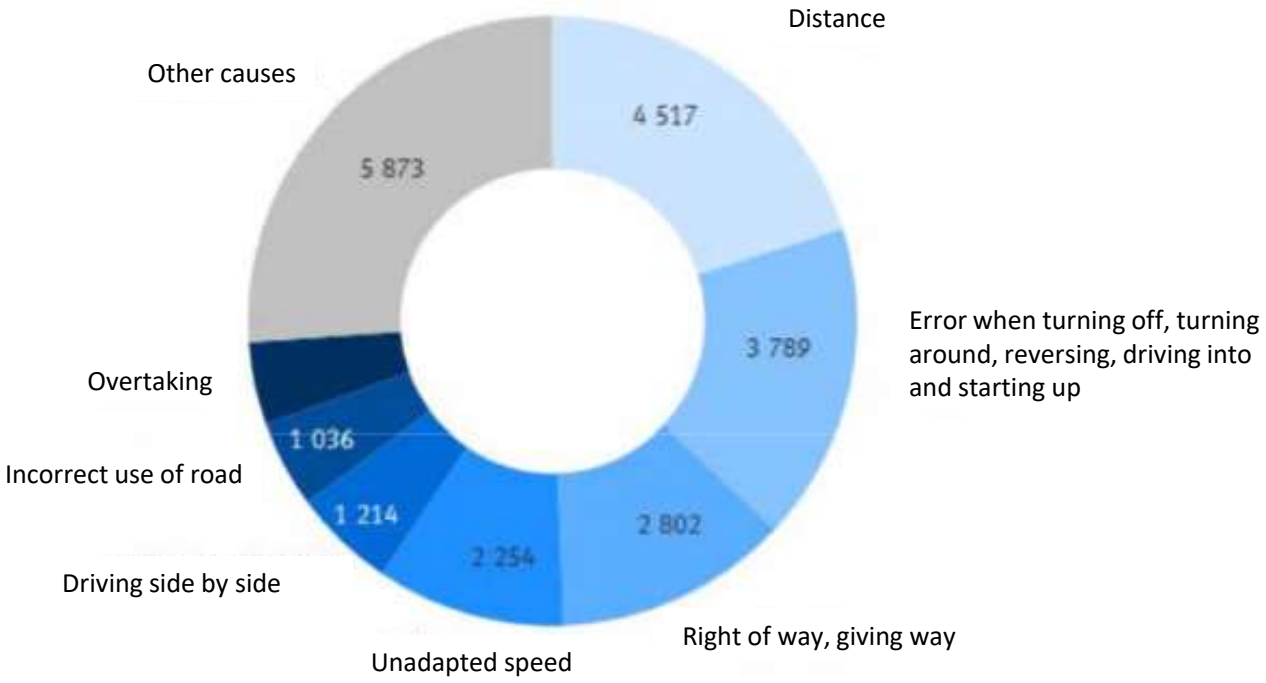
Radar- and camera-based driver assistance systems in the workshop

Introduction

- For which vehicles?
- Since when?
- How is the configuration, adjustment or calibration performed?

Reason for assistance systems



Source: German Federal Statistical Office. “Unfälle von Güterkraftfahrzeugen im Straßenverkehr 2014” P.12.

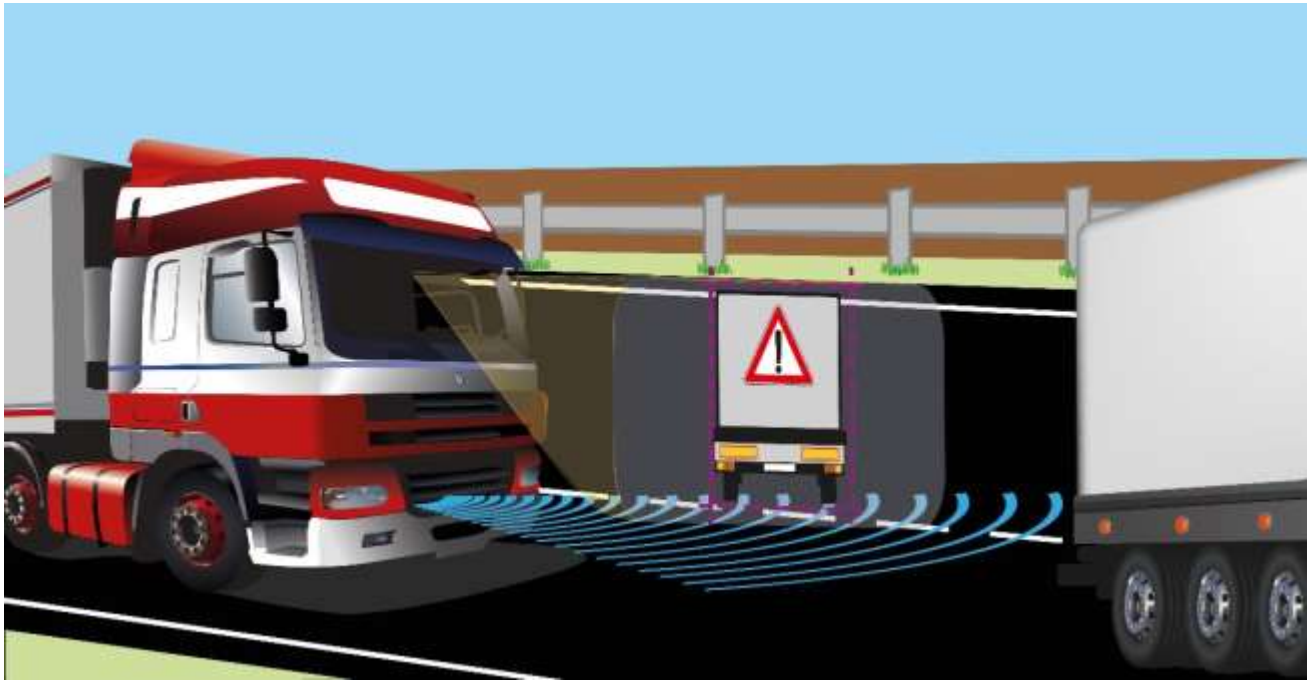
The EC regulation EC 661/2009 dated 13 July 2009 requested the following safety systems for vehicles:

- Electronic Stability Programme ESP for all vehicles (from 1 November 2011 for type approval and from 1 November 2014 for all new registrations)
- LDWS (Lane Departure Warning System) and AEBS (Advanced Emergency Braking Systems) for heavy goods vehicles from 8 t gross vehicle weight. (From 1 November 2013 for type approval and from 1 November 2015 for all new registrations)
- From 1 November 2018 (initial registration) for all lorries above 3.5 t

These measures are to lower the number of serious accidents by 5,000 per year.
The requirements were further tightened as of 1/11/2016 and 1/11/2018 respectively, but still fall far short of the technical potential.

ADAS systems and description

Adaptive Cruise Control (ACC)



The adaptive cruise control ACC keeps to a speed that was set for the vehicle. A certain specified distance to the vehicle in front is also adhered to at the same time.
This distance is not undercut by the system.

The system works predominantly with radar sensors.

If a vehicle is detected that drives more slowly, the ACC will brake automatically to adapt the speed to the other vehicle.

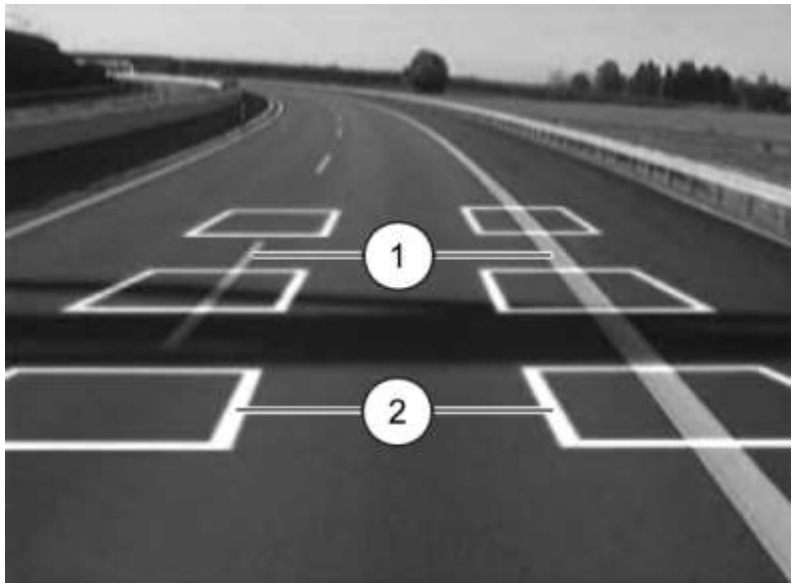
Adaptive Cruise Control (ACC)

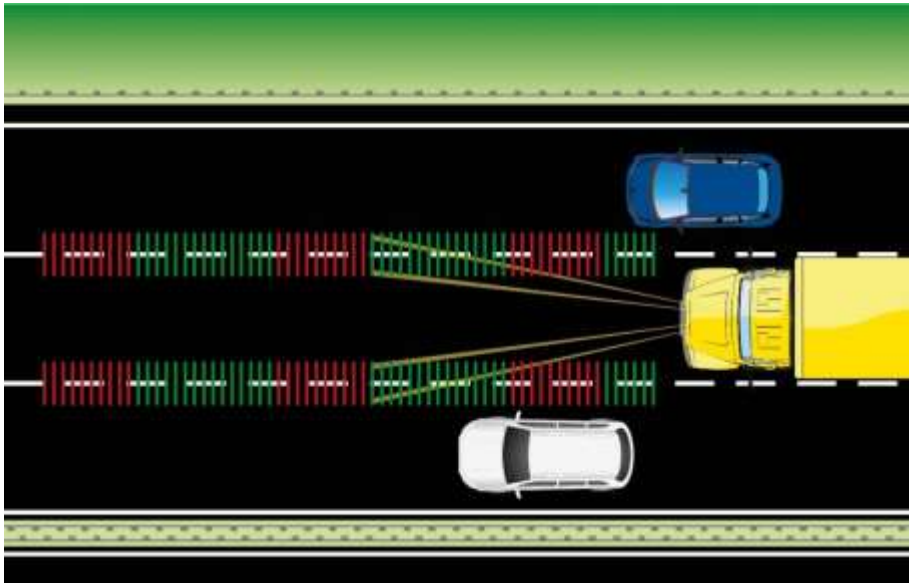
If the road in front of the vehicle is clear again, the ACC will accelerate to the previously set speed.

If the ACC is switched off and the distance to a vehicle in front is getting too small, a warning is issued to the driver. However, automatic braking does not occur.

The ACC system can brake without any driver input.

Lane Departure Warning System (LDWS)





The LDWS system orients itself on the road markings. If the vehicle gets too close to the markings on the left or right, there is an acoustic or haptic warning. Sometimes both.

Statistics show that one in five accidents are caused by a sideways collision.

The LDWS system can detect the road markings up to 40 metres in advance.

