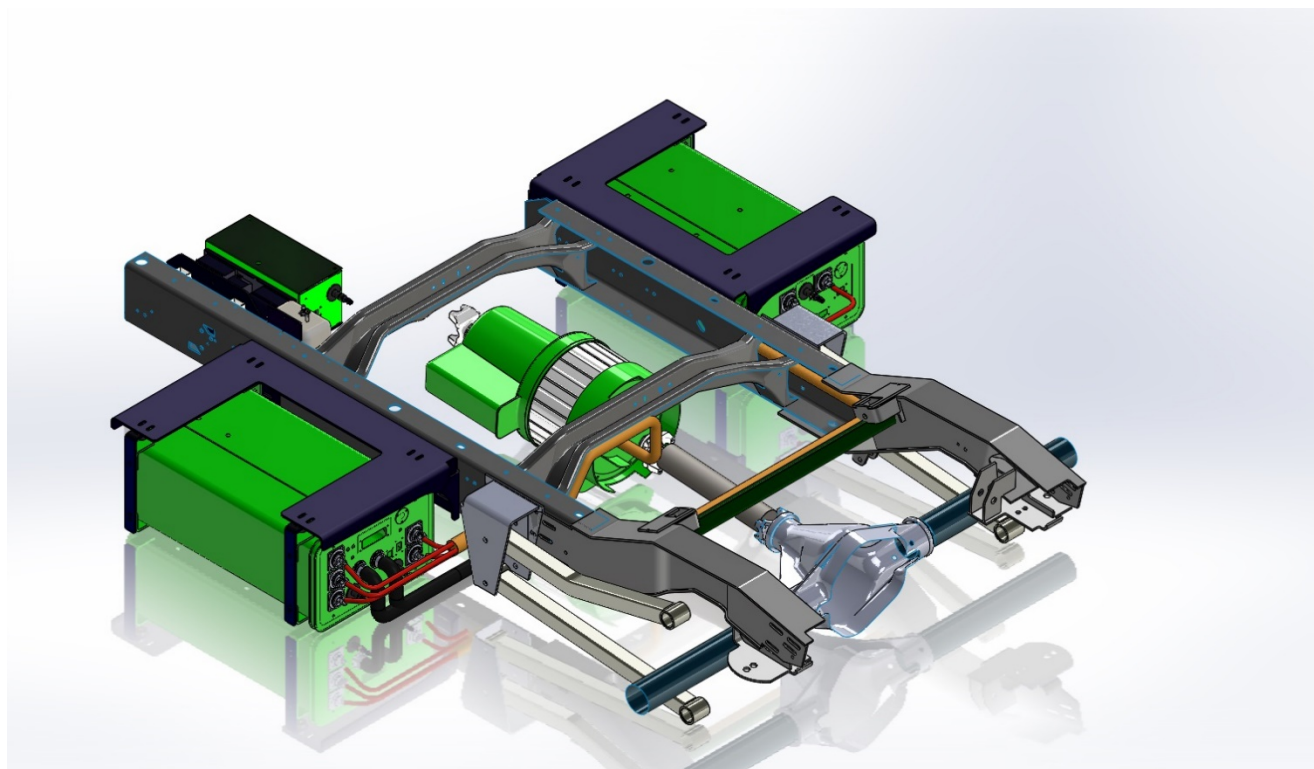


Crosspoint Kinetics

Kinetics Hybrid System Maintenance Manual



REVISION RECORD						
REV	DCN	DESCRIPTION	BY	CHECKED	APPROVED	DATE
00		Draft	FJ			02/01/13
01	CN 0027	Initial Release & Update	FJ		WAB	03/08/13
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Printed versions of this document are not controlled

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Forward:

This information is intended to aid technicians in the maintenance of the Crosspoint Kinetics hybrid system as well as make the technicians aware of any unique/special processes that will be required during maintenance. The following steps must be completed prior to being approved for performing warranty work on the Crosspoint Kinetics Electric Hybrid system:

- Technicians will be responsible for correct use/torque of common mounting hardware and fasteners supplied by the installer.
- Technicians will be responsible for hose/harness routing (sharp edges, chaffing, ect.)
- **Download wiring diagrams and other maintenance documents at:**
<http://crosspointkinetics.com/techdocs>

Warning: High Voltage System

- All of the components in **GREEN** on page 6 are high voltage/amperage components and pose a shock hazard if handled incorrectly or compromised during installation/service. The high voltage/amperage cabling is identified by orange loom or orange tape around the loom. Only qualified technicians/personnel should handle/install these high voltage components and cables.



SHOCK HAZARD

The electrical system in this vehicle is capable of producing lethal amounts of amperage.

All drivetrain and control systems **MUST** be installed/maintained by personnel who are trained and qualified to handle/install Crosspoint Kinetics hybrid components/systems.

Never use water to extinguish electrical fires; doing so greatly increases the risk of shock.

KINETICS Hybrid Operation:

Condition: Key On, Hybrid Off

12 vdc bus power is applied through the energized bus manufacturer's solenoid (Trombetta or Blue Sea) in the hybrid power distribution box. Power is then branched out to three wires. One each to two 40 amp fuses in the power box and one to the CR2 Enable String relay in the power box connected to the # 6 spade terminal. Power here stops at the spade because the CR2 relay is not yet energized. On the other two wires, 12 vdc continues through the fuse and out of the box one via a two wire set and a three wire set. On the two wire set, 12 vdc travels to the J205 plug on the cooling unit, pins 1 & 2. This applies power to the cooling fan and the two miniature fluid pumps inside. Pins 7 & 8 on J205 are the chassis grounds for the cooling unit. On the three wire set, power is routed to the controller via pins P, Q, & R on the PWR plug (Left plug) for Weatherpack and pins G, F & S for the Deutsch PWR plug harness. Pin P powers the actuator circuitry in the W'pack controller and pin S for the Deutsch. The other two pins power the controller electronics. Pins J, K & L are chassis grounds for W'pack and A, E, & N for the Deutsch. See Troubleshooting Guide Supplement, Index M for the interpretation of the controller display LED's. At this time, the Main contactors in the Ultracap box are open and the Phase contactors in the Controller box are open also. This means there is no hi-voltage electrical power in the harness 2/0 cables (Orange shielded), regardless of the palm switch position on the Ucap box. Finally, to power the Driver Display Panel, 12 vdc comes from SIG plug, (right plug on controller) pin A on W'pack and SIG, pin 14 for Deutsch. Inputs for the Controller are:

1. Motor temperature (J203 pins 3 & 4 to PWR plug pins C & V, W'pack).
2. Encoder signal (speed input from motor) from J103 to J203A on Controller (4 pin Deutsch plug on motor and controller).
3. Position sensor input from motor actuator (J203 pins 2, 7, & 8 to PWR pins D, E, & F). Pin 2 is 5 vdc, pin 8 is ground and pin 7 is the signal.
4. Float switch input signal from Controller 12 vdc output at PWR pin O to J205 pin 5 out Pin 6 then through float switch then to PWR pin M.
5. Brake sensor input from J209 to SIG M, N, & O. Pin M is 5 vdc input to sensor and pin C is signal out to Controller SIG on pin N.
6. Ground Fault Circuitry (GFI) in the controller is monitoring the three orange braid hi-voltage harnesses. The controller is in State 3 which drives the actuator to the extended position (rotor out of stator) and all contactors are open. A red flashing light on the Driver Display and far left red LED on the Controller display indicate the hybrid is 'Off'.

System Operation (cont)

Condition: Key On, Hybrid Switch On

When the Driver switch is turned on, 12 vdc power is routed from a contact in the switch to the Normally Closed Ford Impact switch located near driver seat, out to the NC Palm switch on the Ultracap and then back to the power box applying 12 vdc to spade terminal one. This energizes the coil in the CR2 relay, closing the switch. 12 vdc is applied to the two wire set on spade terminal 4 sending power through the harness to J206 on the Ultracap, pins 3 & 4. Power is applied to the main contactor in the Ucap but at this time the contactor is not yet engaged. Power is also routed out J206 pins 2 & 11 to send 'Enable' commands to the controller. Internally, the controller is charging a small bank of capacitors in the controller to balance the voltage with the Ultracap capacitors which takes about 20 seconds. When all is equalized, grounds in the controller are applied to the main and phase contactors energizing them closed. At this time, the actuator retracts moving the rotor in the stator, the system goes to State 9 and the green light illuminates. The system is now ready to operate.

Condition: Driving the bus, Hybrid On

When the accelerator is pressed a throttle command is sent to the controller from a string pot attached to the pedal. At approximately .5 mph, the controller applies the full 400 foot pounds of torque to the driveline to assist the bus engine. The green light will be flashing indicating there is activity in the system. In this case the amperage is depleting the ultracapacitors. The controller is in State 6 which is 'Boost'. As the bus increases speed, the actuator is slowly moving the rotor out of the stator and at approximately 35 mph, the rotor is fully out and the controller is state 10 which is 'Standby'. At this time there is no ultracap activity and no driveline drag.

When the driver lifts his foot off the pedal, the controller goes to state 7 below 35 mph which is 'Regen'. At approximately 30 mph, the rotor slowly starts moving the rotor into the stator. The motor is generating current which is charging the ultracapacitors and the green light is flashing indicating hybrid activity. On a long coastdown, the green light may stop flashing, indicating the ultracapacitors have fully charged. The driver may feel the lack of regenerative braking at this time.

In this system, moderate accelerations and long coast downs will greatly improve fuel savings as well as extend brake life.

Component Locations for Chevy 4500

Note: OEMs install components in various locations

Ultracap & Coltroller side/side aft of rear wheels

Heat Exchanger is between the frame rails aft of the rear wheels

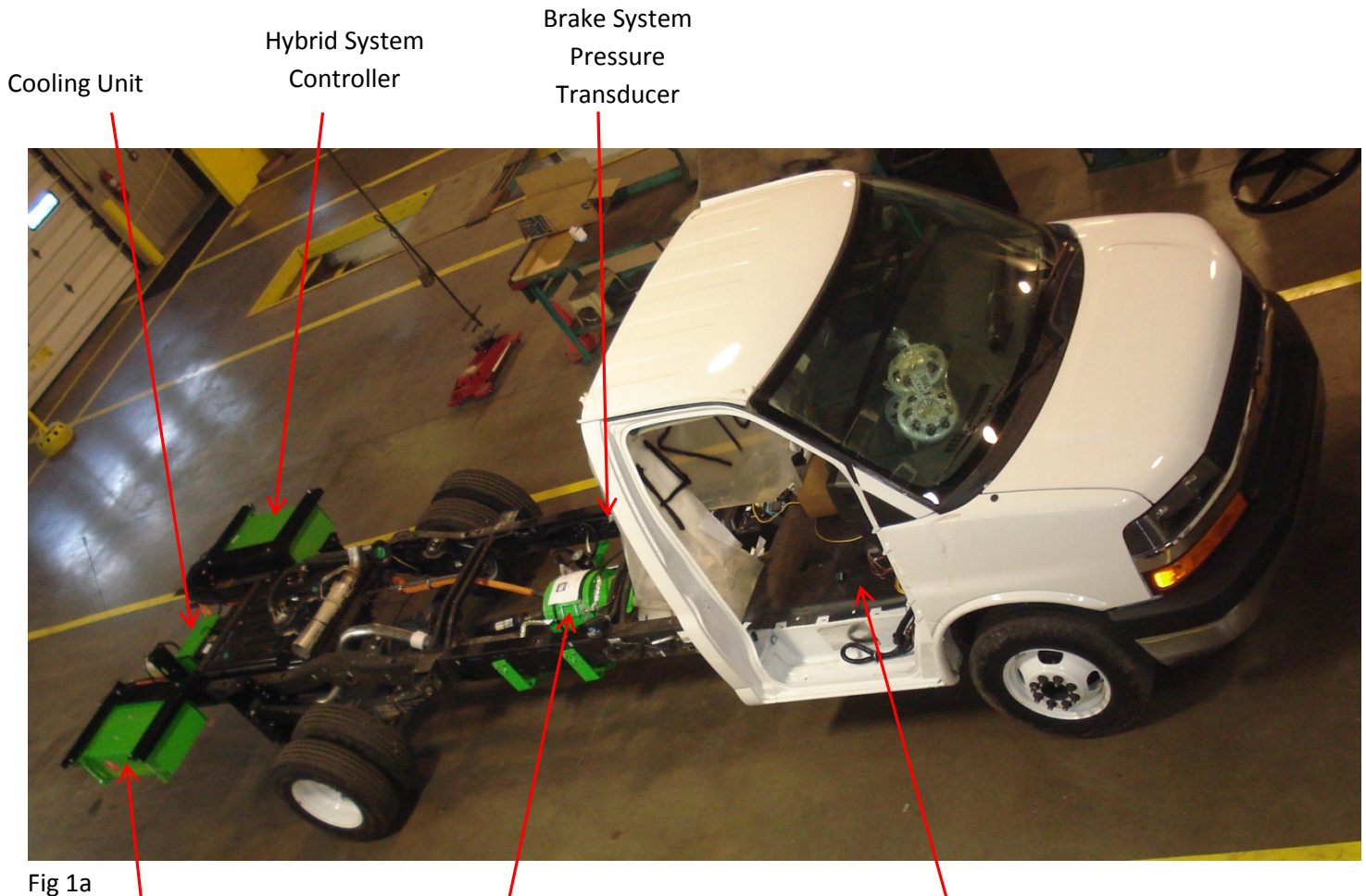


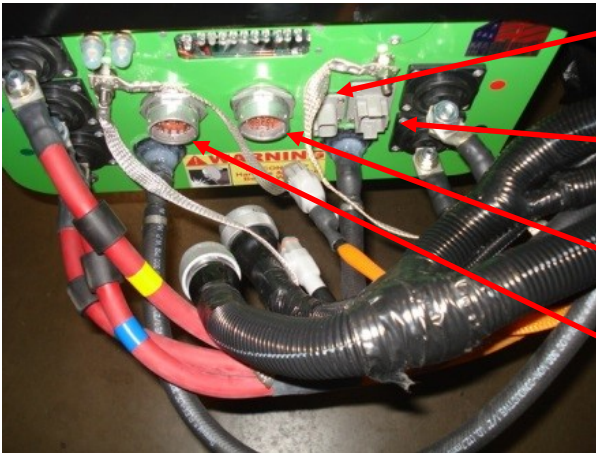
Fig 1a

Ultra-Capacitor
Energy Storage

Hybrid Drive
Motor

Inside Cab:
 Power Distribution Box (RF foot well area)
 Diagnostic Connector (RF foot well area)
 Accelerator Pedal Sensor with adjust Box
 Inertia Switch (behind driver's seat)
 Driver Display with LED's (Center of I/P)

Major Connector Locations



J107

J103

SIG

PWR

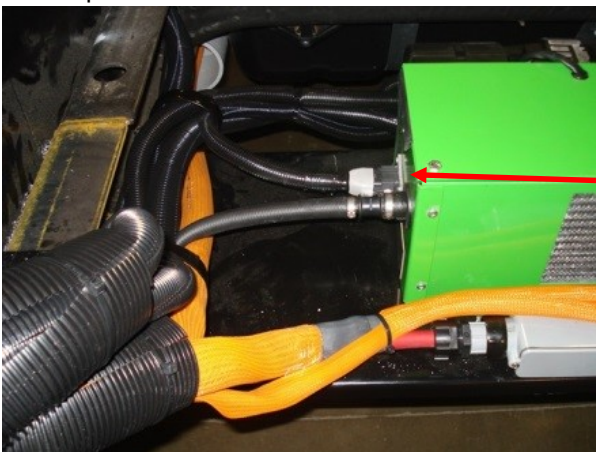
Controller



J207

J206

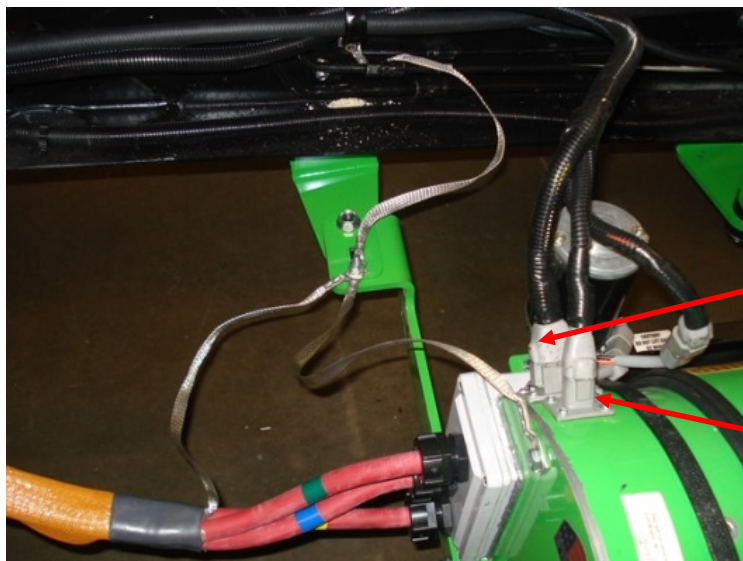
Ultracap



J205

Heat Exchanger

Connector Locations (cont)



J203 Motor temp and
actuator position sense

J203A Speed encoder

Motor

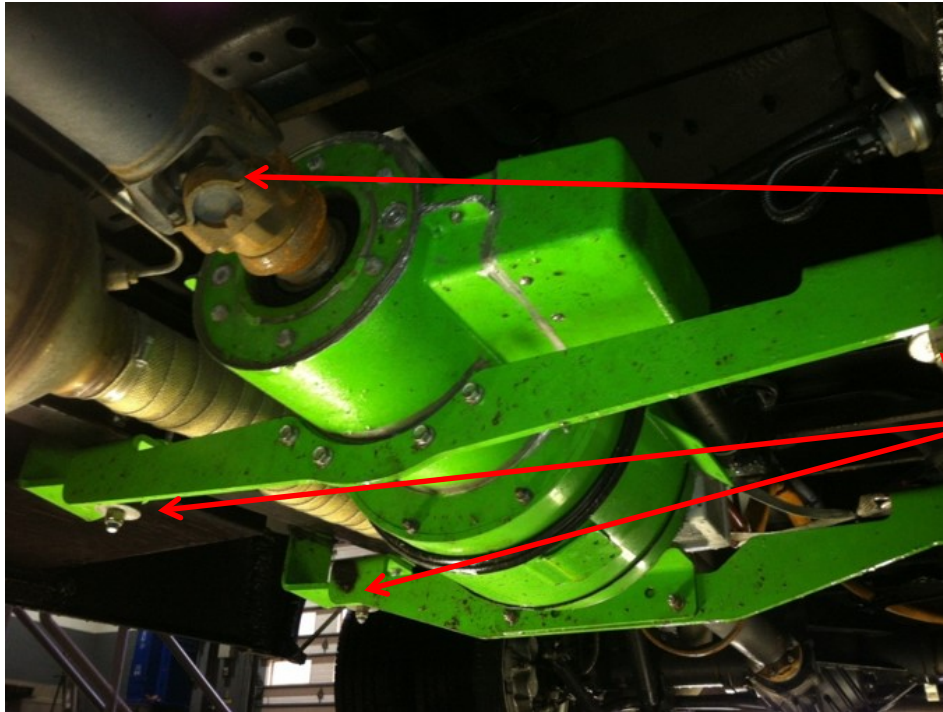


J203C Actuator
position sense
4 pin

J203B Actuator power
2 pin

Actuator

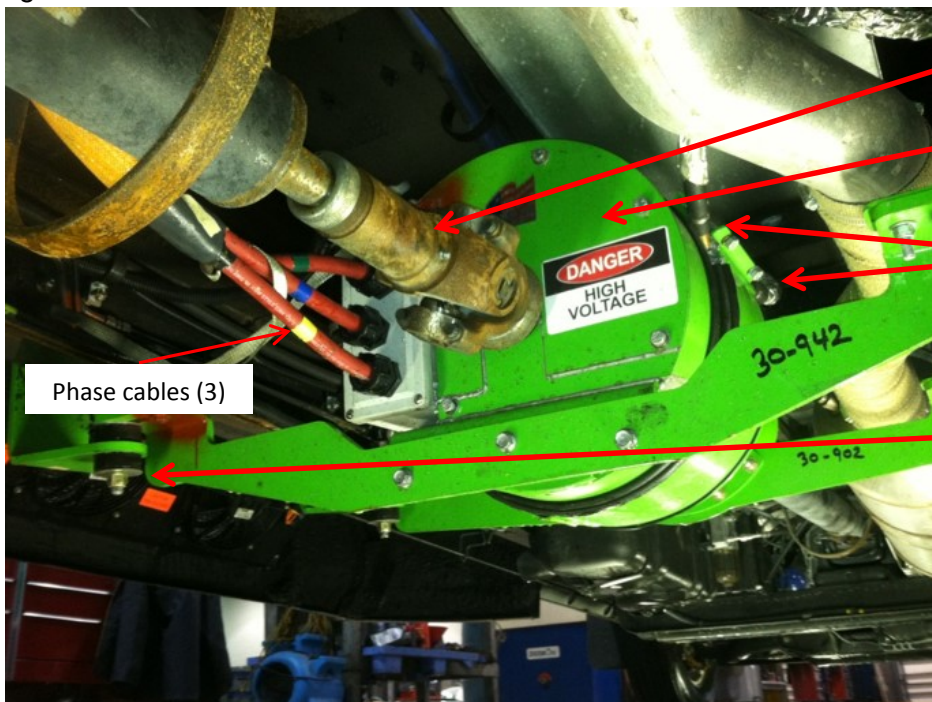
Permanent Magnet Motor



Front driveshaft

Motor mounts
(3 of 4)

Fig 1b



Rear driveshaft

Motor encoder
under panel

Glycol hose
connections

Phase cables (3)

Motor mount
1 of 4

Fig 1c

Motor Inspection:

1. Lift bus to get easier access to motor.
2. Remove (8) screws holding actuator cover and remove cover.
3. Under cover, look for loose debris, grease, and actuator attach components. Brown grease can indicate loose rotor thrust bearings. Black fibrous debris can indicate rotor delamination.
4. Check glycol inlet/outlet hoses for kinks, condition and leaks.
5. Inspect motor mountings for general condition.
6. Inspect driveline attach components for general condition.
7. Install cover and lower bus.

