Malta Police Training

EDRs General Information

Event Data Recorder EDR is typically located as a feature inside the Airbag ECU

The main function of the EDRs is to read constantly the data related to the real-time driving parameters that a vehicle is subjected to. When a vehicle is subjected to an impact that exceeds its acceleration threshold, the captured data is stored on the Airbag Control Module, and can be later on retrieved through a specialized crash data retrieval tool.

Depending on the impact severity, the event can be divided into two main types being, non-deployment or deployment events. For non-deployment events, the impact is of low severity that the Airbag Control Module (ACM) does not command airbag deployment. This may be the case for bumper-to-bumper or the vehicle hitting a curb.

Secondly, as the name implies, a deployment event occurs when the vehicle is subjected to a certain impact that it exceeds the threshold and in turn, the ACM sends a signal to command airbag deployment. For both non-deployment and deployment events, data will be available for both pre and post-crash analysis. Such technology can be implemented on both private and commercial use vehicles and acts as a valuable and effective research tool for crash reconstruction and accident analysis. Some of its advantages as outlined by the same European Commission Council include; the knowledge using the traditional accident reconstruction methods was difficult or impossible to obtain, better understanding of new safety technologies, better evaluation of injury thresholds for a crashworthy vehicle design, provides information for researching into further detail the injury mechanisms and injury causes and it is also deemed useful for legal proceedings.

The NHTSA reported that the EDRs have been existing for approximately 50 years, with General Motors (GM) being in the front line for introducing this technology in their vehicles. In 1974, the year that the EDRs were invented, these promising devices had a very limited storage capability and were primarily invented to control and keep track of the sensors' data alongside with the airbag restraint system's deployment times and thresholds. Later on, this information stored on these modules would be retrieved by the OEMs and used for research purpose analysis only. Until recently, this data was not available for the general public. It was only in the 2000 calendar year that a readout gadget, referred to as the Crash Data Retrieval tool (CDR) was made available to the public and allowed them to connect with the module and retrieve the data stored within. GM was the first manufacturer to grant access to the general public to interpret and download the captured data from its EDRs when thresholds were met.

Subsequently, in 2003, Ford Motor Company was the second manufacturer to integrate the CDR application for the EDR's installed on-board its vehicle fleet. Later on, in 2008, Chrysler also announced that data from its EDRs would be downloadable through a publicly-available tool.

In 2001, Toyota started phasing EDRs in some of its vehicle models and by 2007 model year forward, all of the Toyota vehicles were equipped with EDRs. It was however after 2010 that all Toyota vehicle models were capable to record both pre and post-crash data as some models from earlier dates were only capable to record post-crash data only.

Nowadays, with the advancements in memory technology, EDRs' manufacturers have also improved their storage capacities which results in collecting a wider range of inputs over a larger time span. Amongst the key information captured by the EDR includes; status of various vehicle systems (which or if any airbags have been deployed and seat belt status i.e. buckled or unbuckled), driver inputs and activity prior to a crash (accelerator pedal angle, vehicle velocity and brake status) and the severity of the crash pulse (longitudinal delta-V in miles per hour or km per hour). Hence, when a minor accident or other catastrophic events occur and the threshold is met, irrespective whether the airbags have been deployed or not, the EDRs automatically save the last five seconds of data from the volatile to the non-volatile memory. Here, the data captured from an array of sensors and other electronic control units can be later on downloaded through the application of the CDR tool interface module which the latter, retrieves and interprets the non-volatile memory of the EDR while presenting it in a user-friendly format.

By the lapse of time, more and more car manufactures are introducing and implementing these event data recorders following its high potential in improving road and vehicle safety. In consequence of this, several governments in tandem with various consulting companies have spurred encouragement to make EDRs compulsory. In fact, on the 13th of December, 2012, a Notice for Proposed Rule-Making (NPRM) [11] published by the NHTSA stated that all light vehicles were required to be equipped with EDRs by the start of September 2014. Adding to this, following the EU General Safety Regulations of April 2019, the EU Parliament has also proposed and approved a law whereby the EDRs will become standardized on the modern vehicle fleet [12].