The LDWS system is switched off automatically under the following conditions:

- Direct sun shining into the camera
- Lane markings cannot be detected clearly
- Poor visibility (fog, snow)

If the LDWS system is deactivated, there is a respective light in the instrument cluster

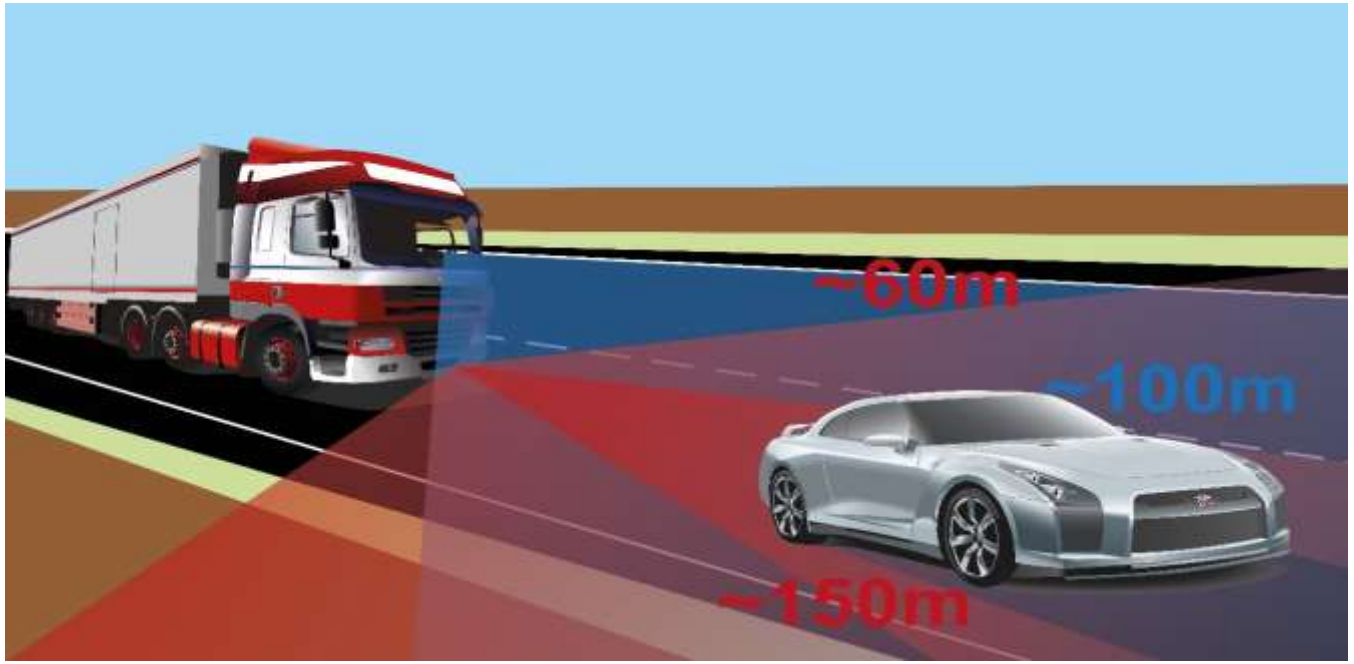
Forward Collision Warning (FCW)

The FCW warns drivers about travelling or stationary obstacles in front in the lane.
There is an optical and acoustic warning.

If the driver does not respond to this warning, partial braking is triggered up to standstill.

For the XF 106, the maximum brake power is 3 m/s2

Advanced Emergency Braking System (AEBS)



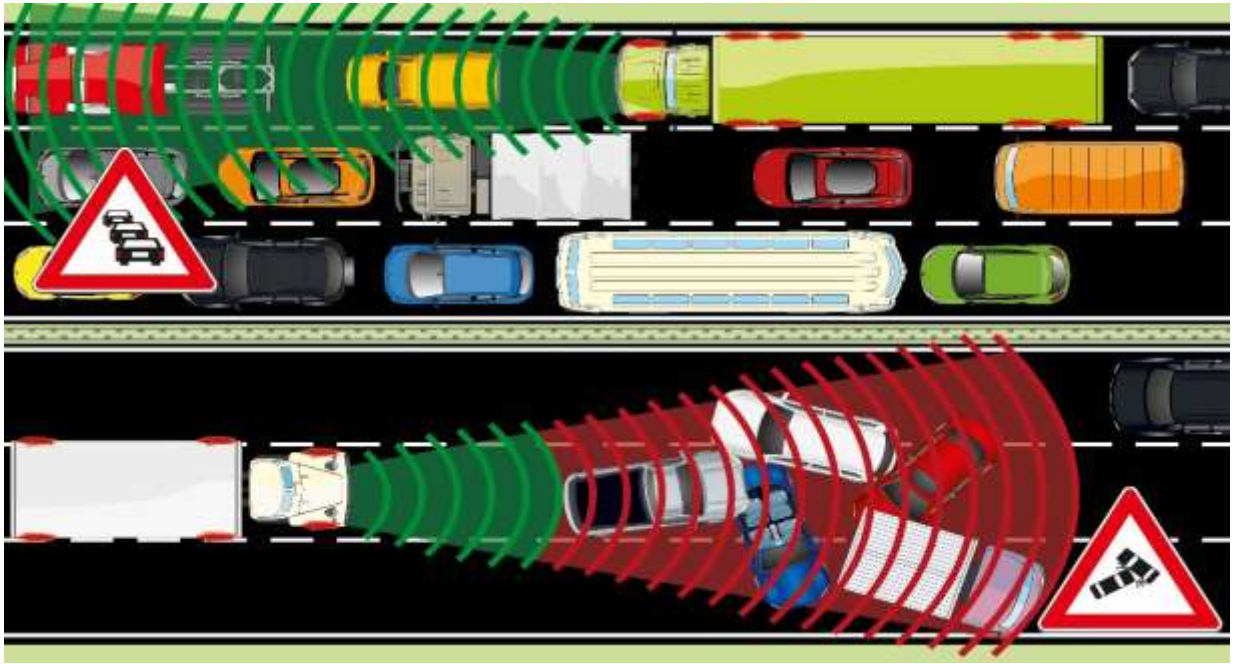
The AEBS is a further development of the FCW (DAF). A maximum brake power of 6 m/s2 is achieved here.

FCW = Forward Collision Warning

AEBS = Advanced Emergency Braking System

The AEBS system is automatically disabled after 3 emergency brakes or it issues an error message.

