UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DATASPEED INC.,
Petitioner,

v.

SUCXESS LLC,
Patent Owner.

Case IPR2020-00147
Patent 10,027,505

EXPERT DECLARATION OF MAHDI SHAHBAKHTI, PH.D.

IN SUPPORT OF PATENT OWNER RESPONSE

TABLE OF CONTENTS

I. INTRODUCTION

1. I have been retained by Patent Owner Sucxess LLC ("Sucxess" or "Patent Owner") as an expert in the area of automotive networks. I make this Declaration at the request of Sucxess regarding my opinions as an independent expert regarding issues of validity of U.S. Patent No. 10,027,505 (the "505 Patent") raised in the matter of *Inter Partes* Review, Petition IPR2020-00147 ("Petition").

2. I am being compensated for my services in connection with this *Inter Partes* Review proceeding. My compensation is not dependent upon the outcome of the present *Inter Partes* review proceeding.

3. I have reviewed the Petition for *Inter Partes* Review of Patent No. 10,027,505 filed by Dataspeed Inc. ("Petitioner"), including Mr. Leale's Declaration[1]. I have also reviewed the exhibits cited in those documents, including Negley[2], SAE[3], and Bosch[4].

4. I have also reviewed the exhibits cited in this declaration. This includes:

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[1] Ex. 1103, "Leale"
[2] Bruce Negley, Getting Control Through CAN, The Journal of Applied Sensing Technology, Oct. 2000, vol. 17, no. 10, pages 16–33. Ex. 1006.
[3] Craig Szydlowski, A Gateway for CAN Specification 2.0 Non-Passive Devices, SAE Technical Paper Series, 930005, Society of Automotive Engineers, Inc. 1993, pages 29–37. Ex. 1009.
[4] Robert Bosch, CAN Specification Version 2.0, Bosch, Sept. 1991. Ex. 1010.

- Currie, Roderick. "Developments in Car Hacking." (2015). https://www.sans.org/reading-room/whitepapers/ICS/paper/36607. Ex. 2011, "Currie".
- Bernd Elend, Tony Adamson. "Cyber security enhancing CAN transceivers." (2017). https://www.can-cia.org/fileadmin/resources/documents/conferences/2017_elend.pdf. Ex. 2012, "Elend and Adamson".
- Service Training – Self Study Program 871603 – Eos Electrical System Design and Function, Volkswagen of America, Inc. Volkswagen Academy, May 2006 which I obtained from Volkswagen's Website at https://erwin.vw.com. Ex. 2007, "Eos Training Material".
- "VW Eos Convertible Hardtop Emergency Opening and Closing Using Autologic DrivePRO", a website published at https://us.autologic.com/news/vw-eos-convertible-hardtop-emergency-opening-and-closing showing a publication date of Sept. 17th, 2019. Ex. 2008.
- YouTube Video "VW Eos Convertible Hardtop Emergency Opening and Closing" published Sept. 17, 2019 by "Opus IVS" at https://youtu.be/KhgrBsIDO_0. Ex. 2010.

- YouTube Video "EOS ROOF MODULE SETUP MENU" published Nov. 26, 2006 by "lctcom" at https://youtu.be/yQ9xqvHwe0o and described to be "featuring the www.l-c-t.com EOS VARIO PLUS ROOF MODULE setup menu." (Ex. 2027).
- YouTube Video "Vario Plus Control Module Ultra features walk-through" published June 25, 2007 by "lctcom" at https://youtu.be/9PYK9j3FFx4 having the following description: "Want to know how everything works? What the world's best aftermarket gadget for your JETTA, GTI, RABBIT, GOLF, PASSAT, Touareg, Tiguan, A3, A4, A6, A5, Q7 has to offer? watch the video and find out! more infos at www.l-c-t.com". (Ex. 2030).
- YouTube Video "EOS ROOF OPENING WHILE DRIVING" published Nov 17, 2006 by "lctcom" at https://youtu.be/Fll2sWA-iwA and described to be "featuring the www.l-c-t.com eos roof module and opening the roof while driving." (Ex. 2013).
- Wiring diagrams obtained from Alldata (http://my.alldata.com) or Alldatadiy (https://www.alldatadiy.com/) of the following vehicles: 2007 Volkswagen Eos (Ex. 2014), 2007 Cadillac XLR (Ex. 2015), 2007 Lexus SC 430 (Ex. 2016), 2007 Mazda MX-5 Miata (Ex. 2017), 2007 Saab 9-3. (Ex. 2018), 2007 Pontiac G6 (Ex. 2019), 2007 Mini

Cooper S Convertible (Ex. 2020), 2007 Audi S4 Quattro Cabriolet (Ex. 2021), 2007 Ford Mustang (Ex. 2022), 2007 Porsche Boxster (987) (Ex. 2023).

- Connector pinout of 2007 Audi A4 Cabriolet, Bose Amplifier, 25-Pin and 32-pin obtained from Alldatadiy (https://www.alldatadiy.com/). (Ex. 2031).

I have also reviewed the transcript of Mr. Leale's deposition, which I refer to as "Leale Tr."

II. QUALIFICATIONS, PUBLICATIONS, AND PRIOR TESTIMONY

5. I am an Associate Professor of Mechanical Engineering at the University of Alberta and an Adjunct Associate Professor of Mechanical Engineering at Michigan Technological University. At these two universities, I serve as the Director of Energy Mechatronics Laboratory that conducts research in a multidisciplinary area of engineering that includes electrical and mechanical systems, telecommunications, and control engineering.

6. Before joining Michigan Technological University in August of 2012, I spent two years as a post-doctoral scholar at the Mechanical Engineering Department at the University of California, Berkeley. My post-doctorate work focused on developing control systems for automotive applications, including powertrains and others.

7. I earned a Ph.D. in Mechanical Engineering from the University of Alberta in 2009 and a Masters degree from KNT University of Technology in 2003. My research activities in the past 20 years have centered on propulsion systems, energy systems, and related control systems for automotive applications.

8. I also have direct industry experience. From 2001 to 2004, I worked as a researcher in the automotive industry. During this time, I was involved in research and development work on powertrain management systems for gasoline and natural gas vehicles. In the past ten years, I have performed controls-related research sponsored by various automotive companies such as Ford Motor Company, Toyota Motor Corporation, General Motors Corporation, Hyundai, Cummins, Westport, IAV, Hitachi, and Denso.

9. I have experience with automotive control systems including modeling, design, implementation, and utilizing vehicle networks including CAN. These include numerous projects in the past 20 years for vehicles including conventional, hybrid electric, electric, and connected and automated vehicles. Many of these projects included CAN communications and design of prototype (or aftermarket) systems for collecting required vehicle/powertrain data, implementing and testing designed real-time automotive controllers.

10. I have taught graduate courses in the areas of model predictive controls, and vehicle propulsion systems; Led international workshops in the areas of controls and data systems including “Methods of Easily verifiable Control Design”, “Connected and Automated Vehicles (CAVs)”, “From Data to Models and Decisions in Engineering Systems” at American Control Conference, and ASME (American Society of Mechanical Engineers) Dynamic Systems and Controls conferences.

11. I have supervised/mentored 119 graduate and undergraduate students, including 28 PhD, 63 MS and 28 BS students in Mechanical Engineering and Electrical Engineering Departments in four academic institutions during 2010-2020. These mentorships have been in the area of modeling, experimental studies (including instrumentation, CAN setup), and control of automotive, HVAC, and energy systems.

12. My current research activity at the University of Alberta and Michigan Tech University focuses on increasing efficiency of energy systems through utilization of advanced modeling, control, and network communication techniques, focusing on the transportation and building sectors.

13. I am Associate editor (2017-) for ASME Journal of Dynamic Systems, Measurement, and Controls and also Guest editor (2017-), and Associate Editor (2014- 2020) for International Journal of Powertrains (Inderscience).

14. I have served on the US Department of Energy (DOE), and United States' National Science Foundation (NSF) review panels in the areas of controls and energy systems in the past seven years. I have also been reviewer for (i) international grant proposals from funding agencies from Croatia, France, Germany, Poland, and the Netherlands, (ii) US Academy of Engineering for the Research Program of the US DRIVE Partnership, (iii) 24 international journals mostly in the area of controls and energy systems, (iv) Springer International Publishing for books in the area of controls and automotive systems.

15. I am an active member of ASME Dynamic Systems & Control Division (DSCD), serving as vice-chair of the Automotive Transportation Systems (ATS) technical committee (181 international members), the chair (2018-2020) of the Energy Systems (ES) technical committee (141 international members) and, chairing (30 sessions) and co-organizing sessions (> 60 sessions) in the areas of modeling, fault diagnosis, and control of automotive systems, and energy/HVAC systems in American Control Conference, SAE World Congress, and ASME Dynamic Systems Control Conferences.

16. I have won the following awards for my work relating to modeling and control of automotive systems:

- Awarded over $2.1M grants/support as a Principle Investigator (PI) and over $6.6M as a co-PI from international, federal, provincial, and industry sources for conducting research in the areas of modeling, design, and implementation of novel control systems for automotive systems, HVAC and energy systems.

- Society of Automotive Engineers (SAE) International Ralph R. Teetor Educational Award, 2016. This international award "recognizes top engineering educators for outstanding contributions."
- 2018 MARQUIS Who's Who in the World ("top 3% of the professionals in the world").
- Best Paper Award, ASME Automotive and Transportation Systems Technical Committee – ASME Dynamic Systems Control Conference, 2015.
- Best Paper Award, ASME Automotive and Transportation Systems Technical Committee – ASME Dynamic Systems Control Conference, 2012.
- Best Presentation in the Session, American Control Conference (ACC), 2012, 2015, 2016.
- Best Presentation Award, SAE Int. Powertrain, Fuels & Lubricants Conference, Baltimore, MD, USA, 2016.
- Canada National Sciences and Engineering Research Council (NSERC) Postdoctoral Fellowship (for research in the area of automotive controls), 2010 - 2012.

- Andrew Stewart Memorial Graduate Prize, University of Alberta, 2009.
- David Morris Graduate Scholarship in Automotive Engineering, University of Alberta, 2008.
- Lehigh Inland Cement Graduate Scholarship in Environmental Studies, University of Alberta, 2007.
- Winning Team (first prize) of a Total of 66 Research Teams from 26 Canadian Universities, Canada Automotive21 High Qualified Personnel Competition, Windsor, Canada, June 11-13, 2007.
- Chevron Graduate Scholarship in Natural Gas Engineering, University of Alberta, 2005.

17. My curriculum vitae has been submitted as Exhibit 2009 to this proceeding. My publications are found at https://sites.ualberta.ca/~mahdi/Shahbakhti_Publications.html. This includes 171 peer-reviewed publications. These research publications have been recognized and cited over 2400 times from over 45 different countries (Source: Google Scholar).

III. PERSON HAVING ORDINARY SKILL IN THE ART

18. It is my understanding that when considering the claims of the '505 patent and the prior art, I am required to do so based on the perspective of one of ordinary skill in the art at the relevant effective filing date, which I understand is April 30, 2007.

19. I understand that the Board has provided guidance that a person of ordinary skill in the art would "have a bachelor's degree in engineering with relevant coursework or post-secondary education (Bachelor's or associate degree) and four years of work experience in the design, operation, and functioning of CAN systems." Paper 10, 7.

20. I have adopted this proposed level of skill in the art in formulating my opinions. Given my background and experience listed in Section II above, I consider myself as having met this skill level.

IV. CLAIM CONSTRUCTION

A. "data bus"

21. The Petition suggests that a "data bus" refers to "a contiguous network providing a communication channel for two or more modules." The term "contiguous network" is used in IP-based networks and refers to a network in which packets sent between every pair of subnets pass through subnets of the same network. Petitioner's Expert Mr. Leale understands "contiguous" to mean "continuing, without break". Leale Tr. 17:2. In my opinion, referring to a vehicle data bus as a "contiguous network" is confusing, given the more elaborate meaning of the word "contiguous network" in other network technologies.

22. CAN was standardized by the International Standard Organization in in International Standard ISO 11898-1 "Road vehicles – Controller area network

(CAN) – Part 1: Data link layer and physical signalling". Ex. 2002, "ISO-11898". ISO-11898 defines certain terms. In chapter 4, the standard defines "bus" as "topology of a communication network, where all nodes are reached by passive links which allow transmission in both directions". In my opinion, the use of the term "data bus" in the '505 patent is consistent with the definition of a "bus" in ISO 11898-1. A POSITA would have understood "data bus" to refer to topology of a communication network, where all nodes are reached by passive links which allow transmission in both directions.

B. "receives"

23. Negley's Figure 8 provides an overview of receiving CAN messages. The Petitioner understands a message to be received when it arrives in the "Receive Assembly Registers" block. Consequently, all nodes on a CAN bus receive all messages, and the act of "receiving a message" becomes meaningless to differentiate nodes.

24. A PHOSITA would understand a message to be received when it has passed the Message Filters/Masks block and is accepted in the "*Receive* Register" block so that a microcontroller can now act on the received message.

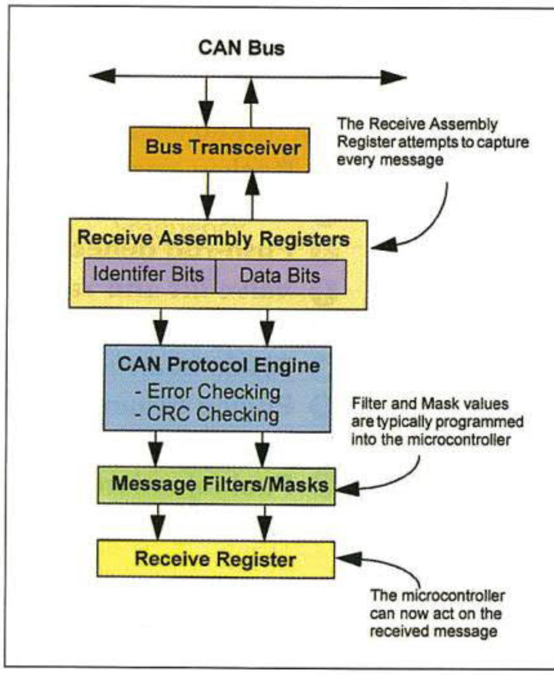


Figure 8. Every active node reads every message transmitted on the bus. When a node receives a message and determines that there are no errors with the message, the identifier field of the message is checked against filter and mask registers to determine if the message should be acted on. Different CAN controllers implement filters and masks in different ways, and most controllers have multiple receive registers to increase the throughput of message reception. The system designer is free to determine how to use the receive buffers and filters to manage messages in a way that suits their needs.

The ‘505 patent repeatedly refers to apparatuses being “configured to receive” (Ex. 1101, 2:25, 9:40, 9:53, 9:56) or “programmed to receive” (Ex. 1101, 11:43, 12:16). This indicates that “receiving” requires configuration or programming. In case of a CAN bus, this includes setting appropriate message filters/masks in the “Message Filters/Masks” block between the “Receive Assembly Registers” and “Receive Register” block. In the context of the ‘505 patent a POSITA would understand the term “receive” to mean “accept”.

V. BACKGROUND: HACKING VEHICLE NETWORKS

25. Currie describes the CAN bus architecture as follows:

> At the heart of any modern vehicle’s interconnected systems is the Controller Area Network bus, or CAN bus. The CAN bus is a single, centralized network bus on

> which all of a vehicle's data traffic is broadcast. The CAN bus carries everything from operator commands such as "roll down the windows" or "apply the brakes", to readouts from sensors reporting engine temperature or tire pressure. The advent of the CAN bus brought about improvements in efficiency and a reduction in complexity while also reducing wiring costs.

Currie, 6. I find that to be an accurate description.

> Development of the CAN bus protocol was begun in 1983 by German company Robert Bosch GmbH. After three years of development, CAN bus technology hit the public market in 1986, first showing up in the BMW 850.

Currie, 9. Bosch introduced CAN as "a serial communications protocol which efficiently supports distributed realtime control with a very high level of security". Bosch, 4. The characterization of CAN as being secure, however, is simply not correct with respect to spoofing. CAN is inherently insecure:

> The CAN bus is a 30-year old architecture that was developed for various valid reasons, but security certainly was not one of them. Automakers at the time could not possibly envision the risk of cars being hacked decades into the future, nor could the governing bodies that mandated the CAN and OBD standards. The CAN architecture was designed to be lightweight and robust,

> and those qualities it accomplishes very well. However, CAN contains numerous vulnerabilities that are inherent in its design.

Currie, 10.

26. Today, spoofing of CAN messages is a recognized technique to retrofit cars and is widely used.

> Spoofing a CAN identifier means that a compromised node attempts to use an identifier that it is not allowed to send, see Figure 1. This can be useful to pretend to be another node.

Figure 1: Spoofing attack.

Ex. 2012, 2. Mr. Leale explains spoofing similarly as "send[ing] a message with the same identifier as another message". Leale Tr. 26:13-14. Spoofing of CAN messages would have worked in the first BMW with CAN in 1986. Notably though, none of references cited in the Petition explains spoofing or shows any example of spoofing. Neither Munoz nor Dietz nor any of Negley, SAE, or Bosch mention i) a message using an identifier that it is not allowed to use or ii) a message using the same identifier as another message. General familiarity with a

CAN bus does not enable a POSITA to spoof CAN messages. Spoofing involves sending a message with the same identifier as another message. *See* Leale Tr. 26:13-14. That is, a node uses an identifier that it is not allowed to send. *See* Ex. 2012,2.

27. While spoofing of CAN messages is an effective technique by which an owner can retrofit an existing vehicle, it can also be abused to attack vehicles of others. Car manufacturers have recognized this threat and actively attempted to conceal it:

> Manufacturers are floundering when it comes to locking down their vehicles' systems, with some taking the approach of "security by obscurity" (Bourne, 2015), and yet others using litigation as a means to silence security researchers and keep vulnerabilities under wraps. In one recent case, Volkswagen engaged a team of European security researchers in a 2-year long legal battle to prevent the group from presenting its research paper on a vulnerability they had found in Volkswagen's remote keyless entry system (Cimpanu, 2015).

Currie, 3-4.

VI. THE MUNOZ REFERENCE

28. In my opinion, the Munoz patent is not properly drafted and violates basic rules of technical writing. For example, Munoz defines a "CAN-bus" as "including but not limited to CAN-bus, LIN-bus, FlexRay, or other such automobile network systems." Munoz, 6:22-25. This self-referencing and expanding a definition make it impossible to understand whether Munoz "CAN-bus" refers to a "CAN-Bus" as defined by Bosch or to another serial data bus. A LIN-bus is not a CAN-bus, neither is FlexRay a CAN-bus.

29. Munoz routinely refers to the same element by different names and refers to different elements by the same or confusingly similar names. For example, Fig. 3 in step 308 refers to "RECEIVE lock/unlock *signal*" but then in step 318 asks "did we receive another lock/unlock *message*"? Terms used in the drawings are not explained in the specification. For example, Fig. 1 element 100 refers to "removing or altering data" without any further explanation in the specification *how* data can be removed or altered. Similarly, Fig. 1 element 115 refers to "all communication" without any further reference in the specification what "all communication" entails.

VII. A PERSON OF ORDINARY SKILL IN THE ART WOULD HAVE UNDERSTOOD THAT MUNOZ DOES NOT DISCLOSE SPOOFING OF CAN MESSAGES.

30. Munoz discloses an aftermarket automobile device that is seamlessly integrable to factory automobile networks such as CAN-bus and its ECU systems and allows multiple convenience and performance enhancements to be controlled through factory controls and displayed on factory displays. Munoz, 3:7-12.

31. Munoz discloses the operation of several high-level features. Those include a convertible top control mechanism (FIG. 3), a horn upon lock/unlock feature (FIG. 4), a vehicle's horn while reversing feature (FIG. 5), a module's emergency flasher mode (FIG. 6) and a blind spot assistant system (FIG. 7). While Munoz discloses these high-level features, Munoz fails to teach the lower level details how these features are implemented in a vehicle.

32. Munoz mentions a feature for vehicles that only allow the cabriolet top to be opened or closed when the vehicle is moving slowly. In that case, his "device increases the maximum speed of the vehicle at which the cabriolet top may be opened or closed". Munoz, 3:62-64. Compared to the features discussed above, Munoz provides even fewer details as to *how* this "open roof while driving" feature is *implemented*. For example, there is no hardware schematic or flowchart to explain implementation of the "open roof while driving" feature. The schematic in Fig.1 is a very basic illustration that fails to show critical elements of the claims. For example, Fig. 1 does not show the factory cabriolet top open/close button recited in claim 1 (Munoz, 8:37-38) and claim 15 (Munoz, 10:9-10). Neither does Fig. 1 show the remote keyless entry system recited in claim 1 (Munoz, 35-36) and claim 15 (Munoz, 10:6-7).

33. In my opinion, a POSITA having studied Munoz and being familiar with the operation of a CAN bus as disclosed in Bosch, Negley and SAE would not have been enabled to implement the "open roof while driving" feature.

34. Munoz broadly refers to "removing or altering data" in Fig. 1, box 100. But Munoz does not explain how data can be removed. A CAN bus does not provide any mechanism for "removing" data. Nor would a POSITA expect that removing data from a CAN bus causes a convertible roof to open. Elend and Adamson describe a possible tampering attack on a CAN bus in paragraph 2.2 of their paper:

> For the tampering attack, the attacker aims to adjust a message, which another node is currently sending on the bus. The attacker must also adjust the cyclic redundancy check (CRC) to match the tampered data, see Figure 2.

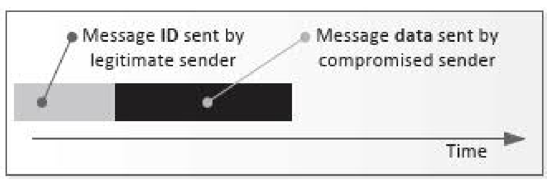


Figure 2: Tamper attack.

