

Audi Occupant Protection Systems



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Always check Technical Bulletins and the latest electronic repair literature for information that may supersede any information included in this booklet.

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The Self-Study Workbook provides introductory information regarding the design and function of new models, automotive components or technologies.

The Self-Study Workbook is not a Repair Manual!
All values given are intended as a guideline only.
Refer to the software version valid at the time of publication.

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

Reference



Note



Introduction

Audi has a long history of pursuing vehicle safety. The first crash tests were conducted in 1938. While those early tests were done in pursuit of the same goal of occupant protection, technology has increased the scope to levels never dreamed of at that time.

Today, the development of a new vehicle requires more than just crash testing. It involves a systemic approach that includes many vehicle components and how they work together not only for crash survival but also in crash avoidance. Naturally, computers play a large role but actual vehicle testing is always carried out.

The engineers of Audi AG not only evaluate the results of in-house tests, but also actual accidents recorded by the accident researchers and scientists at the Audi Accident Research Unit (AARU). The AARU works hand-in-hand with police and doctors to compile as much accident data as possible. Using this information, Audi is constantly working to refine its test parameters.

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



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Introduction

This Self-Study Program cannot cover the specific details for all Audi models. Specific information for each model is included with that model's introductory information.

Highly sophisticated passenger protection features such as those described in this Self-Study Program help prevent serious injury to our customers in the event of a crash. However, the best precaution to prevent or reduce serious injury during a crash is from wearing a properly fastened safety belt.



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Passive Versus Active

Passive safety systems are designed to reduce injuries during or after a crash event.

Active systems are designed to help the driver avoid a crash event.

The passive safety system components are:

- ▶ Airbag control module
- ▶ Driver and passenger airbags
- ▶ Side airbag
- ▶ Curtain airbags
- ▶ Crash sensors
- ▶ Safety belt tensioners and belt force limiters
- ▶ Safety belt reminder indicator
- ▶ Driver and passenger seat position sensors
- ▶ Battery isolator elements (only for vehicles with the battery in the interior or luggage compartment)
- ▶ Safety belt buckle switches
- ▶ Passenger seat occupant sensor
- ▶ Key switch for deactivating the passenger front airbags with accompanying warning lamp
- ▶ Roll-over protection (convertible models)

The active safety system components are:

- ▶ Braking systems such as ABS, ESC, TCS, EBD
- ▶ Tire pressure monitoring
- ▶ Adaptive cruise control
- ▶ Adaptive headlamps
- ▶ Audi pre sense
- ▶ Parking Aids
- ▶ Reverse camera
- ▶ Audi side assist
- ▶ Night vision

Passive Systems

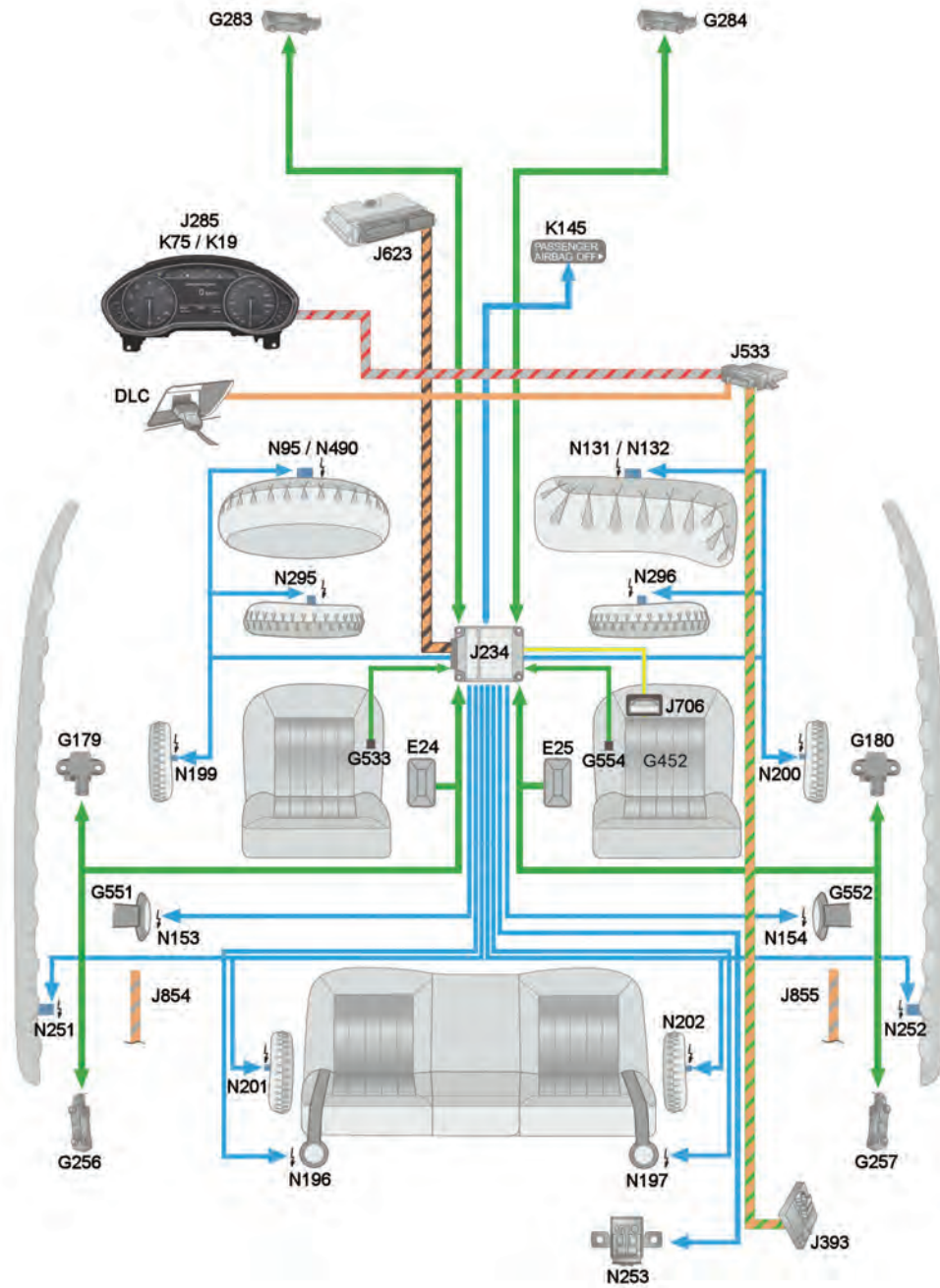
System Overview

The system overview shows the equipment options available for an Audi A7. Not all of these components are available or installed on every model.








Key:

E24	Driver Safety Belt Switch	K19	Safety Belt Indicator Lamp
E25	Front Passenger Safety Belt Switch	K75	Airbag Indicator Lamp
G179	Driver Side Airbag Crash Sensor	K145	Front Passenger Airbag -Disabled- Indicator Lamp (optional)
G180	Front Passenger Side Airbag Crash Sensor	N95	Driver Airbag Igniter
G256	Driver Side Rear Side Airbag Crash Sensor	N131	Front Passenger Airbag Igniter 1
G257	Passenger Side Rear Side Airbag Crash Sensor	N132	Front Passenger Airbag Igniter 2
G283	Driver Front Airbag Crash Sensor	N153	Driver Safety Belt Tensioner Igniter 1
G284	Passenger Side Front Airbag Crash Sensor	N154	Front Passenger Safety Belt Tensioner Igniter 1
G452	Passenger Occupant Detection System Pressure Sensor	N196	Driver Side Rear Safety Belt Tensioner Igniter
G551	Driver Belt Force Limiter	N197	Passenger Side Rear Safety Belt Tensioner Igniter
G552	Front Passenger Belt Force Limiter	N199	Driver Thorax Airbag Igniter
G553	Driver Seat Position Sensor	N200	Front Passenger Thorax Airbag Igniter
G554	Front Passenger Seat Position Sensor	N201	Driver Side Rear Thorax Airbag Igniter
J234	Airbag Control Module	N202	Passenger Side Rear Thorax Airbag Igniter
J285	Instrument Cluster Control Module	N251	Driver Head Curtain Airbag Igniter
J393	Comfort System Central Control Module	N252	Front Passenger Head Curtain Airbag Igniter
J533	Data Bus On Board Diagnostic Interface	N253	Battery Interrupt Igniter
J623	Engine Control Module	N295	Driver Knee Airbag Igniter
J706	Passenger Occupant Detection System Control Module	N296	Front Passenger Front Knee Airbag Igniter
J854	Left Front Safety Belt Tensioner Control Module	N490	Driver Airbag Release Valve Igniter
J855	Right Front Safety Belt Tensioner Control Module	T16	16 Pin Connector, Data Link Connector

Passive Systems



A7_Airbag_USA

-  Powertrain CAN bus
-  Display and Operation CAN bus
-  Extended CAN bus
-  Convenience CAN bus
-  Diagnostics CAN bus
-  Input Signal
-  Output Signal

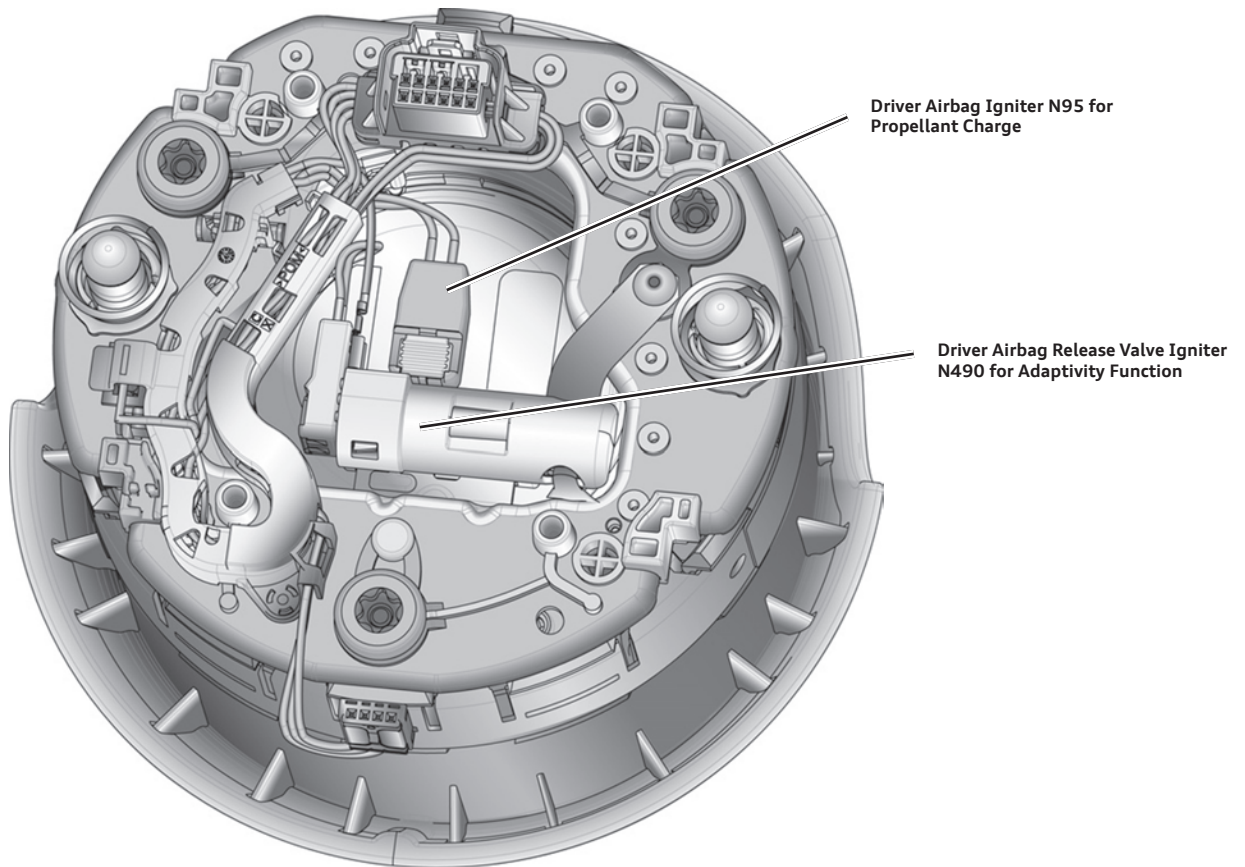
Passive Systems

Terminology Used for Airbags by Audi

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 igniters.

It does not matter if an igniter activates a propellant charge or activates an adaptive feature (opens an additional outlet orifice).

Igniter	Propellant Charges	Adaptivity	Old Designation Settings	New Designation Settings
1	1	None	1	1
2	2	None	2	2
2	1	Yes	1	2
3	2	Yes	2	3



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

Passive Systems

Front Airbags

Two different style front airbag modules are used on Audi models.

