TOYOTA

Toyota Motor North America, Inc.

Vehicle Safety & Compliance
Liaison Office
Mail Stop: W4-2D
6565 Headquarters Drive
Plano, TX 75024

January 17, 2020

DEFECT INFORMATION REPORT

1. Vehicle Manufacturer Name:

Toyota Motor Corporation ["TMC"]
1, Toyota-cho, Toyota-city, Aichi-pref., 471-8571, Japan

Toyota Motor Manufacturing Canada Inc. ["TMMC"]
1055 Fountain Street North, Cambridge, Ontario, Canada N3H 5K2

Toyota Motor Manufacturing, Kentucky, Inc. ["TMMK"]
1001 Cherry Blossom Way Georgetown, KY 40324

Toyota Motor Manufacturing, Mississippi, Inc. ["TMMMS"]
1200 Magnolia Way, Blue Springs, MS 38828

Affiliated U.S. Sales Company:

Toyota Motor North America, Inc. ["TMNA"]
6565 Headquarters Drive, Plano, TX 75024

Manufacturer of Airbag Control Module:

ZF Friedrichshafen AG
Löwentaler Straße 20
ZF Forum 88046 Friedrichshafen, Germany
Phone: +49 7541 77 0

Country of origin: U.S.A., UK

2. Identification of Involved Vehicles and Affected Components:

Based on production records, we have determined the involved vehicle population as in the table below.

Make/Car Line	Model Year	Manufacturer	Production Period
Toyota / Corolla	2011-2019	TMC, TMMC, TMMMS	November 23, 2010 through February 25, 2019
Toyota / Corolla Matrix	2011-2013	TMMC	December 6, 2010 through June 18, 2013
Toyota / Avalon	2012-2018	TMMK	May 10, 2012 through April 13, 2018
Toyota / Avalon HV	2013-2018	TMMK	May 22, 2012 through March 29, 2018

Applicability	Part Number	Part Name	Component Description
MY2011-2019 Toyota Corolla	89170-02D51 89170-02D52 89170-02D53 89170-02A60 89170-02C60 89170-02G60 89170-02K90 89170-02F10	Sensor Assy, Air Bag	Airbag Control Module
MY2011-2013 Toyota Corolla Matrix	89170-02C50 89170-02C51 89170-02C52 89170-02C53 89170-02A70		
MY2012-2018 Toyota Avalon	89170-07250 89170-07280 89170-07290 89170-07350 89170-07310		
MY2013-2018 Toyota Avalon HV	89170-07260 89170-07300 89170-07360 89170-07320		

Note: (1) Although the involved vehicles are within the above production period range, not all vehicles in this range were sold in the U.S.

(2) Other Toyota or Lexus vehicles sold in the U.S. are equipped with an SRS ECU of a different design, not containing the DS84 ASIC, or are equipped with an SRS ECU containing the DS84 ASIC, but, due to different body construction and other factors, Toyota believes at this time that an occurrence of a sufficient negative transient at a timing that can affect airbag deployment in a crash is unlikely.

3. Total Number of Vehicles Potentially Involved:

Toyota Avalon	:	241,845
Toyota Avalon HV	:	63,785
Toyota Corolla	:	2,576,108
Toyota Corolla Matrix	:	10,238
Total	:	2,891,976

4. Percentage of Vehicles Estimated to Actually Contain the Defect:

Toyota is unable to provide an estimate. Although the involved vehicles potentially are equipped with the subject ECU, damage to the application-specific integrated circuit (ASIC) that will affect airbag deployment can occur only under a very narrow set of factors and circumstances in a crash that Toyota believes to be rare. However, Toyota is unable to estimate the likelihood for this to occur in the real world.

5. Description of Problem:

The subject vehicles may be equipped with an airbag control module for the supplemental restraint system (SRS ECU) manufactured by ZF-TRW. The ECU receives signals from crash sensors and deploys the airbags and seat belt pretensioners in accordance with design specifications. This ECU contains a model DS84 application-specific integrated circuit (ASIC) which controls the communication of the crash sensor signals, firing commands (i.e., when to deploy the airbag(s) and/or pretensioners), and fault information (e.g., diagnostic trouble codes).

This ASIC does not have sufficient protection against negative electrical transients that can be generated in certain severe crashes, such as an underride frontal crash where there is a large engine compartment intrusion before a significant deceleration. In these cases, the crash sensor and other

powered wiring can be damaged and shorted so as to create a negative electrical transient of sufficient strength and duration to damage the ASIC before the deployment signal is received in the SRS ECU. This can lead to incomplete or nondeployment of the airbags and/or pretensioners. In model year 2014-2019 Corollas, one potential mechanism contributing to the short circuit appears to be the headlight mounting bracket engagement with the crash sensor wiring along with damage to powered wiring. In the other involved vehicles, the mechanism which could create a sufficient negative electrical transient in a crash is not fully understood and is under investigation. Airbag non-deployment and/or lack of pretensioner operation can increase the risk or severity of injury in a crash.