For troubleshooting the motor/actuator, refer to the 'Procedures' section.

Motor Removal: (Use Fig 1b,c on prior page for location of components)

Tools required: bus lift, transmission jack, air ratchets and hand tools.

1. With ignition on, push in Palm Switch on Ultracapacitor. Turn ignition off.
2. Lift bus to get easier access to motor.
3. With hose pinchers, squeeze both glycol hoses on motor and remove hoses.
Note: glycol may drain out of motor.
4. Remove drive axles from each end of motor shaft.
5. Remove (4) screws holding conduit box lid, loosen and slide back the 3 gland nuts. Remove (3) bolts holding the 2/0 cable terminals.
6. Remove the two Deutsch connectors on rear of motor.
7. Remove the plug for the actuator motor. If no plug, cut the actuator black and orange wires.
8. Remove any ground shielding on motor.
9. Support motor on bottom with transmission jack. Note: support motor on larger diameter either side of cooling band.



WARNING – Motor weight is about 250 pounds.

10. Remove the two ½" forward mount bolts. Remove the forward cross member from motor.
Note orientation of cross members, mounts and its spacer. *See Fig 1d, e on next page.*
11. Remove the two ½" rear mount bolts. Lower the motor slowly. The jack may have to be moved forward to clear rear cross member with frame mounts. Lower the motor.

Motor Installation (cont)

12. Remove nuts for yokes and discard nuts. Discard the spacer under the yoke, if any.
13. Remove the rear cross member from motor.
14. Transfer the replacement motor to lifting jack.
15. Note the 4 numbers on the motor label on new motor. These will be entered in the HCal program later.

Installation of Motor

1. Transfer yokes to new motor using new nuts (supplied with replacement motor). The replacement motor will NOT require a spacer. Torque to approximately 300 ft/lbs.
2. Install rear cross member on replacement motor using 3/8" bolts.
3. Lift motor to bus and reverse removal steps. *Note orientation of motor mount hardware, see fig1d, e below.*
4. Go to 'Reconnect Section' in this manual for cable, harness and hose connections. Return to step 5.
5. Service cooling tank with glycol.
6. Power up bus while on lift (key on), note coolant level and air bubbles in tank to ensure pumps are running. Go to 'Procedures Section' for Purging Cooling System. Adjust level as necessary. *Note: Low coolant will result in solid Red LED on driver panel.*
7. Lower bus at this time and go to 'Calibration Section' of manual.

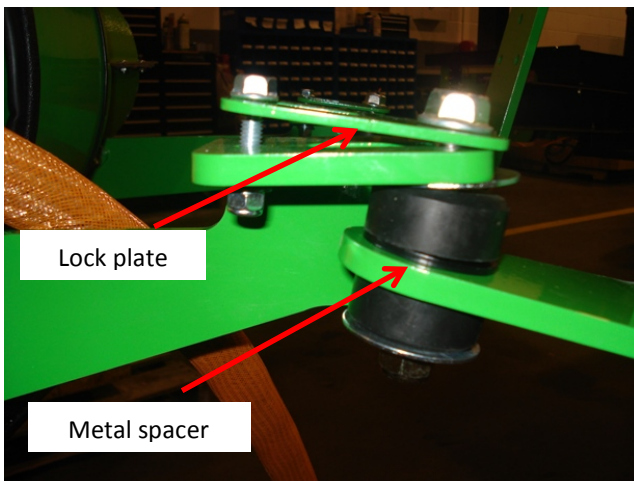


Fig 1d



Fig 1e

Note orientation of crossmembers upon removal, they vary with OEM.

Motor Thermistor

See 'Procedures Section' for maintenance on thermistor.

Motor Encoder

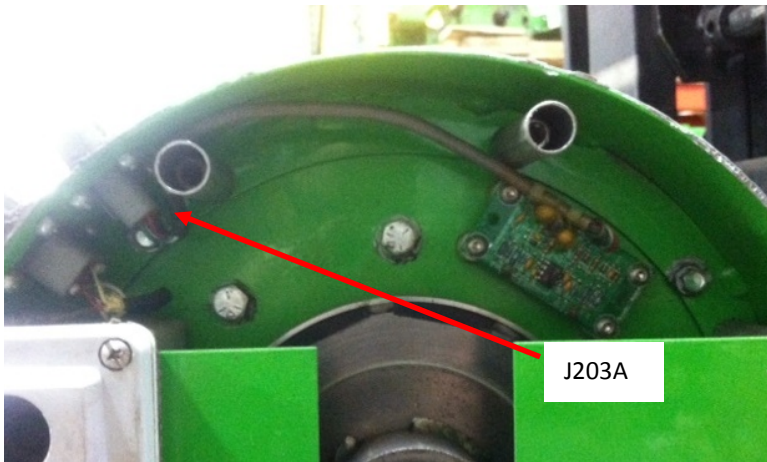


Fig 1f

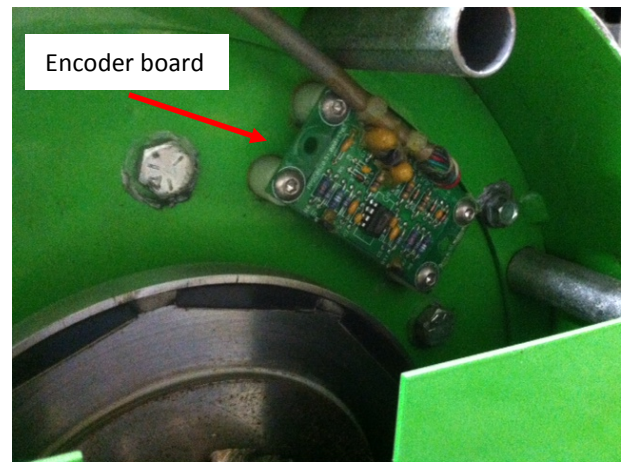
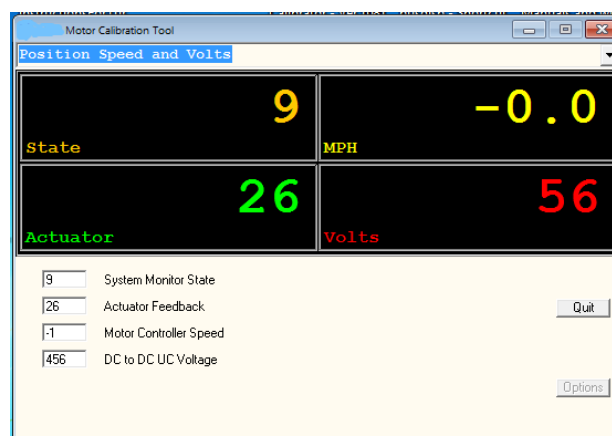


Fig 1g

Motor Encoder Removal/Install:

Tools required: bus lift and hand tools.

1. With ignition on, push in Palm Switch on Ultracapacitor. Turn ignition off.
2. Lift bus to get easier access to motor.
3. Remove the (4) bolts that hold the rear upper plate to the motor.
4. Cut silicone seal around plate and slide plate away from motor.
5. Remove the wedge lock from J203A. Release the latches and pull the 4 pins from the receptacles.
6. Remove (4) screws holding the encoder board from the motor.
7. Install encoder board with reverse steps. *Use Loctite on the (4) encoder board screws.*
8. Lower bus.
9. Connect laptop to DB9 serial port on hybrid.
10. Drive bus and look for MPH readout on 'Position, Speed and Volts' page. *See below.*
11. MPH Reading should be a negative number in reverse and positive going forward.
12. If these results are not seen, go to the 'No MPH Signal' section later in this manual.



12 Volt DC Actuator

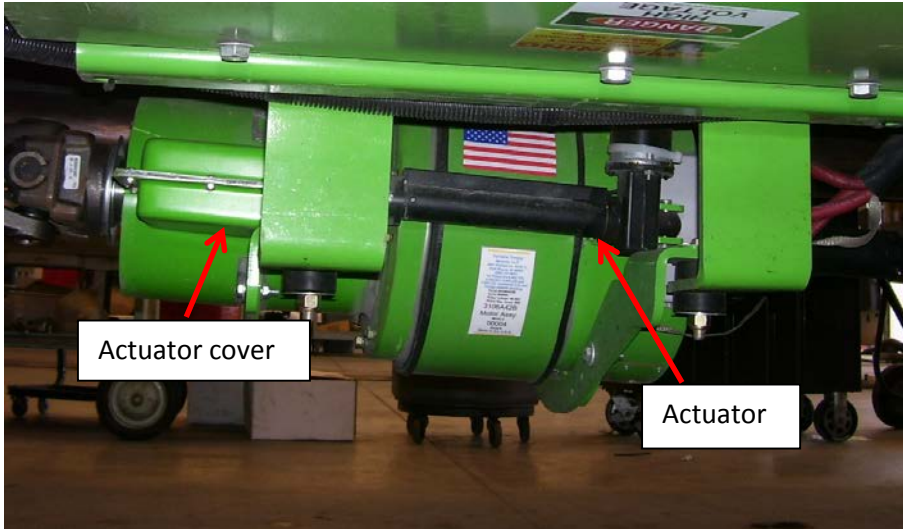


Fig 2a

Actuator Removal

Tools required: bus lift, and hand tools.

1. Engage hybrid by turning driver switch ON.
2. Wait for green light and turn bus ignition off.
3. Put bus on lift.
4. To gain access to forward end of actuator. Remove screws on top and bottom of cover on forward end & left side of motor and remove cover.
5. Disconnect two Deutsch connectors on actuator, see *Fig2b*. If only one, "Alternate removal" must be accomplished later in this section.



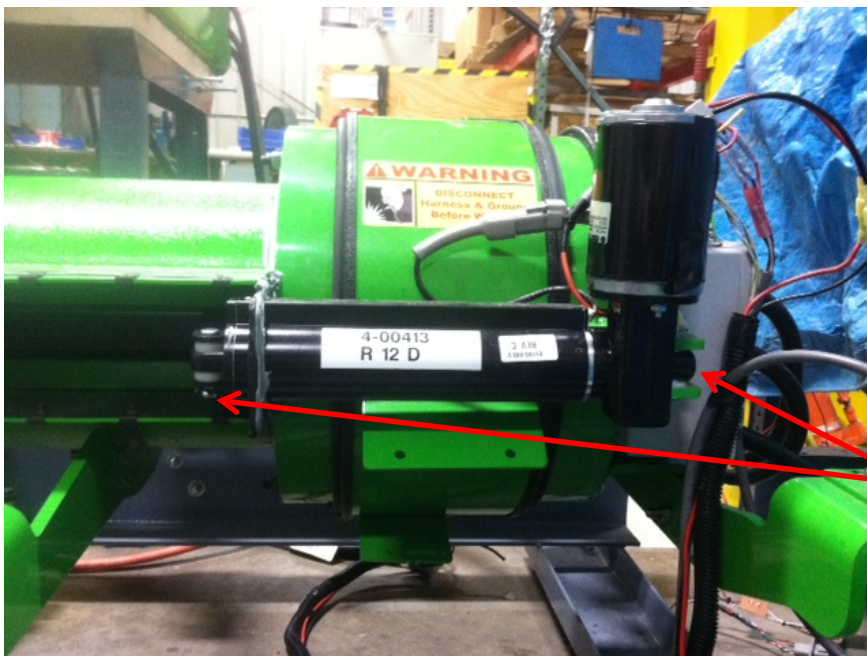
Fig 2b

Actuator Removal (cont)

6. Actuator position can be determined by looking at shaft which is now visible under the cover. It should be retracted.



CAUTION – Actuator must be retracted for removal.



Attach pins

7. Remove both clevis pins holding actuator in place. There may be slight tension on actuator due to strong magnets on rotor pulling rearward. A pry bar may be required on actuator attach bracket.
8. Remove actuator from motor.

Install Actuator

1. Retract new actuator by hand turning shaft or powering orange and black wires with 12 vdc.
2. Install actuator using reverse steps above. ***'One connector' type actuators must have the 3 wire harness routed and spliced in unless new actuator has connector kit.***
3. When all mechanical and electrical is connected, turn off hybrid switch and turn bus key on. Actuator will move by controller command to fully extended position.
4. Install actuator cover and final inspect the installation.
5. Lower the bus and go to the 'Functional Test' Section in this manual.

Alternate removal for older actuators:

- a) Remove 5/16" bolts on rear face of motor and remove upper plate.
- b) Remove 8 pin Deutsch plug on top of motor at approximately 11 o'clock position.
- c) Remove wedge lock inside of Deutsch bulkhead connector, unlocking the pins.
- d) Remove the three wires leading to the actuator, pins 2, 7 & 8. Use small screwdriver to unlatch pins where wedge lock was.
- e) Pull the 3 wire harness out of the motor toward actuator.
- f) Go to step 6 of "Actuator Removal".

Inspect and functional test actuator

1. Lift bus to gain access to the motor actuator.
2. Remove the eight screws from the cover of the actuator.
3. Inspect rear actuator attach pin and brackets for condition (cracks at radius).
4. Inspect the front attach clevis pin and the attachment of the arms to the sleeve inside the motor.
5. Have a helper turn on and off hybrid and watch actuator movement. It should be quiet and smooth.
6. If available, use HCal on a laptop and go to 'Position, Speed and Volts' page.
7. Watch the 'Actuator' block when cycling the hybrid system on and off. Actuator retracted reading is approximately 20. Extended reading is approximately 390.
8. Install cover and lower bus to complete.

For further troubleshooting of the actuator, refer to the 'Procedures' section.

Controller

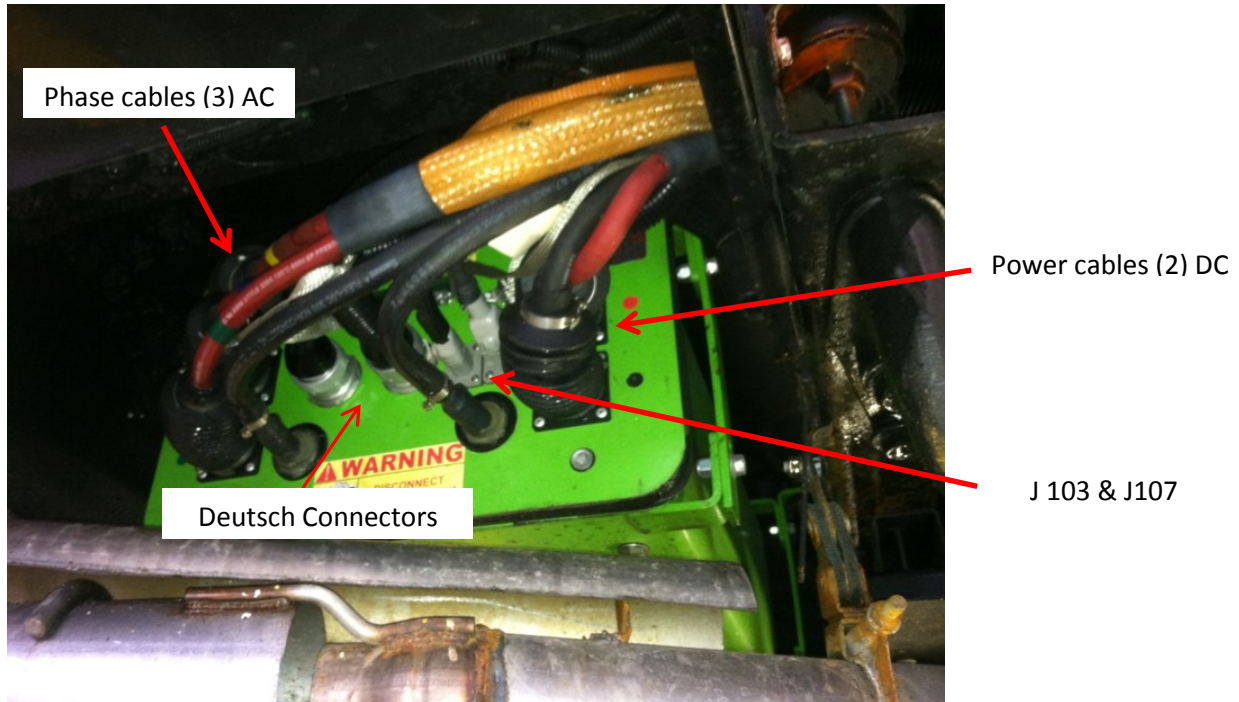


Fig 3a

Controller Removal

Tools required: bus lift, transmission jack, and hand tools.

1. Push in Palm Switch on Ultra capacitor. Turn ignition off.
2. Lift bus to get easier access to controller.
3. With hose pinchers, squeeze both glycol hoses on controller and remove hoses.
Note: glycol will drain out of controller.
4. Remove boots on the 5, 2/0 cables to gain access to bolts and remove bolts. Note orientation.



WARNING – Remove cables with power OFF the bus to avoid shock.

5. Remove 22 pin Weather Pack plugs with 1/4" socket OR remove Deutsch connectors.
6. Remove the two Deutsch connectors, 4 & 8 pin.
7. Remove ground cables from studs.

Controller Removal (cont)

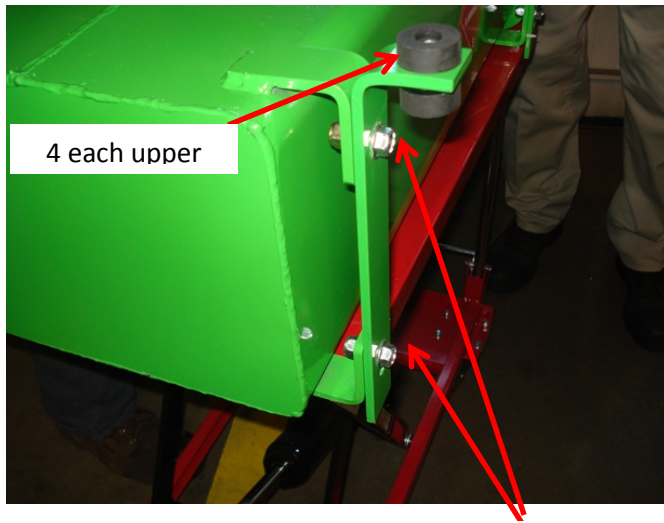


Fig 3b

8 each sides



Fig 3c

8. With controller supported at bottom, remove the eight attach bolts from bracket. If access allows, the 4 upper bolts may be easier instead, see *Fig3b*.
9. Lower controller from bus.

