TOYOTA

Toyota Motor North America, Inc.

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

July 12, 2023

DEFECT INFORMATION REPORT

1. Vehicle Manufacturer Name:

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

Affiliated U.S. Sales Company:

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

Manufacturer of DC-DC converter:

DENSO CORPORATION
1-1, Showa-cho, Kariya-city, Aichi-pref., 448-8661, Japan
Phone: +81-566-25-5511

Country of Origin: Japan

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 / RAV4 Prime	2021-2022	TMC	November 25, 2019 through May 27, 2022
Lexus/ NX450h+	2022		April 7, 2021 through May 27, 2022

Applicability	Part Number	Part Name	Component Description
MY2021-2022 Toyota RAV4 Prime MY2022 Lexus NX450h+	G9270-42060	Converter Assy, Hybrid Vehicle	DC-DC Converter

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) This issue only affects the vehicles equipped with a DC-DC converter containing a current rectifying module with the specific design described in this report. Other Toyota or Lexus vehicles sold in the U.S. are equipped with a DC-DC converter of a different design or not equipped with a DC-DC converter.

3. Total Number of Vehicles Potentially Involved:

RAV4 Prime : 41,535
NX 450h+ : 1,907
Total : 43,442

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

Toyota is unable to estimate the percentage of the involved vehicles that actually contains the DC-DC converter with a damaged rectifying module as described in this report. However, as the NHTSA manufacturer portal requires an integer value be entered, Toyota has entered the value “1” in response to this question in the portal. For the purpose of this report, “1” means “unknown”.

5. Description of Problem:

The plug-in hybrid system of the subject vehicles includes a DC-DC converter that reduces the voltage of the electricity from the Hybrid Vehicle (HV) battery in order to charge the vehicle’s 12V battery. Contained within the DC-DC converter is an electric current rectifying module that is installed on the circuit board. Some of these modules may have been damaged during production by the supplier and could fail. Based on its design, if the module does fail, it will not fail to an open circuit, but instead a short circuit could occur. This allows current from the 12V battery to continue to flow through the module and the module will generate heat. Under certain conditions, if excessive heat is generated, components within and outside the DC-DC converter could sustain thermal damage, increasing the risk of a vehicle fire.

6. Chronology of Principal Events:

June 2021 – January 2022

In mid-June 2021, Toyota received a field report from Europe which indicated the driver had observed warning messages in the display and smoke from the rear seat while driving on the highway. An initial inspection was conducted at the dealer and damage was found to be concentrated to a plastic cooling duct on the DC-DC converter located under the rear seat.

The DC-DC converter with the cooling duct was then sent to the supplier for further investigation. As a result, the supplier found the cooling duct on the DC-DC converter had melted and an electric current rectifying module inside the DC-DC converter was consumed by thermal damage. The supplier could not determine the root cause of the failure of the DC-DC converter because of the extent of damage to the DC-DC converter. Separately, an investigation including Failure Tree Analysis (FTA) at the supplier identified that semiconductor chip failure could potentially be caused by different types of manufacturing damage. At that time, it was determined that Static Electrical Charge (SEC) in the manufacturing process had the highest potential to damage the electric current rectifying module and needed further investigation.

The supplier began duplication testing with a DC-DC converter that contained a chip with damage from over voltage and/or over current which simulated the chip damaged by SEC. As a result, the supplier found that if the chip failed, a short circuit occurred and the current from the 12V battery continued to flow into the module and the module generated excessive heat, resulting in the cooling duct melting. However, Toyota confirmed the temperature around the cooling duct could not reach the ignition point of the material of the cooling duct. Toyota also confirmed that vehicle systems continue to operate as long as the 12V battery had remaining charge and that a DTC for internal short circuit of the DC-DC converter is set and the customer receives a warning message on the informational display.

February-December 2022

In mid-February, Toyota received a field report from Canada which indicated that black smoke and burned plastic smells were noticed the day after plugging a vehicle into a home charger. As a result of the inspection of the vehicle, it was confirmed the right rear seat cushion had sustained fire damage and there was melting of the cooling duct and the cooling blower adjacent the DC-DC converter. Because of the new field report, Toyota conducted further investigation to reevaluate the worst case scenario of a DC-DC converter failure. Toyota rechecked its prior analysis and reconfirmed that the highest temperature that could be reached if the DC-DC converter failed was below the ignition point of the cooling duct material, and thus would not lead to a fire.

Toyota decided to continue the investigation regarding the relationship between the failure of the DC-DC converter and the fire damage of the rear seat cushion alleged in the field report from Canada since duplication testing could not produce fire damage to the rear seat cushion material.

In late-May, the design of the rectifier module was changed so that potential damage that occurs in the manufacturing process would not cause the module to fail to a short circuit. With the design change, the module will fail to an open circuit and would not allow the flow of current from the 12V battery through the module if the module had been damaged.

In mid- June, the rear seat cushion, the DC-DC converter, and the cooling blower from the Canada vehicle were sent to Toyota to support this investigation. Toyota and the supplier investigated these parts and found that the fire did not originate from the rear seat cushion (e.g., from a cigarette or match). The module within the DC-DC converter was consumed and the cooling blower had no signs of internal heat generation. As a result, Toyota could not determine the cause of the fire damage of the rear seat alleged in the field report from Canada.

The supplier conducted multiple duplication tests with various conditions that did not include a charging condition. Under those conditions, the supplier could not duplicate the fire damage and could not identify any new information from this testing that indicated the cause of the alleged fire damage to the rear seats. Therefore, Toyota again began to review the condition of the vehicle and the recovery parts.

January 2023-July 2023

As a result of the review, Toyota determined that testing of the vehicle was needed under charging conditions. Toyota also identified the breather plug of the recovered DC-DC converter was clogged. Because of these findings, Toyota requested that the supplier begin to build a testing bench to simulate the conditions of charging with a clogged breather plug.

The supplier found that if the vehicle is charging and the HV battery temperature is low enough to require a heater be activated, the current from a sub DC-DC converter within the charger also flowed into the module, resulting in increasing the maximum temperature of the DC-DC converter. In addition, the supplier observed that if the vehicle was charging and the breather plug was clogged, the temperature in the DC-DC converter became high enough to melt the aluminum case housing the DC-DC converter. The melting created small holes within the aluminum case allowing the excessive high temperature gas inside the DC-DC converter to escape from the holes, and allowing the cooling duct to ignite.

July 6, 2023

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

As of June 21, 2023 based on a diligent review of records, Toyota's best engineering judgment is that there are four Toyota Field Technical Reports and two 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.

7. Description of Corrective Repair Action:

All known owners of the subject vehicles will be notified to return their vehicles to a Toyota and Lexus dealer. The dealers will replace the DC-DC converter with an improved part at no cost.

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 September 10, 2023. 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 July 12, 2023. Copies of dealer communications will be submitted as they are issued.

10. Manufacturer's Campaign Number:

	Interim	Final
Toyota:	23TB07	23TA07
Lexus:	23LB01	23LA01