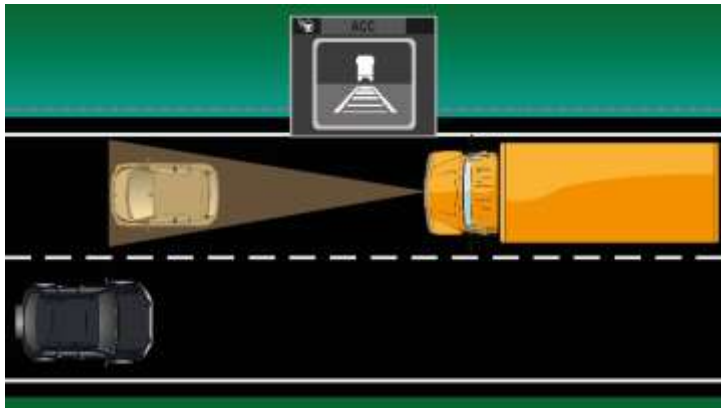
Advanced Emergency Braking System (AEBS)

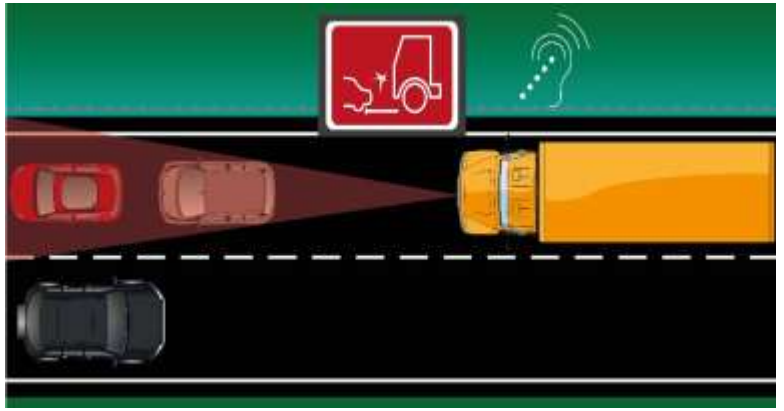


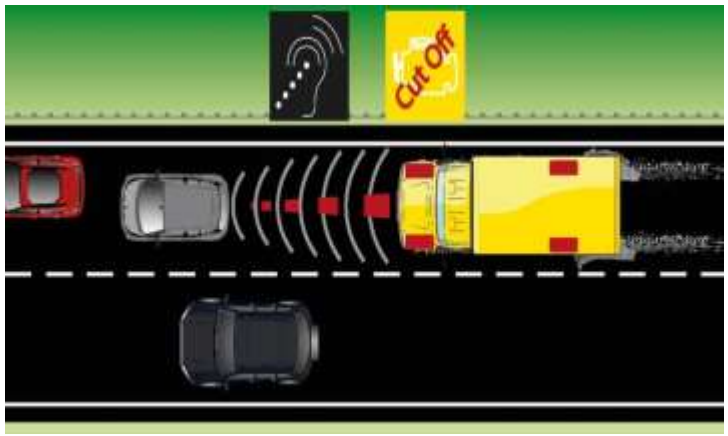
To prevent automatic braking, the driver has the option to switch off the system or override it by accelerating.
Today's AEBS systems usually include the FCW and ACC functions.
The Stop&Go Assistant is an extension of this.

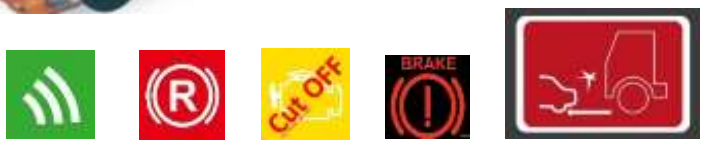
If the AEBS detects an obstacle, the warning and automatic brake occur in three steps.

Advanced Emergency Braking System (AEBS)









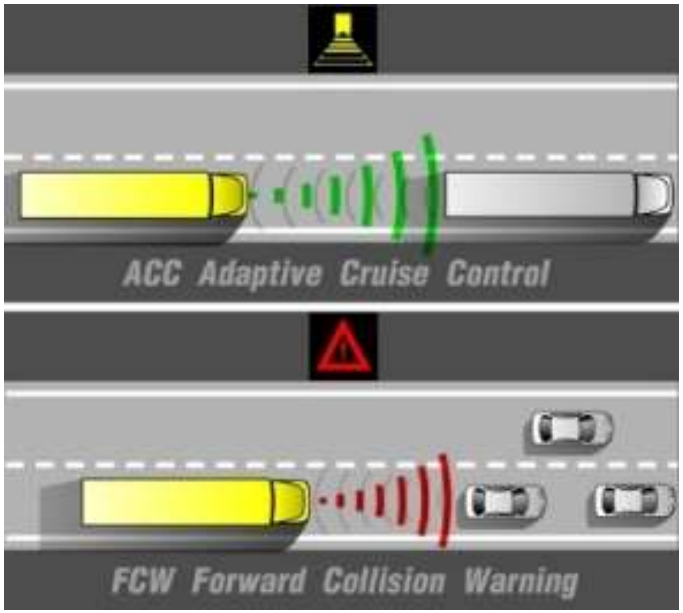
Radar

The RADAR sensor (Radio Detection And Ranging) uses microwaves to measure the distance to an object.

The radar sensor comprises the following components:

1) Sensor for microwaves
2) Receiver
3) Aerial
4) Control unit

Radar



The radar works by means of the Doppler effect. If the runtime of radar waves in the air is known, the distance to an object can be calculated based on the runtime differences between the waves sent and received.

Multi-function camera

Conventional cameras are used in vehicles. However, these are adapted for the use in vehicles. The camera has a chip with a lens in front. In addition, a control unit is also integrated.

A distinction is made between two types of cameras:

(CCD) Charge Coupled Device
(CMOS) Complementary Metal Oxide Semiconductor

Both types are based on the photodiode technology (PIXEL).
A photo-sensitive element creates electrical voltage on exposure to light, which is processed in the control unit as image information.

