To: LFEVY42016 Team  
From: Timothy Andrews  
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Subject: QAR003d

Abstract

Upon Implementing the Isolation Monitoring device to the High Voltage Tractive System Interface it was discovered that the curtis motor controller did not provide adequate isolation between the pre-charge input line and the motor controller common point. In addition to this the isolation designed into the Tractive System High Voltage Isolation Board does not allow for proper pre-charge relays behavior.

Technical Findings

After wiring the IMD to the HV+ and HV- input lines on the motor controller it was discovered that the IMD remained in the fault state unless the connection to the high voltage plus or high voltage minus line was removed. Upon further investigation it was discovered that the KSI (pre-charge) input line and the HV- input line are only isolated by approximately 30 KOHMS causing the a ground fault whenever the pre-charge line is attached to the HV+ input line. (Competition calls for 50KOHMS of isolation @ 100volts)

The original design called for isolating the main contactor line and the coil return line from the pre-charge relay, and this signal would be re-routed through the TSI low voltage section allowing the desired selector switch functionality. Although it has not been fully characterized I speculate, with a great deal of confidence that the pre-charge relay must be solely controlled by the motor controller. I believe that when the motor controller caps are charged a brief signal (several milliseconds) is sent out and at this point the motor controller waits for high voltage to be present at both of its high voltage inputs and if it does not detect the relay contact closure the voltage between the main contactor and the coil return will go to -24V and the motor controller will enter a fault state.

Recommendations and Conclusions

The motor in its current state will not be usable for competition without modification or additional isolation. The easiest way to address this issue is to find some kind of DC to DC converter with the correct voltage and current rating but I am currently not aware of any with the correct output current that would be suitable for this application. This problem must be addressed quickly because a new motor controller may be necessary

Addressing the pre-charge relay issue is rather simple leave it as the motor controller intended it, but the pre-charge relay should be switch for an AIR styled 24V GIGAVAC relay. Also there is the potential for placing a relay on the main contactor input line which would not allow you to close the pre-charge relay because the state must be entered promptly. But you would be able to open the pre-charge relay allowing the pre-charge relay to be opened as an additional safety feature.