Miguel Tabone, "LABORATORY EXPERIMENTS OF VEHICLE CRASH DATA FROM EVENT DATA RECORDER AND ADDITIONAL CAN BUS DATA," Masters Dissertation, Mechanical Engineering, University of Malta, 2019.

Event Data Recorder (EDR) Performance Elements Appropriate for Adoption in 1958 and 1998 Agreements, https://unece.org/fileadmin/DAM/trans/doc/2020/wp29grsg/GRSG-118-13e.pdf

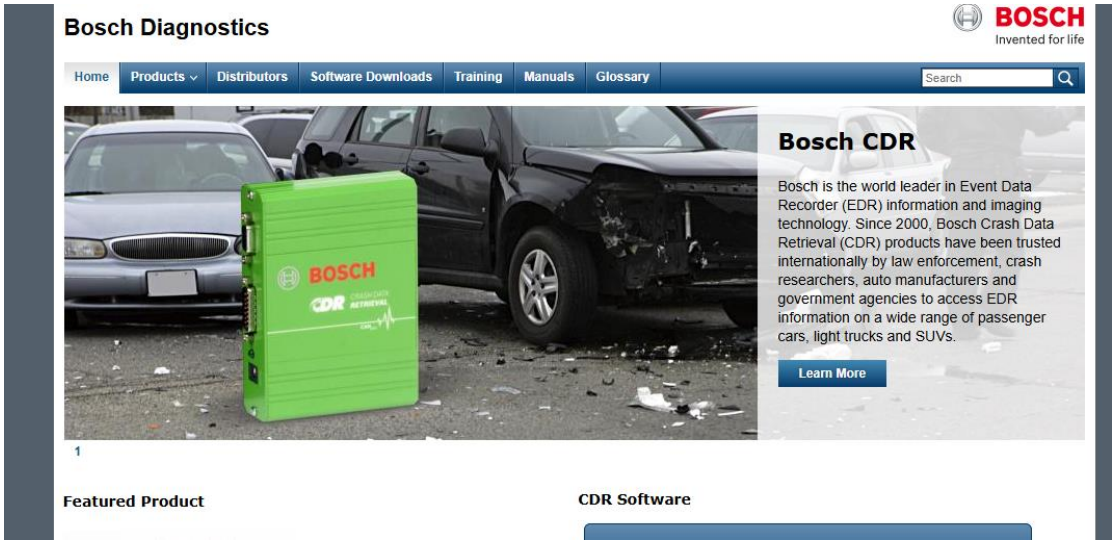
[7] NHTSA, "Analysis of Event Data Recorder Data for Vehicle Safety Improvement," in U.S. Department of Transportation, Springfield, Virginia, April, 2008.

European Commission, "Black Boxes/ In-Vehicle Data Recorders," Mobility and Transport - Road Safety. [Online]. https://road-safety.transport.ec.europa.eu/european-road-safety-observatory/statistics-and-analysis-archive/esafety/black-boxes-vehicle-data-recorders_en

European Parliament, “Parliament Approves EU Rules Requiring Life-Saving Technologies in Vehicles,” Press Room, 16th April 2019. [Online]. Available: http://www.europarl.europa.eu/news/en/pressroom/20190410IPR37528/parliament-approves-eu-rules-requiring-life-savingtechnologies-in-vehicles. [Accessed 15th June 2019].

Crash Data Retrieval CDR

Crash Data Retrieval CDR is a tool similar to a scan tool that is able to download the EDR data from the vehicle.
The Bosch CDR is a universal tool capable to communicate with a wide range of vehicles.



