



January 13, 2021

BY EMAIL

Mr. Al Prescott
Vice President, Legal
Tesla, Inc.
3550 Deer Creek Rd.
Palo Alto, CA 94304
aprescott@tesla.com

NEF-104aa
EA20-003

Dear Mr. Prescott:

The Office of Defects Investigation (“ODI”) of the National Highway Traffic Safety Administration (“NHTSA”) is investigating a potential safety-related defect concerning incidents of media control unit (“MCU”) failures resulting in loss of rearview camera and other safety-related vehicle functions in certain model year (“MY”) 2012 through 2018 Tesla Model S and MY 2016 through 2018 Tesla Model X vehicles.

Certain of these Model S and X vehicles were equipped with an NVIDIA Tegra 3 processor with an integrated 8GB eMMC NAND flash memory device (the “subject vehicles”). Part of this 8GB storage capacity is used each time the vehicle is started. The eMMC NAND cell hardware fails when the storage capacity is reached, resulting in failure of the MCU. The MCU is the vehicle’s display screen, which controls certain aspects of performance subject to Federal motor vehicle safety standards (“FMVSS”)¹ and other safety-relevant functions. Specifically, failure of the MCU results in loss of the rearview/backup camera² and loss of HVAC (defogging and defrosting setting controls (if the HVAC status was OFF status prior to failure). The failure also has an adverse impact on the Autopilot advanced driver assistance system (“ADAS”), as well as turn signal functionality due to the possible loss of audible chimes, driver sensing, and alerts associated with these vehicle functions.

As discussed more fully below, ODI has tentatively concluded that the failure of the media control unit (MCU) constitutes a defect related to motor vehicle safety. Accordingly, ODI requests that Tesla initiate a recall to notify all owners, purchasers, and dealers of the subject vehicles of this safety defect and provide a remedy, in accordance with the requirements of the National Traffic and Motor Vehicle Safety Act, 49 U.S.C. §§ 30118-30120.

¹ While FMVSS apply to new motor vehicles and items of motor vehicle equipment, the fact that a system is subject to FMVSS is indicative of the system’s relevance to safety.

² Backup cameras are required by FMVSS No. 111, which has a stated purpose of “reduc[ing] the number of deaths and injuries that occur when the driver of a motor vehicle does not have a clear and reasonably unobstructed view to the rear.” 49 C.F.R. § 571.111 S2.

I. ODI's Investigation

ODI began its investigation of the subject vehicles when it opened Preliminary Evaluation (“PE”) PE20-010 on June 22, 2020. The investigation was upgraded to Engineering Analysis (“EA”) EA20-003 on November 12, 2020. The EA covers approximately 158,000 vehicles.

During its investigation, ODI collected, reviewed, and analyzed information from a number of sources. The Office considered complaints and data provided by Tesla and consumers, surveyed consumers, and reviewed repair invoices. Further, ODI compiled data, identified trends, and made comparisons to peer vehicles and other similar safety recalls. ODI considered Tesla’s technical briefing presentations and responses to ODI’s formal and informal requests for information, and evaluated Tesla’s assertions.

II. The Safety Defect and its Frequency

ODI has tentatively concluded that a defect related to motor vehicle safety exists in the subject vehicles because the eMMC NAND flash devices have a finite lifespan based upon the number of program/erase (P/E) cycles, after which the MCU fails due to memory wear-out. ODI tentatively concludes that this constitutes a premature failure of safety-critical part.

According to Tesla, for subject vehicles equipped with the NVIDIA Tegra 3 processor with an integrated 8GB eMMC NAND flash memory device, the eMMC NAND cell hardware will fail when reaching lifetime wear, for which the eMMC controller has no available memory blocks necessary to recover. With this failure mode, the only recovery available is a replacement of the eMMC device, achieved by physical part replacement of either the MCU assembly or visual control module subcomponent. Tesla provided information concerning the effects of MCU failure on vehicle function, which include in loss of rearview/backup camera and loss of HVAC (defogging and defrosting) setting controls (if the HVAC status was OFF status prior to failure.) The failure also affects the Autopilot advanced driver assistance system (ADAS) and turn signal functionality due to the possible loss of audible chimes, driver sensing, and alerts associated with these vehicle functions.

