Self Study Programme 605
For internal use only

Audi Occupant Protection – Passive Systems II Audi pre sense

Audi
Service Training

Audi has a long tradition to look back on. The company is now over 100 years old. Vehicle safety has a long history behind it, too.

The first crash tests were conducted back in 1938. Of course, the crash tests back in those days cannot be compared to modern-day crash tests.

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605_093

The development of a new vehicle entails numerous crash tests, which are initially performed virtually on the computer and then, finally, on the actual car at the Audi Safety facility. The engineers of Audi AG not only evaluate the results of own in-house tests, but also actual accidents recorded by the accident researchers and scientists at the Audi Accident Research Unit (AARU). The AARU was founded in 1998 and works hand in hand with police and doctors to develop as exact a knowledge of accidents as possible. Using this information, we are constantly working to refine our test scenarios.

The focus of Audi vehicle safety is on people.
When it comes to safety, therefore, Audi relies on its most special workers - its crash test dummies.

605_001

Contents

▸ The Self Study Programme teaches a basic knowledge of the design and functions of new models, new automotive components or new technologies.

It is not a Repair Manual! Figures are given for explanatory purposes only and refer to the data valid at the time of preparation of the SSP.

For further information about maintenance and repair work, always refer to the current technical literature.

Note

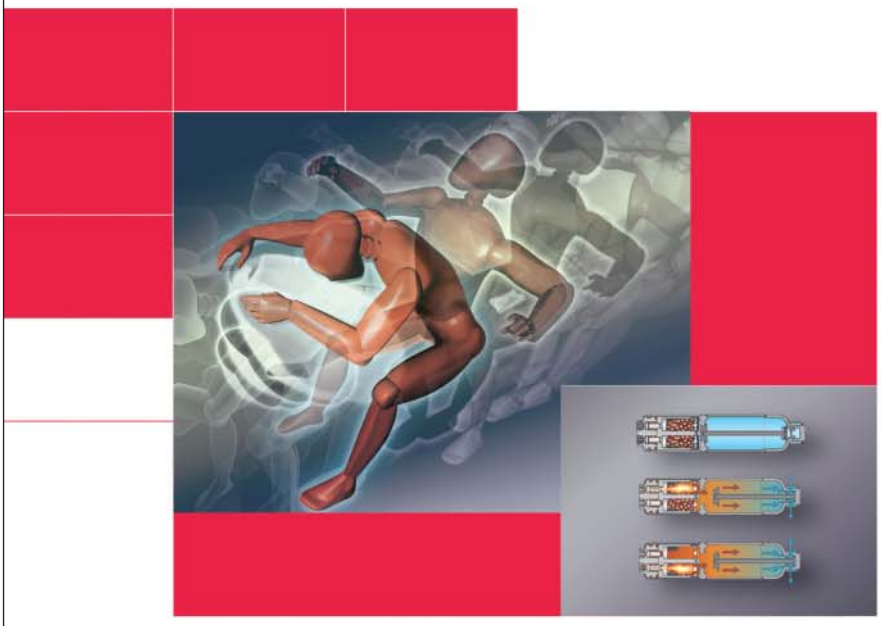
Reference

Introduction

Introduction

This self study programme is a supplement to Self Study Programme 410 "Audi Occupant Protection – Passive Systems" and describes the changes to the safety systems effective from launch of the Audi A5 in 2007 up until and including the launch of the Audi A6 Avant '12.

Service Training



Audi Occupant Protection – Passive Systems

Self Study Programme 410

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Components

You will find model-specific information on the various safety systems in the self study programmes for each vehicle model. Refer to page 43 for an overview of the relevant self study programmes.

It is important to be aware that the wearing of seat belts is safety precaution number 1.
All other measures are supplementary and just enhance safety, but are only effective in combination with a fastened seat belt.

The passive safety system can comprise the following components:

- Airbag control unit
- Driver and passenger airbags
- Side airbags
- Head airbags
- Crash detection sensors
- Seat belt tensioners
- Seat belt force limiters
- Seat belt reminder
- Driver and passenger seat position sensors
- Battery isolator elements (only available for vehicles in which the battery is fitted in the interior or luggage compartment)
- Switches in the seat belt buckles
- Passenger side seat occupancy sensor
- Key switch for deactivating the passenger front airbags with accompanying warning lamp
- Roll-over protection (Cabriolet and Spyder)

605_091

System overview

The adjacent system overview shows by way of example the equipment options available for a model earmarked for the German market. Not all of these components need necessarily be available in every model type.

Key to figure on page 7:

E24 Seat belt switch, driver side
E25 Seat belt switch, passenger side
E224 Airbag disabling switch, passenger side (optional)
E258 Rear seat belt switch, driver side
E259 Rear seat belt switch, passenger side
E609 Rear central seat belt switch

G128 Passenger side seat occupancy sensor
G179 Side airbag crash sensor, driver side
G180 Side airbag crash sensor, passenger side
G256 Rear side airbag crash sensor, driver side
G257 Rear side airbag crash sensor, passenger side
G283 Front airbag crash sensor, driver side
G284 Front airbag crash sensor, passenger side
G551 Belt force limiter, driver side
G552 Belt force limiter, passenger side
G553 Seat position sensor, driver side
G554 Seat position sensor, passenger side

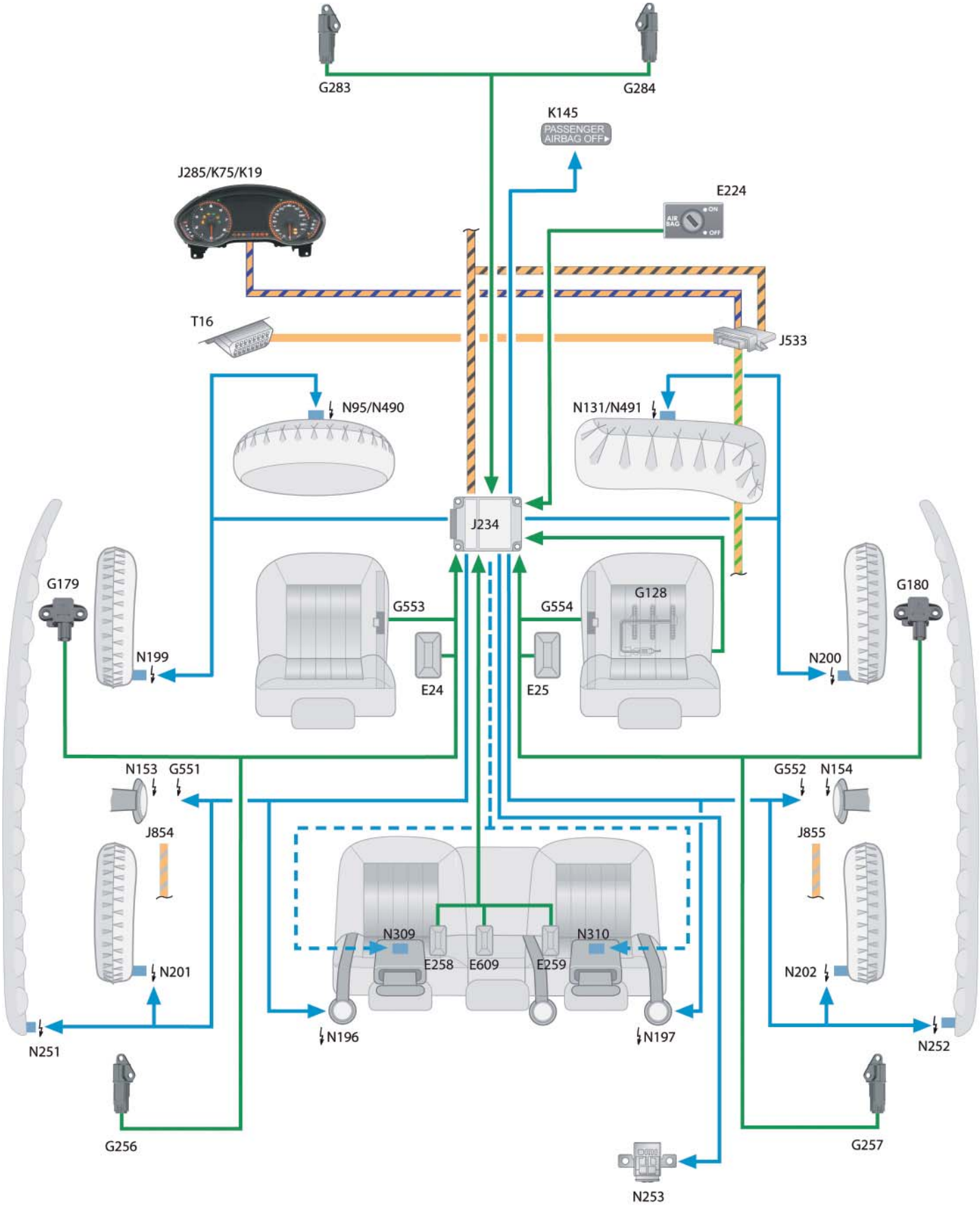
J234 Airbag control unit
J285 Control unit in dash panel insert
J533 Data bus diagnostic interface (gateway)
J854 Front left seat belt tensioner control unit
J855 Front right seat belt tensioner control unit

K19 Seat belt reminder warning lamp
K75 Airbag warning lamp
K145 Passenger airbag off warning lamp (PASSENGER AIRBAG OFF) (optional)

N95 Driver side airbag igniter
N131 Passenger side airbag igniter 1
N153 Seat belt tensioner igniter 1, driver side
N154 Seat belt tensioner igniter 1, passenger side
N196 Rear seat belt tensioner igniter, driver side
N197 Rear seat belt tensioner igniter, passenger side
N199 Side airbag igniter, driver side
N200 Side airbag igniter, passenger side
N201 Rear side airbag igniter, driver side
N202 Rear side airbag igniter, passenger side
N251 Head airbag igniter, driver side
N252 Head airbag igniter, passenger side
N253 Battery isolation igniter
N309 Roll-over protection solenoid, driver side (Cabriolet and Spyder only)
N310 Roll-over protection solenoid, passenger side (Cabriolet and Spyder only)
N490 Driver airbag relief valve igniter
N491 Passenger airbag relief valve igniter

T16 16 pin connector, diagnostic port

Note
The graphics and illustrations shown in this self study programme are basic representations and are given to help understand concepts.



605_002

Key:

- Powertrain CAN bus
- Display and operation CAN bus
- Extended CAN bus
- Convenience CAN bus
- Diagnostics CAN bus
- Input signal
- Output signal

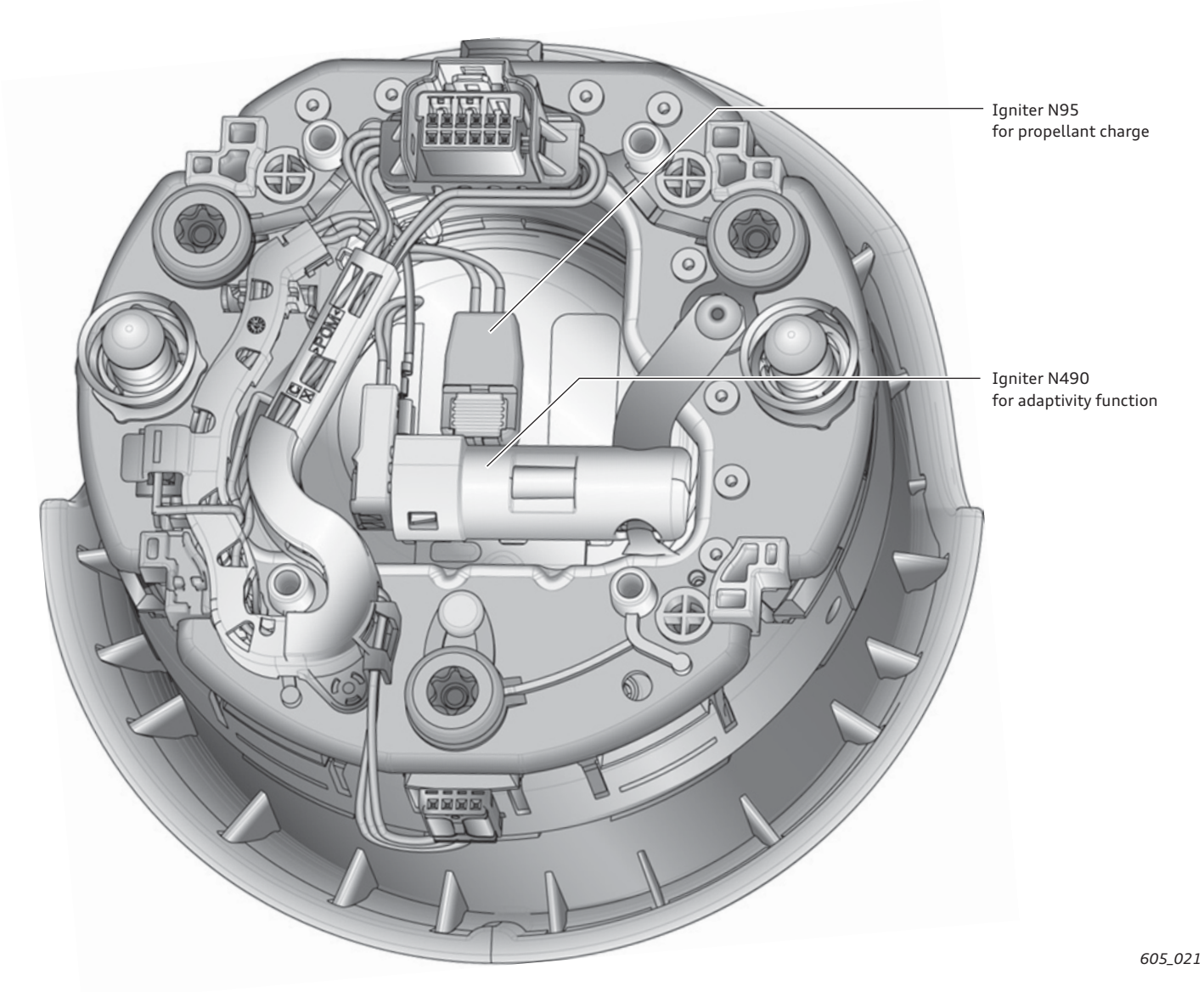
Passive systems

Definition of terminology used for airbags in Audi vehicles

The deployment stages of an airbag were previously defined by the propellant charges, which inflate the airbag with gas. Today, the deployment stages of an airbag are determined by the number of installed igniters.

Here, it does not matter if an igniter ignites a propellant charge or activates an adaptivity feature (opening of an additional outlet orifice).

			Old designation	New designation
Igniter	**Propellant charges**	**Adaptivity**	**Settings**	**Settings**
1	1	None	1	1
2	2	None	2	2
2	1	yes	1	2
3	2	yes	2	3



605_021

Together, the igniter for the propellant charge and igniter for the adaptivity function form a two-stage airbag module.

Front airbags

Various driver and passenger airbag modules are used on Audi models. These are equipped with different gas generators.

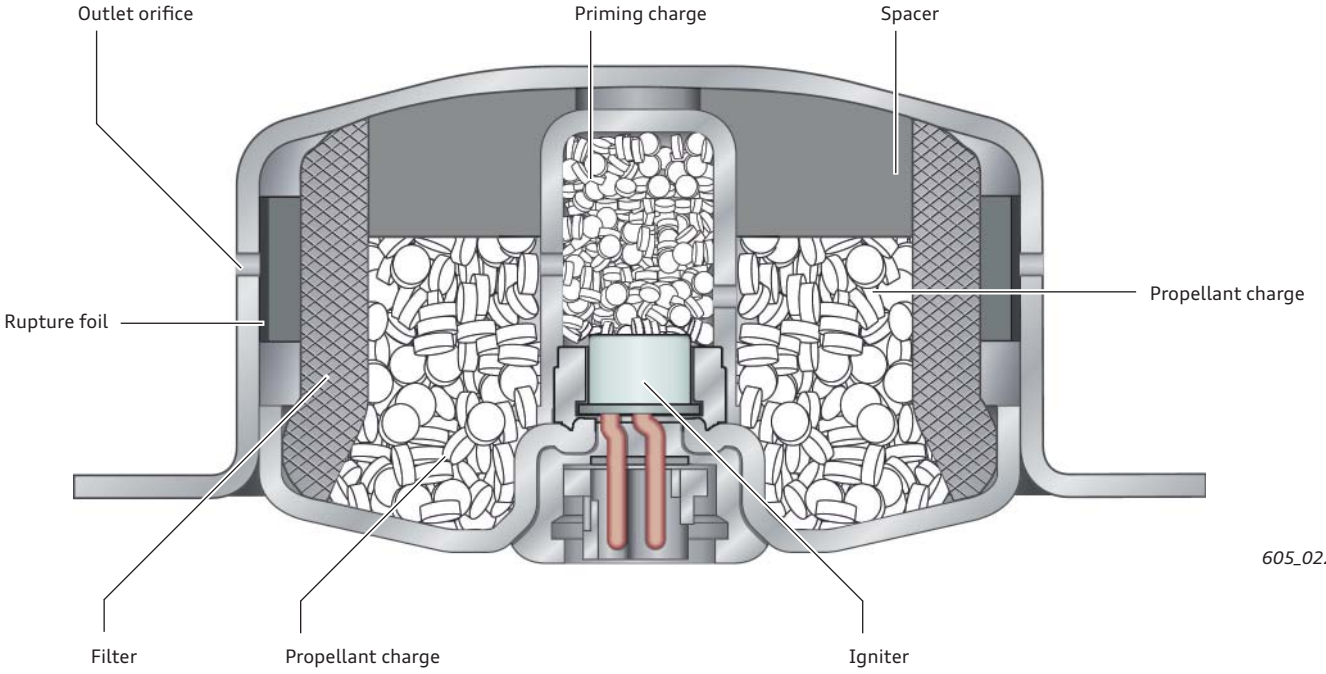
On the driver's side there is a solid propellant generator, and on the passenger side a hybrid gas generator which inflates the airbag.

Depending on model, the gas generators of the front airbag modules are mounted oscillatingly in a rubber ring so as to reduce the vibration transmitted to the steering wheel.

Driver side airbag gas generator

The igniter activated by the airbag control unit ignites the priming charge, thereby igniting the actual propellant charge.

If the developing gas pressure exceeds a set value due to combustion of the propellant charge, the rupture foil opens the outlet orifices and allows the gas to flow into the airbag. The airbag unfolds and is inflated.

