

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

Acting Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Washington, DC 20590

24 April 2025

Dear Acting Administrator,

On May 12, 2023, I sent a letter to NHTSA requesting that investigation DP 20-001 be re-opened because of new information that NHTSA investigators erred in ascribing the cause of these incidents to pedal misapplication. The enclosed letter from NHTSA dated July 3, 2023, and enclosed ODI Resume Number DP 23-002 verify that NHTSA accepted this letter as a valid petition and stated that NHTSA would notify me upon completion of the investigation. As of 24 April 2025, this has not yet happened.

According to the rules for NHTSA petitions contained in the US Code of Federal Regulations, Title 49, Subtitle B, Chapter V, Part 552, NHTSA is required by law to:

- 1) conduct a technical review of the petition, and
- 2) notify the petitioner of the decision to grant or deny the petition within 120 days after its receipt of the petition.

It has now been almost two years since submitting my petition and this technical review has not still not happened. Therefore, I expect NHTSA to abide by this regulation and perform a technical review of my petition and notify me of the results. As acting administrator, it is your personal obligation to see that this is done.

In my letter to you dated 14 April 2025, I enclosed a paper entitled "*LOG Data Confirms Tesla Unintended Acceleration*". After sending NHTSA this paper, an engineering thesis completed in October 2024 was found that supports the paper's conclusion that the TLF35584 PMIC device on the Tesla Model 3 inverter board is going into reset. The paragraphs below summarize the findings contained in this thesis. I request that this summary be considered with my paper entitled "*LOG Data Confirms Tesla Unintended Acceleration*" when a review of my petition DP 23-002 is performed by NHTSA.

[Beginning of Summary]

After completing the paper entitled "*LOG Data Confirms Tesla Unintended Acceleration*", an engineering thesis completed in October 2024 was found that supports the author's conclusion that the TLF35584 PMIC device on the Tesla Model 3 inverter board is going into reset.

The thesis was performed by an engineering student at the Polytechnic University of Turin in Italy under the sponsorship of a company named Ideas & Motion (I&M) who provides engineering services (both HW and SW) to OEM and Tier1 companies in the automotive industry. I&M is responsible for the complete design, development, and prototyping of automotive-grade traction inverters for hybrid and electric vehicles. The thesis, entitled "*Control Board Design for Dual Voltage Source Inverters in*

Automotive Applications" [Footnote 1], describes the development of a control board for an inverter that is similar to Tesla's Model 3 inverter board. Like the Tesla Model 3 inverter, it contains a DSP with an ADC, two APP sensors, multiple temperature sensors, two angular position sensors, one high voltage sensor, two CAN bus transceivers, and their interface electronics, but not the high voltage inverter transistors and their drivers with their own power supplies. And like the Tesla Model 3 inverter, it uses a TLF35584 PMIC device to provide the multiple supply voltages required by all the components on the control board. A completely operable control board was designed and fabricated by the student with engineering assistance provided by I&M.

What is really interesting is that Section 4.3.2 of the thesis analyzes how the thermal environment is met. The following is a summary of this thermal analysis.

The TLF35584 PMIC device operates at a high temperature because it must source all the current for the DSP with ADC, two APP sensors, multiple temperature sensors, two angular position sensors, one high voltage sensor, two CAN bus transceivers, and their interface electronics (but not the high voltage inverter transistors and their drivers with their power supplies). Summing the power dissipation of all these loads leads to a total power dissipation for all the loads of 0.8765W. This value, combined with the losses from the post-regulators within the chip, leads to a total PMIC device power dissipation of 1.336 W. This value is then multiplied by the "junction to ambient" ratio of 37 K/W to account for the thermal resistance of a typical PWB as specified in the TLF35584 datasheet, to obtain the junction-to-ambient temperature rise during operation. The result of this analysis shows that the junction temperature of the PMIC is approximately 50°C higher than the ambient temperature under worst-case conditions. The ambient temperature inside the inverter housing is calculated to be the water cooling temperature of 60°C plus a temperature delta of 20°C for the water-to-ambient-air temperature difference, or about 80°C. This gives a TLF35584 junction temperature of $80^{\circ}\text{C} + 50^{\circ}\text{C} = 130^{\circ}\text{C}$ above ambient. This is compared to the junction temperature specification of 150°C above ambient for the TLF35584 device in a 48-pin QFN package. This leaves a temperature margin of about 20°C. The inclusion of the PMIC junction-to-ambient temperature rise in this estimation of the temperature margin explains how the PMIC device operation can resume so quickly after PMIC reset, because reset causes the PMIC junction temperature to decrease well below the reset temperature of 150°C. But the cause of increasing the PMIC junction temperature above the reset temperature can be any one of the sources of PMIC heating considered.