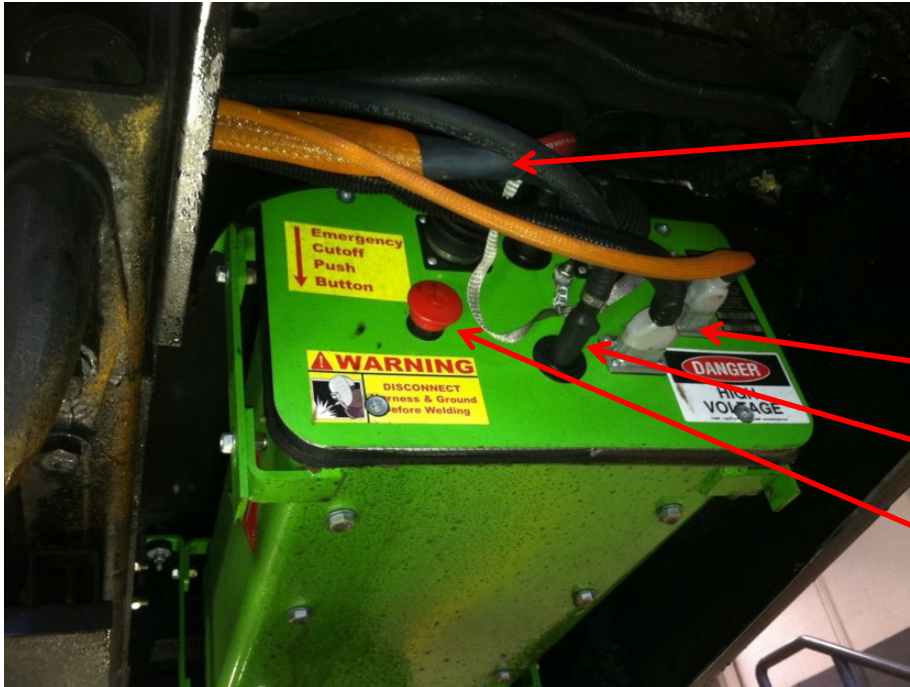


CAUTION – Controller weight is about 100 pounds.

Controller Installation

1. Reverse steps for 'Controller Removal'. If applicable, transfer brackets from unit to unit.
2. Go to 'Reconnect Section' in this manual for cable, harness and hose connections. Return to step 3.
3. Record the four numbers on the serial number label on hybrid motor. These will be entered later in HCal.
4. Service cooling tank with ethylene glycol.
5. Power up bus while on lift (key on), note coolant level and air bubbles in tank to ensure pumps are running. Go to 'Procedures Section' for Purging Cooling System. Adjust level as necessary. *Note: Low coolant will result in solid Red LED on driver panel.*
6. Lower bus at this time and go to 'Calibration Section' of manual.

Ultracapacitor



Power cables (2) DC

J206 & J207

Glycol hose (2)

Palm switch

Fig 4a

Ultracapacitor Removal

Tools required: bus lift, transmission jack, and hand tools.

1. With ignition on, push in Palm Switch on ultracapacitor, see Fig4a. Turn ignition off.
2. Lift bus to get easier access to ultracap.
3. With hose pinchers, squeeze both glycol hoses on controller and remove hoses.
Note: glycol will drain out of ultracap.
4. Remove boots on the 2, 2/0 cables to gain access Power DC bolts and remove bolts. Note orientation.



WARNING – Remove cables with power OFF the bus to avoid shock.

5. Remove the two Deutsch connectors, 8 & 12 pin.
6. Remove ground cables from stud.

Ultracap Removal (cont)

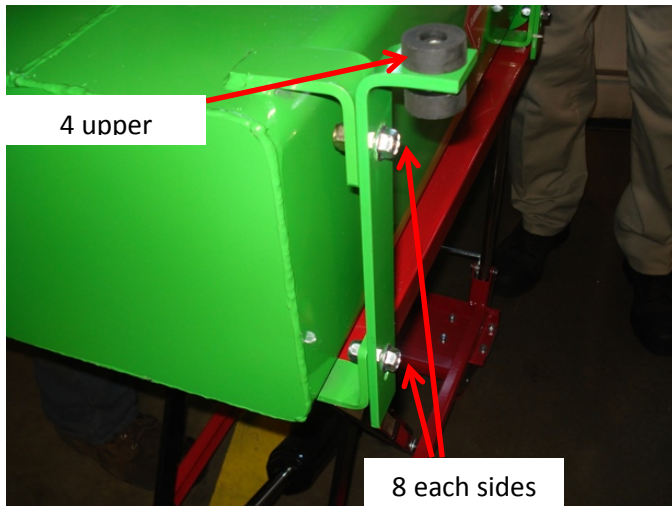


Fig 4b



Fib 4c

7. With controller supported at bottom, remove the eight attach bolts from bracket, see Fig4b. If access allows, the 4 upper bolts may be easier instead.
8. Lower ultracap from bus.

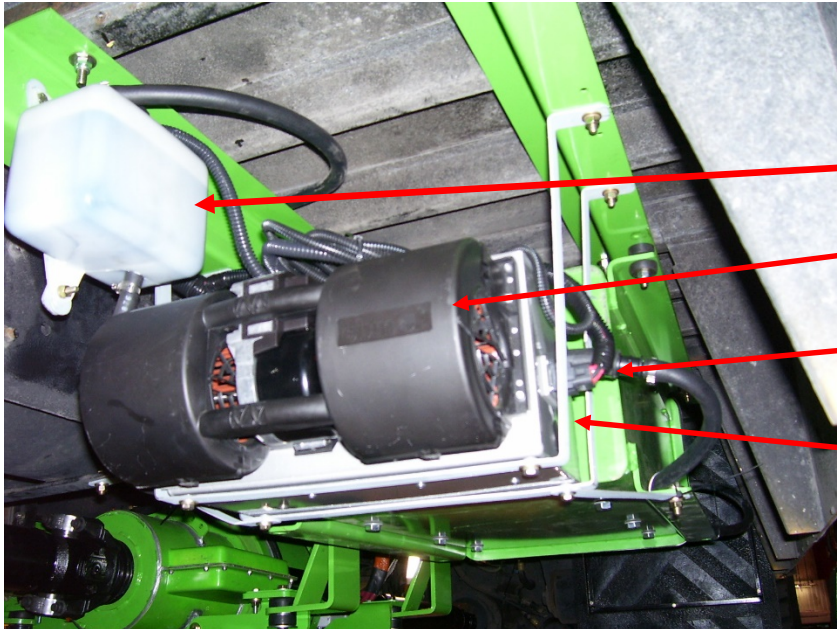


CAUTION – Box weight is about 100 pounds.

Ultracapacitor Installation

1. Reverse steps for 'Ultracap Removal'. If applicable, transfer brackets from unit to unit.
2. Go to 'Reconnect Section' in this manual for cable, harness and hose connections. Return to step 3.
3. Service cooling tank with ethylene glycol.
4. Power up bus while on lift (key on), note coolant level and air bubbles in tank to ensure pumps are running. Go to 'Procedures Section' for Purging Cooling System. Adjust level as necessary. *Note: Low coolant will result in solid Red LED on driver panel.*
5. Lower bus at this time and go to 'Functional Test' Section of manual.

Heat Exchanger (Cooling Unit)



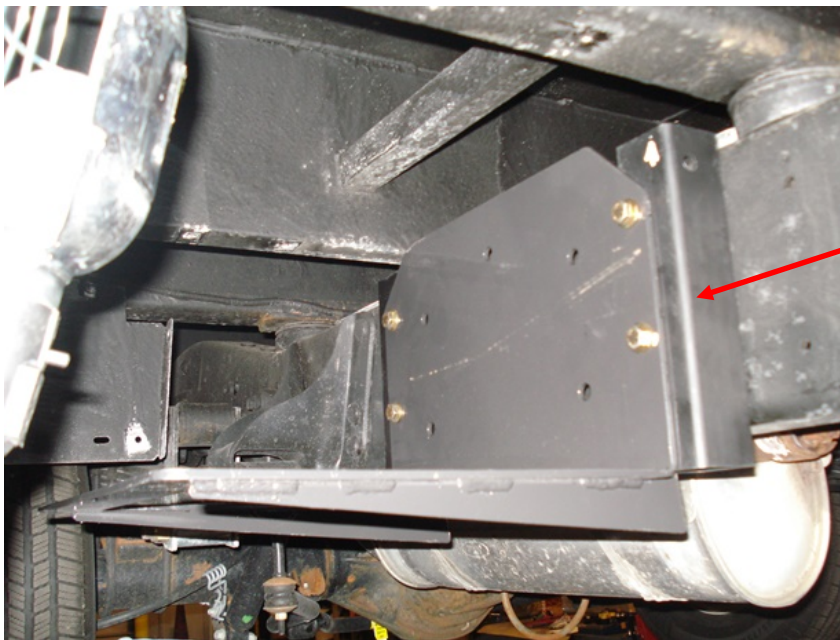
Reservoir

Cooling fan

J205

Older style
Cooling fan
bracket

Fig 5a



New style Cooling
fan bracket

Fig 5b

Here are two of the several ways Cooling Units are installed.

Cooling Unit (cont)

Heat Exchanger Removal

Tools required: bus lift and hand tools.

1. With ignition on, push in Palm Switch on ultracapacitor. Turn ignition off.
2. Lift bus to get easier access to cooling unit.
3. With hose pinchers, squeeze both glycol hoses on unit and remove hoses.

Note: glycol will drain out of cooling unit. Install plugs on connector.



WARNING – Remove connector with power OFF the bus to avoid unit electrical damage.

4. Remove J205 Deutsch connector, *see Fig 5a*.
5. Remove bolts attaching unit to bracket and remove unit.

Heat Exchanger Installation

1. Use reverse order to install cooling unit.
2. Service cooling tank with ethylene glycol.
3. Power up bus while on lift (key on), note coolant level and air bubbles in tank to ensure pumps are running. Go to 'Procedures Section' for Purging Cooling System. Adjust level as necessary. *Note: Low coolant will result in solid Red LED on driver panel.*
4. Fan should be running at low speed.
5. Lower bus and go to 'Functional Test' Section of manual.

See next page for Blower replacement

Blower (Fan) Replacement

Tools required: bus lift and hand tools.

1. Use above procedure to remove cooling unit. *Note: if cooling unit has Deutsch connector in blower harness, fan removal may be possible without removing entire unit. See Fig 5c.*
2. Disconnect electrical plug for blower.



Fig 5c

3. Remove the pins on both inlet shields. It does not take much pressure to remove them.

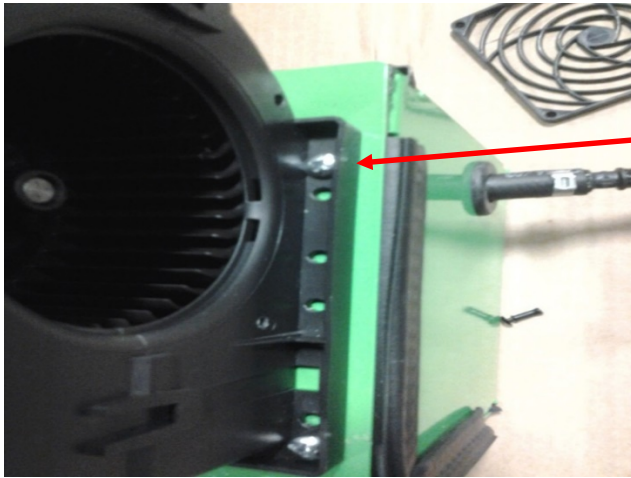


4 plastic pins each
shield

Fig 5d

Blower Replacement (cont)

4. Remove the four screws that hold the Blower to the assembly.



4 screws total

Fig 5e

5. Remove the blower.
6. Install new blower in reverse order.
7. If no connector was on original assembly, follow instructions packaged with the new blower. *Note: New fan will have a connector kit to modify harness.*
8. Install unit on bus.
9. Service cooling tank with ethylene glycol.
10. Power up bus while on lift (key on), note coolant level and air bubbles in tank to ensure pumps are running. Go to 'Procedures Section' for Purging Cooling System. Adjust level as necessary. *Note: Low coolant will result in solid Red LED on driver panel.*
11. Fan should be running at low speed.
12. Lower bus at this time and go to 'Functional Test' Section of manual.

Coolant Reservoir Removal

Tools required: bus lift and hand tools.

1. With ignition on, push in Palm Switch on ultracapacitor. Turn ignition off.
2. Lift bus to get easier access to cooling bottle.
3. With hose pinchers, squeeze both return hose and feed hose to cooling unit. *Note: glycol will drain out of cooling bottle.*
4. Remove hoses and drain bottle.
5. Disconnect float connector plug or cut wires.
6. Remove mounting bolts holding bottle. *(Vary with OEM)*
7. Install new bottle in reverse order.
8. Service cooling tank with ethylene glycol.
9. Power up bus while on lift (key on), note coolant level and air bubbles in tank to ensure pumps are running. Go to 'Procedures Section' for Purging Cooling System. Adjust level as necessary. *Note: Low coolant will result in solid Red LED on driver panel.*
10. Lower bus at this time and go to 'Functional Test' Section of manual.



Fig 5f

Brake Pressure Transducer



Fig 6a



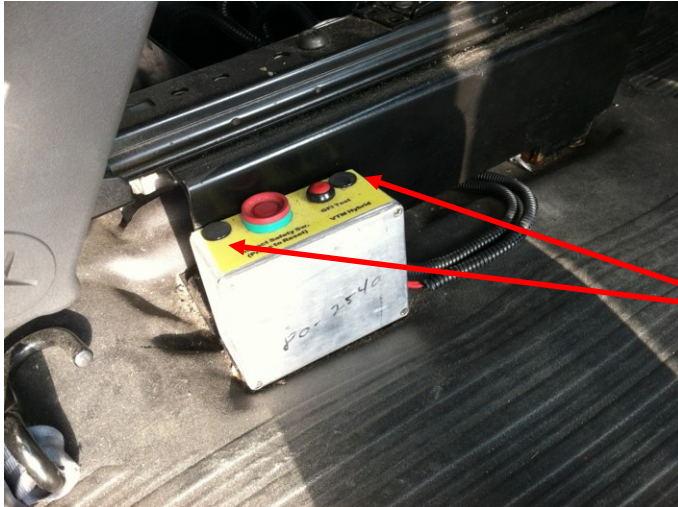
Fig 6b

Transducer Removal

Tools required: bus lift and hand tools.

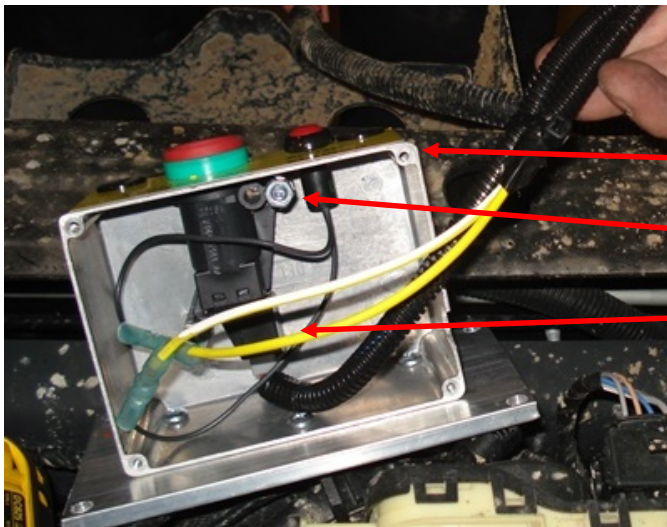
1. Locate transducer in left brake line on frame.
2. Disconnect J209 plug from unit.
3. Remove unit from NPT fitting. Note: *Loss of brake fluid may occur.*
4. Replace with new unit using pipe thread compound or Teflon tape.
5. Connect J209 plug.
6. Adjust bus brake fluid level as necessary.
7. Start bus and cycle brakes, check for leaks at transducer.
8. Go to 'Calibration Section' in this manual.

Impact Switch



Plugs

Fig 7a



1 of 4 screws

1 of 2 through bolts

J210 Conn

Fig 7b

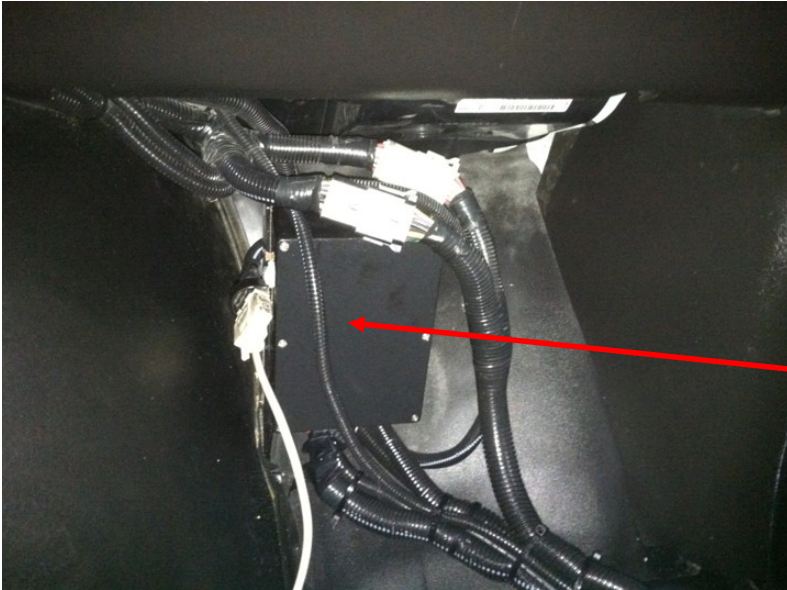
Impact Switch Removal

Tools required: hand tools.

1. Locate unit near driver seat.
2. Remove 2 plugs on top of unit and using Phillips screwdriver, remove screws in bottom of box. *Fig 7a.*
3. Remove 4 screws in side plate to expose switch. *Fig 7b.*
4. Disconnect J210 connector from switch.
5. Remove switch from box removing 2 through bolts.
6. Install new switch in reverse order.
7. Go to 'Functional Test' in this manual.

Power Distribution Box

Installation in Chevy 4500 (below Passenger dash)



Power Box

Fig 8a

Installation in Ford E-450 (Passenger airbag panel)



Fig 8b

Power Box (cont)

Power Box Removal (fuse replacement)

Tools required: hand tools.

1. Disconnect batteries.
2. Locate unit based on OEM.
3. Remove 4 screws in top plate to expose harness connections. *Fig 8c.*
4. If replacing 40 amp fuse, remove fuse holder hardware and remove/replace fuse.
5. If replacing Power box, disconnect battery cable #6 wire from main solenoid. *Fig 8c.*
6. Remove 4 screws at bottom of box to release from frame. *(May vary with OEM).*

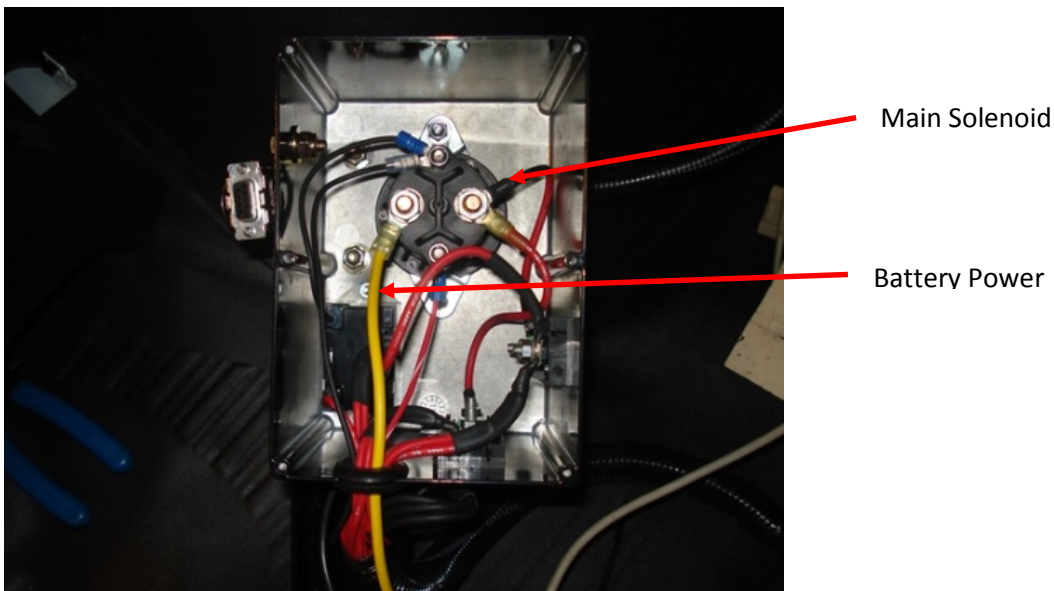


Fig 8c



Fig 8d

Power Box Removal (cont)

7. Locate connectors along harness located under floor or behind panels. (*Varies with OEM.*)
8. Remove 3 connectors on harness. *Fig 8e.*
9. Remove assembly from bus.

