

EDR Key Cycles - Is this recording from my event? Perspective over 20 years....

When EDR first became accessible in 2000, General Motors was the only manufacturer supported, not all EDR's even reported event recording complete, the recording threshold was very low (any algorithm wake up), we had only one ND space in memory and we only had X Delta V magnitude in frontal airbag algorithm wakeups (negative Delta V_x). In that world of many unrelated spurious recordings, we came to rely heavily on key cycles to help us determine if the recording was from our event, or at least to rule out those that were clearly NOT from our event.

Occasionally, a crash record would be read where the data seemed to match our event, but the key cycles didn't match, perhaps by as many as a few hundred key cycles. In these cases we theorized that if the key was left on after the crash, and the voltage bled down slowly, that when it got to 9.0 volts (the voltage where most automotive microprocessors shut down), the current draw went to zero, causing the voltage to come back up slightly, which turned everything back on again. Then the current draw would increase again, and the voltage would drop below 9 volts again, and the system would turn off again. This "dithering process could repeat hundreds of times in relatively short order. If the reader finds many extra key cycles, in a file that otherwise seems appropriate, I would advise to charge the battery back up to 10+ volts and let it decay through 9 volts again, then read it out again and see if more key cycles were added. I have offered this test or check many times in the past. Only once I received a call back and was told that this dithering process replicated successfully. On the other hand, no one ever called to say it didn't work. It is likely that the rest likely just used the explanation offered (hopefully after checking to make sure their key was on and the battery was now below 9V) and wrote off the discrepancy.

Recently it seems like we are hearing of more of incidents of dithering where the key cycles don't match but the recording is clearly from our event. I suspect this is because we as a community are doing more readouts of more supported vehicles than ever before. This writeup counsels that **we still pay attention to key cycles**, but we live in a different world today where it is much easier to determine if a recording is from our event even if the key cycles do NOT match.

1. The recording threshold for MOST manufacturers is now a **5mph Delta V** over 150ms – so there are NO "spurious" recordings anymore that we need to dismiss.
2. The larger the total Delta V and the more devices that deployed which match physical evidence, the more certain we are that a recording is from our event. A recent case with a 63 key cycle discrepancy had a 30 mph Delta V and frontal airbag deployment. Most vehicles are not repaired and put back into service after a 30mph Delta V, and such an extensive and expensive repair would normally show up on a CARFAX, so check that. Using the average key cycle count per day of 7, 63 key cycles would translate to 9 days of normal driving before the event under investigation. NHTSA data indicates there are 7 airbag deployments per 1000 vehicles per year, or about 1 deployment per 140 years. The odds of having had a second deployment crash within 9 days are 9/365 times 1/140 or about 1 in 5700.
3. All Part 563 intent vehicles have **both X and Y Delta V** in both positive and negative directions, so we can calculate a total Delta V and PDOF to compare to our physical crash damage to better determine if a recording is from our event.

4. Some manufacturers have **additional data elements like vehicle mileage** or lifetime operating timers or day date time or Toyota event record summary that specifically address whether a recording was recent. Fords also have a key on timer that can be matched to time/distance from vehicle start to crash location. Toyota includes data limitations that specifically advise the freeze signal (deployment) locks the recorder and will not let additional events in, and other manufacturers give rules for overwriting nondeployment events that give guidance on whether a new event would be expected to replace an older event in memory,
5. Some manufacturers also have additional data elements like **steering or yaw rate** to tie a recording to a crash. All these changes make it possible to tie a recording to our event even if the key cycles do not match perfectly.
6. If multiple events occur and are captured by the ACM, the relative timing and time distance analysis matching impact locations perhaps the best way to be certain your data is from your crash.

Key cycles that match is still a good indication that a recording is recent and most likely from our event. If they do not match, the other considerations above, and particularly total Delta V magnitude and PDOF direction from the arc tangent of Y over X, are valid reasons to discount a key cycle discrepancy.

In 2005 model year, GM changed some ACM families to only advance a key cycle if a CAN message that an OFF-RUN-CRANK cycle had been completed to advance the key cycle count. "The ignition cycle counter relies upon the transitions through OFF->RUN->CRANK power-modng messages, on the GMLAN communication bus, to increment the counter. Applying and removing of battery power to the module will not increment the ignition counter." Those vehicles are not subject to the dithering of ignition voltage. In addition, "note 6" GM vehicles do not advance the key cycle count based simply on battery voltage being applied (or battery voltage dithering). Some do not require the CAN bus message and do rely on IGNITION power and may still be susceptible to ignition power dithering. When the part 563 EDR regulation came into effect, the official definition of a key cycle became "the number (count) of power cycles applied to the recording device", so GM had to quit using the "off-run-crank" CAN message as its counting method and revert to "The ignition cycle counter will increment when the power mode cycles from OFF/Accessory to RUN. Applying and removing of battery power to the module will not increment the ignition cycle counter."

Other recent quirks in key cycles include key cycles at investigation less than key cycles at event. GM 2010 SDM 10 data limitations say

-Ignition Cycles At Event may be reported higher than Ignition Cycles At Investigation. This is due to the way Ignition Cycles At Investigation is written during a vehicle power loss situation.

Event Data (General)

Ignition Cycles At Investigation	22331
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Event Data (Event Record 2)

Ignition Cycles At Event	22334
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Chrysler has a warning in their data limitations that key cycles may not match exactly.

Other unusual situations have occurred when a new ACM has been installed that begins counting from zero, but the lifetime key cycle counter kept in another location (such as the body control module) has a significantly higher value than the ACM counter at event.

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