Laboratory tests on a Toyota Auris 2007

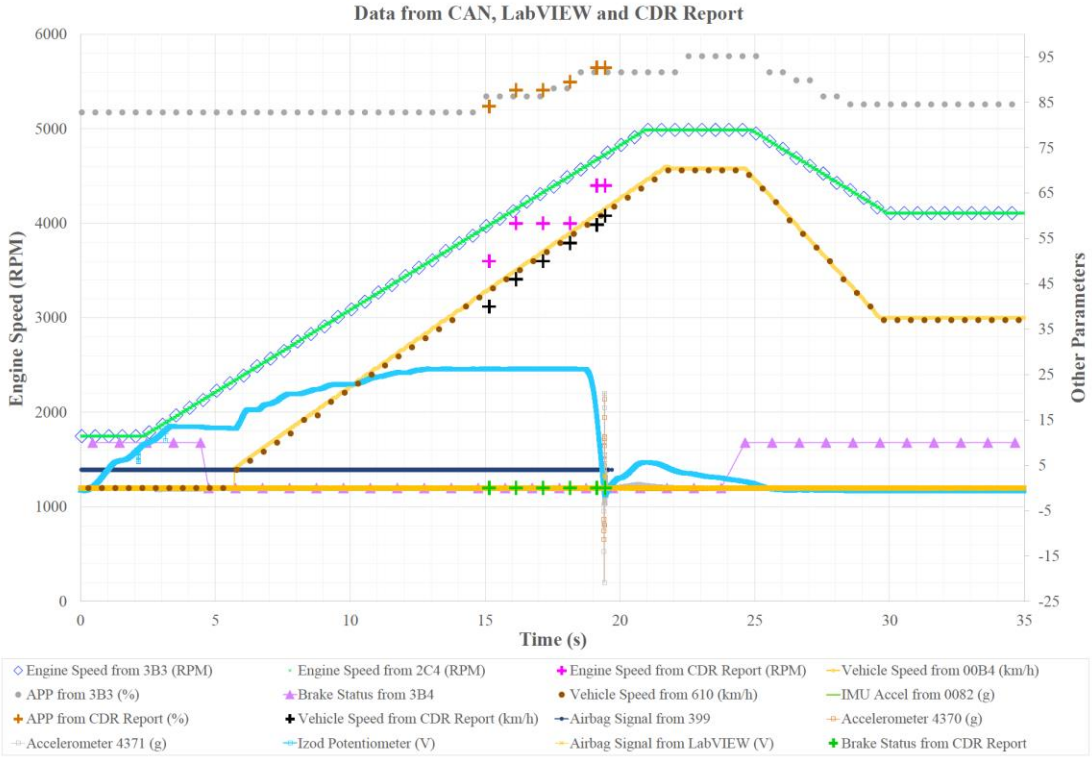
Experiments were performed in the lab on a Toyota Auris harness and the air bag module(in which the EDR feature is implemented) was subjected to many different tests. The over one hundred tests showed that the minor events can be overwritten as is well established in the literature. Vehicle speed was emulated by means of an Arduino circuit that provided pulses to the vehicle wheel speed sensors.
In this manner a number of statements in the data limitation section of the Auris EDR report could be validated and shown to be true. As example that the maximum value of vehicle speed recorded was 126 km/h and the speed increment is 2 i.e., only even numbers. Also vehicle speed reported is the average of the driven wheels.
It was confirmed that the EDR reported engine speed is in fact rounded down to the nearest 400 RPM increments as denoted in the Data Limitations.

Tabone, Miguel; Azzopardi, Jean Paul; Farrugia, Mario; Farrugia, Michael; “Laboratory Experiments Using a 2007 Toyota Auris Event Data Recorder and Additional Data from CAN Bus”, SAE technical

