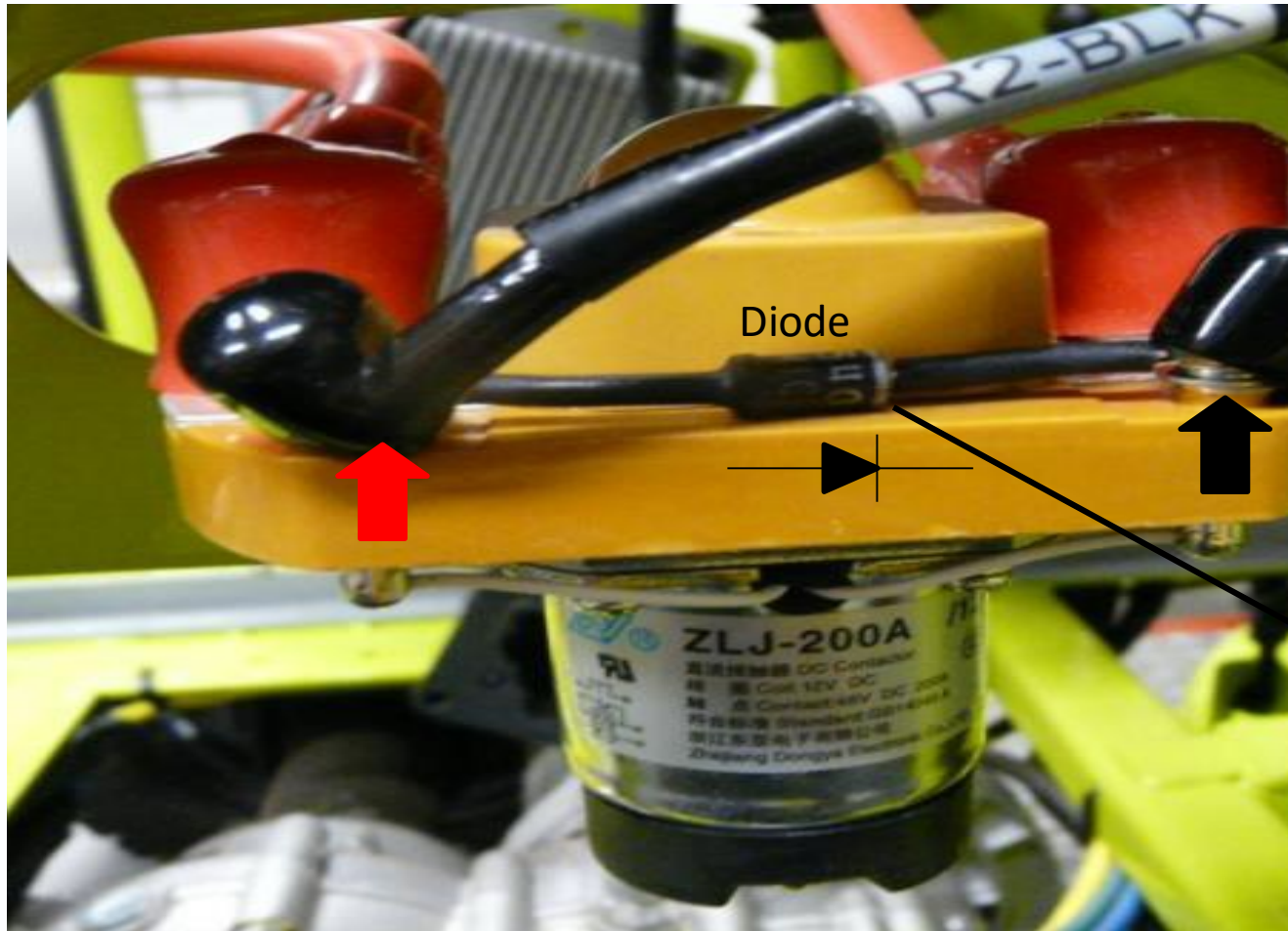
1. Power Mower ON.
2. Set DMM to "DC Volts".
3. Check for 12V on the small terminals (under the black caps).
4. Check for approximately 39+V on the large terminals (under the red caps).