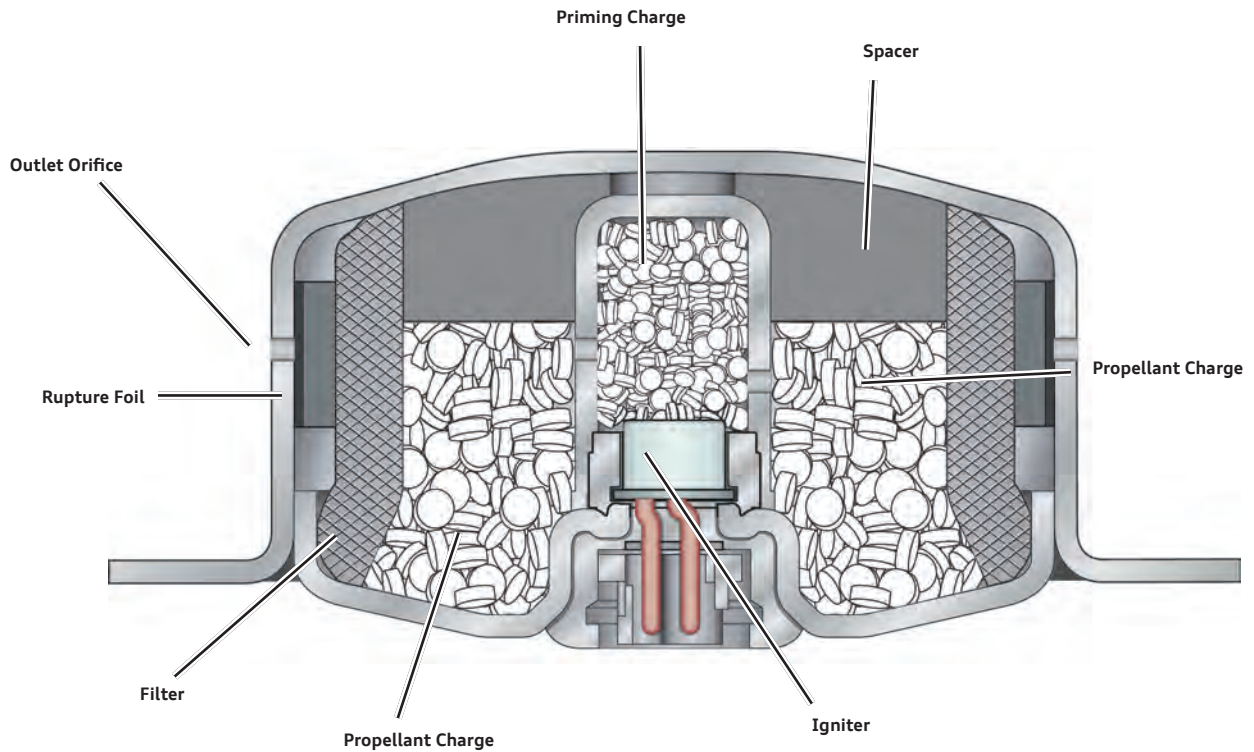
On the driver's side there is a solid propellant generator, and on the passenger side a hybrid gas generator which inflates the airbag.

Depending on model, the gas generators of the front driver's side airbag modules are mounted in a rubber ring to reduce the vibration transmitted to the steering wheel.

Driver Airbag Gas Generator

To deploy an airbag, the airbag control module sends an electrical signal which ignites the priming charge. The priming charge ignites the actual airbag propellant.

When the gas pressure from the propellant charge is high enough, the rupture foil opens the outlet orifices and allows the gas to flow into the airbag. The airbag unfolds and is inflated.



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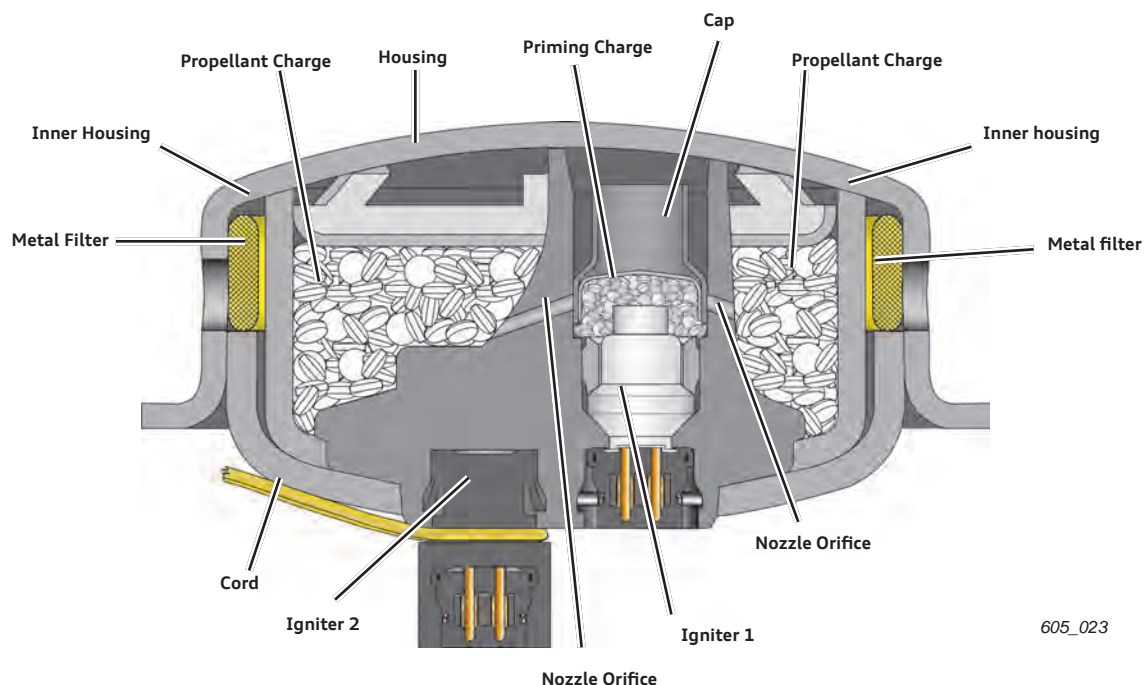
Passive Systems

Adaptive Driver's Airbag Gas Generator - Version 1

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

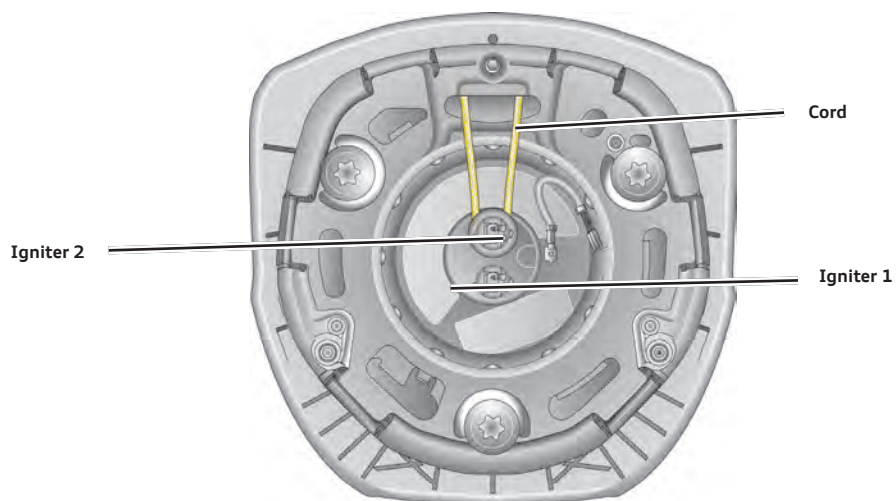
The Airbag Control Module J234 activates igniter 1, which in turn ignites the priming charge.

The actual propellant charge is ignited through holes in the nozzles. When the gas pressure of the propellant charge is high enough, the gas generator housing deforms and allows the gas to flow into the airbag via the inner housing and metal filter. The airbag unfolds and is inflated.



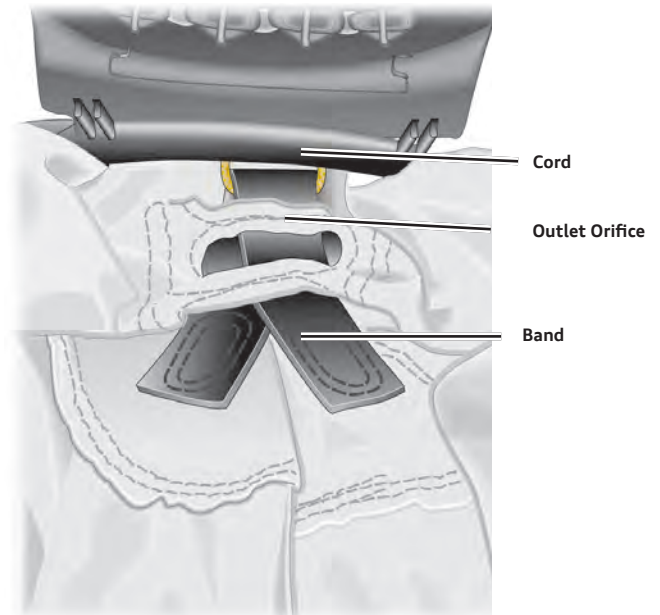
An additional igniter - the Driver Airbag Igniter 2 N250 - is mounted on the back outside the gas generator.

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



Additional Outlet Orifice Closed

An additional outlet orifice in the airbag is sealed shut as long as the cord from the igniter is held in position.

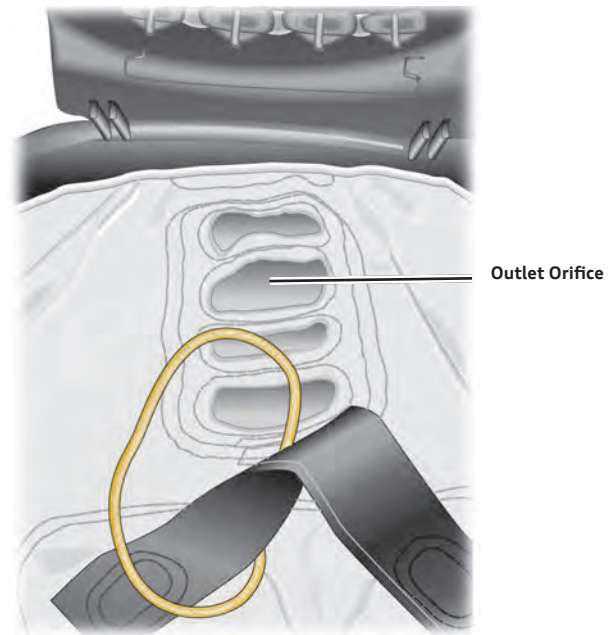


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Additional Outlet Orifice Open

Depending on impact severity and the driver's seating position, Airbag Control Module J234 activates Driver Airbag Igniter 2 N250. The igniter housing ruptures and the cord is released.

The volume of the airbag increases by about 4 liters, and the additional outlet orifice is opened. As a result, more gas can escape through this outlet orifice. In this way the airbag is "adapted" to the severity of the crash and the occupants' seated position.



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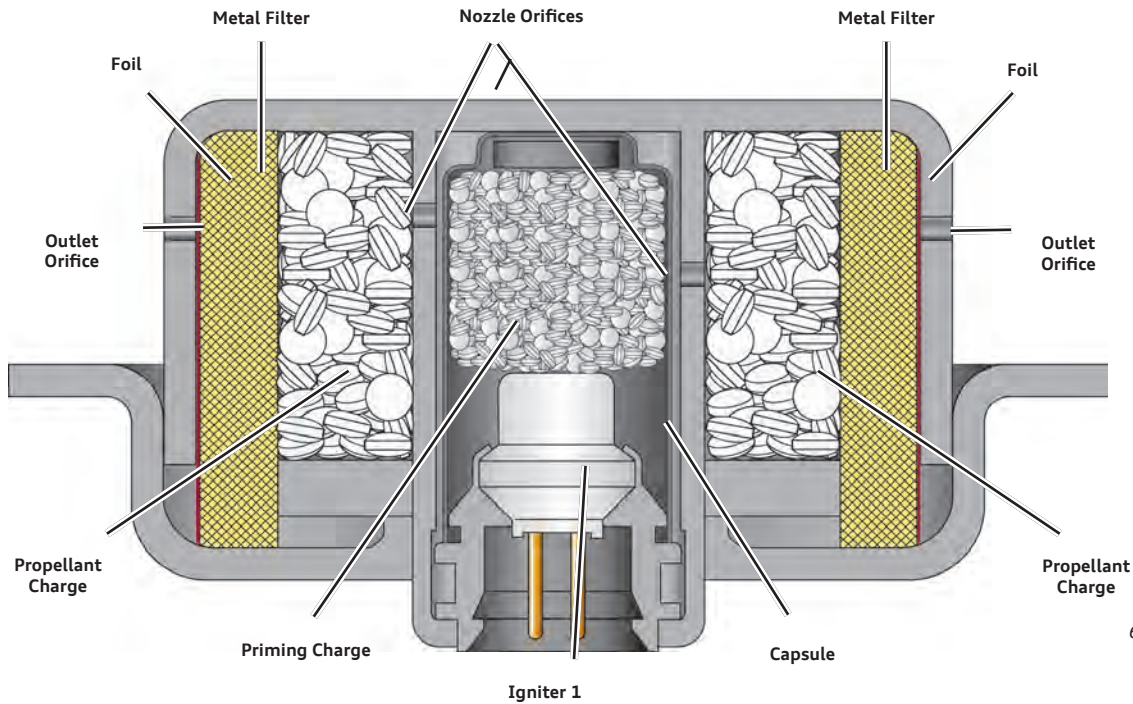
Passive Systems

Adaptive Driver's Airbag Gas Generator – Version 2

The priming charge is ignited by igniter 1, which is activated by Airbag Control Module 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.

