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## **Background information regarding Toyota EDRs**

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## **Background Concerning EDRs**

Event Data Recorders (EDR) have been utilized by the automobile industry since the early 1990s to gather real-world data on the performance of various vehicle safety systems. The EDR is part of the airbag control module which is usually located in the center structure of the vehicle. EDR functionality was initially confined to the collection of data used to determine when to fire an airbag. This data typically pertained to the “post-crash” regime—after the airbag control module was enabled by an impending crash. As airbag systems increased in sophistication, information from the pre-crash regime was also captured. Pre-crash information gives insight concerning the driver’s actions and vehicle performance during the time immediately prior to an impact. Accordingly, pre-crash data offers objective information when investigating allegations of UA and pedal entrapment.

To support the UA analysis, NHTSA investigators used EDR readout tools obtained from Toyota to image pre-crash data from Toyota vehicles’ airbag control module. EDR data can be imaged in two ways; the first is to image the pre-crash data without removing the airbag control module from the vehicle. If the vehicle is intact enough to be powered on its own and the ignition keys are available, the EDR readout tool is connected to the vehicle through the Onboard Diagnostic (OBD) port<sup>1</sup>—the same location used by technicians or emission testing facilities to retrieve diagnostic trouble codes and vehicle performance data. The readout tool software copies and processes the data from the EDR and generates a report that includes a graphical/tabular display of vehicle data in the 5 seconds prior to vehicle crash or threshold vehicle deceleration, additional information concerning the vehicle’s airbag and control systems at the time of the incident, and deceleration data during the post-crash regime. If the vehicle cannot provide power to the airbag control module (e.g., excessive crash damage, absence of ignition keys), the airbag control module can be physically removed from the vehicle and the EDR pre-crash image is retrieved using the EDR readout tool interface cord. NHTSA does not retain airbag control modules<sup>2</sup> that it removes from vehicles without the express consent of the vehicle owner.

The EDR deployment algorithm can “enable” under various circumstances that include non-crash impacts such as curb and pothole strikes. While non-crash impacts may enable an EDR’s algorithm and cause it to store data, heavy vehicle acceleration or braking (without impacts) will not. EDRs may record a wide range of data elements, potentially including whether the brakes were applied, vehicle speed at the time of impact, and whether seat belt circuits were shown as “Buckled” or “Unbuckled” at the time of the crash.

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<sup>1</sup> Also referred to as the Diagnostic Link Connector (DLC)

<sup>2</sup> Strictly speaking, the EDR is a subcomponent of the airbag control module. Within this report, the two terms will be used interchangeably.

Pre-crash data of particular interest when reviewing a UA incident include brake light switch status, accelerator pedal voltage, engine rpm, and vehicle speed.

With respect to Toyota vehicles equipped with pre-crash capability, vehicle speed, accelerator pedal voltage, brake light switch status, and engine rpm are recorded at five- one second intervals prior to the crash. A sixth and final interval of data is recorded at algorithm enable (AE) or when the EDR senses an impact. The length of time between AE and the fifth data element is also recorded.

As part of the airbag control module, EDRs are on all the time but record data only during AE. The limited data recorded contains no location information or personal identifiers.

On Toyota model vehicles the storage area for data from each incident is referred to as either a ‘Page’ or a ‘Bank’. Depending on the vehicle model, Toyota EDRs can store two or three incidents. Once written to the EDR, crash data remain available for readout until overwritten by a subsequent incident. Data images are stored and overwritten in a first-in, first-out (FIFO) manner. Deployment of the airbag system locks the EDR, preventing any additional data from being written or deletion/overwrite of the data already stored. Blank data banks contain default data values which differ<sup>3</sup> depending on the vehicle model (and EDR supplier). In some cases, multiple pages of pre-crash data are recorded during the same incident with varying degrees of overlap. These can frequently be reconciled against each other after a comparison of the data and the scene facts.

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<sup>3</sup> Some default values are non-zero. For example, certain TRW- supplied EDR default values are 6,000 rpm and 78.3 mph