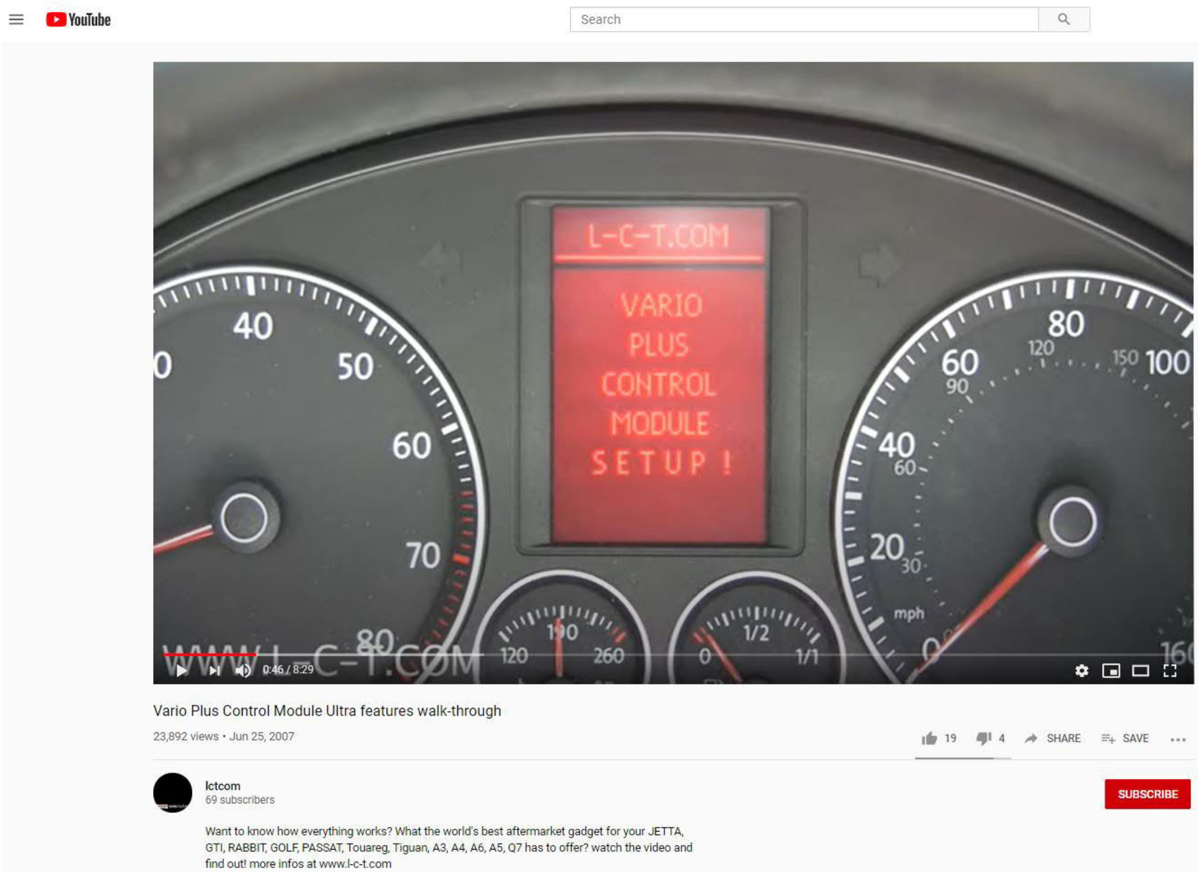
Ex. 2012, 2. "The tampering attack is useful since it gives the attacker the power to tamper with the messages that are being sent on the bus." Ex. 2012, 2. To "tamper" with a message means altering the message. In my opinion, a POSITA would have understood Munoz's disclosure of "altering data exchanged between integrated and closed systems" (Fig. 1, box 100) to be some sort of tampering attempt which adjusts a message that another node is currently sending on the bus as described by

Elend and Adamsom. The tampering attempt better reflects the words "altering data" than "spoofing". Spoofing can be accomplished by retransmitting, from a retrofit device, the exact same message that a factory installed device sends. Spoofing a message does not require any removing or altering of data. *See* Ex. 2012, 2. None of SAE, Bosch or Negley explain "removing or altering data" on a CAN bus.

35. A POSITA would not have filled the gaps of Munoz's disclosure with general knowledge of a CAN bus to arrive at what is claimed in the '505 patent. Munoz lacks disclosure of the lower level implementation of his features. This lack of disclosure does not lead a POSITA to the spoofing of normal mode CAN messages as described and claimed in the '505 patent.

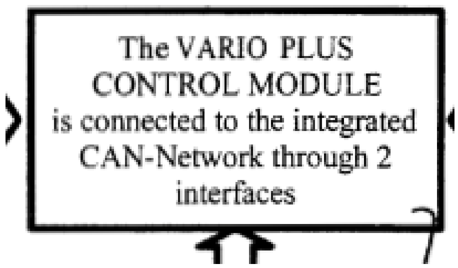
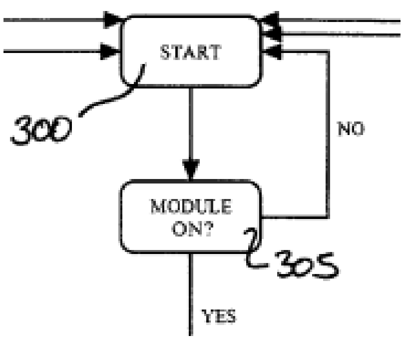
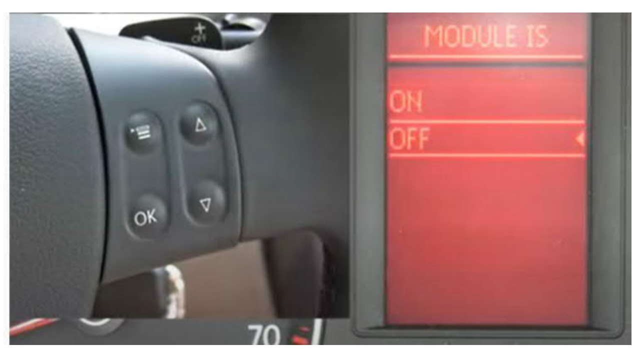
36. In an effort to understand how Munoz's invention may operate I have reviewed additional material not considered in the petition. This includes a YouTube Video "Vario Plus Control Module Ultra features walk-through" published June 25, 2007, by "lctcom" at https://youtu.be/9PYK9j3FFx4. Ex. 2030. The video shows the operation of a "VARIO PLUS CONTROL MODULE" in a

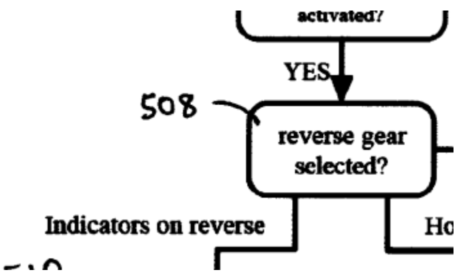
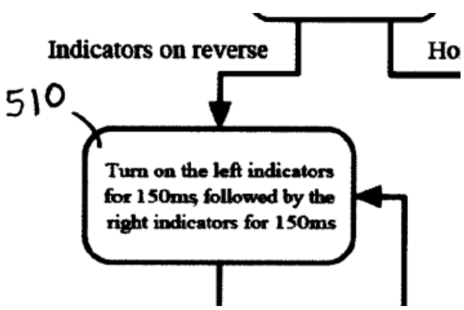
Volkswagen vehicle. I will refer to this video as "the Vario Plus video".



37. The Vario Plus video shows clear correlations to the Munoz patent as illustrated below.

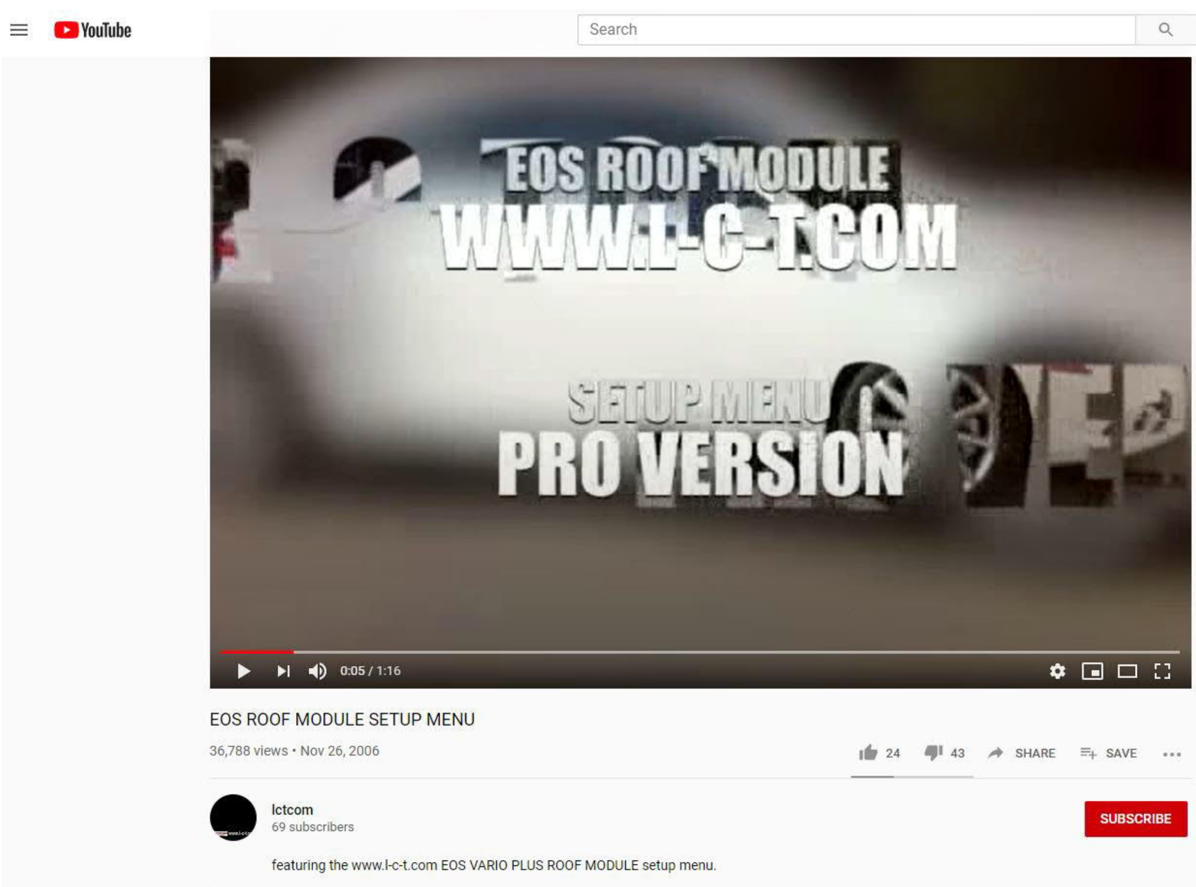
Munoz	**the Vario Plus video**

Fig. 2  	Video @ 0:46 
Fig. 3  	Video @ 1:11  Video @ 1:12 
"FIG. 5 is a flow chart that illustrates the operation of the	Video @ 3:00

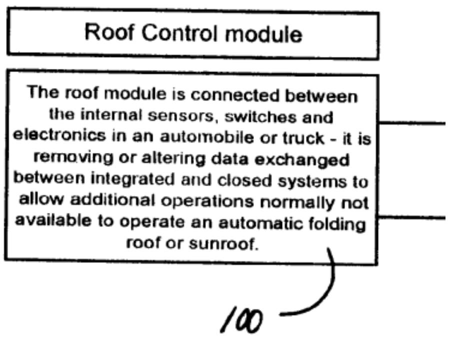
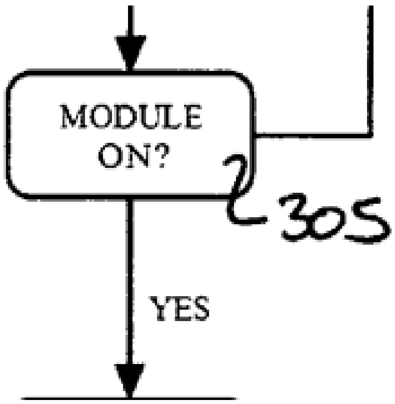
vehicle's horn while reversing feature." (7:28-29).	
Fig. 5 	Video @3:03 
Fig. 5 	Video @3:06 

38. Given the apparent similarities between Munoz and the Vario Plus video it is my opinion that the two are related. My opinion is further supported by the fact that a trademark for the word "VARIO PLUS CONTROL MODULE" was registered to Mr. Munoz for "Electronic Control Modules for enhancing the performance of automotive electronic system and displays", filed 6-5-2007, Ser. No. 77-198,481, Reg. No. 3,388,116. (Ex. 2029).

39. Under the same username "lctcom" a video "EOS ROOF MODULE SETUP MENU" was published Nov. 26, 2006 at https://youtu.be/yQ9xqvHwe0o and described to be "featuring the www.l-c-t.com EOS VARIO PLUS ROOF MODULE setup menu." Ex. 2027. I will refer to this video as the "EOS roof module video".



40. The EOS roof module video also shows a clear correlation to Munoz as illustrated below:

Munoz	**the EOS roof module video**
Fig. 1 	Video @0:19 
Fig. 3 	Video @0:21

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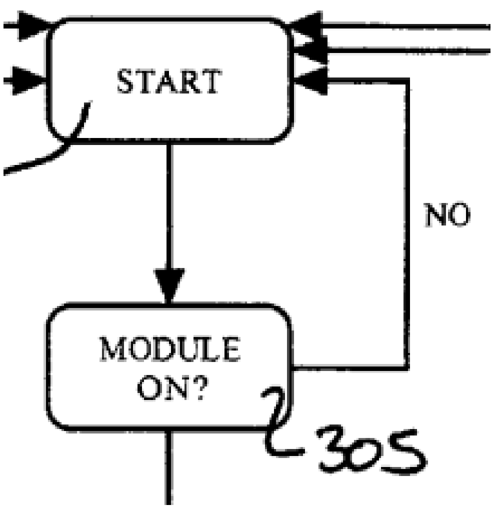
<tr><td>
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<tr><td>“FIG. 5 is a flow chart that

illustrates the operation of the</td><td>Video @0:35</td></tr>
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<td>vehicle's horn while reversing

feature.” (7:28-29).</td>
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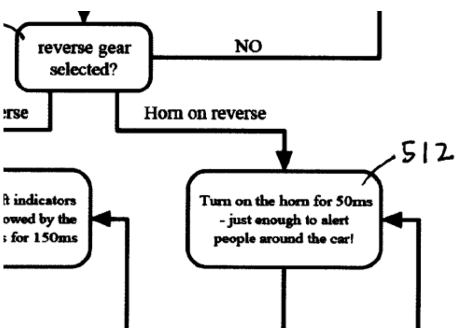
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<td>Fig. 5</td>
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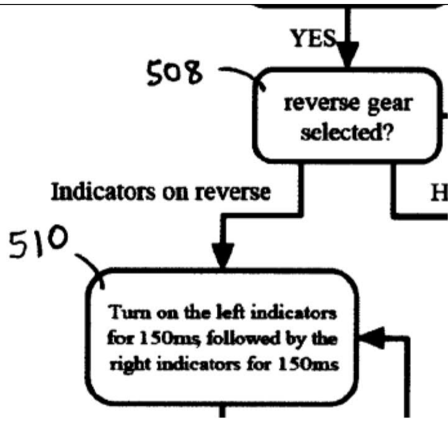


Fig. 3	Video @0:52

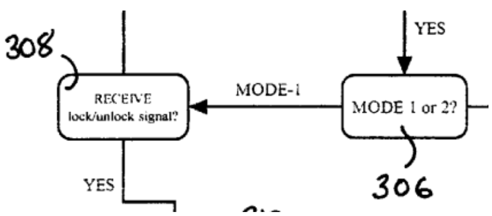
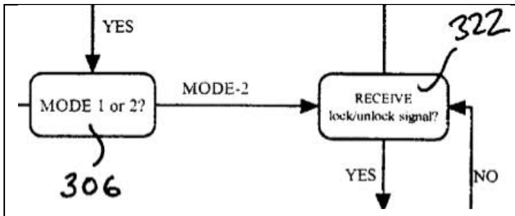



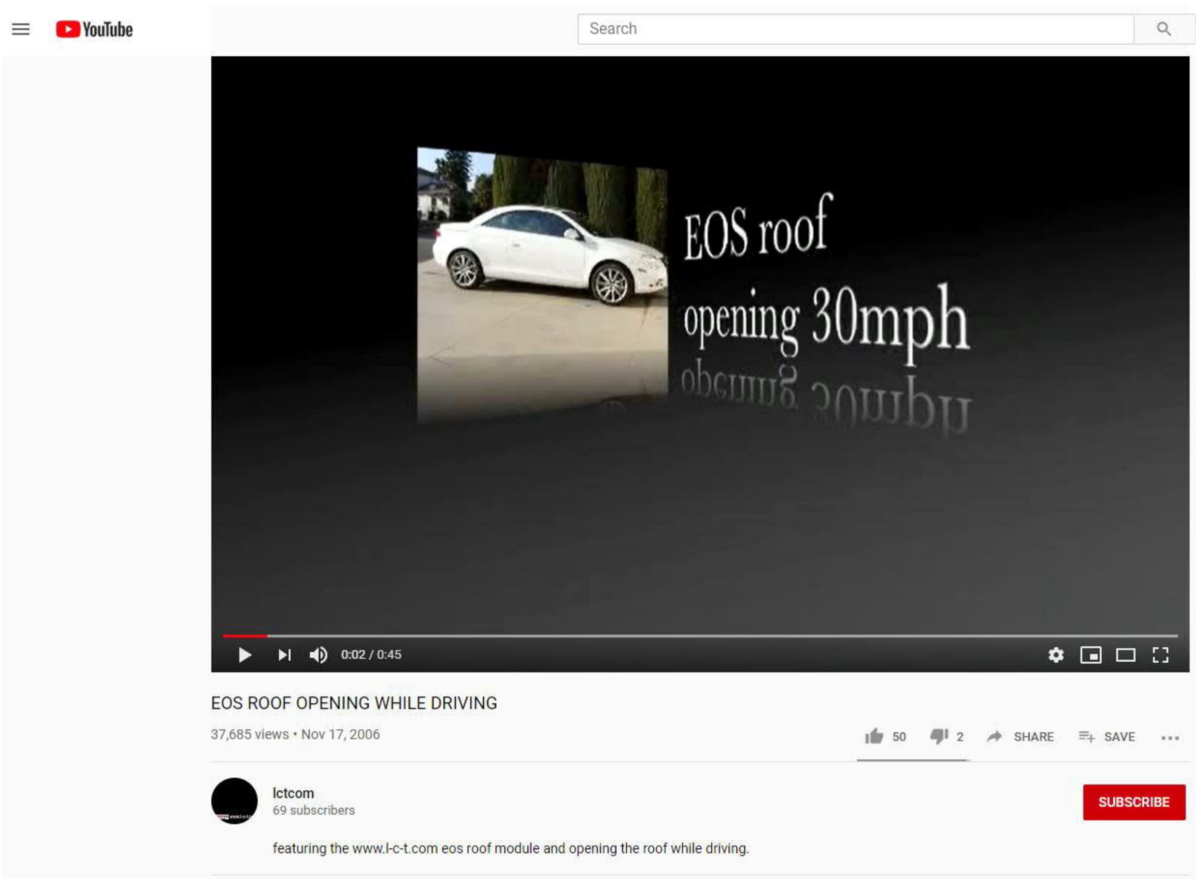
Fig. 3	Video @0:46



In my opinion, the EOS roof module video shows an example of Munoz's roof control module 100 in operation.

41. Under the same username "lctcom" a further video "EOS ROOF OPENING WHILE DRIVING" was published Nov. 17, 2006 at https://youtu.be/Fll2sWA-iwA and described to be "featuring the www.l-c-t.com eos roof module and opening the roof while driving." Ex. 2031. I will refer to this video as the "Roof

Opening Video".



42. The Roof Opening Video shows a VW EOS convertible vehicle opening its convertible roof while driving:

 0.19: Roof closed	 0:31: Roof in intermediate position	 0.39: Roof in open position

43. In my opinion, the Vario Plus Video, the EOS roof module video and the Roof Opening Video, all of which were published by the same YouTube user, show examples of Munoz's roof control module 100 in operation.

44. Neither the Munoz patent, nor the videos provide sufficient details to enable a POSITA, in particular an inexperienced engineer or a technician without engineering degree, to practice what Munoz describes.

45. To understand how Munoz may have been able to open the roof of a VW Eos while driving, I obtained and reviewed a VW Service Training document titled "Self Study Program 871603, Eos Electrical System Design and Function" available online at https://erwin.vw.com. Ex. 2007.

46. To assess whether the VW Eos was representative of convertible vehicles at the time I reviewed wiring diagrams of several further convertibles sold in 2007, including the 2007 Volkswagen Eos (Ex. 2014), 2007 Cadillac XLR (Ex. 2015), 2007 Lexus SC 430 (Ex. 2016), 2007 Mazda MX-5 Miata (Ex. 2017), 2007 Saab 9-3. (Ex. 2018), 2007 Pontiac G6 (Ex. 2019), 2007 Mini Cooper S Convertible (Ex. 2020), 2007 Audi S4 Quattro Cabriolet (Ex. 2021), 2007 Ford Mustang (Ex. 2022), and 2007 Porsche Boxster (987) (Ex. 2023).

47. Based on my review, none of these vehicles could have been retrofitted as claimed in the '505 patent to implement an "open roof while driving" feature. Most significantly, a roof control switch in *all of the reviewed vehicles* is wired directly into the vehicle's original roof control electronics. The original roof electronics receives a hardwired signal about an operator's intent to open or close the roof, and therefore no other module would know to send a roof open / roof close message. *See* Ex. 2014-2023.

VIII. DIFFERENCES BETWEEN MUNOZ AND CLAIMED INVENTION; EXPERT ASSUMPTIONS

48. There are several differences between Munoz and the '505 patent. Those differences have been highlighted in red color in a modified copy of Munoz Fig. 1 below[5]. Ex. 2026. The modified copy of Munoz's Fig. 1 shows how Munoz would have to be understood in order to operate as claimed in the '505 patent.

[5] The annotated copy reflects Mr. Leale's understanding that Munoz discloses separating the original CAN bus into a first bus "A" and a second bus "B". The '505 patent does not require a second CAN bus. The separation into two busses is therefore not a difference between the '505 patent and Munoz but shown to reflect the Petitioner's understanding of Munoz.