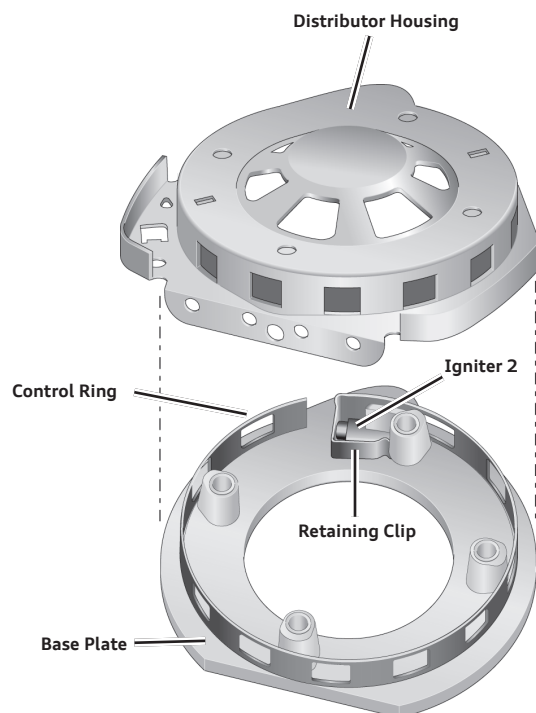
When the gas pressure is high enough, the tab opens the outlet orifices. The gas is now able to flow freely through the metal filter into the airbag. The airbag unfolds and is inflated.



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Driver Airbag Igniter 2 N250 is located inside the airbag module.

The igniter is integrated with the base plate, a control ring with orifices and the distributor housing.



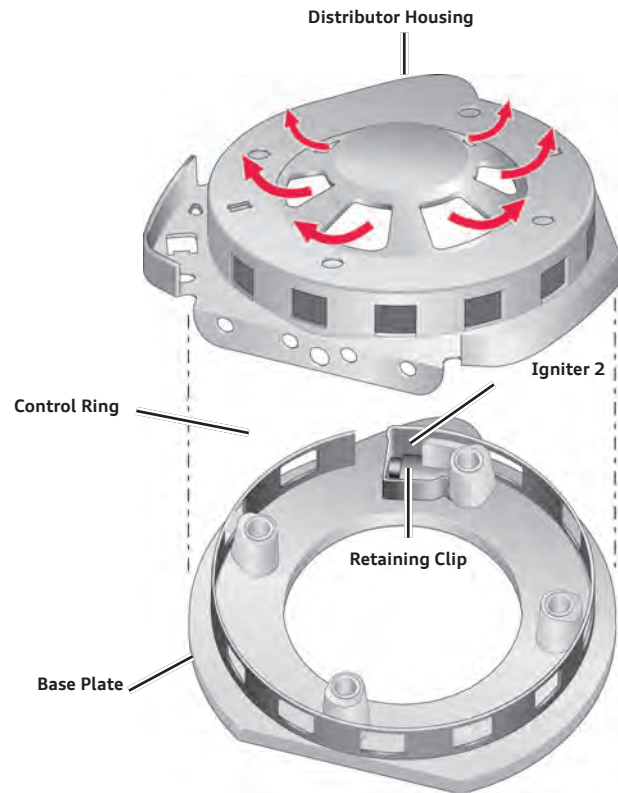
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Passive Systems

Additional Outlet Orifices Close

As long as Driver Airbag Igniter 2 N250 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, preventing unwanted rotation of the control ring.



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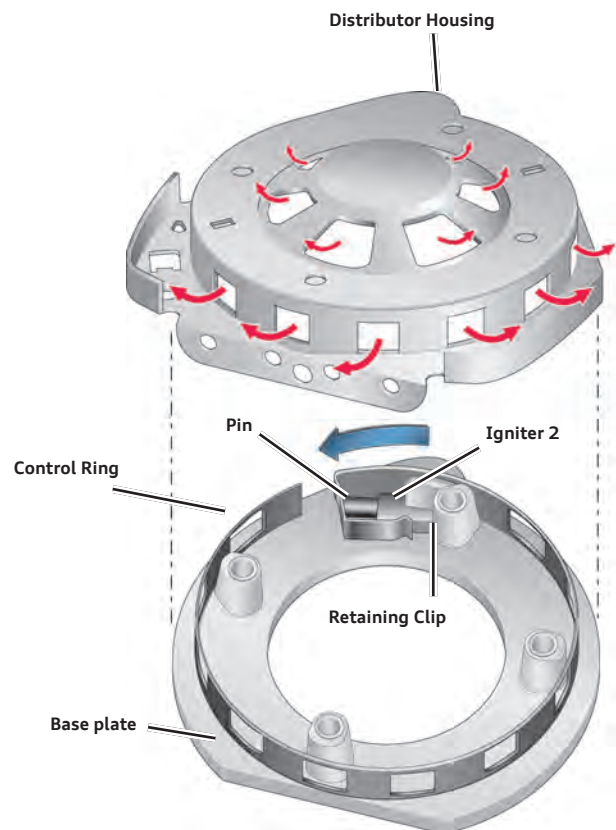
Additional Outlet Orifices Open

Depending on impact severity and the driver's seating position, the Airbag Control Module J234 decides when to activate the N250.

When N250 is ignited, the resulting gas pressure displaces a pin which 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 can also escape into the atmosphere through the orifices in the distributor housing. This prevents the airbag from inflating further, and ensures the airbag is "adapted" to the occupant's seated position.



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Passive Systems

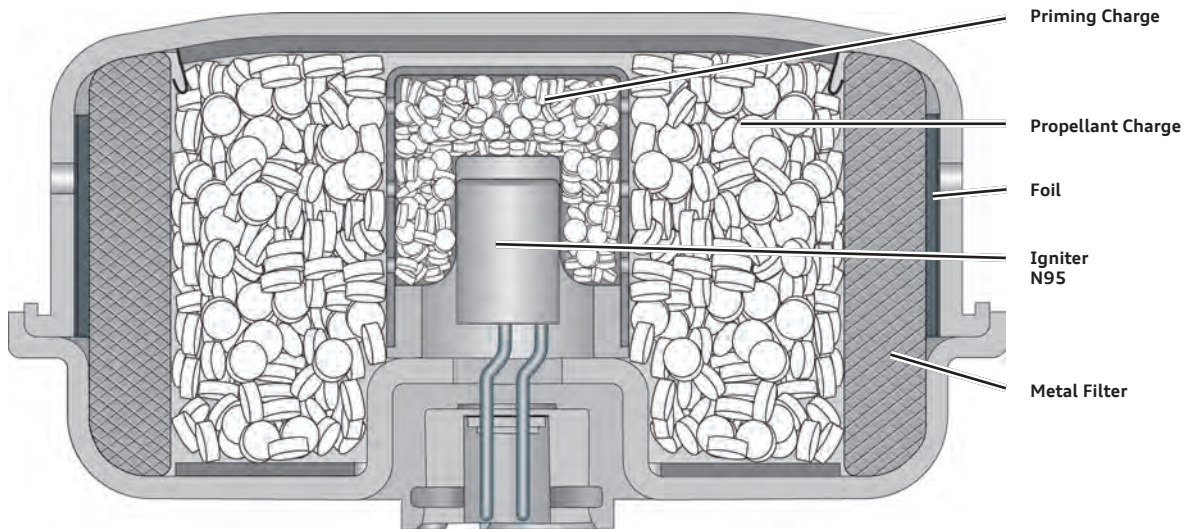
Adaptive Driver's Airbag Gas Generator – Version 3

The Driver Airbag Igniter N95 activated by Airbag Control Module J234 and ignites the priming charge which in turn ignites the actual propellant charge. If the gas pressure resulting from ignition of the propellant charge is high enough, 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.

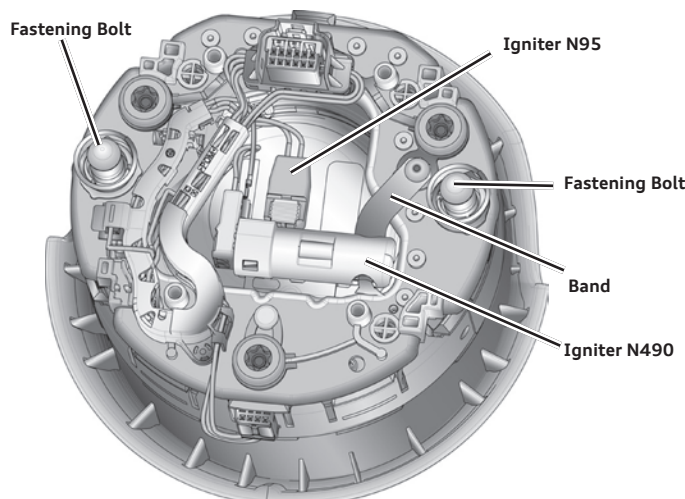
An additional igniter for airbag adaptivity, Driver Airbag Release Valve Igniter N490, is attached to the back of the airbag module. The airbag also has an extra snout-like outlet orifice.

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

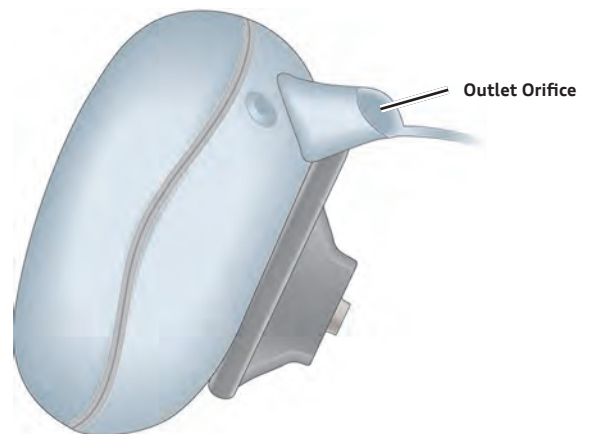
As a result, the additional outlet orifice opens. The airbag is "adapted" to suit the occupants in a manner appropriate to the situation.



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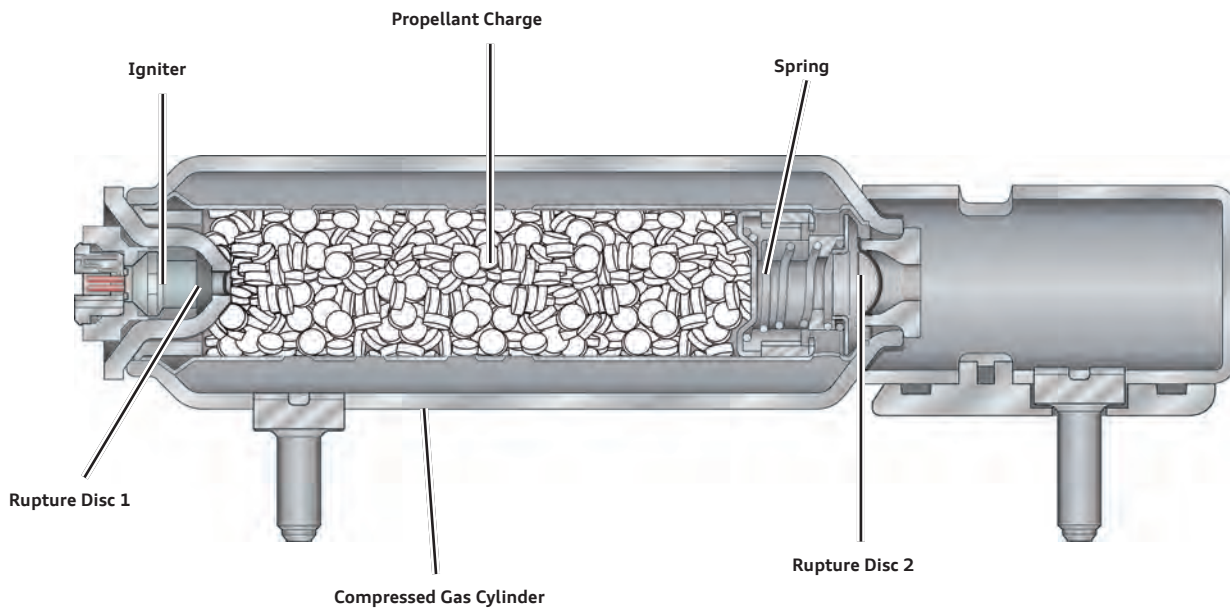


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Front Passenger Airbag Gas Generator

This gas generator is a hybrid gas generator. Airbag Control Module J234 activates the Front Passenger 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.



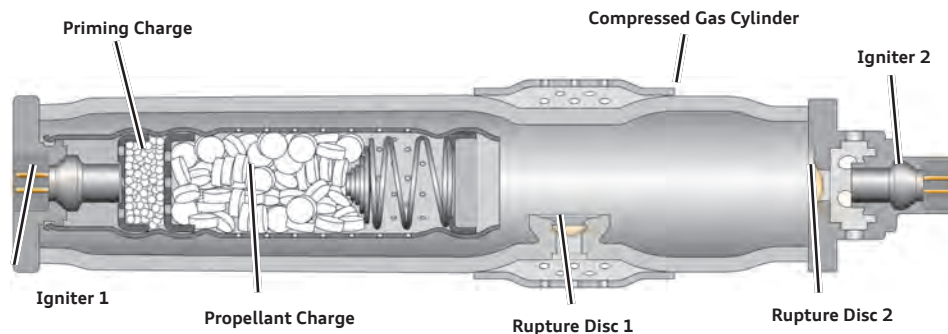
605_034

Passive Systems

Adaptive Front Passenger Airbag Gas Generator – Version 1

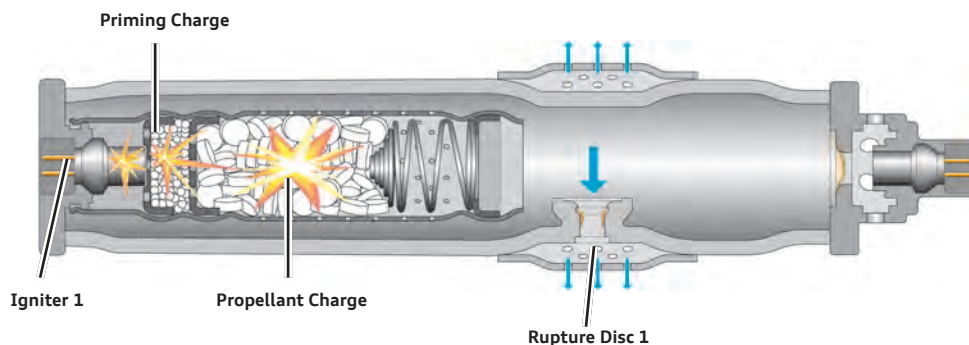
This is a hybrid gas generator with a second outlet orifice. This type of gas generator allows the passenger airbag to be filled to different degrees.