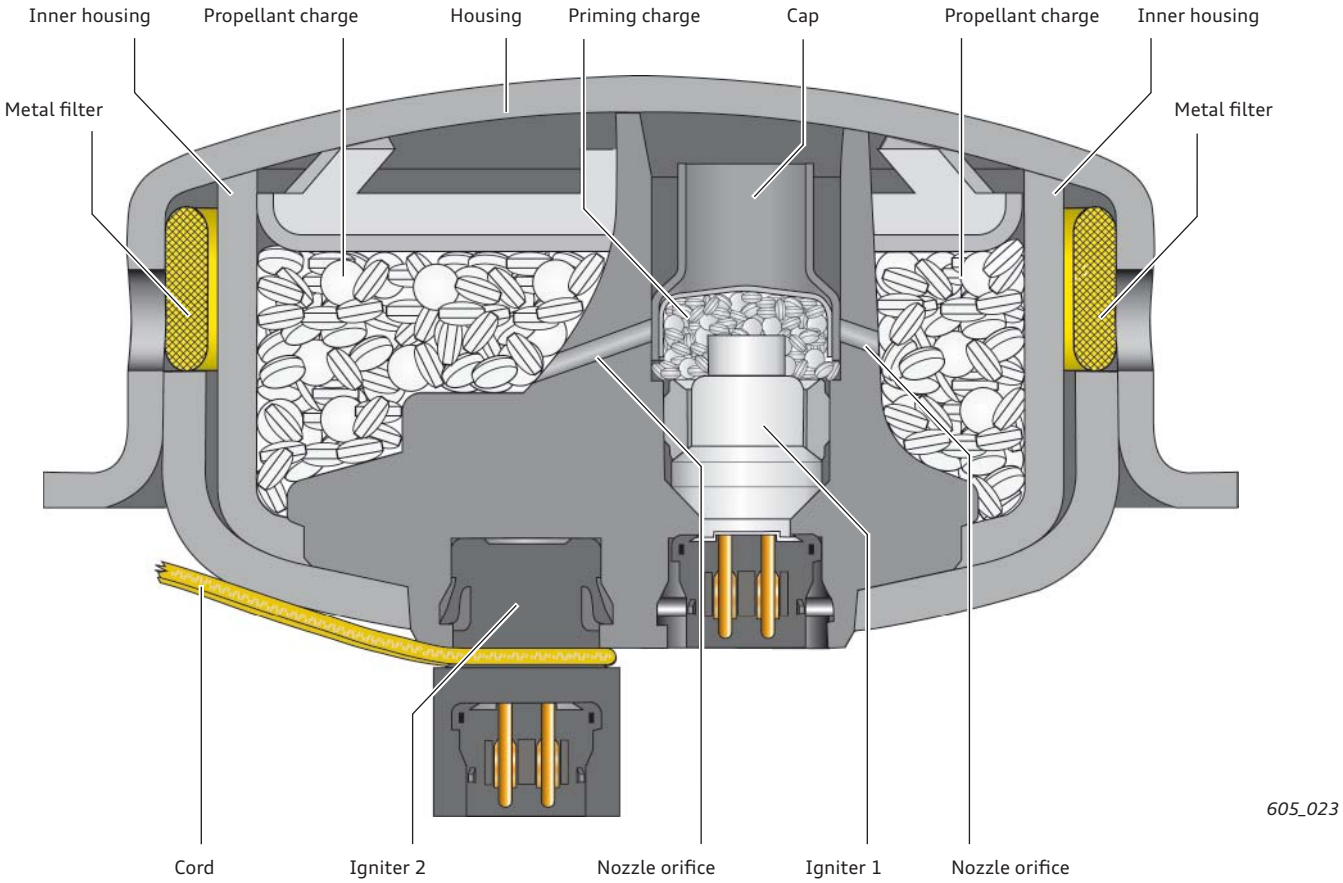


Adaptive driver side airbag gas generator — version 1

Depending on model, adaptive airbag modules can also be used.

The airbag control unit J234 activates igniter 1, which in turn ignites the priming charge.

The actual propellant charge is ignited through holes in the nozzles. If the gas pressure resulting from combustion of the propellant charge exceeds a set value, the gas generator housing will become deformed and allow the gas to flow into the airbag via the inner housing and metal filter. The airbag unfolds and is inflated.



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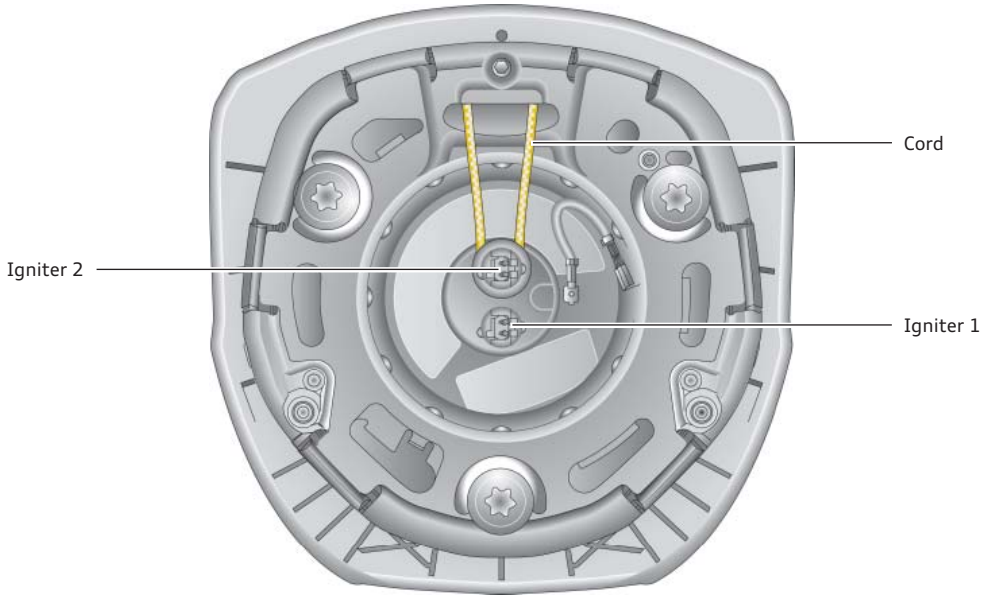
An additional igniter - the driver side airbag igniter 2 N250 - is mounted on the back outside the gas generator.

A cord, which closes an additional outlet orifice by means of a band, is wrapped around this igniter.



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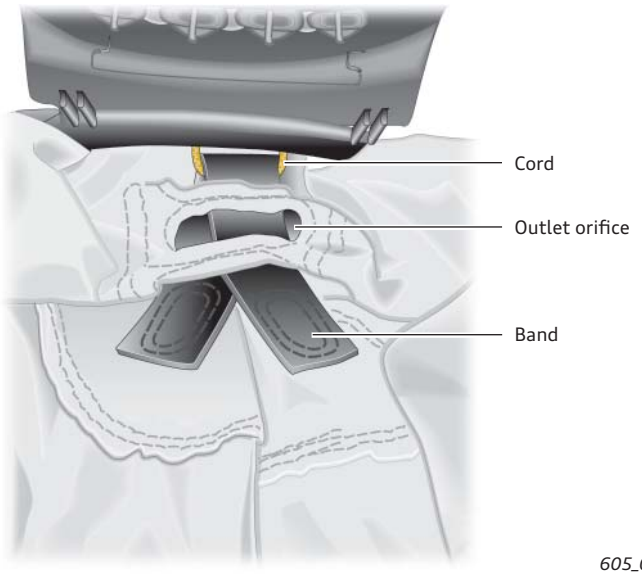
Additional outlet orifice closed

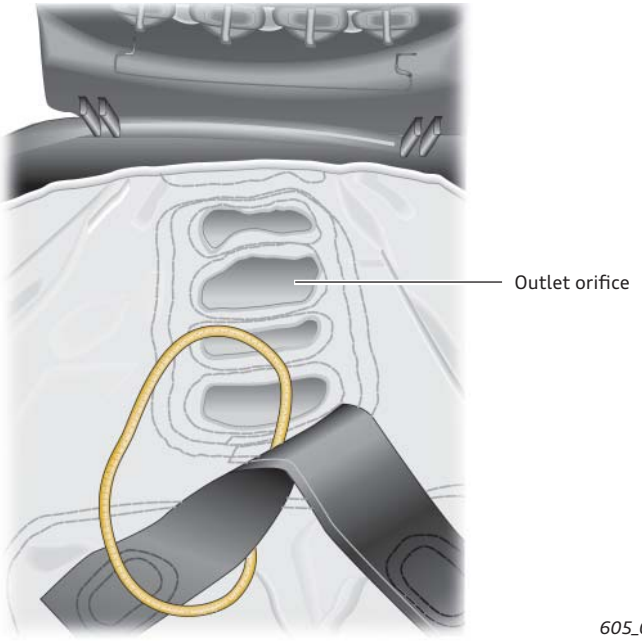
This outlet orifice is sealed shut as long as the cord from the igniter is held.



605_025

Additional outlet orifice open

Depending on impact severity and the driver's seating position, the airbag control unit J234 activates igniter 2. The igniter housing ruptures and the cord is released.
The volume of the airbag increases by about 4 litres, and the additional outlet orifice is opened. More gas is now able to escape from the airbag through this outlet orifice. In this way the airbag is "adapted" to suit the occupants.

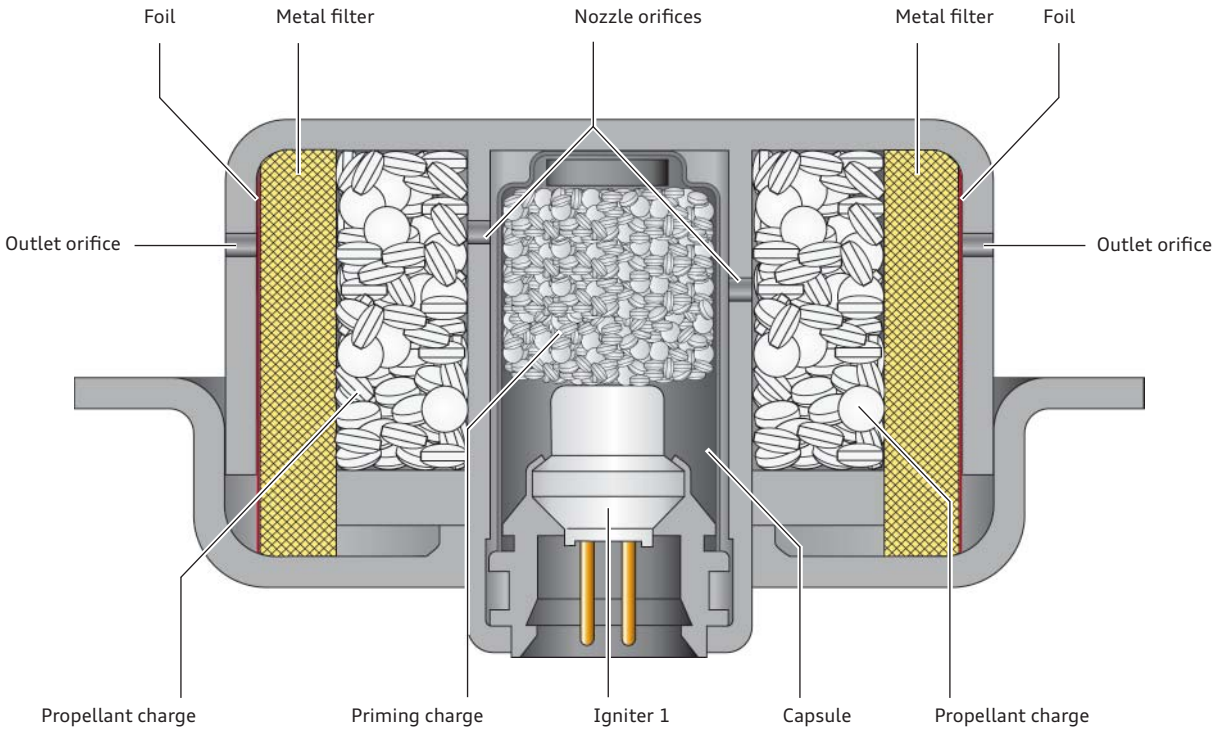


605_026

Adaptive driver side airbag gas generator — version 2

The priming charge is ignited by igniter 1, which is activated by the airbag control unit J234.
The combustion of the priming charge causes the pressure inside the capsule to increase until the capsule ruptures and the propellant charge is ignited through holes in the nozzles.

If the gas pressure resulting from ignition of the propellant charge exceeds a set value, the tab opens the outlet orifices. The gas is now able to flow freely through the metal filter into the airbag. The airbag unfolds and is inflated.



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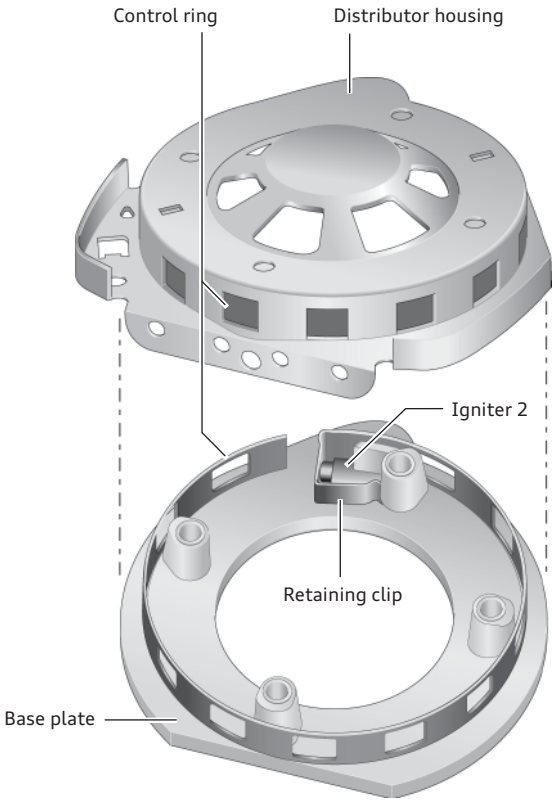
Driver side airbag igniter 2 N250 is located inside the airbag module.
The igniter is integrated in a unit comprising the base plate, a control ring with orifices and the distributor housing.

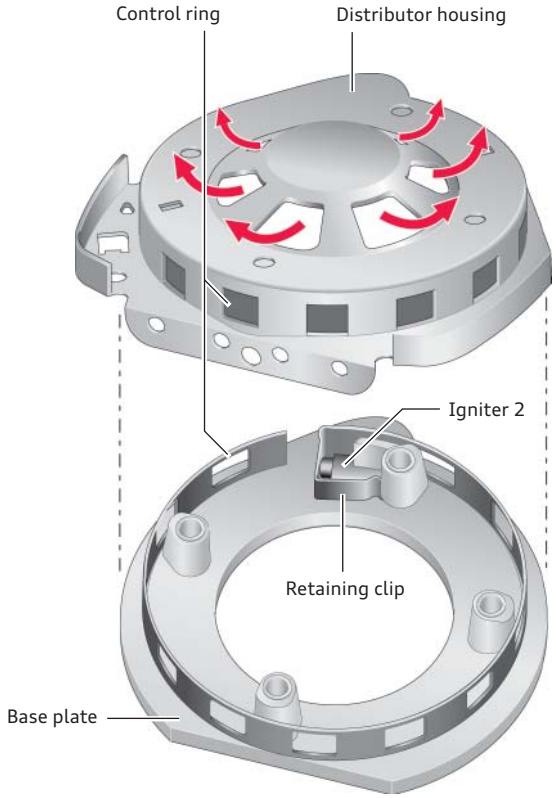


605_028

Additional outlet orifices closed

As long as igniter 2 has not been activated, the additional outlet orifices in the distributor housing are sealed by the control ring.

The gas from the gas generator flows through the upper orifices in the distributor housing and directly into the airbag. A retaining clip holds the control ring in its rest position, thus preventing unwanted rotation of the control ring.

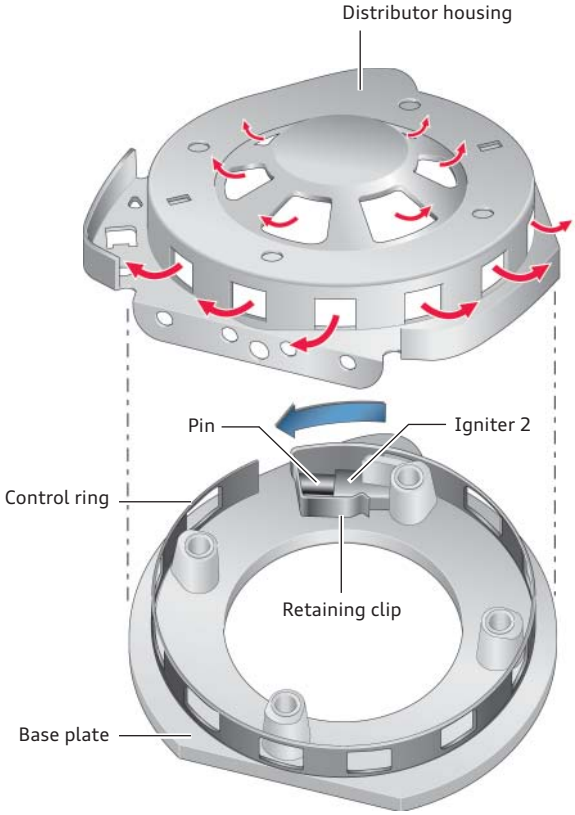


605_029

Additional outlet orifices open

Depending on impact severity and the driver's seating position, the airbag control unit J234 decides when to activate the igniter 2 N250.

When igniter 2 is ignited, the resulting gas pressure displaces a pin which in turn rotates the control ring. The additional outlet orifices in the distributor housing are opened.
A portion of the remaining gas from the gas generator can now be released directly into the atmosphere.
The gas from the airbag is also able to escape into the atmosphere through the orifices in the distributor housing. This prevents the airbag from inflating any further, and so ensures the airbag is "adapted" to suit the occupants.



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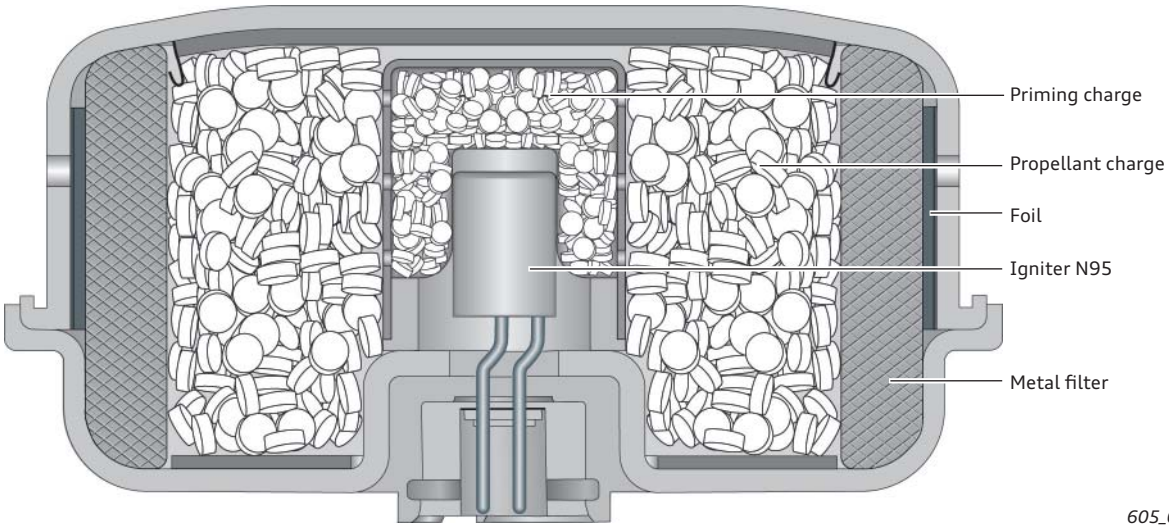
Adaptive driver side airbag gas generator — version 3

The driver side airbag igniter module N95 activated by the airbag control unit J234 ignites the priming charge, thereby igniting the actual propellant charge. If the gas pressure resulting from ignition of the propellant charge exceeds a set value, a tab opens the outlet orifices. The gas is now able to flow freely through the metal filter into the airbag. The airbag unfolds and is inflated.
An additional igniter for airbag adaptivity (driver airbag relief valve igniter N490) is attached to the back of the airbag module. The airbag also has an extra snoutlike outlet orifice.

The igniting propellant charge inside the airbag keeps this outlet orifice closed. Depending on the impact severity and the driver's seating position, the airbag control unit J234 activates the driver airbag relief valve igniter, thus severing the metal band.

As a result, the additional outlet orifice is opened. The airbag is thus "adapted" to suit the occupants in a manner appropriate to the situation.