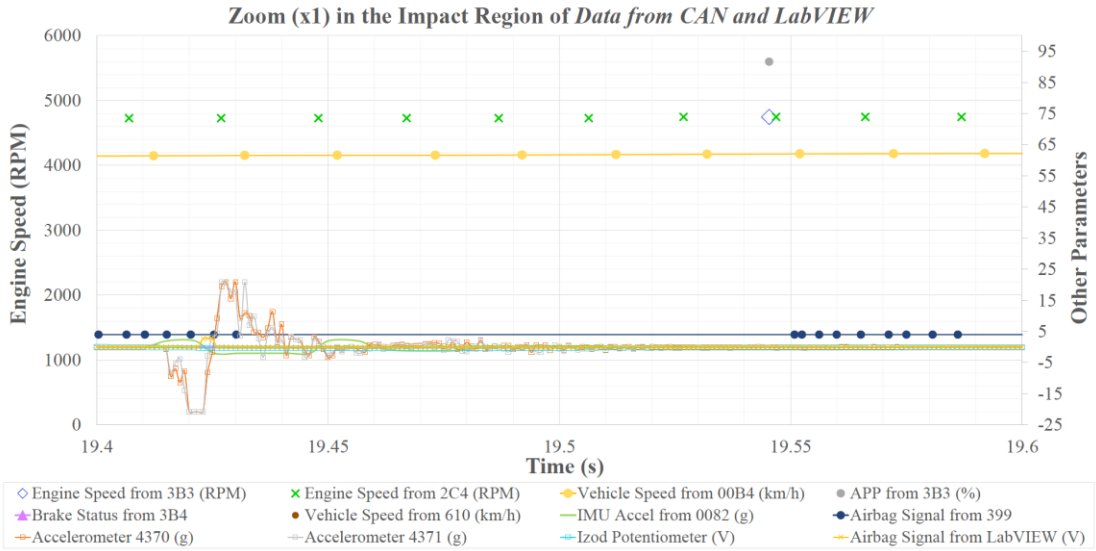
paper 2019-01-0635, WCX SAE World Congress Experience April 9-11 2019, Detroit, Michigan, USA, ISSN: 0148-7191, e-ISSN: 2688-3627, DOI: https://doi.org/10.4271/2019-01-0635
Miguel Tabone, Mario Farrugia, "Further Non-Deployment and Deployment Laboratory Experiments Using a Toyota Auris 2007 Event Data Recorder", SAE paper Number, SAE technical Paper 2020-01-1329, WCX SAE World Congress Experience April 21-23, 2020, Detroit, Michigan, USA,.

Therefore it is very important that the data limitations section is read well and understood.

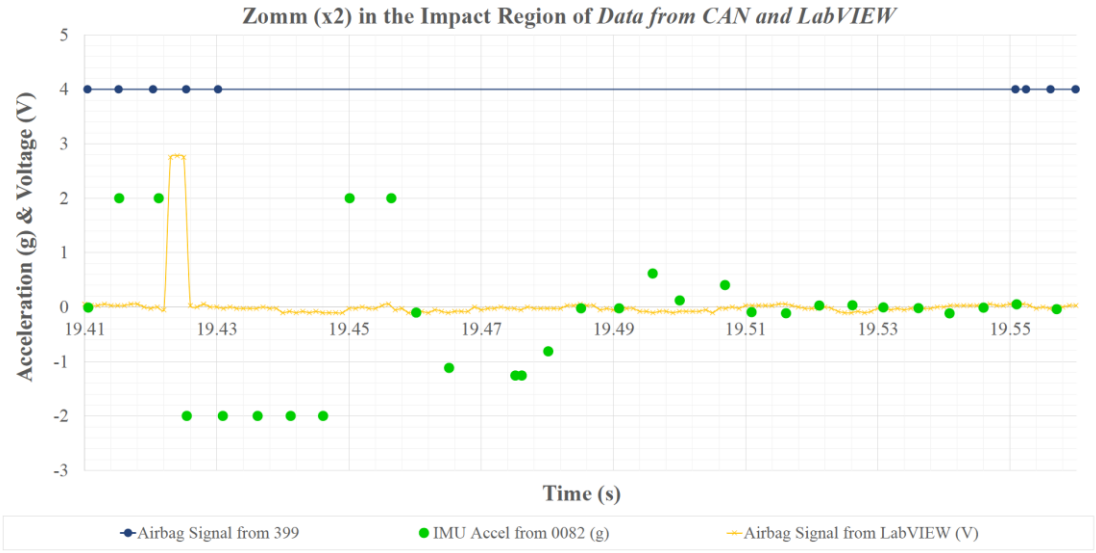
A major event was also done on this Auris Airbag Module and the data collected from the EDR was cross checked with data obtained from laboratory equipment such as piezo electric accelerometers. The data collected showed good agreement



