Acceptance Testing Plan - Fall 2018 Dyno Room

Revision 3

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Updates

11/14/2018 - Original
12/01/2018 - Addressed concerns in Professor Nadovich Comments
ATR in separate document
12/05/2018 - Corrected required equipment for ATP006 and ATP007
Added specificity to pass criteria for ATP017

Block Diagram

Below is a link to the block diagram of systems that will be delivered in the AEC 401 (Dyno room).

https://sites.lafayette.edu/motorsports/dyno-room/

Motor Tests

Test Number	Summary	Description	Pass Criteria	Required Equipment
ATP001	Motor spinning	Motor is spinning at >100 RPM for longer than 1 minute (or until maximum motor operating temperature is reached).	N/A	timer
ATP002	Motor RPM Measurements	RPM measurement verified against RPM sensor. ● Dyno RPM ● Motor encoder RPM ● Handheld tachometer	RPM measurements are with ±5% of the handheld tachometer measurement.	handheld tachometer, reflective aluminum tape
ATP003	Motor Torque Measurements	Observe motor torque reading for static known loads on torque gauge.	Measured torques are within ±5% of actual.	2 objects with different known masses, fastener between weights and torque gauge
ATP004	Motor Voltage Measurements	TSV voltage measurements verified against multimeter. Record 5 voltage measurements: ● TSV before pre-charge ● TSV after pre-charge ● TSV at MC (MC) ● TSV with multimeter ● TSV power supply with the pre-charge relay closed.	Measurements are within ±3% of the voltage observed on the multimeter.	multimeter

ATP005	Motor Current Measurements	TSI current measurement verified against power supply reported current.	Measurement matches the reported dc current on the power supply with ±5%	

Pre-charge and Discharge Tests

Test Number	Summary	Description	Pass Criteria	Required Equipment
ATP006	Pre-Charge Circuit Test with Integrated Motor Controller	The TSI will charge the motor controller using 100V input voltage from the Dyno Room power supply.	The pre-charge relay should be closed when the motor controller input reaches a voltage between 94 V and 96 V.	Oscilloscope
ATP007	Discharge Circuit Test with Integrated Motor Controller	The system should start with the motor controller charged to 100V and the pre-charge circuit should be bypassed. When the safety loop is broken, the discharge relay should turn on when AIRs open discharging the capacitor.	The motor controller should be discharged to under 30 V in less than 5 seconds.	Oscilloscope

Throttle Plausibility

Test Number	Summary	Description	Pass Criteria	Required Equipment

ATP008	Pedal 1 Undervoltage Limit	Observe that the Throttle_PL signal goes high when Pedal 1 is too low.	Throttle becomes implausible at a Pedal 1 Voltage between 5.22 V and 5.26 V.	2 lab bench power supplies
ATP009	Pedal 1 Overvoltage Limit	Observe that the Throttle_PL signal goes high when Pedal 1 is too high.	Throttle becomes implausible at a Pedal 1 Voltage between 9.74 V and 9.78 V.	2 lab bench power supplies
ATP010	Pedal 2 Undervoltage Limit	Observe that the Throttle_PL signal goes high when Pedal 2 is too low.	Throttle becomes implausible at a Pedal 2 Voltage between 0.22 V and 0.26 V.	2 lab bench power supplies
ATP011	Pedal 2 Overvoltage Limit	Observe that the Throttle_PL signal goes high when Pedal 2 is too high.	Throttle becomes implausible at a Pedal 2 Voltage between 4.74 V and 4.78 V.	2 lab bench power supplies
ATP012	Pedal Voltage Difference Lower Limit	Observe that the Throttle_PL signal goes high when the pedal voltage difference is too low.	Throttle becomes implausible at a a pedal voltage difference (Pedal 1 - Pedal 2) between 0.4 V and 0.5 V.	2 lab bench power supplies
ATP013	Pedal Voltage Difference Upper Limit	Observe that the Throttle_PL signal goes high when the pedal voltage difference is too high.	Throttle becomes implausible at a a pedal voltage difference between -0.4 V and -0.5 V.	2 lab bench power supplies