During its investigation, ODI learned that the expected usage life rating for the 8GB eMMC NAND flash memory device is approximately 3,000 “P/E” or Program-Erase cycles, after which the eMMC NAND flash memory device would become fully consumed and no longer be operational, leading to a failure of the media control unit (MCU). At a daily cycle usage rate of 1.4 per block, accumulation of 3,000 P/E cycles would take only 5-6 years. Historically, the expected life of a vehicle generally far exceeds 5-6 years of service.³ ODI believes that a 5- or 6-year life expectancy for a component integral to providing the driver with safety functions is insufficient. During our review of the data, Tesla provided confirmation that *all* units will inevitably fail given the memory device’s finite storage capacity. Tesla provided its own statistical model showing the number of projected weekly MCU repairs from 2020 to 2028, estimating that replacement rates for MCU failures will peak in early 2022 and gradually decline until (near) full part turnover has been accomplished in 2028

³ The current average age of vehicles in the light duty fleet is approximately 12 years. [CITE]

Tesla used the same MCU with the Tegra 3 processor in approximately 158,000 MY 2012-2018 Model S and MY 2016-2018 Model X vehicles built by Tesla through early 2018. In response to ODI's Information Request (IR) for PE20-010 in August 2020, Tesla provided ODI over 52,000 complaints, field reports, warranty claims, and non-warranty claims. ODI reviewed the records for duplicate Vehicle Identification Numbers ("VINs") and identified 12,588 incidents at the time, including complaints, field reports, warranty claims, and non-warranty claims related to MCU replacements. The IR response submitted by Tesla, which included data current as of July 2020, showed MCU failure rates between 14.2 – 17.3% for the range of MY 2012-2015 Model S vehicles, and MCU failures rates between 1.9 – 4.1% for the later MY 2016-2018 Model S and Model X vehicles. ODI believes failures rates will continue to accelerate, as shown in Tesla's projection models. We attribute the differences in failures rates between the model years to the respective time in service for the subject vehicles, in addition to some variances in memory demand from driver to driver based on vehicle functions performed. As the vehicles continue to in use, more memory blocks are subsequently consumed, shortening the life of the 8GB eMMC device leading to inevitable failure of the MCU. Given Tesla's projects of MCU repairs, even MY 2018 subject vehicles will experience 100% failure of the MCU within approximately 10 years.

III. The Safety Consequences and Precedent

A. The lack of an image on a backup camera display increases the risk of a crash

In subject vehicles, the MCU (media control unit) displays the rearview/backup camera image. During an MCU failure, the screen becomes black, and a rearview/backup camera image is no longer available to the driver. If this image is not available, the risk of crash increases potentially causing injury or death. FMVSS No. 111 was designed to address this safety risk by improving driver visibility when a vehicle is in reverse. The standard commenced a phase in beginning on May 1, 2016 requiring an increasing percentage of each manufacturer's passenger car⁴ fleet to display a rearview image while reversing. 100% fleet compliance was required for covered vehicles manufactured on or after May 1, 2018.

NHTSA has overseen several vehicle safety recalls related to the loss of backup/rearview camera (see table 1.0 below). ODI believes past recalls support the tentative determination that the media control unit (MCU) failures in the subject vehicles resulting in the loss of the rearview camera image constitutes a defect related to motor vehicle safety. The following table lists some of the various recalls submitted to NHTSA regarding loss of backup/rearview camera image from the last 5 years.

⁴ GVWR of 4,536 kg or less.

Table 1.0 – Vehicle safety recalls related to loss of rearview camera (FMVSS 111)

| RECALL | MFR | MMY | RECALL TYPE | SAFETY DEFECT DESCRIPTION |
|---------|----------|---|-------------|---|
| 20V-046 | MBUSA | 2019 Mercedes Benz A220 | C | In certain operating conditions, the rearview camera software may cause a delay in displaying the rearview camera image |
| 19V-684 | BMW | 2018-20 5-Series, 6-Series, 7-Series, X3, X4, X5, X6, Z4, RR Phantom & Toy. Supra | C | Back-up camera and display settings can be adjusted such that the rear image is no longer visible |
| 19V-654 | Nissan | 2018-19 Nissan Altima, Armada, Frontier, Kicks, Leaf, Maxima, Murano, NV, NV200 | C | Back-up camera and display settings can be adjusted such that the rear image is no longer visible |
| 19V-603 | JLR | 2018 Range Rover & Range Rover Sport with Continental Surround Camera systems | D | Back-up camera may fail to display rearview image with vehicle is in reverse |
| 18V-632 | Bentley | 2018 Bentley Bentayga & Mulsanne | C | Rearview camera may be obstructed or may not be fully visible within two seconds |
| 18V-629 | Honda | 2018 Honda Accord & 2019 Honda Insight | C | In certain scenarios, the back-up camera center display may not function properly |
| 18V-398 | FCA | 2018 Ram 1500/2500/3500 & Dodge Journey | C | Rearview mirror backup camera may experience a loss of image display while backing up |
| 17V-132 | Subaru | 2017 Subaru Impreza | D | Due to a software problem, the rearview camera display may not work properly |
| 16V-839 | Maserati | 2017 Maserati Quattroporte, Ghibli, and Levante | D | In below freezing temperatures, the entertainment telematics module (ETM) may place itself in a protection mode, disabling the back-up camera |

B. The lack of a functioning windshield defogging and defrosting system may decrease the driver’s visibility, increasing the risk of crash.

