Based on the data and engineering analysis conducted to date, this Issue has the potential to occur when all of the following three conditions are met (1) specific Occupant Restraint Controller ("ORC")/Application Specific Integrated Circuit ("ASIC") design; (2) front impact sensor cross-car wire routing; and (3) certain crash events.

To FCA US's knowledge, this Issue has not occurred in (1) other 2010–2014 MY vehicles with the same ORC/ASIC with front sensor wiring routed independently along the left and right side of the vehicles (2009-2012 MY Ram 1500 ("DS"), 2010–2012 MY Ram 2500/3500 ("DJ/D2"), 2011–2012 MY Ram 3500/4500/5500 Cab-Chassis ("DD/DP"), 2010–2014 MY Jeep Wrangler ("JK"), 2010–2012 MY Dodge Nitro ("KA"), 2010–2013 MY Jeep Liberty ("KK"), 2012–2016 MY Fiat 500 ("FF")); or (2) any Dodge Caliber ("PM"), Chrysler 200, Chrysler Sebring and Dodge Avenger ("JS") or Jeep Compass and Jeep Patriot ("MK") vehicles prior to 2010 MY which have a different ORC/ASIC design but the same front impact sensor cross-car wire routing.

The investigation was initiated in April 2015 and included review of (1) 10 crash events and one third-party barrier test (e.g., IIHS small overlap rigid barrier test of 2012 MY MK), (2) bench and in-vehicle transient testing, (3) supplier ORC analysis, (4) Event Data Record ("EDR") review, (5) warranty and production build data, (6) wiring design and layout changes for the subject population, (7) ORC design and changes for the subject and non-subject populations, (8) Customer Assistance Inquiry Record ("CAIR") system, (9) event timing analyses, and (10) temperature and geography considerations.

The chart below is a summary of the 10 crash events and one third-party barrier test that were the focus of the investigation due to suspected ASIC Electrical Overstress ("EOS"). The chart identifies whether ASIC EOS was confirmed, if an EDR was written and airbag deployment status.

NOTE: FCA US LLC ("FCA US") engineering did not have access to all of the vehicles or ORCs identified below. The Incidents will be referred to throughout the chronology below by way of their letter designation.

Incident	Vehicle Make/Model	Model Year	ASIC EOS	Airbags Deployed	CDR Present
A	JEEP PATRIOT	2012	Yes	No	No events recorded
B	DODGE AVENGER	2012	Yes	No	No events recorded
C	JEEP PATRIOT	2012	Yes	Yes	Interrupted
D	JEEP PATRIOT	2012	Yes	Yes	Interrupted
F	CHRYSLER 200	2012	Yes	No	No events recorded
G	CHRYSLER 200	2012	Yes	No	No events recorded
H	DODGE AVENGER	2011	Suspected (*)	No	No events recorded

I	JEEP COMPASS	2014	Suspected (*)	No	No events recorded
J	JEEP COMPASS	2012	Unknown	No	Unknown
K	CHRYSLER 200	2013	Suspected (*)	No	No events recorded
M	CHRYSLER 200	2012	Suspected (*)	No	No events recorded

(*) ASIC EOS is strongly suspected; however, FCA US was unable to obtain ORC for analysis

A detailed timeline of the FCA US Vehicle Safety and Regulatory Compliance ("VSRC") organization's investigation and review (as summarized above) follows:

- On April 6, 2015, FCA US engineering contacted the VSRC about the analysis of two ORCs involved in frontal collisions with no airbag deployment which did not communicate with the Crash Data Retrieval ("CDR") tool. FCA US became aware of these two crash events (i.e., Incidents A and B) through its U.S. Office of General Counsel ("OGC").
- FCA US engineering confirmed ASIC EOS in the two ORCs from Incidents A and B. Neither Incident A nor B had an EDR record.
- On April 8, 2015, FCA US engineering contacted the VSRC about an IIHS small overlap rigid barrier test conducted on a 2012 MY MK (Incident C) because the ORC did not communicate with the CDR tool after the test although the supplier later retrieved a partial EDR record. The ASIC in this ORC also sustained ASIC EOS damage.
- In each of these three incidents (i.e., Incidents A, B and C), the damaged ASIC prevented the ORC's microcontroller from operating by drawing excessive current from the ORC power supply. This damage also explains why the ORCs could not communicate with the CDR tool.
- On April 8, 2015, FCA US also reviewed a document that had been submitted by the ORC supplier on May 30, 2013 (and previously reviewed by FCA US Engineering) addressing a potential warranty concern. The document described a potential condition of ORC ground offset and intermittent power connection (while a front acceleration sensor signal wire is shorted to vehicle ground) that may cause ASIC EOS. The document recommended countermeasures that were later implemented in production.
- On April 15, 2015, FCA US engineering informed the VSRC of a design change introduced on 2015 MY MK, JK, PF and KL and 2016 MY UF vehicles to improve the robustness of the ORCs against ASIC EOS as a quality improvement in response to an unrelated issue.
- On April 15, 2015, the VSRC was made aware of six potentially related field incidents involving various frontal crash configurations associated with no frontal airbag deployment. These Incidents (i.e., Incidents D -J) came into FCA US through the OGC.
- From April 15, 2015, through August 31, 2015, the VSRC reviewed available police reports, vehicle photos, test video and EDR reports, if any, for Incidents A-J and conducted laboratory and other tests. A summary of the work, analysis and information from this timeframe is set forth below:
    - The ORC from Incident I communicated with the CDR tool based on the CDR report obtained. The ORC was not inspected for ASIC EOS damage because it was not available to FCA US.
    - FCA US was not given permission to analyze the ORCs from Incidents D, F or H for ASIC EOS damage during this period.
    - No ORC information was available about Incidents G and J during this period.

- Incident C was a confirmed ORC ASIC EOS. The crash was a 40 MPH 25% offset rigid barrier test performed by a third-party where airbag deployment occurred. The test is not required for regulatory compliance and the vehicle passed the test. After extensive analysis and review during this investigation, it was determined that the second stage airbag may not have deployed.
- FCA US inspected the 2012 MY JS vehicle involved in Incident B. The sensor signal wiring was pinched and the insulation was compromised in several locations throughout the wiring harness. Electrical conductivity was confirmed between the two front sensor connectors and the ORC connector. The resistance in the ground path from the ORC to the negative battery jump post was less than 10 milliohm.
- From April 16, 2015, to June 2, 2015, lab bench tests determined that 70 to 100 milliohms of resistance between the ORC ground and chassis (while a front sensor signal is shorted) is required to create an ASIC EOS failure during an intermittent power-feed condition of at least a 170 milliseconds.
- On June 12, 2015, the ORC supplier proposed that ASIC EOS failure could be caused by an electrical transient generated during the crash under the conditions of a front sensor signal wire and high current power feed simultaneously shorted to vehicle chassis and subsequently the power feed short opens.
- On June 26, 2015, the ORC suppler demonstrated in a lab bench test the conditions required to create a negative transient capable of creating ASIC EOS. The supplier indicated that a negative transient of -1.2 Volts to -2.0 Volts with duration of less 100 microseconds is sufficient to create an ASIC EOS failure in the subject ORC population.
- On June 30, 2015, FCA US inspected the 2012 MY MK vehicle involved in Incident A. The sensor signal wiring was pinched and the insulation was compromised in several areas. Electrical conductivity was confirmed between the sensor connectors and the ORC connector. The resistance in the ground path from the ORC to the negative battery jump post was less than 10 milliohm.
    - Based on the low resistance between the ORC ground and chassis measured on the vehicles from Incidents A and B, it was determined by FCA US engineering and the ORC supplier that resistive ground offset was not a contributor to the ASIC EOS failures.
- On July 29, 2015, FCA US simulated the conditions of a simultaneous shorted sensor signal wire and shorted high current power feed to vehicle chassis on an MK vehicle. When the shorted power feed condition was removed, transients of similar magnitude and duration that could cause an ASIC EOS failure were generated.
- On August 21, 2015, FCA US conducted a review of the sensor wiring architecture for the vehicle in the subject ORC population. It was determined that the left and right front sensor signal wires are routed together on the left-side of the vehicle between the engine compartment and fender on MK, JS and PM vehicles. The routing continues across the front left corner of the engine to the position of the left front sensor. The right front sensor signal wires continue across the front of the vehicle near the top of the radiator. Two high current power feeds for the anti-lock braking system are similarly routed across the front of the vehicle.
- Other vehicles using the same or similar ORC module were determined to have the left and right front sensors signal wiring routed independently along the left and right side of the engine compartment.
- On August 28, 2015, FCA US provided the ORC from Incident G to the ORC supplier for analysis.