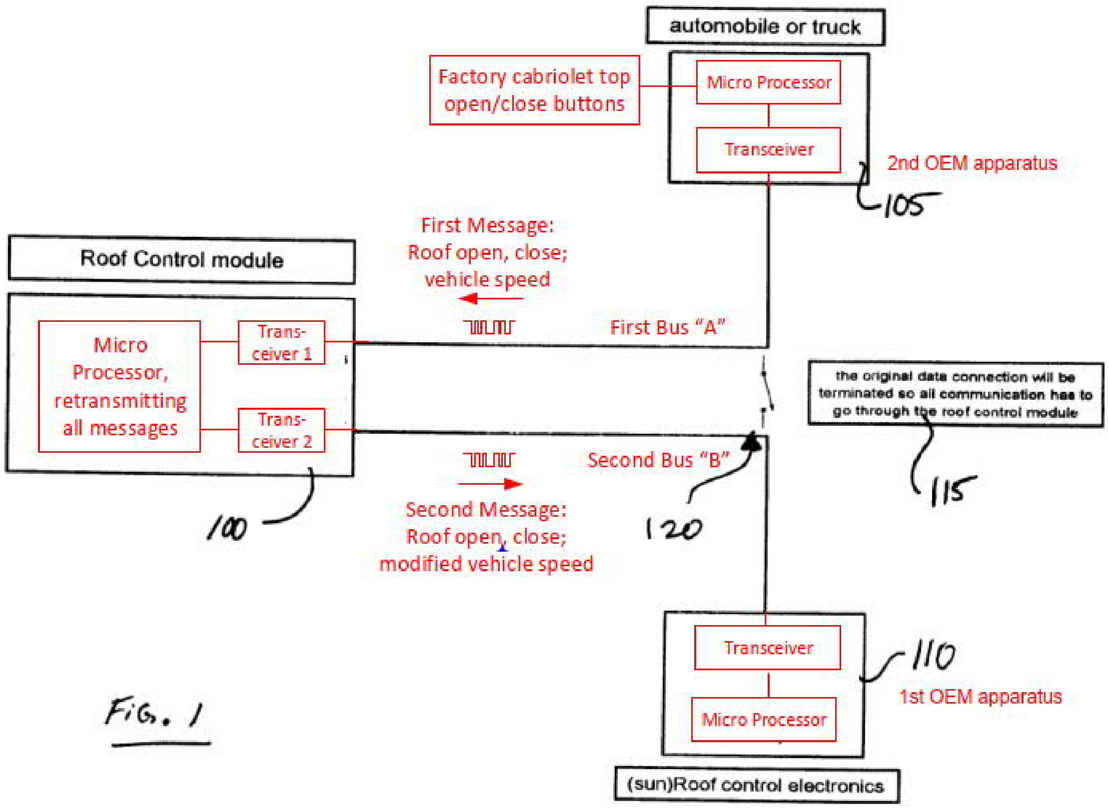


FIG. 1

I summarize the differences as follows:

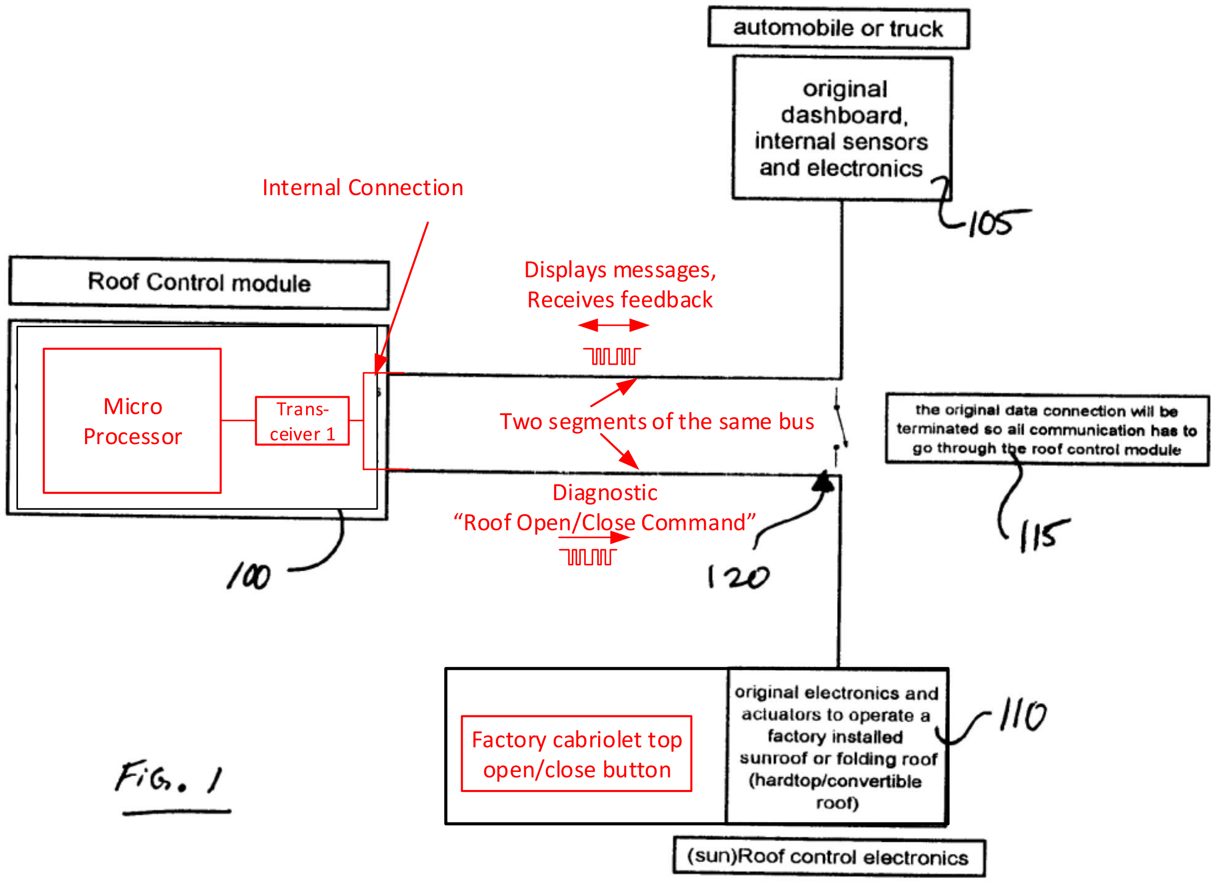
1. Munoz fails to disclose a micro-processor in the vehicle factory dashboard electronics and controls 105.
2. Munoz fails to disclose a roof open (first) message sent by the 2nd factory-installed apparatus (105) to the first factory-installed apparatus (110).

3. Munoz mentions factory cabriolet top open/close buttons but fails to disclose how they are connected.

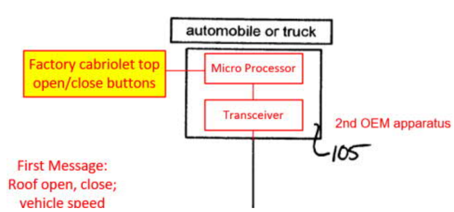
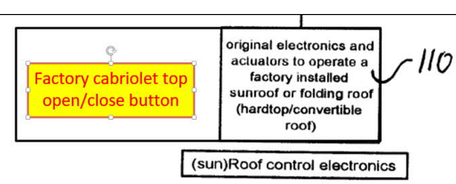
5. Munoz discloses an open roof signal (second message) sent from his retrofit module (110) but fails to disclose that the second message spoofs a first message.

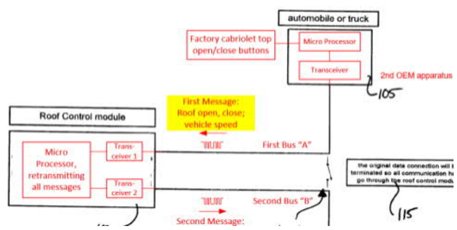
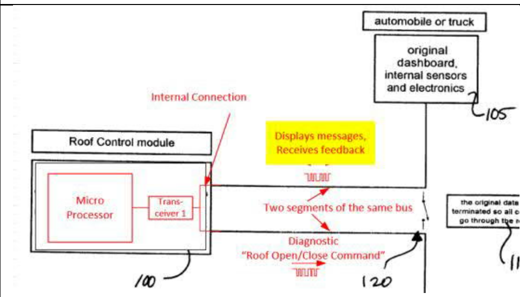
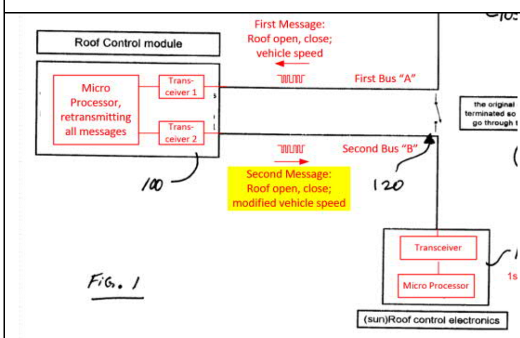
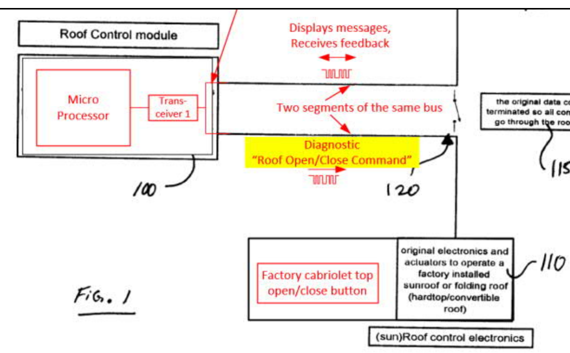
6. Munoz fails to disclose that the roof control electronics (110) includes a micro-processor.

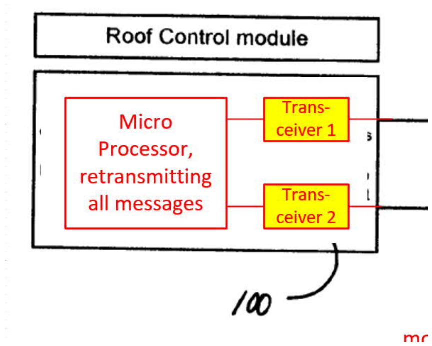
49. Based on Munoz and supported by the additional material discussed above, I believe Munoz was implemented as indicated in the annotated Fig. 1 below:

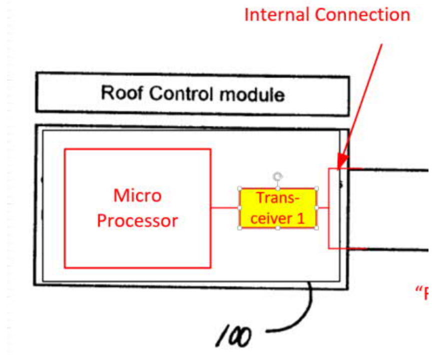


50. Mr. Leale and I disagree on several assumptions and draw different conclusions. I summarize those differences as follows:

Mr. Leale's understanding	My understanding
	

Factory open/close buttons are wired to dashboard 105. Leale Tr., 50:8-10.	Factory open/close buttons are part of original electronics and actuators to operate factory installed roof 110.
 105 sends periodic roof button status to 100.	 105 and 100 interact to display messages to driver
 Second message spoofs roof button status message. Leale Tr., 60:6-8.	 Second message is diagnostic roof open/close command.

<table>
<tr>
<td>

Roof Control Module 100 is connected to two separate busses; includes gateway, spoofs periodic messages</td>
<td>

Roof Control Module 100 includes passthrough; has no need to spoof periodic messages.</td>
</tr>
</table>

51. With respect to the wiring of the factory roof open/close buttons my assumption of them being wired to or being part of an original roof control module is supported by wiring diagrams of numerous vehicles at the time. Exhibits 2014-2023. In spite of Mr. Leale's statement to the contrary (Leale Tr., 70:14-22), the roof buttons in the Pontiac G6 were wired directly to the roof control module electronics (Ex. 2019). Similarly, in a Saab 9-3 there were roof buttons directly wired to a soft top control module (Ex. 2018).

52. With respect to the first message Mr. Leale said that the "factory buttons must be connected to a CAN bus module and that CAN bus module must be transmitting the message over the CAN bus in order for the roof control, the factory roof control 110 to receive it". Leale Tr., 61:20-24. Mr. Leale confirmed that Munoz would not work if the buttons were connected to the original roof electronics 110. See Leale Tr., 62:11-16. Yet, Munoz demonstrated his invention in a VW Eos in which the roof buttons are part of the original roof electronics 110 and not wired to a separate CAN bus module. Mr. Leale's understanding of Munoz is therefore incorrect.

53. With respect to the second message being a diagnostic command I note that Mr. Leale admitted to that possibility. Leale Tr., 69:8-13. I find his ad-hoc attempt to walk back his admission by saying that diagnostics could only be used to open a convertible top not to be credible. The convertible roof of a VW Eos can be closed by a diagnostic command. Ex. 2008, Ex. 2010. Similarly, GM's Service Manual for the 2007 Pontiac G6 shows Scan Tool Output Controls which include a "Top Open/Close" Output Control. This output control "Commands the Folding Top Control Module to completely open or completely close the folding top". *See* Ex. 2025, 6.

54. With respect to Munoz separating the existing vehicle bus into two as part of the "open roof while driving" feature, only spoofing a periodic message would necessitate such a separation. Without spoofing a periodic message, there is no need to split the existing vehicle bus. Mr. Leale agrees: "Munoz uses a two-network system, two networks, he has the first bus and a second bus, and he does that because the bus, so as to alter the data, and if that message was not periodic, then he need only connect to the bus to send the information, he would not need to open the network." Leale Tr., 60:12-17. But Munoz does not disclose any periodic messages. I see no need to spoof a periodic message. The use of a diagnostic command to open or close the roof bypassed vehicle sensors, which I understand to include a vehicle speed sensor. Ex. 2008, 4. Ex. 2010@0:32.

A. Claim 1 [1.1]: Munoz does not teach a first message from the first apparatus 110 to the factory-installed second apparatus 105

55. Claim 1 of the '505 patent requires "providing a vehicle having a factory-installed first apparatus including a processor, programmed to communicate with a factory-installed second apparatus through a vehicle data bus with a first message having an identifier". This "first message" is specific, because claim 1 further requires a second message being indistinguishable from the first message.

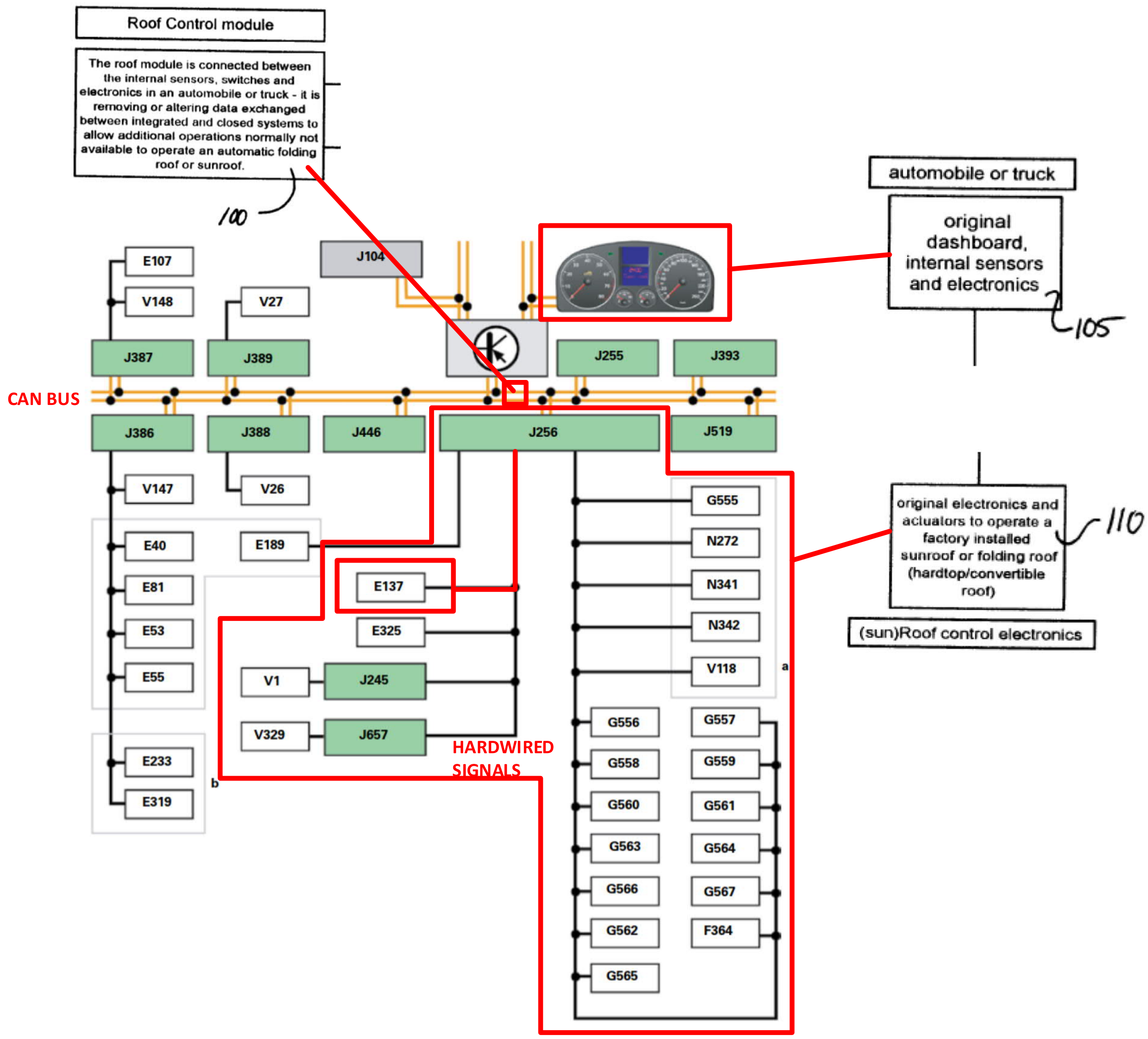
56. Mr. Leale refers to a specific "first CAN message sent from the original dashboard 105 intended for the original electronics to operate the factory-installed roof 110". Leale, ¶132. Munoz does not disclose any communication between the original dashboard 105 and the roof control electronics 110. Munoz's Fig. 1 is oversimplified, in that it shows only two original components, the original vehicle dashboard electronics 105 and the original roof electronics 110 connected to the bus.

57. As discussed before, it is my opinion that Munoz's invention had been demonstrated in a VW Eos. My further analysis is therefore based on that vehicle. The operation of the convertible roof in a VW Eos involves significantly more components than illustrated in Munoz's Fig. 1. As described in the EOS training material:

> Smooth roof operation is a result of the rapid exchange of information between control modules, sensors and actuators. For example, the Convertible Top Control Module must request the Door Control Modules to 'Lower windows' or 'Raise windows'. In return, the Door Control Modules inform the Convertible Top Control Module where the side windows are located. This is necessary because the side windows must be lowered before the roof starts moving. This prevents interference between the moving parts of the convertible top

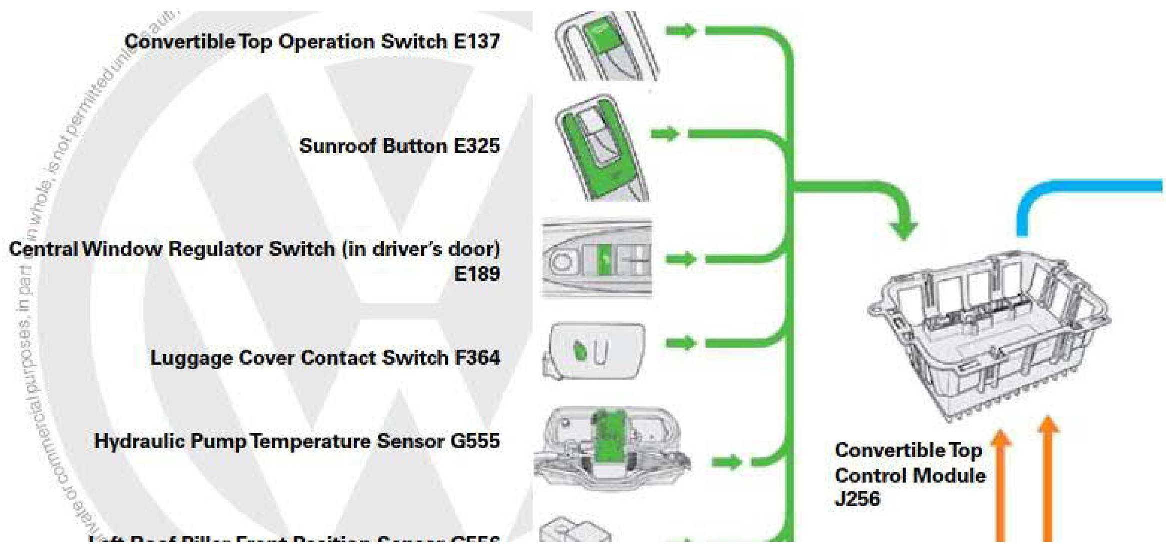
Ex. 2007, 12.

58. The EOS training material includes a diagram which shows "all of the electronic components and control modules that communicate with each other to control the convertible top." Ex. 2007, 16. The following annotated copy of the diagram on page 13 relates the VW Eos to Munoz's Fig. 1:

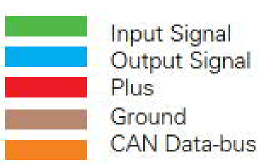


59. The comparison shows that Munoz's Fig. 1 is inadequate to convey the complexity of opening a convertible roof. Munoz does not even show the factory remote keyless entry system required by claim 1 (Munoz, 8:35-36) and claim 15 (Munoz, 10:6-7), even though those provide required inputs to his device. Munoz also fails to show the factory cabriolet top open/close buttons required by claim 1 (Munoz, 8:37-38) and claim 15 (Munoz, 10:9-10).