Cooling

Test Number	Summary	Description	Pass Criteria	Required Equipment
ATP014	Cooling system has no observable leaks	Run water through the cooling system for 10 minutes and observe to ensure there aren't any leaks.	N/A	
ATP015	Cooling fan	Cooling fan spins at 100 RPM for longer than a minute	N/A	handheld tachometer, reflective aluminum tape
ATP016	Coolant pumped at 5L/min	Run cooling system for 10 minutes and use flow meter to ensure that coolant flows at least 5 L/min	N/A	
ATP017	Temperature data sent to SCADA	Connect Cooling to SCADA with CANBus. Verify reported motor controller temperature measurement is within ±5% of the temperature sensor measurement.	N/A	

Drive State Tests

Test Number	Summary	Description	Pass Criteria	Required Equipment
ATP018	SCADA UI displays drive	Displays current drive state while	N/A	SCADA

	states. This can be tested while performing ATP020-ATP026	following 2018 start-up procedure		
ATP019	SCADA logs why drive state changes. This can be tested while performing ATP020-ATP026	Check SCADA logs after state change for reason. The log will be attached to the ATR.	N/A	SCADA
ATP020	Ability to transition from IDLE state to PRECHARGE state	Close the safety loop	Observe on the SCADA rack display that the drive state begins in IDLE and moves to PRECHARGE when the safety loop closes	SCADA
ATP021	Ability to transition from PRECHARGE state to DRIVE_SETUP state	Close the precharge relay	Observe on the SCADA rack display that the drive state begins in PRECHARGE and moves to DRIVE_SETUP when the precharge relay closes	SCADA
ATP022	Ability to transition from DRIVE_SETUP state to DRIVE state	Push the drive button, Throttle is not implausible, Throttle is less than 0.5 V, brake pressed, and precharge circuit is 100% charged	Observe on the SCADA rack display that the drive state begins in DRIVE_SETUP and moves to DRIVE when all the conditions in the description column are met	SCADA

ATP023	Ability to transition from DRIVE state to DRIVE_SETUP state	Push the drive button, throttle is implausible, brake is pressed and throttle is above 0.5 V, turn off motor controller	Observe on the SCADA rack display that the drive state begins in DRIVE and moves to DRIVE_SETUP when any one of the conditions in the description column are met	SCADA
ATP024	ABILITY to transition from DRIVE state to OVERCURRENT state	Increase the current	Observe on the SCADA rack display that the drive state begins in DRIVE and moves to OVERCURRENT when the current sensor measures a current within ±5% of value specified by SCADA	SCADA, current sensor
ATP025	Ability to transition from OVERCURRENT state to DRIVE state	Lower the current, Throttle is less than 0.5 V	Observe on the SCADA rack display that the drive state begins in OVERCURRENT and moves to DRIVE when the current sensor measures a current within ±5% of value specified by SCADA and throttle is below 0.5 V	SCADA, current sensor
ATP026	All states can transition back to the IDLE	Open the AIRs	Observe that the system transitions to the	SCADA

	state.		IDLE state when the AIRs are open	

Safety Loop Tests

Test Number	Summary	Description	Pass Criteria	Required Equipment
ATP027	Left Side BRB breaks safety loop and de-energizes high voltage	Pressing the Left Side BRB turns off TSEL	N/A	
ATP028	Right Side BRB breaks safety loop and de-energizes high voltage	Pressing the Right Side BRB turns off TSEL	N/A	
ATP029	Driver BRB breaks safety loop and de-energizes high voltage but leaves GLV energized	Pressing the Driver BRB turns off TSEL but leaves GLV powered	N/A	
ATP030	GLVMS completely de-energizes system when disengaged	Turning off GLVMS completely de-energizes system	N/A	
ATP031	TSMS breaks safety loop and de-energizes high voltage	Turning off TSMS turns off TSEL	N/A	
ATP032	Brake Over-Travel switch breaks safety loop and de-energizes	Pushing brake over-travel switch turns off TSEL	N/A	

	high voltage			
ATP033	Master Reset	Following the 2018 start up procedure, the SSOK lights up.	N/A	
ATP034	IMD	When an IMD fault is detected the safety loop opens	N/A	
ATP035	Safety Loop closed	Video showing all components of the safety loop working such that the AIRs close and TSEL turns on.	N/A	
ATP036	Open safety loop	SCADA opens the safety loop when the user defined condition is met.	N/A	