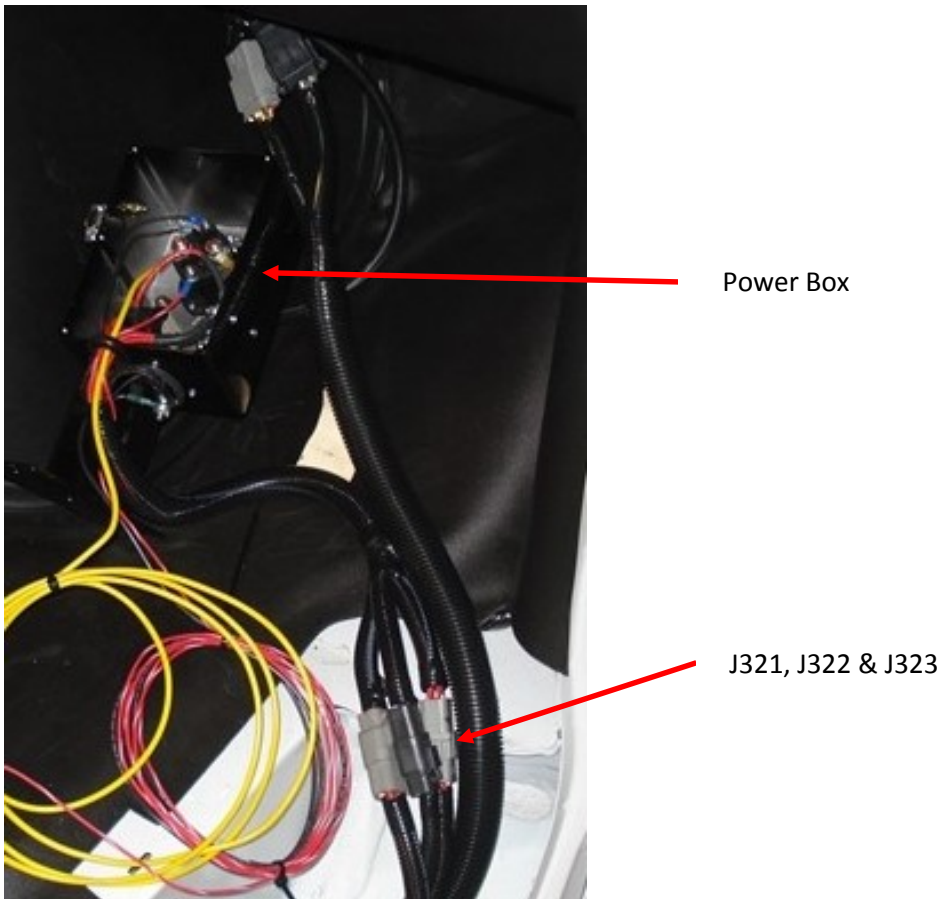


Fig 8e

10. Install replacement unit in reverse order.
11. Connect batteries.
12. Go to 'Functional Test' Section in this manual.

400 Amp Power Cable Fuse

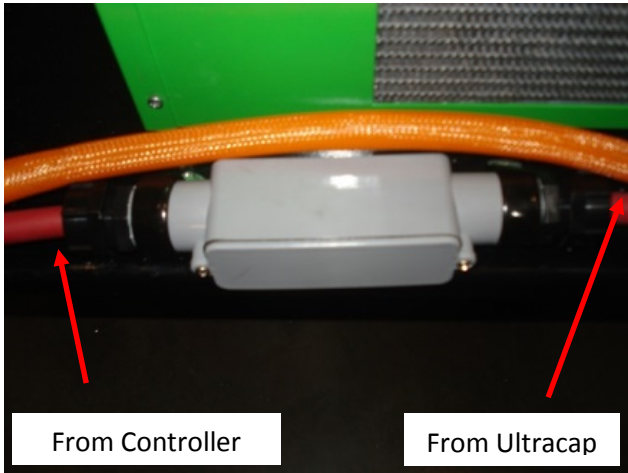


Fig 9a



Fig 9b

400 Amp Fuse Replacement

Tools required: hand tools.

1. Locate fuse holder (*Varies with OEM*). Follow 'Red' 2/0 cable harness from ultracap or controller to locate. *Fig 9a*.
2. Remove 2 screws in top plate to expose fuse. *Fig 9a*.

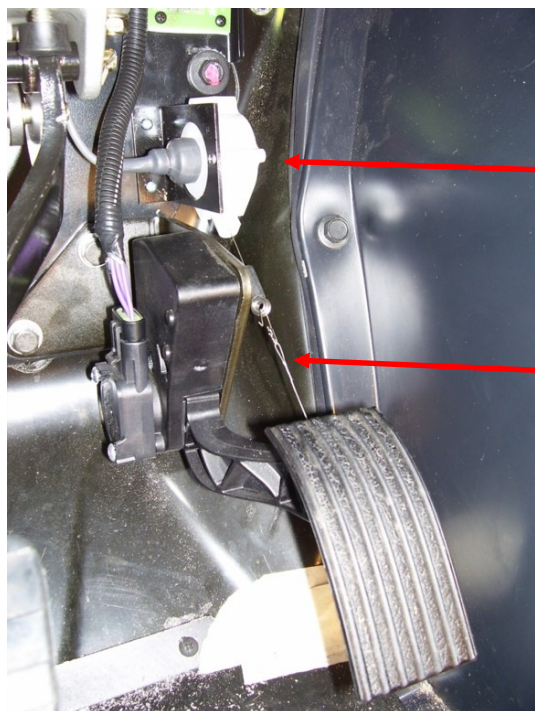


WARNING — Remove fuse with power OFF the bus to avoid shock.

3. Remove nuts from studs and remove fuse. *Fig 8c*.
4. Install new fuse in reverse order.
5. Go to 'Functional Section' in this manual.

Note: To verify condition of fuse, use ohmmeter to measure electrical resistance. A good fuse will read '0.0' on Ohm scale.

Throttle String Pot



String Pot

String Pot cable
to pedal arm

String pot bracket
for Chevy 4500

Fig 10a

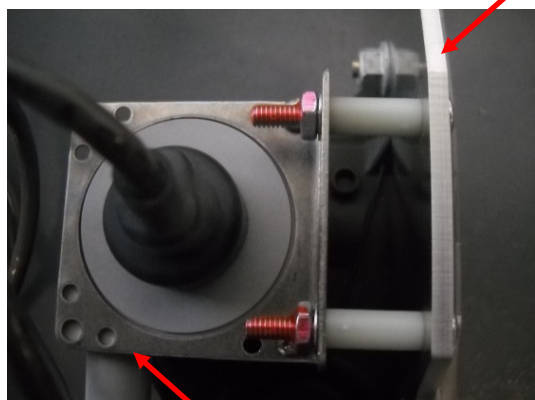


Fig 10b

String Pot bracket
for all OEMs

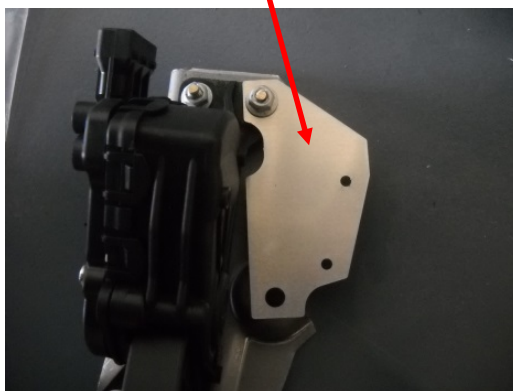
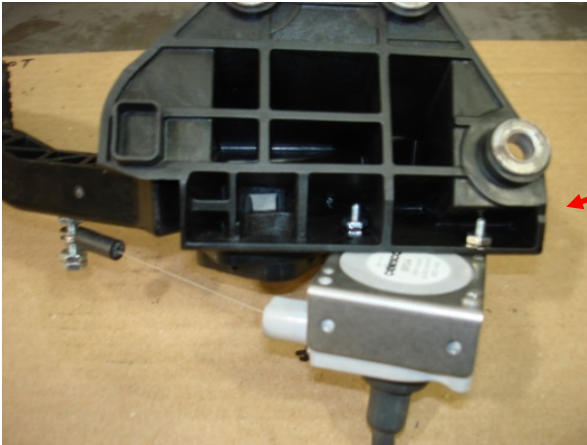


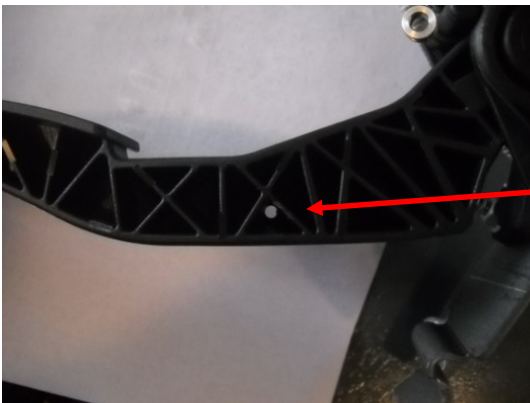
Fig 10c

Throttle String Pot (cont)



Ford E450
installation

Fig 10d



String pot cable
attach

Fig 10e

String Pot and Throttle Box Replacement

Tools required: hand tools.

1. Using Figures 10a – 10e, remove components based on the OEM installation. *Note: Pedal assembly may be required to remove from bus.*
2. Install new component(s).
3. Make sure pedal moves without cable interference.

Throttle String Pot (cont)

4. Gain access to Calibration Box if not replaced.
5. Go to "Calibration Section" of this manual.

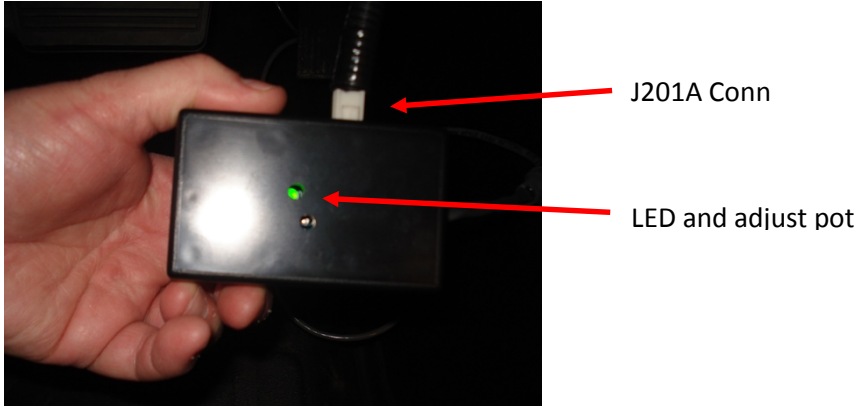


Fig 10f



Fig 10g

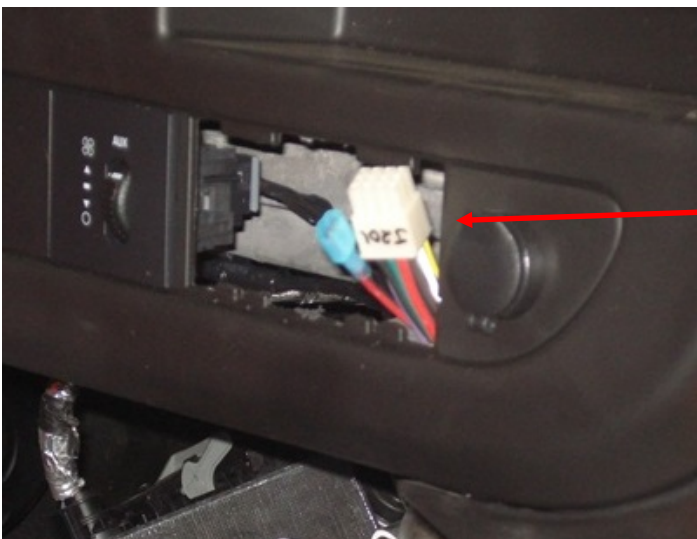
Driver Display



Driver Display Replacement

Tools required: hand tools.

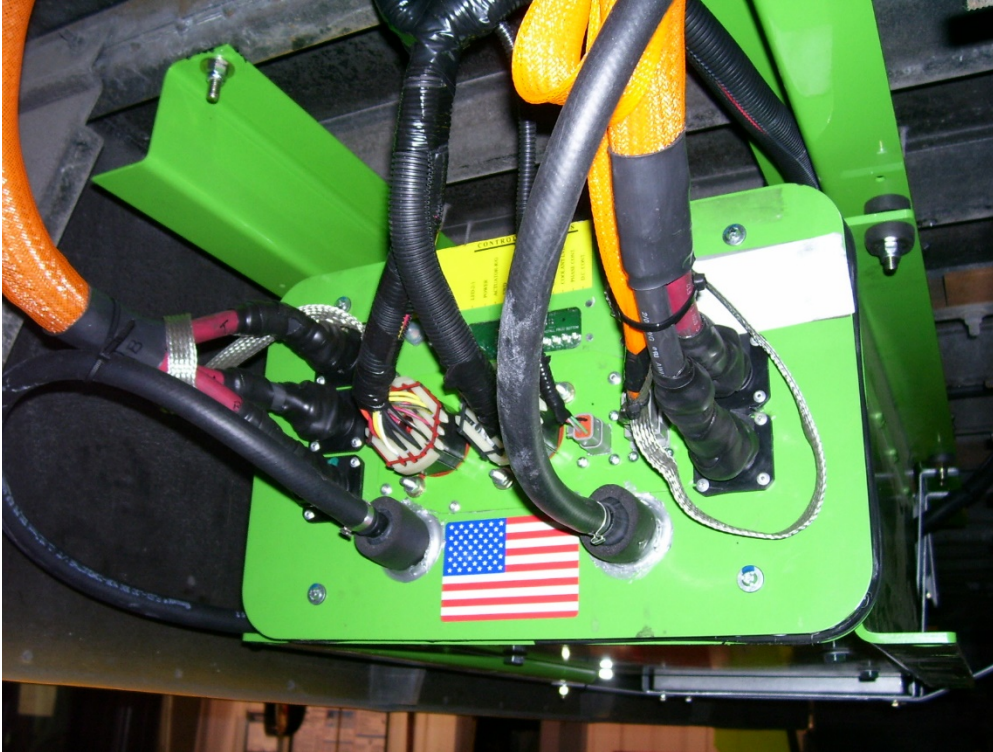
1. Remove 4 screws that hold display to panel.
2. Disconnect J201 from harness.
3. Disconnect two spade connectors in harness.
4. Install new driver display in reverse order.
5. Go to the 'Functional Test' section in this manual.



J201 Conn
behind panel &
two spade
terminals

Welding Safety

Welding to the vehicle frame without disconnection of the hybrid harness as noted below may permanently damage the circuitry and void the hybrid warranty.



Controller:

- a. **Main connectors (2)** - Part the approx. 20 wires exiting the large harness connector on the left side – marked in red, (next to the three motor cables) in the center, insert a ¼” deep socket to engage the clamp bolt in the center of the connector. Turn clamp bolt counter clockwise while pulling outward on the connector body, until the connector comes out. Repeat this for the right connector. Note that these connectors are keyed and cannot be plugged into the wrong socket.
- b. **Gray Connectors (2)** - Press the latches and pull to disconnect (1) gray four pin and (1) gray 8 pin connector on the controller front panel.
- c. **Chassis Grounding Straps** - Remove ALL braided ground straps from the two (2) grounding studs on the front panel of the controller.
- d. DO NOT unseal or remove the (3) large motor cables on the left side of the controller or the two power cables on the right side of the controller.
- e. DO NOT disconnect the cooling hoses.

Welding Safety (cont)

Welding Safety



Ultracapacitor:

- a. **Two gray connectors** - Press the latches and pull to disconnect (2) gray connectors on the energy storage front panel.
- b. **Chassis Grounding Straps** - Remove ALL braided ground straps from the one grounding stud on the front panel.
- c. DO NOT unseal or remove the (2) large power cables on the center of the energy storage panel
- d. DO NOT disconnect the cooling hoses.

Welding Safety (cont)

Welding Safety



Motor:

- a. **Two gray connectors** - Press the latches and pull to disconnect (2) gray connectors on the right rear of the motor assy. Housing.
- b. **Chassis Grounding Straps** - Remove ALL braided ground straps connecting the motor to the frame.
- c. DO NOT unseal or remove the (3) large motor cables on the left side of the motor
- d. DO NOT disconnect the cooling hoses.
- e. DO NOT disconnect the orange and black wires to the actuator motor on the left rear of the motor.
- f. Protect the motor assembly connectors from welding sparks or dirt.

Welding Safety (cont)

Welding Safety



Cooling Unit:

- a. **One gray connector** - Press the latch and pull to disconnect (1) gray connector on the side of the cooling module
- b. DO NOT disconnect the cooling hoses

Welding Guidelines –

ALWAYS connect the welder ground clamp to the vehicle frame as close to the area being welded (within 1 ft.)

ALWAYS protect the hybrid components from excessive heat, sparks and dirt while they are disconnected

Reconnection after welding is complete and test hybrid.

Follow the Welding Safety Guide!

Reconnect Section

Applies to Motor, Controller and Ultracap. Procedures for connecting all cables, harnesses, straps and hoses post component change

2/0 Cable Connection Procedure. Applies to all cables on motor, controller and ucap.

Phase/Power terminal connection process – Push the sealing boot back approx. 4". Use scotch-brite abrasive pad to polish terminals. Apply a thin film of NO-OX-ID electrical contact grease onto both terminals. Place the cable on the appropriate terminal and with the 3/8" or 12 mm bolt, install a coned Belleville washer with the small end up, flat washer, split lock washer and nut. Keep the cable and terminal within 20 deg. Of straight as shown. Torque the nut until the split lock washer is flat and the Belleville washer is compressed to maintain torque. Repeat this process for any and all terminals. After all ring terminals are tight, slide the boots forward and snap the boot flange into the black insulator on the hybrid controller panel. Note that the small end of the boot must be centered on the 1" dia. Hose on the cable. Adjust this position if required. Tighten the large and small hose clamps to compress the boot to seal. Note that this **MUST** be a watertight seal or the hybrid GFI will keep tripping the system OFF in wet weather.



Note – boot is shown cut away only for illustration



WARNING – Remove and install cables and harness with power OFF the bus to avoid shock.

1. **Hybrid Controller – (If replaced)** Reference the picture below for orientation.



- a. **Phase Cables** – Using the same hardware removed during disassembly, install the motor phase cables using the cable sealing boots and other hardware. Note position of the (3) cable ring terminals with yellow, blue and green tape labels.
Main harness connectors (2) – Locate round silver body connector that has the larger terminals - the power connector. Plug this into the left socket and lock with a ¼ turn. Repeat this for the right connector. Note that these connectors are keyed and cannot be plugged into the wrong socket.
- b. **Gray Connectors (2)** – Align the connector keys. Press the connectors into the mating socket on the controller front panel until the latches click and the connectors are fully seated.
- c. **Chassis Grounding Straps** – Connect BOTH braided ground straps from the two (2) grounding studs on the front panel of the controller. Tighten the nut to retain.

Controller Reconnect (cont)

- Rev02

3. **Motor Assembly (if replaced)**



- a. **Phase terminal connection process** – Using the same hardware removed during disassembly, install the motor phase cables using the cable sealing boots and other hardware. Note position of the (3) cable ring terminals with yellow, blue and green tape labels.
- b. **Two gray connectors (2)** – Align the connector keys. Press the connectors into the mating socket on the controller front panel until the latches click and the connectors are fully seated.
- c. **Actuator motor connector** – Align and insert connector on the orange and black motor wires until the latches click.
- d. **Chassis Grounding Straps** - Connect ALL braided ground straps connecting the motor to clean metal on the vehicle frame
- e. **Check the cooling hoses** for tight, leak free connections
4. **Main Hybrid Harness and Jumpers** –
 - a. **Follow the harness from the controller, to the motor and driver station and push together EVERY connector to make sure it is fully seated.**
5. **Additional Reconnection Notes after change is complete** –
 - a. Make sure connector latches and alignment pins are in the correct position – Do Not force connectors
 - b. Connect and tighten all ground strap connections
 - c. **Calibration is required after motor change**

Functional Check Section

Some components require functional testing but not calibration after changing. Following this will test the system components.