Based on this student's thermal analysis of his control board, we can now make the following inferences about the Tesla Model 3 inverter board:

- 1) Assessment of whether the TLF35584 PMIC device remains below its maximum specified temperature should be made using the junction temperature of 150°C

¹ Luca Montangero, "Control Board Design for Dual Voltage Source Inverters in Automotive Applications", Master's thesis, Polytechnic University of Turin, October 2024.
<https://webthesis.biblio.polito.it/33127/1/tesi.pdf>

for the PMIC device and not the ambient temperature of 85°C because the junction temperature is more physically meaningful than the device ambient temperature.

- 2) The junction temperature of the TLF35584 PMIC device on the Tesla Model 3 inverter board is determined not only by the power dissipation of the braking resistor bank, but by the power dissipation of all the devices that are powered by the TLF35584 PMIC device, which increases the current through the PMIC device. This total current can cause the junction temperature of the PMIC device to be 50°C higher than the ambient air temperature.
- 3) If the water cooling temperature of the Tesla Model 3 inverter is also 60°C as assumed by the student, then the temperature margin of the TLF35584 PMIC device in the Tesla inverter should be roughly the same as the temperature margin of the student's board, or about 20°C below the junction temperature specification of 150°C. However, the Tesla Model 3 inverter board differs from the student's inverter control board in the following two respects:
 - a. The Tesla Model 3 inverter board contains a braking resistor that the student's board does not have. This resistor is cooled by adding a silicone heat spreader over the resistors to provide a direct path to the water-cooled aluminum chassis. It was believed by some that this was done to keep the temperature of the braking resistor down, to prevent its resistance from decreasing as the current increased in a potential runaway fashion. But now we know that the power dissipation of the braking resistor can also increase the temperature of the PMIC device by heating the inverter board nearby. This heating will make the junction temperature of the TLF35584 PMIC device increase, causing it to operate closer than 20°C to its maximum junction temperature of 150°C. It may even exceed this temperature at times.
 - b. The Tesla Model 3 inverter board contains drivers for the high voltage transistors in the inverter along with a power supply for the drivers. This power supply is transformer-based and is powered by switching the 12V battery voltage. So its power dissipation is not included in the TLF35584 PMIC device dissipation. Since this power supply is close to the TLF35584 PMIC device on the inverter board, its power dissipation can heat the inverter board near the PMIC device to cause the junction temperature of the TLF35584 PMIC device to increase. This will also make the PMIC device operate closer than 20°C to its maximum junction temperature of 150°C. It is not known yet if this temperature increase can cause the PMIC junction temperature to exceed its specified maximum temperature.
- 4) The new Tesla Model Y inverter board is shown in Figure 1. Notice that it does not have a braking resistor bank covered by a silicone heat spreader. This suggests that Tesla engineers may be aware of the fact that heat from the braking resistor can cause an increase in the junction temperature of TLF35584 PMIC

device, which is still used in this new design.^[Footnote 2] Tesla may claim that the braking resistor was removed for other reasons, such as reducing the board size. However, if this claim of board size reduction were valid, it would have been applied to the original Model 3 inverter board as well. But in that case the braking resistor was left on the board.

