**Check list for safety tripping version 1.2 Created on 21/08/2018 Created by: WL**

| **Which part in the system** | **Function** | **Condition under test drive** |
| --- | --- | --- |
| HB battery level check | If anything is abnormal to the heartbeat warning/error will be print to screen. | It works, stay the same as 3.5 V before and after the field test |
| LED on top dash – HBT  [10Hz binary square wave sampled at 50Hz] | Blinks on and off at normal state but stays on after a trip due to lost heartbeat. | It works at the tripping condition due to lost heartbeat, by pressed down e-stop button on the base station |
| Dead man’s switch on dash | Allows simulation of the heartbeat by a person in the car. **1 Hz interval minimum** | It seems to response when pressing the dead man switch on dash, however it requires to press in a very fast speed for it to work, suggestion to improve:  1. Switch replacement with easier pressing button  2. Apply push then let-go check on the software setting instead of frequently button press.  However, it is not recommended to focus on response with the dead man switch in the emergency event, as the **observer** should apply the **e-stop button** on remote base station to safely stop the vehicle. And **driver** should apply **brake**, **e-stop on dash** and **observe** the road condition |
| Low-level controller WDT [ER2] | Reset the controller in the event of main loop freeze - puts the controller to trip state | When Autonomous mode driving is activated but ROS is not started, it will not publish any topics, then the brake will engage and trips eventually |
| Steering motor current [ER4]  + LED on front dash – STR Over | Indicator of excess steering force if someone steers against the motor) will result in steering motor disconnection that causes a trip of the safety supervisor, by wiring the relay contacts in series with the safety supervisors e-stop feedback. | Not a safety practice to test this feature. In the emergency event, it is recommended to engage brake first. As excess steering might bring the vehicle to completely lost control position |
| Safety supervisor with DES condition | Indicate a trip came from the dash traction motor e-stop being pushed in or from the low level safety box. | It works when pressed down the e-stop next to the steering wheel to stop the SAE |
| High level controller | At the tripped state, it will re-trip if the high level controller hasn’t also reset and is still sending trip commands | Required to restart ROS SAE |
| LED on top dash - ACL | Throttle voltage error. Either no power on traction motor controllers, or there was a positive throttle signal after enabling the motor controllers (which could have caused the car to unexpectedly take off). | Tested in the lab and works. SAE cannot be ARM’d while accelerator pedal is pressed |
| LED on top dash - ESTOP | lights on all trips. If HBT and ACL don’t also light then it either came from the dash e-stop, low level safety box or was commanded by the high level controller. | It has happened, possible from low level safety box. Suspect abnormal brake engagement due to the over sensitivity of brake hall sensor initiate the trip |
| LED on top dash – Safety mode | This **blue LED** should be always switched **on** | When it’s off, then it is not depending on HBT anymore (i.e. heartbeat remote e-stop will not trip the SAE) |
| LED on front dash – BRK Over | Indicate that SAE is tripped due to abnormal brake action | Activated, suspect abnormal brake engagement due to the over sensitivity of brake hall sensor initiate the trip |
| No new command in 300 ms [ER5] | SAE will trip as Jetson is not responding | It works |
| Steering sensor out of bounds [ER6] | Extreme steering condition that will initiate the trip. | It might damage the steering motor if happened. Have not happened |
| High level controller | Reset speed to zero when no new speed command received in 100ms. This is in case demo program crashes. | Tripped because of not receiving command due to program is crashed. Set speed to zero but kept the same steering |
| Serial port connection | If the connection to safety serial port is failed, the program will exit. | Happened, due to the USB connection lost detected from the 4 ports USB hub. Required to remove USB connection/reconnect from the Jetson’s end |

Other Notes:

1. USB port on Jetson (due to power overload by the USB hub) can be the cause of tripping and requires reboot of Jetson to fix the issue. Possible solution is powering the USB hub from the 5 V source instead via the round power plug.

2. If speed set above 3 m/s will trip SAE as of the 17/08/2018 field test.