Hybrid system test

- a. Check that all connectors are installed and latched.
- b. Make sure the red palm button on the energy storage module is pulled out.
- c. Push down on the red top of the inertial switch located behind the driver's seat to reset.
- d. Connect a laptop PC and serial cable to the DB9 serial port in the hybrid harness. Start HCal.
- e. Press hybrid switch in OFF position.
- f. Turn ON vehicle ignition and start engine.
- g. Select the "Position, Speed and Volts" screen in HCal. The actuator position should read 390-400 and in State 3 indicating that the hybrid is disabled.
- h. Turn hybrid driver panel switch ON. After 5-15 seconds, the green LED should stay ON to show the system is ready and the actuator position should change to a 20 +/-5 position reading. The system state should be 9.
- i. IF the hybrid does not enable and the red LED continues to flash, the enable string has an open circuit. Check impact switch pressed IN, hybrid switch ON, red palm button pulled out, then check all connectors fully latched.
- j. Press the 'GFI Test' button to simulate fault. It is located on the Impact switch.
- k. After red light comes on, press the GFI Reset button on the driver display. Hold for 2-5 seconds.
- l. System should reset to solid green light.
- m. Monitor the "Position, Speed and Volts" screen in HCal.
- n. Test drive the vehicle to verify the hybrid operates.
- o. With the vehicle moving at less than 30 mph, take your foot off the accelerator pedal – the green LED should flash and regen braking should be noted. State will be 7.
- p. After several decelerations, when the vehicle accelerates from a stop, the green LED should flash and hybrid torque boost should be noted to help the vehicle accelerate. State will be 6.

Additional troubleshooting information at www.crosspointkinetics.com/techdocs

Procedures Section

Troubleshooting the Motor

GFI Faults

- a. Lift bus to access the motor.
- b. Inspect motor as per the 'Motor' section earlier in this manual.
- c. Remove the (4) screws holding the phase cable connections lid to the motor
- d. Remove the (3) gland nuts on lid and slide back.
- e. Slide the lid back to expose the terminal connections.
- f. Using a Volt-Ohmmeter, set to 'resistance' and check any terminal to chassis ground. The only acceptable reading is "infinity".
- g. Check resistance from terminal to terminal (3 readings). The only acceptable readings are "0".
- h. If readings do not agree, contact your Crosspoint Kinetics hotline or Field Service Representative.

Driveline Noise and Vibration

- a. Lift bus to access the motor.
- b. Inspect motor as per the 'Motor' section earlier in this manual.
- c. If possible, raise the rear wheels off the lift by lifting the rear axle.
- d. With helper in the cab, start engine and put in drive.



WARNING – Take caution with a spinning driveline and wheels

- e. Inspect driveline while running at various speeds to locate driveline noise. If noise and vibration is located at hybrid motor, suspect main or thrust bearings. Contact your Crosspoint Kinetics hotline or Field Service Representative.

Motor Thermistor

A thermistor is located in the stator with a temperature signal monitored by the controller. Replacement of thermistor is currently not available.

A 10003 fault code indicates motor temp overheat or thermistor shorted. Check coolant flow and blower for operation.

Resistance can be measured at SIG connector on controller, (pins 2 & 3 on Deutsch harness connector). Ambient reading is approx. 100K ohms. The resistance decreases as the motor temp increases.

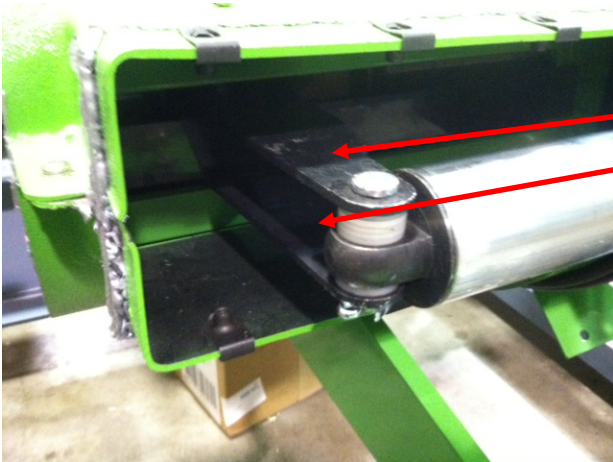
Purging Cooling System

When a component is replaced in the cooling system, follow this recommended procedure:

- a. With the ignition OFF, disconnect the return hose at the top of the coolant reservoir from the 90 deg. Angle barb.
- b. Place this hose in an empty container for excess coolant. Have a helper turn ON the ignition while the coolant level in the reservoir is observed. Turn OFF the ignition when the reservoir is down to 1" – ½" coolant level.
- c. Place the AC pump inlet hose in a coolant supply jug (50/50% water glycol standard). Place the ½" ID outlet hose in the coolant supply jug also. Pulse the power ON to the pump to completely purge all trapped air in the hoses.
- d. With the vehicle ignition OFF, connect the AC powered pump outlet to the return hose using a ½" barb union fitting. Pulse the AC pump ON to back flush and purge air out of hybrid system. Stop the AC pump before the reservoir is full.
- e. Place the return hose in the coolant reservoir fill cap opening. Turn ON the vehicle ignition and circulate coolant for at least 2 minutes. Verify steady and full coolant flow out of the return hose. If air is seen in the coolant stream or if coolant flow is not strong, check for kinked hoses and repeat the above procedure.
- f. Reconnect the return hose to the angle barb return on the top of the coolant reservoir.
- g. Fill coolant reservoir to within ½" of reservoir top. Coolant purge is complete.

Actuator Lockout and Hybrid Disabling (for continued bus operation after actuator or controller failure)

- a. The operator wants to have vehicle in-service until resolution of problem.
- b. To lock out the actuator, first remove actuator cover on motor.
- c. Are the two arms attached to the inner part of the motor? See picture. Note: If the arms are not attached inside the motor, there are no options to easily extend the rotor. In this case, contact a hybrid qualified service center.



- d. If the rear actuator brackets are broken off the motor, no easy option exists to use this lockout method.
- e. Is actuator extended? If not, turn hybrid switch off. Does actuator extend? If the actuator is not extended through the fault in the controller and not a mechanical issue, a battery can be connected directly to the Orange/Black wires on the actuator to extend it out (12 VDC).
- f. After the actuator is extended, you can cut 2"x 2" steel angle iron (approx. two 6"pieces) and a hose clamp (preferably 2) to actuator shaft as shown in picture below.
- g. Remove 12 VDC power from the hybrid system by:
- h. Removing the wire to the hybrid solenoid or remove the two 40 amp fuses in the power box. Power box location: (ARBOC-behind driver seat on floor) (E-450-behind passenger dash panel or overhead driver in electrical area)
- i. Once the rotor is pulled out fully, the actuator can be locked out as shown in photo. Ensure angle iron is large enough it cannot pass through the actuator



Towing the Hybrid

Towing the hybrid is a concern if the driveline is compromised such as motor or actuator failure.

- Transport the bus on a roll back if possible.
- Removing the rear driveshaft is the recommended option before towing. No speed or distance limit.
- If raising the front of bus and towing, limit towing speed and distance to the repair shop. Preferably 35 mph and 5 miles.
- If driving the bus to the repair shop, comply with the Driver's Operator label attached near the driver's seat. See below.

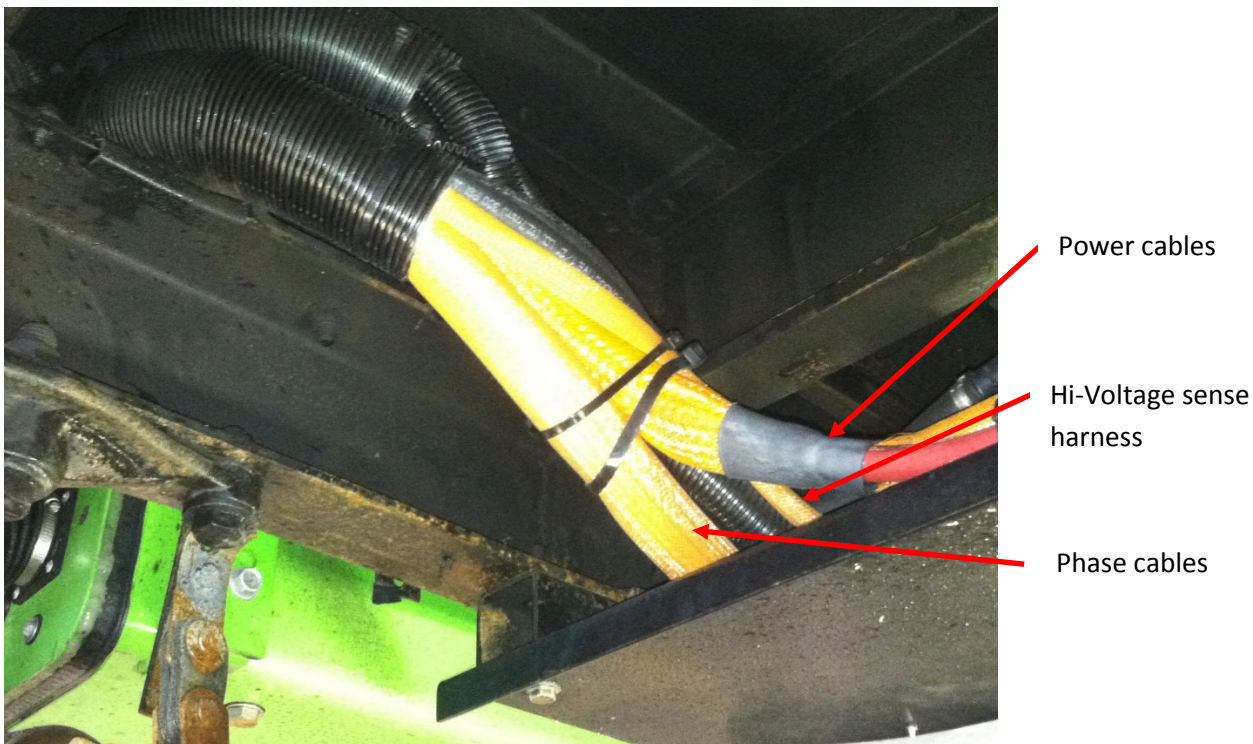
Hybrid Drive System Status

Green ON = System Ready
Blinking Green = Hybrid Active
Blinking Red = Hybrid OFF

RED ON – GFI Fault OR System Fault
To Reset: Press GFI Reset 1 second
and release. IF RED still ON – Ignition Off/
On If RED still ON, Limit Speed to 35 MPH
and get service Within 50 miles

GFI (Ground Fault Interruption) Protection and 10006 Code

- Three cable/harness sets GFI protected. Phase, Power and Hi-Voltage Sense.
- Wrapped in orange-loom for identification.
- Cables (wires) are in a copper-braid sleeve which is grounded to chassis.
- Any metallic penetration through braided sleeve to inner core will trip GFI circuit in controller and disable the system.
- Fault code: 10006 must be cleared before system will engage.
- Press-to-test button on Impact switch should be tested monthly or relevant PMI check.



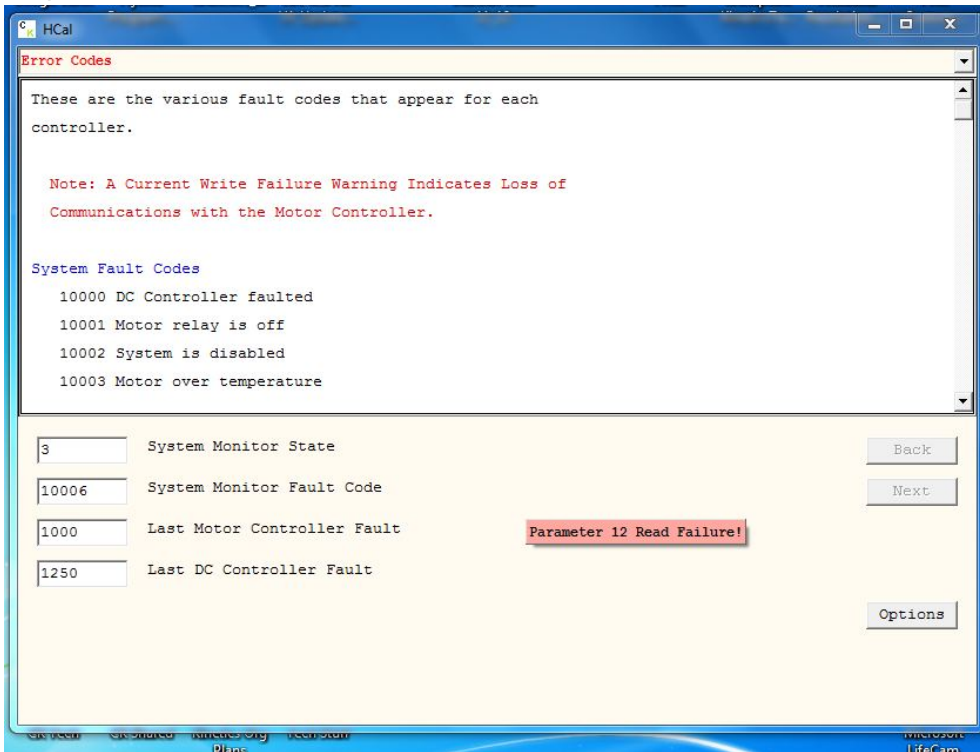
Possible GFI Faults

- Motor stator grounding to chassis. See Troubleshooting the motor earlier this section.
- Ultracap internal short. Disconnect J206 on Ultracap and check if fault clears.
- Disconnect 4 pin connector on motor or controller (encoder) and check if fault clears.
- Pinching of orange loom harness under bus. Inspect all lengths of cable/harness.

GFI Faults (cont)

GFI Fault: Driver switch ON, Red light on solid, Green light comes on briefly about every 10 seconds.

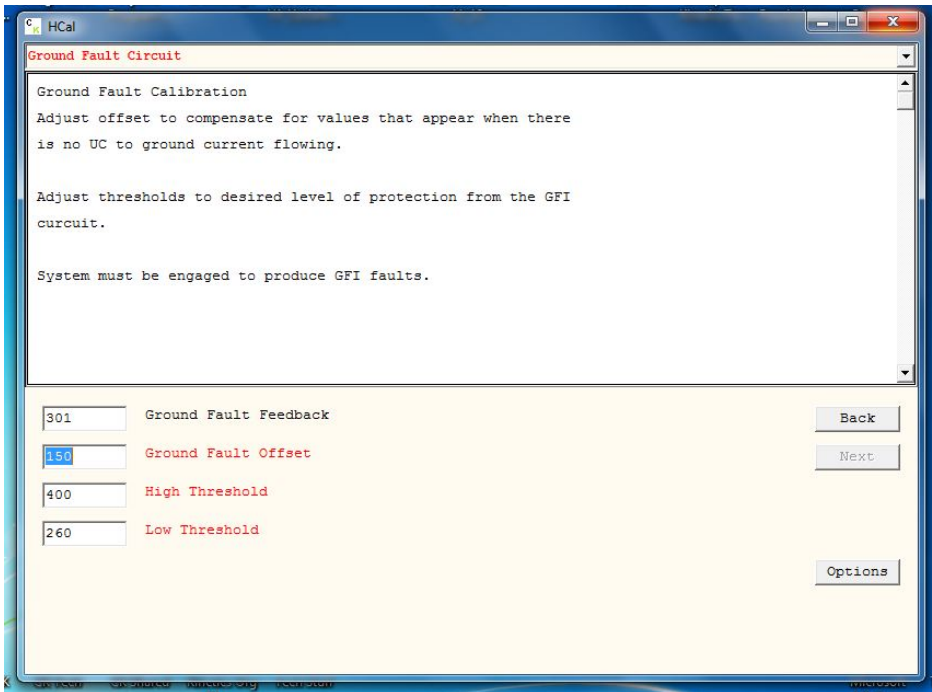
a. To determine if a GFI fault has occurred, connect laptop and start HCal program, go to Error Codes page with dropdown menu.



b. If a GFI fault has occurred, 10006 will show in the 'System Monitor Fault Code' box. *You may have to watch this page when the fault occurs. After it faults, it disables the hybrid off and fault clears.*

c. Using dropdown menu, go to Ground Fault Circuit page, press 'N' on the laptop keyboard twice. Follow the procedure on next page.

To determine where the GFI fault is originating, it's a matter of disconnecting ground straps, cables and plugs one at a time and checking GFI Feedback number until it falls in between Hi-Lo range. Install checked plugs before moving on to next one. TURN OFF key to connect-disconnect plugs & cables.



- Ground Fault Offset should be set to 150, IF NOT, set at 150 and save parameters: Click 'Options', click 'EEPROM Write', wait for green 'EEPROM Complete' window to appear in HCal. (Driver switch must be 'OFF')
Note: 'High' and 'Low Threshold' are fixed numbers (H=400, L=250). These numbers are the trip points for GFI faults. The 'Ground Fault Feedback' should be in between these numbers. If the feedback is at or outside these numbers, the GFI circuit will trip.
- Press and hold the GFI Reset button for 5 seconds. This should reset the controller to a 'No fault' state. OR, turn bus key 'OFF' then 'ON'. Does the system reset to Green light ON? IF OK, go to step c.
- If possible, note the GFI Feedback number. Does it spike outside the Hi-Lo Threshold range? IF not OK, this is the result of the GFI fault.
- Disconnect the ground shields from the studs on the Motor (1ea) Controller (2ea) and Ultracap (1ea). This will isolate the 2/0 cables and High Voltage sense harness grounds.
- Reset the system. Does the system still fault?
- IF NOT, using ohmmeter, check 2/0 terminals to chassis ground. This should be 'infinity'. IF NOT OK, look for short to ground in cables. IF OK, go to step g.
- Turn off ignition switch. Pull the 8 pin plug on the ucap. Turn on ignition and hybrid. Does hybrid fault? If not OK, go to next step.
- Pull the plugs on motor, one at a time, (4 & 8 pin) and check for fault. IF NOT OK, go to step i.
- Remove the two 2/0 power cables on ucap. Check feedback, IF NOT OK, go to step j.
- Using an ohmmeter, check for continuity across two of any three phase cables disconnected at controller in any combination. Continuity is normal but there should be 'infinity' from any terminal to motor ground. IF NOT OK, replace motor. IF OK, go to step k.
- Progressively, continue disconnecting plugs on all units and check GFI faults. IF NOT OK, call technical support.

Actuator Troubleshooting

10050 or 10051 Fault Code, Actuator Not Running (or running all the time)

- a. Connect laptop and start HCal program.
- b. Go to Error Codes page to verify code. If 10050 or 10051, proceed next step.
- c. Check both circuit breakers on controller face. IF OK, go to next step. IF NOT OK, press in **(one time only)** and go to next step.
- d. Disconnect / reconnect two Deutsch plugs on motor and two Deutsch plugs on actuator. Check for fault again. IF NOT, go to next step.
- e. Disconnect J203B plug at actuator (2 pin). If none, cut orange & black wires.
- f. Connect external 12 vdc power to actuator wires, one +, one -. If actuator does not run, reverse wires and check for movement. If no movement either direction, replace actuator. IF OK, go to next step.
- g. In HCal, go to 'Position, Speed and Volts' page. Check to see if when the actuator runs in either direction if the Actuator number changes. Check through its entire range in both directions, the reading should move in a linear way. With actuator extended, number will be approx. 390. Actuator retracted, 20.
- h. If not OK, check position sense wires from 4 pin Deutsch (*See picture below*) on actuator to 31 pin Deutsch on controller. If OK, change actuator.

Note Resistance value of sensor pot can be checked directly on actuator at 4 pin plug, pins 2 & 3. With actuator extended, 7.5 K ohms should be indicated. Retracted is less than 100 ohms. IF NOT OK, replace actuator.

If all checks are good in these tests and the system faults 10050 or 10051, the controller is likely at fault.

Have helper look at the LED display on controller. Does the 'Actuator R/G' light illuminate Red or Green when engaging or dis-engaging hybrid? Either light indication indicates controller is trying to move rotor. No lights indicate no power to actuator or faulty controller.

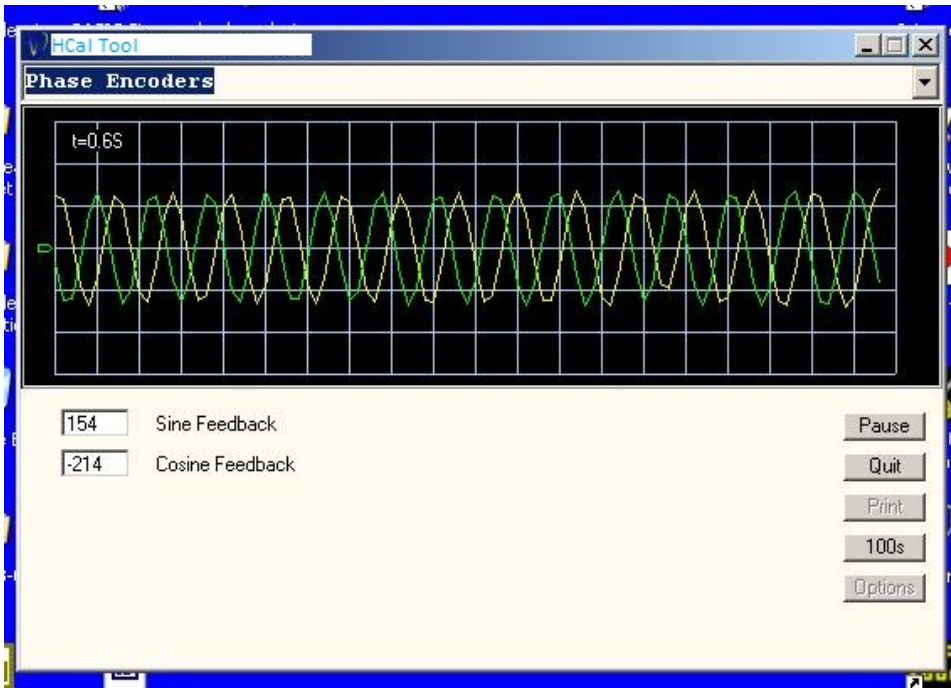
Green is rotor moving in to stator. Red is rotor moving out of stator.