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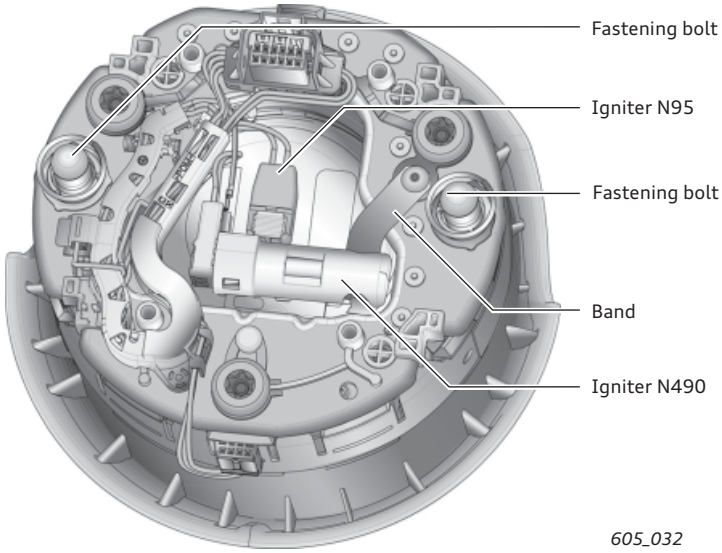

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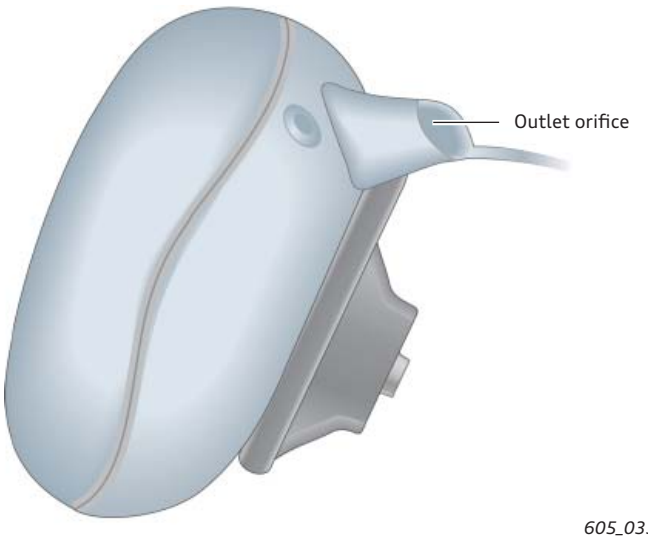
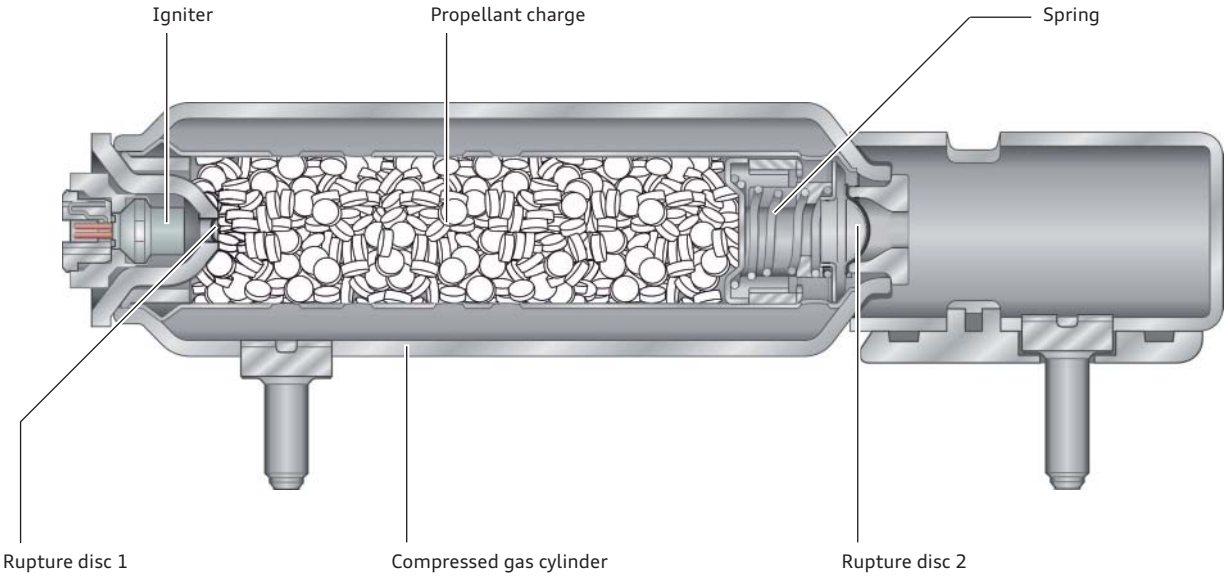


605_033

Passenger side airbag gas generator

This gas generator is a hybrid gas generator. The airbag control unit J234 activates the passenger side airbag igniter 1 N131. The activated igniter breaches the rupture disc 1 and ignites the propellant charge.

The combustion of the propellant charge causes the pressure inside the compressed gas cylinder to increase until rupture disc 2 breaks. The gas mixture unfolds and inflates the airbag.

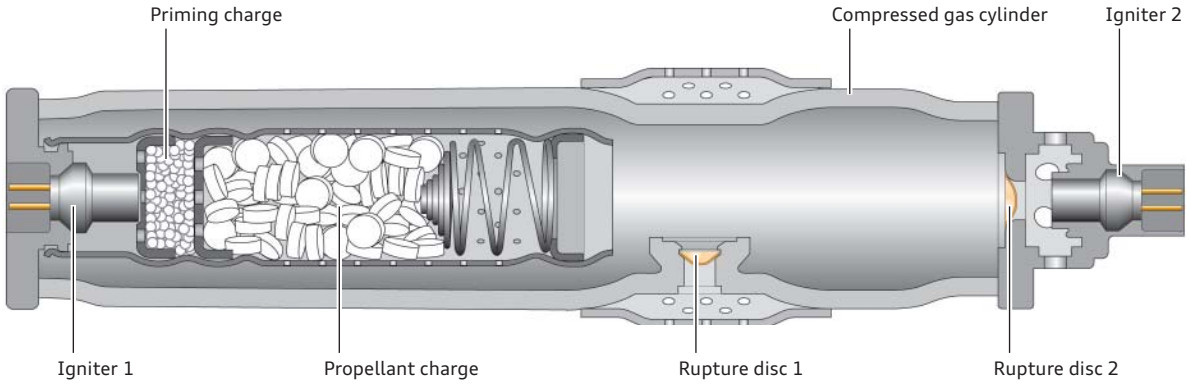


605_034

Adaptive passenger side airbag gas generator — version 1

This is a hybrid gas generator with a second outlet orifice.
This type of gas generator allows the passenger airbag to be filled to different degrees.

The airbag control unit J234 determines the time interval between activation of both igniters based on impact severity and the passenger's seating position.



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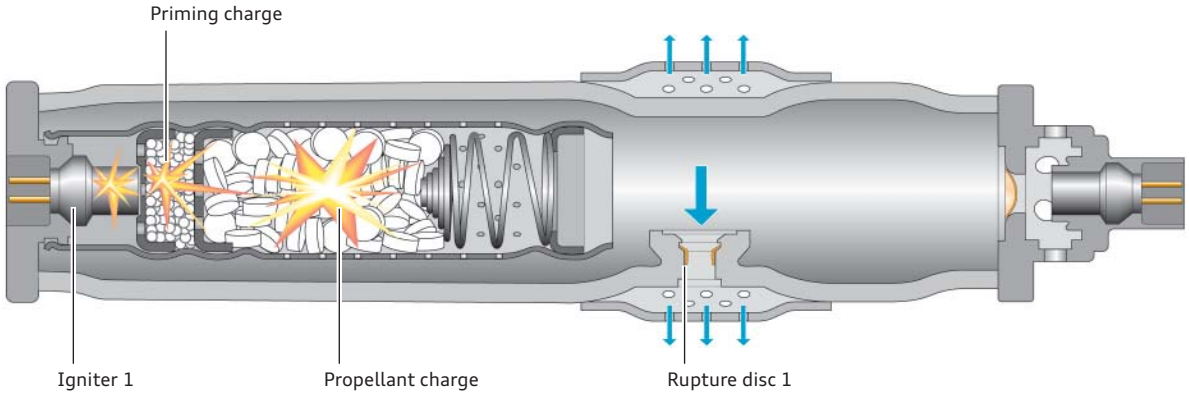
The priming charge, which is ignited by igniter 1, ignites the actual propellant charge. The pressure inside the compressed gas cylinder increases until rupture disc 1 bursts at a certain pressure.

The gas mixture inflates and unfolds the airbag.



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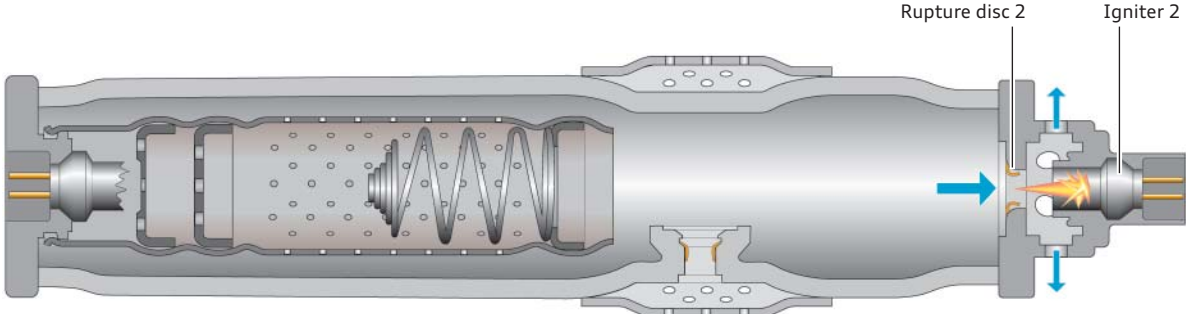
The airbag control unit J234 ignites igniter 2 after a defined period of time. A targeted pressure pulse from igniter 2 causes rupture disc 2 to burst.

A portion of the remaining gas from the compressed gas cylinder now vents into the atmosphere and is not admitted to the airbag.

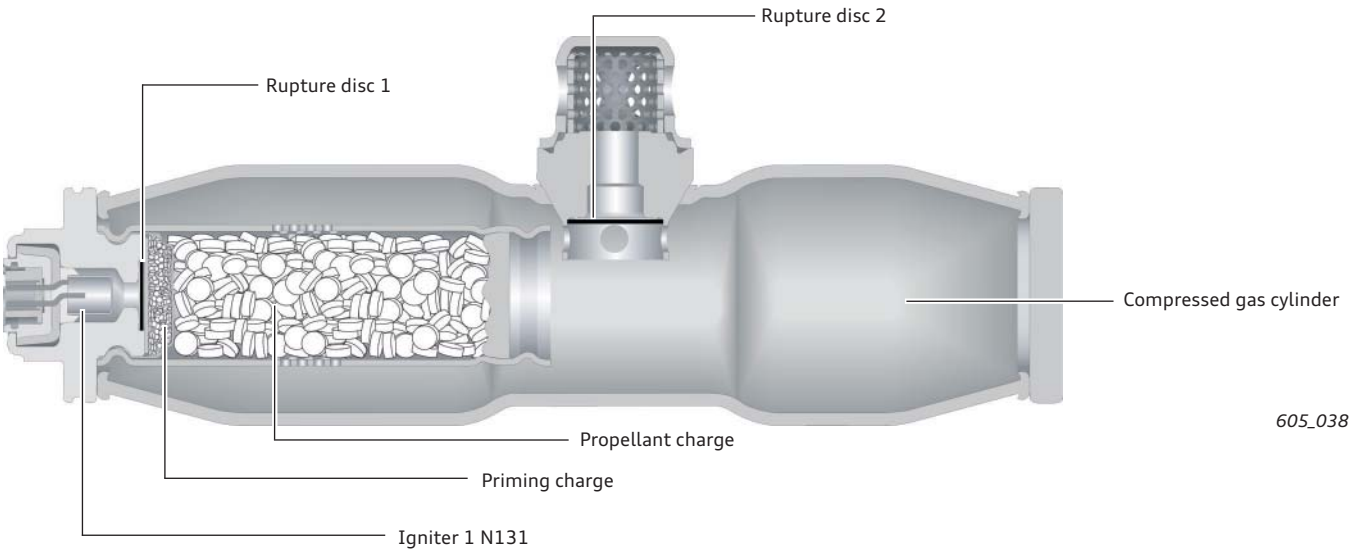


605_037

Adaptive passenger side airbag gas generator — version 2

The airbag control unit J234 activates the passenger side airbag igniter 1 N131. The flame of igniter 1 flame breaches rupture disc 1 and ignites the priming charge, which in turn ignites the actual propellant charge.

The combustion of the propellant charge causes the pressure inside the compressed gas cylinder to increase until rupture disc 2 breaks. The gas mixture unfolds and inflates the airbag.
The adaptivity function on the passenger side is similar to that on the driver side, and is described on page 14.



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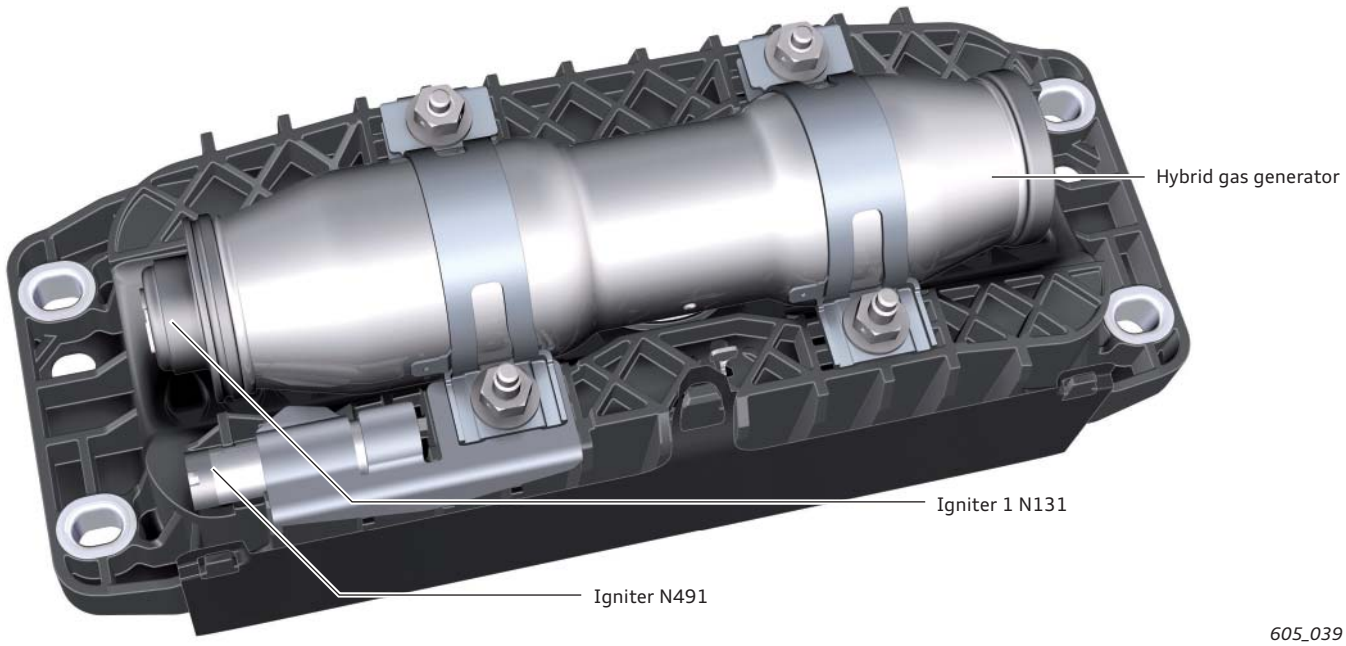
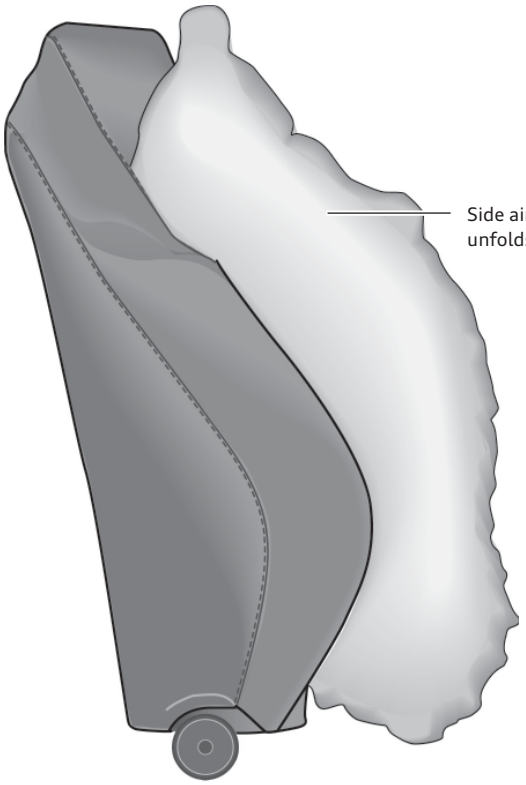


605_039

Side airbags

The side airbag modules are adapted to the individual characteristics of each Audi model.
The latest-generation side airbag modules are known as "Soft Cover Modules".

In these modules, a a textile casing replaces the plastic shell enveloping the entire airbag module. The soft surface of the textile casing allows the airbag module to be integrated better into the seat back. The lower weight of the casing is another advantage.



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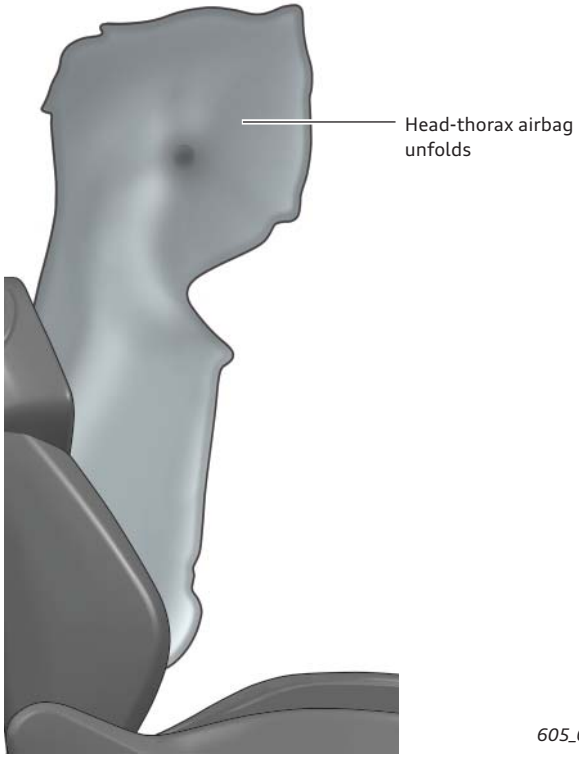
Head-thorax airbags are used in some Audi models, e.g. Audi A5 Cabriolet. The airbag module is integrated into the backrest of each of the front seats. This ensures good positioning of the airbag in relation to the occupants, irrespective of the seat adjustment.

The airbag in this airbag module is designed to protect not only the head, but also the body of the occupants.