    - On August 28, 2015, FCA US inspected the 2012 MY JS vehicle from Incident G. The wiring was compromised in several locations.
    - On August 31, 2015, FCA US examined the CDR from Incident I. No crash data was recorded. An active internal ORC fault was noted in the data record.
- On September 15, 2015, FCA US received a lab report from the ORC supplier confirming that a microcontroller reset occurs at the same instant a negative transient creates an ASIC EOS event.
- On September 18, 2015, FCA US was informed by the National Highway Transportation Safety Administration ("NHTSA") of a Vehicle Owner Questionnaire ("VOQ") concerning a 2015 MY MK vehicle involved in a frontal offset crash with a midsize sedan ("the VOQ Incident"). On February 23, 2016, FCA US received the CDR from NHTSA for this Incident. The ORC communicated with the CDR tool and two crash events were recorded.
- On September 25, 2015, FCA US determined through design analysis and inspection of JS and MK vehicles that no significant changes were made to the left and right sensor wiring routing between models years 2008 and 2014.
- On September 30, 2015, the ORC supplier determined that the failure can also result in an ORC that communicates with a CDR tool but has an active internal diagnostic trouble code related to an ASIC failure.
- On October 8, 2015, FCA US determined the driver- and passenger-side front airbags deployed during Incident D based on a picture obtained of the vehicle. It was not known at this time whether the second stage airbags deployed.
- On October 14, 2015, FCA US received a report from the ORC supplier confirming ASIC EOS failure had occurred on the ORC from Incident D.
- On October 14, 2015, FCA US reviewed the CAIR system and did not find any additional suspect crashes involving ASIC EOS and no airbag deployment within the vehicle population using the subject ORC/ASIC design.
- On October 28, 2015, FCA US received a report from the ORC supplier confirming ASIC EOS failure had occurred on the ORC from Incident G.
- On November 2, 2015, FCA US determined that vehicles, other than JS, MK and PM, with ORCs using the same subject ORC/ASIC design did not have high current anti-lock brake system power feeds in the same wiring bundles as the left- and right-front sensor signals.
- On November 17, 2015, FCA US received a lab report from the ORC supplier confirming ORCs with certain ASIC EOS robustness improvements can withstand negative voltage transients up to approximately -15 Volts without failure; however anomalies are observed; compared to the subject ORCs which exhibit failures starting at approximately -1.2 Volts.
- On November 18, 2015, FCA US received a report from the ORC supplier confirming ASIC EOS failure had occurred and an active internal diagnostic failure related to ASIC EOS was present in the ORC from Incident F.
- On December 14, 2015, FCA US determined other ORCs that are not in the subject population are capable of withstanding negative transients on the sensor signal inputs up to approximately -14 Volts or greater before anomalies appear.
- On December 15, 2015, the VSRC was informed of a potentially related crash involving a 2013 MY JS vehicle, referred to as Incident K.
- From January 4, 2016, to January 28, 2016, FCA US reviewed CAIR claims of no airbag deployment in frontal collisions involving 2008–2009 MY JS and 2007–2009 MY MK vehicles and found no suspected incidents of ASIC EOS.
- On February 18, 2016, a representative from FCA US inspected the vehicle involved in Incident K. The ORC from this vehicle did not communicate with the CDR tool.
- On March 3, 2016, FCA US met with NHTSA to discuss the status of the investigation and analysis.