No MPH Indication in HCal

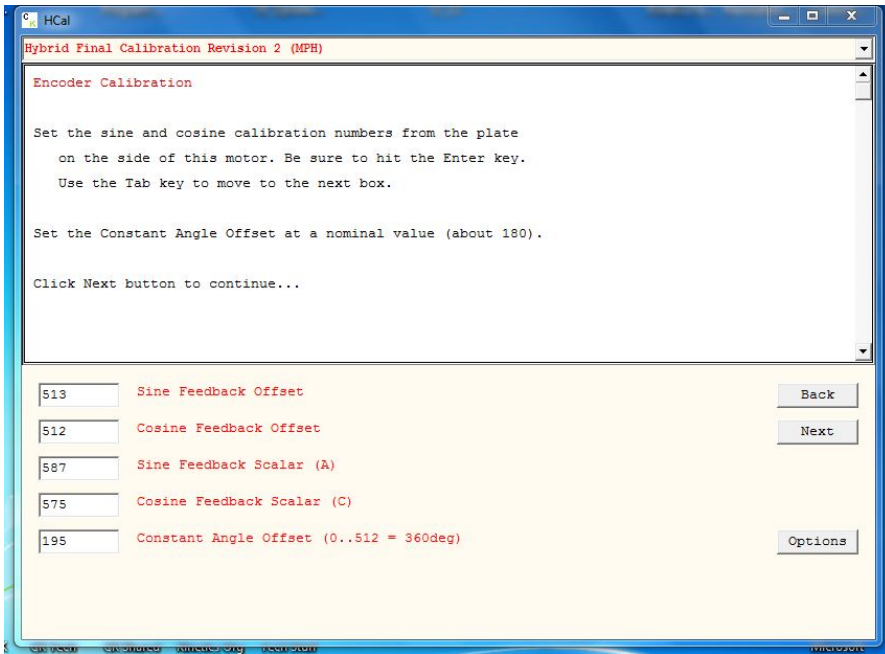
Motor Encoder Troubleshooting

- Connect laptop and start HCal program.
- Open 'Position, Speed and Volts' page.
- With Driver panel switch OFF, start bus and put in drive and move forward slowly. MPH should show bus speed and be positive number. Driving in reverse will show a negative MPH. **IF OK**, go to step d.



- Go to 'Phase Encoders' page with dropdown menu. There will be an oscilloscope display. Drive bus very slowly forward (<1 mph). Two sine waves should be generated with same height and width. **IF NOT OK**, go to step e. **IF OK**, go to step g. as motor encoder is functional.
- If no sine waves are generating (flatline), check for 12 vdc at motor plug J203A, pin 1, ground is pin 4. **IF OK**, next step.
- If one sine wave is flat line, suspect wiring or encoder board under back plate on rear of motor. The wiring on Controller J103 to Motor J203 connectors (4 pin) can be continuity tested. **IF OK**, go to step g.

No MPH (cont)

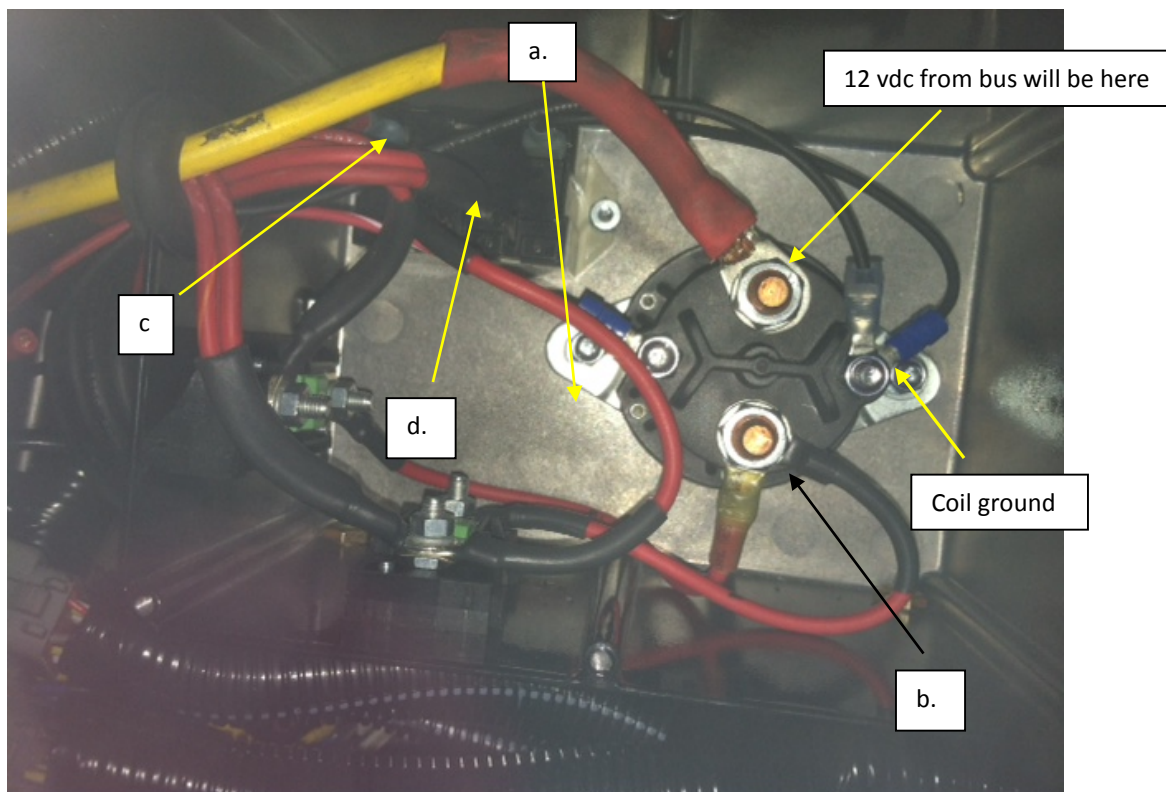


- g. The final check is the (4) encoder parameters can be checked against the label on the motor label. Do this at the 'Hybrid Final Calibration Revision 2' page in HCal. Click 'N' once to get to correct page.
- h. To make changes, press 'Enter' after typing in each number. Press "Options", press 'EEprom Write', to save changes. Note: Driver switch must be OFF to save.
- i. **If Not OK**, suspect motor encoder board. Contact your local Crosspoint Kinetics Technical Representative.

12 Volt Power Checks

Power Box Troubleshooting

Location: Behind driver seat on floor (ARBOC), behind passenger air bag panel (E-450) or floor on passenger side.



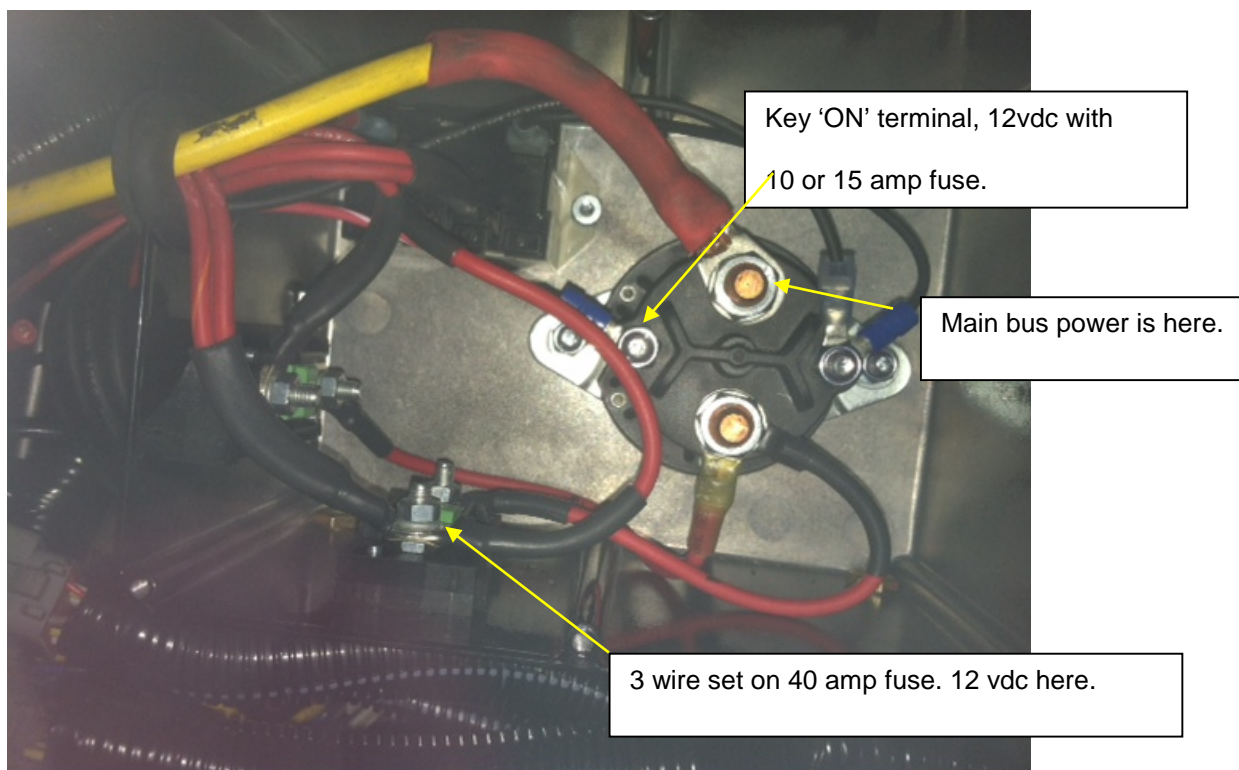
- a. 12 vdc to Solenoid with key ON. IGN wire is fused with 10 or 15 amp fuse. **IF OK, GO TO step b.**
- b. With Ignition key ON, check for 12vdc here. **IF OK, GO TO step c.**
- c. If Hybrid switch is enabled, check 12vdc here. **IF NOT OK**, check Palm switch and Impact Switch first. If either RED or GREEN light(s) are on, this indicates correctly the Driver panel is powered from the controller. If no lights, check male ¼" spade connector at Driver panel connections for 12 vdc. **IF OK, GO TO d.**
- d. 12vdc here at b wire set if Enable string intact. **IF NOT OK**, 12vdc at c and not at d indicates switch inside relay is not closing, coil is open or ground is not made.

Note: c & d are at the small rectangular relay. Hybrid Driver Switch must be on to get 12vdc to c.

12 Volt Power Checks (cont)

Symptom: No power to Controller

- a. Check main power to controller. Check 20 amp circuit breaker on controller face. **IF OK**, go to step b. **IF NOT OK**, press in. (one time only)
- b. Check 12 vdc at power box, see pic below.

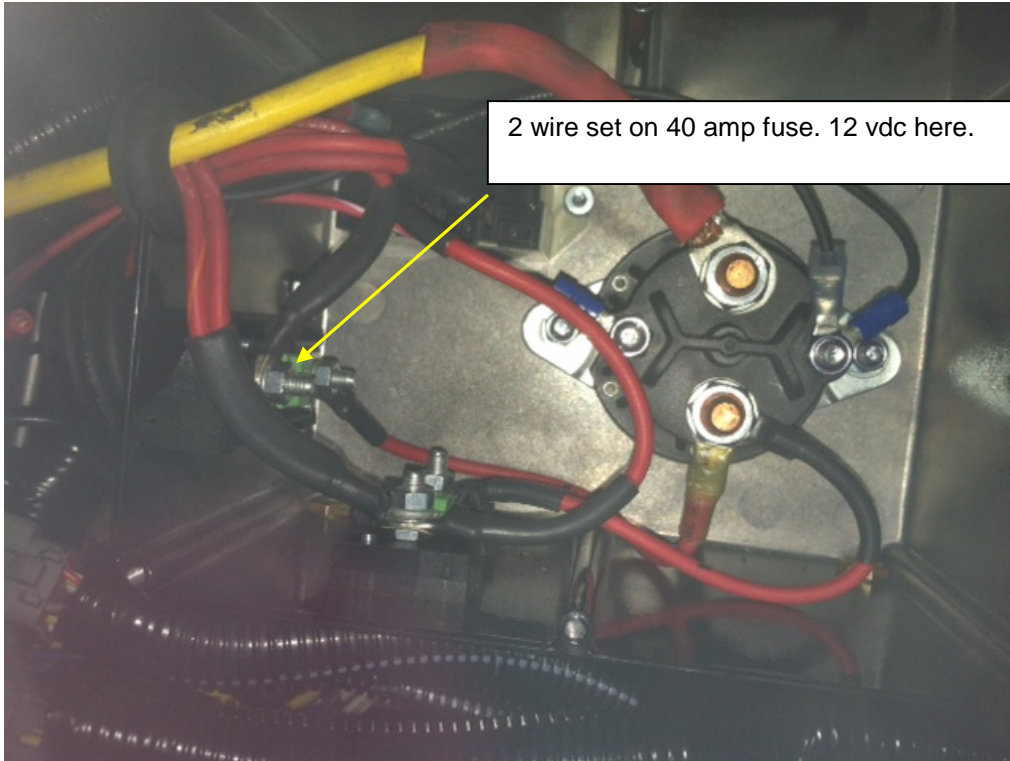


- c. Check for 12 vdc at 40 amp fuse. Key must be 'ON' and solenoid energized. Driver panel switch can be off or on. **IF OK**, GO TO step d.
 - d. Remove left Weather Pack plug on controller (PWR) and check for 12 vdc at P, Q, & R and check J, K, & L for chassis grounds. (For Deutsch plug (PWR), 12 vdc is S, G, & F. Chassis grounds are E, A, & N.)
- IF NOT OK**, check connector 222-322 for 12 vdc at pins 1, 3 & 4. Check connector 221-321 for grounds at pins 1, 2 & 4. Typically, these connectors are under the bus near the cooling unit. (See Index J for Weather Pack numbering)

12 Volt Power Checks (cont)

Symptom: No power to Cooling Unit (Fan or pumps not operating)

a. First, check unit 12 vdc at power box.



b. Check for 12 vdc at 40 amp fuse. Key must be 'ON' and solenoid energized. Driver panel switch can be off or on. **IF OK, GO TO step c.**

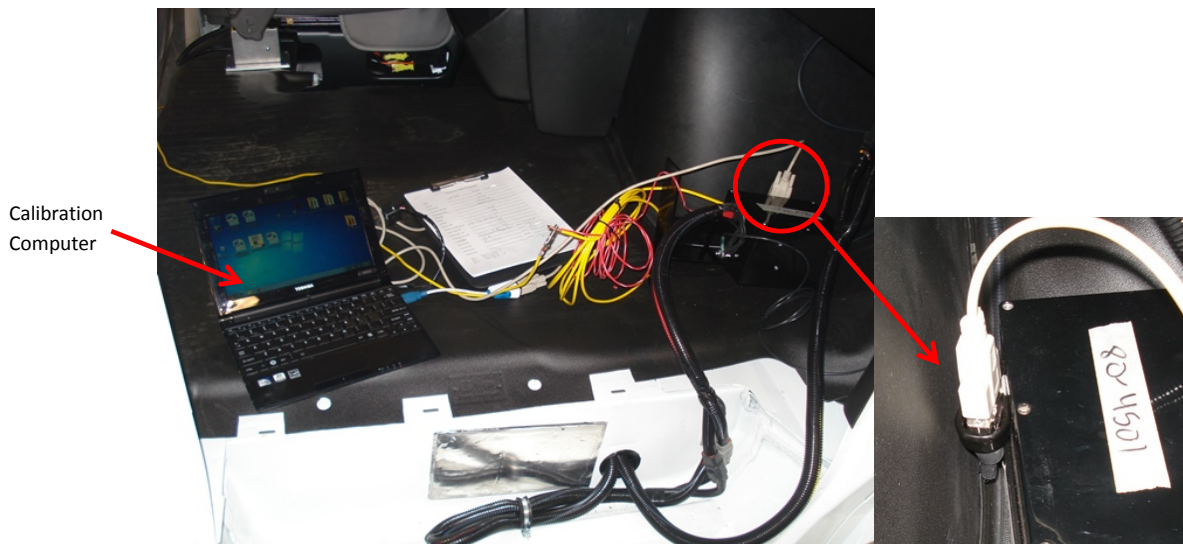
c. Remove J205 plug at Cooling Unit and check harness for 12 vdc at pins 1 & 2. Check chassis grounds at pins 7 & 8. **IF NOT OK, go to step d.**

d. Check connector 223-323 for 12 vdc will at pins 1 & 2 and grounds at pins 7 & 8. Typically, the connector is under the bus near the cooling unit.

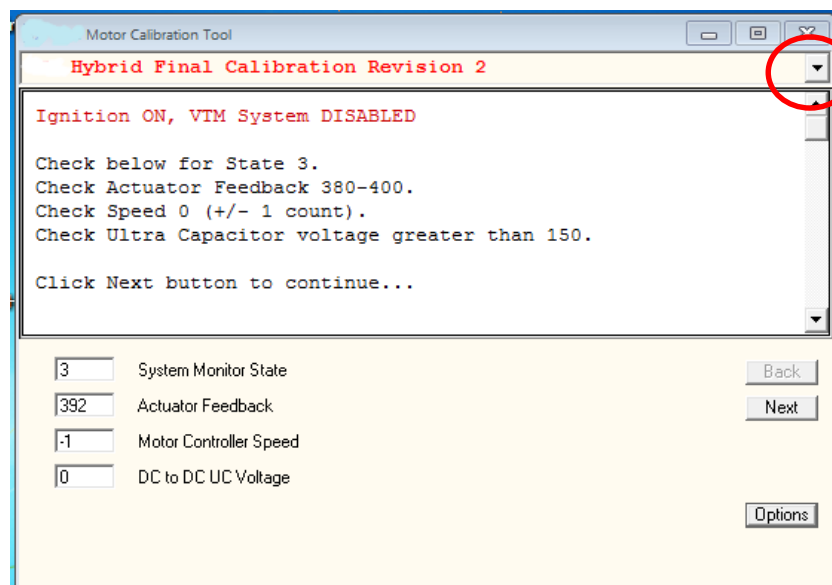
Calibration Section

Some components require calibration after changing. They are noted as so in the following procedure.

- Connect a laptop computer to the data connector using the serial/USB cable provided.
- Hybrid switch to “OFF” position.

