Motor Vehicle Defect Petition to Recall All Tesla Vehicles Due to Sudden Unintended Acceleration

Sophie Shulman, Acting Administrator
National Highway Traffic Safety Administration
400 Seventh Street, S.W.
Washington, DC 20590

5 June 2023

Dear Acting Administrator Shulman,

The purpose of this letter is to provide additional evidence in support of my petition to NHTSA dated 12 May 2023 to re-open NHTSA's Office of Defects Investigation number DP 20-001, entitled "Tesla Sudden Unintended Acceleration". This letter is a follow-up to two previous petition letters to NHTSA dated 12 May 2023 and 19 May 2023.

The first item of new evidence is a second paper entitled "EDR Accelerator Pedal Data Can Be Wrong With This Cause of Sudden Acceleration", dated 1 June 2023. This new paper goes into more detail on how ADC calibration is performed and how ratiometric sensors require using the APP supply voltage for ADC calibration. It also explains why voltage dips in the APP supply voltage are not removed by ADC calibration like slower voltage changes caused by temperature changes are removed. You can obtain a copy of this new paper by going to the Center for Auto Safety web site: [redacted] and clicking on the paper [redacted]. Note that this new paper does not mention Tesla or any other auto manufacturer, but deals only with the technical issues involved to avoid disparaging any auto manufacturer.

The second item of new evidence is a list of design factors that contribute to sudden acceleration as compiled from this author's two recent papers.

In the January 8, 2021 Denial of Petition to NHTSA's Office of Defects Investigation (investigation number DP 20-001), it is clearly stated by NHTSA that *"There is also no evidence of a design factor contributing to increased likelihood of pedal misapplication."* This assertion was used by NHTSA as a reason for denying the petition. In response to this assertion, here is a list of design factors that provide new evidence of an increased likelihood of the pedal sensors increasing during sudden acceleration [aka "pedal misapplication" in NHTSA's terminology] to support reopening investigation number DP 20-001:

1) [New evidence] Both ADC's that digitize the APP sensor outputs in Tesla's inverters are being calibrated by a single ADC calibration voltage or reference voltage.
2) [New evidence] If the ADC calibration voltage decreases by some ratio, then both digitized APP signals will increase by the same ratio even though the two analog APP signals do not change.
3) If the two digital APP output signals increase because of a decrease in the calibration voltage, then:

a. [New evidence] The increased digital APP output signals will produce a point that lies on the original transfer function of each sensor that normally is produced by stepping on the accelerator pedal.
b. [New evidence] The increased digital APP signals will mimic in every way the driver stepping on the accelerator pedal even though the driver has not stepped on the accelerator pedal.
c. [New evidence] The increased digital APP signals will pass all tests performed on the digital APP signals, causing no alerts or DTC's.
d. [New evidence] The increased digital APP signals will produce non-zero log data and no-zero EDR data even though the driver did not step on the accelerator pedal.

4) [New evidence] If the decrease in the ADC calibration voltage is large enough, then both digital APP signals can be increased up to 100% without the driver stepping on the accelerator pedal.
5) All of the operations 1) through 4) above are true regardless of the cause for a decrease in the ADC calibration voltage.
    a. [New evidence] One reason for a decrease in the ADC calibration voltage is a change in the ADC calibration voltage due to temperature changes in the reference voltage. This produces only a small increase or decrease in the ADC calibration voltage.
    b. [New evidence] Another reason for a decrease in the ADC calibration voltage is a voltage dip in the reference voltage. This can produce a large decrease in the ADC calibration voltage that can produce a large increase in the digitized APP sensor signal.
6) [New evidence] Specifically, there is evidence that a decrease in the ADC calibration voltage can occur during its digitization if a voltage dip occurs while the analog ADC calibration voltage is being sampled.
    a. [New evidence] It is known that voltage dips occur on the 12V supply line that are caused by inrush currents created when electric motors turn on.
    b. [New evidence] In Tesla vehicles the electric motor having the largest inrush current is the booster motor for the electronic power steering, which produces an inrush current of over 300 amps. This is because Tesla vehicles are very heavy and create very large forces during turns at low speeds, which require very large currents.
    c. [New evidence] This EPS inrush current can cause a voltage dip in the 12V supply line that reaches below 2V and that lasts for about 100 microseconds.
    d. Evidence a) through c) above has been verified by several academic papers.
    e. [New evidence] There is evidence from PMIC device operation used in the Tesla inverter that a voltage dip in the 12V supply line can cause a voltage dip in the ADC calibration voltage.

f. [New evidence] The probability of a coincidence of a 100 microsecond dip in the 12V supply line with a 10 microsecond sample time of the ADC calibration voltage can explain the probability for SUA occurring in the sudden acceleration statistics for Tesla vehicles.

7) [New evidence] It is known that ADC calibration is performed continuously during vehicle operation. This can explain:
   a. [New evidence] Why some SUA events can have long durations, like the incidents in China and Paris, if the time between ADC calibrations is on the order of a minute or so.
   b. [New evidence] Why some drivers have reported that re-starting the vehicle after an SUA incident causes the vehicle to return to normal operation. This can be explained by a new ADC calibration voltage being digitized immediately after starting that yields a normal value of the ADC calibration voltage. The probability for no voltage dip to occur during digitization of the ADC calibration voltage is much higher than the probability for a voltage dip to occur during digitization.

These design factors provide new evidence that the same design factors that cause sudden intended acceleration also cause an increase in the accelerator pedal sensor values in the EDR and the log data, which is what NHTSA has referred to as "pedal misapplication". However, it is not the driver that is causing the sudden unintended acceleration because of pedal misapplication. It is the vehicle's control system that is causing the sudden acceleration because it allows an incorrect lower ADC calibration voltage to be used that creates an increase in the digitized accelerator pedal outputs even though the analog values of the accelerator pedal outputs remain the same because the driver has not pressed on the accelerator pedal. As a result of this new evidence, it is essential for NHTSA to re-open ODI investigation DP 20-001, entitled "Tesla Sudden Unintended Acceleration" in order to determine whether Tesla sudden unintended acceleration incidents are caused by an ADC calibration error or by pedal misapplication.

Sincerely yours,

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Ronald A. Belt

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