60. Mr. Leale believes that Munoz's factory cabriolet top open/close buttons are connected to the original dashboard 105 and that Munoz would not work if they were not. Leale Tr., 61:9-62:16- Yet, in the VW Eos the Convertible Top Operation Switch E137 is hardwired to the convertible top control module J256 as highlighted above. The EOS training material shows this connection even more clearly in a different illustration:



Ex. 2007, 38. The Eos training material uses green color to indicate hardwired input signals whereas orange lines indicate a CAN data bus:



Ex. 2007, 53.

61. Munoz describes FIG. 1 as "105 illustrates the vehicle factory dashboard electronics and controls that are used to control Roof Control Electronics 110." Ex.

1004, 6:28-30. That the original vehicle dashboard electronics 105 is used to control the original roof electronics 110 as part of Munoz's invention *after* the retrofit does not disclose that the two exchanged messages with one another *before* the retrofit.

62. The Petition refers to "[a] bus message sent by the 2nd factory-installed apparatus (105) directed to 1st factory-installed apparatus (110) to control the roof (e.g., steps 312 and 314 of Fig. 3)". That is not what steps 312 and 314 show. "FIG. 3 is a flow chart that illustrates the operation of the convertible top control mechanism of the device." Munoz, 5:43-45. "The device" refers to Munoz's own roof control module 100. The "close roof message" of step 312 and the "open roof message" of step 314 are transmitted by the retrofitted roof control module 100, not by the original dashboard 105. Munoz generally refers to "message" as something that is being displayed on the vehicle display: "Messages [...] are displayed on the vehicle's factory display." Munoz, 3:45-47. The "messages" referred to in steps 312 and 314 of Fig. 3 appear to be what Munoz describes as "the vehicle display displays information related to the status of the cabriolet top as it is opened or closed". Munoz, 4:31-33.

63. Based on the wiring of the Convertible Top Operation Switch E137 directly to the Convertible Top Control Module J256, I conclude that in a VW Eos there cannot be a "Roof Open" or "Roof Close" first CAN message.

64. Based on my review of other convertible vehicles sold in 2007, convertible roofs were generally not controlled by CAN messages but rather by cabriolet top open/close buttons hardwired into the respective roof control modules. My opinion is based on reviewing wiring diagrams of the following vehicles which were obtained from Alldata and AlldataDiy:

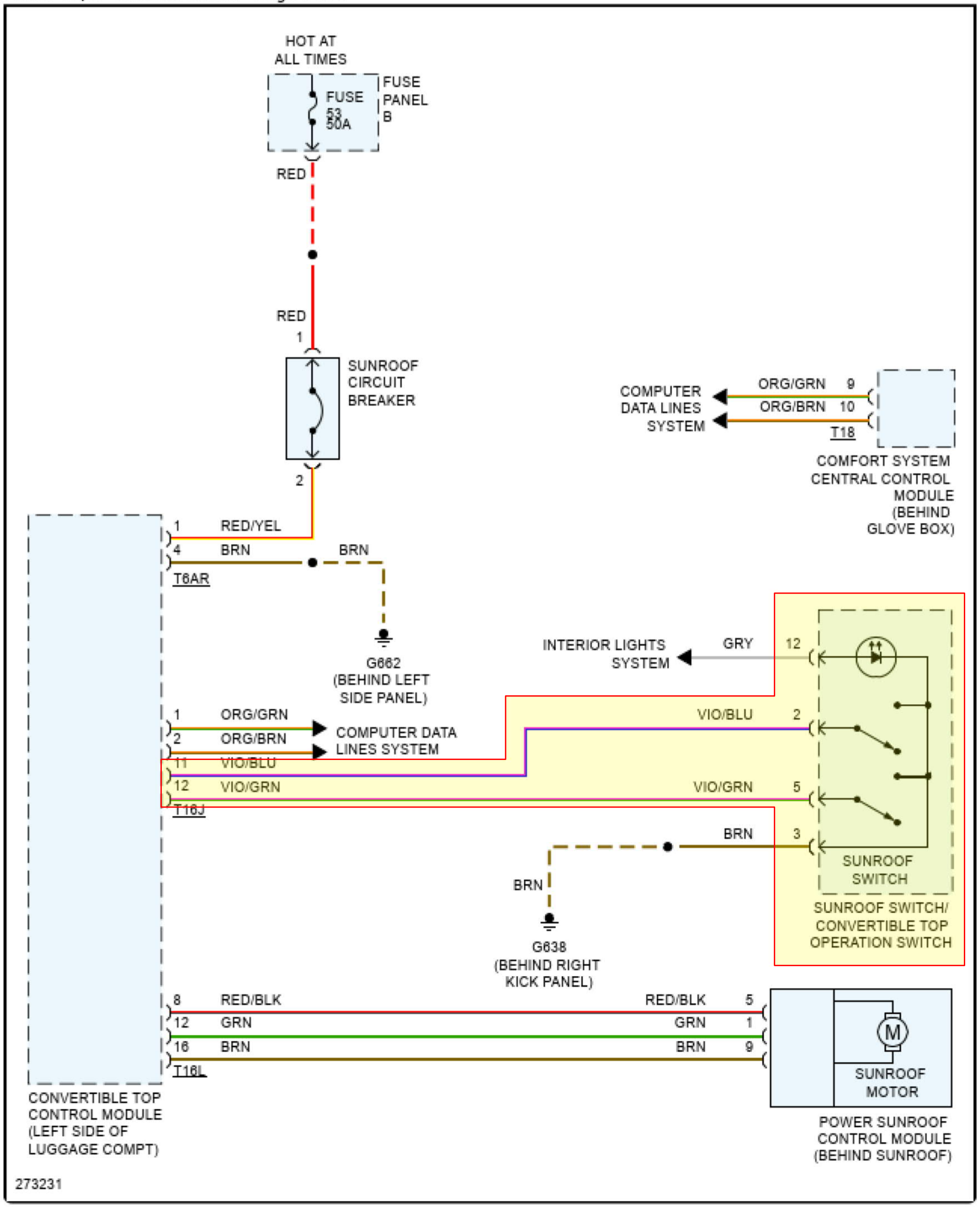
- 2007 Volkswagen Eos (1F7) V6-3.2L (BUB) (Ex. 2014)
- 2007 Cadillac XLR V8-4.6L (Ex. 2015)
- 2007 Lexus SC 430 (Ex. 2016)
- 2007 Mazda MX-5 Miata (Ex. 2017)
- 2007 Saab 9-3 (Ex. 2018)
- 2007 Pontiac G6 (Ex. 2019)
- 2007 Mini Cooper S Convertible (Ex. 2020)
- 2007 Audi S4 Quattro Cabriolet (Ex. 2021)
- 2007 Ford Mustang (Ex. 2022)
- 2007 Porsche Boxster (987) (Ex. 2023)

65. 2007 Volkswagen Eos (1F7) V6-3.2L (BUB) (Ex. 2014); connection between the convertible top operation switch and the convertible top control module is highlighted.

2007 Volkswagen Eos (1F7) V6-3.2L (BUB)

Vehicle > Body and Frame > Roof and Associated Components > Sunroof / Moonroof > Diagrams > Electrical - Interact

Power Tops - Sunroof Circuit - Page 1 of 1



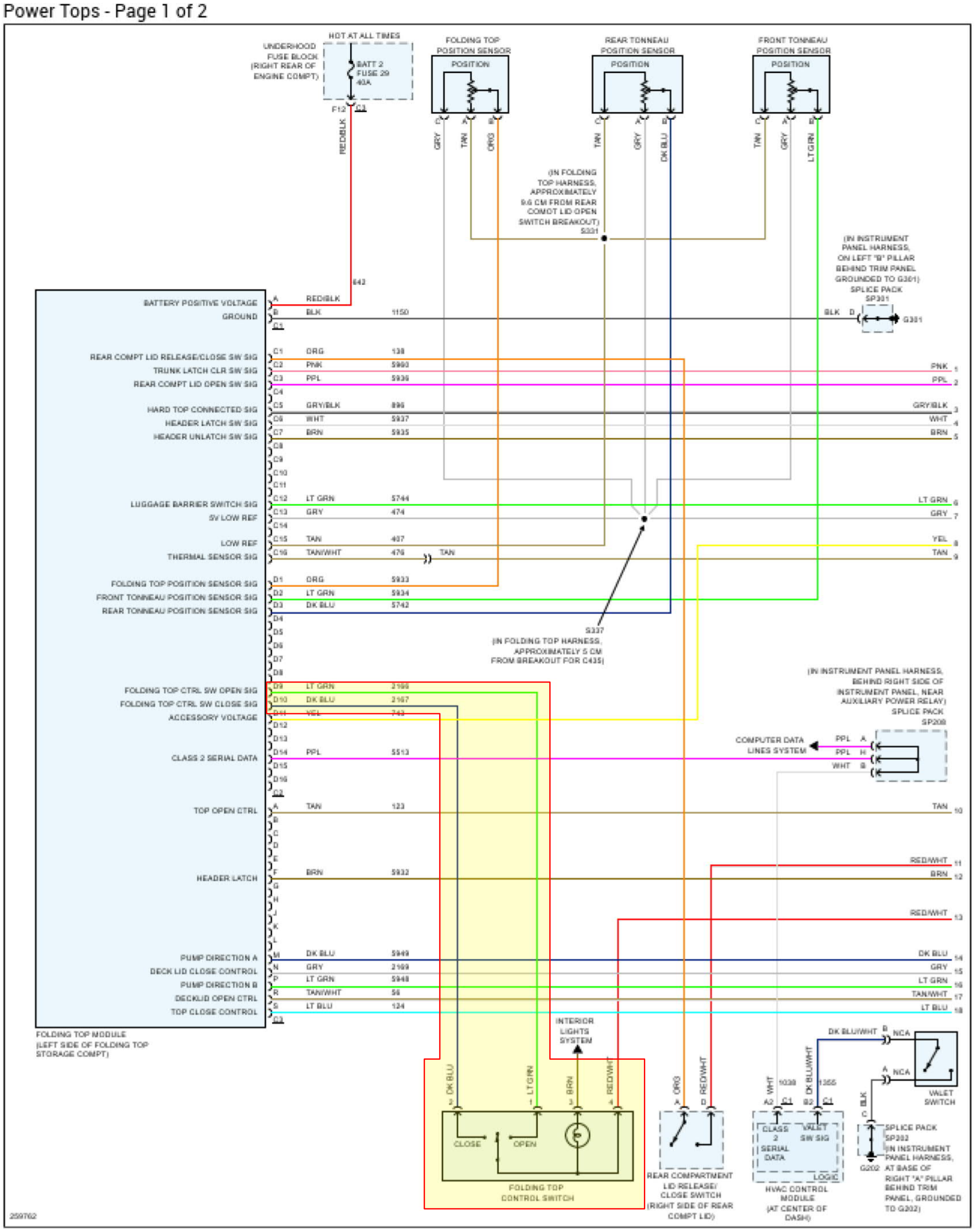
66. 2007 Cadillac XLR V8-4.6L (Ex. 2015); connection between the folding top control switch and the folding top module is highlighted.

6/15/2020 Power Tops (Sunroof / Moonroof) - ALLDATA Repair

2007 Cadillac XLR V8-4.6L

Vehicle > Body and Frame > Roof and Associated Components > Sunroof / Moonroof > Diagrams > Electrical - Interact

Power Tops - Page 1 of 2



https://my.alldata.com/repair/#/repair/article/43161/component/176/itype/437/nonstandard/21179/selfRefLink/true 1/2

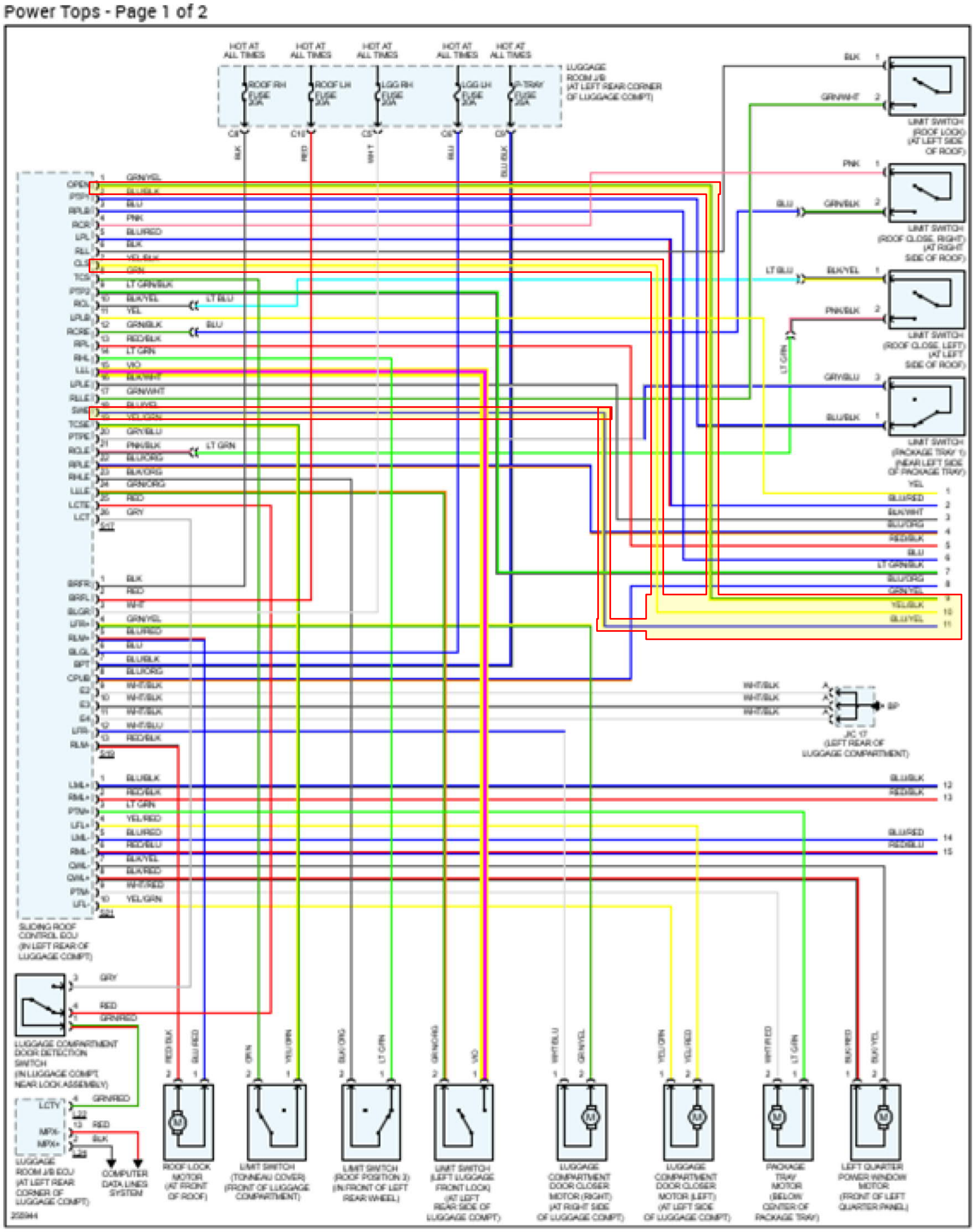
67. 2007 Lexus SC 430 (Ex. 2016); connection between the CLS/OPEN switch in A/C control assembly and the sliding roof control ECU is highlighted.

6/15/2020 Power Tops (Sunroof / Moonroof) - ALLDATA Repair

2007 Lexus SC 430 V8-4.3L (3UZ-FE)

Vehicle > Body and Frame > Roof and Associated Components > Sunroof / Moonroof > Diagrams > Electrical - Interact

Power Tops - Page 1 of 2

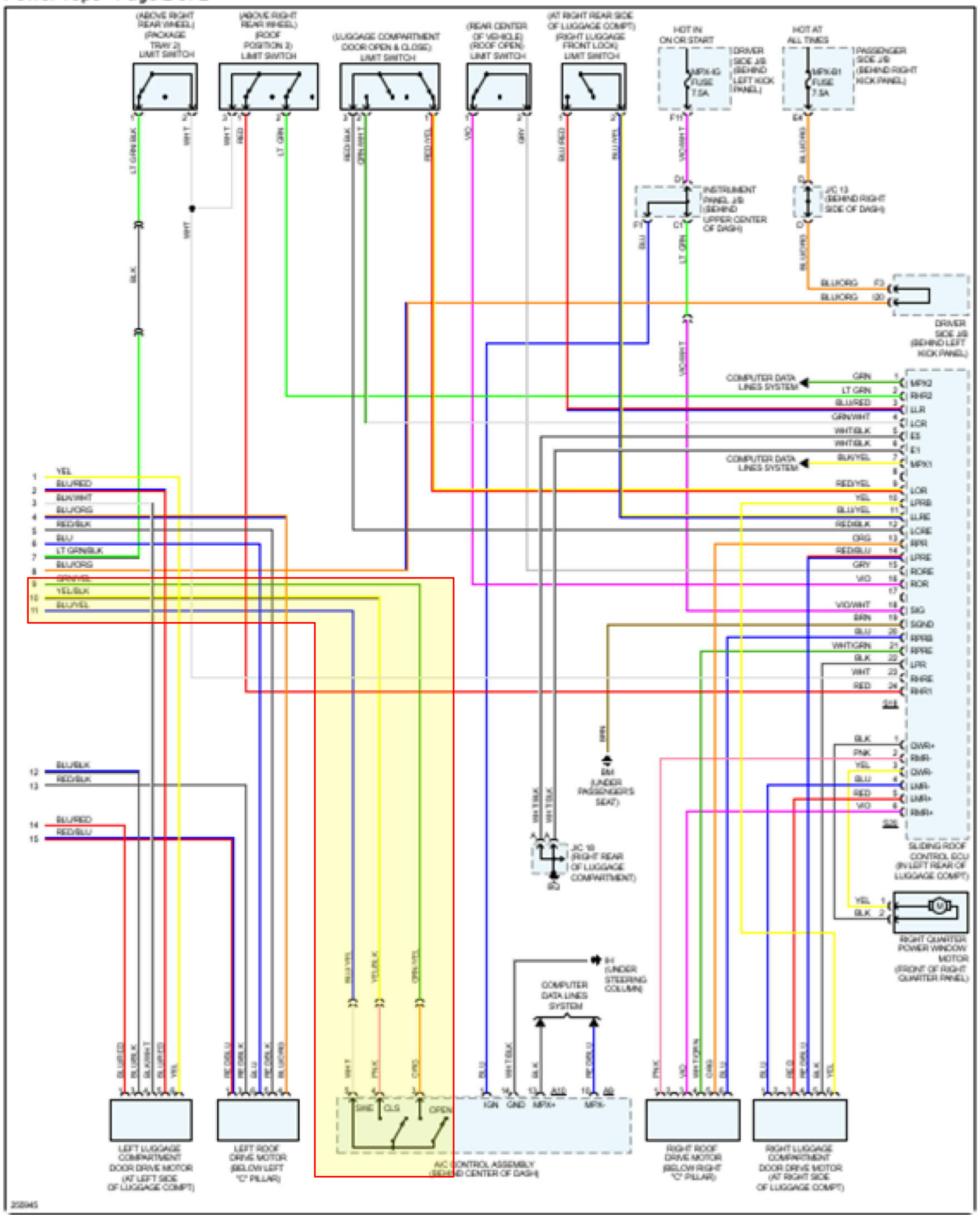


https://my.alldata.com/repair/#/repair/article/43744/component/176/itype/437/nonstandard/16407/selfRefLink/true 1/2

2007 Lexus SC 430 V8-4.3L (3UZ-FE)

Vehicle > Body and Frame > Roof and Associated Components > Sunroof / Moonroof > Diagrams > Electrical - Interact

Power Tops - Page 2 of 2



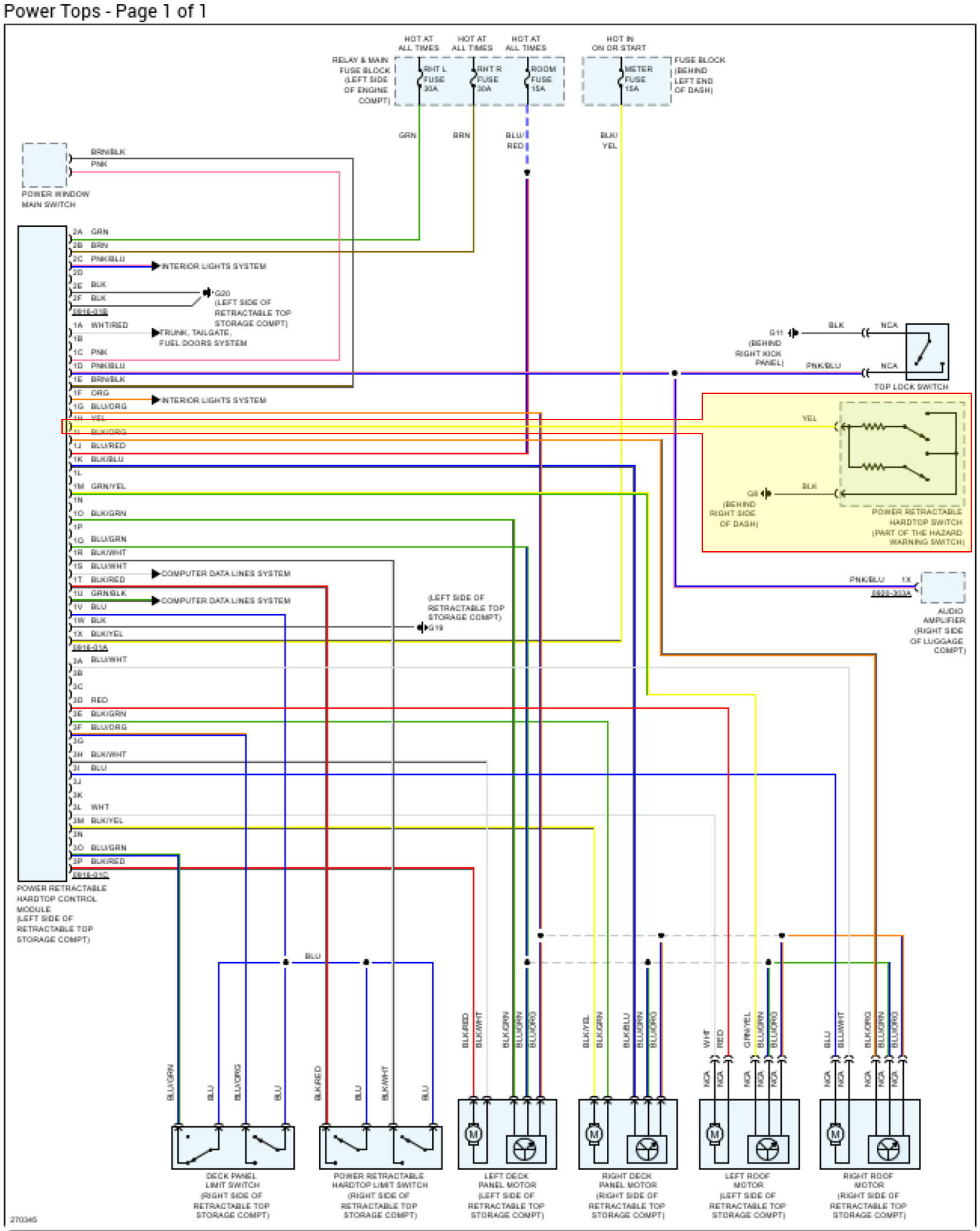
68. 2007 Mazda MX-5 Miata (Ex. 2017); connection between power retractable hardtop switch and power retractable hardtop control module is highlighted.