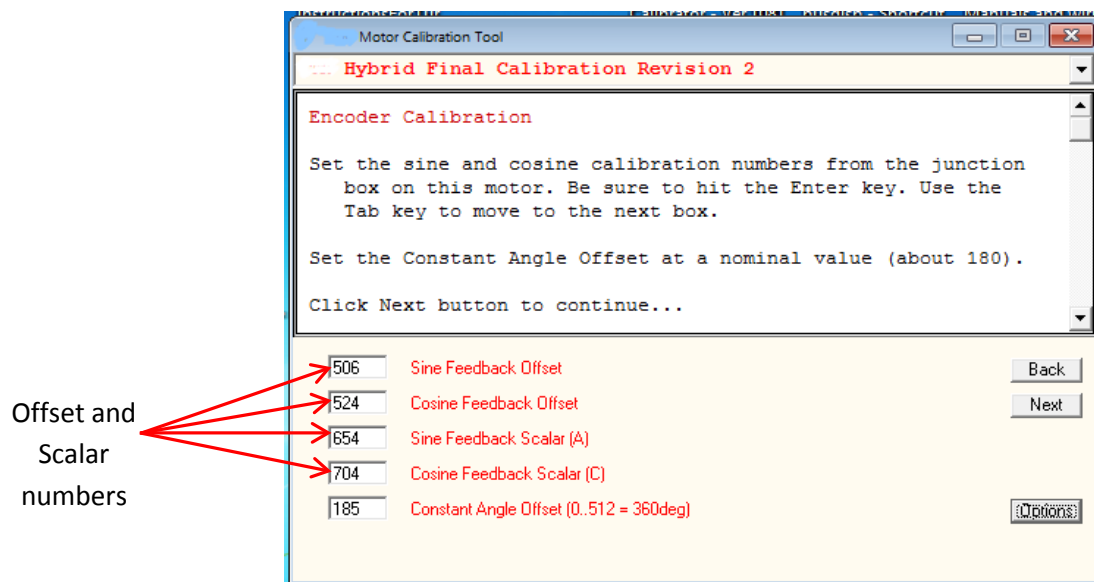


- Open the “HCal Calibration Tool”

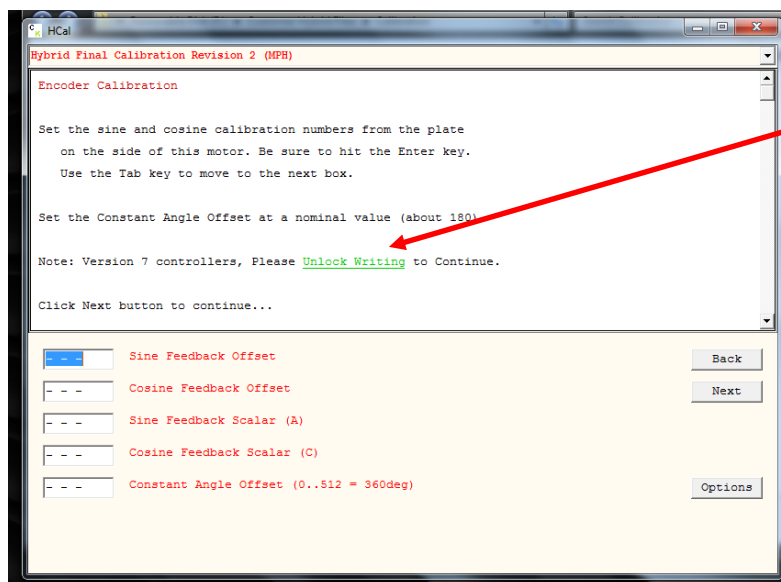


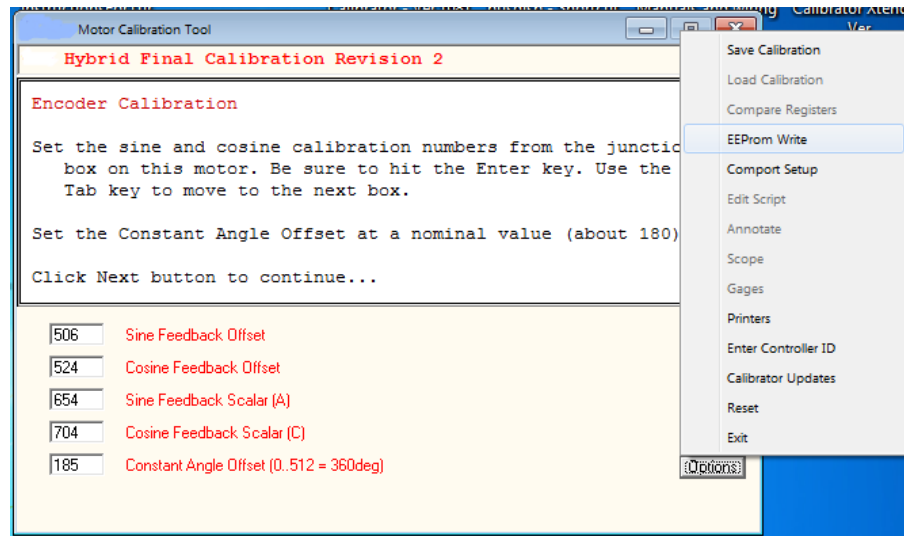
After Motor or Controller change:

- Push “next” or “N” on keyboard to get to the “Encoder Calibration” screen

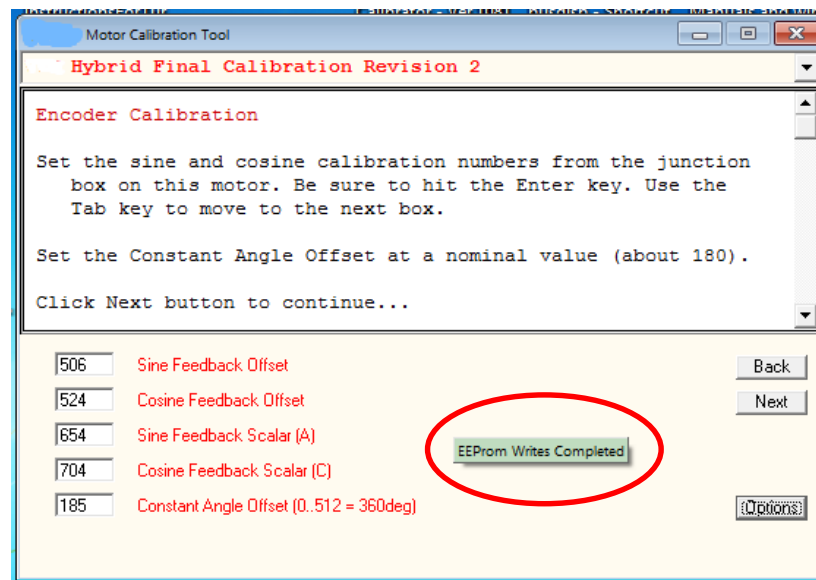


- Input the offset and scalar numbers in order from the hybrid motor assy. Be sure to hit “enter” after each number and use the “tab” key to move down to the next number. The Constant Angle Offset number should NOT change at this time.
- **Note:** if Version 7 or higher controllers, click the ‘Unlock Writing’ link shown here. This version is verified by the inability to change any parameters. If this link is not shown on the ‘Final Calibration’ page, go to <http://crosspointkinetics.com/techdocs> and download the latest version of HCal.

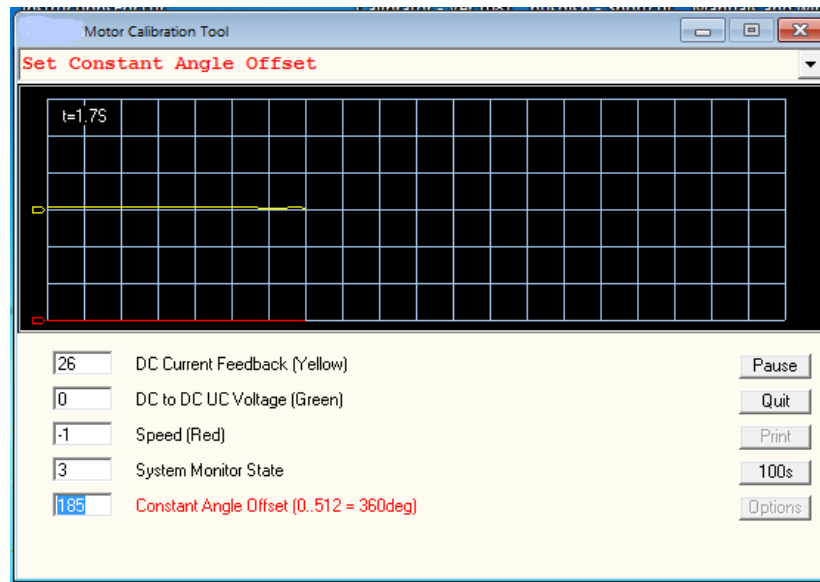




- Hit the “Options” tab and go to “EEPROM Write”. This will write the new motor configuration numbers into the controller.
- When the programming is complete, the system will display a message on the screen.



After Controller change: (in addition to Encoder numbers)
 Go to the “Constant Angle Offset” page.



- Hit the “N” key twice from the Constant Angle Offset page. This will take you to the “Variable Angle Settings”.
- Change the Variable Angle Offset Scaler to -512 and hit the “enter” key
- Tab down to the Max Variable Angle Offset and change that to 35. Again hit the “enter” key.

Motor Calibration Tool

Set Constant Angle Offset

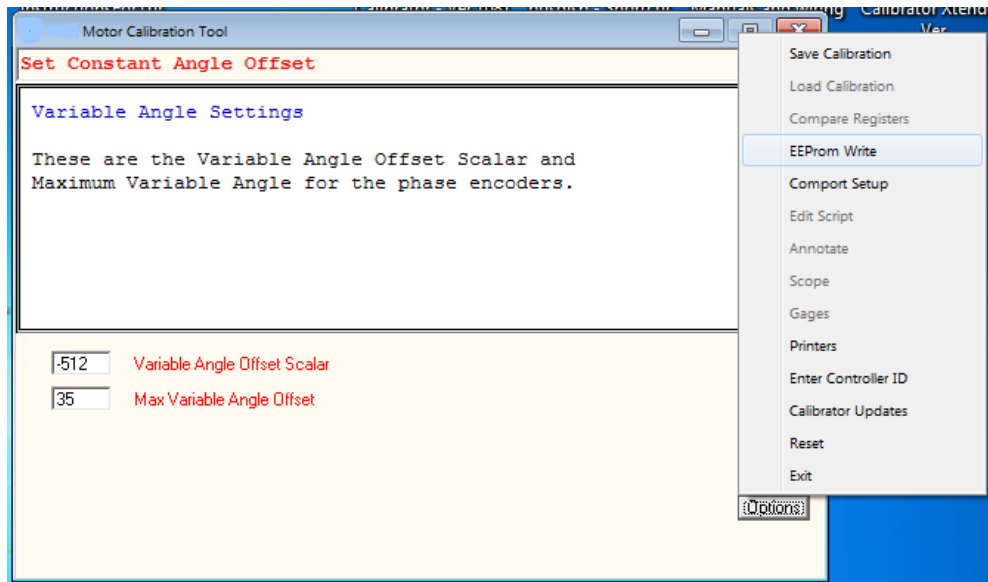
Variable Angle Settings

These are the Variable Angle Offset Scaler and Maximum Variable Angle for the phase encoders.

0 Variable Angle Offset Scaler Back

0 Max Variable Angle Offset Next

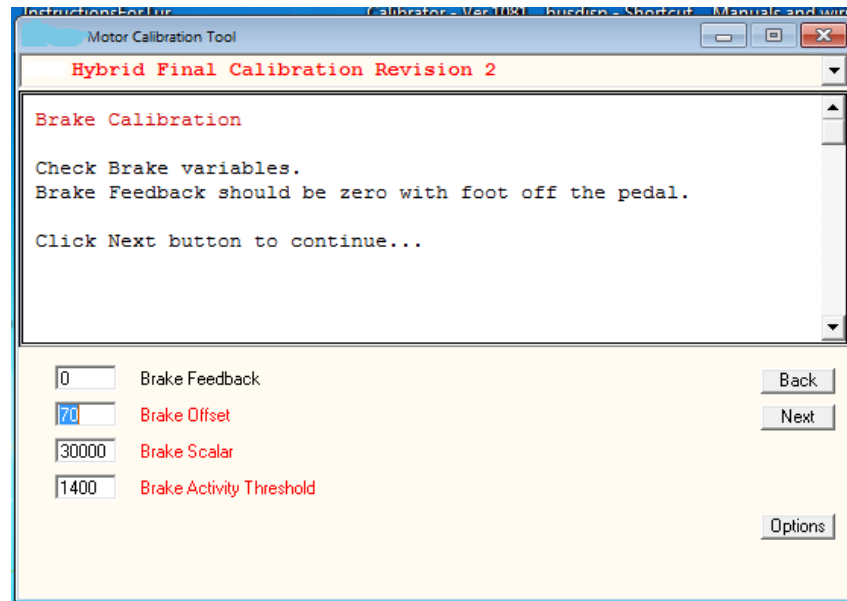
Options



- Hit “Options” and again EEPROM Write to write the new angle offset parameters to the controller.

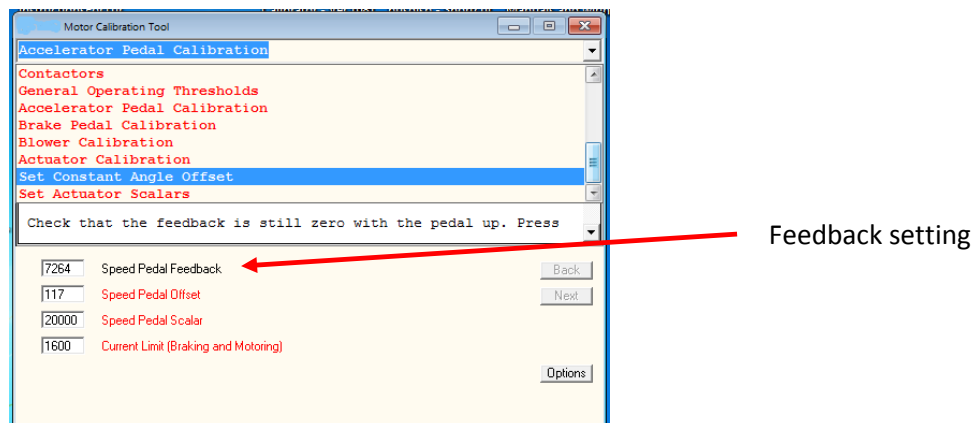
Check or Adjust brake transducer:

- Next, go to the “Brake Calibration” page.
- Brake Feedback should be at “0” with brake off. Brake Offset can be adjusted to achieve this.
- The feedback number will increase when the brake pedal is depressed.



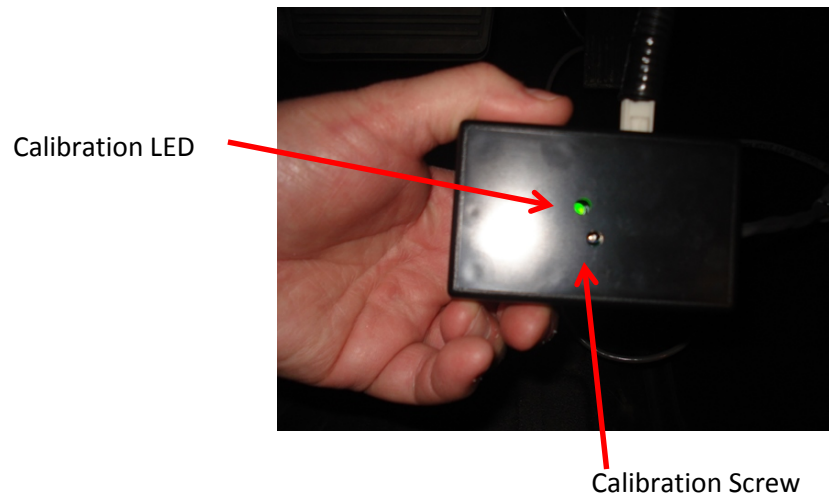
Check or Adjust Throttle Switch:

- Go to the “Accelerator Pedal Calibration” page in HCal.
- Verify on the Accelerator Calibration Page that the Speed Pedal Feedback is > 10000. (It may be < 10000 with engine off). There is no hard number, it is approximate. Small adjusting of the Speed Pedal Offset will change the Feedback number. **This is not normally required to adjust.**



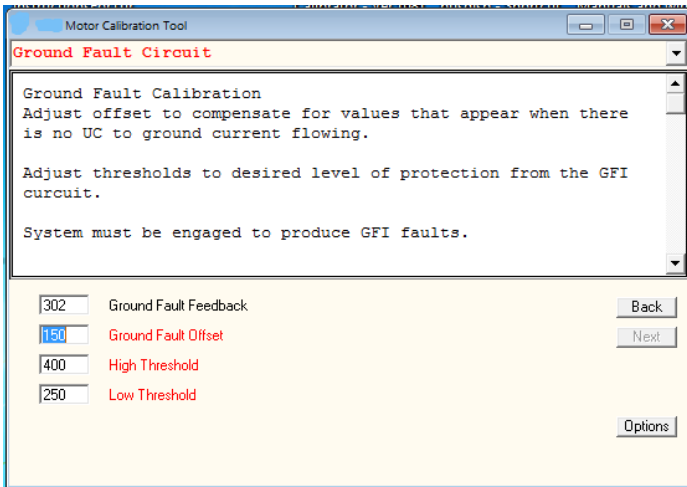
- Locate the calibration box.
- Adjust the string pot calibration screw so that the light is off, and the light comes on just as the accelerator pedal is depressed approx. ¼”.
- Verification of the switch operating can be viewed on the controller LED display labeled “Throttle”. Pedal up: light off, Pedal down ¼”: light on.

- Another verification of switch actuation is found in HCal on the same level as the “Encoder Calibration” page. Continue pressing “N” on the keyboard until page with “Throttle Switch” is seen.



GFI Test:

- Turn the hybrid system on so that the green light on the dash is illuminated.
- Go to the “Ground Fault Circuit” page.
- Verify the ground fault check by pushing the red button on the top of the Inertia Switch box. This switch will activate a ground fault in the system. The green light on the dash should go off and the red light should illuminate.
- Reset the GFI by pushing the red button on the dash panel for 2-5 seconds.



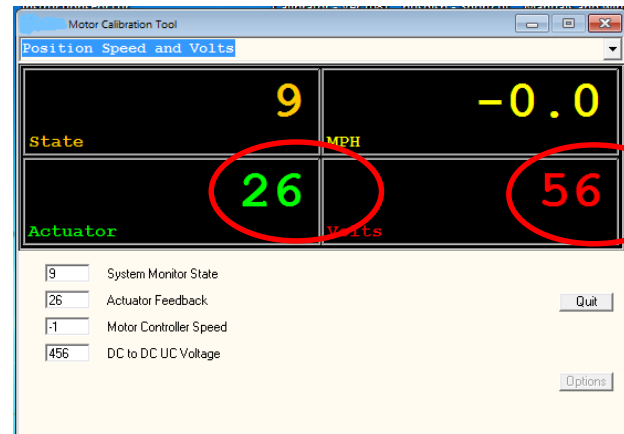
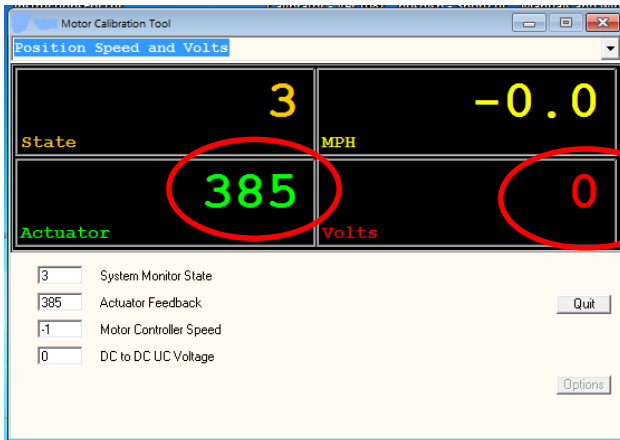
GFI Test



GFI Reset

Testing the Hybrid:

- Go to the screen labeled “Position Speed and Volts”.
- With the Hybrid Switch in the OFF position, the Actuator number should read high (350-400 range). When the hybrid switch is turned ON, the Actuator number should drop low (25-35 range) and the Volts box should read the available voltage in the Ultra-Capacitor.
- State will change to “9”, meaning the ready state.
- The States during boost is “6”. Regen is “7”.