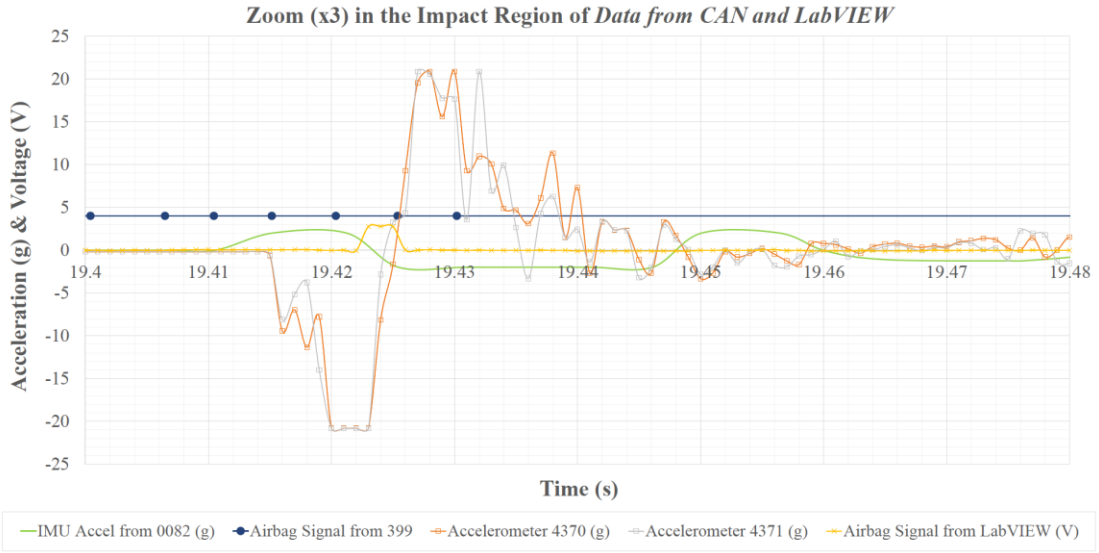
A whole plot for the parameters acquired from CAN, LabVIEW and CDR Report, while having all the data perfectly synchronised in time. Figure 89 from Miguel Tabone masters dissertation



A zoomed plot in the impact region of Figure 89. Figure 90 From Miguel Tabone's dissertation.



A further zoom in the impact region of Figure 90. Figure 91 from Miguel Tabone's dissertation.



A further zoom in the impact region of Figure 91 while replotting both 4370 and 4371 accelerometers' response. Figure 92 From Miguel Tabone's dissertation