6. Chronology of Principal Events:

2016 – Early May 2018

In early 2016, ZF-TRW met with Toyota to review a presentation it had made to NHTSA about SRS ECUs supplied to other manufacturers containing the DS84 ASIC where the ASIC sustained Electrical Overstress (EOS) damage. ZF-TRW indicated that it was not aware of such an issue with ECUs supplied to Toyota.

In September 2016, FCA filed a Part 573 report with the National Highway Traffic Safety Administration (NHTSA) describing that certain vehicles may experience a loss of airbag and seat belt pretensioner deployment capability in certain crash events due to a shorting condition resulting in a negative voltage transient that travels to the Occupant Restraint Controller (ORC) produced by ZF-TRW.

Thereafter, ZF-TRW contacted Toyota and shared information regarding FCA's recall filing, explaining that it was related to the wire harness routing in certain FCA vehicle models and that Toyota vehicles were not affected.

In February 2018, Hyundai filed a Part 573 report with NHTSA concerning ZF-TRW SRS ECUs in certain of its vehicles. Hyundai later expanded the recall to include additional vehicles that did not contain certain diodes that provide increased circuit protection against EOS.

Subsequently, NHTSA contacted Toyota inquiring about the use of ZF-TRW SRS ECUs equipped with the DS84 ASIC and any field experience in Toyota vehicles. In response, Toyota conducted a U.S. field data review, and reported to NHTSA that no U.S. cases were found at that time based on Toyota's understanding of the issues.

Although ZF-TRW had previously explained to Toyota that Toyota vehicles were not affected by the previous recalls, Toyota continued communication with ZF-TRW to understand their design and development of the SRS ECU, the use of the DS84 ASIC, and the differences between ECUs supplied to Toyota and those supplied to other OEMs. ZF-TRW stated that it had not found evidence to link non-deployments to electrical overstress and that electrical overstress with a non-deployment is vehicle dependent. ZF-TRW also stated that the Toyota ECUs had certain diodes (Schottky diodes) that provided incremental protection against negative transients. They also advised Toyota that they were not aware of any non-deployments with observed EOS involving a customer which was provided ECUs containing DS84 ASIC with Schottky diodes.

May 2018 – December 2018

On May 30, 2018 Toyota was contacted by the California Highway Patrol (CHP) seeking assistance regarding how to read/download the EDR from a 2018 Toyota Corolla SRS ECU which had been involved in a severe frontal collision in which no airbags had deployed. The CHP had removed the SRS ECU from the vehicle, and multiple unsuccessful attempts were made by both CHP and Toyota to download the EDR data. ZF-TRW was sent the ECU for further evaluation, and they advised Toyota that no data could be obtained from it, although ZF-TRW confirmed damage consistent with EOS. This was further discussed with NHTSA representatives, who were present for ZF-TRW's inspection.

On June 1, 2018, Kia filed a Part 573 report with NHTSA concerning ZF-TRW SRS ECUs in certain of its vehicles. Subsequently, at the request of NHTSA, ZF-TRW filed a Part 573 report related to the prior Hyundai recall and the latest Kia recall. According to ZF-TRW's report, "the ASIC in the ACUs may experience EOS damage caused by negative transient voltages generated in the vehicle environment that are outside the vehicle manufacturer's specification during particular front impact events". Further, the Part 573 report states, "this submission does not cover vehicles included in 16V-668 [the 2016 FCA recall]. The ZF component referenced in that recall [the 2016 FCA recall] has design differences, and the root cause in that recall was attributed in part to specific vehicle conditions".

In early October 2018, Toyota requested ZF-TRW to conduct transient testing on ECUs that did not contain the DS84 ASIC to compare to previous test data conducted by ZF-TRW on ECUs equipped with the DS84 ASIC in order to understand the difference in the ECUs. Toyota continued discussions with ZF-TRW in order to understand how negative transients could be created and can potentially flow within the electrical system.

In late November through December 2018, Toyota continued technical discussions with ZF-TRW on how to create a negative transient and how to set up and conduct a bench test for such a transient. ZF-TRW provided electrical diagram information and test set up information to help Toyota understand the bench testing set up. Toyota also further inquired of ZF-TRW as to certain changes previously made by ZF-TRW in its internal development standard for SRS ECUs.

January 2019 – March 2019

In late January 2019 Toyota met with ZF-TRW to review the DS84 EOS issue. During that meeting, Toyota was advised that ZF-TRW had previously changed certain specifications for the ECU that were not before shared with Toyota. Toyota continued discussions with ZF-TRW to understand more about the specification changes but was unable to obtain further information.

Toyota began recovering in-use parts across all of the models and model years of vehicles which contain the DS84 ASIC in which no alleged failure had occurred to investigate the actual field condition of the electrical strength of the airbag ECUs through bench testing. Strength testing then began in order to attempt to understand the conditions under which the ECU might reset (i.e., shutdown). Additionally, a vehicle wiring architecture study was begun.

In March Toyota met with NHTSA to provide the Agency with information about the progress of its investigation and future activities.