6/15/2020 Power Tops (Sunroof / Moonroof) - ALLDATA Repair

2007 Mazda MX-5 Miata L4-2.0L

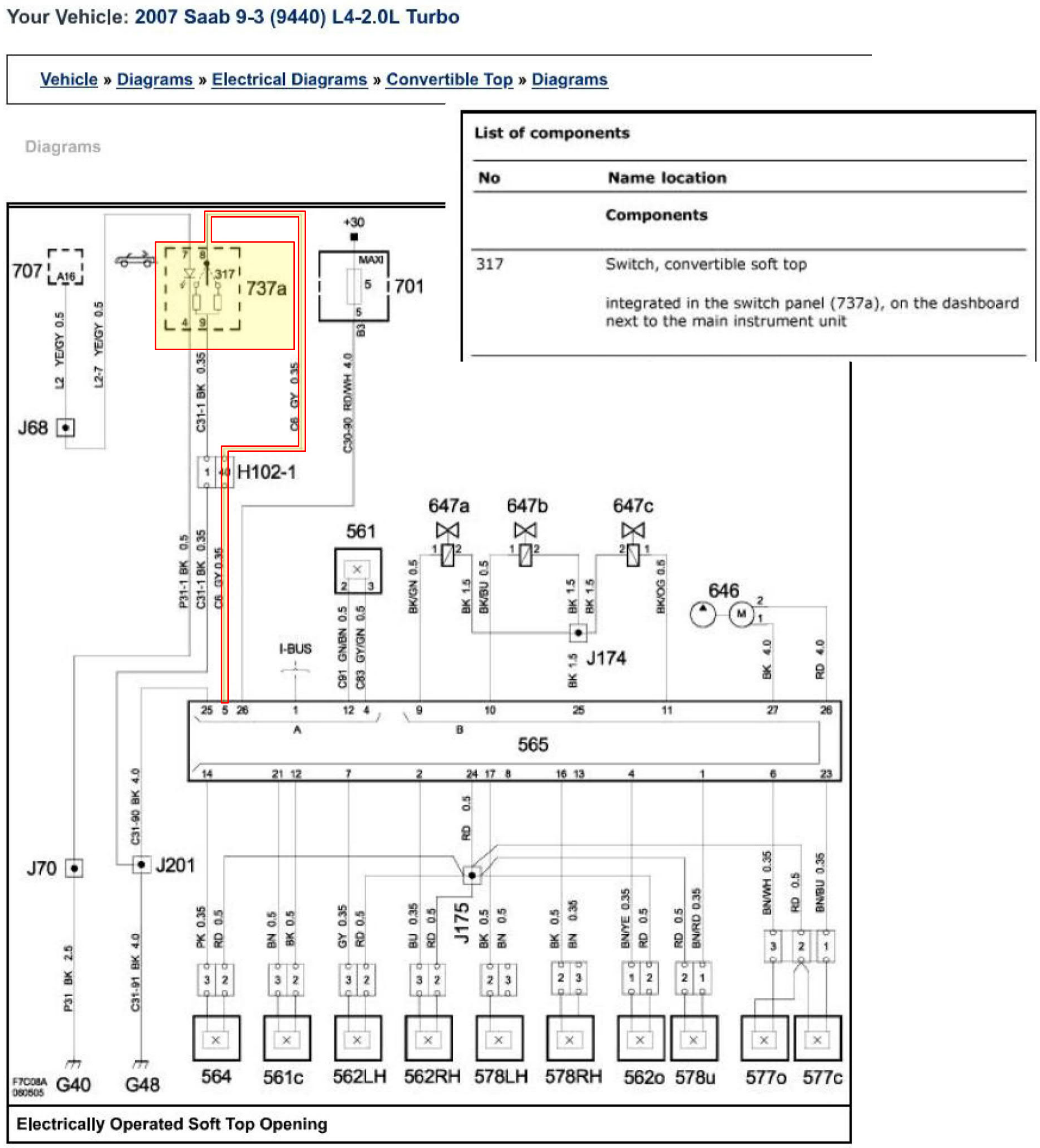
Vehicle > Body and Frame > Roof and Associated Components > Sunroof / Moonroof > Diagrams > Electrical - Interact

Power Tops - Page 1 of 1



https://my.alldata.com/repair/#/repair/article/43274/component/176/itype/437/nonstandard/14006/selfRefLink/true 1/1

69. 2007 Saab 9-3 (Ex. 2018); connection between the switch, convertible soft top 317 and the control module, STC 565 is highlighted.

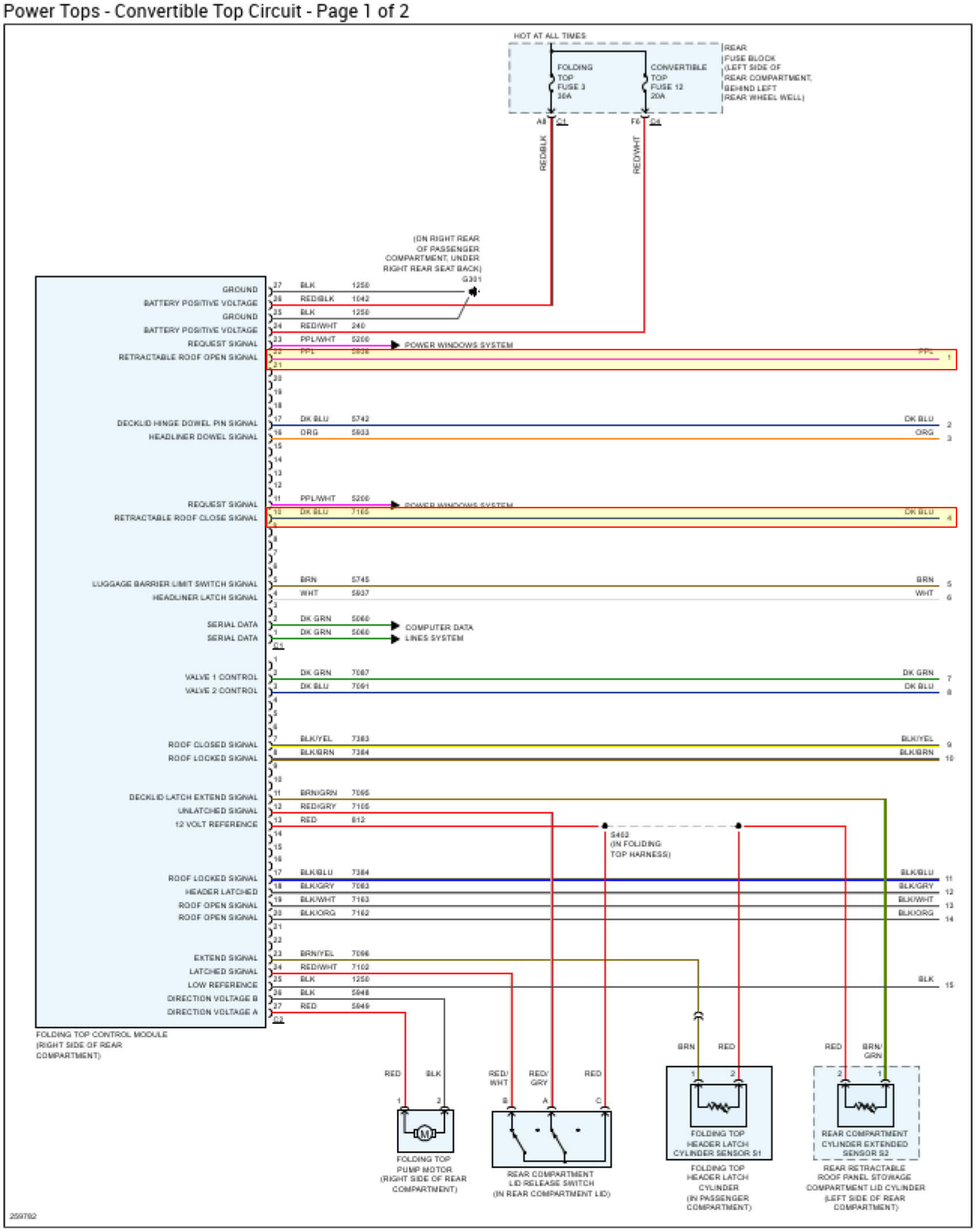


70. 2007 Pontiac G6 (Ex. 2019); connection between the folding top open/close switch and the folding top control module is highlighted.

2007 Pontiac G6 V6-3.6L

Vehicle > Body and Frame > Roof and Associated Components > Convertible Top > Diagrams > Electrical - Interactive (

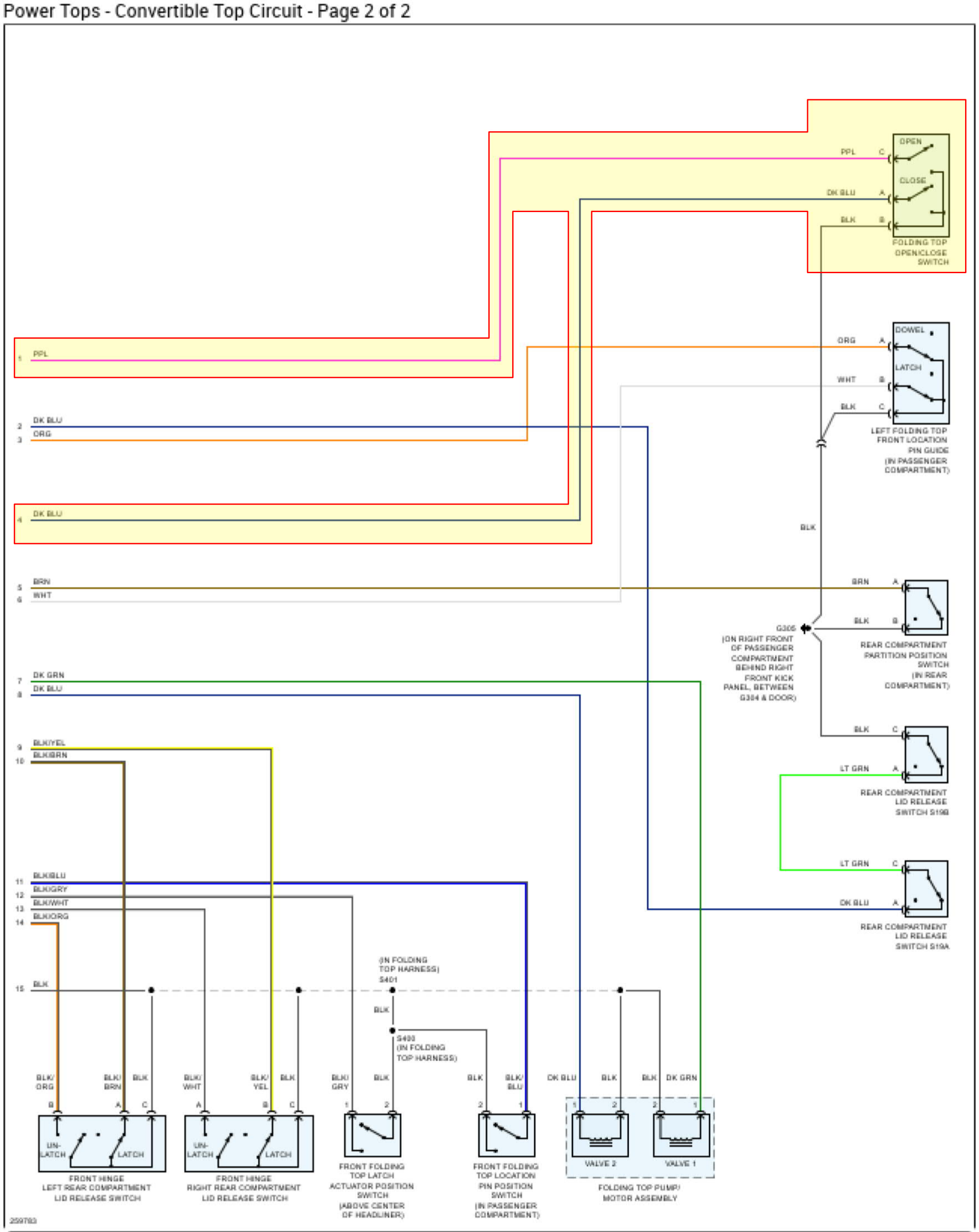
Power Tops - Convertible Top Circuit - Page 1 of 2



2007 Pontiac G6 V6-3.6L

Vehicle > Body and Frame > Roof and Associated Components > Convertible Top > Diagrams > Electrical - Interactive (

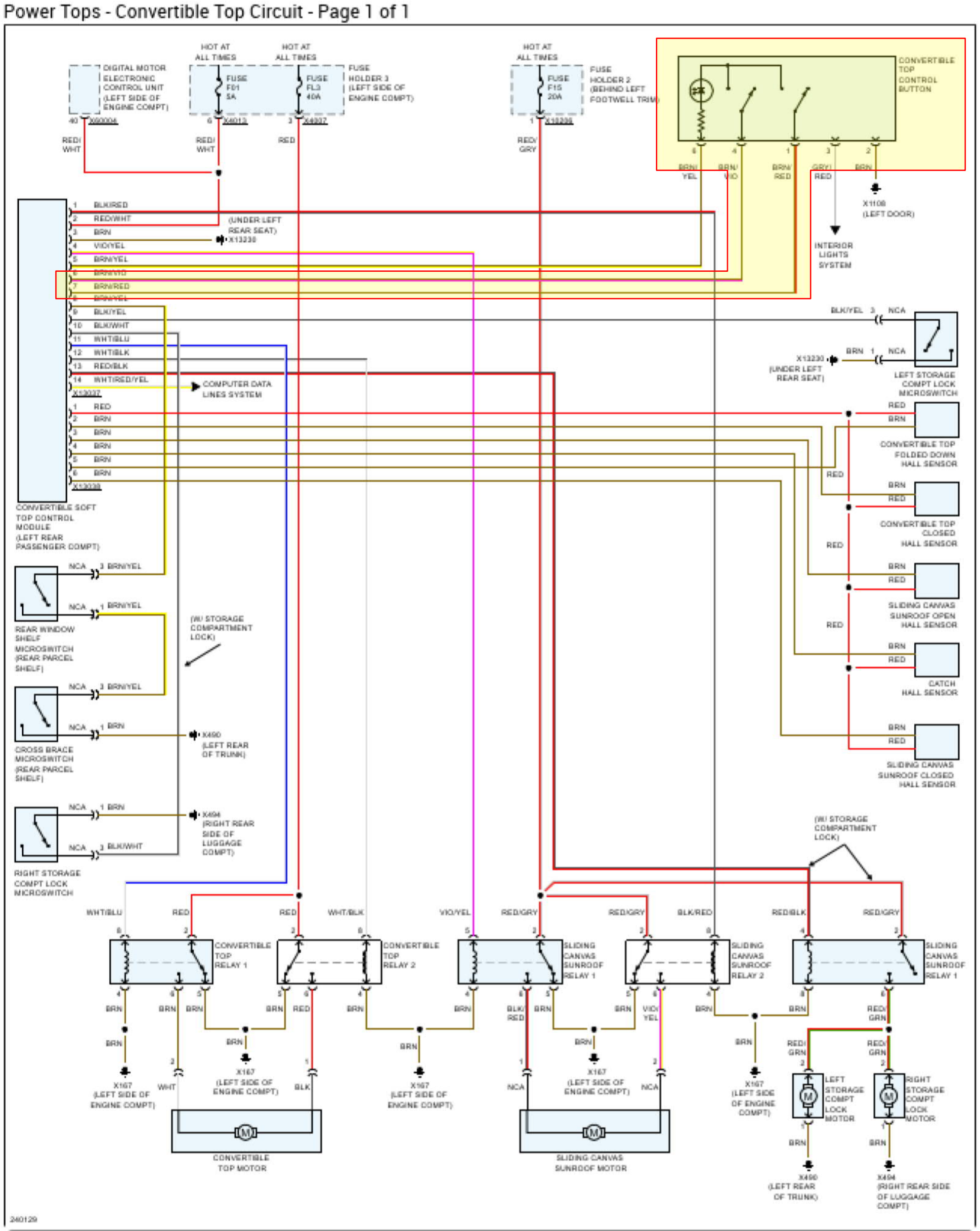
Power Tops - Convertible Top Circuit - Page 2 of 2



71. 2007 Mini Cooper S Convertible (Ex. 2020); connection between the convertible top control button and the convertible soft top control module is highlighted.

6/15/2020 Power Tops - Convertible Top Circuit (Convertible Top) - ALLDATA Repair

2007 Mini Cooper S Convertible (R52) L4-1.6L SC (W11)
Vehicle > Body and Frame > Roof and Associated Components > Convertible Top > Diagrams > Electrical - Interactive (
Power Tops - Convertible Top Circuit - Page 1 of 1



https://my.alldata.com/repair/#/repair/article/44223/component/1278/itype/437/nonstandard/10679/selfRefLink/true 1/1

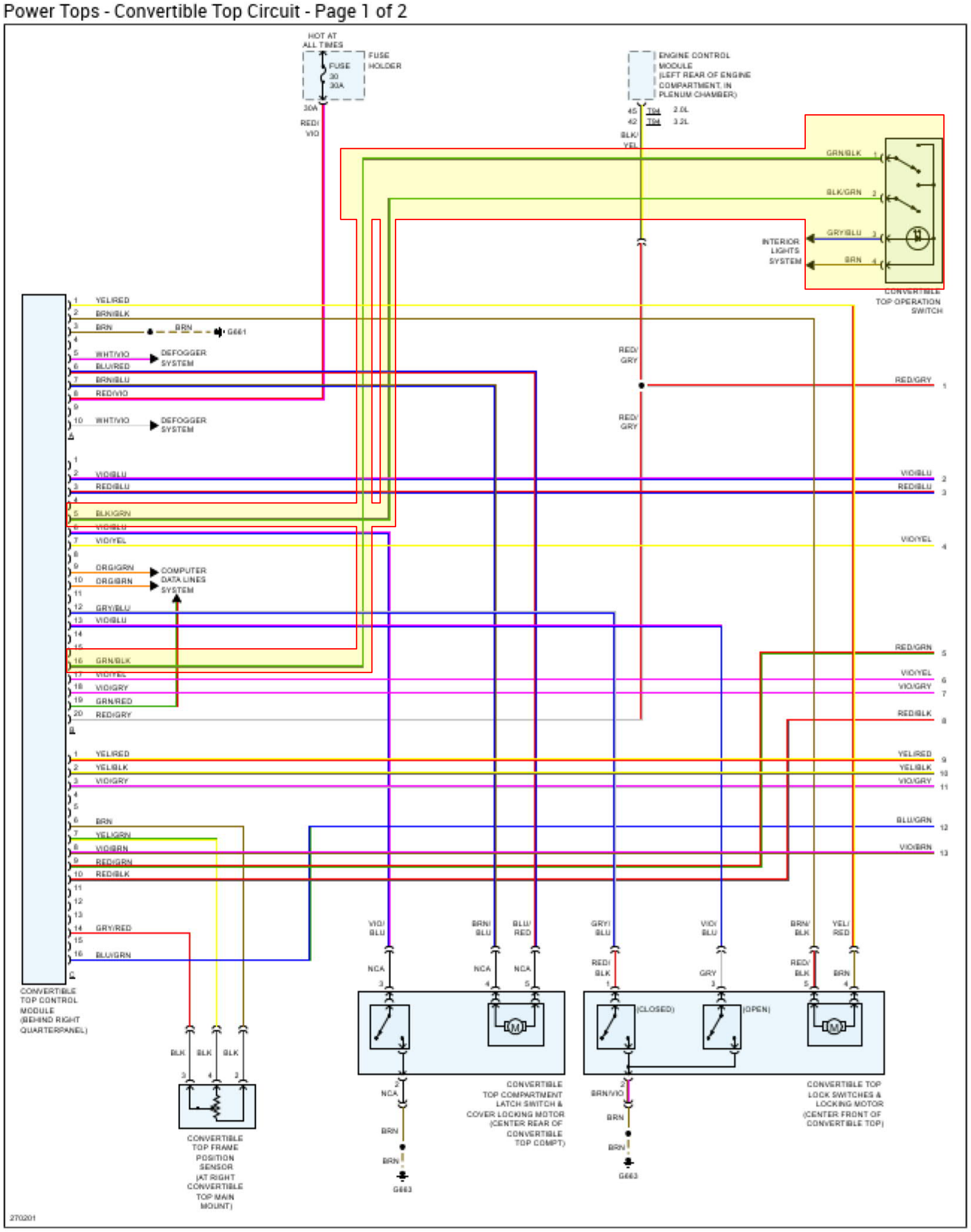
72. 2007 Audi S4 Quattro Cabriolet (Ex. 2021); connection between convertible top operation switch and convertible top control module is highlighted.