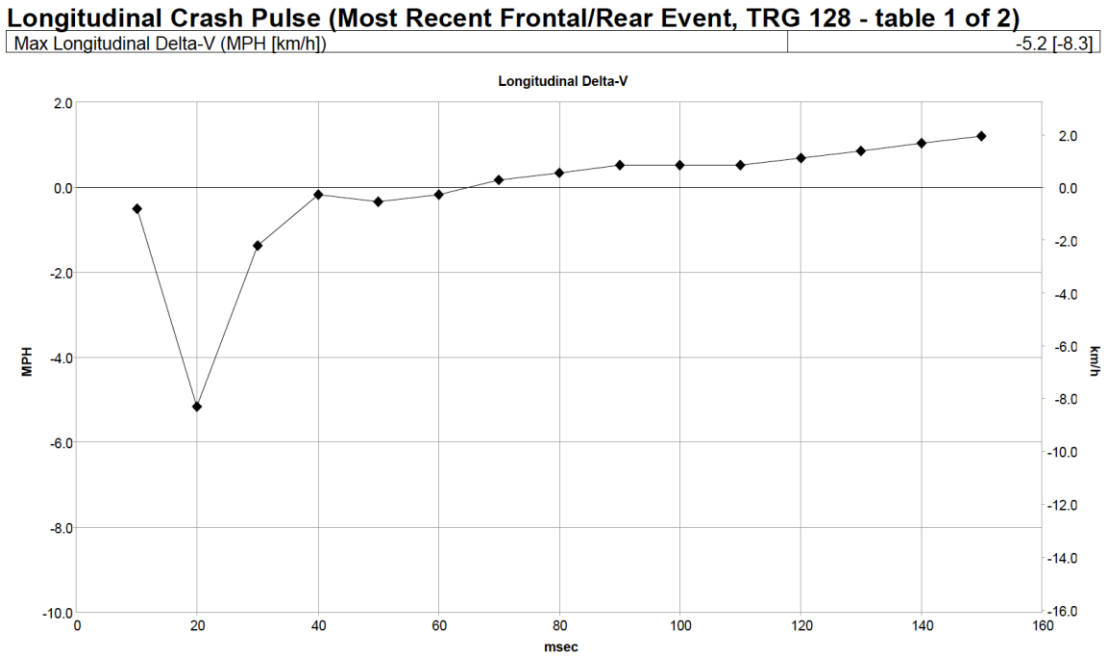
Post-Crash Data from CDR Report

The CDR also obtained the post crash data of the impact from the EDR. Most imporatantly this is the delta v information.

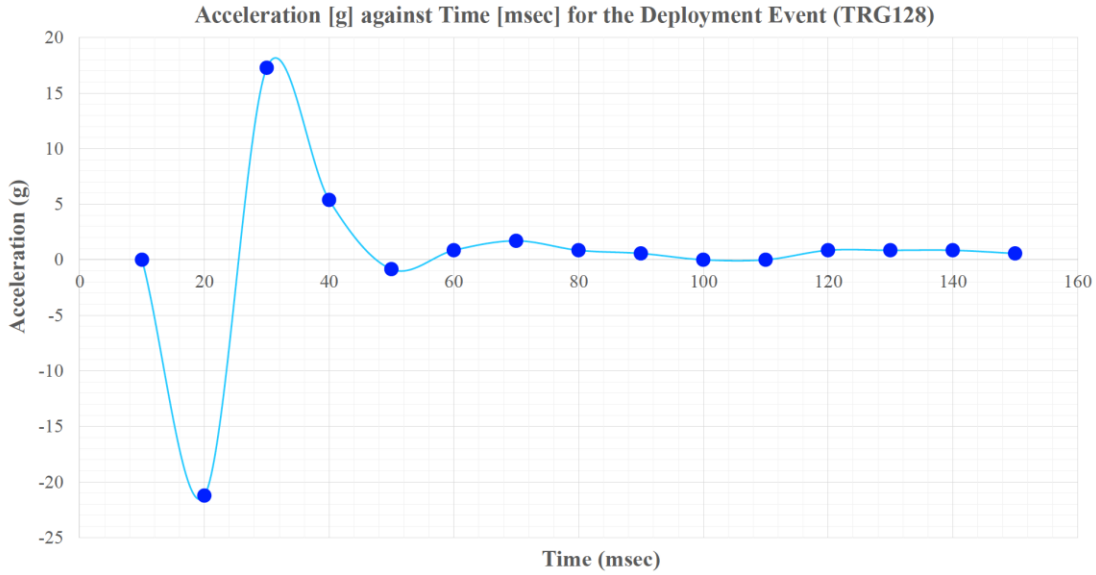
7.3.4 Post-Crash Data from CDR Report

The post-crash data section for the CDR report generated for this test was also plotted. Here, the Longitudinal delta-V in km/hour was translated to acceleration in *g*'s and the resultant plot is shown in Figure 94. It was noted that the maximum acceleration recorded by the 02EDR was −21.237 7.

Comparison could be made with the 4371 and 4370 external piezoelectric laboratory accelerometers, which recorded −20.847 7 and −20.872 7 respectively.



CDR report screenshot for the longitudinal crash pulse [15]. Figure 93 from Miguel Tabone's dissertation.



A plot for the post-crash data section denoted in this test's CDR report (TRG128) with translated Longitudinal delta-V [km/h] to acceleration [g]. Figure 94 from Miguel Tabone's dissertation.

To obtain Acceleration from delta V EDR data, it is noted that the delta V is actually cumulative delta V .
Change the delta V km/hr to delta V in m/s by multiplying by 1000 and dividing by 3600.
Then the change in velocity over the time step is found by subtracting the Delta V at step i minus Delta V at step i-1. Divide the value by the time interval between step I and step i-1. This is the acceleration in m^2/s. To change acceleration in to number of g's divide by g 9.81.