Airbag Control Module J234 determines the time interval between activation of both igniters based on impact severity and the passenger's seating position.



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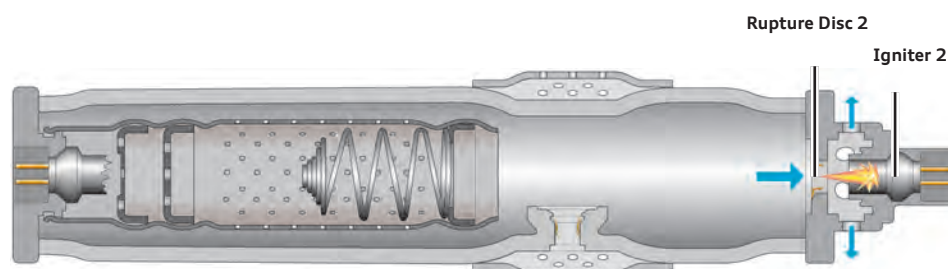
The priming charge, which is ignited by igniter 1, ignites the actual propellant charge. The pressure inside the compressed gas cylinder increases until rupture disc 1 bursts at a certain pressure. The gas mixture inflates and unfolds the airbag.



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The Airbag Control Module 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 bypasses the airbag.

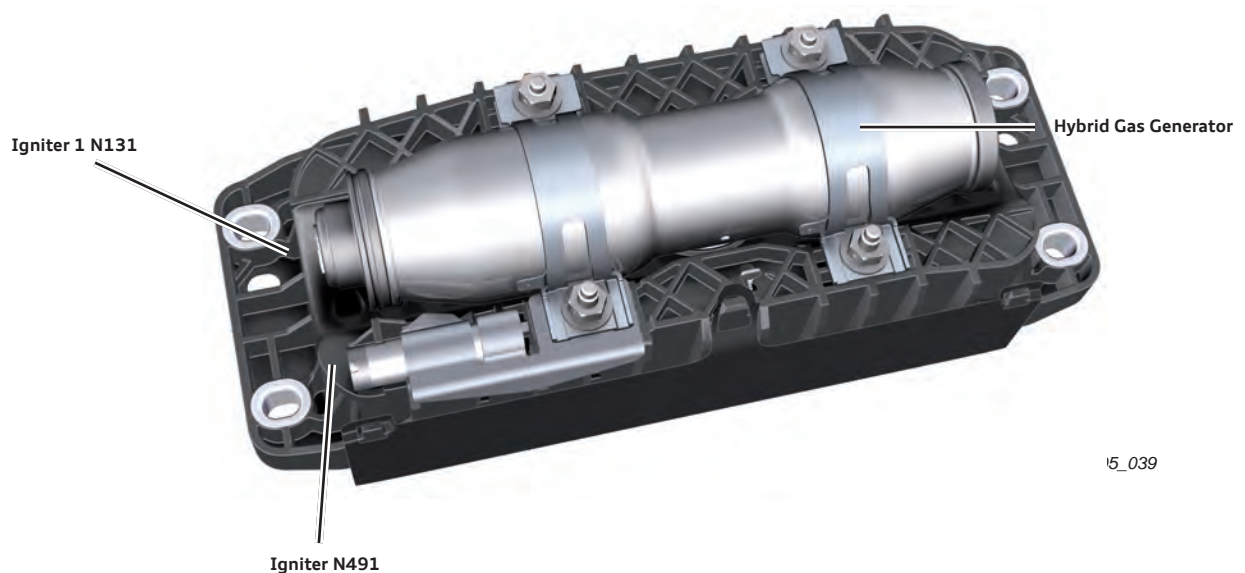
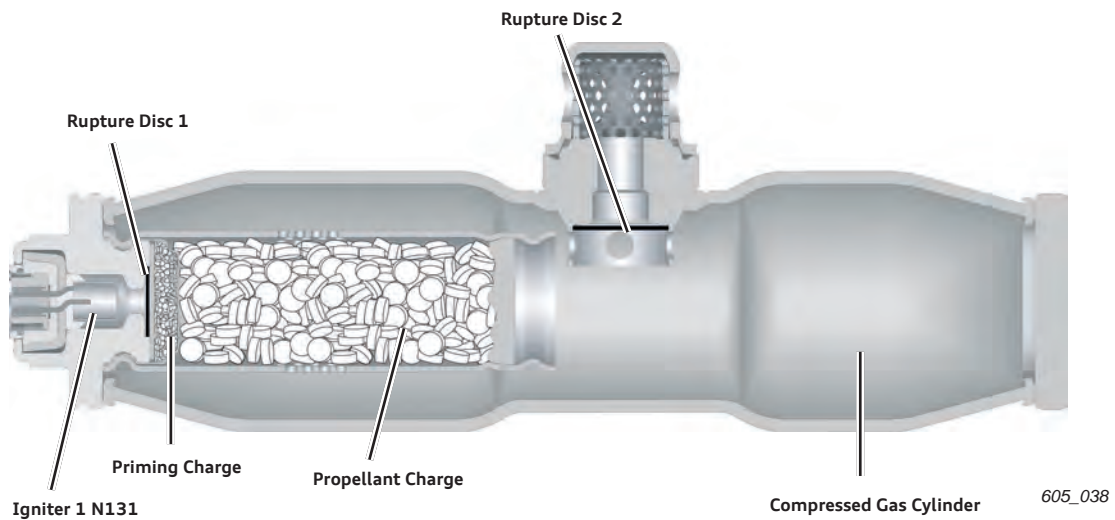


605_037

Adaptive Front Passenger Airbag Gas Generator – Version 2

The Airbag Control Module J234 activates the Front Passenger Airbag Igniter 1 N131. The flame of igniter 1 ruptures disc 1 and ignites the priming charge, which in turn ignites the actual propellant charge.

The combustion of the propellant charge increases the pressure in the compressed gas cylinder until rupture disc 2 breaks. The gas mixture unfolds and inflates the airbag. The adaptability function on the passenger side is similar to that on the driver side.



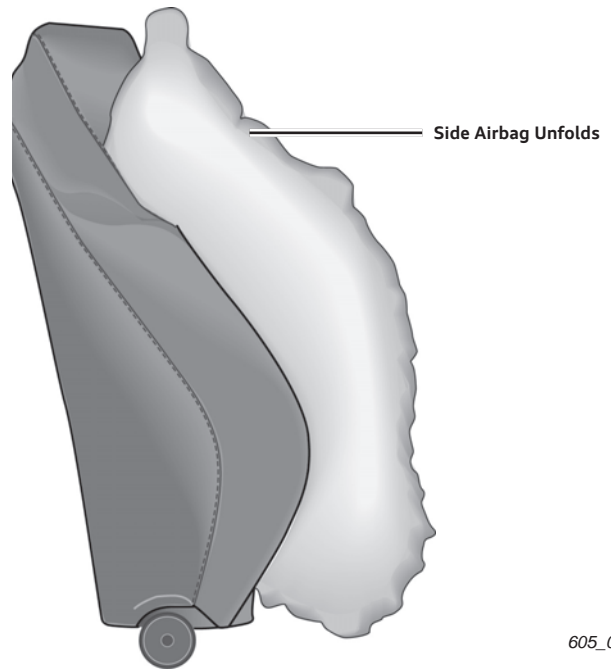
Passive Systems

Side Airbags

The side airbag modules are specific for each Audi model.

The latest-generation side airbag modules are known as "Soft Cover Modules".

In these modules, a textile casing replaces the plastic shell enveloping the entire airbag module. The soft surface of the textile casing integrates into the seat. It is also lower in weight.

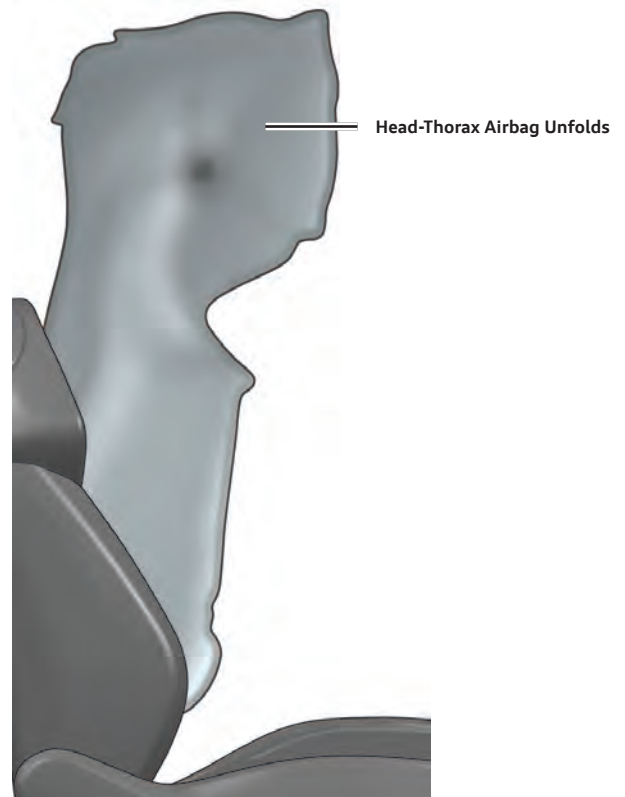


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Head-thorax airbags are used in some Audi models such as the Audi A5 Cabriolet. Since a curtain airbag will not be present when the top is in the open position, there must be some means to protect occupants in side collisions.

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

The airbag module is integrated into the backrest of each of the front seats. This ensures proper positioning of the airbag in relation to the occupants, regardless of the seat adjustment.

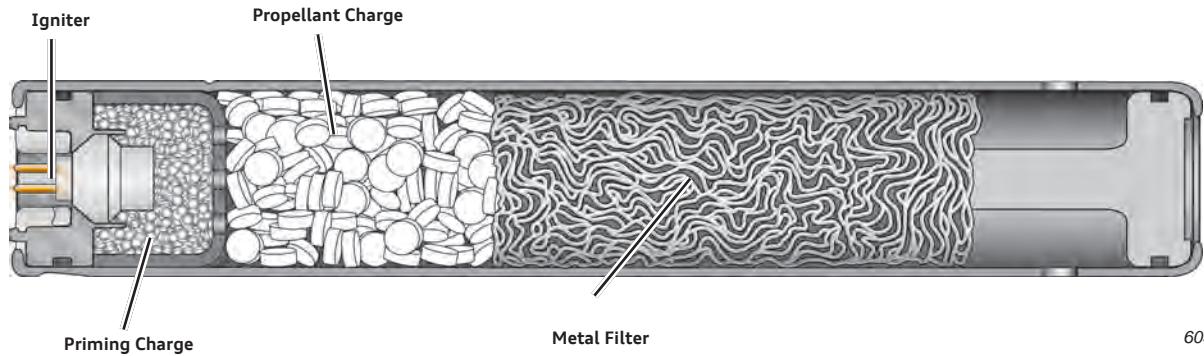


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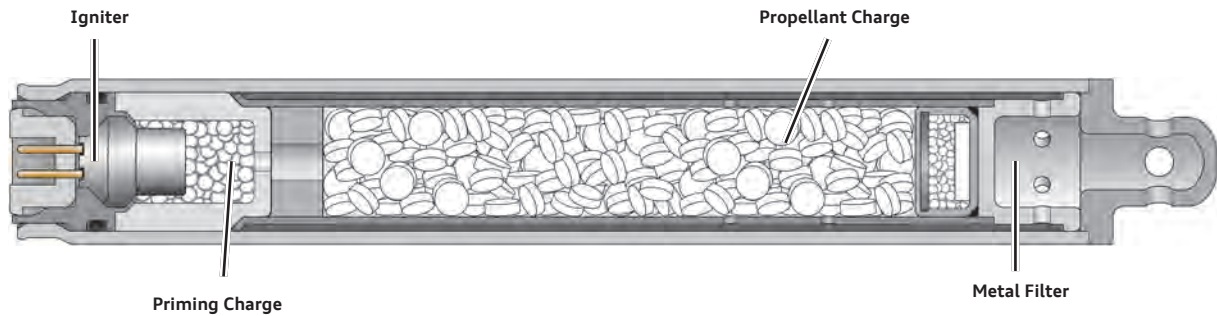
Gas Generator For Side Airbag

The side airbags use various pyrotechnic solid propellant generators.