In the subject vehicles, the media control unit (MCU) provides the driver with the touchscreen display to control the base-level heating, ventilation and air conditioning (“HVAC”) system.

Upon the failure of the (MCU), the touchscreen display will appear as a black screen and the vehicles will not have a functioning windshield defogging and defrosting system. As a result, the lack of a functioning windshield defogging and defrosting system may decrease the driver's visibility in inclement weather, increasing the risk of crash.

NHTSA has overseen numerous vehicle safety recalls involving the loss of windshield defogging and defrosting (see table 2.0 below) function. ODI believes past recalls support that the media control unit (MCU) failures in the subject vehicles resulting in the loss of functioning windshield defogging and defrosting system constitute a defect relating to motor vehicle safety. The following table lists some of the recalls overseen by NHTSA regarding loss of windshield defogging and defrosting systems over the last 20 years.

Table 2.0 – Vehicle safety recalls related to loss of windshield defogging and defrosting function (FMVSS 103)

| RECALL | MFR | MMY | RECALL TYPE | SAFETY DEFECT DESCRIPTION |
|---------------|------------|--|--------------------|--|
| 19V-051 | FCA | 2019 Ram 1500 with 12" touchscreen display and base HVAC | C | Do not have a functioning windshield defrosting and defogging system |
| 18V-139 | JLR | 2018 Land Rover Range Rover Velar | D | Air inlet door linkages may detach |
| 15V-233 | Mitsubishi | 2009-11 Lancer, Lancer Sportback, Lancer Evolution, Outlander, Outlander Sport | D | Blower motor may fail |
| 13V-567 | GM | 2014 Chevrolet Malibu | C | HVAC system may become inoperative at startup |
| 11V-149 | GM | 2011 Buick LaCrosse and Cadillac SRX | C | Electronic Climate Control software may disable the ability to adjust HVAC settings |
| 10V-514 | Mitsubishi | 2006-08 Endeavor with manual air-conditioning | D | The HVAC controller may intermittently send incorrect signals to the HVAC mode door |
| 10V-096 | GM | 2009-10 Chevrolet Express and GMC Savana | C | HVAC control knobs may fracture and spin on the control shaft, resulting in loss of HVAC control |
| 09V-489 | GM | 2010 GMC Terrain and Chevrolet Equinox | C | Software in center instrument panel may cause HVAC, radio and panel illumination to become inoperative |
| 09V-158 | FCA | 2009 Dodge Ram | D | HVAC module software may cause windshield defrosting |

| | | | | |
|---------|-------|--|---|--|
| | | | | and defogging functions to become inoperative. |
| 08V-634 | GM | 2009 Chevrolet Malibu Hybrid | C | HVAC system may become inoperative and mode selector would remain in last setting |
| 07V-563 | Volvo | 2007-08 Volvo XC90 | D | Climate Control Module (CCM) may get a shutdown signal from the Engine Control Module (ECM) on key insertion |
| 06V-494 | FCA | 2007 Chrysler Sebring with Automatic Temperature Control | D | HVAC module software defect may cause defrosting and defogging systems to become inoperative |
| 00V-355 | Ford | 2000 Mustang GT | C | Coolant flow blockage in heater core, resulting in no warm air from the heater |

C. The impact on alert/sensing functions on ADAS and turn signal functionality increases the risk of a crash.

In the subject vehicles, the loss of the media control unit (MCU) subsequently impacts the Autopilot ADAS System and turn signal functionality due to the possible loss of audible chimes, driver sensing, and alerts associated with these vehicle functions. If the media control unit (MCU) were to fail during an active drive scenario, the driver would not have functioning turn signal alert “blinker sounds.” Safety tell-tales such as audible chimes, driver sensing, and alerts all play an important role in maintaining driver safety while operating the vehicle. The loss of these functions can increase the risk of crash.

NHTSA has overseen several vehicle safety recalls related to loss of turn signal function (see table 3.0 below). ODI believes these recalls support tentative determination that the media control unit (MCU) failures in the subject vehicles resulting in the loss of turn signal function as a vehicle safety defect. Additionally, NHTSA has overseen several vehicle safety recalls related to the possible loss of audible chimes, driver sensing, and alerts associated with ADAS systems (see table 4.0 below). Loss of alerts associated with ADAS systems increases the risk of a crash occurring because drivers may be unaware of system malfunctions.