The difference between the two types is how the individual pixels are detected.

1. (CCD) Pixels are summarised in a matrix and are analysed accordingly.
2. (CMOS) Individual pixels are present and can be requested accordingly.

ADAS system calibration

For calibration, the camera or sensor is provided with a test image. During calibration, the internal image is corrected to this template.

Calibration must be performed with diagnostic software, and a distinction is made between two procedures:

- **STATIC** calibration (in the workshop + IDC5 + panel)

- **DYNAMIC** calibration (on the road + IDC5)

IDC5 + adjustment system and reflector panel

SCANIA

MAN

VOLVO

HAWEKA

IDC5 + adjustment system and reflector panel

Mercedes-Benz

DAF
A PACCAR COMPANY

IVECO

VOLVO

WABCO

** EURO6 vehicles*

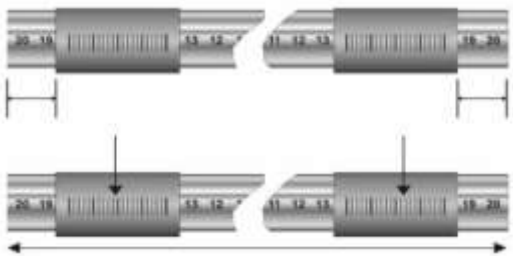
ADAS system calibration

The ADAS system must be calibrated under the following circumstances:

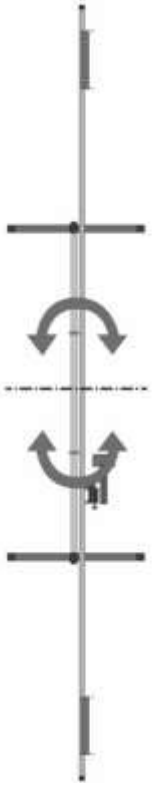
- Error in the LDWS or AEBS system
- Radar unit was replaced
- Camera unit was replaced
- Windscreen was replaced
- Wheel alignment was adjusted
- Driving level was modified. Level sensors are new.
- After post-accident repairs (e.g. replacement of the bumper)
- Temporary deactivation of the system (see AEBS)

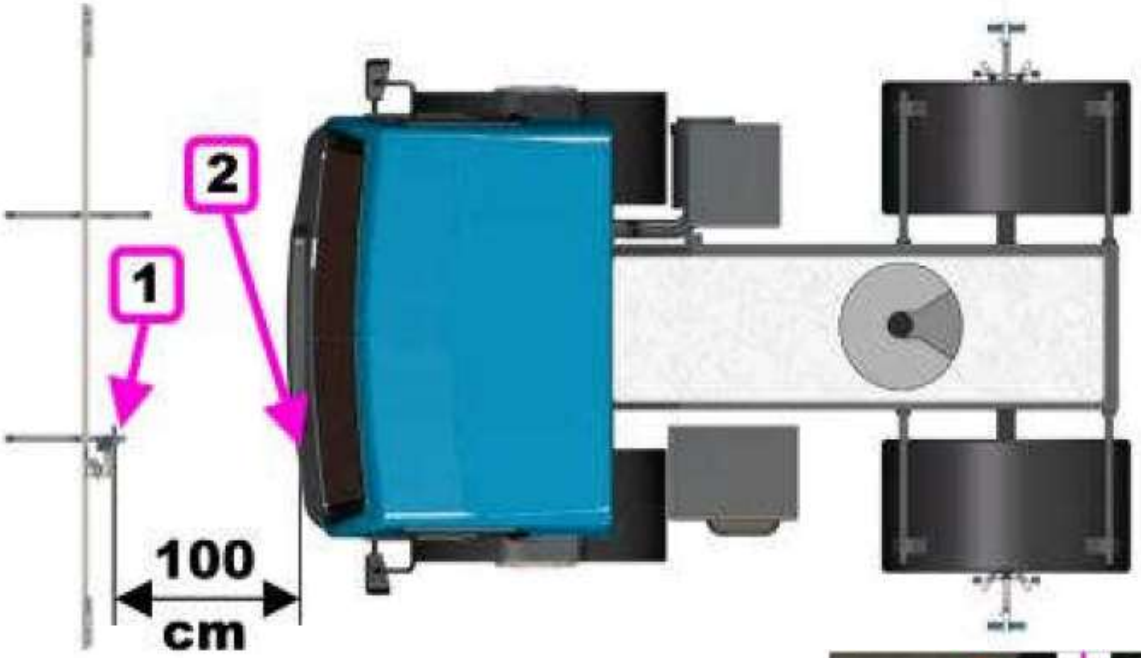
ADAS system calibration

For static calibration in the workshop, an adjustment system and diagnostic software are required.




