Accuracy and Timing of 2013 Ford Flex Event Data Recorders
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Purpose

• The Autoliv RC6 family of EDR’s in the 2010-14 Flex was the first to record Stability Control System Inputs at 0.1 second intervals.
• The testing measures and reports the accuracy of these new data elements, in addition to the usual speed data and evaluation of reporting time delays.
Two Step Test Process

• Drive 2013/4 Flex in steady state, hard braking, figure 8 and yaw conditions. Record VBOX speed and all vehicle CAN bus traffic on VECTOR data acquisition system. Compare VBOX speed to CAN bus speed.

• Go to laboratory. Mount ACM onto computer controlled linear sled. Replay CAN bus data from driving as the sled creates recordable events. Compare EDR data to CAN data and reference instrumentation.
Accelerometer mounted on test ACM and its Delta V used to synchronize with Delta V in CDR report.
CAN Speed and GPS Speed

- **GPS Speed (km/h)**
- **CAN Speed 0x07C (km/h)**

*Graph shows the comparison between GPS and CAN speed over time.*
EDR accepted accuracy is ±4%, this is much tighter.
Note truncation to whole km/h rounded to mph

<table>
<thead>
<tr>
<th>Times (sec)</th>
<th>Speed vehicle indicated MPH [km/h]</th>
<th>Accelerator pedal, % full</th>
<th>Service brake, on/off</th>
<th>Engine RPM</th>
<th>ABS activity (engaged, non-engaged)</th>
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</thead>
<tbody>
<tr>
<td>- 5.0</td>
<td>48 [78]</td>
<td>18.0</td>
<td>Off</td>
<td>1,460</td>
<td>non-engaged</td>
</tr>
<tr>
<td>- 4.5</td>
<td>48 [78]</td>
<td>15.3</td>
<td>Off</td>
<td>1,462</td>
<td>non-engaged</td>
</tr>
<tr>
<td>- 4.0</td>
<td>48 [78]</td>
<td>15.3</td>
<td>Off</td>
<td>1,464</td>
<td>non-engaged</td>
</tr>
<tr>
<td>- 3.5</td>
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<td>15.3</td>
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<td>non-engaged</td>
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<tr>
<td>- 3.0</td>
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<td>0.0</td>
<td>Off</td>
<td>1,468</td>
<td>non-engaged</td>
</tr>
<tr>
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<tr>
<td>0.0</td>
<td>0 [0]</td>
<td>0.0</td>
<td>On</td>
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</tbody>
</table>
ACM was dithered to create stability control system input
EDR Speed vs CAN vs VBOX

- Truncation
- Time Delay

Legend:
- Vehicle Speed (0x201)
- VBox GPS Speed
- CDR Reported Speed
CAN Bus speed and EDR reported speed versus GPS speed during hard braking from 113 km/h.
Min Time Delay CAN -> EDR: <0.1 Seconds
Max Time Delay CAN -> EDR: <0.5 seconds
Stability Control System Longitudinal Accel

![Graph showing longitudinal acceleration over time](image)
GPS Acceleration vs. CAN Longitudinal Accel
Yaw Rate CAN vs GPS in Figure 8

Note: CAN yaw rate was inverted
CAN Bus Yaw Rate vs. reference instruments (entire fixture rotated)
GPS Lateral Accel vs. Stability 2 (Figure 8)
Steering Wheel Can Bus Output vs. Input

\[ y = 0.05x - 1599.6 \]
\[ R^2 = 1 \]

\[ y = 0.0473x - 946.61 \]
\[ R^2 = 1 \]

\[ y = 0.0499x - 1598 \]
\[ R^2 = 1 \]
EDR Steering Data vs. CAN Bus
Steering data

![Chart showing steering data comparison between EDR and CAN bus]

- **CAN Steering**
- **CDR Reported Steering**
- **External Accelerometer*10**
- **VBox GPS Speed**
- **CDR Reported Speed**
Summary and Conclusions

• CAN bus reported steady state speed data lower than reference instrumentation by an average of -1.26 km/h with a range of -0.6 to -1.8 km/h.

• When the speed is truncated for reporting in the EDR, the difference to reference instrumentation becomes more negative to an average of -1.9 km/h (1.2mph) difference to GPS with a range of -0.8 to -2.9 km/h (-0.5 to -1.8 mph).

• Well within the +/-4% widely accepted as EDR speed accuracy

• Hard Braking Speed Data – A time delay of 0.0 to 0.5 seconds is possible
Summary and Conclusions 2

• Yaw Rate – Vehicle CAN bus Yaw rate closely tracks GPS calculated yaw rate.
• Longitudinal Acceleration-The EDR longitudinal acceleration closely tracked a dithering +/-0.5G input on the stroker fixture.
• Steering Angle – Actual steering angle magnitude closely tracked CAN bus reported steering angle.
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