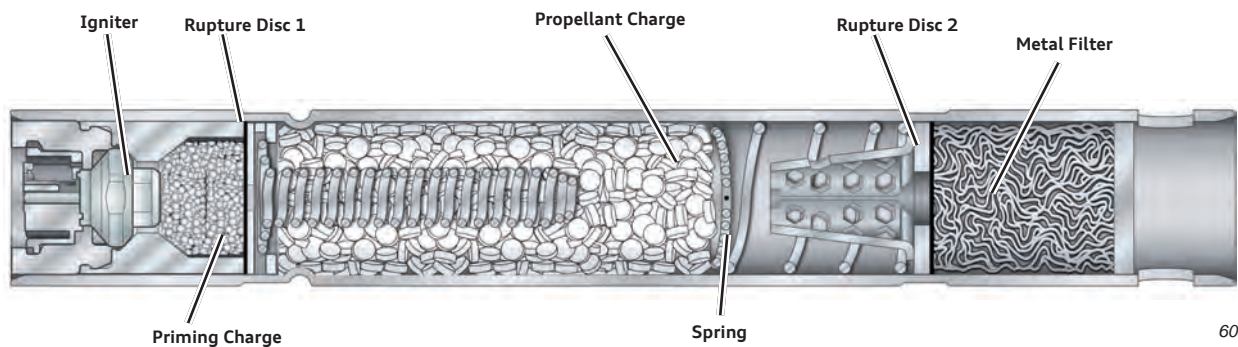
Version 1



Version 2



Version 3

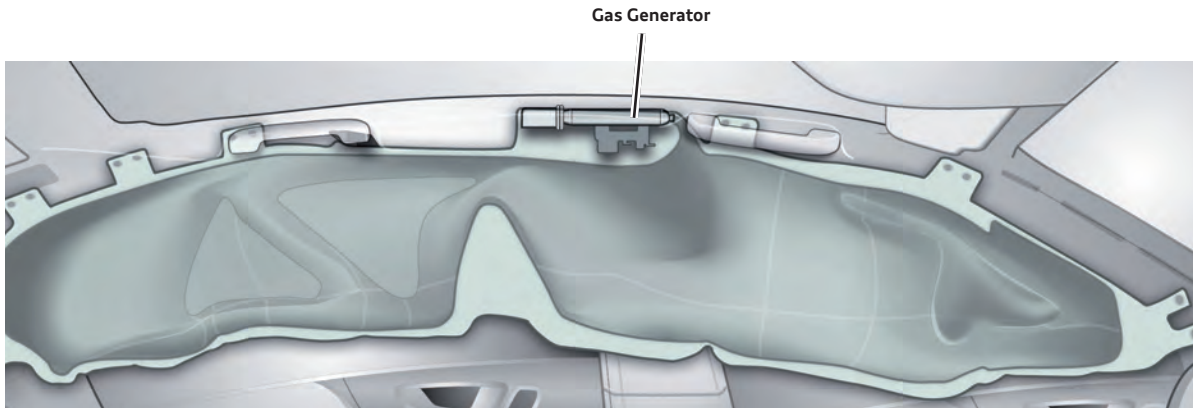


Airbag Control Module J234 energizes the corresponding side airbag igniter. This ignites the priming charge that will ignite the actual propellant charge. The developing gas, which is purified and cooled by the metal filter, unfolds and inflates the airbag.

Passive Systems

Side Curtain Airbags

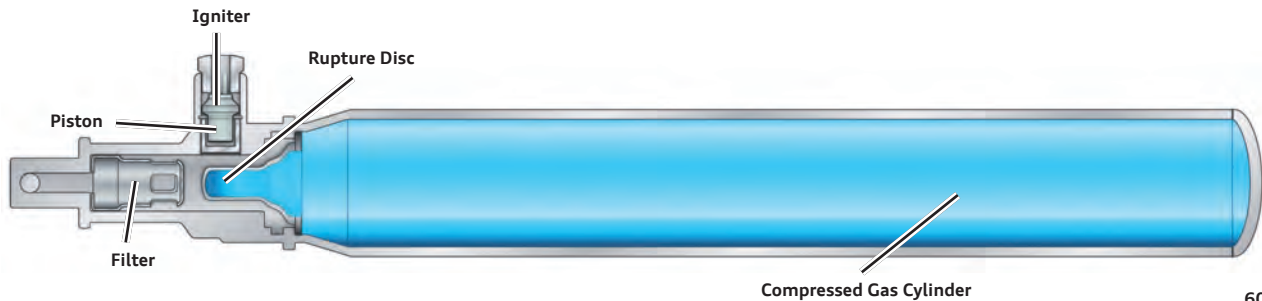
The side curtain airbags are installed on the left and right hand sides behind the headliner. Hybrid gas generators are used to inflate the curtain airbags. The curtain extends from the A pillar to the D pillar, covering almost the entire side window area. The curtain airbags help provide occupant protection in the event of a side impact. The position of the gas generators can vary depending on model.



605_045

Version 1

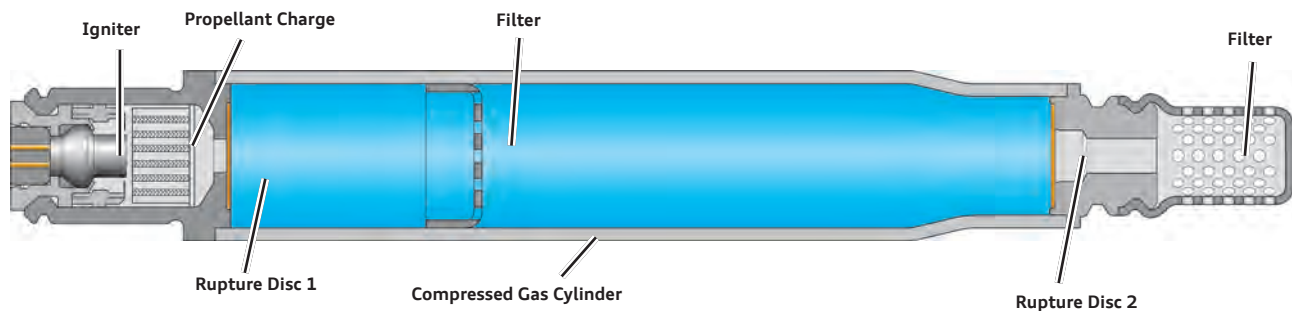
The igniter is activated. The gas pressure produced in the igniter displaces a piston, which in turn shears off the rupture disc. The compressed gas emerging from the cylinder can flow into the airbag. The airbag unfolds and is inflated. With these gas generators, the pyrotechnic igniters have only the task of opening the compressed gas cylinder.



605_046

Version 2

The compressed gas cylinder igniter is activated by the Airbag Control Module J234, igniting the priming charge. The combustion of the priming charge produces a gas pressure which causes rupture disc 1 to burst. The gas pressure travels through the compressed gas cylinder and causes the rupture disc 2 to burst. The gas mixture flows through the filter and into the airbag.

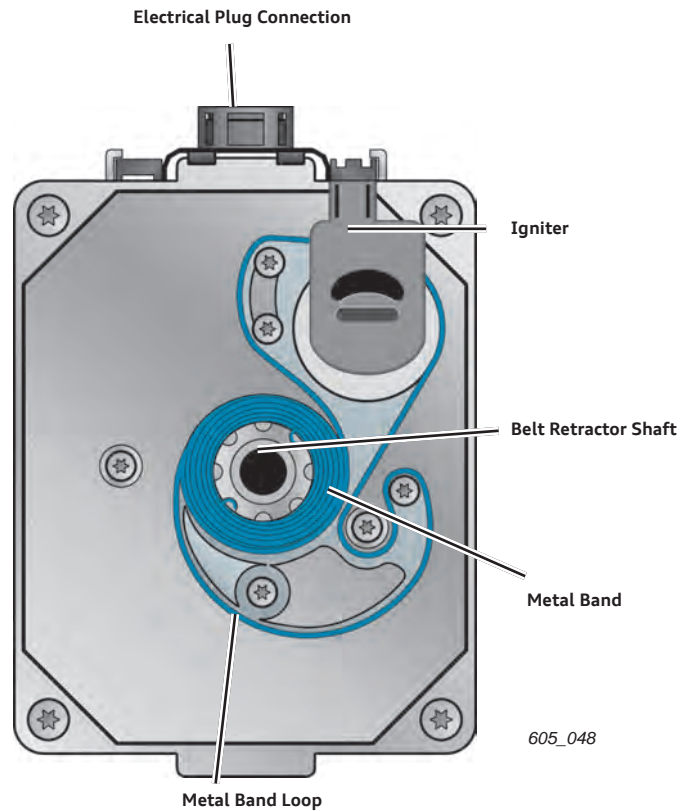


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Front Belt Retractors

Pyrotechnic Safety Belt Tensioner — Safety Belt Tensioner

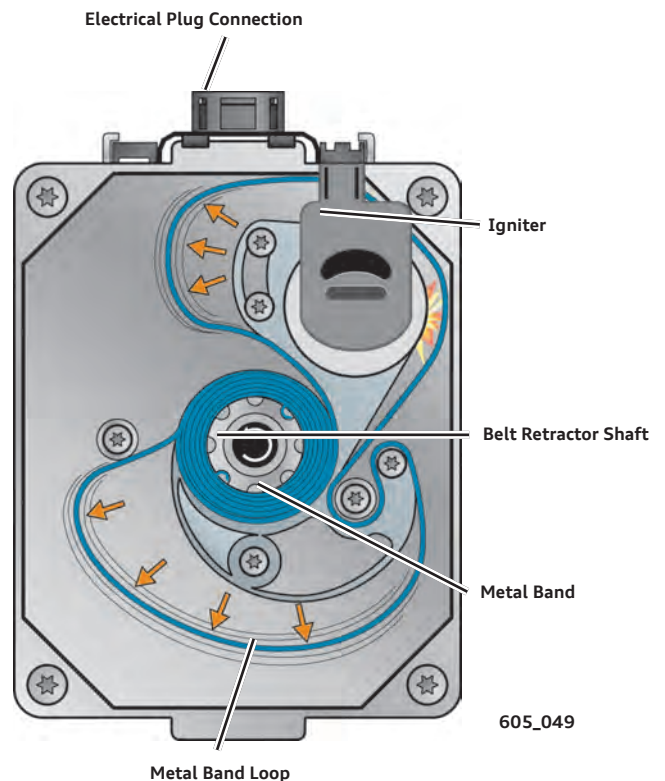
A metal band is wound around the belt retractor shaft. Both open ends of the band are connected to the belt retractor shaft. The closed end is looped around the safety belt tensioner igniter.



When Airbag Control Module J234 ignites the safety belt tensioner igniter, the pressure causes the loop of the metal band to expand.

The movement of the metal band pulls on the belt retractor shaft rotates to tension the safety belt.

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

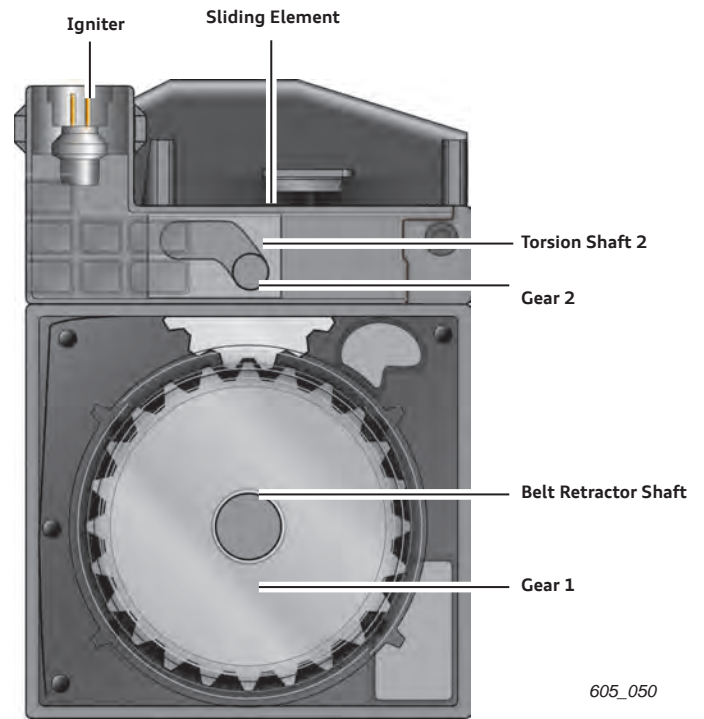


Passive Systems

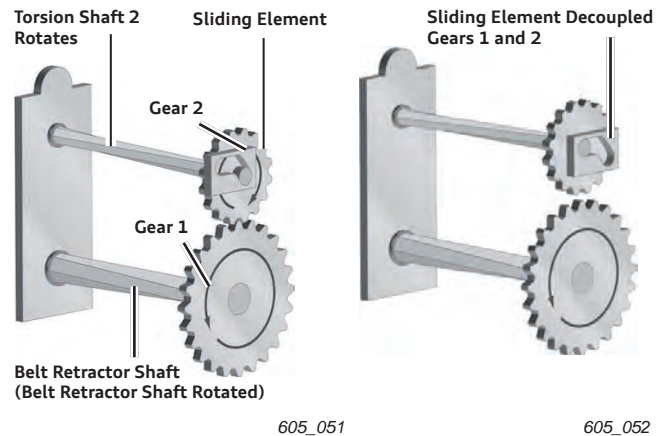
Adaptive Belt Force Limitation

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 safety belt tensioners (band tensioners) are ignited first. The safety belt tensioner retracts the safety belt as far as possible. The belt retractor blocks the belt retractor shaft, preventing the safety belt from unreeling, controlling the forward motion of the occupants. If the occupant moves further forward, the belt force limiter permits controlled unreeling of the safety belt at a certain force level.



Both shafts of the retractor system are torsion-type shafts. They are coupled together by gears.