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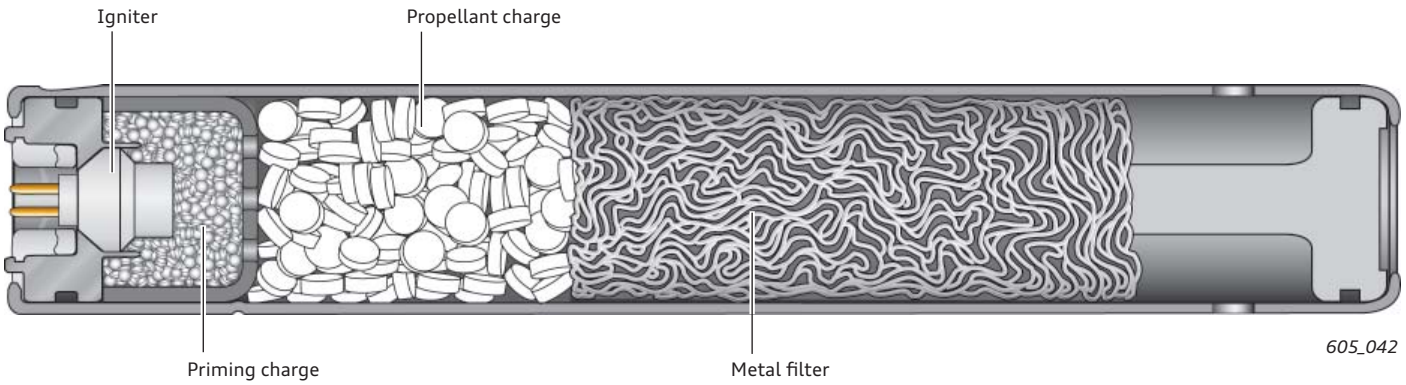
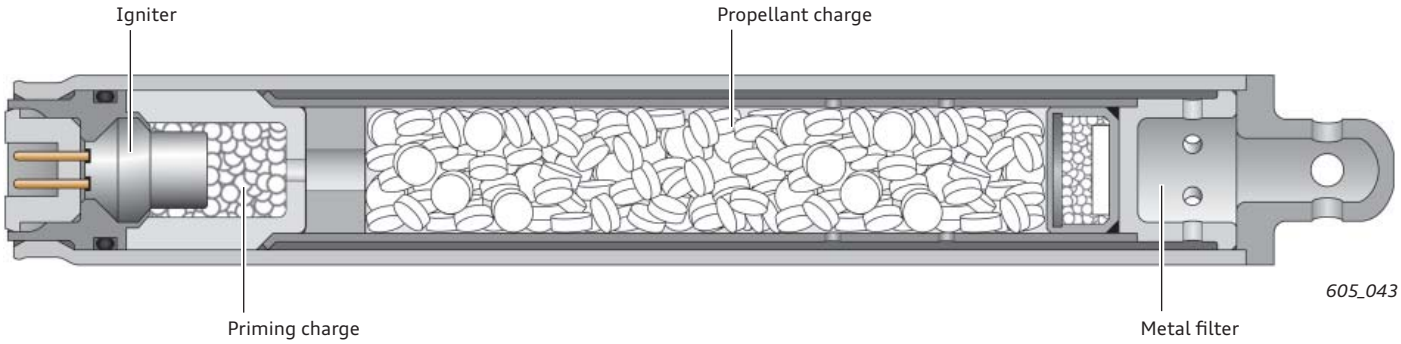
Gas generator for side airbag

The side airbags use various pyrotechnic solid propellant generators, which have the task of inflating the airbag with gas whenever necessary.

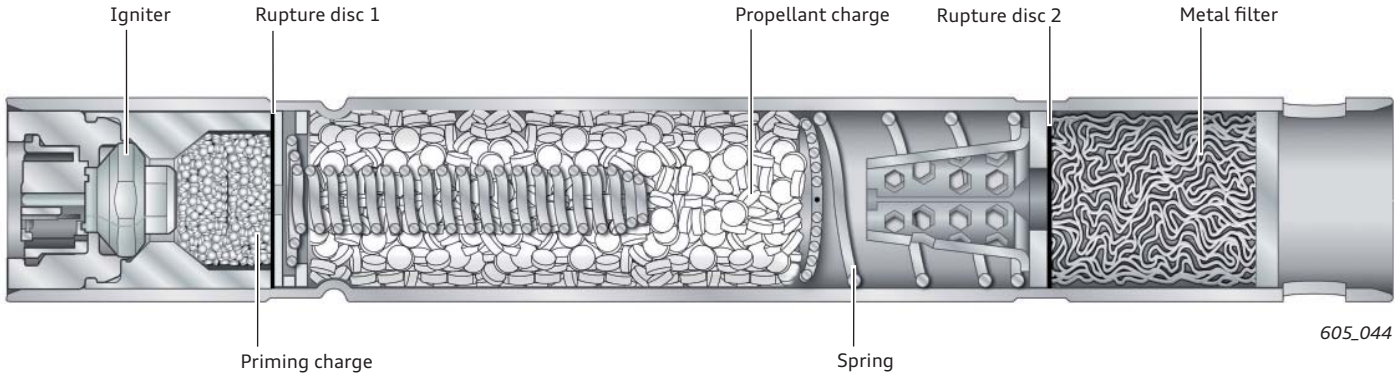
Version 1



Version 2



Version 3



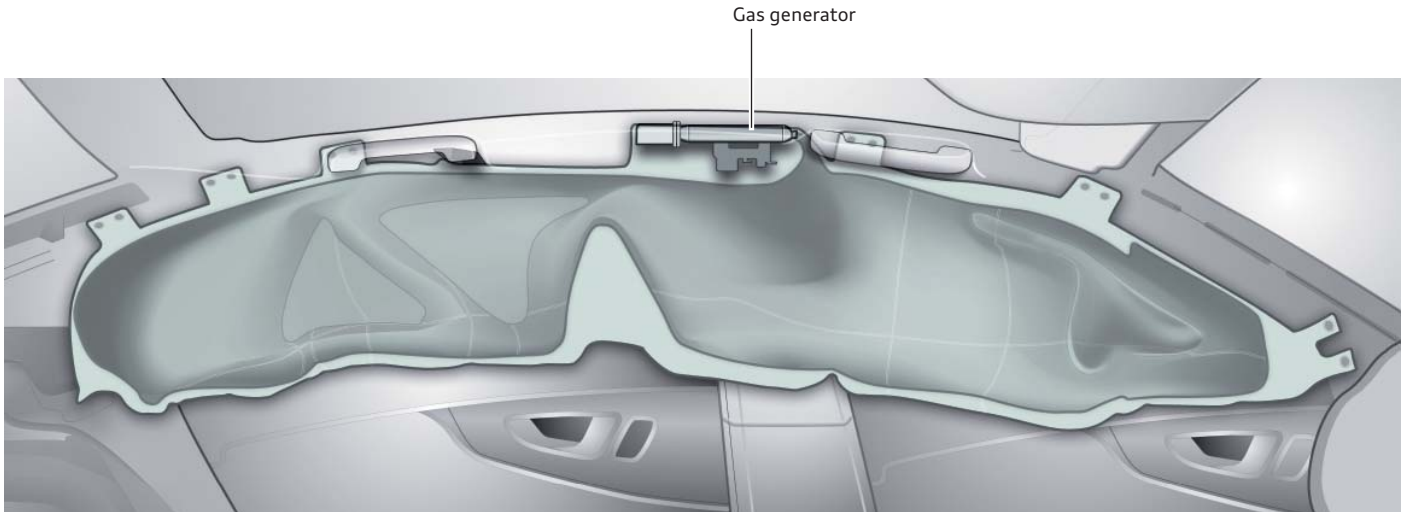
The airbag control uinit J234 energises the corresponding side airbag igniter. The priming charge, which is ignited by the igniter, in turn ignites the actual propellant charge.

The developing gas, which is purified and cooled by the metal filter, unfolds and inflates the airbag.

Head airbags

The head airbags are installed on the left and right hand sides behind the headliner. Hybrid gas generators are used to inflate the head airbags. Their range of action extends from the A post to C to the D post and, therefore, covers almost the entire side window area.

Installed in this way, the head airbags are able to afford the occupants better protection in the event of a side impact. The position of the gas generators can vary depending on model.

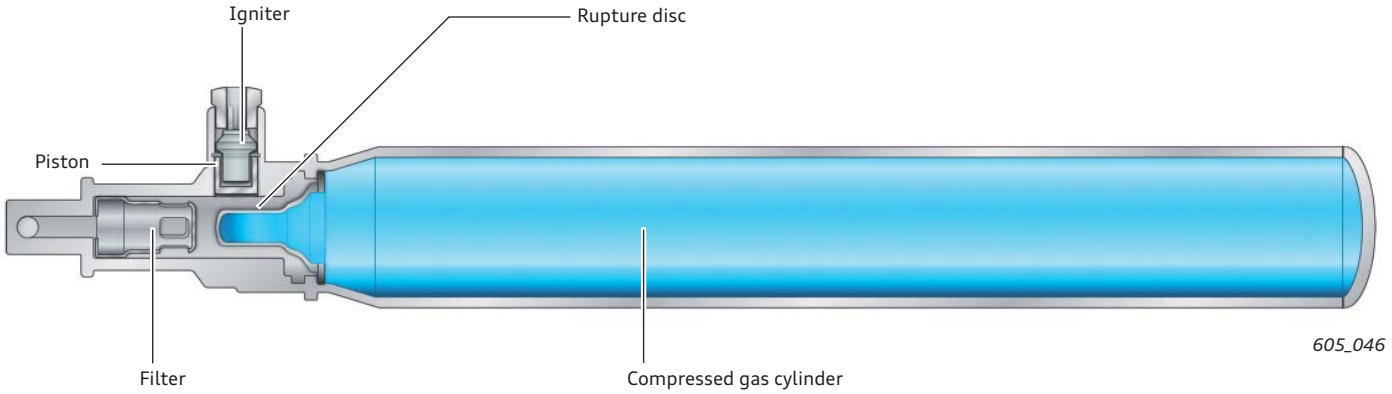


605_045

Version 1

The igniter is activated. The gas pressure produced in the igniter displaces a piston, which in turn shears off the rupture disc.
The compressed gas emerging from the compressed gas cylinder is now able to flow into the airbag. The airbag unfolds and is inflated.

With these gas generators, the pyrotechnic igniters have only the task of opening the compressed gas cylinder.

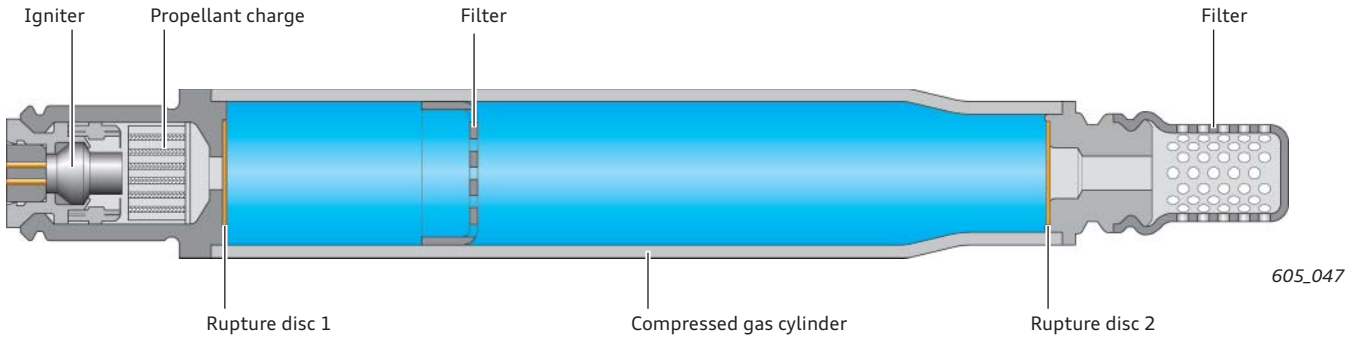


605_046

Version 2

The compressed gas cylinder contains compressed gas.
The igniter is activated by the airbag control unit J234, thereby igniting the priming charge. The combustion of the priming charge produces a gas pressure which causes rupture disc 1 to burst.

The gas pressure propagates through the compressed gas cylinder and causes the rupture disc 2 to burst as of a certain pressure. The gas mixture flows through the filter and into the airbag.

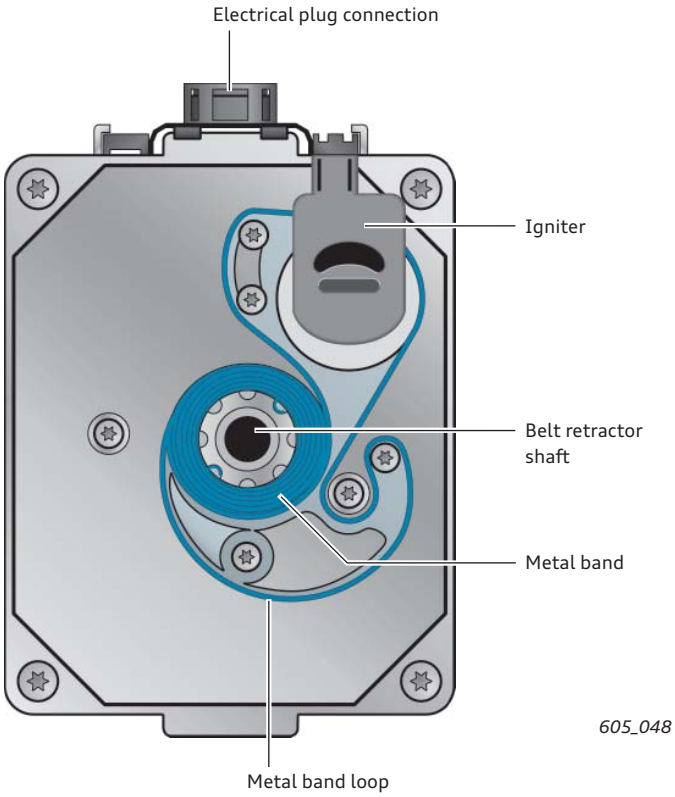


605_047

Front belt retractors

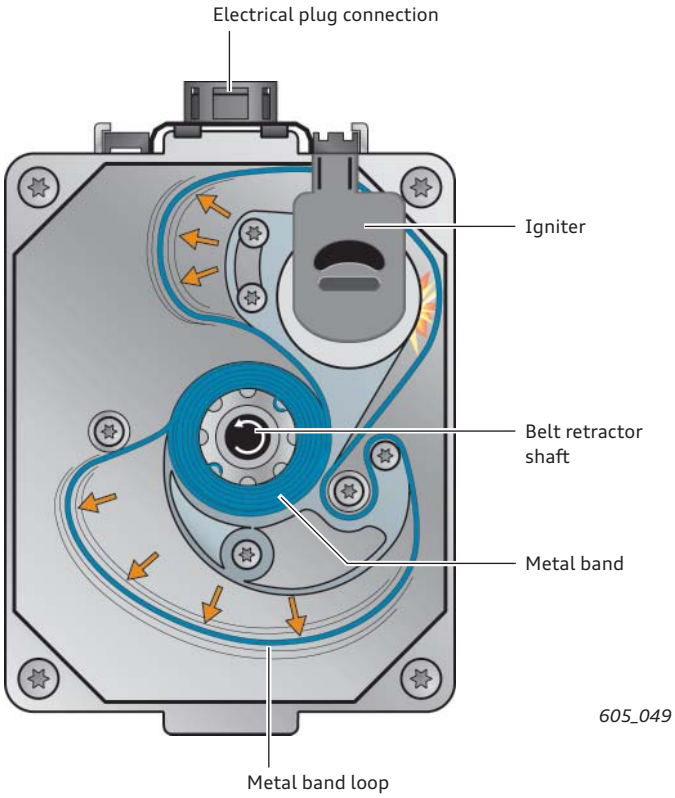
Pyrotechnic seat belt tensioner — seat belt tensioner

A metal band is wound around the belt retractor shaft. Both open ends of the band are connected to the belt retractor shaft.
The closed end is looped around the seat belt tensioner igniter.



When the seat belt tensioner igniter is ignited by the airbag control unit J234, the resultant pressure causes the loop of the metal band to expand.
The movement of the metal band exerts a pull on the belt retractor shaft, which thereupon begins to rotate, tensioning the seat belt.

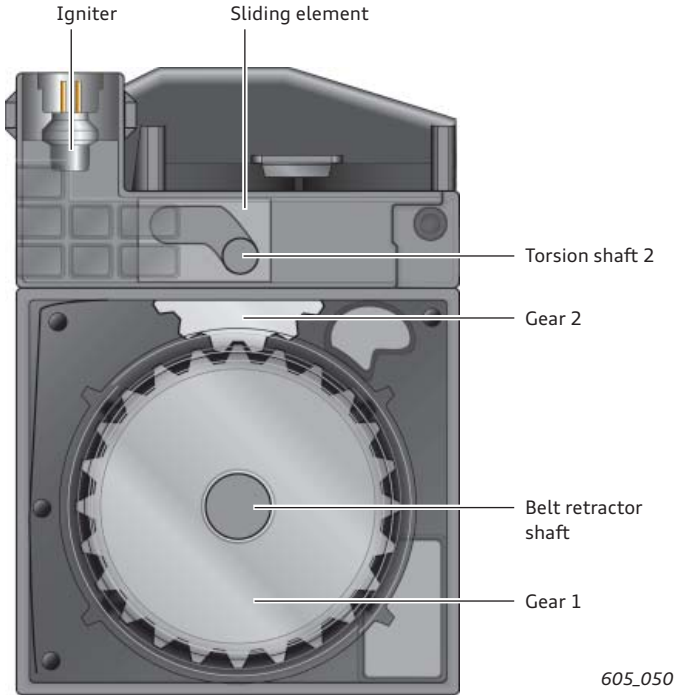
The retractor stops tensioning the seat belt when the counterforce on the seat belt is greater than the force exerted by the seat belt tensioner.



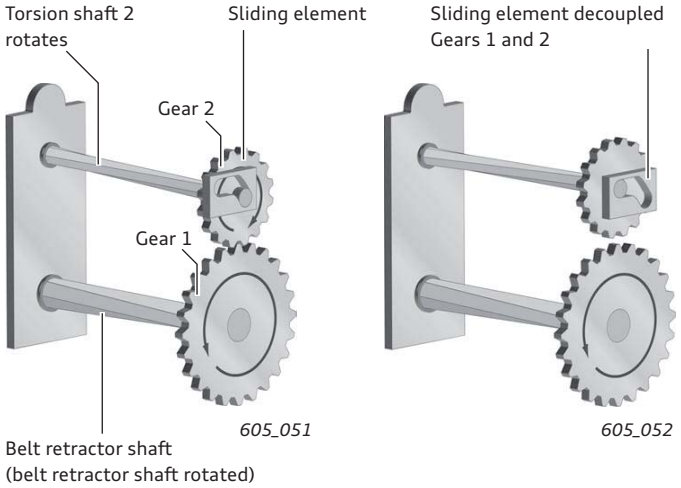
Adaptive belt force limitation

In models with adaptive airbag systems, the front belt retractors have an adaptive two-stage belt force limiter.

In the event of a collision, the seat belt tensioners (band tensioners) are ignited first.
The seat belt tensioner retracts the seat belt as far as possible. Then, the belt retractor blocks the belt retractor shaft and thus prevents the seat belt from unreeling, which otherwise would take place due to the forward motion of the occupants.
If the occupant moves further forward due to deceleration, the belt force limiter permits controlled unreeling of the seat belt as of a certain force level.

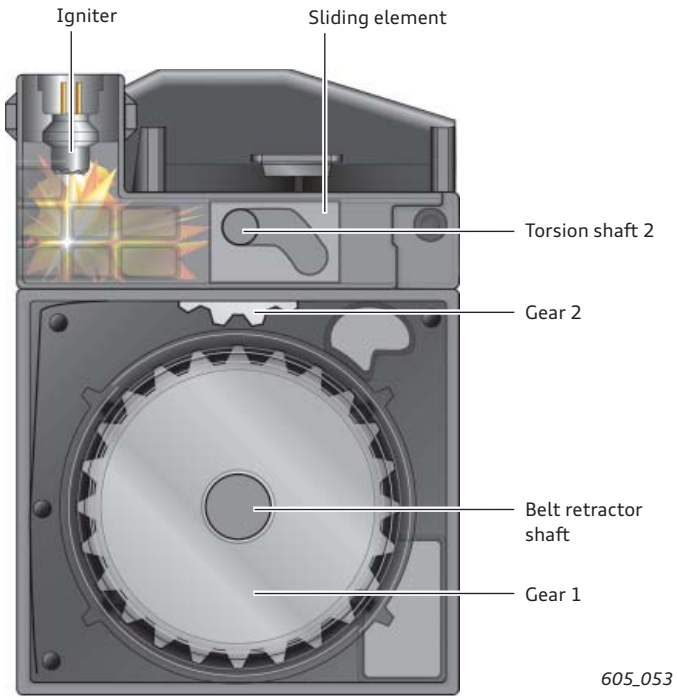


The belt retractor shaft is designed as a torsion shaft and coupled to torsion shaft 2 via gears 1 and 2. Both torsion shafts are rotated (high belt force level).