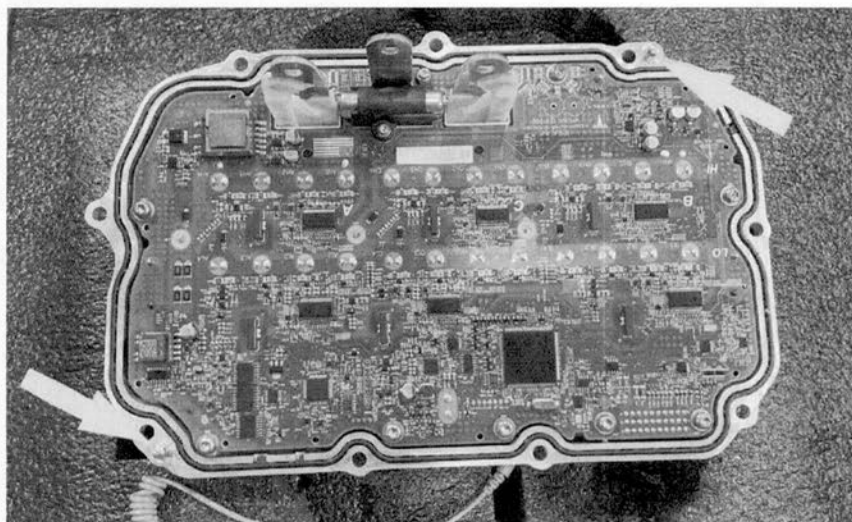


Figure 1. The newer Model Y inverter board has no braking resistor.

- 5) A simple way to prevent the TLF35584 PMIC device on the Model 3 inverter board from going into reset by exceeding the junction temperature is to put a silicone heat spreader directly on the TLF35584 PMIC device itself, just like the one on the braking resistor. If this is so simple, then why doesn't Tesla do this? The answer may be that this would make it obvious to all concerned that Tesla knows that PMIC device heating is a problem. This would almost certainly lead to a mandatory recall to add the heat spreader to the PMIC in all Tesla Model 3 vehicles. This recall would drain Tesla's financial resources because it would require opening up the inverter housing on all Tesla Model 3's currently on the road. It would also risk losing many court cases for unintended acceleration caused by the reset of the TLF35584 PMIC device. Therefore, it is better for Tesla to not modify the Model 3 inverter boards, and to claim ignorance of, or even deny the fact that, reset of the TLF35584 PMIC device can occur that may lead to unintended acceleration.

In summary, the similarity of the control board studied in this thesis to the Tesla Model 3 inverter board suggests that the TLF35584 PMIC on the Tesla Model 3 inverter board operates normally at a junction temperature within 20°C of its maximum specified junction temperature of 150°C. Heating of the PMIC to a junction temperature over 150°C is possible if either the total PMIC current increases, the water cooling

² If this is true, then Tesla engineers may also be aware that the TLF35584 PMIC device on Model 3 inverters can go into reset at times due to too high a PMIC junction temperature, which can lead to unintended acceleration.

temperature increases, the braking resistor current increases, or the power supply current to the drivers that control the high voltage inverter transistors increases.^{[Footnote}

^{3]} The total PMIC current can increase if the current to any one or more of the devices it provides power to increases. If the TLF35584 PMIC junction temperature increases above 150°C, then the device will go into reset for one second or more leading to the possibility of unintended acceleration.

[End of Summary]

If you desire to contact me for any reason relevant to this letter, or wish to obtain a color copy of the enclosed summary and the paper to which it should be added, please use the email address given below.

Sincerely yours,

Ronald A. Belt

Ronald A. Belt



³ The most likely of these to increase the junction temperature of the TLF35584 PMIC to cause reset of the PMIC is the braking resistor current increasing. A close second cause could be an increase in the water cooling temperature as a result of inverter transistor heating due to a drive motor stall torque condition.

Ronald Belt

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Acting Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Washington, DC 20590

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