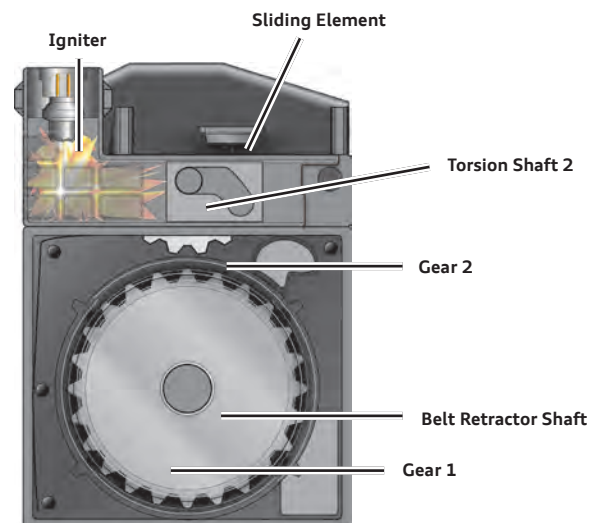


The Airbag Control Module decides when to activate the belt force limiter igniter depending on impact severity and seating position.

The second torsion shaft is decoupled from the belt retractor shaft. The belt retractor shaft now counteracts the force that the safety belt exerts (low force).

The safety belt tensioning function, the belt force limiting function and the front airbags are coordinated to help ensure the protection of the occupants.

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

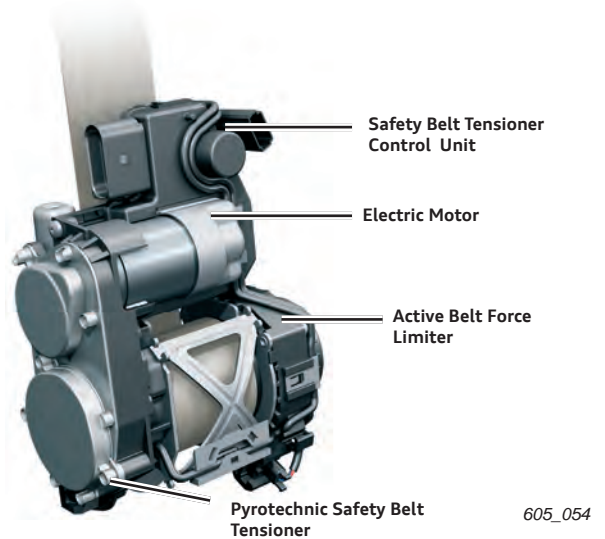
If the vehicle is equipped with the Audi pre sense system, the following functions are integrated in the front belt retractors:

- ▶ Reversible safety belt tensioner with control unit
- ▶ Pyrotechnic safety belt tensioner
- ▶ Adaptive belt force limiter

Reversible Safety Belt Tensioners

Front Left Safety Belt Tensioner Control Module J854 and Front Right Safety Belt Tensioner Control Module J855

The Front Left and Right Safety Belt Tensioner Control Modules J854 and J855 are networked using an extended CAN bus and the Data Bus On Board Diagnostic Interface J533. The safety belt tensioner control modules activate the reversible safety belt tensioning motors.



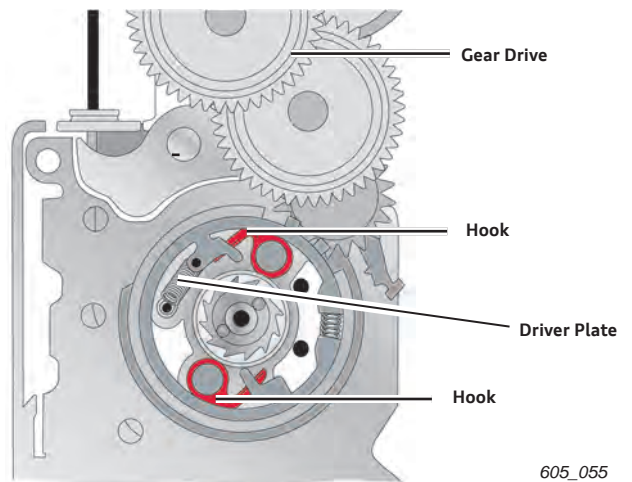
There different force levels are available depending on the situation:

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

In addition:

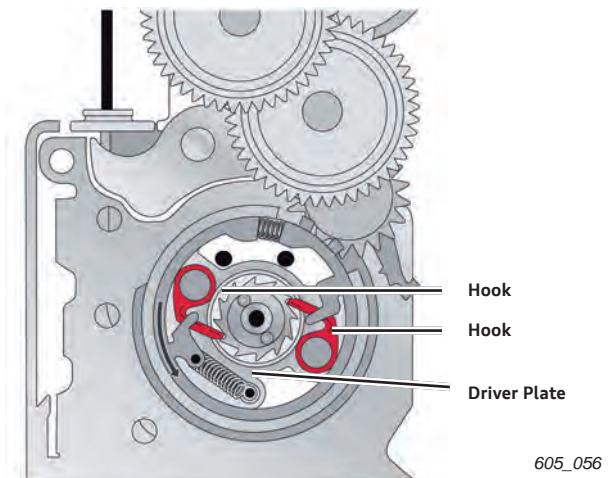
In the event of a head-on collision, Airbag Control Module J234 decides, based on the severity of the impact, which safety belt tensioners will be activated. (pyrotechnic or reversible).

At this point, J234 sends a data signal. J854 and J855 initiate the correct tensioning of the safety belts based on the data signal received.



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

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

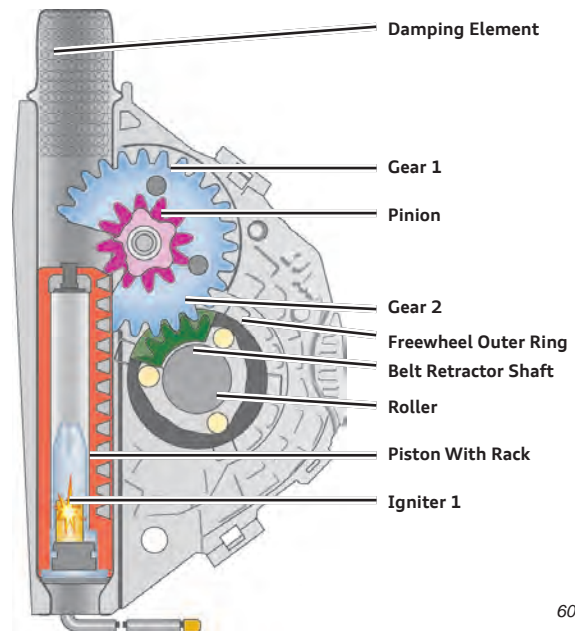


Passive Systems

Front Pyrotechnic Belt Tensioners Combined With Audi pre sense

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

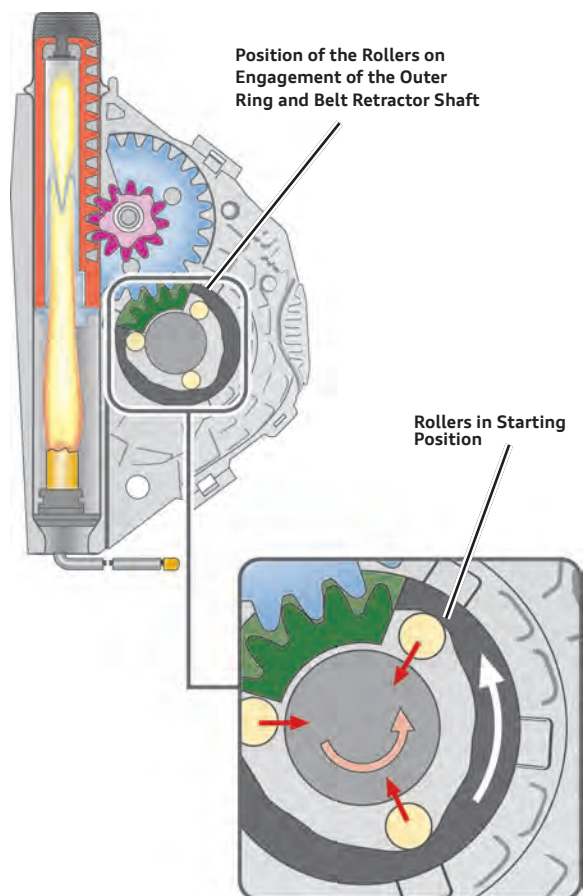
The signal from Airbag Control Module J234 ignites Driver/Passenger Safety Belt Tensioner Igniter 1 N153 and N154. The pressure causes the piston coupled to the rack to move upwards. The rack turns gears 1 and 2 via the pinion.



605_057

Gear 2 is part of 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. The rotational movement is now transmitted to the belt retractor shaft, and the process of retracting the safety belt begins.

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



605_058

Passive Systems

Adaptive Belt Force Limiters In Combination With Audi pre sense

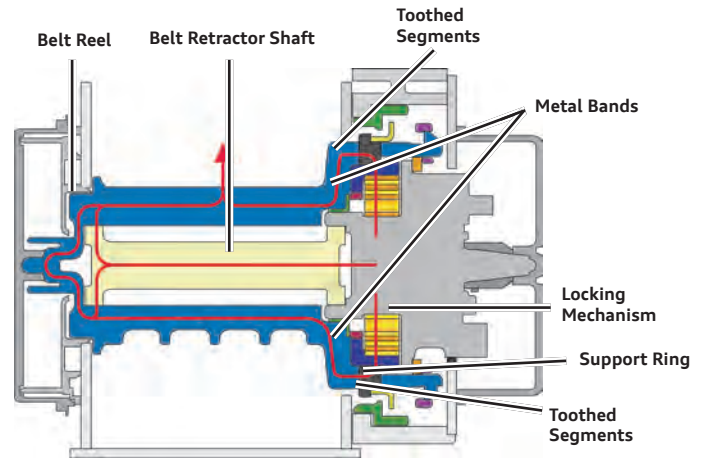
The front belt retractors have two-stage belt force limiters. In the event of a head-on collision that meets the conditions for deployment, the pyrotechnic belt tensioners are ignited first. The locking mechanism locks the belt retractor shaft and prevents the safety belt from unreeling, which would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

The amount of force that the safety belts can apply to the occupants is limited. If this force is exceeded, the belt retractor shaft and a belt winder allow controlled unreeling of the safety belt. The force is distributed as follows:

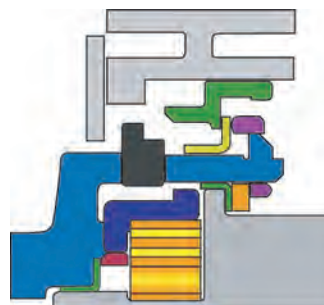
1. From the safety belt reel through the retractor shaft to the locking mechanism. The belt retractor shaft, which is designed as a torsion bar, begins to rotate.
2. From the belt reel to the locking mechanism through the toothed segment, support ring and metal bands. The metal bands are connected to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

Depending on impact severity and longitudinal seating position, the Airbag Control Module J234 activates the Belt Force Limiter Igniters G551 and G552. The 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 decouples. The torsion bar now counteracts the safety belt force.

To provide maximum protection, the belt tensioning function, the belt force limiting function and the front airbags are coordinated. The belt force limiter igniters are not activated in the event of a side impact or rear collision.



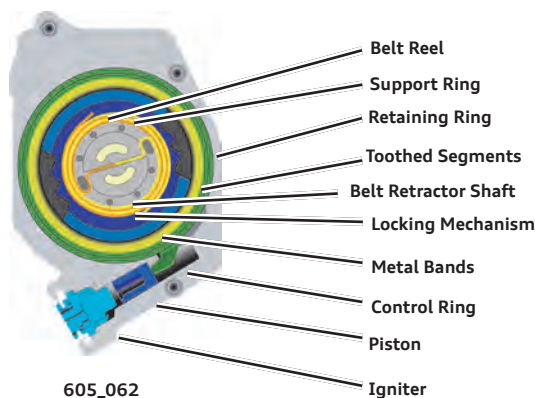
605_059



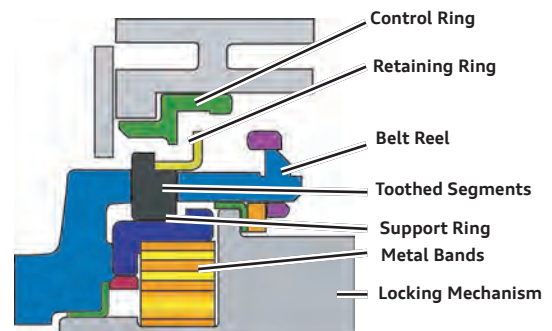
605_061



605_063



605_062



605_060

Passive Systems

Roll-Over Protection System

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

A sensor for detecting an imminent roll-over is integrated in the Airbag Control Module. This sensor, together with other sensors built into the control module, determine the severity of the impact. If a rollover is detected, both the roll-over protection system and the safety belt tensioners will be activated.