Depending on impact severity and seating position, the airbag control unit J234 decides when to activate the belt force limiter igniter.
The second torsion shaft is decoupled. The belt retractor shaft now counteracts, by itself, the force which the seat belt exerts (low force).
To afford the occupants a good level of protection, the seat belt tensioning function, the belt force limiting function and the front airbags are activated in a co-ordinated manner.

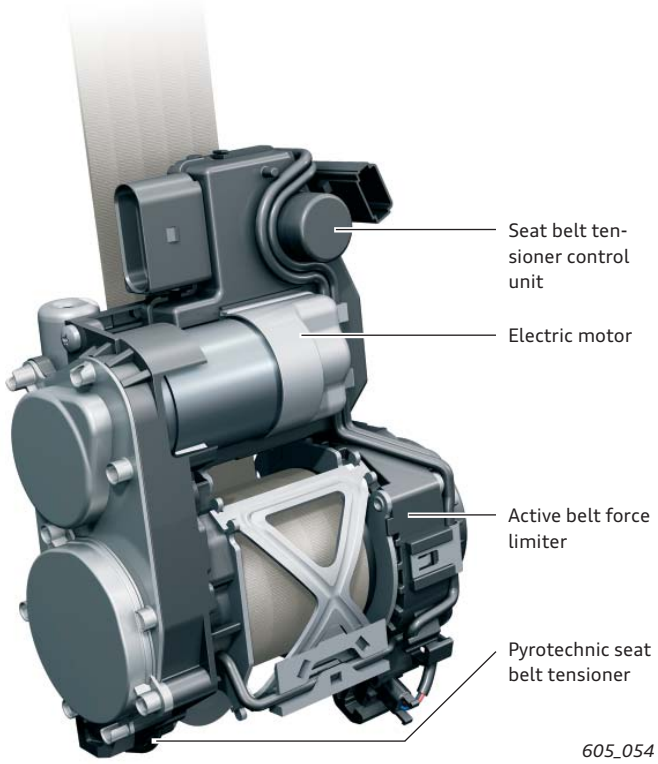
The belt force limiter igniters are not activated in the event of a side impact or rear collision.



Front belt retractors in combination with Audi pre sense

If the vehicle is equipped with the Audi pre sense system, the following functions are integrated in the front belt retractors:

- Reversible seat belt tensioner with control unit
- Pyrotechnic seat belt tensioner
- Adaptive belt force limiter



605_054

Reversible seat belt tensioners
Front left seat belt tensioner control unit J854 and front right seat belt tensioner control unit J855

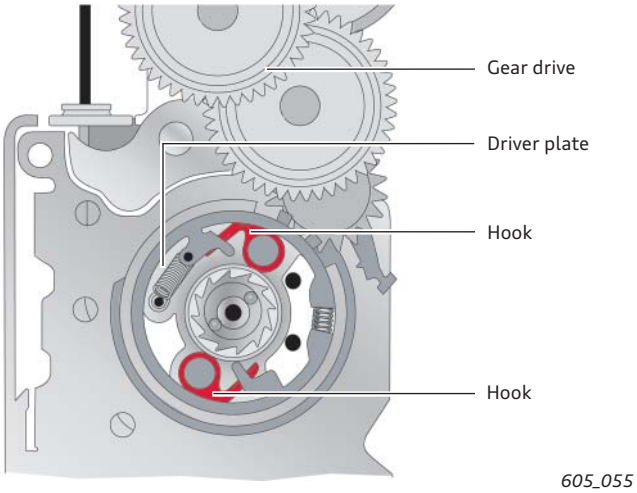
The front left and right seat belt tensioner control units J854 and J855 are integrated in the vehicle network via an extended CAN bus and the data bus diagnostic interface J533.
The seat belt tensioner control units activate the connected reversible seat belt tensioning motors based on the information provided via the data bus.

There different force levels are available depending on the situation:

1. Low force level = belt slack reduction
2. Medium force level = pre-tensioning
3. High force level = full tensioning

In addition:

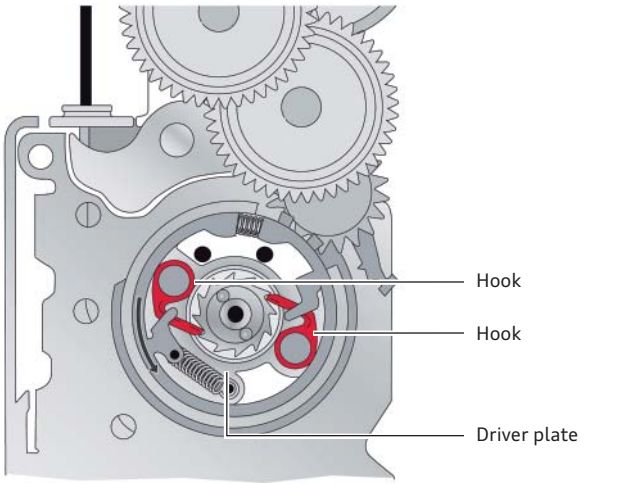
In the event of a head-on collision, the airbag control unit J234 decides, based on the severity of the impact, which seat belt tensioners are required (pyrotechnic or reversible).
Accordingly, the control unit J234 sends a data signal.
The front seat belt tensioner control units J854 and J855 initiate a reversible full tensioning of the seat belts based on the data signals.



605_055

When the electric motor begins to rotate, the driving plate is driven via a gear drive. Two extending hooks connect the driving plate to the belt retractor shaft, and the seat belt is retracted.

If the electric motor stops or reverses slightly, the hooks are able to retract again and release the belt retractor shaft.

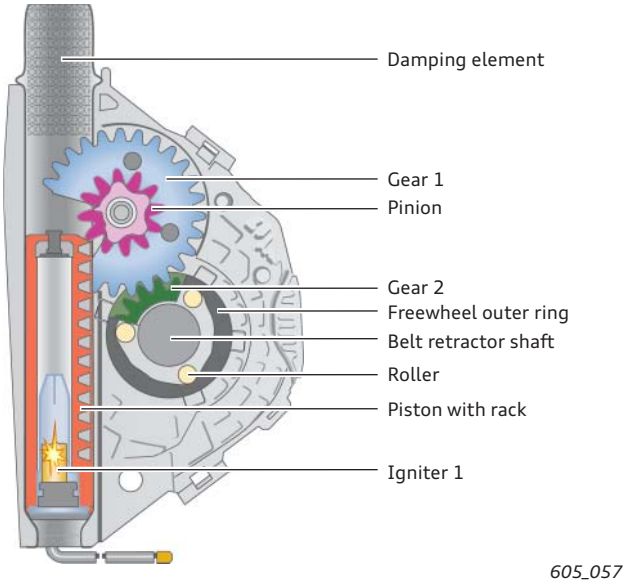


605_056

Front pyrotechnic belt tensioners in combination with Audi pre sense

These pyrotechnic seat belt tensioners have a rack-and-pinion design.

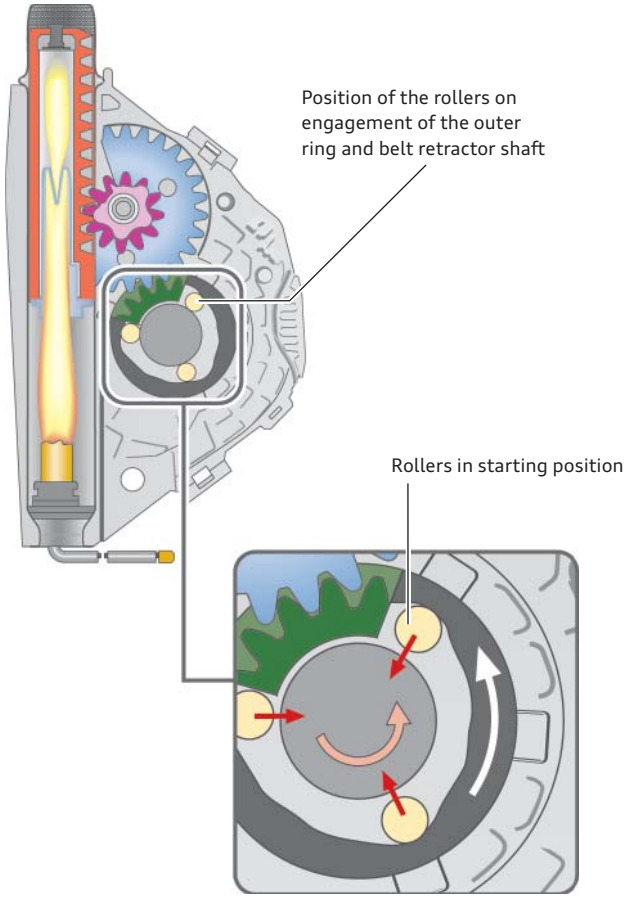
The signal from the airbag control unit J234 ignites seat belt tensioner igniters 1 N153 and N154. The build-up of pressure causes the piston coupled to the rack to move upwards. The rack turns gears 1 and 2 via the pinion.



605_057

Gear 2 is permanently connected to the outer ring of the belt retractor shaft freewheel. When the outer ring turns, the rollers are thrust inwards until they lock into place between the outer ring and the belt retractor shaft. Traction is thus established between the outer ring and the belt retractor shaft. The rotational movement is now transmitted to the belt retractor shaft, and the process of retracting the seat belt begins.

The retractor stops tensioning the seat belt if the counterforce acting on the seat belt is greater than the force exerted by the seat belt tensioner.



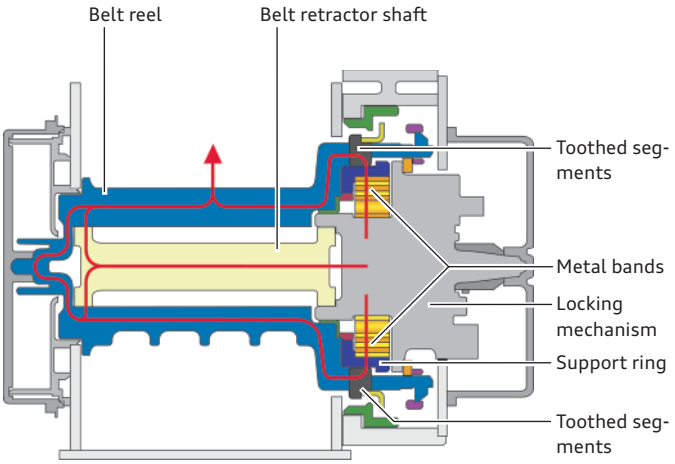
605_058

Adaptive belt force limiters in combination with Audi pre sense

The front belt retractors have two-stage belt force limiters. In the event of a head-on collision which meets the conditions for deployment, the pyrotechnic belt tensioners are ignited first. The locking mechanism blocks the belt retractor shaft and prevents the seat belt from unreeling, which would otherwise occur due to the forward motion of the occupants.

To limit the load which the seat belt exerts on the occupants, the belt retractor shaft and a belt winder permit controlled unreeling of the seat belt.
The force, which the seat belt counteracts, is distributed as follows:

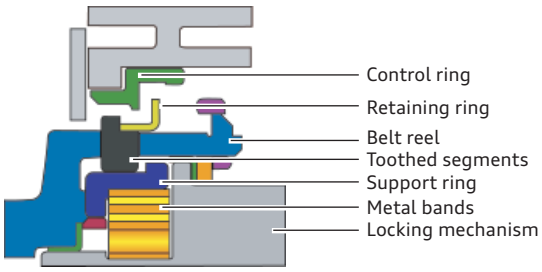
1. From the seat belt reel via the retractor shaft to the locking mechanism. The belt retractor shaft, which is designed as a torsion bar, begins to rotate.
2. From the belt reel to the locking mechanism via the toothed segment, support ring and metal bands. The metal bands are connected to the support ring and the locking mechanism. The metal bands are retracted.



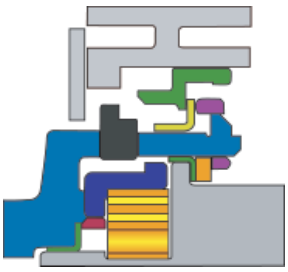
605_059

Depending on impact severity and longitudinal seating position, the airbag control unit J234 activates the belt force limiter igniters G551 and G552.
The resultant gas pressure displaces the piston and causes the control ring to rotate. This displaces the retaining ring and disengages the toothed segments from the support ring. The belt winder is decoupled. The torsion bar now counteracts, by itself, the force which the seat belt exerts.

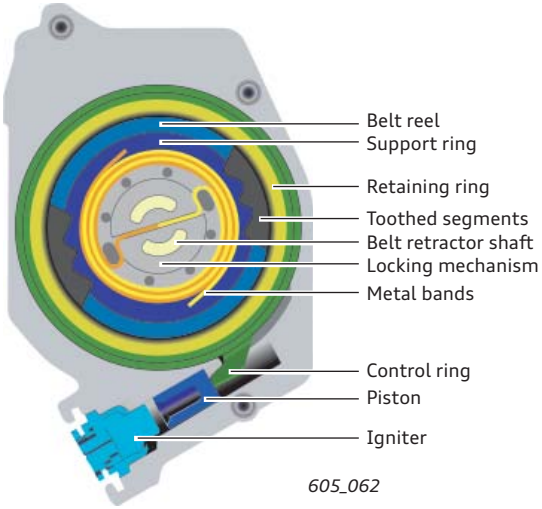
To afford the occupants a good level of protection, the belt tensioning function, the belt force limiting function and the front airbags are activated in a co-ordinated manner.
The belt force limiter igniters are not activated in the event of a side impact or rear collision.



605_060



605_061



605_062

605_063

Roll-over protection system

Several Audi models, e.g. Audi R8 Spyder, have special roll-over protection systems on account of their body design.
When activated, the roll-over protection system works in combination with the A posts to create a safety zone for the occupants.

A sensor for detecting an imminent roll-over is integrated in the airbag control unit. This sensor, together with other sensors built into the control unit, determines the severity of the impact and activates both the roll-over protection system and the seat belt tensioners.

As a safety precaution, the roll-over protection system is also activated in the event of a heavy head-on collision, side-impact collision or rear collision as soon as a seat belt tensioner or airbag deploys.

Function

In the rest state, the roll-over protection solenoids N309 and N310 are deenergised and hold the roll-over protection system in the retracted position by means of a hook.
If the airbag control unit detects a collision or an imminent roll-over, the roll-over protection solenoids are energised and enable the roll-over protection system.

The roll-over bar is extended within approximately 0.25 seconds by the pretensioned springs.
Once the roll-over bar has extended a distance of approximately 170 mm, a locking rail prevents it from being pushed back into the starting position. An activated roll-over protection system can be mechanically unlocked and moved back into the starting position.

605_064

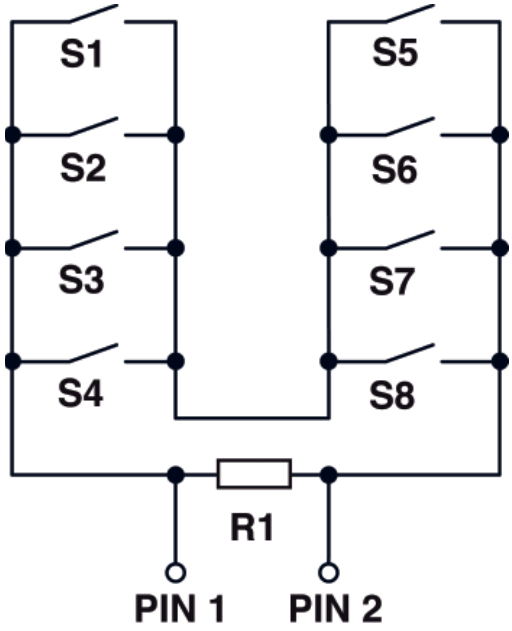
Sensors

Seat occupancy sensor

Depending on model and trim, different seat occupancy sensors are used.
The passenger side seat occupancy sensor G128 is a plastic film with 2x 4 pressure sensors. The resistance of the individual sensors changes under load. The system recognises an occupied seating position only if two pressure sensors are triggered simultaneously. One pressure sensor of sensors S1 – 4 and one pressure sensor of sensors S5 – 8.

The position of the seat occupancy sensor G128 on the seat foam moulding is pre-defined in order to monitor the relevant area of the seat swab.

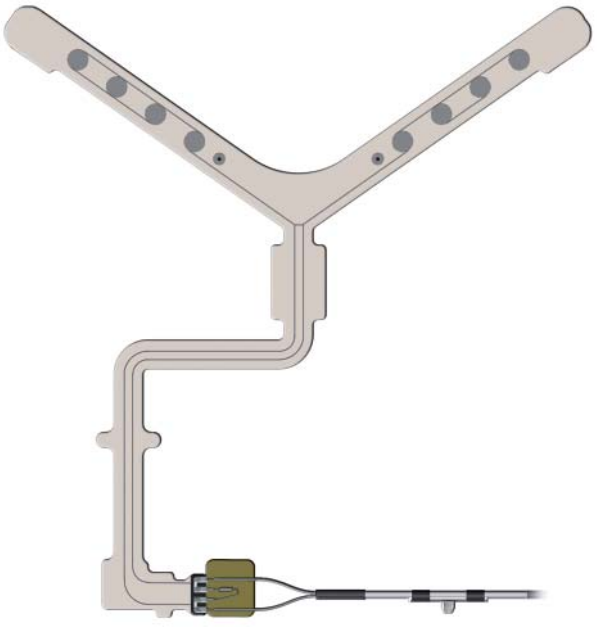
The airbag control unit J234 utilises the information supplied by the seat occupancy sensor and belt lock switch for seatbelt fastening detection.



605_065

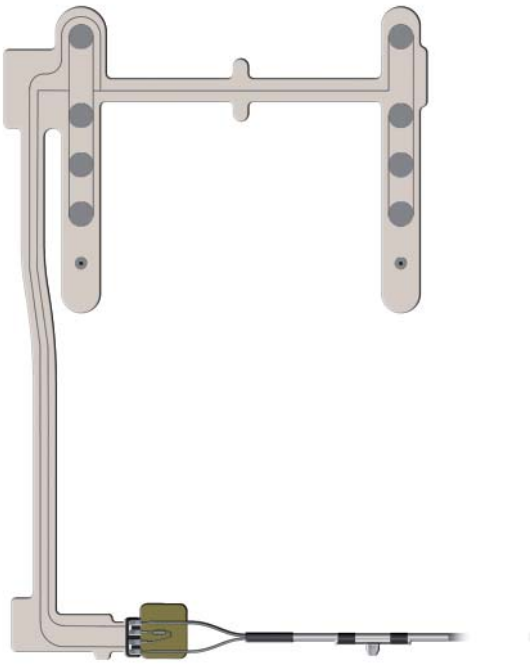
Examples:

Multicontour sear sensor G128



605_066

Normal and sport seat sensor G128



605_067

Seat position detection

The driver and passenger seats on several models are fitted with seat position sensors G553 and G554. These sensors are Hall sensors. Based on the power consumption of the seat position sensors, the airbag control unit J234 detects whether the seats are located in the front third of the seat adjustment range or in the rear two thirds. The airbag control unit utilises this information to activate the adaptivity function of the belt force limiters and the front airbags at the right moment.