6/15/2020 Power Tops - Convertible Top Circuit (Convertible Top) - ALLDATA Repair

2007 Audi S4 Quattro Cabriolet (8HE) V8-4.2L (BHF)

Vehicle > Body and Frame > Roof and Associated Components > Convertible Top > Diagrams > Electrical - Interactive (

Power Tops - Convertible Top Circuit - Page 1 of 2



https://my.alldata.com/repair/#/repair/article/50115/component/1278/itype/437/nonstandard/15595/selfRefLink/true 1/2

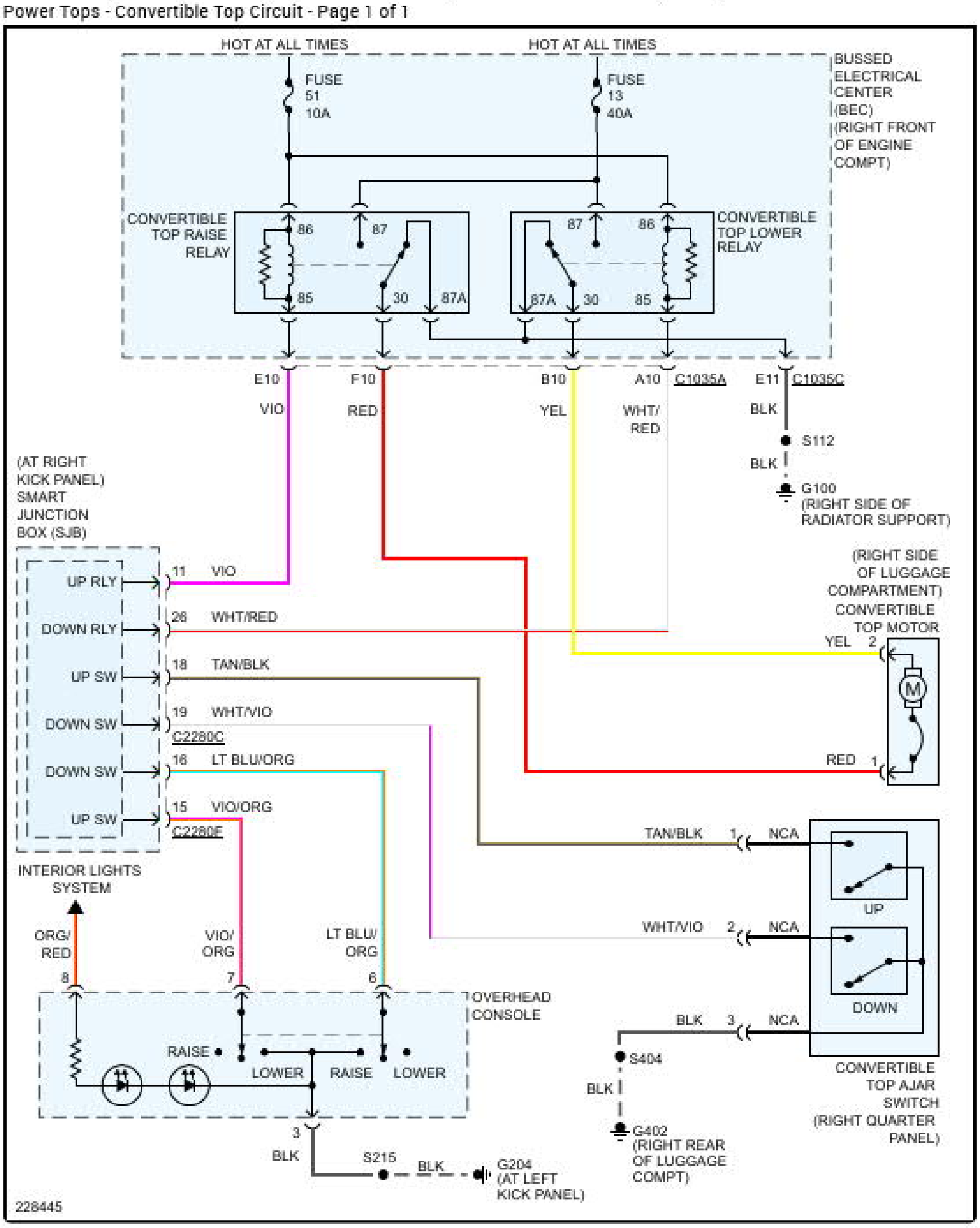
73. 2007 Ford Mustang (Ex. 2022). Conventional wiring not showing a CAN bus.

6/15/2020 Power Tops - Convertible Top Circuit (Convertible Top) - ALLDATA Repair

2007 Ford Mustang V6-4.0L VIN N

Vehicle > Body and Frame > Roof and Associated Components > Convertible Top > Diagrams > Electrical - Interactive C

Power Tops - Convertible Top Circuit - Page 1 of 1



https://my.alldata.com/repair/#/repair/article/43347/component/1278/itype/437/nonstandard/18050/selfRefLink/false 1/1

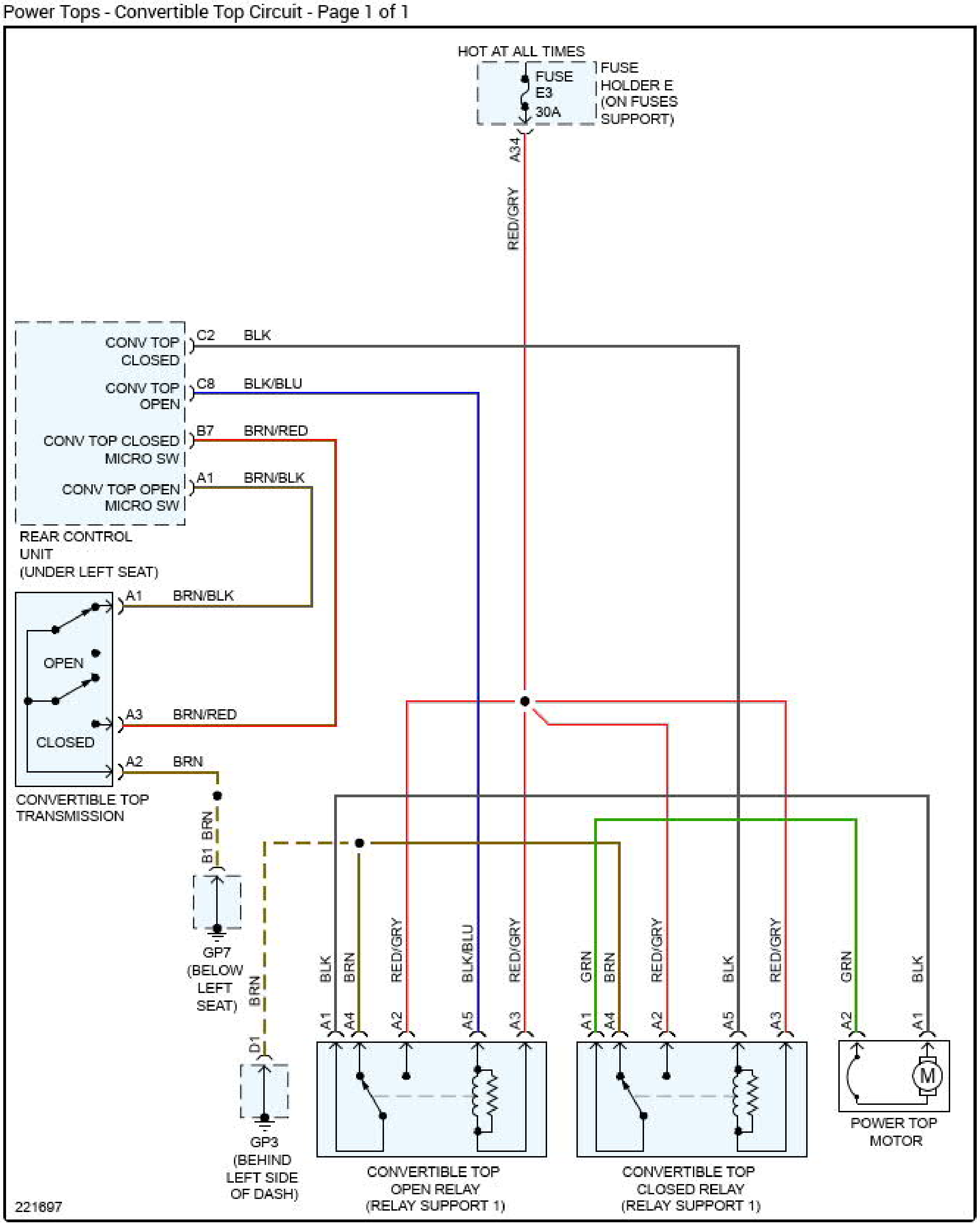
74. 2007 Porsche Boxster (987) (Ex. 2023). Conventional wiring not showing a CAN bus.

6/15/2020 Power Tops - Convertible Top Circuit (Convertible Top) - ALLDATA Repair

2007 Porsche Boxster (987) F6-2.7L

Vehicle > Body and Frame > Roof and Associated Components > Convertible Top > Diagrams > Electrical - Interactive (

Power Tops - Convertible Top Circuit - Page 1 of 1



https://my.alldata.com/repair/#/repair/article/46500/component/1278/itype/437/nonstandard/12793/selfRefLink/true 1/1

75. The Ford Mustang and the Porsche Boxter roof control electronics wiring does not show a CAN bus. The convertible roofs of a Ford Mustang and a Porsche Boxter were controlled by traditional switches and relays. In a Ford Mustang convertible or a Porsche Boxter there would consequently not be any "roof open message" on the CAN bus.

76. In the Volkswagen Eos, the Cadillac XLR, the Lexus SC 430, the Mazda MX-5 Miata, the Saab 9-3, the Pontiac G6, the Mini Cooper S Convertible, and the Audi S4 Quattro Cabriolet the equivalent of Munoz's "factory cabriolet top open/close buttons" is a hardwired part of the equivalent of Munoz's original roof electronics 110. Consequently, no other modules, including an original dashboard 105, would know of a driver's intention to open or close the convertible roof, before the original roof electronics 110 know. Therefore, there would not be a roof open/roof close "first" CAN message sent to the original roof electronics 110 in any of the reviewed vehicles.

B. Munoz does not add a second data bus.

77. The Petition alleges that Munoz teaches adding a second data bus, separating an existing bus into a first bus "A" and a second bus "B". The separation requires two separate transceivers in the retrofit module 100 and implementation of a gateway as illustrated below.

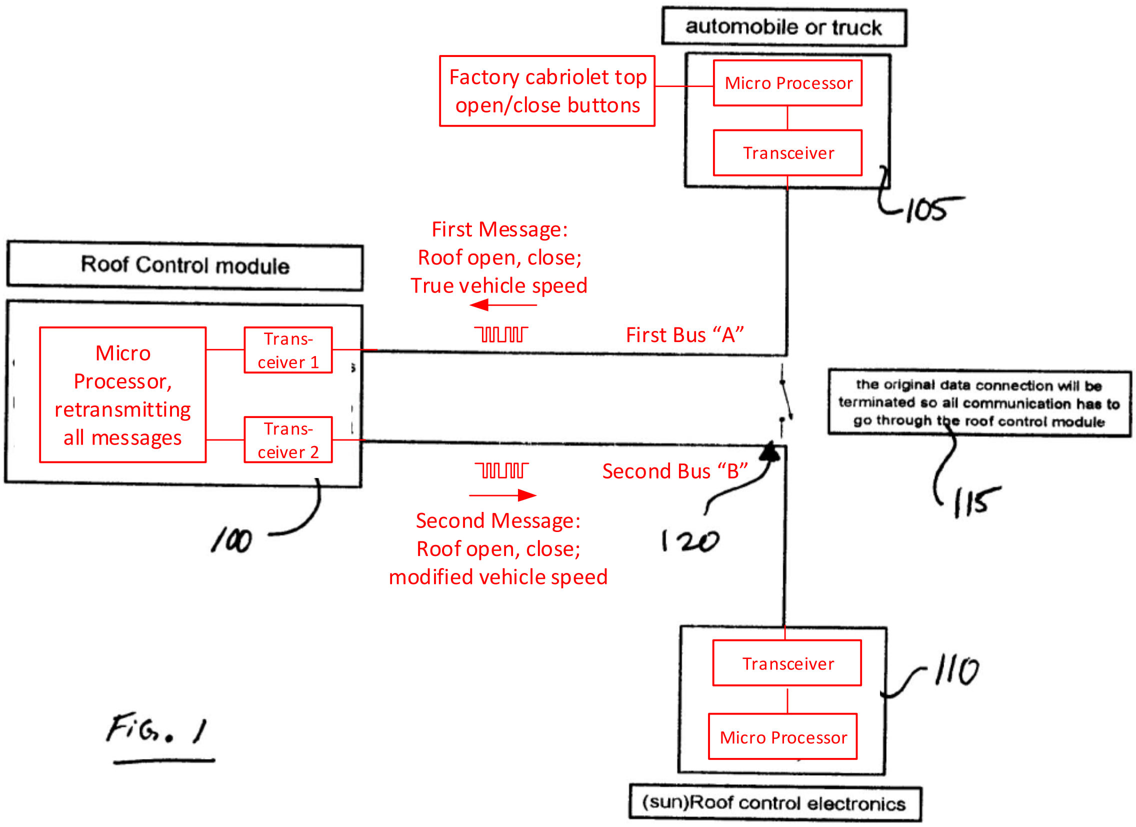
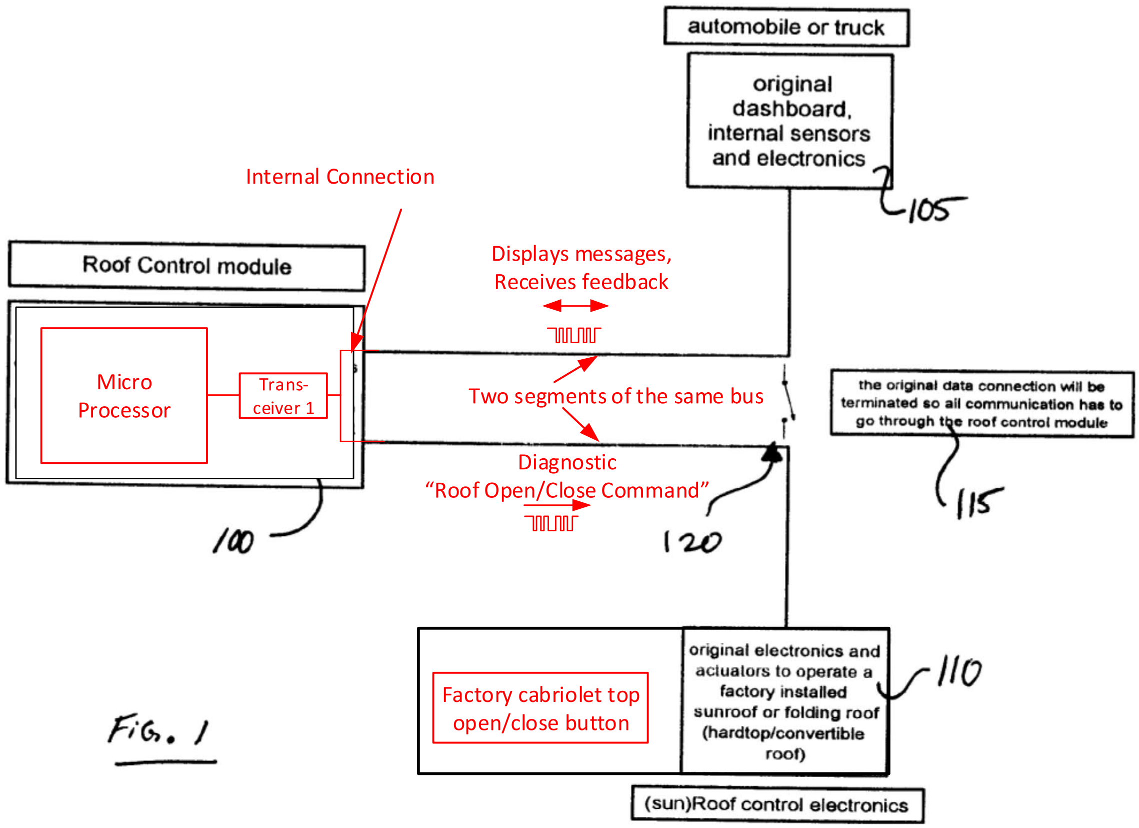


FIG. 1

78. I believe Mr. Leale's understanding to be overly complicated and inconsistent with Munoz's disclosure. A POSITA in 2007 would not have been enabled to add all of the red elements shown above based on general familiarity with CAN.

79. Even if a POSITA were able to practice Munoz for retrofitting a roof-open-while-drive features in vehicles in 2007, the POSITA could not have arrived at the implementation as shown above, considering that only the retrofit apparatus is added to the vehicle and existing ECUs and buttons are not changed. I believe the POSITA would have implemented Munoz as follows:



The diagram shows that the original data connection has been terminated and all communication has to go through the roof control module. Communication "going through" a module is achieved by an internal connection within the module 100 connecting the two segments "A" and "B" of the same bus.

80. Munoz's showing of a switch 120 is confusing. There is no apparent need for the switch 120, and no clear description is provided what purpose the switch 120 serves, or when the switch is opened or closed. In my opinion, the switch 120 shown in Fig. 1 symbolizes the original CAN bus before the vehicle was retrofitted and the CAN bus was rerouted through the roof control module 100. I recognize that Munoz's specification describes the switch 120 as if it were a real component ("a switch 120 connects the vehicle factory dashboard electronics and controls 105 to the Roof Control Electronics 110", 6:32-33) which is not consistent with my interpretation. But Munoz also states that his "device further relies upon these controls, without the need for new buttons, knobs, or switches to be added to the vehicle." 3:35-37, which is inconsistent with Mr. Leale's understanding that the switch 120 is real and has been added to the vehicle but "would be used very seldomly, likely hidden away". *See* Leale Tr., 52:3-55:5.

81. The word "routing" can have two different meanings:

*Meaning of **routing** in English*

routing

noun [C or U]

UK /ˈruː.tɪŋ/ **US** /ˈruː.t̬ɪŋ/ /ˈraʊ.t̬ɪŋ/

the use of a particular path or direction for something to travel or be placed:

- *There is the dispute over the routing of a gas pipeline into County Mayo.*
- *Logistics companies use computer-aided routing to maximize efficiency.*

INTERNET & TELECOMS

the process of sending information from one computer network to another:

- *algorithms to aid the routing of computer data*
- *DataPower appliances support XML routing.*

https://dictionary.cambridge.org/us/dictionary/english/routing

Here, Munoz meant the use of a particular path for the bus wire that has to be installed or moved when connecting his retrofit module. Munoz does not refer to "data" being routed but a "data *connection*" being routed. Munoz, 6:35. Munoz simply says that the bus wire (an electrical connection) is routed through (arranged to have a path through) the Roof Control Module. Thereby "all communication has to go through the roof control module" as Munoz Fig. 1 states.

82. Munoz use of the word "routing" is consistent with the use of the same term in the '505 patent. "Optionally, the vehicle data bus connection between telecommunication apparatus 200 and vehicle data bus 212 may be disconnected and instead re-*routed* into the emergency call apparatus 214". Ex. 1101, 7:3-6.

83. Mr. Leale's understanding that Munoz meant to separate an existing CAN bus into two separate busses is flawed for several reasons:

84. Munoz does not disclose separating an original bus into two separate busses. A POSITA would have known that separating a bus into two causes significant effort and increases the cost and complexity of the retrofit module. *See* Ex. 1015, 2-3. Given a choice between a simple physical passthrough and a complex gateway a POSITA would have understood Munoz disclosure that "the original data connection will be terminated so all communication has to go through the roof control module" (Munoz., Fig. 1, 115) to describe a simple pass-through.

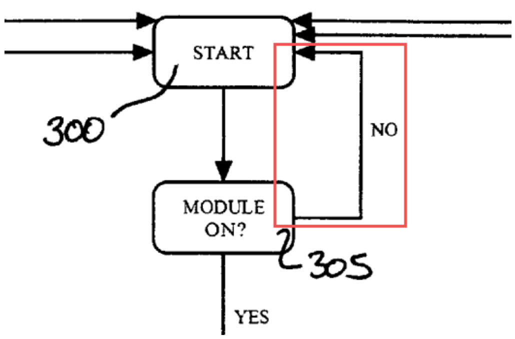
85. Munoz discloses there are more than two ECUs on a vehicle's CAN bus. "Some of the ECU's featured in modern automobiles include the Engine Control Unit, the Transmission Control Unit, the Telephone Control Unit, the Man Machine Interface, the Door Control Unit, the Seat Control Unit, the Climate Control Unit, the Suspension Control Unit, and several other such control units." Munoz, 1:20-25. Munoz's independent claims refer to "factory remote keyless entry systems". If Munoz meant to split the CAN bus into a first bus "A" and a second bus "B" a POSITA would need to know where the bus was to be split and which ECUs to connect to bus "A" and which to bus "B". Munoz does not address this question. The question does not arise if the bus is left intact.

86. Separating an existing vehicle network and re-connecting it as two separate networks with a gateway was not a known practice in 2007. CAN was specifically designed to allow nodes to be added to an existing network. Negley, 8. Gateways are complex devices, which are used by car manufacturers to connect separate busses that have been designed to be separate ab initio. Designing an aftermarket device as a gateway rather than a simple pass-through makes Munoz unnecessarily complex. *See* Ex. 1015, Ex. 1009.

87. There is no reason why Munoz device should be a complex gateway. Absent a clear reason to do so, a POSITA practicing Munoz's invention would leave the bus intact to avoid the additional cost and effort of implementing a gateway.

88. Munoz's goal is to provide operation "without compromising existing factory features." Munoz, 5:21-26. This goal is most readily and reliably achieved by leaving the CAN bus intact.

89. Munoz's FIGS. 3 – 7 explicitly show that Munoz's device does nothing when the module is off. *See* Munoz, Fig. 3: transition 305→300; Fig. 4: transition 402→400; Fig. 5: transition 502→500; Fig. 6: transition 602→600; Fig. 7: transition 702→700.