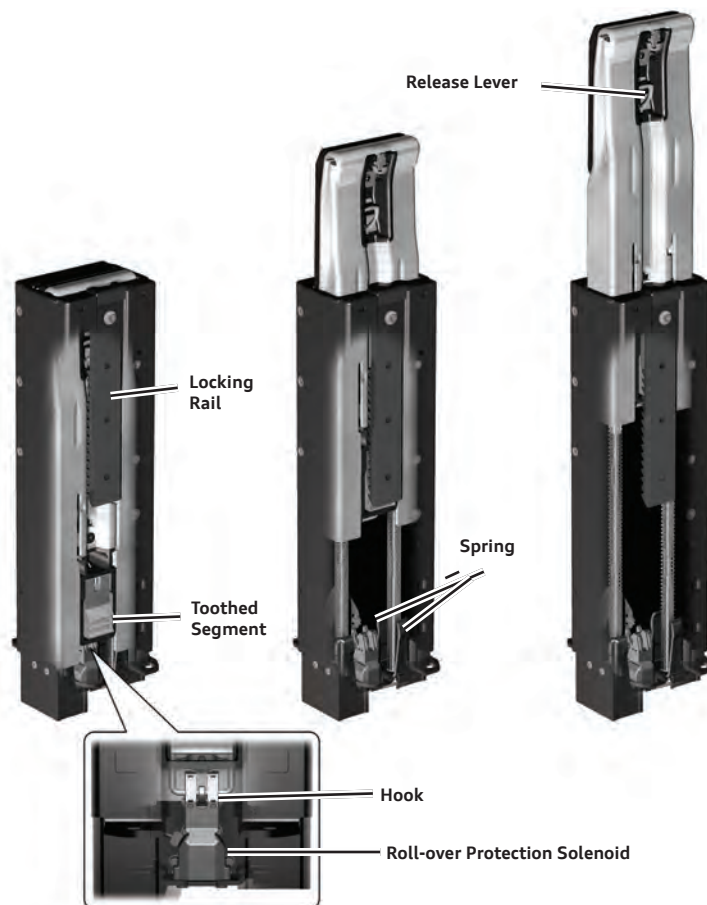
As a safety precaution, the roll-over protection system is also activated in the event of a strong head-on collision, side-impact collision or rear collision as soon as a safety belt tensioner or airbag deploys.

Function

In the resting state, the Roll Over Protection Solenoids N309 and N310 are de-energized and hold the roll-over protection system in a retracted position by means of a hook. When the solenoids are energized this hook is released, allowing the rollover protection elements to raise.

The springs raise the roll-over protection bars in approximately 0.25 seconds.

When deploying, a locking rail engages after approximately 6.7 in (170 mm) of travel. This keeps the roll-over protection bars extended. For service, the roll-over bars can be mechanically unlocked and moved back into their starting position.



605_064

Sensors

Seat Occupant Sensor

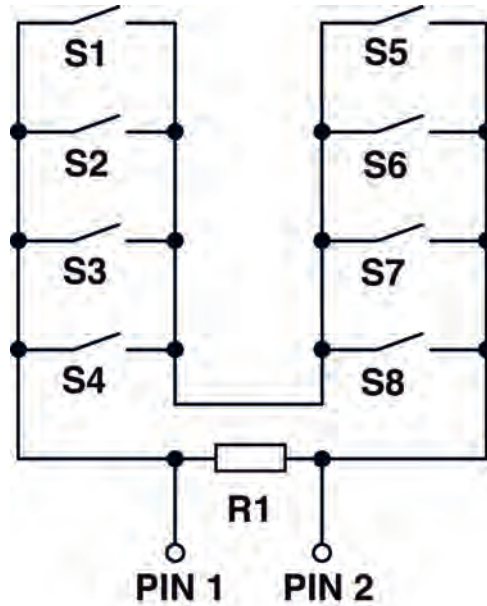
Depending on model and trim, different seat occupant sensors are used.

The Front Passenger Seat Occupant Sensor G128 is a plastic film with eight pressure sensors. The resistance of the individual sensors changes under load. The system recognizes an occupied seating position only if two pressure sensors are triggered simultaneously.

The seat foam molding is recessed to assure that the G128 is installed in the correct position.

Airbag Control Module J234 uses the signals from the seat occupant sensor and belt lock switch to determine if:

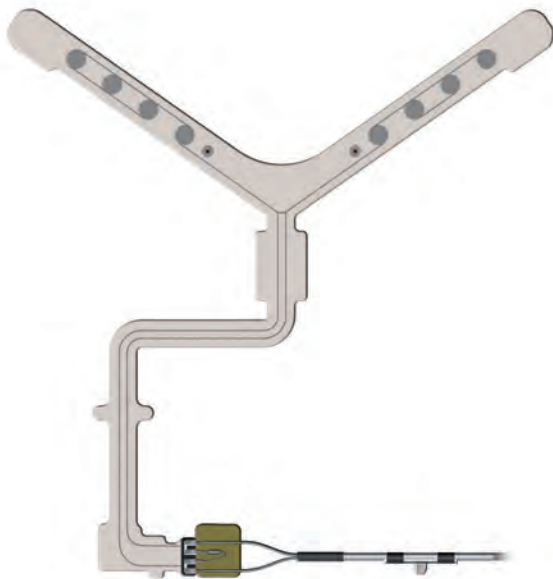
- ▶ A person is in the seat
- ▶ The safety belt is fastened



605_065

Examples:

Multi-Contour Sensor G128



605_066

Normal and Sport Seat Sensor G128



605_067



Note

This system is found only on earlier models

Passive Systems

Seat Position Detection

Seat Position Sensors G553 and G554 are located on driver and passenger seat rails of several models. These are Hall sensors. Based on the power consumption of the seat position sensors, Airbag Control Module J234 detects whether the seats are in the front third or in the rear two thirds of the seat adjustment range. The Airbag Control Module uses this information to correctly time the adaptability of the belt force limiters and the front airbags.

If the seat is in the front third of its adjustment range, J234 can activate the Adaptive Airbag Igniter 2 earlier than if the seat was in the rear two thirds of its adjustment range.

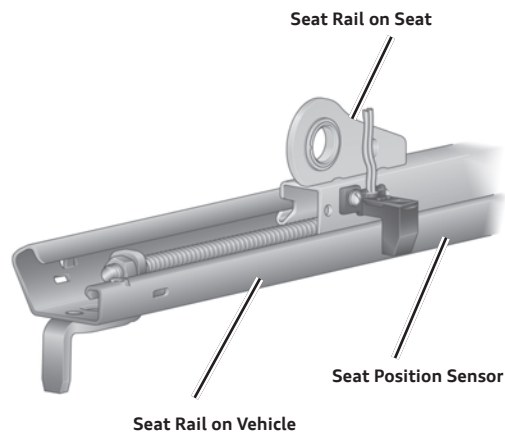
Seat in "Back" Position

The seat position detection sensors are installed on the seat rail towards the center of the vehicle.

If the seat position detection sensor is above the seat rail, J234 will determine that the seat is in the "back" position.

Early ignition of the second airbag igniter allows airbag deployment adaptation so that occupants with a small body mass plunge into the airbag in a controlled manner. Driver Belt Force Limiter G551 and Front Passenger Belt Force Limiter G552 are also activated early. As a result, the restraint systems are adapted to the accident situation and seat position.

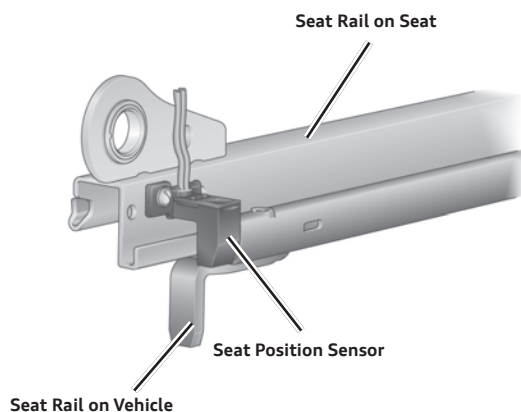
As always, a properly adjusted seat, correct seating position and a correctly fastened safety belt are the first steps to effective occupant protection.



605_068

Seat in "Front" Position

If the seat is pushed forwards and the seat position sensor moves beyond the seat rail, the J234 will determine that the seat is in the "front" position.



605_069

Safety Belt Reminder

Front Safety Belt Reminder

If the front occupants are not wearing their safety belts, the Safety Belt Indicator Lamp K19 will illuminate after the ignition is switched on.

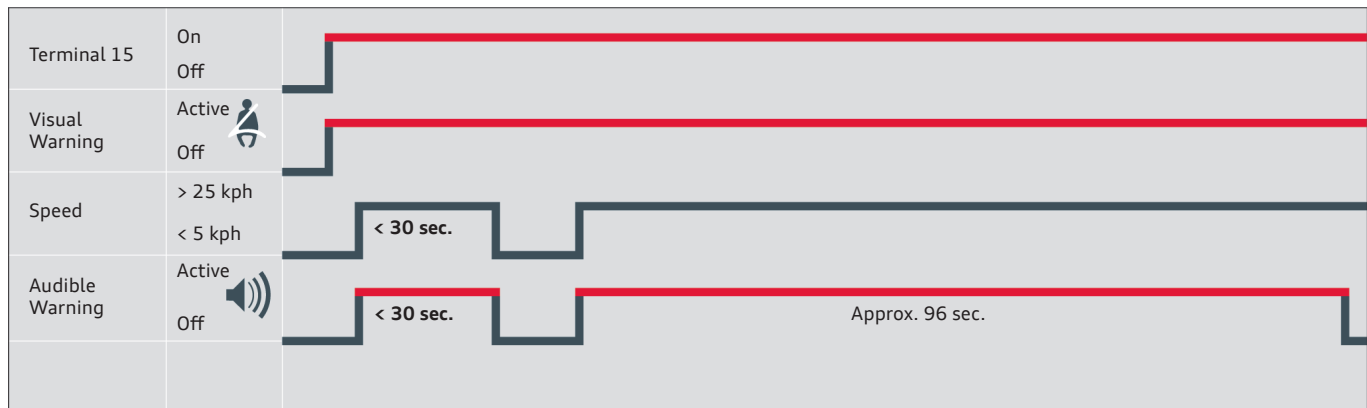
The Safety Belt Indicator Lamp K19 illuminates if the driver and/or passenger has not fastened his/her safety belt. When the vehicle exceeds 15.5 mph (25 kph), an acoustic warning will sound.

If the acoustic warning starts and the vehicle decelerates to a speed of less than 3 mph (5 kph) within the first 30 seconds, the acoustic warning will stop.

If the vehicle's speed increases again to above 15.5 mph (25 kph), the acoustic warning resumes. If 30 seconds have elapsed since the acoustic warning started, the acoustic warning does not stop until the safety 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 below can vary depending on model type and model year.

Front Safety Belts Not Fastened Warning



605_070

Market-Specific Special Features

Occupation Protection Systems For Specific Markets

Vehicles can be equipped with other systems to meet the statutory and specific requirements of several countries.

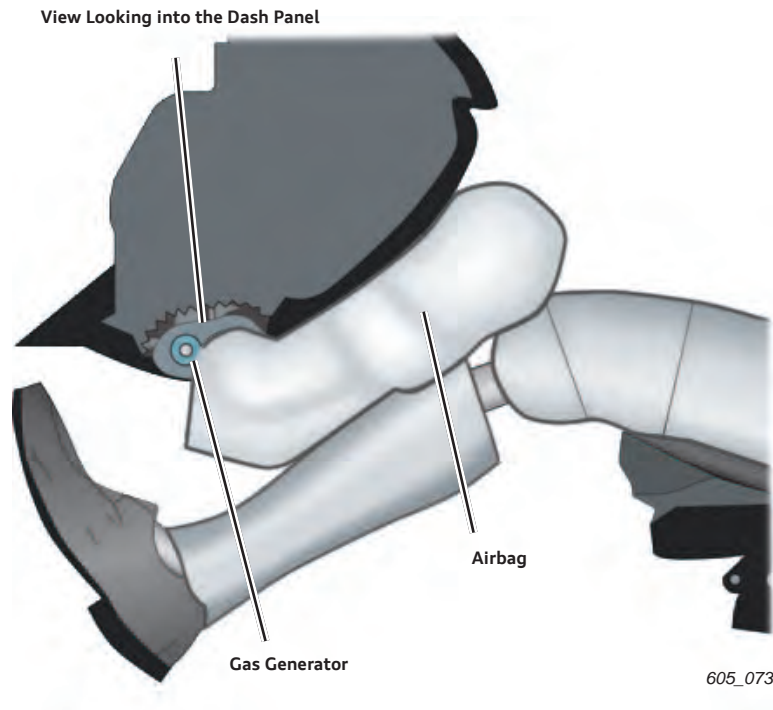
Roll-Over Protection Bar System

Depending on the actual specifications, two additional sensors are integrated Airbag Control Module J234 for rollover detection. ABS Control Module J104 reads this additional information to provide higher rollover detection sensitivity.

The airbag control module 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/curtain airbags are deployed.

Knee Airbags

Knee airbags are optional on some models. They provide for additional protection upon 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 located behind the glove compartment flap. The knee airbags are activated in combination with the front airbags. Hybrid gas generators are used for inflation.



Market-Specific Special Features

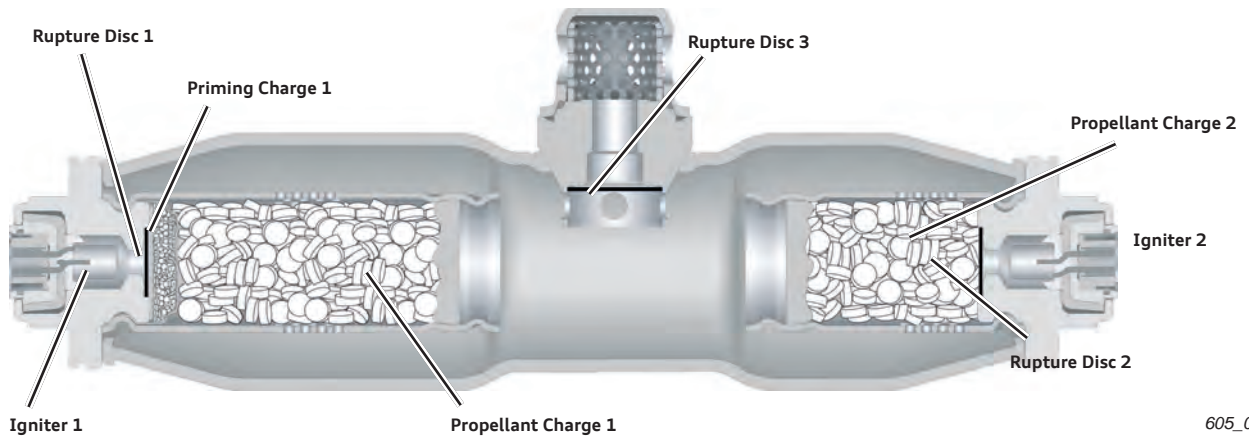
Passenger Front Airbag

Adaptive Passenger Side Gas Generator

A hybrid gas generator with two pyrotechnic propellant charges for inflation the airbag may be used depending on country specifications.