Table 3.0 – Vehicle safety recalls related to loss of turn signal function (FMVSS 108)

| RECALL | MFR | MMY | RECALL TYPE | SAFETY DEFECT DESCRIPTION |
|---------------|------------|---|--------------------|---|
| 19V-403 | Mazda | 2018 Mazda CX-9 | D | Weak retention force of wiring harness connectors may disrupt communications and disable frontal airbag, turn signals and engine starting system. Inoperable turn signals prevent the driver from signaling to other drivers, increasing the risk of crash. |
| 14V-294 | FCA | 2014 Ram Promaster | D | Water intrusion around in-floor battery cover may disable air bags, stop lamps, turn signals, backup lights and/or door locks |
| 12V-454 | GM | 2013 Chevrolet Sonic | C | Body Control Module (BCM) fails to warn when turn signal lamp fails to illuminate |
| 06V-263 | GM | 2004-05 Cadillac XLR | D | Bulb used for DRL, turn signal & parking lamps may become damaged by vibration and burn out prematurely |
| 04V-584 | VW | 2000-02 VW Golf, GTI, Jetta | D | Hazard switch and flasher system function may degrade over time because of distortion and material transfer resulting in intermittent or inoperative turn signal and hazard flasher function |
| 04V-547 | GM | 2003-04 Saturn ION | D | Front turn signal lamp and DRL may stop working on either side due to loss of contact between bulb and socket |
| 04V-524 | GM | 2003 Chevrolet Cavalier & Pontiac Sunfire | D | Rear lamps that provide stop, turn signals and tail lamp functions stop working because of inadequate contact between bulb and socket |

Table 4.0 – Vehicle safety recalls related to loss of (ADAS) warning notifications to the driver

| RECALL | MFR | MMY | RECALL TYPE | SAFETY DEFECT DESCRIPTION |
|---------|---------------|---|-------------|--|
| 19V-540 | Mercedes-Benz | 2019-20 platforms equipped with Driver Assistance Package | D | A software error in the radar sensor control unit may impair the functionality of the Active Brake Assist function with no warning displayed to the driver |
| 15V-366 | Subaru | 2015-16 Impreza, Legacy, Outback, WRX, XV Crosstrek | D | Loss of driving assist system function with no warning displayed to the driver |

IV. Conclusion

ODI tentatively concludes that the subject MY 2012-2018 Tesla Model S and MY 2016-2018 Model X vehicles contain a defect related to motor vehicle safety. The failure rate in this investigation is significantly greater than the failure rate for vehicles involved in prior recalls involving similar behavior. ODI’s analysis of the data demonstrates that the number of failures of the media control unit (MCU) will steadily increase over time until all parts in the subject vehicles have failed. The tentatively-determined safety defect in the MY 2012-2018 Tesla Model S and MY 2016-2018 Model X is a clear, identified failure mode that leads to an unrecoverable status for the media control unit (MCU) and adversely affects vehicle safety functions. ODI requests that Tesla recall each of the subject vehicles in accordance with 49 U.S.C. §§ 30118-30120.

NHTSA notes that Tesla has implemented several over-the-air updates in an attempt to mitigate some of the issues described in this letter, but tentatively believes these updates are procedurally and substantively insufficient. As a matter of Federal law, vehicle manufacturers are required to conduct recalls to remedy safety-related defects.

ODI’s request that Tesla conduct a safety recall does not constitute a formal conclusion by NHTSA with respect to the evidence in its investigative file. This recall request does not constitute an initial or final agency decision that the subject vehicles contain a safety-related defect pursuant to 49 U.S.C. § 30118, or an order to recall vehicles.

If Tesla decides not to conduct the requested recall, it must provide ODI with a full explanation of its decision, including any additional analysis of the problem beyond Tesla’s past presentations. If not satisfied after consideration of this information, the Agency may proceed to publish in the Federal Register an Initial Decision that these vehicles contain a safety-related defect, describing the alleged safety defects, the safety consequences of these defects, the ODI investigation, and the scheduling of a public meeting pursuant to 49 U.S.C. § 30118, and may take other appropriate action.

Tesla’s written response to this letter referencing the identification codes in the upper right hand corner on page 1 of this letter, must be submitted to this office no later than January 27, 2021, by

email to Jeff.Quandt@dot.gov. It is important that Tesla respond to this letter on time. This letter is being sent pursuant to 49 U.S.C. § 30166, which authorizes this agency to conduct investigations and require the submission of reports that may be necessary to enforce Chapter 301 of Title 49. Failure to respond promptly and fully to this letter may be construed as a violation of 49 U.S.C. § 30166, which could subject Tesla to civil penalties pursuant to 49 U.S.C. § 30165.

If you have any questions about this letter, please contact Mr. Jeffrey L. Quandt of my staff at (202) 366-5207. If you have any questions regarding the recall procedures, please contact Mr. Joshua Neff of my staff at (202)-366-0698.

Sincerely,

Stephen Ridella, Ph.D.
Director
Office of Defects Investigation