April 2019 – May 2019

In April, NHTSA opened EA19-001 by expanding PE18-003(Hyundai/Kia) to include ZF-TRW, FCA, Honda, Mitsubishi, and Toyota. Toyota continued to monitor and look for field incidents that could relate to this issue. It conducted vehicle inspections itself, and in some cases, together with representatives of ZF-TRW and NHTSA. By early May, over 200 in-use ECUs had been recovered. Strength and stress testing was performed on many of the recovered parts, but Toyota did not have sufficient technical information to understand whether these test results could be representative of any potential real world incidents. At the end of May, Toyota provided an update to NHTSA about this testing. It also discussed upcoming testing that was being conducted by a testing contractor on behalf of ZF-TRW to be attended by Toyota and NHTSA representatives. In addition to electrical testing, three crash tests were conducted. Airbags deployed in all tests, although ZF-TRW informed Toyota after one test that an ECU reset had occurred.

June 2019 – September 2019

In early June, ZF-TRW conducted three additional crash tests. In both tests all the airbags deployed, and no ECU resets occurred. In late June, Toyota advised the Agency on the status of its investigation and the test data obtained thus far. In addition, Toyota provided an update regarding the status of its field investigations.

On July 16, Toyota received an Information Request from the Agency in connection with EA19-001. An initial response was provided on August 30, 2019, with additional supplements thereafter.

Toyota conducted three crash tests in September. In these tests, all of the airbags deployed, no ECU resets occurred, and no transients were detected.

October 2019 – January 2020

Toyota provided NHTSA an update of the testing that had been conducted to date. At this time Toyota had been unable to duplicate any of the bench testing or static vehicle testing conditions in a real-world crash scenario. Toyota advised the Agency that the investigation would be continued to evaluate other test methods, including other crash test modes in an attempt to understand the conditions that may contribute to a reset of the ECU.

In mid-October Toyota conducted an additional crash test. All of the airbags deployed, and Toyota was able to communicate with and retrieve the EDR data from the SRS ECU. In addition, no electrical transients were detected, and no ECU resets occurred even though sensor communication was lost during the test. The results of the additional crash testing were discussed with NHTSA. Additionally, Toyota continued to monitor and investigate field incidents that could relate to this issue.

In early December 2019, Toyota conducted three additional crash tests. The crash tests were conducted using a more severe underride condition to more closely match certain potential field cases. The hypothesis was that, while prior testing was unable to duplicate the condition, this more severe type of crash condition might be able to create a sufficient negative transient that theoretically could affect the ECU prior to the airbag deployment command. In all three tests, all of the airbags deployed, and Toyota was able to communicate with and retrieve the EDR data from the SRS ECU.

As these tests were again unable to duplicate any of the negative transients or resets that were observed during bench testing and static vehicle testing, Toyota continued to explore crash modes that could increase the severity of the damage to the vehicle. In mid-December, Toyota conducted two additional crash tests that closely matched the previous tests, although certain test parameters were changed to further increase the severity of the underride condition. In the first test the passenger side seat cushion airbag did not deploy and the second stage for the frontal airbags also appeared to have not deployed. Toyota was unable to communicate with the SRS ECU and retrieve the EDR data. In the second test the airbags did not deploy, and no data were recorded in the EDR.

Toyota discussed the results of the most recent crash tests with NHTSA. At this time, Toyota was still investigating the presence of any transients and/or ECU resets from these crash tests. In early January, Toyota investigated the ECU from one of the tested vehicles and confirmed that there was damage to the DS84 ASIC.

Toyota also considered the performance of the DS84 ASIC in vehicles of different size and construction, such as passenger cars versus trucks/SUVs. Due to size, body construction, and other factors in trucks and SUVs, Toyota believes at this time that an occurrence of a negative transient in timing to affect airbag deployment is unlikely.

January 15, 2020

Based on the results of the above investigation, Toyota decided to conduct a voluntary safety recall campaign for the vehicles identified above.

As of January 13, 2020 based on a diligent review of records, Toyota's best engineering judgement is that there are 15 Toyota Field Technical Reports and no warranty claims that have been received from U.S. sources that relate or may relate to this condition and which were considered in the decision to submit this report. In some cases, multiple reports were completed for one potential incident.

7. Description of Corrective Repair Action:

All known owners of the subject vehicles will be notified by first class mail to return their vehicles to a Toyota dealer. In most cases, the dealers will install a noise filter between the airbag control module and its wire harness. In some cases, Toyota may inspect the ECU to determine if the noise filter is necessary before installing it.

Reimbursement Plan for pre-notification remedies

The owner letter will instruct vehicle owners who have paid to have this condition remedied prior to this campaign to seek reimbursement pursuant to Toyota's General Reimbursement Plan.

8. Recall Schedule:

Notifications to owners of the affected vehicles will occur by March 17, 2020. A copy of the draft owner notification will be submitted as soon as it is available.

9. Distributor/Dealer Notification Schedule:

Notifications to distributors/dealers will be sent on January 21, 2020. Copies of dealer communications will be submitted as they are issued.

10. Manufacturer's Campaign Number:

[Interim / Remedy] 20TB03 / 20TA03