90. If Munoz's device included a gateway, it would have to receive every message on bus "A" and re-transmit the same on bus "B" and vice versa to not compromise existing factory features. Such a device would not read on Munoz's claims. Both of Munoz's independent claims 1 and 15 require "said device configured to receive input signals **only** from factory buttons, switches, and knobs". Munoz, claim 1, 8:21-23 and claim 15, 9:59-60, emphasis added.

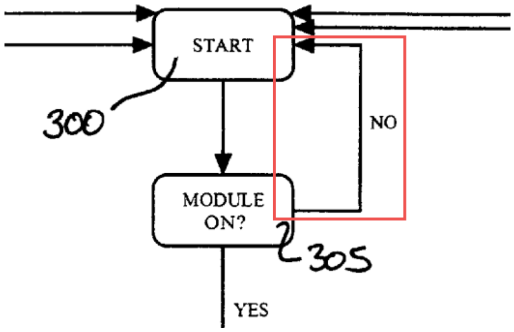
91. The only reason I can imagine why a POSITA would separate an existing CAN bus into two separate busses is to spoof a periodic CAN message, i.e. a message that is continuously sent in fixed time intervals from the original dashboard 105 to the roof control electronics 110. I believe Mr. Leale recognizes the second bus because he assumes that Munoz's factory cabriolet top open/close buttons are wired to the original dashboard and that the original dashboard 105 reports the status of the buttons in periodic messages. Leale Tr., 60:6-8. Nothing in Munoz's disclosure supports this assumption.

C. Claim 1 [1.4]: Munoz does not teach transmitting a second message being indistinguishable from a first message.

92. Mr. Leale's conclusion that Munoz teaches a second message which is indistinguishable from a first message is based on a series of unsupported conclusions.

93. First, Mr. Leale misunderstands the term "routing" to imply two different busses connected by a gateway when Munoz simply describes the path of a wire. Then, Mr. Leale assumes a first message from the original dashboard 105 to the factory-installed roof 110, even though there is no disclosure for the existence of such a message. Finally, Mr. Leale concludes that continued operation when Munoz's device is off can only be explained by it transmitting a second CAN message that is indistinguishable from the first CAN message.

94. Mr. Leale ignores that Munoz specifically shows how his device operates when off. For example, Fig. 3 shows that in step 305 a check is performed if the module is on. If the module is not on, the logic transitions back to start, i.e. the device does nothing.



The same specific instruction to "do nothing" is shown four more times in Figs. 4-7. A POSITA would not have read Munoz's repeated and consistent instructions to "do nothing" and understood them to mean "implement a bi-directional gateway".

95. Mr. Leale argues that a "POSITA would have understood that [...] the retrofit roof control module 100 would have transmitted a second CAN message, indistinguishable from the first CAN message". Ex. 1103, ¶158. Mr. Leale's argument inevitably fails because Munoz does not teach a first CAN message as explained above. Since there is no first message, a second CAN message cannot be indistinguishable from the first CAN message.

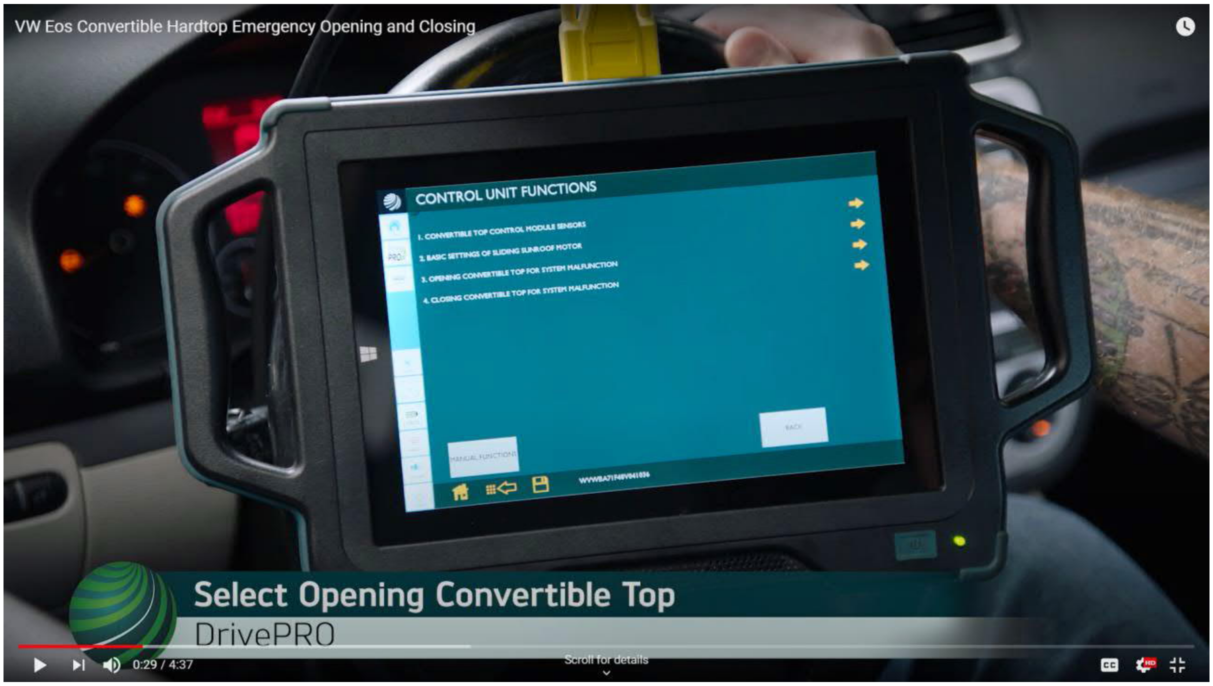
96. Munoz does teach sending a close roof signal though: "[W]hen the ECU receives a door lock or unlock signal, it [...] sends a close roof signal to the roof control mechanism". 6:50-53. This close roof signal (second message) must be received and acted upon by the original roof control electronics 110, which implies that it is sent with a CAN bus identifier which the roof control electronics 110 is configured to recognize and respond to. Munoz does not explain how this is possible.

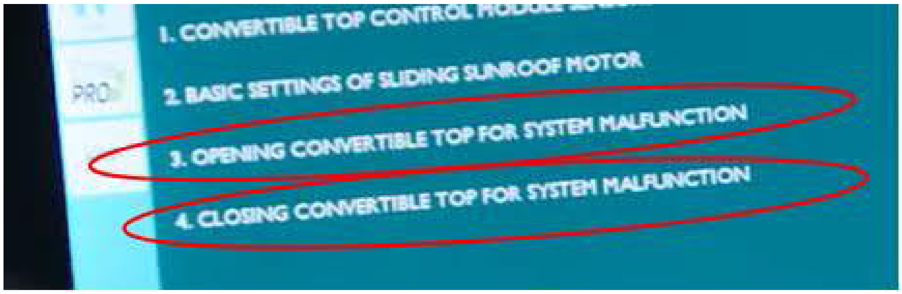
97. Munoz's silence led Mr. Leale to conclude that there must be an undisclosed first message transmitted by the original dashboard 105 that the second message mimics: "The first message exists because the second message exists". Leale Tr. 58:3-4. But that cannot be concluded. As demonstrated above, a VW Eos did not contain such a message. The VW Eos did however include the ability for a diagnostic tool to control the roof. Diagnostic services include "input/output controls", which allow a technician, through a diagnostic test tool, to control a vehicle feature. This includes opening and closing the roof of a convertible. A detailed sequence showing how the roof of a VW Eos is opened with an Autologic DrivePRO diagnostic test tool is shown in Ex. 2008. The original roof control electronics (in the VW Eos the J256 Convertible roof actuation control unit) responds to diagnostic CAN messages. Munoz's open roof message does not mimic any first message sent from a factory-installed device, but likely uses a diagnostics command.

98. Several considerations support this understanding of using diagnostic command to control the roof:

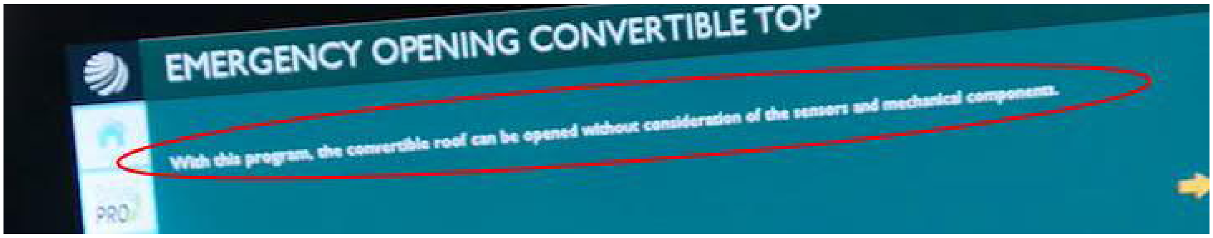
A) Using a diagnostic roof open command would work in a VW Eos, whereas spoofing a regular CAN message as taught by the '505 patent would not. Neither could the approach taught in the '505 patent be used to control the roof of a 2007 Cadillac XLR, a 2007 Lexus SC 430, a 2007 Mazda MX-5 Miata, a 2007 Saab 9-3, a 2007 Pontiac G6, a 2007 Mini Cooper S Convertible or a 2007 Audi S4 Quattro Cabriolet. In all of those vehicles, the roof open/close switch or buttons are wired directly into respective roof control modules so that an "open/close roof" message cannot exist on the respective data bus.

B) Diagnostic input/output controls provide direct control over actuators which allows circumventing lockouts, for example a speed dependent lockout of a convertible roof. The Autologic DrivePRO diagnostic tool described in Ex. 2008 is shown in operation in a YouTube video published at https://youtu.be/KhgrBsIDO_0 (Ex. 2010). As shown at 0:29 in the video the tool offers options for both opening and closing the convertible top.





At 0:32 the video shows that "with this program, the convertible roof can be opened without consideration of the sensors and mechanical components". I understand this to include "without consideration of vehicle speed".



C) The use of diagnostic messages to communicate with the original roof electronics is supported by the wording of Munoz's claims. In claim 1, Munoz describes the operation of his device as "configured to transmit **output signals** [...] to one or more factory displays". Munoz, 8:24-26, emphasis added. In contrast, "said device [is] being further configured to **supply open and close commands** to said factory cabriolet top controls". Ex, 1004, 8:33-34. That is, Munoz distinguishes sending signals from supplying commands. In the field of automotive electronics, the term "commands" are used when referring to the actions the diagnostic system asks vehicle electronics (e.g., ECUs) to perform.

99. Munoz vaguely describes the operation of his Roof Control Module 100 as "removing or altering data exchanged between integrated and closed systems". Munoz, Fig. 1. The specification does not explain what "removing or altering" means, which "integrated and closed systems" he refers to, and what "data" is being removed or altered. A POSITA faced with implementing Munoz's invention on convertible vehicles at the time would have concluded that "supply open and close commands" (Claim 1 and 15) meant to refer to diagnostic services.

D. Claim 2: Munoz does not teach that the second message uses the identifier of the first message.

100. As explained before, Munoz does not disclose the first message. Without the first message, there is no identifier of the first message for the second message to use.

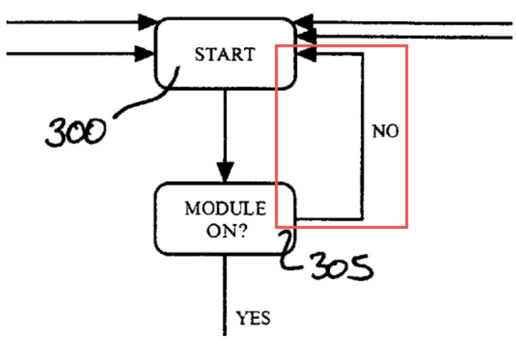
101. Munoz states that "when the ECU receives a door lock or unlock signal, it [...] sends a close roof signal to the roof control mechanism for 26-seconds 312." Munoz, 6:50-53. Even though Munoz refers to "the ECU" I believe he means his device, the Roof Control Module 100. Even if one considers this "close roof signal" as a "second message" similar to claim 2 in '505, this message must have an identifier which the original roof module is configured to receive. For such a so-called second message to work in a 2007 VW EOS, a 2007 Cadillac XLR, a 2007 Lexus SC 430, a 2007 Mazda MX-5 Miata, a 2007 Saab 9-3, a 2007 Pontiac G6, a 2007 Mini Cooper S Convertible or a 2007 Audi S4 Quattro Cabriolet a POSITA cannot spoof the identifier of a factory installed first apparatus since there was no first message, but the POSITA could use an identifier assigned to a diagnostic test device.

E. Claim 3: Munoz does not teach receiving the first message in the retrofit device.

102. As explained before, Munoz does not disclose the first message. Consequently, there is no first message for the retrofit device to receive. Mr. Leale argues that "all communication **[from 105 to 110]** has to go through the [retrofit] roof control module [100]." Ex. 1103, ¶162. Mr. Leale's addition "[from 105 to 110]" is without basis in Munoz's disclosure. As discussed, there are additional ECUs on Munoz's CAN bus. The phrase "all communication" refers to those. Munoz does not disclose any communication between 105 and 110.

F. Claim 4: Munoz does not teach that the retrofit apparatus re-transmits messages received on the vehicle data bus to the factory-installed first apparatus.

103. Mr. Leale understands Munoz to teach a gateway so that messages going "through the roof control module" will be re-transmitted over the second data bus "B" to the 1st apparatus 110. Ex. 1103, ¶164. Mr. Leale fails to recognize that Munoz expressly discloses that his device does nothing when the module is off.



Munoz, Fig. 3. The "do nothing" transition is shown in every one of Munoz's flow charts in Fig. 3, Fig. 4, Fig. 5, Fig. 6 and Fig. 7.

G. Claim 5: Munoz does not teach a vehicle that has been retrofitted according to the method of the '671 patent.

104. As explained before, Munoz does not teach the method of claim 1. Therefore, a POSITA would have recognized that Munoz does not teach a vehicle that has been retrofitted according to that method.

H. Claim 6 [6.1]: Munoz does not teach a factory-installed first apparatus including a first processor which is programmed to receive a first message on a vehicle data bus from a factory-installed second apparatus.

105. As explained with regard to claim 1, Munoz does not disclose any communication between the original dashboard 105 and the roof control electronics 110. A POSITA, trying to practice Munoz's invention, would have found that a real vehicle which reads on Munoz, for example a VW EOS, would not have communicated "roof open" messages through CAN. The same applies to a 2007 Cadillac XLR, a 2007 Lexus SC 430, a 2007 Mazda MX-5 Miata, a 2007 Saab 9-3, a 2007 Pontiac G6, a 2007 Mini Cooper S Convertible or a 2007 Audi S4 Quattro Cabriolet.

I. Claim 6 [6.2]: Munoz does not teach a retrofit apparatus connected to the vehicle data bus including a second processor programmed to transmit a second message that mimics the first message.

106. Munoz does not teach a first CAN message sent from the original dashboard 105 intended for the original electronics to operate the factory-installed roof 110. Therefore, the "open roof message" which corresponds to "the second message" in the claims and which Munoz does disclose cannot mimic a non-existent first message.

107. Mr. Leale believes that a "POSITA would have understood that when the aftermarket functionality is disabled [...] the retrofit roof control module 100 would have transmitted a second CAN message [...] to the factory-installed roof 110". Ex. 1103, ¶158. This is directly contradicted by Munoz's disclosure which explicitly shows that Munoz's device does nothing when the module is off. *See* Munoz, Fig. 3: transition 305→300; Fig. 4: transition 402→400; Fig. 5: transition 502→500; Fig. 6: transition 602→600; Fig. 7: transition 702→700.

J. Claim 7: Munoz does not teach wherein the first message comprises a message identifier that has been assigned to the factory-installed second apparatus and wherein the second processor is programmed to transmit the second message with the same message identifier.

108. Mr. Leale believes that "a POSITA will understand that a roof open or roof close 2nd CAN message coming from the Munoz retrofit roof control module 100 would employ the same message identifier as that originally formed or created by the 2nd OEM apparatus 105, original dashboard electronics, to cause the actuators in the 1st apparatus 110 to operate as intended." Munoz does not disclose such a message originally formed or created by the 2nd OEM apparatus 105. There is no first message which comprises a message identifier that has been assigned to the factory-installed second apparatus as required by claim 7. As explained with respect to claim 1, the retrofit roof control module can however transmit messages using a message identifier assigned to a diagnostic tester to open and close the roof.

K. Claim 10 [10.1]: Munoz does not teach a factory-installed first apparatus including a first processor, programmed to receive a first message via a vehicle data bus from a factory-installed second apparatus, the first message having a message identifier.

109. As discussed with respect to claims 1 and 6, Munoz does not disclose any communication between the original dashboard 105 and the roof control electronics 110. A POSITA would have thus understood that Munoz does not teach the first message required by claim 10.

L. Claim 10 [10.2]: Munoz does not teach a retrofit apparatus, operatively connected to the vehicle data bus, including a second processor programmed to send a second message having the same message identifier.

110. Since Munoz does not teach the first message, a POSITA would have understood that Munoz cannot teach a second message having the same message identifier as the non-existent first message.

M. Claim 11: Munoz does not teach that the second message originating from the retrofit apparatus is indistinguishable to the first apparatus from the first message which the first processor is programmed to receive from the second apparatus.

111. Munoz does not teach the first message. A POSITA would thus recognize that Munoz cannot teach that the second message is indistinguishable to the first apparatus from the non-existent first message. Munoz does not disclose that the first processor is programmed to receive any messages from the second apparatus.

N. Dependent Claim 12: Munoz does not teach that the factory-installed first apparatus responds to the second message originating from the retrofit apparatus as if it were the first message which the first processor is programmed to receive from the factory-installed second apparatus.

112. Munoz does not teach the first message. A POSITA would thus recognize that Munoz cannot teach that the factory-installed first apparatus responds to the second message originating from the retrofit apparatus as if it were the first message which the first processor is programmed to receive from the factory-installed second apparatus. Munoz does not disclose that the first processor is programmed to receive any messages from the second apparatus.

O. Dependent Claim 13: Munoz does not teach that the factory-installed first apparatus is electrically disconnected from the vehicle data bus.

113. As explained in ¶¶77-91 above, I do not agree with the Petition that Munoz teaches separating the data bus into two separate busses "A" and "B". For the same reasons, Munoz does not disclose that the factory installed first apparatus (110) is electrically disconnected from the vehicle data bus.

IX. DIETZ DOES NOT TEACH THE CLAIMED INVENTIONS

A. The Dietz reference is not enabling.

114. Dietz [6]is an installation manual showing how a "multimedia interface 1280" is installed in a vehicle. Dietz describes the function of the device as: "[The multimedia interface 1280] makes it possible to view the picture of a for e.g rear view camera on the navigation screen while moving.". Dietz, 3.

115. The Dietz 1280 module is essentially a black box. Based on the pinout I recognize that it is connected to a vehicle CAN bus, but also uses a hard-wired input (pin 4, purple wire) and a hard-wired output (pin 8, orange wire).

GB **Connector assignment:**

PIN	I/O	Bezeichnung / marking	Kabel / cable
1	Input / output	CAN HIGH	gelb / yellow
2	Input / output	CAN LOW	blau / blue
3	Input	Masse / ground	schwarz / black
4	Input	Schalter / switch	violett / purple
5	Input / output	CAN high	gelb / yellow
6	Input / output	CAN low	blau / blue
7	Input	Power +12 V, KL. 30	rot / red
8	output	Steuerleitung / remote + 5V	orange

116. Dietz states that "Unit 1280 is an interface which processes afterwards described data from the CAN-protocol of a car." Dietz, 2. Yet, no data is described afterwards. A POSITA, having studied Dietz, would not be able to ascertain how

[6] Audiotechnik Dietz, Installation/connection manual for multimedia interface 1280, Ex. 1005.

the 1280 module operates. I believe that to be intentional. Dietz enables a user to install the 1280 module, but would not have wanted a POSITA to understand its inner workings and be able to copy the 1280 module.

B. Dietz does not teach a vehicle having a factory-installed first apparatus including a processor, programmed to communicate with a factory-installed second apparatus through a vehicle data bus with a first message having an identifier.

117. Identifying the first message in the prior art is critical due to its unique relationship to the second message. Mr. Leale suggests this first message to be a "not in motion" message, e.g., a Park gear indication. Leale, ¶239. But Dietz does not describe any "not in motion" message. Mr. Leale is unable to identify a particular message that is supposedly being spoofed, offering various alternatives including the position of a gear shift, a parking brake, or a vehicle speed signal (Leale, ¶215). Yet none of these are mentioned in Dietz.

118. The Petition argues that a "POSITA would understand that Dietz monitors and alters gear-shift related signals because Dietz refers to ascertaining the position of a gear-shift ("as long as the reverse gear is laid in") to determine whether to provide an output signal for automating switching of the unit." Pet., 43-44. I find no support for this conclusion in Dietz. While Dietz states that the 1280 module processes data from the CAN-protocol of the car, that could mean that the 1280 module receives messages from the CAN bus. It does not suggest that the 1280 module alters gear-shift related signals, or that the 1280 module transmits any messages on the CAN bus at all.

119. Dietz explicitly states that "the purple wire from 1280 has to be connected with the signal for back up light." A POSITA would know that the back up light is on when the gear is in reverse and otherwise off if the gear is not in reverse. Dietz's reference to "as long as the reverse gear is laid in" is therefore equivalent to "as long as the back up light is illuminated". Since the purple wire is connected to the back up light, "as long as the reverse gear is laid in" is also equivalent to "as long as the purple wire is powered". A POSITA could not have read the words "as long as the reverse gear is laid in" and concluded that the Dietz module must read the gear status by a CAN message.

C. Dietz does not to teach transmitting a second message from the retrofit apparatus to the factory-installed first apparatus, the second message being indistinguishable from the first message.

120. Mr. Leale believes that "a POSITA would understand that Dietz intends to spoof a message from a vehicle motion module on the OEM control bus so as to indicate to the navigation unit that the vehicle is not in motion when the vehicle is in motion". I find no support for this conclusion in the Dietz installation manual.

D. Dietz does not teach that the second message uses the identifier of the first message.

121. Mr. Leale writes "[t]his step is taught by Dietz as a Gear Shift Signal, a Park Brake On/Off, or a Vehicle Speed CAN Bus message coming from the Car (BCM or others). Ex. 1103, ¶227. But Dietz does not mention any of a Gear Shift Signal, a Park Brake On/Off signal or a Vehicle Speed CAN Bus message. In fact, Dietz does not mention any CAN signal being transmitted by the 1280 module.

