To: LFEVY42016 Team
From: Timothy Andrews
Date: 5/10/2016
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

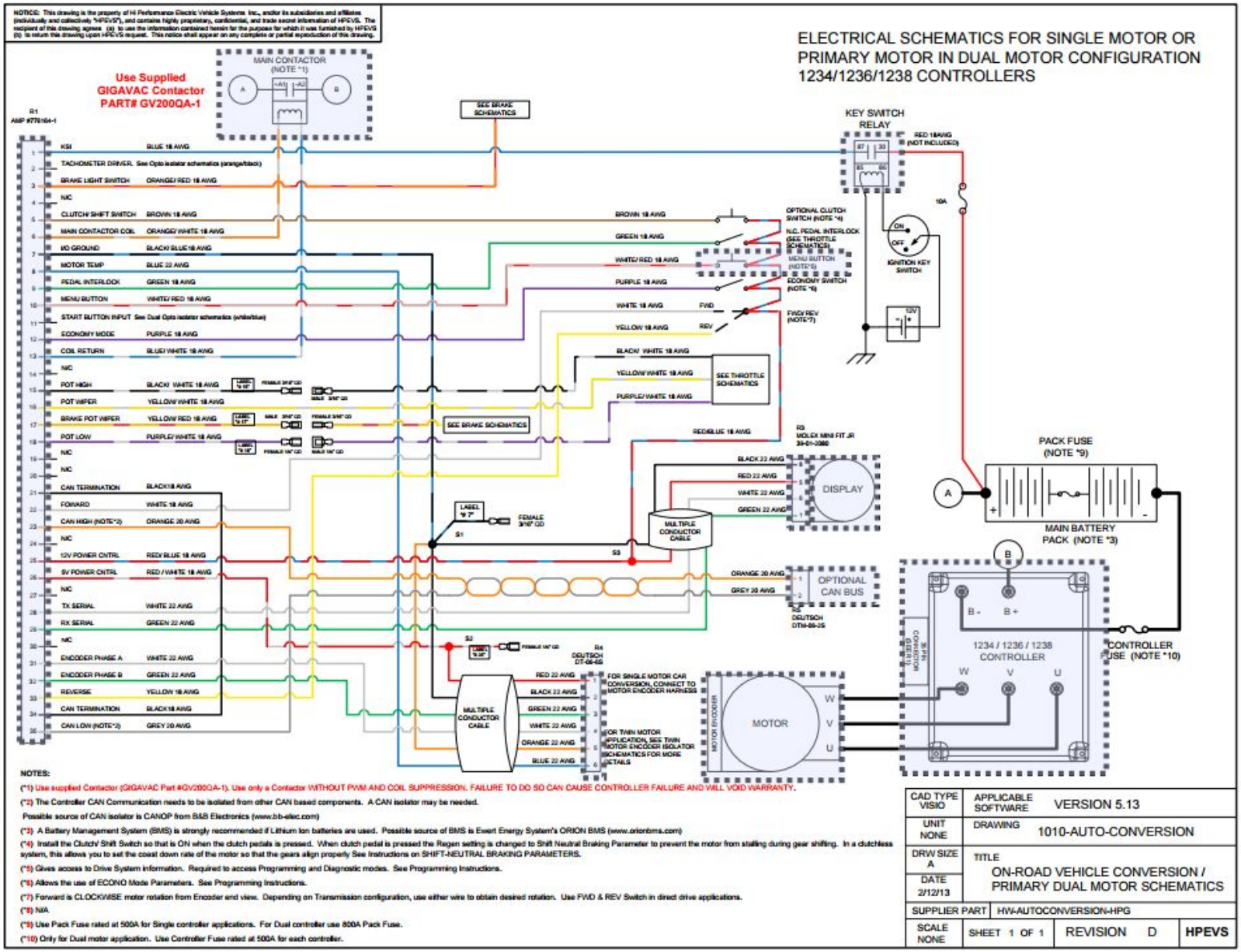
After wiring the IMD to the HV+ and HV- input lines on the motor controller it was discovered that the IMD remained in the fault state unless the connection to the high voltage plus or high voltage minus line was removed. Upon further investigation it was discovered that the KSI (pre-charge) input line 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.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ELECTRICAL SCHEMATICS FOR SINGLE MOTOR OR PRIMARY MOTOR IN DUAL MOTOR CONFIGURATION 1234/1236/1238 CONTROLLERS
Use Supplied GIGAVAC Contactor PART# GV200QA-1
MAIN CONTACTOR (NOTE *1)
KEY SWITCH RELAY
IGNITION KEY SWITCH
PACK FUSE (NOTE *9)
MAIN BATTERY PACK (NOTE *3)
CONTROLLER FUSE (NOTE *10)
1234 / 1236 / 1238 CONTROLLER
MOTOR
DISPLAY
OPTIONAL CAN BUS
MULTIPLE CONDUCTOR CABLE
KSI
TACHOMETER DRIVER
BRAKE LIGHT SWITCH
CLUTCH/ SHIFT SWITCH
MAIN CONTACTOR COIL
I/O GROUND
MOTOR TEMP
PEDAL INTERLOCK
MENU BUTTON
START BUTTON INPUT
ECONOMY MODE
COIL RETURN
POT HIGH
POT WIPER
BRAKE POT WIPER
POT LOW
CAN TERMINATION
FORWARD
CAN HIGH (NOTE *2)
12V POWER CNTRL
5V POWER CNTRL
TX SERIAL
RX SERIAL
ENCODER PHASE A
ENCODER PHASE B
REVERSE
CAN LOW (NOTE *2)
OPTIONAL CLUTCH SWITCH (NOTE *4)
N.C. PEDAL INTERLOCK (SEE THROTTLE SCHEMATICS)
MENU BUTTON (NOTE *5)
ECONOMY SWITCH (NOTE *6)
FWD/ REV (NOTE *7)
SEE THROTTLE SCHEMATICS
SEE BRAKE SCHEMATICS
FOR SINGLE MOTOR CAR CONVERSION, CONNECT TO MOTOR ENCODER HARNESS
FOR TWIN MOTOR APPLICATION, SEE TWIN MOTOR ENCODER ISOLATOR SCHEMATICS FOR MORE DETAILS
NOTES:
(*1) Use supplied Contactor (GIGAVAC Part #GV200QA-1). Use only a Contactor WITHOUT PWM AND COIL SUPPRESSION. FAILURE TO DO SO CAN CAUSE CONTROLLER FAILURE AND WILL VOID WARRANTY.