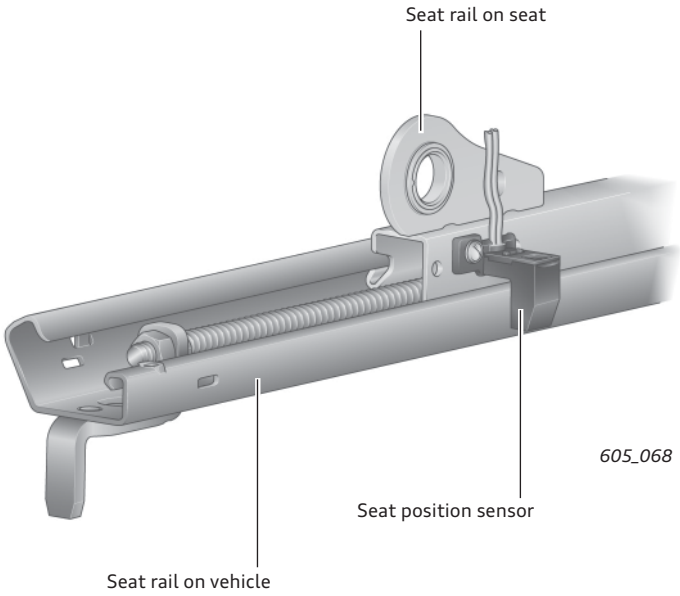
If the seat is in the front third of its adjustment range, the airbag control unit J234 can activate the adaptive airbag igniter 2 earlier than if the seat was in the rear two thirds of its adjustment range.

Early ignition of the second airbag igniter allows airbag deployment to be adapted to the situation and occupants with a small body mass to plunge into the airbag in a controlled manner. Belt force limiter igniters G551 and G522 are also activated early. As a result, the restraint systems are adapted accordingly to the accident situation and seat position.

As before:
a properly adjusted seat, correct seating position and a correctly fastened seat belt are the first steps to effective occupant protection.

Seat in "back" position

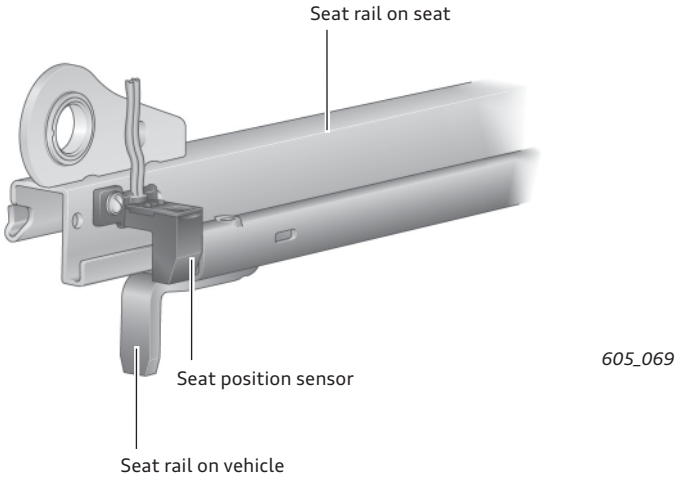
The seat position detection sensors work in concert with the seat rails on the tunnel side.
If the seat position detection sensor is above the seat rail attached to the vehicle body, the airbag control unit J234 will ascertain that the seat is in the "back" position.



605_068

Seat in "front" position

If the seat is pushed forwards and the seat position sensor moves beyond the seat rail attached to the vehicle body, the airbag control unit J234 will ascertain that the seat is in the "front" position.



605_069

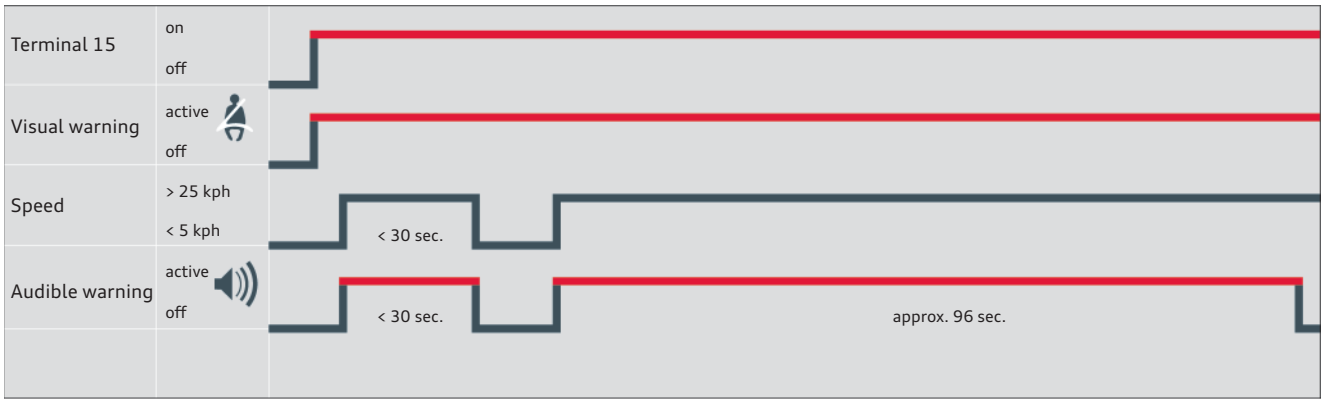
Seat belt reminder

Front seat belt reminder

If the front occupants are not wearing their seat belts, they are alerted to this by the seat belt reminder warning lamp K19 after the ignition is turned on.
The warning lamp K19 comes on if the driver and/or passenger has not fastened his/her seatbelt. When the vehicle exceeds a speed of 25 kph, the front occupants are also reminded to fasten their seat belts by an acoustic signal.
If the acoustic warning has started and the vehicle decelerates to a speed of less than 5 kph within the first 30 seconds, the acoustic warning is suppressed.

If the vehicle's speed increases again to above 25 kph, the acoustic warning resumes. If the first 30 seconds have elapsed since commencement of the acoustic warning, the acoustic warning does not stop, unless the seat belts are fastened.
The total duration of the acoustic warning is limited to 126 seconds. The acoustic warning also varies in volume and frequency. The values specified here can vary depending on model type and model year.

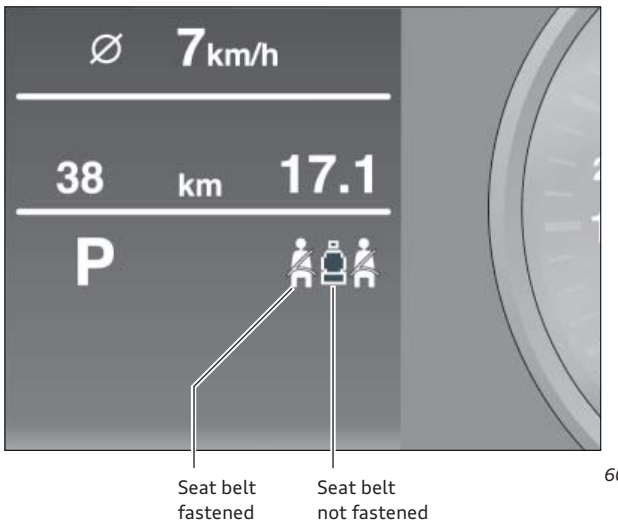
Front seat belts not fastened warning



605_070

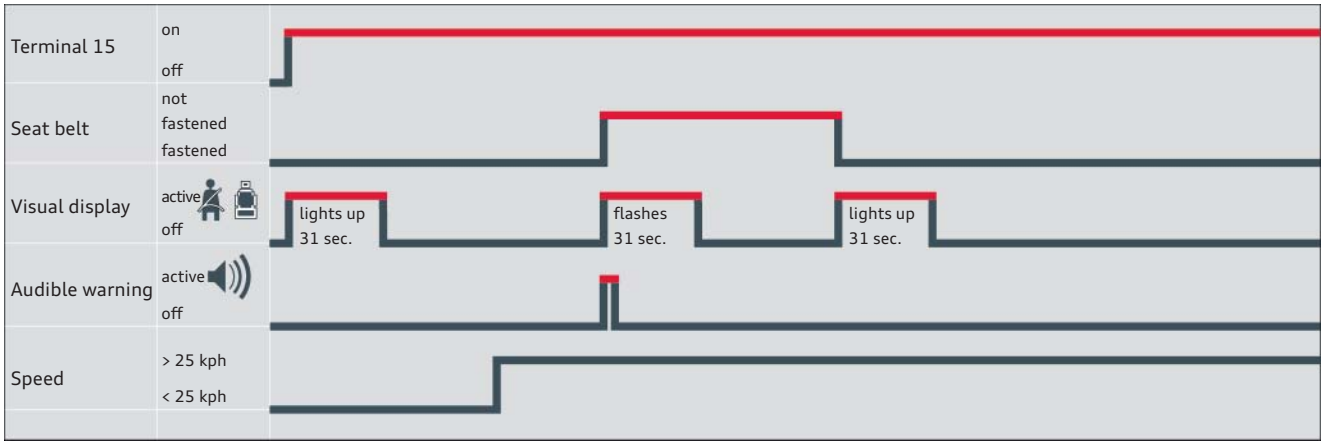
Rear belt warning (model-dependent)

After the ignition is turned on, the status of the seat belts (fastened/not fastened) is indicated on the centre display of the dash panel insert for 31 seconds.
Each change of status is indicated for an additional 31 seconds.
If a rear passenger removes his/her seat belt while the vehicle is travelling (at a speed of greater than 25 kph), an acoustic warning sounds once and the relevant indicator on the centre display flashes for 31 seconds.
The airbag control unit J234 receives signals from the rear belt switches on the driver side E258, on the passenger side E259 and in the centre E609 indicating whether the seat belts are fastened.



605_071

Rear seat belts not fastened warning



605_072

Market-specific special features

Additional notes on the occupation protection system for specific markets

To meet the statutory and specific requirements of several countries, vehicles can be equipped with additional systems.

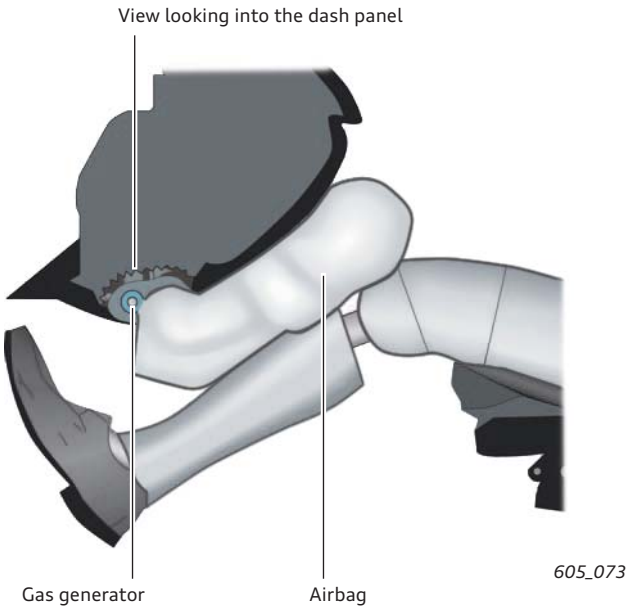
Roll-over protection bar system

Depending on country specification, two additional sensors are integrated the airbag control unit J234 for the purposes of roll-over detection. The ABS control unit J104 reads in additional information in order to provide higher rollover detection sensitivity.

The airbag control unit does not necessarily require this information. It has the ability to independently detect a rollover.
If a rollover is detected, the belt tensioners and the head airbags are deployed.

Knee airbags

The ignited knee airbags allow the occupants to participate earlier in the process of vehicle deceleration. On the driver's side, the knee airbag is located in the footwell trim below the dash panel. On the passenger's side, the knee airbag is installed behind the glove comartment flap. The knee airbags are activated in combination with the front airbags. Hybrid gas generators are used as gas generators.

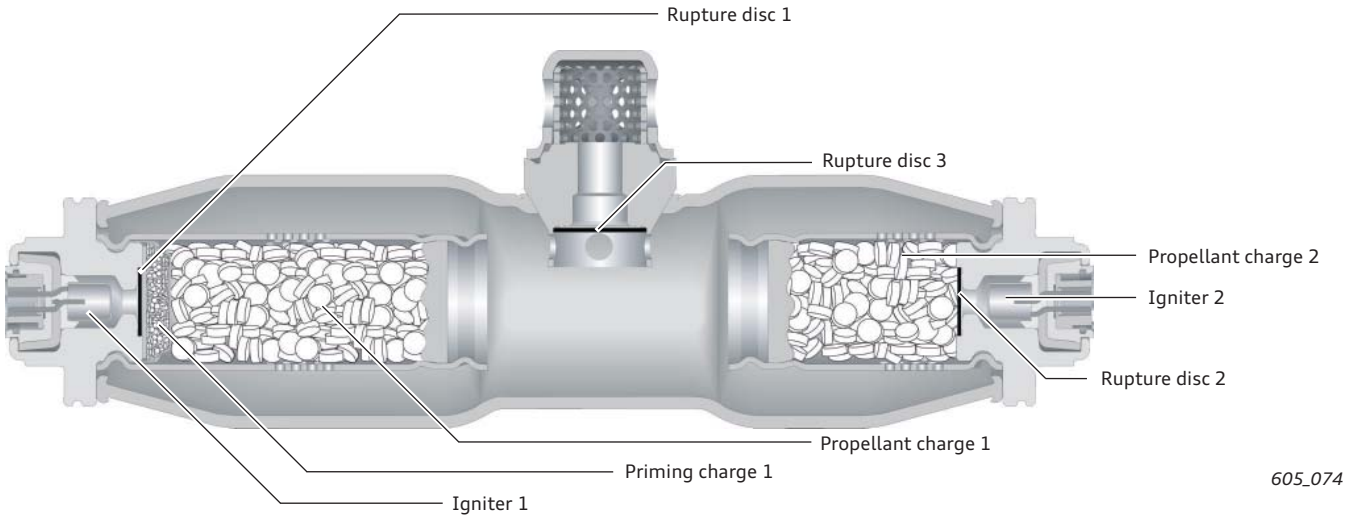


Passenger front airbag

Adaptive passenger side gas generator

A hybrid gas generator with two pyrotechnic propellant charges for inflating the airbag with gas may be fitted depending on country specification.
The adaptivity function of the passenger airbag module is identical to that of the driver side airbag module and is described on page 14.

Depending on the accident situation, the airbag control unit J234 determines the interval at which the passenger side airbag igniter 2 N132 is ignited after the driver side airbag igniter 1 N131.



605_074

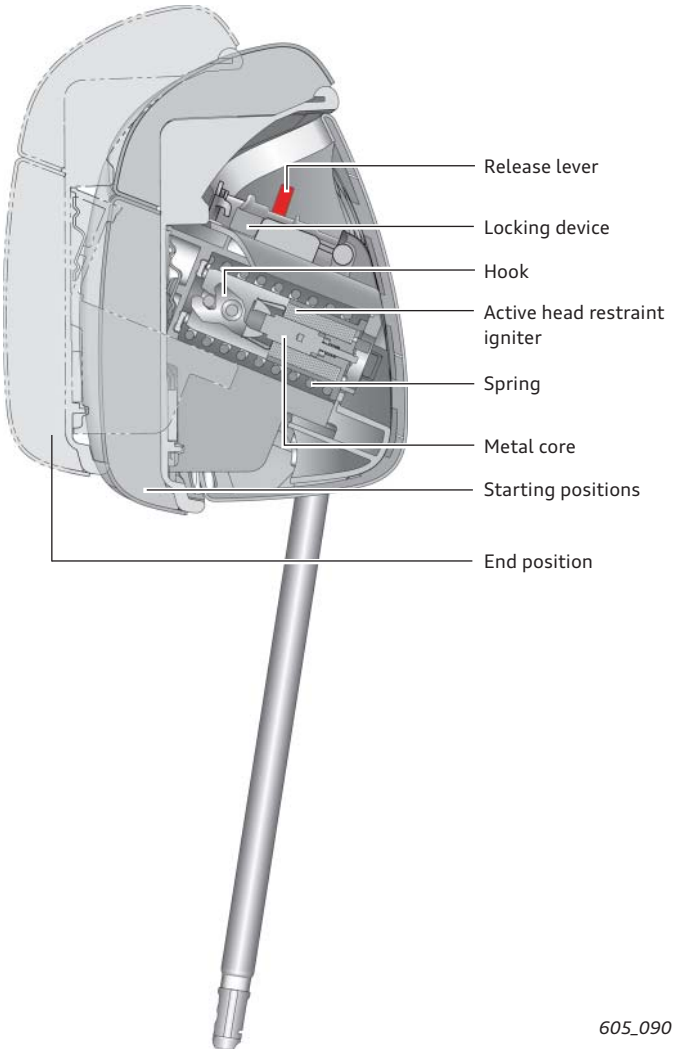
Active head restraint

If the airbag control unit J234 detects a rear collision which meets the conditions for deployment, the head restraints on the front seats are activated in addition to the seat belt tensioners. When the airbag control unit energises the active head restraint igniters, N419 and N420, the metal core is drawn into the solenoid coil. The hook can no longer support itself on the metal core and releases the front part of the head restraint.

The hook moves approximately 50 mm forwards and approximately 20 mm upwards. A locking device prevents the front part of the head restraint from pushing back into its starting position.

Resetting the active head restraint

The active head restraints are reversible. Operating the release lever releases the lock and allows the extended part of the head restraint to be pushed back again. Refer to ELSA for further information.



605_090

Passenger side seat occupancy sensor

In several markets, the passenger seat is equipped with a special seat occupancy recognition system. The task of this seat occupancy recognition system is to indicate the occupancy status of the seat to the airbag control unit J234.

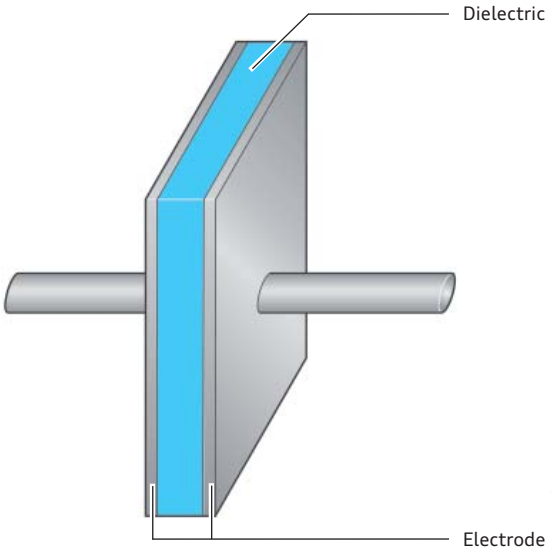
Two occupancy states can be recognised:

1. Seat not occupied or child seat fitted.
2. Seat occupied by an adult.

This determines whether the passenger front airbag and passenger knee airbag are activated or deactivated. If the components are deactivated, the PASSENGER AIRBAG OFF warning lamp K145 comes on in order to inform the occupants.

Passenger side seat occupancy sensor G128

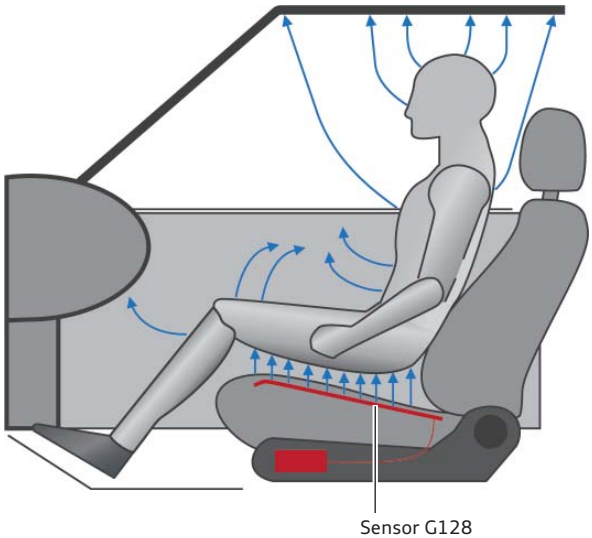
The passenger side seat occupancy sensor G128 is a capacitive sensor and, put simply, acts as a capacitor.
The capacitor comprises two plates (electrodes) and an insulator (dielectric), which is sandwiched between the two plates. When voltage is applied to one of the electrodes and the other electrode is connected to the battery's negative terminal, the capacitor begins to accumulate energy. Capacitance is measured in units called farads. The capacitance of a capacitor can be altered by varying the size of the electrode plate or the dielectric.