### Alternate method to test relay independent of mower:

1. Unbolt one leg of diode if equipped.
2. Set DMM to measure Resistance.
3. Connect DMM to large terminals.
4. Apply 12V to small terminals.
5. You should hear a click as the relay switch is activated, and measure small resistance at relay terminals

**Nominal resistance 1.5 Ohms**

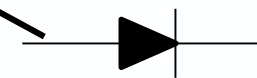
## TESTING RELAY DIODE



Diode Test:

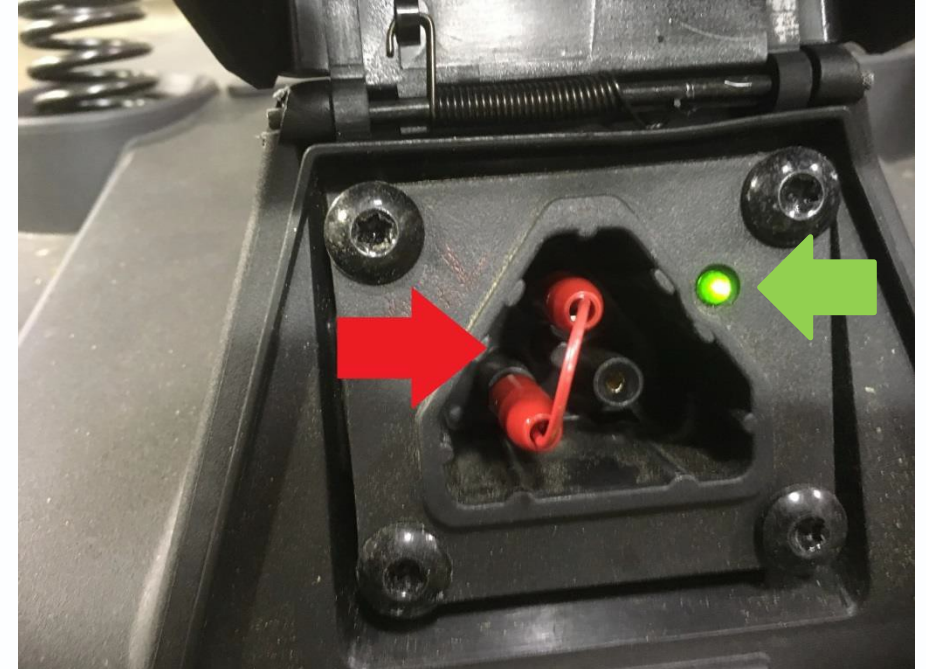
1. **Turn Mower OFF.**
2. Unbolt one leg of diode to disconnect from the circuit.
3. Set DMM to “Diode”.
4. Connect **red** lead at **red** arrow, **black** lead at **black** arrow. DMM should read approx 7V.
5. Reverse the **red** and **black** leads. DMM should read “open circuit”
6. Replace or reconnect diode.

*Note: Make sure diode is installed correctly. band on diode indicates polarity.*





1. Turn mower on.
2. Turn headlights on.
3. Connect a jumper wire as shown. (any insulated wire will do.)
4. Green charge LED should glow as shown.
5. Mower should shut down (relay clicks, headlights go out).
6. Remove the jumper wire.
7. After a few seconds, the mower should come back on (relay clicks) and headlights light again.





# TESTING BATTERY CHARGER

1. *Refer to photos on next page for this procedure*
2. **Disconnect main battery connection.**
3. Disconnect the blue charger wire connector
4. Connect the red alligator clip to the charger plug.
5. Connect the 2 black alligator clips to the other 2 plugs on the charger connector
6. Plug the charger into a 120V outlet.
7. Connect the other end of the jumper wires to the blue connector as shown (red to red, black to black)
8. Reconnect main battery connection.
9. The Charger LED should blink green.
10. **This is a temporary test. Remove wires immediately after test. Test should only take a few second**

