Load Controller Users Manual:

The purpose of the load controller is to control the last switches before the high voltage lines reach the load. There is not a lot the user can do to impact the load controller as there no buttons, outside switches and or user inputs. However, below, I have listed all the connections that are made on the outside of the load controller so that it can be easily hooked up. Also included are any other components (fuses, banana jacks, LEDs) of notable mention. Additionally there is a section on normal use expectations as well as how to trouble shoot simple problems with the load controller.

Connections:

1. F Gnd: Fault ground is connected using a one pin connection. The other side of the wire should be a wire with a ring terminal that is directly connected to the chassis. This provides a secondary ground measurement for the isolation monitoring device.

2. SL In: Safety loop in is connected using a four pin connection. The other side of the wire should be connected to the safety loop box. **In reality it doesn’t matter which safety cable is connected to in and which is out or to which other safety connectors they go. This convention is chosen so that there is a set way of configuring it.**

3. SL Out: Safety loop out is connected using a four pin connection cap. The other side of the wire should be one of the safety loop caps. **In reality it doesn’t matter which safety cable is connected to in and which is out or to which other safety connectors they go. This convention is chosen so that there is a set way of configuring it.**

4. GLV PWR: Grounded low voltage power is connected using a three pin connection. The other side of the wire should be connected to the GLV box at the tractive control power connection. This provides power to the load controller.

5. SC In: Safety control in is connected using a three pin connection. The other side of the wire should be connected to the safety box. This provides communication with the safety box on the status of the isolation monitoring device.

6. SCADA In: SCADA In is connected using a four pin connection. The other side of the wire should be connected to the SCADA box. This provides communication between the load controller and SCADA on whether the isolation relays should be closed.

7. HV+: High voltage plus is the positive high voltage line into the load controller. The other side of this wire should be a power lock connection to the pack.

8. Load+: Load plus is the positive high voltage line out of the load controller. The other side of this wire should be connected to the load. Voltage will only be present if the isolation relay is closed.
9. **HV-**: High voltage minus is the negative high voltage line into the load controller. The other side of this wire should be a power lock connection the pack.

10. **Load-**: Load minus is the negative high voltage line out of the load controller. The other side of this wire should be connected to the load. Voltage will only be present if the isolation relay is closed.

**Components:**

1. **TSAL**: Tractive system active light is the red LED indicator. It turns on when the tractive system is active. This is defined as either when the accumulator isolation relays are closed or when there is greater than five volts present on the tractive system.

2. **IR1 Closed**: Isolation relay 1 closed is the first yellow LED indicator. It turns on whenever the isolation relay across the positive high voltage line is closed. This means that voltage is no present at the load.

3. **IR1 Closed**: Isolation relay 2 closed is the second yellow LED indicator. It turns on whenever the isolation relay across the negative high voltage line is closed. This means that voltage is no present at the load.

4. **GLV GMP**: Ground low voltage ground measuring point is a banana jack connection directly to the low voltage system ground. This measuring point is required by the specifications and can be used in conjunction with the TSMP- to create a ground fault error.

5. **TSMP+**: Tractive system measuring point plus is a banana jack connection directly to the positive high voltage line. This measuring point is required by the specifications and can be used in conjunction with the TSMP- to measure voltage across the high voltage system.

6. **TSMP-**: Tractive system measuring point minus is a banana jack connection directly to the negative high voltage line. This measuring point is required by the specifications and can be used in conjunction with the TSMP+ to measure voltage across the high voltage system. It can also be used in conjunction with the GLV GMP to create a ground fault.

7. **Fuse1**: Fuse 1 is a 2 amp, 2AG fuse that exists between the negative high voltage side coming into the load controller and the low amperage measurement lines that the load controller needs.

8. **Fuse2**: Fuse 2 is a 2 amp, 2AG fuse that exists between the positive high voltage side coming into the load controller and the low amperage measurement lines that the load controller needs.
Normal Use:

In typical operation for discharging, the system will start up and the safety loop will be open. Since the AIRs (accumulator isolation relays) are open at this point, the red TSAL should be off. When the safety loop is closed, the AIRs close and high voltage is now present if coming into the load controller. Since the AIRs are closed the TSAL should turn on. When the user is ready to drive, the will press the drive button on SCADA. This will close the isolation relays in the load controller and the two yellow IR closed LEDs should turn on. If the safety loop opens at any point all three LEDs should turn off. Under normal shutdown procedures, the driver will stop first and turn off the motor. The yellow IR closed LEDs should turn off. Then during shutdown the safety loop will open and the red LED should turn off. If any indication happens other than this normal use case, there is probably an issue with the system or the load controller. Refer to the section below to diagnose any issues.

Troubleshooting:

Blown Fuse: If the safety loop is closed and SCADA drive button has been pressed, the tractive system active light (top red light) should be turned on. If the previous two conditions have been met and the TSAL is not on then there is most likely a blown fuse. Follow these instructions to correct the problem.

1. Use banana jacks and a multimeter to read the voltage measurement across the tractive system measuring points. This should read approximately 0V (it may also be jumping around a lot between negative and positive voltages).
2. If there is a constant non-zero voltage across the measuring points, consult an expert and refer to the maintenance manual. The problem lies within the TSAL circuitry or connections.
3. Safely shutdown the system.
4. The fuse holders are located in the back of the safety box next to high voltage lines. They require a Phillips head screwdriver.
5. It is not possible to tell which of the two fuses have blown so unscrew both of them. Determine which one of them has blown (glass casing should be dark or black)
6. Replace the fuse with a new one and screw the fuses back into their places.
7. The system should now be ready to start again.

Any other errors in the load controller need the consultation of an expert and reference to the maintenance manual. Issues to look out for are the following:

1. If any plastic connectors on the outside of the box break or get pushed into the box, refer to the maintenance manual.

2. The IR1 closed and IR2 closed LEDs respond to the same signal. If they are ever different, refer to the maintenance manual.
3. If any smoke is seen coming from the load controller or if the box has gotten unusually hot (>40 degrees Celsius), refer to the maintenance manual.

4. If it has been noticed that the isolation monitoring device has been constantly tripping or if a test has shown that it does not trip (indicated by the status of the safety loop), consult the maintenance manual.