- On March 7, 2016, FCA US inspected the 2012 MY JS vehicle involved in Incident F.
- On March 9, 2016, FCA US completed an analysis of crash event timing to estimate when the ASIC EOS occurred during Incidents C and D. Based on the amount of data written in the partial EDR retrieved from the ORCs, the timing of the ASIC EOS was estimated relative to the command given by the ORC to deploy the first stage airbag.
    - In the case of Incident C, the data indicated that the ASIC EOS occurred just before or after the second stage deployment command was given by the ORC, potentially inhibiting passenger second stage airbag deployment.
    - In the case of Incident D, the data proved that the ASIC EOS occurred before the second stage deployment command was given by the ORC, inhibiting passenger second stage airbag deployment and potentially inhibiting driver second stage airbag deployment.
- On March 31, 2016, FCA US and NHSTA inspected the vehicle involved in the VOQ Incident. The CDR was imaged from the ORC.
- On March 31, 2016, the ORC supplier transferred the integrated circuit which retains crash record data from Incident K's ORC to a recipient ORC. The CDR retrieved from the recipient ORC did not contain a crash record.
- On May 5, 2016, FCA US and NHTSA conducted a second inspection of the VOQ Incident vehicle. NHTSA took possession of the ORC.
- Between the March 3, 2016, NHTSA meeting and June 1, 2016, FCA US continued its investigation, focusing on timing aspects of ASIC EOS events.
- On June 1, 2016, NHTSA transported the ORC from the VOQ Incident vehicle to the ORC supplier where an image of the internal memory was performed.
- On June 15, 2016, FCA US received the ORC supplier's translation of the data imaged from the VOQ Incident vehicle ORC which took place on June 1, 2016.
- On June 29, 2016, FCA US met with NHTSA and determined, based on the CDR and data imaging from the ORC supplier, that the VOQ Incident was not related to an ASIC EOS issue.
- On July 12, 2016, FCA US and the ORC supplier reviewed the data and conclusions of the investigation.
- On July 18, 2016, the ORC supplier provided additional information regarding wiring and calibration changes which may have influenced the occurrence of ASIC EOS and/or airbag and pretensioner deployment during certain crashes.
- Since July 18, 2016, FCA US has continued to analyze and discuss these topics with the ORC supplier with no change in conclusion.
- On August 9, 2016, FCA US engineering determined that the additional information provided by the ORC supplier did not alter its current analysis with respect to the investigation.
- The root cause of the ASIC EOS failures was determined to be a combination of the relative susceptibility of the subject ORC ASIC to negative transients and the front acceleration sensor signal cross-car wire routing. Based on analysis and testing to date, the subject ORC/ASIC design and front impact sensor cross-car wiring appear to be contributing factors in certain crash events for the occurrence of ASIC EOS, resulting in the potential loss of airbag and seat belt pretensioner deployment capability in such events.
- On August 16, 2016, the VSRC was presented to the FCA US Vehicle Regulations Committee. The Vehicle Regulations Committee asked for additional data, information and analysis.
- Between August 16, 2016, and September 2, 2016, in response to the Vehicle Regulations Committee's request for additional information, the investigation team conducted further review and analyses of existing data, including (1) review of the 10 crash events and the IIHS small overlap rigid barrier test of the 2012MY MK, (2) bench and in-vehicle transient testing, (3) review of supplier ORC analysis, (4) review and confirmation of subject vehicle EDR data, (5) warranty and production

build data, (6) wiring design and layout changes for the subject population, (7) ORC design and changes for the subject and non-subject populations, (8) CAIR system, (9) temperature and geography considerations, and (10) continued its event timing analyses of Incidents C and D and the exhibited deformation patterns of the vehicles from Incidents B, C, D, F, H, and K, concluding that ASIC EOS may contribute to loss of airbag and seat belt pretensioner deployment capability in certain crashes.

- The suspect period was established as February 24, 2009, start of production ("SOP") for the 2010 MY MK vehicles to August 13, 2014, end of production ("EOP") for the 2014 MK vehicles at Belvidere Assembly Plant ; August 10, 2009, SOP for the 2010 MY PM vehicles to December 17, 2011 EOP for the PM vehicles at Belvidere Assembly Plant; February 18, 2009, SOP for the 2010 MY JS vehicles to February 14, 2014, EOP for JS vehicles at Sterling Heights Assembly Plant.
- The vehicles in the subject population utilize ORCs with the subject ASIC design and have similar front sensor cross-car wiring design.
- As of September 2, 2016, FCA US identified approximately five CAIRs, zero VOQs and five field reports related to this issue.
- As of September 2, 2016, total warranty is zero at 0 c/1000.
- As of September 2, 2016, FCA US is aware of three fatalities and five injuries potentially related to this issue.
- On September 6, 2016, FCA US determined, through the Vehicle Regulations Committee, to conduct a voluntary safety recall of the affected vehicles.

Reviewer	Initials	Reviewer	Initials
☒ Team Lead (Jonik, Marck, Cowser, Hendler, Plante)		☐ MGR Product Investigations (David Smith)	
☐ Manager (Jen Shute, Cheryl Fry)		☐ OGC (Alan DeGraw)	
☐ Technical Writer (Gabrielle Elser)		☐ Head Vehicle Safety & Product Analysis (Thomas McCarthy)	