*Note: There are no electronics needed for this test. But you will need suitable 12 gage wires as shown. This procedure will charge the batteries (if the charger and batteries are good). **Use caution Especially If using alligator clip jumper wires. Wear rubber gloves and eye protection.***

\* Note: The LED on the charger will NOT light until connected to mower



# CHARGER ERROR CODES

CODE	MEANING	SOLUTION
One red flash	Charge Enable Fault: May indicate poor contact at the charger connector or the battery temp is too hot (Greater than 122 F)	Check charger/ mower connection and remove any debris. Allow hot batteries to cool, Then try charging again.
Two red flash	Battery Voltage Fault: May indicate installed battery or batteries are less than 36v or more than 67.2v or they are too discharged or overcharged to be charged.	Batteries must be charged by another means to bring them to 36v or mower must be run to discharge batteries to below 67.2v.
Three red flash	Battery Charge Timeout: Charge time exceeded may indicate a problem with the mower batteries or that the charger output current was reduced due to high ambient temperatures.	Disconnect charger. Allow batteries to cool, then try charging again.
Four red flash	Battery Fault: Charge time exceeded indicates a problem with battery voltage not attaining the required nominal level within the maximum time allowed.	Disconnect charger. Check battery series configuration to be sure batteries are properly connected. Allow batteries to cool then try charging again.
Five red flash	Temperature Delay: Charger had to turn off its output due to excessive internal temperature.	Make sure the charger cooling fins are clear of obstruction and that the charger itself is not sitting in direct sunlight. If charger is hot, allow to cool before attempting to charge again.
Six red flash	Charger Fault: Internal fault detected	Unplug charger, then plug back in and try charging again.

\*Delta Q Charger Only



- Disconnect the plastic connector
- Set DMM to measure **RESISTANCE**.
- At room temperature, measurement should be approx 10K Ohms.
- As the sensor is heated, the resistance will *decrease*.
- *If sensor is not connected, the charger will blink an error code.*







# PRE AND POST REPAIR CHECKLIST

1. Jack rear tires approximately 2" off the ground and support securely with jack stands.
2. Sit on mower.
3. Turn main power key to "ON". The Fuel Gauge/Hour meter should light up.
4. Put FNR switch in FORWARD position.
5. Put accelerator at full speed and hold. Rear wheels should be turning...
6. Pull PTO knob up, blade motors should run and rear wheels should slow down . Turn off PTO, ensure blade
7. motors stop.
8. Put accelerator about ½ way down and press cruise. Cruise switch should light and wheels should continue to turn when accelerator is released.
9. Press RMO button. RMO light should come on.
10. Put in REVERSE and press accelerator. Turn on PTO. Blades should operate while wheels turn backwards. Beeper should sound.
11. Press headlights button. Button should light and both headlights should come on.
12. Check that USB has power by verifying blue indicator light is on.
13. Remove yourself from mower seat. Beeping should be heard when there is no weight on chair. Connect charger and verify charging LEDs are working correctly (green)
14. Attempt to start mower and drive away with charger connected. This should not be possible.

Beep codes: Continuous beeping = Normal occurrence when F-N-R switch is in REVERSE condition 3 beeps = key is switched to "ON" but no operator on seat.