E. Dietz does not teach wherein the retrofit apparatus re-transmits messages received on the vehicle data bus to the factory-installed first apparatus through the second data bus.

122. With respect to claim 3, Mr. Leale provides far-reaching conclusions, for example that "a POSITA would understand that the 1280 module must send information about the Navigation Volume Control information to the Amplifier Module (AMP) of the vehicle. As the user of the vehicle requests the volume to be controlled, they will press or turn a volume control button or knob. The information about whether increase or decrease the vehicle's volume is relayed over the CAN Bus to the AMP device. Since the vehicle's CAN Bus has been cut, the Dietz 1280 device must gateway this data back to the second CAN Bus from the OEM CAN Bus." Ex. 1103, ¶231. I do not find any support for Mr. Leale's conclusions.

123. Dietz lists several vehicles in which his device can be used, namely "AUDI A4, A3 with 16:9 DVD Navigation Plus RNS-E, BMW E65 with TV tuner, VW with MFD2 / RNS2 navigation." Dietz,2. In a spot-check of the first named vehicle, the Audi A4, I reviewed the pinout of a 2007 Audi A4 Cabriolet external Bose amplifier obtained from AlldataDiy (Ex. 2031). The pinout shows that the amplifier was not connected to the CAN bus. Mr. Leale's theory that information about the Navigation Volume Control information was sent via CAN to the Amplifier Module is inconsistent with the finding that the amplifier of the vehicle was not connected to the CAN bus.

X. ALLEN DOES NOT EMULATE VEHICLE DATA BUS SIGNALS

124. The Petition states that "Allen discloses a vehicle retrofit system providing control over vehicle systems where **a retrofit control module 21 emulates vehicle data bus commands** used by an OEM controller. Allen, [0018]-[0022]." Pet., 49, emphasis added. I believe the Petition mischaracterizes Allen. Allen does not teach *emulating* vehicle data bus commands.

125. Allen is concerned with providing "[a]n interface system to a vehicle data bus having a communication range greater than a communication range between an Original Equipment Manufacturer (OEM) transceiver and an OEM remote control device already integrated in a vehicle." Allen, abstract. For that purpose, Allen teaches a "Control Module (21) [which] connects directly to the link between the IFCM 12 and its OEM Transceiver 16, while also offering the possibility of being connected directly with the Vehicle Data Bus 14." Allen, [0020]. When Allen mentions *emulating* a signal, that signal is not a vehicle data bus signal. The emulated signal is sent from the Control Module 21 to the IFCM 12. *See* Allen, [0021]. The path of the emulated signal according to [0021] has been highlighted below. As shown, the emulated signal is not sent on the vehicle data bus 14:

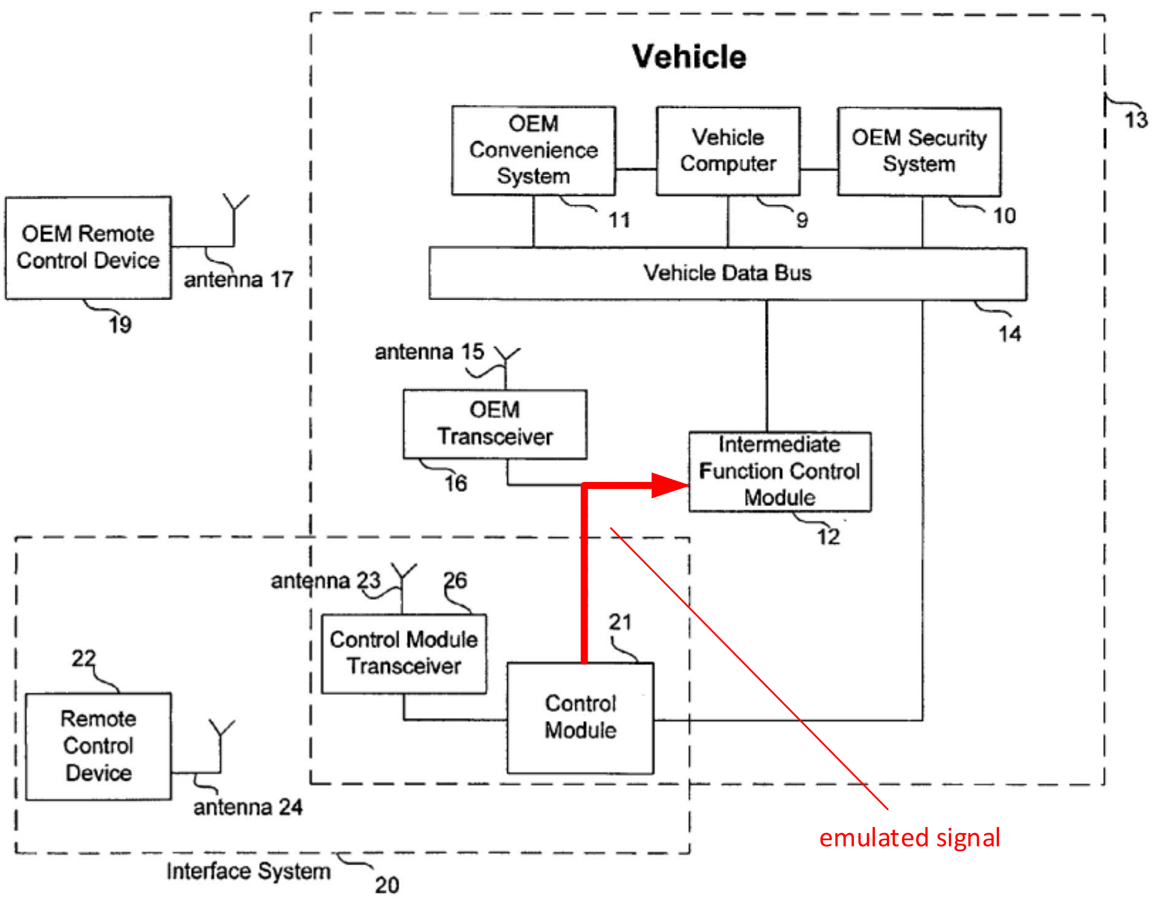


Fig. 1

Allen's "emulated signal" refers to the connection between the Control Module 21 and the IFCM 12 emulating a signal that would usually come from the OEM transceiver 16 to the IFCM 12. "The general configuration requires that the Control

Module 21 emulates the signals usually provided by the OEM Transceiver 16." Ex. 1018, ¶22. "The Control Module 21 is hence equally capable of channeling the appropriately emulated convenience and security command signals to the IFCM 12 as if it came from the OEM Transceiver 16". Ex. 1018, ¶22. Both the OEM transceiver 16 and the Control Module 21 are functionally upstream of the vehicle data bus 14 for the operation highlighted in Fig. 1.

126. Allen also mentions that "[a]lternatively, the Control Module 21 may by-pass the IFCM 12 and communicate directly with the Vehicle Data Bus 14." In respect to the Control Module 21 communicating directly with the Vehicle Data Bus 14 Allen refers to an "appropriate code function" being on the Vehicle Data

Bus as annotated below. *See* [0021].

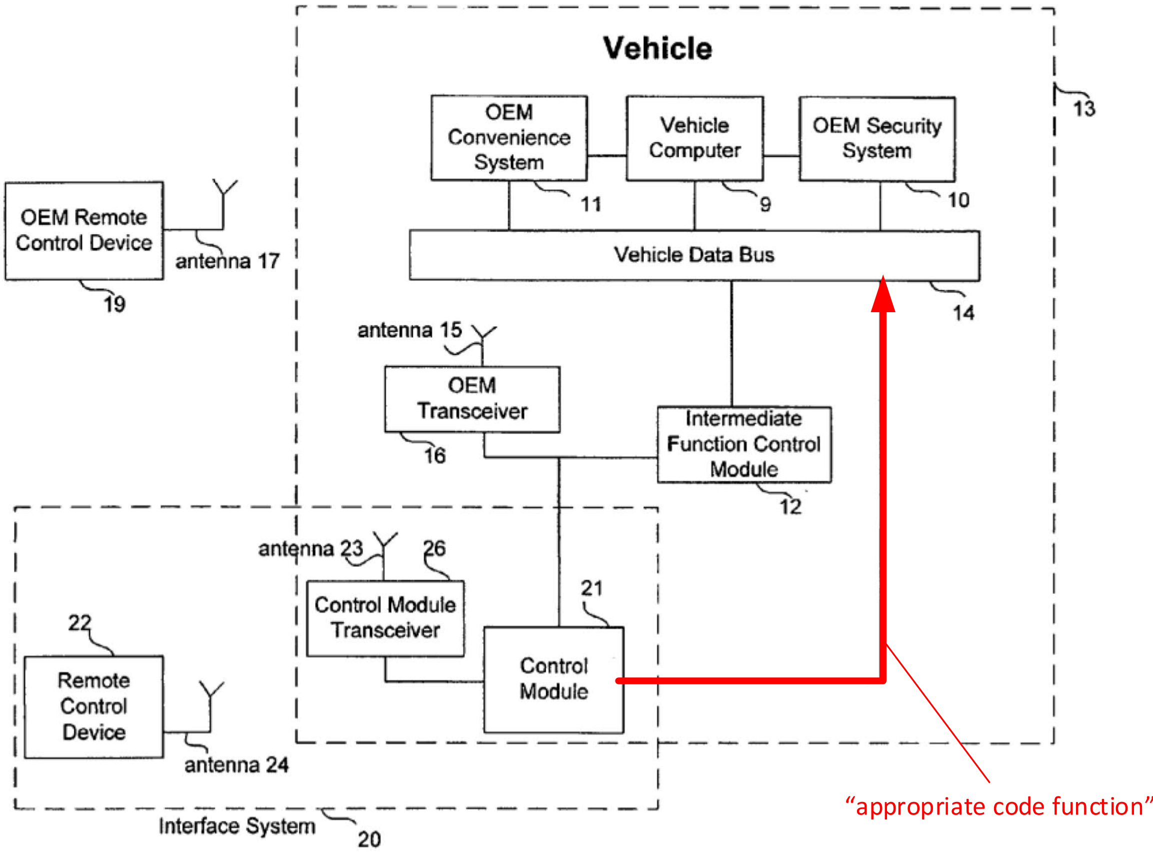


Fig. 1

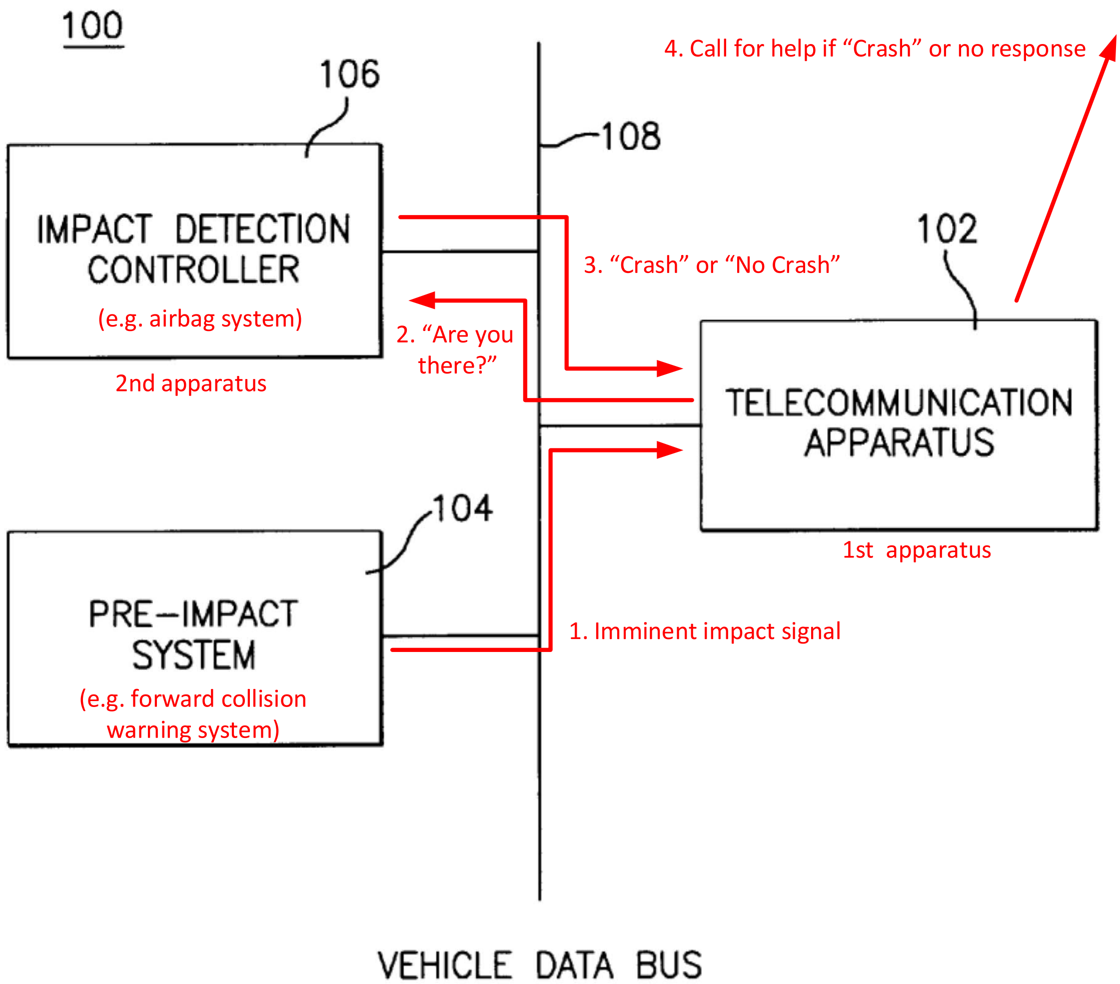
127. Petitioner's conclusion that "[b]ased on Allen's disclosure of emulating data bus commands, a POSITA would understand that Dietz's 2nd message spoofs, mimics, or emulates messages, including message identifiers" is based on Petitioner's misreading of Allen and not supported by Allen's disclosure. Allen describes "placing or inputting the appropriate code function onto the Vehicle Data Bus 14" (Ex. 1018, ¶22), but leaves the reader without any guidance as to what "appropriate code functions" are. A POSITA would know that "[e]ach frame has an identifier, which must be unique (i.e. two nodes on the same bus must not send frames with the same identifier)".Ex. 2003, 9. Transmitting a second message which uses the same identifier as a first message, as required by claim 2, is explicitly prohibited by the applicable International Standard ISO 11898-1: "Within one system, each information bit shall be assigned a unique identifier. A data frame with a given identifier and a non-zero DLC [data length code] may only be initiated by one node". Ex. 2002, 31.

128. In my opinion, a POSITA would not have considered sending a message on the vehicle data bus from the control module 21 that uses the same identifier as that used by the IFCM 12 to be "appropriate". Both the IFCM 12 and the Control Module 21 are connected to the same data bus 14. By definition, spoofing a CAN identifier would mean that the Control Module 21 uses an identifier that it is not allowed to send. *See* 2012, 2. It would however be possible and appropriate for the Control Module 21 to use a diagnostic command to interact with the vehicle data bus and this will allow the Control Module 21 to "bypass" the IFCM 12 as mentioned in Allen, [0021].

XI. LOBAZA CANNOT BE RETROFITTED

129. Lobaza relates to the ability of a vehicle to alert a service provider, such as OnStar, in case of a crash. *See* Lobaza, abstract. Lobaza teaches that "a telecommunication apparatus within the vehicle communication system is configured so as to receive a 'pre-impact' signal from an impact warning system (also included within the vehicle) whenever an imminent impact is detected." Lobaza, 2:54-58. The system solves the problem that during certain crashes, the data bus 108 could be severed, thereby interrupting communication between the impact detection system controller (e.g. an airbag system) 106 and the telecommunication apparatus 102. As a result, the service center would be unaware of the impact and could not send help. *See* Lobaza, 1:46-53, 5:9-12.

130. Lobaza's system can be illustrated and summarized as follows:



1. The system includes a pre-impact system 104, which may be a forward collision warning system. *See* Lobaza, 4:43-45. If the pre-impact system 104 detects an imminent impact it sends an affirmative signal to the telecommunication apparatus 102. *See* Lobaza, 5:33-35. I have illustrated this as the "1. Imminent impact signal" in the annotated drawing above.

2. "Upon receiving the affirmative signal 204, the telecommunication apparatus

102 sends a status query to the impact detection system controller 106 to determine whether the data bus 108 is operational and communication is maintained therebetween." Lobaza, 5:35-40. I have illustrated this as in form of an "2. Are you there?" message.

3. The impact detection controller 106 responds to the "2. Are you there?" message and indicates whether a crash has occurred. *See* Lobaza, 5:45-57. I have illustrated this as in form of an "3. 'Crash' or 'No Crash'" message.

4. In case of a crash, the telecommunication apparatus 102 calls a service provider for help. Interestingly, if no "3. 'Crash' or 'No Crash'" message is received the telecommunication apparatus 102 assumes a worst-case scenario and also calls the service provider for help. *See* Lobaza, 6:1-15. I have illustrated this as in form of an "4. Call for help if 'Crash' or no response" arrow.

131. The Petition suggests that Lobaza's "pre-impact" capability could be retrofitted in an existing vehicle: "A POSITA would have been motivated to retrofit Lobaza's 'pre-impact' capability into vehicles having OEM OnStar capability to allow pre-impact events to be responded to by a service provider because Allen teaches the desirability of adding communications relating to shock sensors through a retrofit to provide additional capabilities to OEM systems." Pet., 64. I disagree with this statement since it is not supported.

132. Allen does not explain what a "shock sensor" is. The "shock sensors" are mentioned together with "automatic defrost functions" and "remote starting", i.e., functions that take advantage of a remote control while the vehicle is parked and unoccupied. Petitioner argues that "[a] POSITA would have recognized that Lobaza's new 'pre-impact' capability would be a type of "shock sensor." Mr. Leale explains that "a 'shock sensor' in Allen refers to a sensor that **detects an impact** to a vehicle, such as to trigger a car alarm if someone smashes a car window or otherwise impacts a car." Leale, ¶348, emphasis added. I agree with Mr. Leale. Shock sensors in vehicles prior to 2007 typically included vibration or piezoelectric (e.g. strain gauge) sensors that sense shock by measuring vibrational energy or force "after" shock is generated due to exerting force on surfaces such as vehicle doors, and windows glass. These sensors cannot detect a shock before it occurs. Thus, they are not used for "pre-impact" systems that are aimed to detect "potential" imminent impact. The shock sensors are used for anti-theft purposes, which are different than "laser technology and/or radar technology" sensors used for detecting objects before an impact as described by Lobaza. *See* Lobaza, 4:50-67.

133. In my opinion, the Petition confuses Lobaza's "pre-impact" system which receives a "pre-impact" signal from an impact warning system (Lobaza, 2:55-56) with a sensor that detect an impact to a vehicle (at the time of impact). Lobaza's pre-impact system is based on the vehicle being equipped "with a sensor (or sensors) capable of detecting objects in the frontal area of the vehicle." Lobaza 4:50-53. Lobaza's pre-impact capability refers to the ability to determine "if there is any imminent threat of impacting an object in the frontal area of the vehicle."Lobaza, 4:65-67. That is a vastly different function than a sensor which detects if someone smashes a car window while the car is parked to trigger an alarm. Allen does not in any way suggest that Lobaza's pre-impact system might be installed during a retrofit.

134. As discussed before, it is critical to identify the first message which is being spoofed. With respect to Lobaza the Petition suggests that "a pre-existing message from the impact detection controller in an OnStar vehicle" (Pet. 65) could be spoofed by a retrofitted pre-impact system. But that would not work. The impact detection system is e.g. an airbag system. *See* Lobaza, 1:41. The impact detection system would not know of an imminent impact before it occurs: "This is due to the fact that the impact detection system controller 106, by itself, can only determine the incident after the impact itself, and because the impact detection engagement is sent after the impact." Lobaza, 5:13-17. It can only communicate a "post-impact" message after a crash has occurred. Lobaza's invention is concerned that this "post-impact" message may not reach the telecommunication apparatus 102 if the vehicle data bus 108 is severed in a serious crash. *See* Lobaza, 5:1-20.

135. Lobaza's invention therefore provides for a "signal reflective of a determined imminent impact". Lobaza, 7:63-64. This pre-impact signal triggers functionality in the telecommunication apparatus dedicated to the pre-impact feature that would not be present without the pre-impact system: The telecommunication apparatus verifies whether it can still communicate with the impact detection controller. If not, it concludes that the imminent impact may have materialized and alerts the service center.

136. Lobaza's pre-impact system 104 could not be retrofitted for two reasons: A) Lobaza's system must distinguish between a "pre-impact signal" and a "post-impact" signal. The impact detection controller (second apparatus) does not transmit a pre-impact signal that a retrofitted pre-impact system could spoof. On the other hand, spoofing the impact detection controller's post-impact signal would lead to an immediate notification of the service center, and not trigger the telecommunication apparatus's (first apparatus) unique "pre-impact" functionality. B) The telecommunication apparatus 102 (first apparatus), the impact controller 106 (second apparatus), and the pre-impact system 104 ("retrofit apparatus") are part of *an integrated system* in which each module has a specific role. Without Lobaza's pre-impact system 104, there would be no "1. Imminent impact signal". The telecommunication apparatus 102 would not know to ask the "2. Are you there ?" question, and the impact detection controller 106 would not know to answer with a "No crash" response. Lastly, the telecommunication apparatus 102 would not be programmed to assume a worst-case scenario of a damaged vehicle data bus and call for help. All three modules must be programmed to support Lobaza's pre-impact functionality. Consequently, Lobaza's vehicle cannot be retrofitted into an existing vehicle by adding just the pre-impact system 104. The impact detection controller 106 and the telecommunication apparatus 102 would also have to be replaced, which is not what the '505 patent claims.

XII. CONCLUSION

137. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code.

Date: Aug. 29, 2020

Respectfully submitted,

Mahdi Shahbakhti, Ph.D.