DANGER




2
1
100
cm

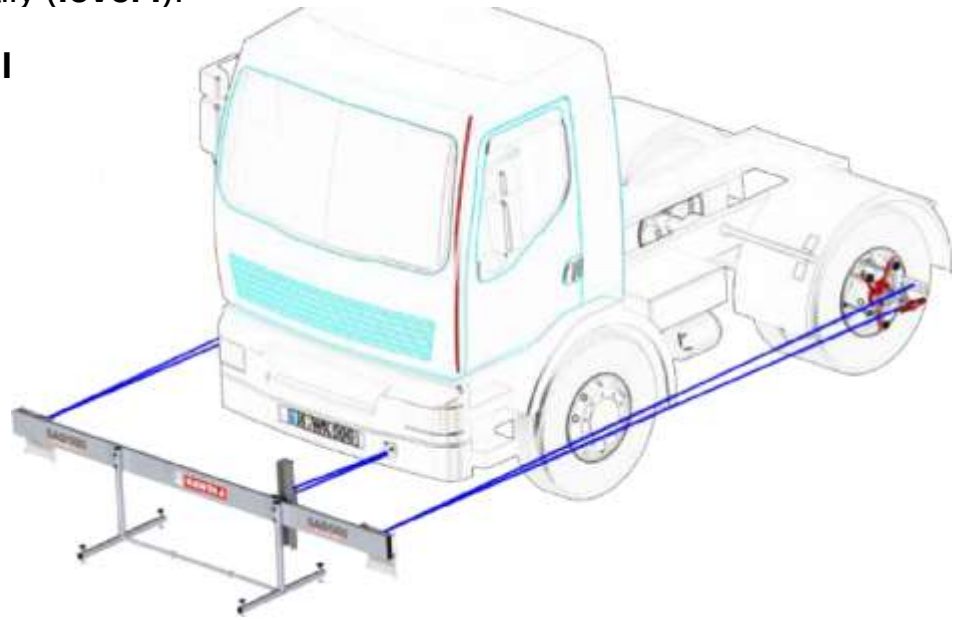

DANGER

Setup of a measuring unit

Assembly of the crosshead is complete

when:

- ✓ the crosshead is aligned **central** to the centre line of the vehicle.
- ✓ the crosshead is aligned **parallel** to the vehicle axle.
  (the reflecting laser beams indicate the same values on the left and right scales of the rear axle).
- ✓ the crosshead is aligned horizontally (**level I**).
- ✓ the laser housing is aligned **(level I** and the laser beam hits the mirror of the ACC sensor on the vehicle.
- ✓ the distance between the ACC sensor on the vehicle and the measuring scale on the laser housing is exactly **100 cm**.



WABCO Radar:
Mercedes, DAF and IVECO vehicle application up to > EU6 version with mirror offset

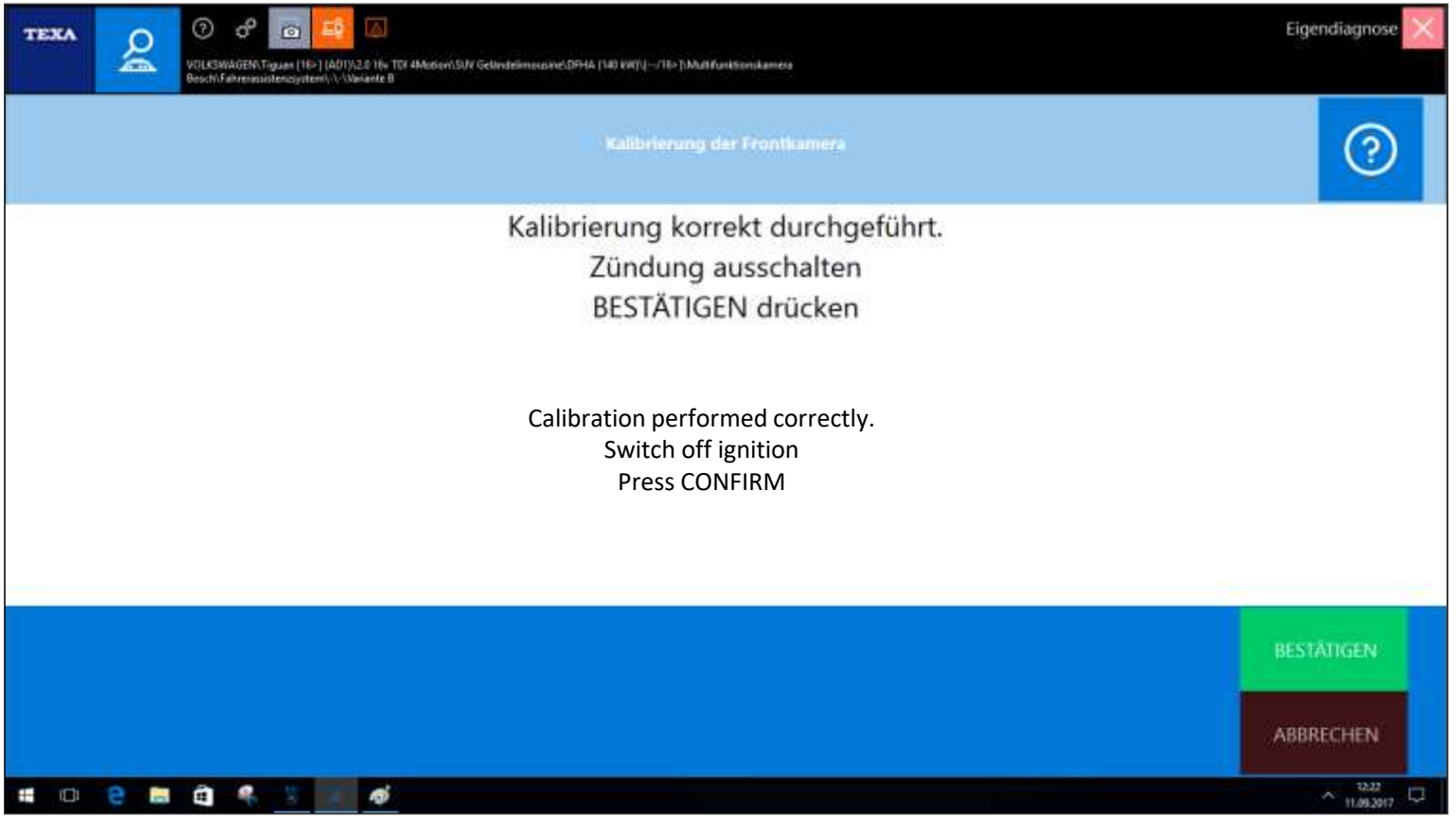
TRW Radar:
MAN, Volvo, Scania and Renault vehicle application up to > EU6

TRW-Knorr Radar:
MAN vehicle application from EU6 > versions

Radar:
Volvo vehicle application from EU6 > versions

ADAS calibration

The following message is shown during self-diagnosis:

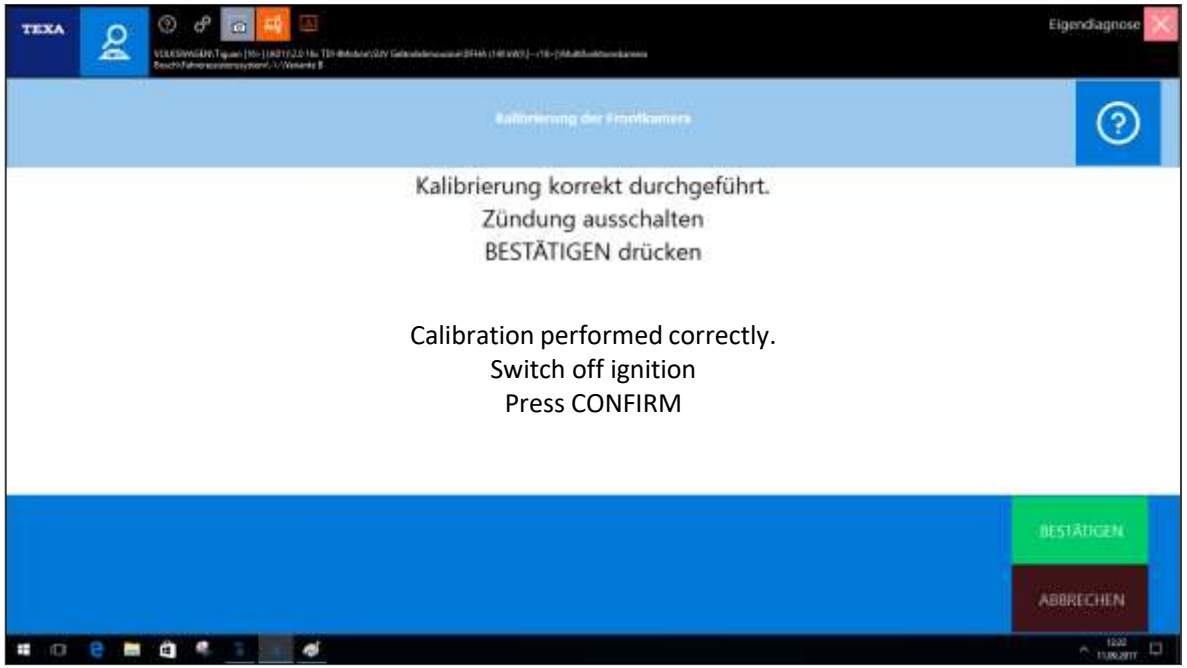


Has the system now been correctly calibrated and is fully functional?

ADAS calibration

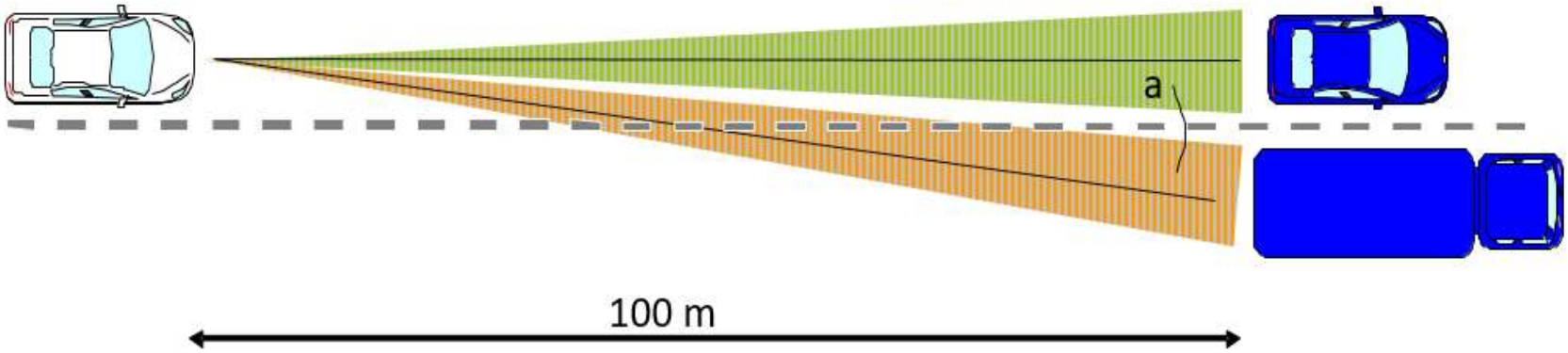
The question once again:

Has the system now been correctly calibrated and is fully functional?



Appearances are deceiving. If this message is issued, it simply means that the control unit has detected a good image. It is not visible here whether the camera is aligned correctly or the vehicle driving axle fits.

ADAS calibration



The radar beam is precisely aligned to the longitudinal axis of the vehicle

The radar beam is deflected by angle “a” to the longitudinal axis

Deviation in °	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Lateral deviation to 100 metres (in cm)	**0.0**	**17.5**	**34.9**	**52.4**	**69.8**	**87.3**	**104.7**	**122.2**	**139.6**	**157.1**	**174.6**

Multi-function camera
TEXA diagnostic coverage

Manufacturer	Camera type	TEXA IDC5
MAN > 2016	LGS	✓
MAN 2016 >	MFC	✓
MERCEDES MPII/MPIII	SPA	✓
MERCEDES MP IV	VRDU	✓
DAF	LDWS	✓
IVECO EU6	ASC WABCO	✓
VOLVO EU6	LPOS	✓
RENAULT EU6	LPOS	✓
SCANIA EU6	FLC1	✓
WABCO	BUS APPLICATION	✓

IDC5 – Self-diagnosis fault memory

Remedy: Perform calibration

Help

Adjusting the radar sensor

Process:
- An adjustment process is required for calibrating the radar sensor. Manual configuration is not possible
- Start calibration before the adjustment process: The sensor is adjusted during the process

The diagnostic device must stay connected during the entire process, as it shows the status of the progress
- The process takes between 5 and 15 minutes
- If there is an error, the control unit automatically interrupts the process after 30 minutes
- Once calibration is complete, a message is displayed in the instrument cluster

Requirements:
- Vehicle is stationary
- Parking brake activated
- The vehicle is at normal level
- Adjust the pressure of all tyres
- The only permissible error code is FCFAED; other errors must be deleted

Requirements for correct calibration:
- During calibration, the driving speed must be the same or higher than 30 km/h
- There must be a certain number of objects along the route which must be detected.