Other Status Indicators

Test Number	Summary	Description	Pass Criteria	Equipment Needed
ATP037	GLV Present Light	Light turns on when GLV battery is connected	N/A	
ATP038	HV Present Light	Light turns on when there is HV present.	N/A	
ATP039	IMD Fault	Light turns on when there is IMD Fault.	N/A	
ATP040	Fault	Turns on when the GLV and	N/A	

		TSV master switches and the BRBs are closed and safety loop 1 is open indicating an IMD fault or AMS fault.		
ATP041	AIRs Light	Light turns on after cockpit reset is pressed indicating that there is safety loop voltage before TSVMS	N/A	
ATP042	Drive Light	Light turns on when in the Drive Mode	N/A	
ATP043	Safety Light	Light turns on when SL1 to SL2 is connected	N/A	
ATP044	Brake Light	Light turns on when brake is pressed	N/A	
ATP045	Ready to Drive Sound (RTDS)	RTDS sounds when system enters drive state	N/A	

Deliverables

Item	Description
Graph of motor RPM vs time	Graph generated from data collected during motor tests
Graph of torque vs time	Graph generated from data collected during motor tests
Graph of power vs time	Graph generated from data collected during

	motor tests
Graph of power in vs power out	Graph generated from data collected during motor tests
D000: PDR Report and Presentation	Slideshow presented to ECE faculty and guests. Slideshow, report, meeting minutes, and other supporting documents uploaded to website.
D001: CDR Materials	Slideshow and demonstrations presented to ECE faculty and guests. Slideshow, report, meeting minutes, and other supporting documents uploaded to website
D002: User Manuals	User manuals for each subsystem uploaded to the website with the following sections: getting started, FAQ, functions and controls, high level block diagram, annotated drawing of control panels/screenshots of UI screens, and troubleshooting, calibration, and maintenance.
D003: Final Report and Maintenance Manual	Maintenance manuals for each subsystem uploaded to the website with the following sections: maintenance, calibration, PCB schematic, PCB BoM, mechanical drawing, mechanical BoM, block diagram, wiring diagram. Final report delivered to the professors via a flash drive or DVD with a high level project summary report and maintenance manuals.
D004: Acceptance Test Plan	List of system tests that includes pass/fail criteria, observed results, and an indication of whether or not each test was successful.
D005: Acceptance Test Report	Report delivered after all tests have been conducted which shows which tests were successfully completed, when, and who witnessed or performed the test.
D007: Project Website	All project documentation uploaded to the website as portable static documents (PDF, TXT, XML) with the original version present as well as links to relevant Cloud storage.
D008: Final Presentation and Delivery	Final presentation including project video

	delivered to ECE faculty and guests. Integrated hardware, software, and firmware will be installed in AEC 400 and 401. All supporting documentation will be delivered as per D003 and uploaded to the website.
D010: Project Posters	Soft and hard copies of the project poster delivered. Poster will contain a QR code and URL to the project website.
D013: Purchasing Report	Table containing all purchases delivered. The report will also include spending summaries based on category, week, and subsystem group as well as statistics for items of interest (e.g. delivery elapsed time, delivery cost, sales tax, etc)
D014: Project Management and Status Letters	Weekly project status letters delivered and uploaded to the website. Weekly status reports delivered on Mondays during class. Management will deliver project wide documents such as the ATP, Work Breakdown Structure, and competition documentation
CD001: Registration	Competition registration fee of $2300 will be paid to SAE
CD002: Project Management Report	Document delivered to the SAE outlining project management plan, project schedule, and risk assessment
CD003: Structural Equivalency Spreadsheet (SES)	Demonstrate structural integrity of the proposed frame design to the SAE
CD004: Electrical Systems Form - Part 1 (ESF-1)	Deliver high level electrical designs to the SAE
CD005: Program Submission	Deliver high level car specifications to the SAE for the competition program
CD006: Team Picture	Deliver a picture of the team to the SAE