**LFEV-Y5**

v0.2

**Lafayette College: Electrical and Computer Engineering**

Acceptance Test Plan: v0.2

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This document outlines all of the tests required to deliver LFEV-Y5. The plan is presented as an overview with the ATP number next to the test. This refers to the document that describes the test procedure. The requirements are from the SoW for 2017

08

**Fall**

# ATPs

None of these tests can be viewed as completed until appropriate documentation has been uploaded to the webpage.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Item | Item description | Demonstrated Requirements | Successful Test Criteria | Verification Method |
| ATP-01 | Accumulator integration | R001a  R001c  R001d  R001e  R002a  R002c  R004a (TSV part)  R005a  R005b (Manual) | Packs power motor and all telemetry is recorded by VSCADA. Control by using the throttle.  Verify by accelerating and looking at dash, pack screens, and log files remotely | Test |
| ATP-02 | Accumulator charging | R001b  R001g  R002b  R002h | Packs charge by the charging port and open the safety loop  VSCADA reacts correctly  Verify by looking at the dash | Test |
| ATP-03 | CAN Bus link | R002a  R002c  R002d  R002e  R002f  R002g  R002j  R002k  R003a(8)  R003d  R004a (CAN Bus part)  R005a (CAN Bus part)  R005c (CAN Bus part)  R007c  R007d | DAQ by VSCADA of TSI, GLV, TSV, Cooling. Verify by looking at cell phone and looking at dash and remote computer in each mode of VSCADA | Test |
| ATP-04 | Safety loop | R001g  R002b  R002c  R002d  R002k  R002m  R003b  R003c  R003d  R004a (Safety loop part)  R005c (IMD fault)  R007b | Fault by:  Crashing  BRB  IMD  Cooling  VSCADA limit  Pack fault  Throttle fault  Brake fault  User defined limit (warn)  User defined limit (halt)  Pack charging  Verify by looking at the dash, the remote computer and the cellphone | Test |
| ATP-05 | Cruise Control | R002l  R005b (Software) | Motor can maintain desired speed  Verify by checking motor speed compared to target | Test |
| ATP-06 | 24h endurance test | GPR006 | At the end of all other tests leave the car running for 24h | Test |
| ATP-07 | Shutdown | R002k  R002i | VSCADA works after unexpected GLV shutdown  All hardware in safe state  Packs stop powering motor with GLV shutdown | Test |

# Compliance Matrix

All requirements should also have a QA by each subsystem.

|  |  |
| --- | --- |
| Requirement | Test(s) to demonstrate acceptance |
| R001a | ATP-01 |
| R001b | ATP-02 OR https://sites.lafayette.edu/ece492-sp16/files/2016/05/QAR001b.pdf |
| R001c | ATP-01 |
| R001d | ATP-01 |
| R001e | ATP-01 |
| R001f | https://sites.lafayette.edu/ece492-sp16/files/2016/05/QAR001e.pdf |
| R001g | ATP-02 |
| R002a | ATP-01 or ATP-03 |
| R002b | ATP-02 |
| R002c | ATP-01 OR ATP-03 OR ATP-04 |
| R002d | ATP-01 OR ATP-03 OR ATP-04 |
| R002e | ATP-03 |
| R002f | ATP-03 |
| R002g | ATP-03 |
| R002h | ATP-02 OR ATP-03 |
| R002i | ATP-02 |
| R002j | ATP-03 |
| R002k | ATP-03 |
| R002l | ATP-08 |
| R002m | ATP-04 |
| R003a(1) | Any ATP |
| R003a(2) | QA by GLV |
| R003a(3) | QA by GLV |
| R003a(4) | QA by GLV |
| R003a(5) | QA by GLV |
| R003a(5) | QA by GLV |
| R003a(6) | QA by GLV |
| R003a(7) | QA by GLV |
| R003a(8) | ATP-03 |
| R003b | ATP-04 |
| R003c | QA by GLV |
| R003d | ATP-03 |
| R004a | ATP-01 AND ATP-03 AND ATP-04 |
| R004b | QA by Interconnect |
| R005a | ATP-01 AND ATP-03 |
| R005b | ATP-01 AND ATP-07 |
| R005c | ATP-04 |
| R005d | QA by TSI |
| R006 | Any ATP |
| R007a | QA by Cooling |
| R007b | ATP-04 |
| R007c | ATP-03 |
| R007d | ATP-03 |
| R007e | Waived |
| R007f | QA by Cooling |
| R007g | QA by Cooling |

# Waived or modified requirements and questions

|  |  |
| --- | --- |
| Requirement | Reason |
| R003a(4) | Cannot tell if GLV is from the battery or 24VDC |
| R002h | Cannot tell if GLV is from the battery or 24VDC |
| R007e | Waived |
| R005d | We’ve changed the switches |

# ATP-01 intermediate steps

1. Packs provide 96V to motor
   1. Each pack provides 24VDC
   2. Packs can provide up to 200A.
   3. Each Pacman monitors pack status correctly
2. Throttle pedal controls motor
   1. Increasing throttle causes motor speed to increase
   2. Decreasing throttle leads to motor deceleration
3. VSCADA is aware about drive mode
   1. VSCADA view is the drive view
   2. VSCADA dashboard is updating appropriately
      1. Value for speed is updating continuously
      2. TSV SOC is updating periodically.
      3. Pack temperatures are updating periodically
4. Remote computer is aware about drive mode
   1. Remote computer display indicates drive mode
   2. Remote computer display of all parameters updates appropriately
5. Cell phone is aware about drive mode
   1. Cell phone displays appropriate drive mode view
   2. Drive mode parameters update on the screen appropriately