Notes:
- Do not switch off the ignition during calibration, as the process can otherwise not be completed
- Narrow bends and tunnels extend the time required for the drive

Measuring and adjusting the ACC sensor SAD500

5.1 Measuring the ACC sensor with reference mirror

- The crosshead is aligned and is in the centre in front of the vehicle and parallel to the vehicle driving axle.

The laser on the crosshead is switched on and pointing directly at the reference mirror of the ACC sensor. (*Fig.18)*

(*Fig.18)*

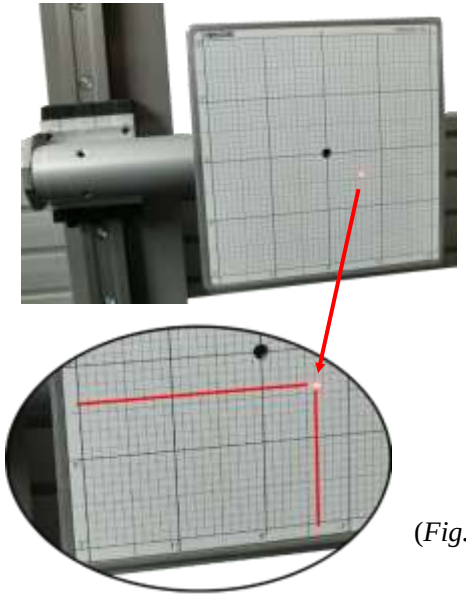
- The reflecting laser beam is projected back at the scale on the crosshead via the reference mirror.

- The currently set value of the ACC sensor can now be read from the scale. (*Fig.19)*

Note

The division on the scale is as follows:

1 scale division = 0.1 degrees



(*Fig.19)*

- Compare the values read with the NOMINAL values from the manufacturer and, as necessary, the ACC sensor must be set to the nominal values using the adjustment screws.

5.2 Measuring the ACC sensor without reference mirror

For checking an ACC sensor without reference mirror *(Fig. 21)*, the optional adapter mirror 922 001 011 *(Fig. 20)* must be mounted in front of the ACC sensor on the vehicle before the check.

- The adapter mirror is suspended in front of the ACC sensor on the vehicle and secured with the knurled screws. *(Fig. 22 + 23)*

(Fig. 20)

(Fig. 21)

Note

If the adapter mirror is mounted correctly, it will rest parallel to the radar output area of the ACC sensor. *(Fig. 24)*

The laser on the crosshead is switched on and pointing directly at the adapter mirror of the ACC sensor.

(Fig. 22)

(Fig. 23)

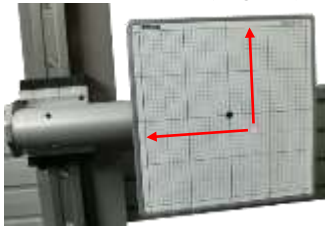
The reflecting laser beam is projected back at the scale on the crosshead via the adapter mirror.

- The currently set value of the ACC sensor can be read from the scale. *(Fig. 25)*

(Fig. 24)

Note

- The division on the scale is as follows:
- **1 scale division = 0.1 degrees**



(Fig. 25)

- Compare the values read with the NOMINAL values from the manufacturer and, as necessary, the ACC sensor must be set to the nominal values using the adjustment screws.

Report after calibration

Following successful calibration, the result can be printed.

SELF-DIAGNOSIS REPORT

Workshop data

Company name	ooo		
Address	ooo, ooo	Province	ooo
City	ooo	Postcode	ooo
Telephone number	ooo	E-mail	
Operator	Default user		

Vehicle data

License plate number		VIN	
Make	MAN	Model	TG-X M.Y. 2013 Euro 6
Engine type	---	Vehicle ID*	--
Outline	Truck	Period	[--/13>]
System	Advanced Driver Assistance Systems (ACC – LDW)		

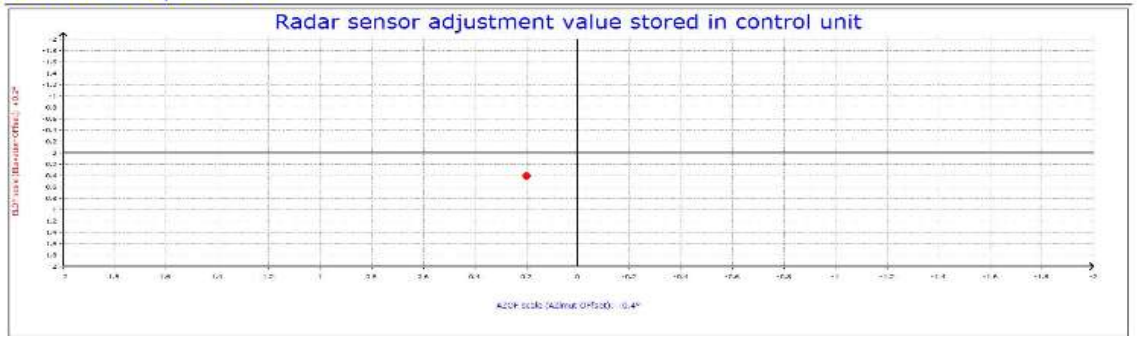
* identification code referred to the VIN or to the engine code

General test data

Date	12-06-2017
Time	09:46

ACTIVATIONS/SETTINGS

Radar sensor adjustment value stored in control unit



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