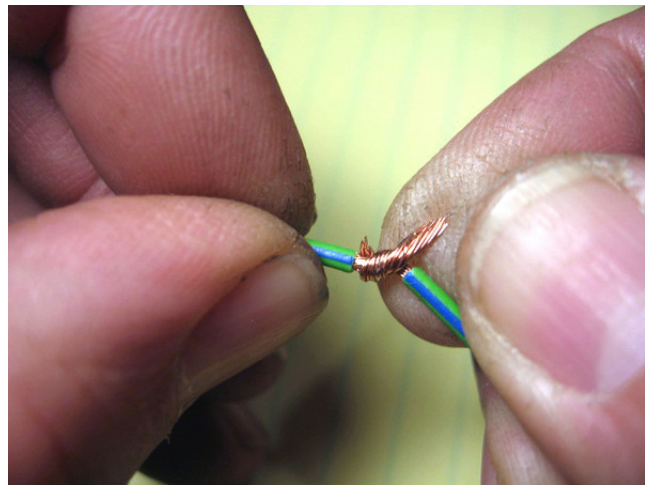
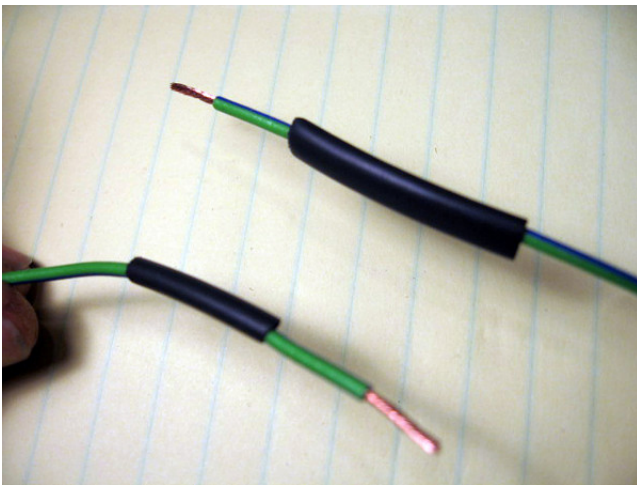


The system should not be functional and ready for a test drive. Verify system operation by monitoring the Actuator and Volts numbers during a drive cycle. The actuator should move in and out (number up and down) and the voltage should go up during deceleration and down during acceleration. **No red light should be noted. A green flashing light is normal during boost and regen.**

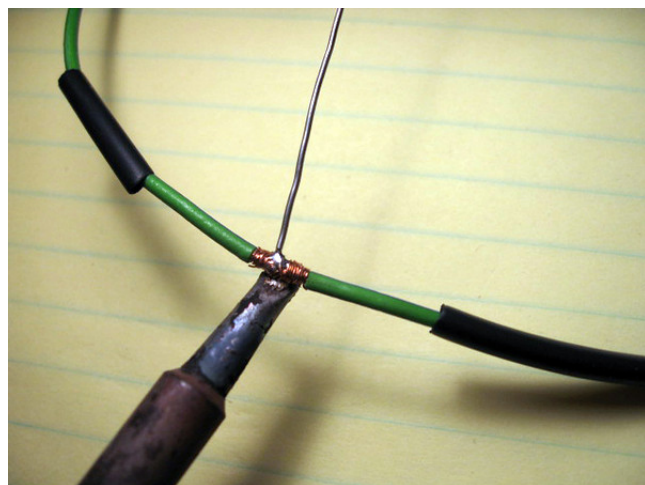
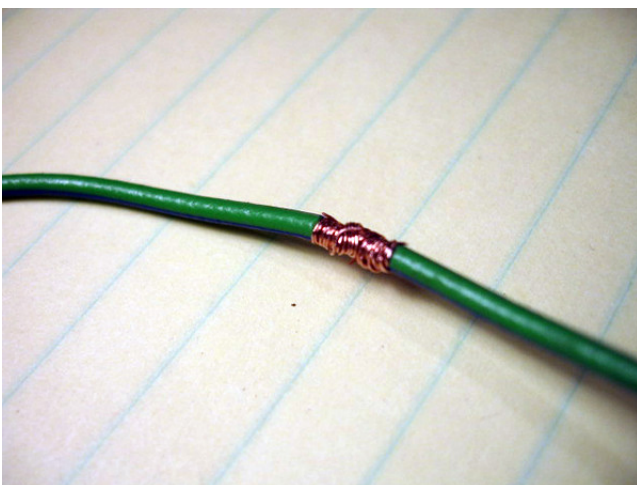
Wire Repairs

Repairs to wiring in the KINETICS harnesses are approved but only use industry standard methods. Crimp splices are not recommended for these repairs. The following repair is the recommended procedure for damaged wiring. This will make a strong and environmentally tight repair.

Note: 2/0 cables are not allowed to be repaired.

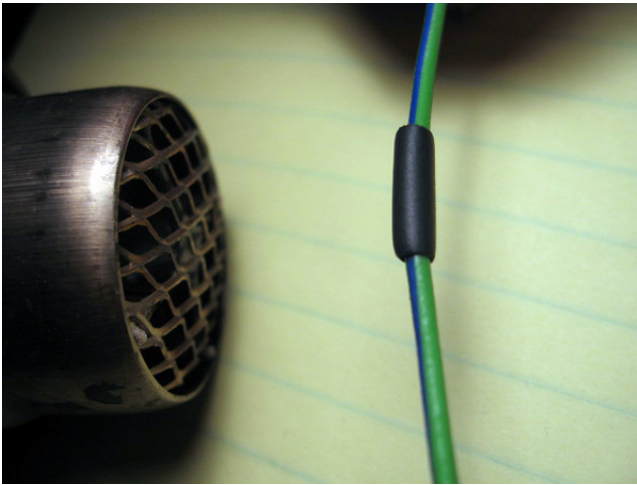


Strip back the damaged wire(s) and install a good quality heat shrink over the wires as shown. Place the two wires together and twist at least two wraps around each other.



It should look like this after twisting the wires together. Solder the wires together using a good quality (RoHS) solder.

Wire Repairs (cont)



Using a heat gun or butane torch, shrink down the heat shrink until tight.

Packard Weatherpack# 1549-2521
 Terminal# Males except where noted**
 then sockets, with seals

A-- cavity plug and 1/4" pc rubber ford from MMC in front.

B-- cavity plug

C-- 18 red from shielded(Quabbin)

D-- 16 Yel/red

E-- 16 Yellow

F-- 16 Blk/yel

G-- 18 Red from 18/4

H-- 18 White from 18/4

I-- 18 Black from 18/4

J--**12 Black**, socket

K--**12 Black**,socket

L--**12 Black**,socket

M-- 16 Wht

N-- 14 Yellow

O-- 14 Red/yel

P--**12 Red/org**,socket

Q--** 12 Red**,socket

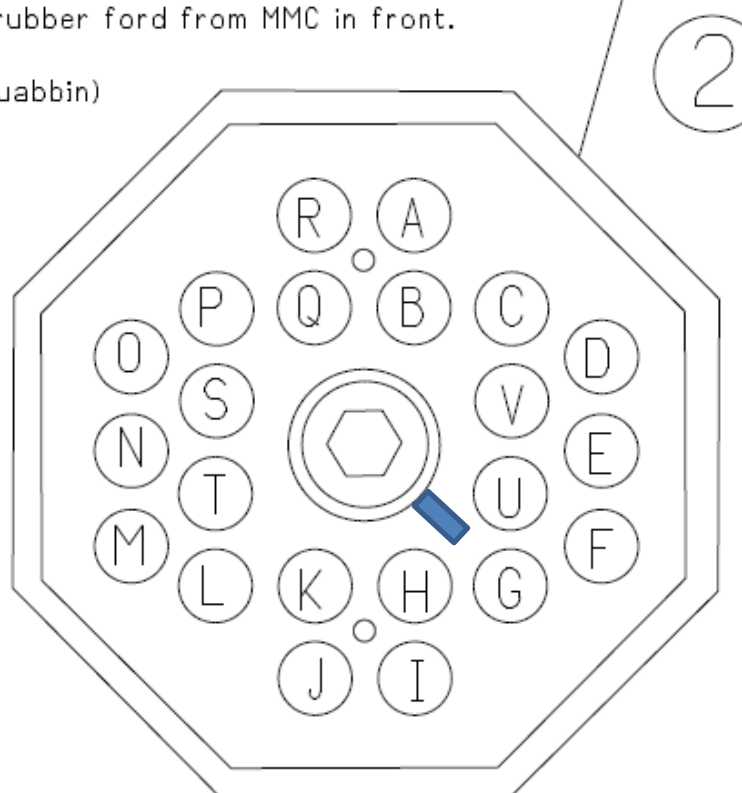
R-- ** 12 Red**socket

S--** 12 Org**,socket

T--** 12 Blk/org**,socket

U-- Cavity plug

V-- 18 Black from shielded(Quabbin)



Red, "POWER"

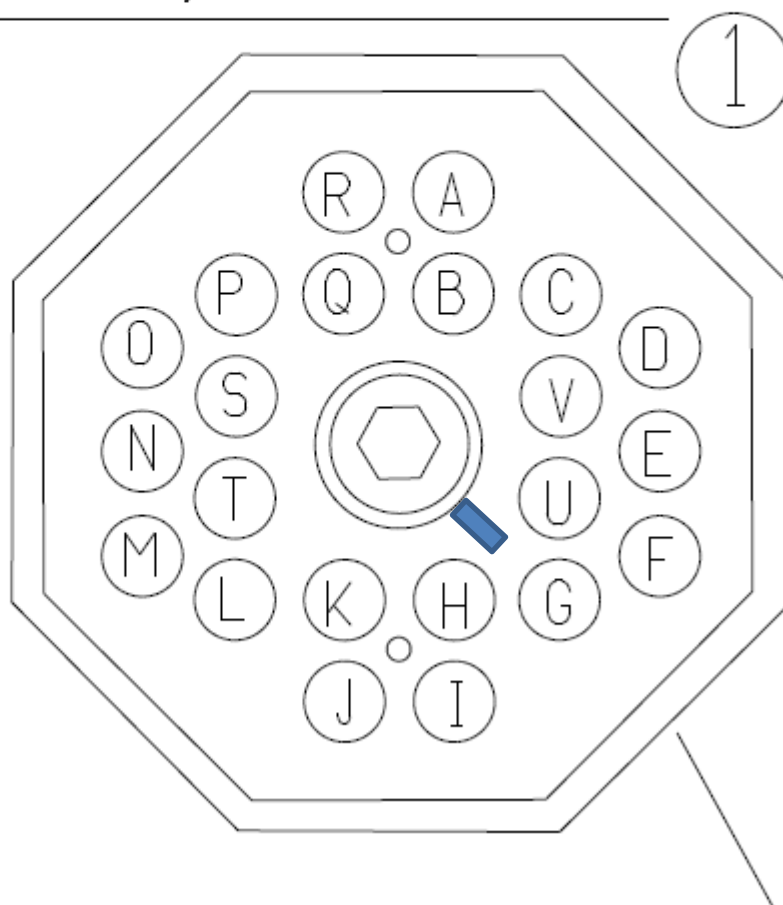
Packard Weatherpack#

1549-2521

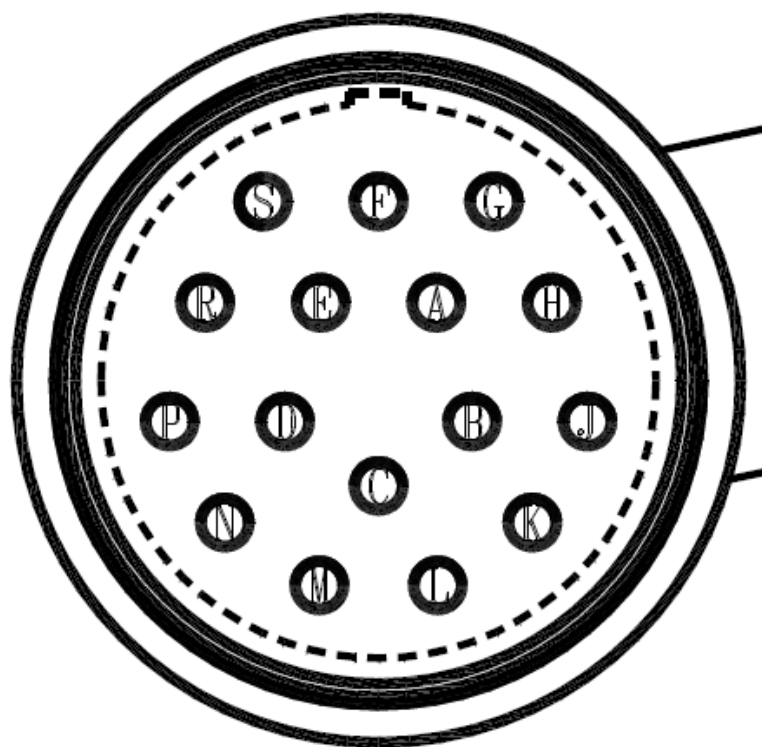
Terminal# All weatherpack
 males with seals.

Black, "SIGNAL"

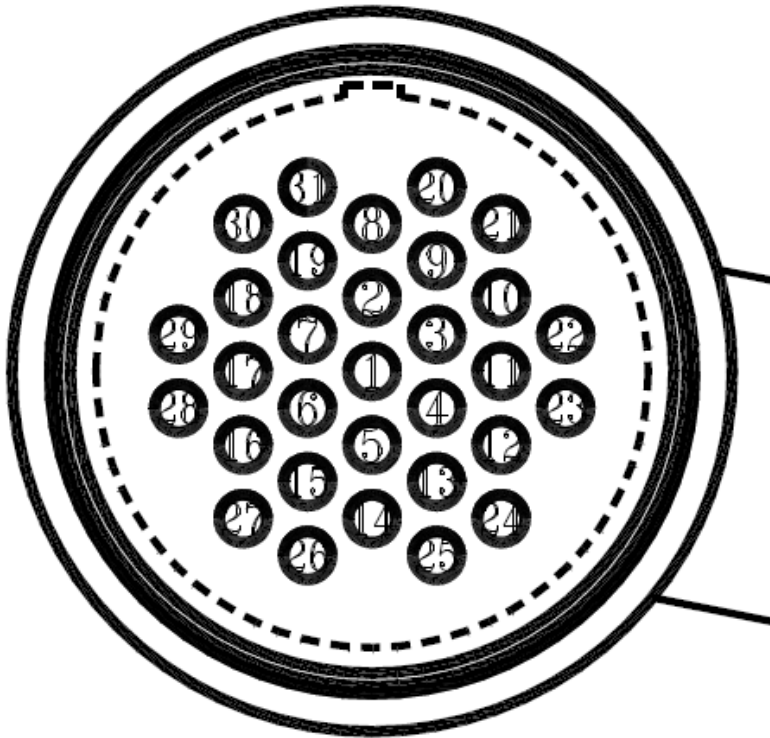
- A-- 16 red
- B-- 16 Blk/yel
- C-- 16 Yellow/blk
- D-- 16 Green/blk
- E-- 16 Brown
- F-- 16 Wht
- G-- 16 Grey
- H-- 16 Green
- I-- 16 Blk/Grn
- J-- 16 Blk
- K-- 16 Yellow
- L-- 16 Green/wht
- M-- 16 Wht/red
- N-- 16 Wht
- O-- 16 Wht/blk
- P-- 14 Red/Yel
- Q-- 16 Blk
- R-- cavity plug
- S-- 14 Red/wht
- T-- 14 Blue/wht
- U-- 16 Blk/wht
- V-- 16 Violet



Deutsch Connector Pin Outs



A--	14	Blk	
B--	Cavity	plug	
C--	Cavity	plug	
D--	Cavity	plug	
E--	12	Blk	
F--	12	Red	
G--	12	Red	
H--	14	Red/wht	
J--	14	Blu/wht	
K--	14	Red/yel	
L--	14	Red/yel	
M--	14	Yel	
N--	12	Blk	
P--	12	Blk/orn	
R--	12	Orn	
S--	12	Red/orn	



- 1-- 16 Blk
- 2-- 18 Red t-pair
- 3-- 18 Blk t-pair
- 4-- 18 Red shld
- 5-- 18 Wht shld
- 6-- 16 Blk/yel
- 7-- 16 Yel
- 8-- 16 Wht
- 9-- 16 Yel/Red
- 10- 16-Yel
- 11- Cavity plug
- 12- Cavity plug
- 13- 18 Blk shld
- 14- 16 Red
- 15- 16 Wht
- 16- 16 Grn
- 17- 16 Blk
- 18- 16-Brn
- 19- 16-Yel
- 20- 16 Blk/wht
- 21- 16 Blk/Yel
- 22- Cavity plug
- 23- Cavity plug
- 24- 16 Grn
- 25- 16 Blk/grn
- 26- 16 Blk/wht
- 27- 16 Vio
- 28- 16 Gry
- 29- 16 Wht
- 30- 16 Grn
- 31- 16 Wht/red

Service Intervals

Recommended Maintenance Intervals for Vehicles in Transit Service:

- Monthly – Review driver comments about hybrid operation, perform visual inspection, perform GFI test per driver manual procedure. With engine running, turn hybrid switch OFF and verify flashing red LED (disabled state). Turn hybrid switch ON and verify green LED (Ready state).
- Every 6 months or 20,000 miles– (whichever comes first)
 - Check hybrid coolant reservoir for correct level, add standard 50 / 50% water / glycol coolant as needed. With ignition ON but engine OFF, have a helper cycle hybrid from ON to OFF and then back ON. Verify the shift actuator on hybrid motor moves and shifts quietly. If operation is noisy, replace actuator.
 - Conduct hybrid motor linear bearing lube procedure: With ignition ON, turn driver panel switch to off – this will shift magnet rotor to the full forward position. Turn OFF ignition. Disconnect forward driveshaft at front motor yoke. Remove 1/8 NPT pipe plug from center of motor shaft. Use a hand operated grease gun containing Mobil 1 high temp grease and verify this is primed and pumps grease. Connect to the 1/8 " NPT thread, and pump the handle six (6) times to dispense a measured amount of grease to the motor shaft ball slide. Disconnect grease gun, replace plug and drive shaft. Turn ON ignition and engine, turn ON hybrid switch. Test drive vehicle to verify correct hybrid and driveline operation.
 - Check hybrid system for correct boost and regen performance using a driving test. Visually inspect for cable and connector sealing.



Service Intervals (cont)

- Every 24 months *OR if using extended life coolant, every 100,000 mi.* – Disconnect hose at the bottom of the coolant reservoir and drain coolant. Turn ON the ignition and hybrid system to drain hybrid coolant for approx. 2 min. Do not allow pumps to run dry for more than 5 minutes or damage will result. Turn OFF, reconnect hose to reservoir and refill with new 50% automotive water / glycol coolant while the hybrid is ON. Verify coolant flow back into reservoir and run for 5 minutes. Top off coolant. **After purging and filling the hybrid system, add 8 ml per gallon of Triadine 20 microbiocide additive (sold by ITW / Rustlick PN 77116) to the hybrid reservoir to prevent bacterial growth. (Available at www.mscdirect.com PN 07559974)**



- Inspect and test actuator operation at 25,000 miles or 6 months. (See 'Actuator Removal/Install' section earlier in this manual)
- 150,000 miles – Replace shift actuator PN 30-3016. (See 'Actuator Removal/Install' section earlier in this manual).
- Replace motor at 250,000 miles.
- Expected service life of the Kinetics Hybrid is 250,000 miles with 6 start/stop per mile cycle.

Hybrid Inspection Form

Visual Inspection under bus.

Note: This can coincide with other operator maintenance items while bus is on a lift.

- ☐ Inspect Ultracap, controller, motor and cooling unit mountings for integrity. Include motor cross members and frame brackets.
- ☐ Inspect mounting of actuator on motor. Check rear actuator mount brackets for cracks.
- ☐ Inspect yokes on front and rear of motor.
- ☐ Check condition of exhaust wrap next to motor.
- ☐ Inspect all glycol hoses for chafing, leaks and kinks.
- ☐ Inspect all electrical connections on motor, Ultracap, motor and cooling unit.
- ☐ Check integrity of cable boots on controller (5ea) and Ultracap (2ea). Worm clamps should be on both ends of boot.
- ☐ Check all ground straps are secure on the controller, Ultracap and motor.
- ☐ Inspect entire harness from entry to floor back to individual units. Check routing for chafing and pinching. Critical area is near suspension where it passes under body forward of rear wheels.
- ☐ With ignition key 'on', check cooling unit fan operation. Fan and cooling pumps run even when hybrid switch is 'off'.
- ☐ Check reservoir mounting and fluid level (1/2" from top).
- ☐ Check that inlets to fan are clear and exit is not blocked.
- ☐ With ignition key on, engage hybrid switch to 'ON'. Press in red 'EMER STOP' button on Ultracap. Actuator will be heard running and stop. Pull red 'EMER STOP' button. Actuator will be heard running and stop. Turn ignition key off.
- ☐ Inspect brake sensor and electrical connection.

Visual Inspection above floor.

- ☐ Check reservoir mounting (ARBOC) and fluid level (1/2" from top).
- ☐ Inspect power box mounting. (location varies)
- ☐ Inspect impact switch and mounting. Must be mounted solidly. Tapping top of box with rubber mallet can trip switch to test. Do not hit on side as this can loosen the mounting.
- ☐ Inspect driver panel mounting and light function. Turn ignition key 'on'.

Hybrid switch 'off': RED light flashing.

Hybrid switch 'on': GREEN light on solid.
- ☐ Check that the Driver Placard is installed near hybrid switch.
- ☐ Inspect mounting of throttle pot switch attached to and above throttle pedal. Check for loose switch pedal wires that may get caught in pedal.
- ☐ Check green LED on throttle calibration box for illumination while depressing pedal (1/4"). Alternately, use 'HCal' to verify operation of throttle switch.
- ☐ Perform Hybrid System Test in 'Functional Check' section.

Technician	
Date	
Bus #	
Mileage	
VIN #	