605_075

Function

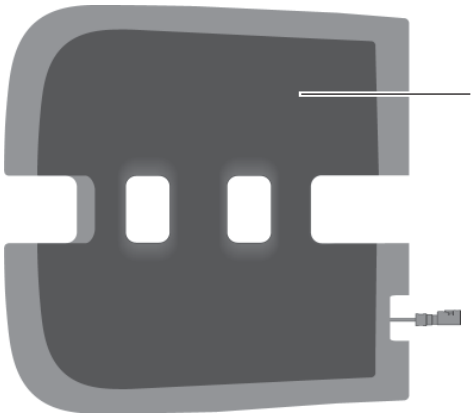
With this seat occupancy recognition system, the first electrode plate is the passenger side seat occupancy sensor G128 and the second electrode plate is the chassis. The size of these components is not variable. The dielectric consists of the seat cover, the atmosphere and the trim parts. It is therefore variable. When an adult is seated in the passenger seat, the dielectric between the sensor G128 and the body changes due to the person's fluid content. The capacitance changes accordingly.
If a child seat is placed on the passenger seat, the dielectric, and hence the capacitance, changes again. The change in capacitance is much smaller compared to an adult.



605_077

Installation position

Seat occupancy sensor G128 is integrated in the seat cover above the seat cushion. Note that there are different seat types and therefore also different seat occupancy sensors.

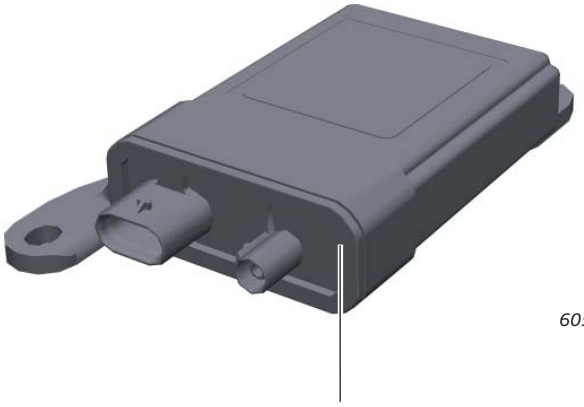


605_076

Seat occupancy recognition control unit J706

Seat occupancy sensor G128 is connected to the seat occupancy recognition control unit J706 by a coaxial cable. In principle, the control unit J706 is the measurement unit for seat occupancy recognition. It detects the change in the capacitance of the seat occupancy sensor G128 and, thus, can determine if the seat is vacant, fitted with a child seat or occupied by an adult. The capacitance of the seat occupancy sensor is measured cyclically by the seat occupancy recognition control unit.

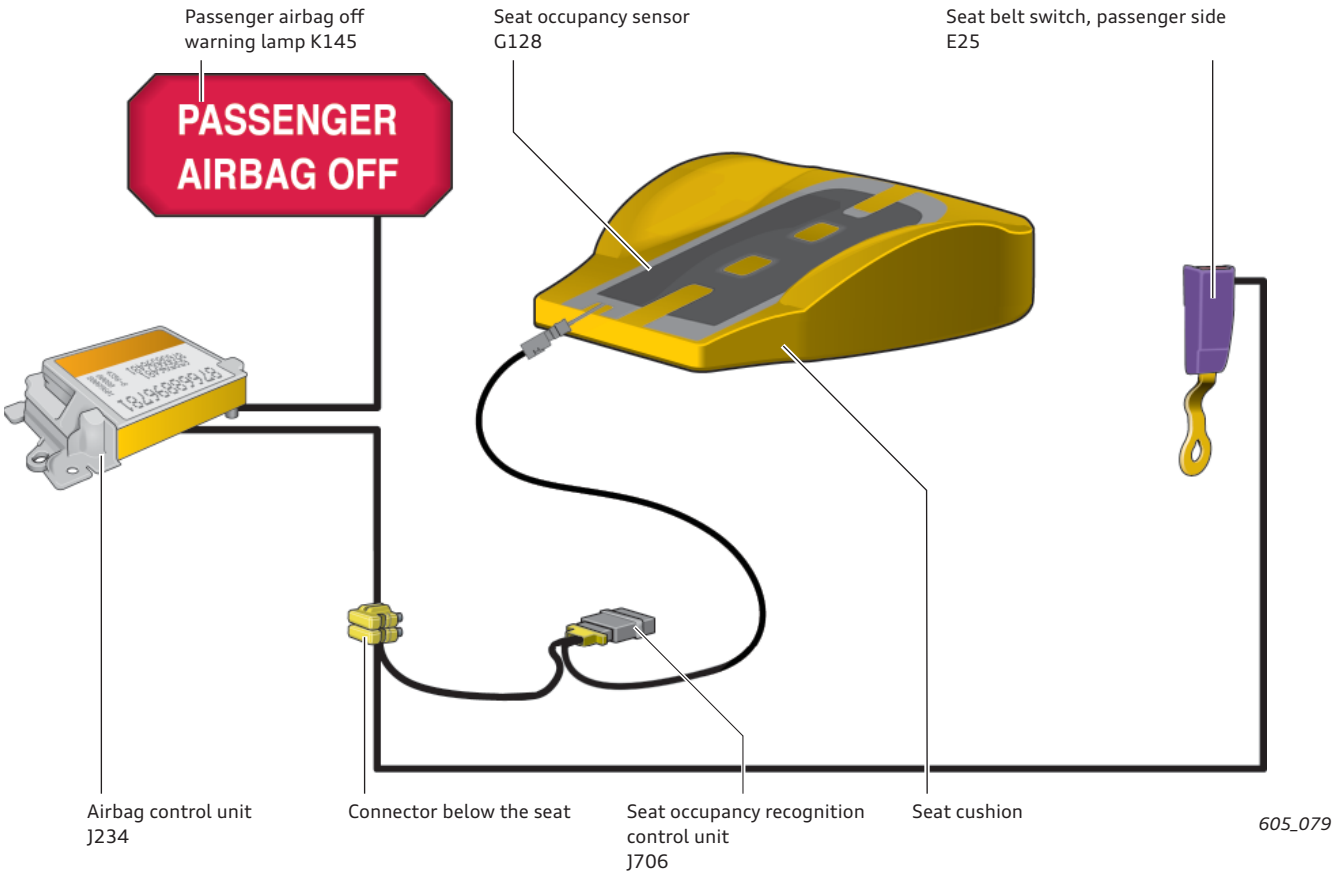
The airbag control unit J234 obtains this information from the seat occupancy recognition control unit J706 via a LIN interface.
The airbag control unit activates or deactivates the passenger airbag and the passenger knee airbag on the basis of this information. The PASSENGER AIRBAG OFF warning lamp K145 is also activated.



605_078

System overview

The seat occupancy recognition control unit J706 is installed under the passenger seat. Note that there are different seat types and therefore also different seat occupancy recognition control units. The software in the control units is adapted specially to the seat.



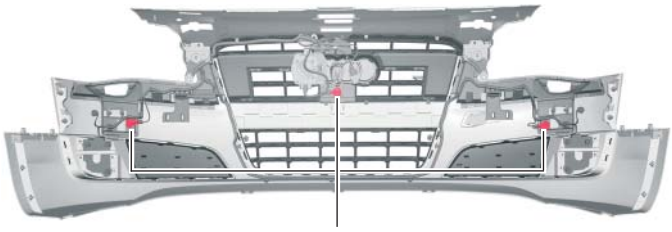
Note
When repairing the seat occupancy recognition system, always refer to ELSA, Guided Fault Finding and the Electronic Parts Catalogue (ETKA).

Pedestrian protection

To detect an accident involving a pedestrian, three additional acceleration sensors are fitted:

- Driver side pedestrian protection crash sensor G570
- Passenger side pedestrian protection crash sensor G571
- Pedestrian protection crash sensor G693

These sensors are positioned on the back of the bumper cover. If a relevant contact with a pedestrian is detected a speed range from approximately 25 to 55 kph, the airbag control unit J234 activates the two pedestrian protection triggers G598 and G599.



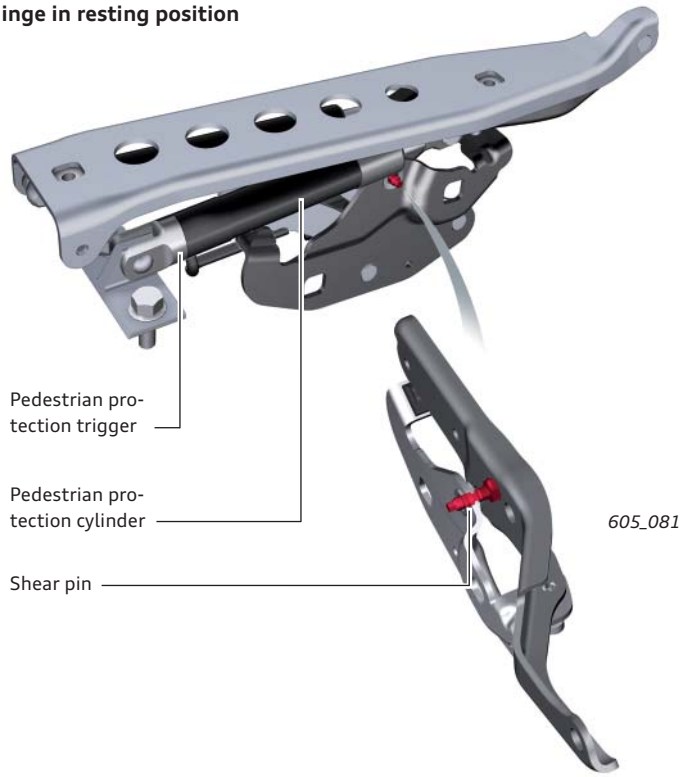
605_080

Function

The pedestrian protection triggers are small pyrotechnic propellant charges.
When the propellant charges are ignited, the resulting gas pressure pushes the pistons into the pedestrian protection cylinders.

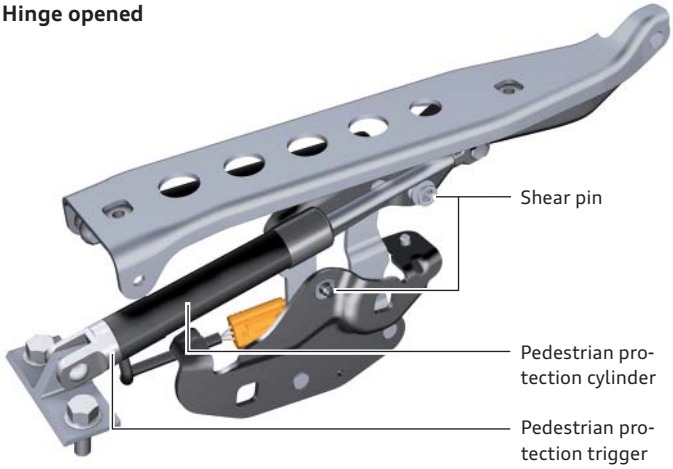
The shear pins are sheared off and the bonnet is raised by approximately 40 mm at the back by the kinematic mechanism of the bonnet hinges.
At the same time, the guided striker causes the bonnet to move back approximately 33 mm.

Hinge in resting position



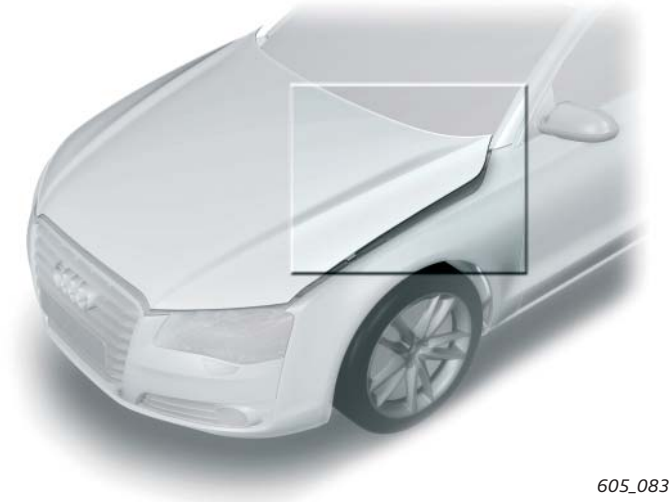
605_081

Hinge opened



605_082

To be able to reopen the bonnet after activation of the pedestrian protection system, the bonnet must first be moved into its starting position.
This is achieved by pushing the bonnet down at the back and simultaneously pushing it as far as it will go in the direction of travel.



605_083

Audi pre sense

Introduction

Active, passive and integral safety, driver assistance systems, preventive occupant protection – there are many terms for today's ever-evolving driver assistance systems. Providing the occupants with a good level of protection means: detecting hazards early and utilising the available technology in a manner appropriate to the situation. This is the idea behind Audi pre sense. If a vehicle has Audi pre sense basic, the customer still has the possibility of equipping the vehicle with the Audi pre sense front and/or Audi pre sense rear option.

Audi pre sense cannot prevent accidents from occurring. Its purpose is to alert the driver to hazardous situations and to assist the driver within the scope of its physical limits.

The Audi pre sense system was made possible by networking a variety of systems. The individual control units concerned provide a continuous flow of information via the vehicle's data bus systems. The corresponding control units are able to evaluate the information and take whatever action is necessary.

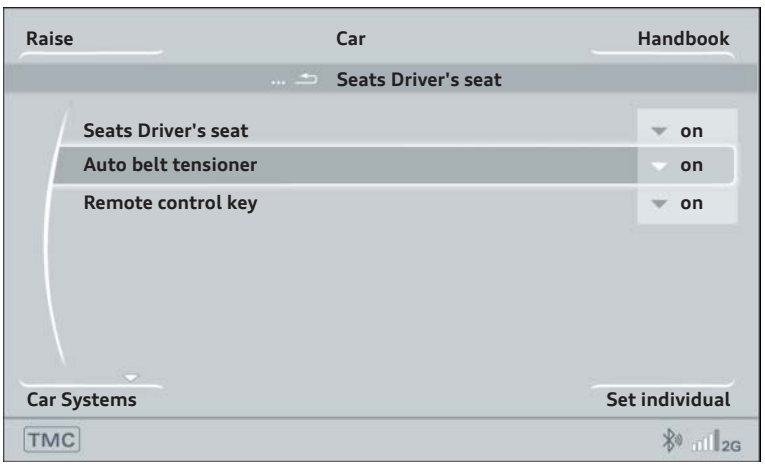
Audi pre sense basic

Automatic belt tensioner function

If the front occupants have fastened their seat belts and a speed signal of approximately 15 kph is detected (driving forwards), the front left and right belt tensioner control units J854 and J855 reduce the belt slack. The seat belts are gently retracted by briefly activating the electric motors in the belt retractors.

The seat belts are subsequently released again. If the front seat belts are fastened and the vehicle is driving forwards at a speed of < 15 kph, the belt slack is reduced after approximately 10 seconds. If the seat belts are not fastened, the electric motors in the belt retractors are not activated.

The occupants have the option of activating or reactivating the automatic seat belt tensioner function (belt slack reduction) via the MMI.



605_084

Longitudinal dynamics function

If the vehicle moves in the direction of travel and driver brakes heavily, the seat belt tensioner control units J854 and J855 initiate the partial tensioning of the seat belts as of a set brake pressure.

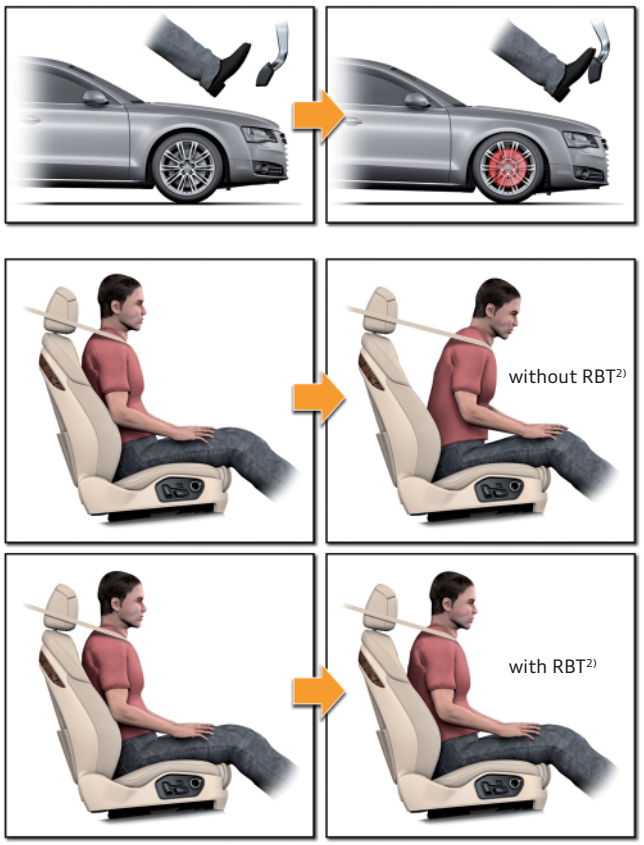
If the driver performs an emergency braking operation, the pressure on the brake pedal produces a sudden increase in brake pressure within the brake system. If the brake pressure reaches a defined value within a defined time, the seat belts are fully tensioned electrically by control units J854 and J855.

The ABS control unit J104 also activates the hazard warning flashers. Depending on the situation, the forwards motion of the occupants can be reduced to approximately 10 cm by electrical tensioning of the seat belts.

Transverse dynamics function

If the vehicle oversteers or understeers, the Electronic Stability Programme (ESP) is activated.
The seat belts are partially tensioned electrically. If the vehicle exceeds its physical limits and, consequently, can no longer be stabilised, the seat belts are fully tensioned electrically.
In addition, the side windows and the tilt/slide sunroof[1)] are closed (if open).

If no accident occurs in any of the driving situations described here, the seat belts are released again and the hazard warning flashers deactivated (if activated).



605_085

Depending on the set-up in Audi drive select and whether ASR is on or off, the seat belts are tensioned electrically in a manner appropriate to the driving situation.

Audi drive select		Auto	Comfort	Dynamic
ASR	on	Partial and Full	Partial and Full	Full
	off	Partial and Full under braking	Partial and Full under braking	Full under braking

Due to the lack of available time in many cases, the side windows and the tilt/slide sunroof[1)] cannot always be fully closed.

Closing the side windows and the tilt/slide sunroof can reduce the probability of miscellaneous objects entering the occupant cell.

[1)] Optional equipment
[2)] Reversible seat belt tensioner

Audi pre sense front

Both Audi pre sense basic and Audi pre sense front are available with the optional adaptive cruise control system (ACC).
The adaptive cruise control system also comes with the Audi braking guard The ACC radar sensors monitor the traffic ahead within the scope of their technical capabilities and send the information they gather to the ACC control unit J428, which in turn evaluates the data and sends any relevant information to the data bus.

Other control units are able to receive and evaluate these messages and take whatever action is appropriate. Even when adaptive cruise control is inactive, the radar sensors monitor the traffic ahead and send the information they gather.

Both adaptive cruise control and Audi side assist are required in order to implement the Audi pre sense plus system. Audi side assist also monitors the traffic behind the vehicle.