# ATP-02 intermediate steps

1. Packs charge and perform safety checks
   1. Packs take charge, and are able to charge up to 100%
   2. Packs do not overcharge
   3. Safety loop opens when charging
2. VSCADA is aware about charging
   1. VSCADA charging view is set as the current view while charging
3. Remote computer is aware about charging
   1. Remote computer displays the charging view during charging
4. Cell phone is aware about charging
   1. Cell app defaults to the charging view during battery charging

# ATP-03 intermediate steps

1. With CAN line connected to the following individual sub-system only, VSCADA acquires and reports the *same*values as reported on the individual system for all sensors:
   1. TSV (all 4 packs)
   2. Dyno / Motor Controller
   3. Cooling
2. With CAN line connected to all systems, VSCADA acquires and reports the *same*values as reported on the individual system for the given sensors:

Sensor values to be monitored

|  |  |  |  |
| --- | --- | --- | --- |
| Test | Seen on VSCADA | Seen on Remote | Seen on Cell |
| Cell Temperature |  |  |  |
| Cell Voltage |  |  |  |
| Pack Current |  |  |  |
| Pack SoC |  |  |  |
| Pack Status |  |  |  |
| Pack Voltage |  |  |  |
| GLV Voltage |  |  |  |
| GLV SoC |  |  |  |
| GLV Current |  |  |  |
| GLV Temperature |  |  |  |
| Safety loop status |  |  |  |
| RPM gauge (Dyno) |  |  |  |
| Strain gauge |  |  |  |
| Throttle position |  |  |  |
| Brake status |  |  |  |
| IMD status |  |  |  |
| FWD/REV status |  |  |  |
| Precharge status |  |  |  |
| MC temp |  |  |  |
| MC current |  |  |  |
| Cooling temp in |  |  |  |
| Cooling flow |  |  |  |
| Cooling temp out |  |  |  |
| TSI temp |  |  |  |
| Speed |  |  |  |
| Safety loop status |  |  |  |

# ATP-04 intermediate steps

1. Each of the following conditions trip the safety loop properly
   1. When the safety loop is closed, the condition opens the loop
   2. This opening is seen on the appropriate view
   3. When the safety loop is open due to another condition, the setting of a new open condition keeps the safety loop from closing (as appropriate)

Safety loop conditions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Fault | Safety loop trip | Seen on VSCADA | Seen on Remote | Seen on Cell |
| Driver resettable BRB |  |  |  |  |
| Non driver resettable BRB |  |  |  |  |
| Crash protection |  |  |  |  |
| Over temperature cooling |  |  |  |  |
| Under flow cooling |  |  |  |  |
| IMD fault |  |  |  |  |
| Cell overtemp |  |  |  |  |
| Cell overcurrent |  |  |  |  |
| Cell overvoltage |  |  |  |  |
| Cell undervoltage |  |  |  |  |
| Brake overtravel |  |  |  |  |
| VSCADA defined violation |  |  |  |  |

# ATP-05 intermediate steps

1. TSI has the hardware to control the throttle
   1. TSI Throttle control demonstrated (without cruise control)
   2. Desired motor speed can be attained through TSI throttle manually
2. Physics model simulated in MATLAB
   1. Model simulation is accurate for all speeds – low and high.
   2. All speeds tested meet accuracy requirements in simulation
3. Physics model implemented on TSI
   1. VSCADA microcontroller implements the cruise control algorithm
   2. VSCADA has ability to communicate to TSI on cruise control throttle control
   3. TSI interfaces correctly to VSCADA cruise control commands
   4. TSI correctly relays SCADA commands to throttle control
4. TSI can hold a throttle position
   1. In cruise control mode, TSI can maintain a steady speed for all speeds – low and high
   2. Cruise control speed maintenance meets accuracy requirements (for all speeds)

# ATP-06 intermediate steps

1. Run system for 24h, under the following conditions:
   1. High voltage off
   2. All systems interfaced with GLV power are running off of 24VDC power supply, instead of GLV battery
2. Test requirements
   1. VSCADA:
      1. VSCADA does not crash
      2. Data is logged into database for entire 24h period
      3. Server remains up and running
      4. Communication with all sub-systems endures
      5. Appropriate errors are logged
   2. GLV:
      1. Safety loop is monitored continuously
      2. Communication to VSCADA remains intact
   3. TSV:
      1. All 4 pacman boards remain up and running
      2. Communication with VSCADA remains intact.
   4. TSI:
      1. TSI board remains up and running
      2. TSI communication with VSCADA remains intact
   5. Cooling:
      1. Cooling controller system remains up and running
      2. Communication remains intact with VSCADA

# ATP-07 intermediate steps

1. VSCADA reboots after shutdown
   1. Upon reboot, VSCADA restarts to a fully operational status without requiring user interaction
   2. Upon reboot after an unexpected shutdown, an error message is logged appropriately
2. Packs disengage from the motor with loss of power
   1. Safety loop is opened
   2. Interfaces record the fault condition
3. VSCADA safely shuts down
   1. Unexpected shutdown does not cause failure
   2. No data is lost or corrupted during an unexpected shutdown
   3. Predefined faults allow VSCADA to shut down the car
4. Packs safely shutdown
   1. Safe shutdown causes a ‘configurable’ error
   2. Pack high voltage disengages
5. Cooling safely shuts down
   1. The cooling system powers off all components during a shut down
6. TSI safely shuts down
   1. TSI powers off all components during a shut down
7. GLV safely shuts down
   1. GLV shutdown causes all GLV components to be powered off
   2. Safety loop is opened during a shut down