# ZTR BEEP DIAGNOSTIC CODES

BEEP #	DESCRIPTION	CHECK:	IF NOT SOLVED...	IF NOT SOLVED...	IF NOT SOLVED...
1	Angle sensor not at neutral	Turn key off, return both levers to open, turn key on	Replace charger board	Check angle sensor connections	Replace control lever assembly
2	Over current	Return both levers to open and try operate again	Replace both drive controllers		
3	Motor stall	Return both levers to open and try operate again	Turn key off, push unit by hand and check if it can be easily pushed, if hard to push, check which side is hard to push.	Lift up the unit to allow rear wheels to spin freely. Check each wheel spinning and replace the motor/transmission assembly on the side that is binding	
4	Seat switch open	Use hand to push down the center of the seat and try again	Check seat switch connection and wiring integrity	Disconnect seat switch and short circuit the male terminal(mower side), if resolved, replace seat switch	
5	Under voltage	Fuel gauge if battery was charged above 5%, if not, charge the unit			
7	Over temperature	Return both levers to open and try operate again	Wait 30 minute and try again	Replace drive controllers	
8	Hall sensor fault	Return both levers to open and try operate again	Check hall sensor connectors and unplug and plug in again	Replace drive motor/gearbox assembly for the affected side	
10	Com port	Check com connectors, unplug and plug in again and tug on the wire to see if any wire is loose	Replace drive controllers		
11	Com port	Check com connectors, unplug and plug in again and tug on the wire to see if any wire is loose	Turn key off, and turn key back on	Replace drive controllers	
13	Self test	Check charger connector, unplug and plug in again and tug on the wires to see if any wire is loose	Turn key off, push unit by hand and check if it can be easily pushed, if hard to push, replace drive controllers		
17	Angle sensor failure	Return both levers to open and try operate again	Check angle sensor connections	Replace control lever assembly	
19	AD error	Return both levers to open and try operate again	Replace control lever assembly		
20	CPU error	Turn key off, return both levers to open, turn key on	Replace drive controllers		



## ELECTRONIC TIPS FOR THE SMALL ENGINE TECHNICIAN

A service person who has spent many years working on gas mowers may feel uneasy when working on the new generation of electric mower. If this sounds like you, fear not, you're not alone. This section is for you.

Keep in mind you were *born* with the most powerful trouble shooting tools:

*Eyes:* **LOOK** for signs of wear, deformation, disconnection, pinched wires, charger LED patterns

*Ears:* **LISTEN** for beeps (error codes), clicks (relay), squeals (bearings)...

*Nose:* **SMELL** overheated components, tranny oil leaks...

*Touch:* **FEEL (carefully)** if components are too hot or not warm at all, vibration

*Mouth:* **ASK** for help or a second opinion if something is in question. A second set of eyes and ears can do wonders.



# ELECTRONIC TERMS, SYMBOLS, AND TOOLS

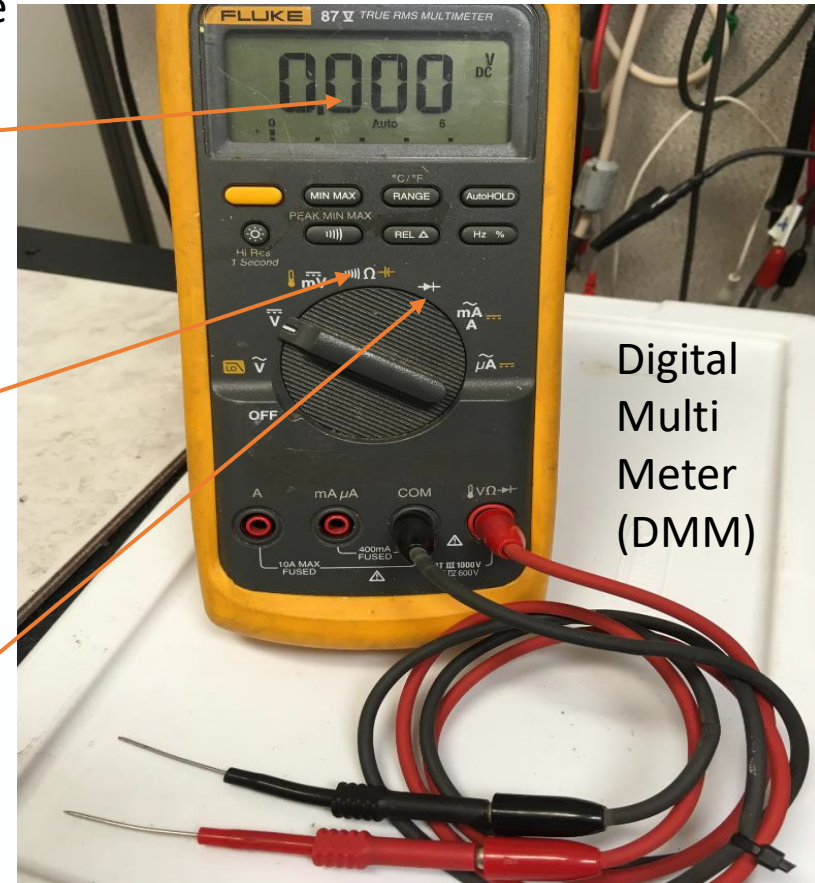
**Voltage** is potential Energy noted by the symbol “V”. For the scope of this document, we are only concerned With DC voltage. So be sure when setting the DMM to Measure voltage it is set to DC.

