European State of the Art for AEBS systems

Stuttgart, May 2008
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Active Brake Assist – demonstration

- Optic warning
  - ACC - acoustic double alert
  - Intermittent acoustic warning
  - Haptic warning (-3 m/s²)
  - Permanent acoustic warning
  - Emergency braking
  - Horn and hazard flasher

Source: TP/EMD
## AEBS (Active Brake Assist) in a nutshell

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation</td>
<td>IAA 2006</td>
</tr>
<tr>
<td>Product Launch</td>
<td>12/2006</td>
</tr>
<tr>
<td>Approx. driven kilometer at customer</td>
<td>&gt; 1.600.000.000</td>
</tr>
<tr>
<td>Feedback from customer</td>
<td>positive</td>
</tr>
<tr>
<td>Feedback from public</td>
<td>positive</td>
</tr>
<tr>
<td>Claims</td>
<td>sporadic after launch, not qualified</td>
</tr>
<tr>
<td>Efficiency</td>
<td>sporadic reports from drivers, first tendencies from statistics very</td>
</tr>
<tr>
<td></td>
<td>promising</td>
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</tbody>
</table>

Source: TP/EMD
AEBS (Active Brake Assist) – public feedback

- Nomination for German Future Award 2002 (Innovation Award)
- Gelber Engel 2007 (Innovation Award from ADAC)
- Safety Award of Autosalon Brussels
- European Safety Award for Heavy Duty Vehicles 2007
AEBS (Active Brake Assist) – functional overview

- **Optic warning**
- **Acoustic warning**
- **Radio/phone - mute**
- **Haptic warning**

**Driver’s activities I**
- Using turn signals, braking or accelerating before or while warning phase 1 – 3 reduces system reaction to optic warning.

**Driver’s activities II**
- Kick Down interrupts even emergency braking.

**Driver’s activities III**
- System can be switched off at any time

**Reaction on driver’s activities**
Active Brake Assist - customer reaction

- Customer reaction has been evaluated explicitly after start of production.

- Customer reaction mainly positive about complete system layout of ACC and Active Brake Assist. Difficult to distinguish between ACC and ABA.

- Warning level is acceptable.

**General:**
Driver is satisfied with system performance.

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(Literally) Since truck is mainly used in Italy, warnings are issued more often, but this is caused by the driving behavior /mentality of drivers, who are used to overtake trucks and cut in close to the truck. Spurious (false) warnings are seldom.

**Drivers additional comment:**
Driver is more willing to abstain from his TV than from ABA/ART

**Positiv:**
System is always switched on.

**Negativ:**
Early warnings while tailgating.
Active Brake Assist – technical attributes

**Feature**
the system has the capability to be switched off at any time.

**Rationale:**
- According to the „Vienna convention“ the driver shall be capable in any situation to control the vehicle.
- If the system design leads to a significant level of “early” warnings in some traffic situations, better acceptance can be achieved, if the is driver able to switch off the system temporarily.
- The proven layout gives in practice a switched off rate of 1% or less, so the “off – switch” does not reduce the efficiency of the system significantly.
Active Brake Assist – technical attributes

**Feature**
the system is using a warning cascade in advance to the emergency braking, drivers reaction during the warning cascade interrupts the warning cascade and reduces system reaction to optic warning and therefore avoids the emergency braking.

**Rationale:**
- One intention of the system should be to initiate drivers reaction to avoid the critical situation that requires emergency braking.
- The warning must be early enough to enable drivers reaction.
- There are a lot of signals and warnings from integrated or nomadic devices, system HMI must raise the urgency of the situation suppressing all other signals. (This is not a matter of loudness!)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tr>
<td>Optical warning</td>
<td>Acoustic warning</td>
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<td>Radio/phone - mute</td>
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![Diagram showing the stages of active brake assist](image-url)
Active Brake Assist – technical attributes

Feature

the system is recognizing moving targets (cars, trucks, motor cycles, as long as they are moving and even if they come to a complete stop.
The system is up to now not recognizing targets that were never detected moving faster than 10km/h.

Rationale:

• The main use case for AEBS systems is highway traffic, where platoon driving is a usual way of traveling for trucks, therefore observing moving targets allows a high efficiency.

• To exclude additional risk of accidents braking by fault must be avoided under all circumstances. Even the correct recognition of moving targets in the majority of all traffic scenarios needs a lot of experience (7 years of development, several millions of test kilometers).

• Since critical situations with stationary targets involved are more seldom and much harder to detect correctly, the system design excludes targets that were never detected traveling faster than 10km/h.
Active Brake Assist – technical attributes

Feature
the system is designed to reduce the number of accidents therefore able to handle differential speeds higher than 70km/h (Accident Reduction System)

Rationale:
• The main use case for AEBS systems is highway traffic, where truck speed is restricted to 80km/h.
• Due to the high mass involved in truck accidents even collisions with low differential speed can lead to significant harms, pure collision mitigation systems are falling short in avoiding fatalities.
• Due to physical restrictions (friction, road curvature, traffic behavior, …) collision avoidance can not be achieved in all cases, therefore the target is to reduce the numbers of accidents as much as possible.
Active Brake Assist – technical attributes

**Feature**

_system has been introduced to vehicles using at least one (the rear) axle air-suspended.

**Rationale:**

- To avoid performance reduction or misbehavior the forward looking sensor must be kept with high accuracy in a direction parallel to the road surface.
- For steel-suspended vehicles it can not be guaranteed that for all load conditions the chassis remains in a direction parallel to the road surface.
- With the sensor chassis-mounted it is necessary to control the chassis position, what can be achieved by a chassis level control system based on at least one axle air-suspended.