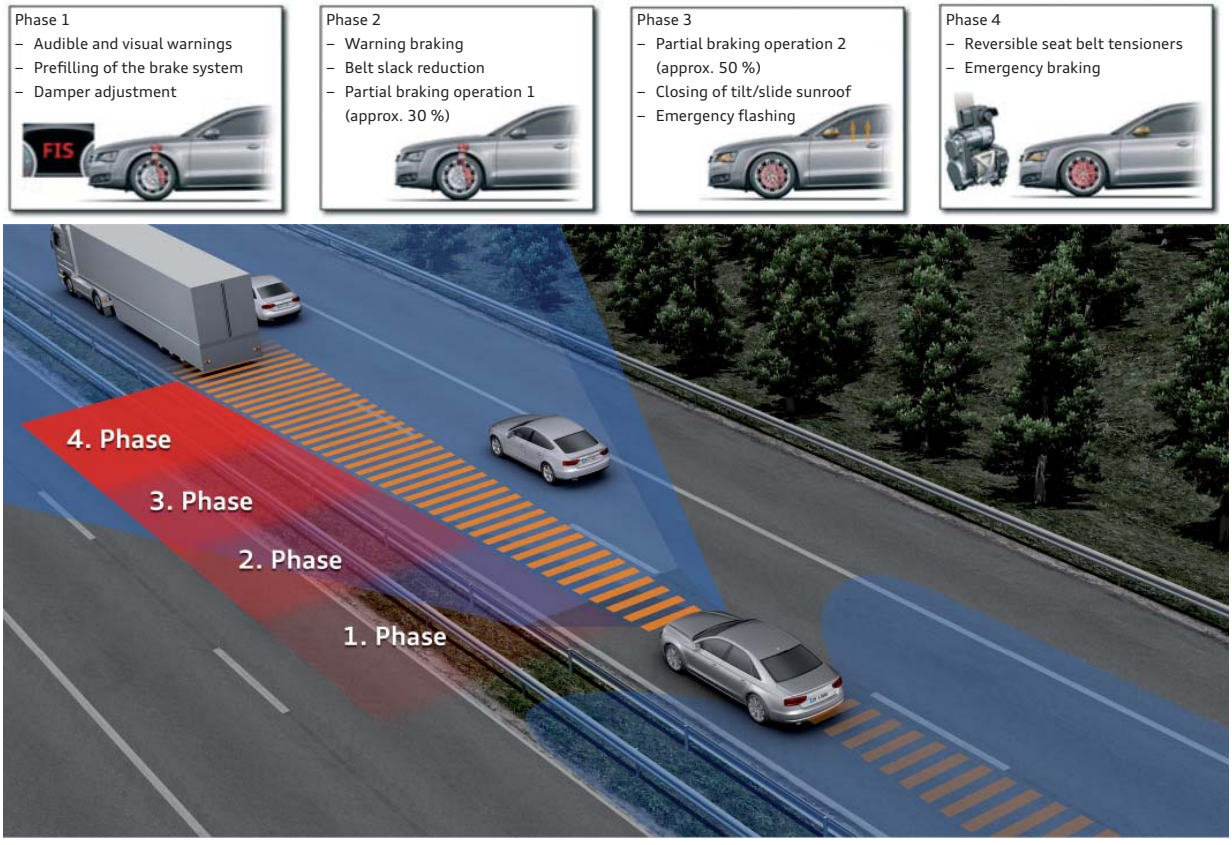
Example of a situation:

Phase 1:
When the vehicle approaches a hazardous situation, the driver is alerted audibly and visually by the control unit in dash panel insert J285. At the same time, the ABS control unit ABS J104 prefills the brake system, and the adaptive suspension control unit J197 sets the damping to "firm".

Phase 2:
If the driver does not respond to the warnings indicated in the instrument cluster or only eases off the accelerator, the ABS control unit performs a warning braking.
The vehicle is then braked further by partial braking operation 1 (approximately 30 % braking force). The belt slack in the seat belts is reduced during the warning braking phase by the left and right seat belt tensioner control units J854 and J855.

Phase 3: (applies to Audi pre sense plus only)
If the driver still does not apply the brake, partial braking operation 2 (approximately 50 % braking force) is initiated by the ABS control unit. In addition to this, the emergency braking function (hazard warning flashers) is activated by the ACC control unit J428 and closing of the side windows and the tilt/slide sunroof[1)] is initiated by the seat belt tensioner control unit on the driver's side.

Phase 4: (applies to Audi pre sense plus only)
An emergency braking operation (approximately 100 % braking force) is initiated, thus reducing the severity of the collision. In addition, the seat belts are fully tensioned electrically.



605_086

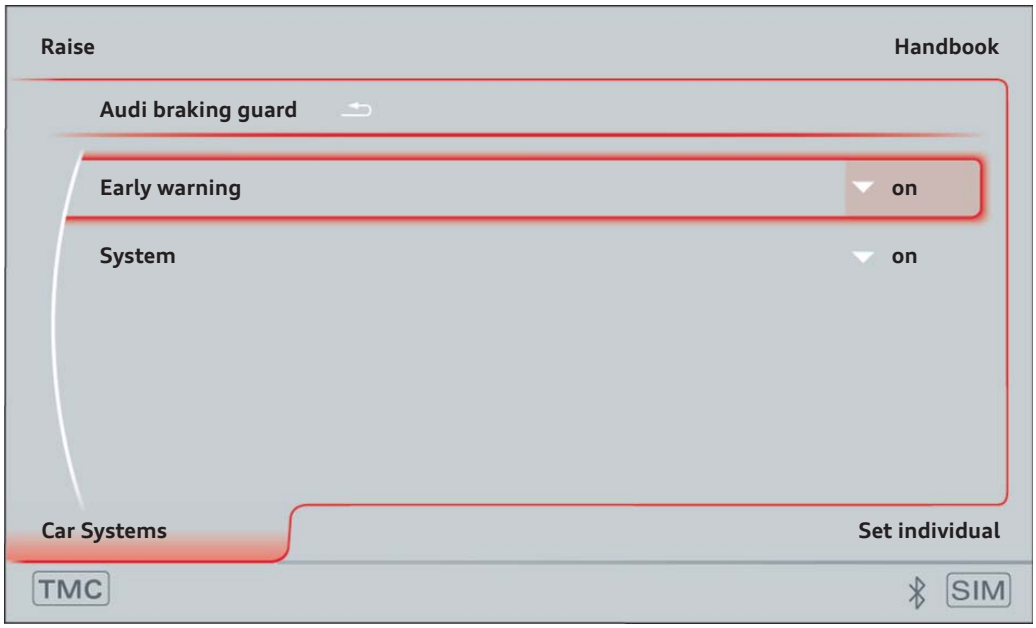
[1)] Optional equipment

Other examples:

If the driver accelerates sharply in phases 2 and 3 despite all warnings given, the partial braking operation is cancelled after the warning braking measure and no further braking operation is initiated by the ACC control unit. If the driver brakes in phase 1, Audi braking guard determines that the driver has been alerted and takes no further action.

If the driver enters a danger zone during normal operation and underestimates the situation, Audi pre sense front assists the driver. If, for example, the driver does not brake hard enough, the Audi braking guard may assist by increasing the brake pressure.

If the driver does not require the Audi braking guard function, it can be deactivated via the MMI. It is possible to deactivate only audible and visual warnings or the entire Audi braking guard system including the following functions: warning braking, partial braking, emergency braking and emergency flashing.



605_087

Audi pre set

The information which the ACC control unit J428 sends to the data bus enables the airbag control unit J234 to respond in the appropriate manner. Key information for the airbag control unit is the "time to collision" and "speed relative to objects ahead". When a set value is exceeded, the control unit J234 is aware that a collision is imminent. The electronics in the airbag control unit are alerted and wait for information from the crash sensors.

Audi pre sense rear

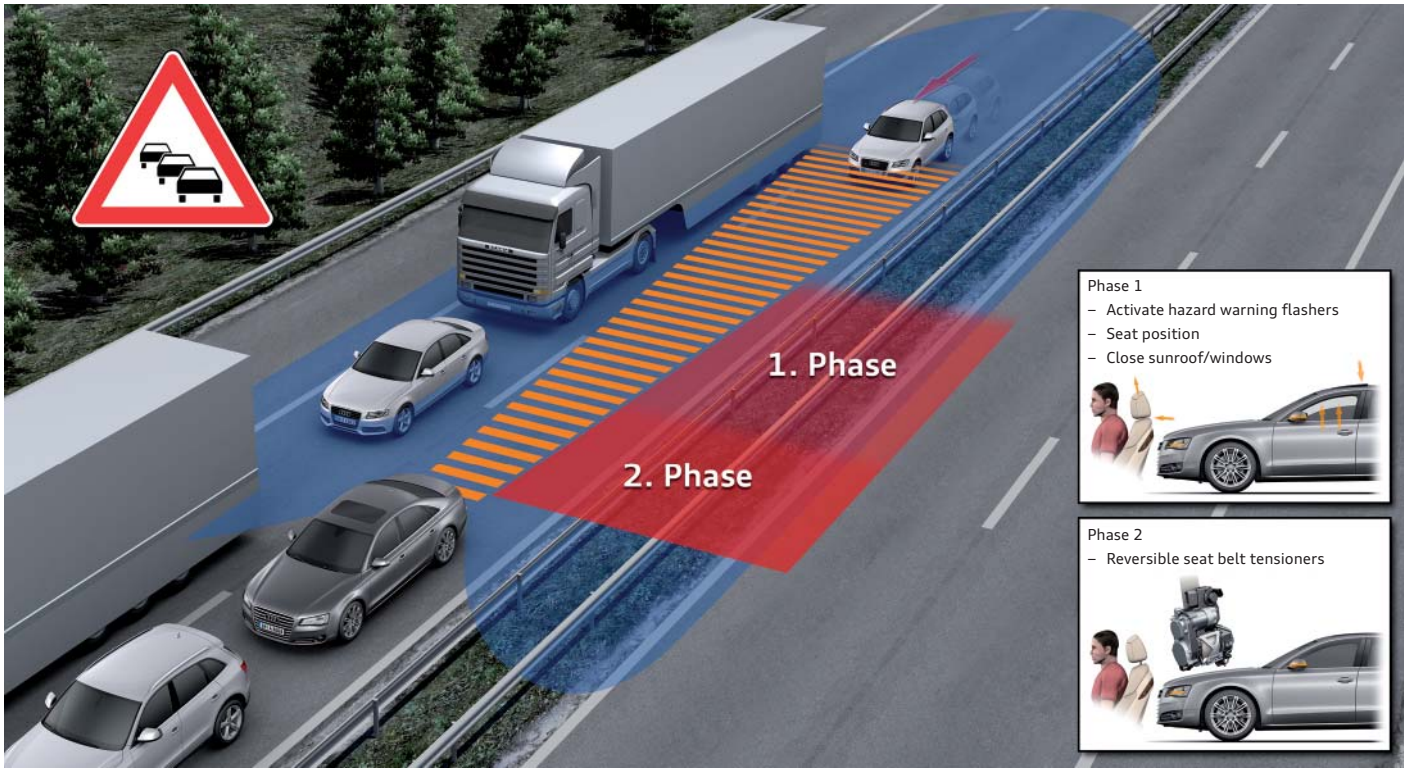
Audi pre sense rear is available in combination with Audi side assist and allows following traffic to be analysed.
The radar sensors of the Audi side assist system continuously feed the Audi side assist control unit J769 with information.

The Audi lane assist control unit evaluates this information and places any relevant information onto the data bus. If Audi side assist is deactivated by the driver, the control until J769 still continues to send relevant data.

Example of a situation:

Phase 1:
If a vehicle is approaching from behind, the front seat belt tensioner control unit on the driver's side sends this information to the data bus. The side windows and the tilt/slide sunroof[1)] are closed and the hazard warning flashers are activated. If the vehicle has memory seats in the front, the head restraints move into their upper position. If the vehicle has comfort seats in the front and memory seats in the rear, the head restraints on all seats are moved into their upper position and the upper seat backs are tilted forwards.
Adjustment of the head restraints and upper seat backs is model-dependent.

Phase 2:
If the vehicle continues to approach and a collision is probably no longer avoidable, the front seat belts are tensioned electrically.



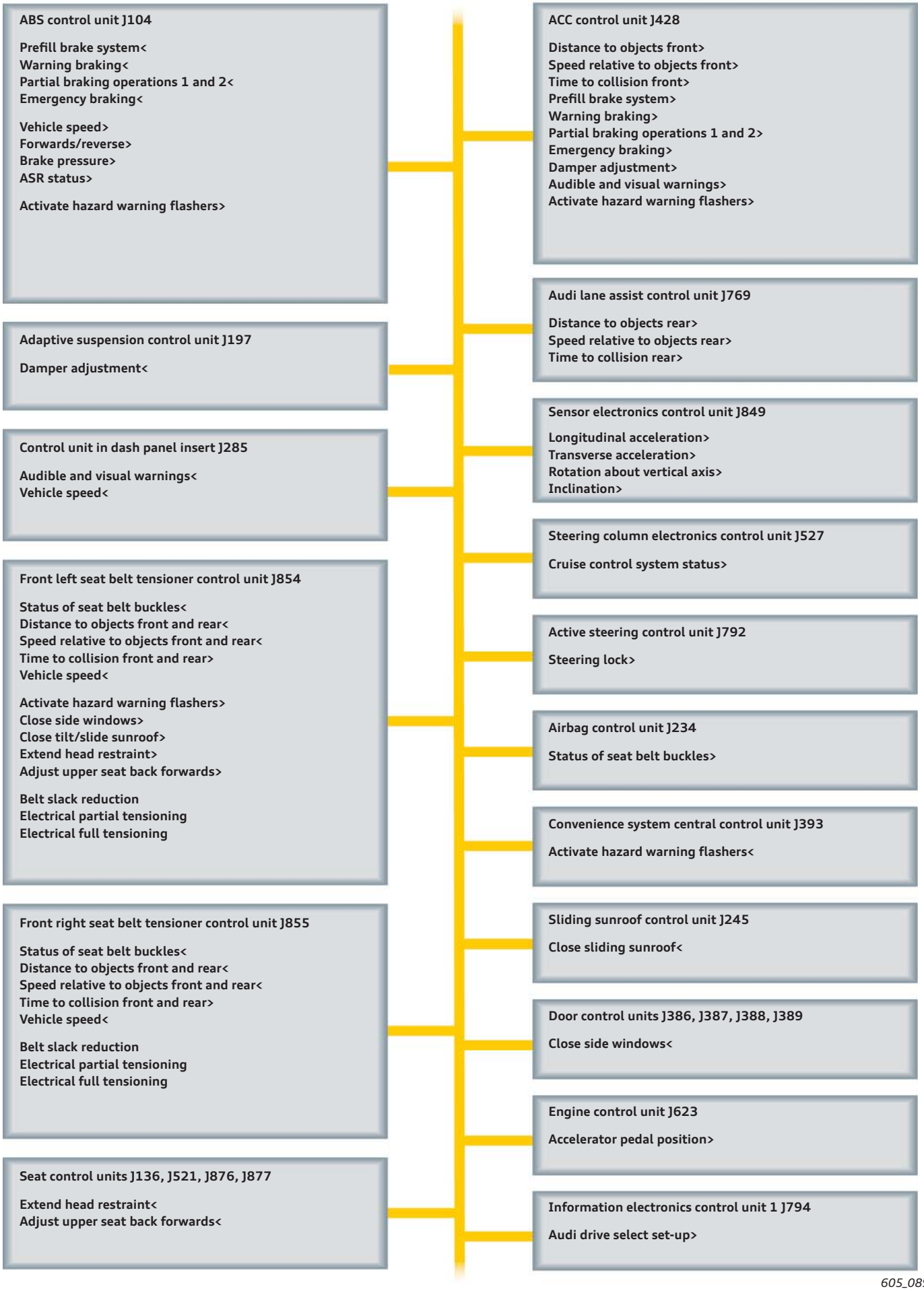
605_088

On models fitted with a tow bar, Audi pre sense rear is only active as long as no trailer is detected.

[1)] Optional equipment

Data bus networking

The overview shows by way of example some of the information which is exchanged via data bus.
> = data is transmitted < = data is received wihtout > / < = initiated actions



605_089

Annex

Test your knowledge

1. How many force levels does a reversible seat belt tensioner have?

☐ a) 3

☐ b) 2

☐ c) 1

2. Where can you find model-specific information on the safety systems?

☐ a) In Self Study Programme 410.

☐ b) In Self Study Programme 605.

☐ c) In the self study programme for the model in question.

3. What are the seat position recognition sensors in terms of type?

☐ a) Pressure sensors

☐ b) Hall sensors

☐ c) Induction sensors

4. What is the electrical code for the front left belt retractor control unit?

☐ a) J706

☐ b) J854

☐ c) J234

5. How many stages does the airbag module on page 17 have?

☐ a) Three

☐ b) Two

☐ c) One

6. When did Audi first carry out crash tests?

☐ a) 1936

☐ b) 1937

☐ c) 1938

7. For which phases does Audi pre sense front also require Audi pre sense rear?

☐ a) 3 and 4

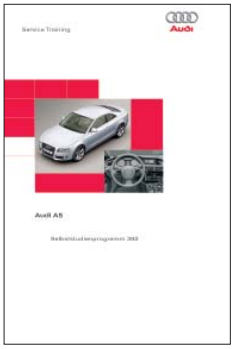
☐ b) 1 and 2

☐ c) 1

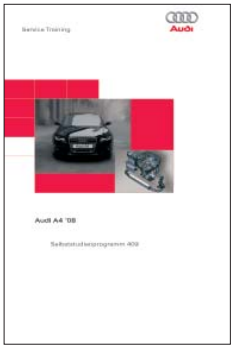
Test solutions:
1 a; 2 c; 3 b; 4 b; 5 b; 6 c; 7 a

Self Study Programmes

You will find further information on the occupant protection system in the following self study programmes.



605_003



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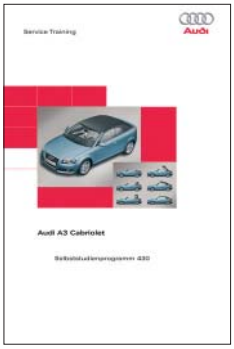
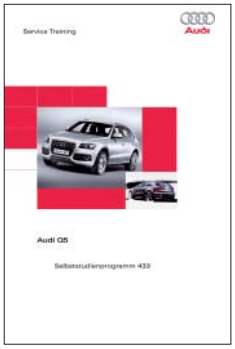
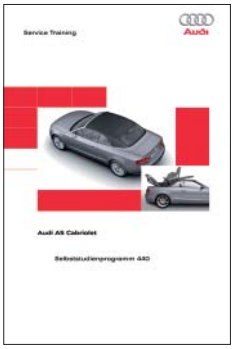


605_005



605_006

SSP 392 Audi A5, order number: A07.5S00.34.20
SSP 409 Audi A4 '08, order number: A07.5S00.40.20
SSP 430 Audi A3 Cabriolet, order number: A08.5S00.46.20
SSP 433 Audi Q5, order number: A08.5S00.49.20



605_007

605_008

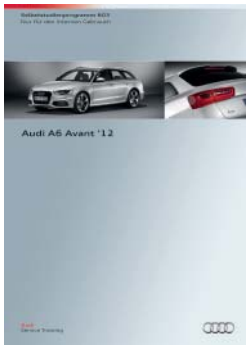
605_009

605_010

SSP 440 Audi A5 Cabriolet, order number: A09.5S00.58.20
SSP 456 Audi A8 '10, order number: A10.5S00.60.20
SSP 477 Audi A1, order number: A10.5S00.70.20
SSP 484 Audi A7 Sportback Occupant Protection, Infotainment and Air Conditioning, order number: A10.5S00.77.20

605_011

605_012



605_013

SSP 486 Audi A8 '11, order number: A11.5S00.80.20
SSP 602 Audi Q3, order number: A11.5S00.86.20
SSP 603 Audi A6 Avant '12, order number: A11.5S00.87.20

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