**Resistance** is opposition to the flow of current. Resistance is noted by the Greek “Omega” symbol, Which resembles a horse shoe or upside down “u” Measuring resistance is often used to detect continuity Or a break in a wire or switch.

A **Diode** is a device that allows current to flow in only one direction and blocks current flow in the other direction. A Diode is noted by the symbol  
The diode has a white band to indicate the polarity



White band



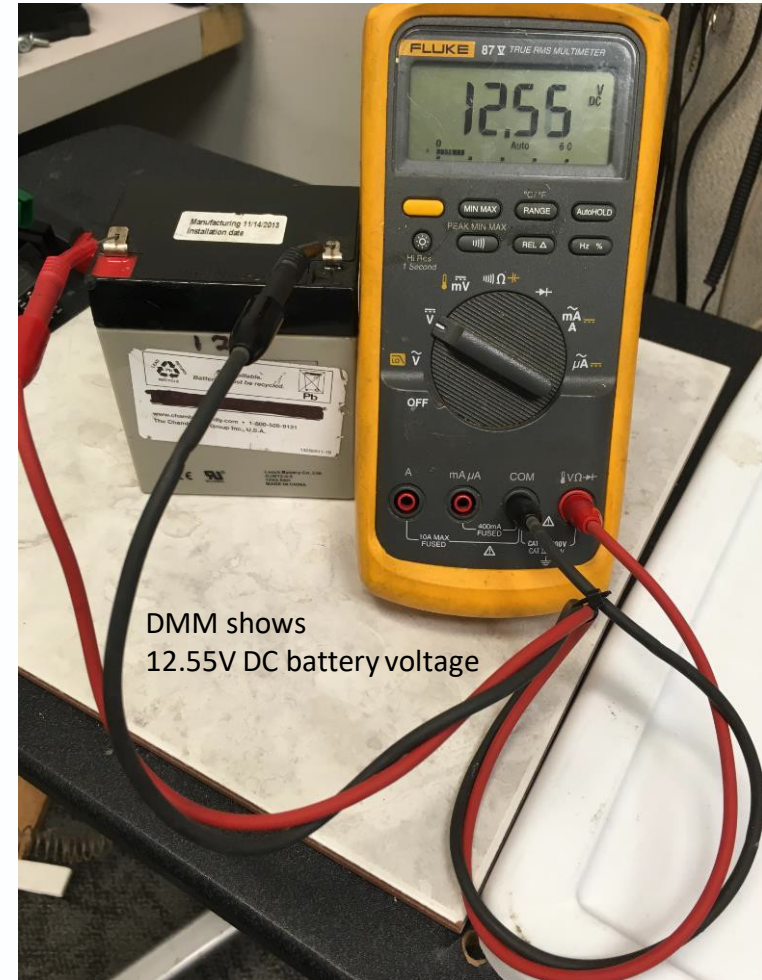
Digital Multi Meter (DMM)



*Before touching the probes of a DMM to Anything, be sure it is set to the correct setting*

To measure DC voltage:

1. first set the DMM to measure voltage, ensuring DC (NOT AC) setting
2. Touch the **Black** probe to ground
3. Touch the **Red** probe to voltage being measured



DMM shows  
12.55V DC battery voltage

*Before touching the probes of a DMM to anything, be sure it is set to the correct setting.*

**Power must be OFF when measuring resistance**

To measure DC voltage:

1. First, set the DMM to measure resistance
2. Touch the black probe to one point.
3. Touch the red probe to the other point.



The DMM in the photo displays 18.46 K ohms  
“K” means Kilo or 1,000 or 18460 Ohms

