Appendix H: Troubleshooting

Some EV behavior may seem unusual to operators when it is in fact normal operation. Be certain that you are familiar with the way the EV is supposed to perform before attempting any diagnostic or troubleshooting procedure with it. Do not perform any of this maintenance without prior approval of your instructor.

Controller Noise

There are no serviceable procedures for the controller. Other than a 1kHz tone, controller operation is silent. Noise may indicate over-temperature.

Sluggish Vehicle Behavior

Low power / loss of power will become noticeable when batteries are discharged. This is normal to low battery voltage.

Controller is Hot

The controller becoming hot does not necessarily indicate a serious problem. The controller has built in circuit protection to protect it from overheating. Shutdown will occur as a normal function of this internal protection. Power will resume when the controller reaches a safe temperature.

No Power to Controller

Raise drive wheels from ground.
Check voltage at Controller B- and Battery B+ terminals >should read full system voltage
if NO > Check for bad, discharged, or mis-wired batteries or connections
if YES > Check voltage at Controller B- and Controller B+ terminals >should read 1 to 5 volts less than full battery voltage
if NO > too high : contactor is welded
if NO > too low : 250 Ω resistor or controller is defective

Main Contactor Operation & KSI

Raise drive wheels from ground.
Check voltage at contactor and at KSI terminal
Contactor should read full rated voltage, KSI must be above 8V
if NO > Trace flow to locate problem
if YES >Check voltage across contactor power terminals
there should be no voltage drop
if YES > if voltage drop occurs contactor is defective

Check Potbox Circuitry

Raise drive wheels from ground.
Check resistance at potbox wires while depressing pedal
Resistance should be between 0-50 ohms with pedal up, and 4500-5500 ohms with pedal down
if NO > Defective potbox, broken wires to potbox, or improper mechanical operation
if YES > Check for shorts between potbox wires and vehicle frame

Resistance should be at least 1 megaohm
if NO > if lower than 1 M Ω, wiring or potbox is defective
if YES > check voltage at upper throttle input terminal on controller
voltage should be 2.7 volts with pedal up, and 7.0 volts with pedal down
if NO > terminal area is likely contaminated with acid or dirt

Check Controller Output

Raise drive wheels from ground.
Check voltage output while depressing pedal (B+ to M-)
Voltage should be zero with pedal up, and full battery voltage with pedal down
if NO > Controller is defective
if YES > Check current in controller's M- (motor field) lead while depressing pedal
Current should be high, motor should turn
if NO > if no current, look for open circuit, if current is high but motor won't trun, check motor, wiring & plug diode

Check for power to Controller

a) Leave keyswitch off.
b) Verify that battery (-) connects to the B- terminal of the controller. Connect voltmeter (-) lead to this point.
c) Connect voltmeter (+) to the battery side of the main contactor. Check for full battery voltage. If no full battery voltage, the trouble is the battery pack, the cables to it, or power fuse.
d) Connect the voltmeter (+) lead to the controller B+ terminal. You should read voltage of 1 to 5 volts less than full battery voltage. If this voltage is zero or close to zero, trouble is bad controller, or bad 250 Ω resistor across the contactor, or an incorrectly connected cable between contactor and controller. Trace the cable to make sure it is attached correctly. Remove and test 250 Ω resistor with ohmmeter. If these check OK, the controller is malfunctioning. If battery voltage is determined at this point, the contactor has likely welded and should be replaced.

Battery Voltage Testing

a) disconnect and reconnect charger
b) measure current and voltage during the last ½ hour of charge
c) if current at the end of charge cycle is below 5 amps and charge per battery is 9.3v battery is healthy; if voltage is below 9.3v battery may need to be replaced.

Battery Specific Gravity Testing

a) fill and drain hydrometer 2-3 times before sampling battery electrolyte
b) measure specific gravity for all cells
c) adjust specific gravity reading by adding 0.004 for every 10 degrees F below 80F
d) if cells in battery pack are below 1.250 batteries may be undercharged, charge battery pack
e) if any battery has specific gravity variation of 0.050 between cells, recharge pack to equalize
f) if there is still variation after equalization there may be a failed battery

Battery Open Circuit Voltage Testing

(this is the least-preferred method of evaluating battery performance)
a) leave batteries idle for 6-24 hours
b) measure individual battery voltages
c) any battery greater than 0.3v from any other battery in pack indicates need for equalization
d) re-measure after equalization
e) if 0.3v variance still exists there may be a failed battery

Battery Discharge Testing

a) connect and start discharger
b) record the runtime in minutes when discharge is complete
c) if the discharge time is greater than 50% of the batteries' rated capacity than all batteries are healthy and operational
d) if the discharge time is less than 50% of the batteries' rated capacity, then any battery with a voltage that is 0.5v lower than the highest voltage may be a failed battery