(*2) The Controller CAN Communication needs to be isolated from other CAN based components. A CAN isolator may be needed.
Possible source of CAN isolator is CANOP from B&S Electronics (www.bb-elec.com)
(*3) A Battery Management System (BMS) is strongly recommended if Lithium Ion batteries are used. Possible source of BMS is Ewert Energy System's ORION BMS (www.orionbms.com)
(*4) Install the Clutch/ Shift Switch so that is ON when the clutch pedals is pressed. When clutch pedal is pressed the Regen setting is changed to Shift Neutral Braking Parameter to prevent the motor from stalling during gear shifting. In a clutchless system, this allows you to set the coast down rate of the motor so that the gears align properly See Instructions on SHIFT-NEUTRAL BRAKING PARAMETERS.
(*5) Gives access to Drive System information. Required to access Programming and Diagnostic modes. See Programming Instructions.
(*6) Allows the use of ECONO Mode Parameters. See Programming Instructions.
(*7) Forward is CLOCKWISE motor rotation from Encoder end view. Depending on Transmission configuration, use either wire to obtain desired rotation. Use FWD & REV Switch in direct drive applications.
(*8) N/A
(*9) Use Pack Fuse rated at 500A for Single controller applications. For Dual controller use 800A Pack Fuse.
(*10) Only for Dual motor application. Use Controller Fuse rated at 500A for each controller.
CAD TYPE VISIO
APPLICABLE SOFTWARE VERSION 5.13
UNIT NONE
DRAWING 1010-AUTO-CONVERSION
DRW SIZE A
DATE 2/12/13
TITLE ON-ROAD VEHICLE CONVERSION / PRIMARY DUAL MOTOR SCHEMATICS
SUPPLIER PART HW-AUTOCONVERSION-HPG
SCALE NONE
SHEET 1 OF 1
REVISION D
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