The adaptability function of the passenger airbag module is identical to the driver side airbag module and is described earlier in this Self-Study Program.

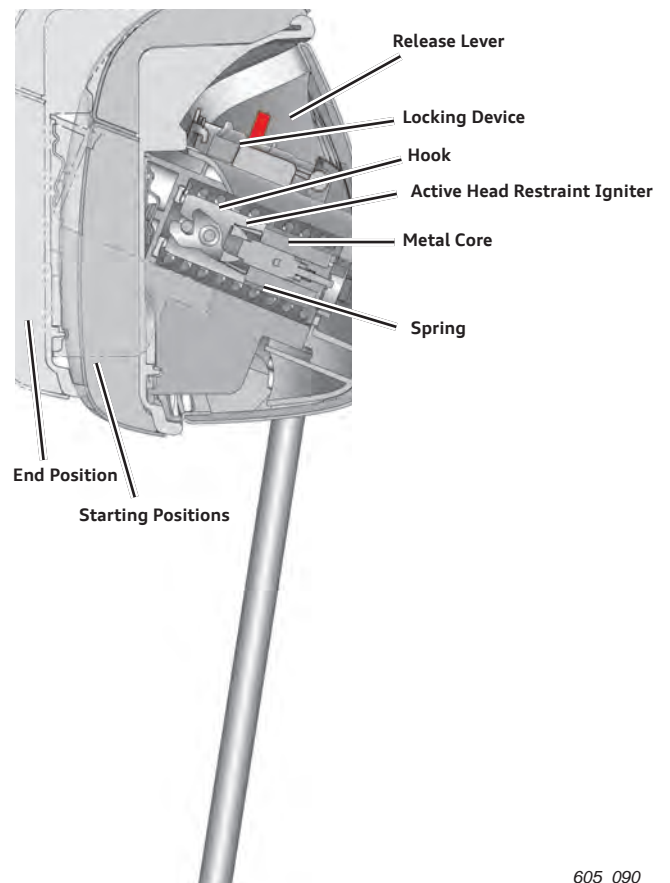
Depending on the accident situation, the Airbag Control Module J234 determines the interval at which the Front Passenger Airbag Igniter 2 N132 is ignited after the Front Passenger Airbag Igniter 1 N131.



Active Head Restraint

If Airbag Control Module J234 detects a rear collision that meets deployment conditions, the head restraints on the front seats and safety belt tensioners are activated. When the airbag control module energizes Driver/Passenger Active Head Restraint Igniter 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 2 in (50 mm) forwards and approximately 3/4 in (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 can be reset. The release lever releases the lock and allows the extended part of the head restraint to be pushed back again. Refer to ElsaWeb for specific model information.

Passenger Occupant Detection System

Passenger Side Seat Occupant Sensor

In several markets, the passenger seat is equipped with a special seat occupant recognition system. Airbag Control Module J234 can recognize two conditions:

1. Seat not occupied or child seat installed.
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 Front Passenger Airbag -Disabled- Indicator Lamp K145 illuminates to inform the occupants.

Capacitive Front Passenger Seat Occupant Sensor

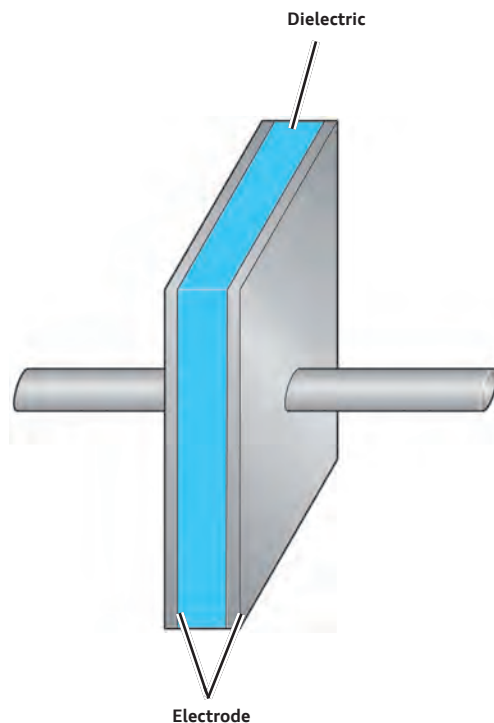
In some Audi vehicles, the Passenger Occupant Detection System Pressure Sensor G452 is now a capacitive sensor.

The capacitor is made of two plates (electrodes) and an insulator (dielectric), 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. The capacitance of a capacitor can be altered by varying the size of the electrode plate or the dielectric.

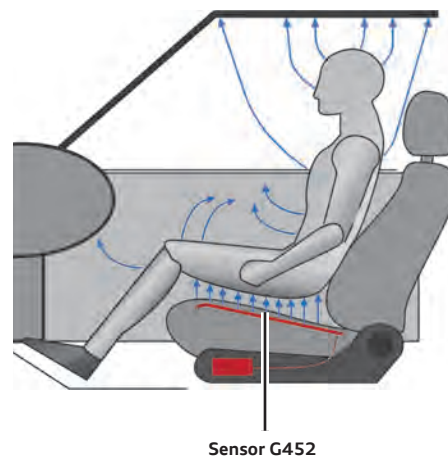
Function

With this seat occupant recognition system, the first electrode plate is G452 and the second electrode plate is the vehicle chassis. The size of these components is not variable. The dielectric consists of the seat cover, the atmosphere and the trim parts. These components are the variable. When an adult is seated in the passenger seat, the dielectric between the seat mat and the body of the vehicle 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 capacitance changes again. The change in capacitance is much less than an adult.



605_075

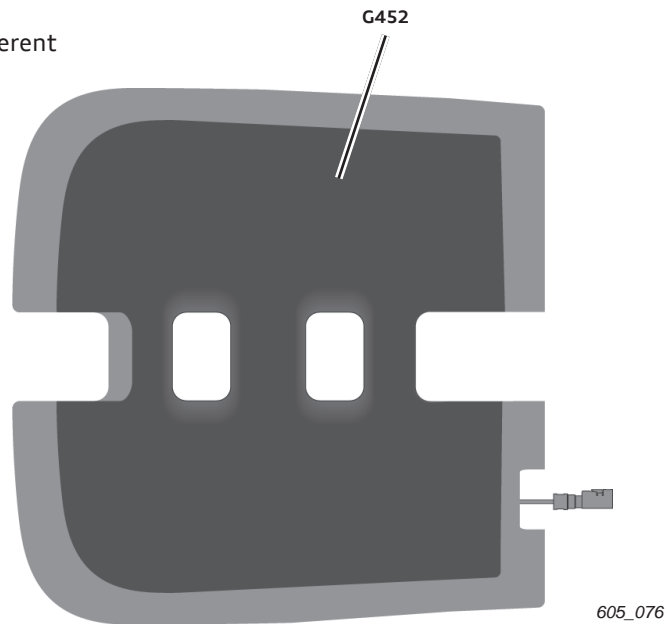


605_077

Passenger Occupant Detection System

Installation Position

Passenger Occupant Detection System Pressure Sensor G452 is integrated in the seat cover above the seat cushion. There are different seat types and also different seat occupant sensors.

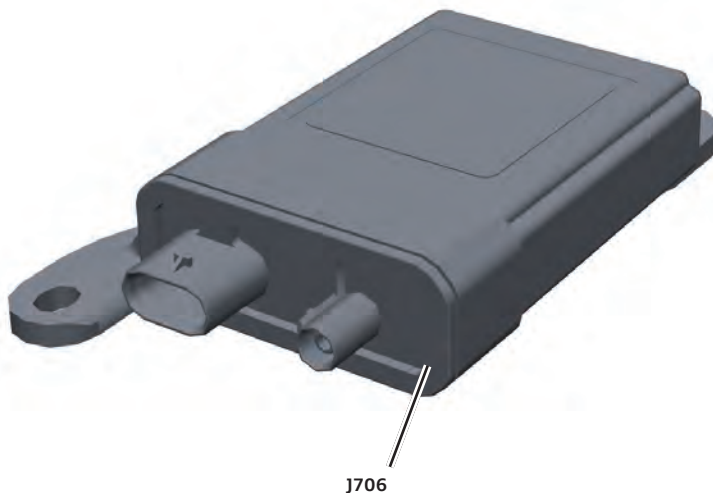


Passenger Occupant Detection System Control Module J706

G452 is connected to J706 by a coaxial cable. J706 is in charge for performing the measurements that determine seat occupant recognition. It detects the change in the capacitance of the seat occupant sensor G452 and can determine if the seat is vacant, has a child seat or is occupied by an adult. The capacitance of the seat occupant sensor is measured regularly by the seat occupant recognition control module.

Airbag Control Module J234 obtains the passenger information from J706 through a LIN interface.

The Airbag Control Module uses this information to activate or deactivate the passenger airbag and the passenger knee airbags. It is also used to activate or deactivate the Front Passenger Airbag -Disabled- Indicator Lamp K145.

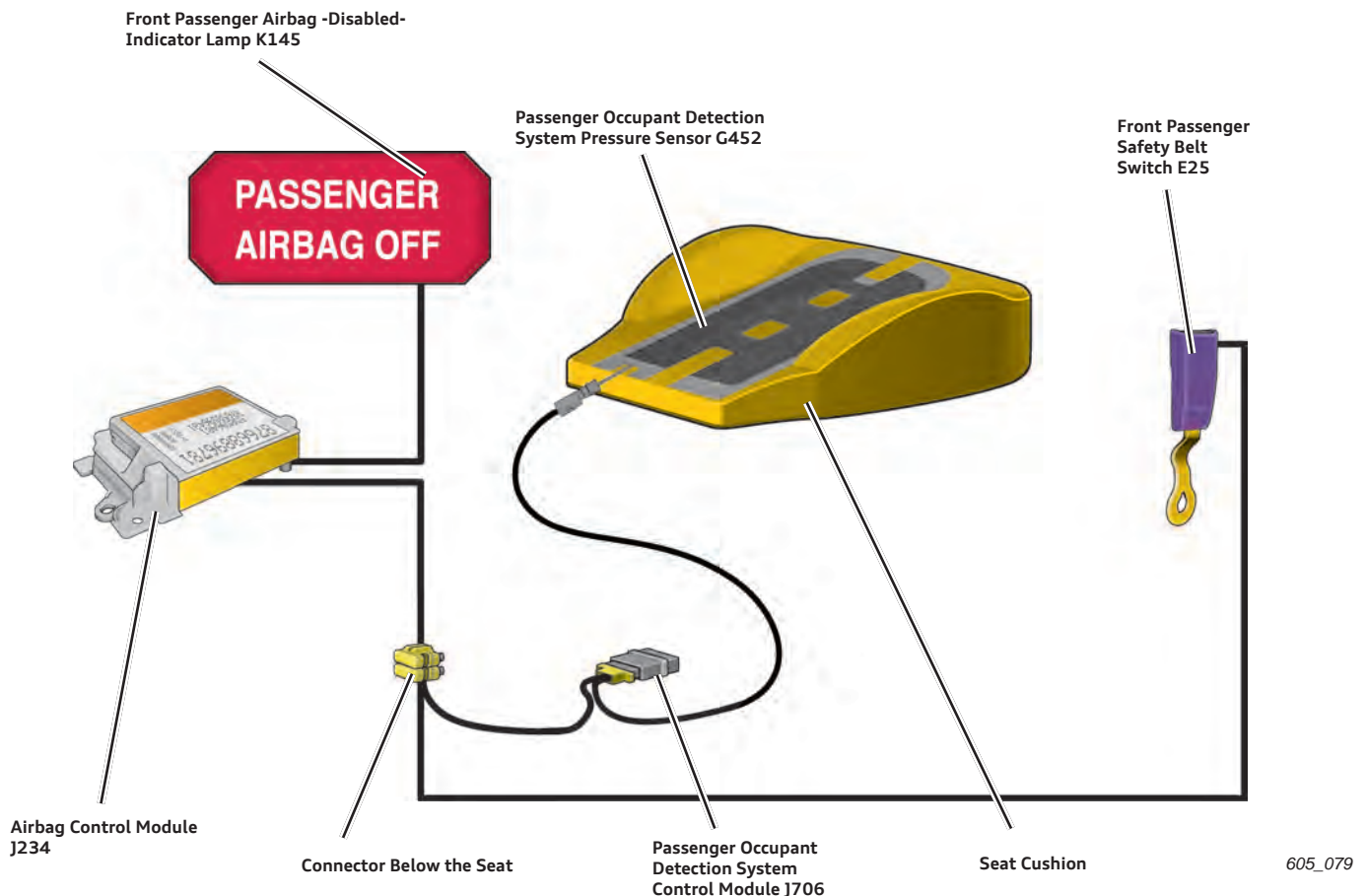


Passenger Occupant Detection System

System Overview

The Passenger Occupant Detection System Control Module J706 is located under the passenger seat. Note that there are different seat types and also different seat occupant recognition control modules.

The software in the control modules is adapted specially to the seat.



Note

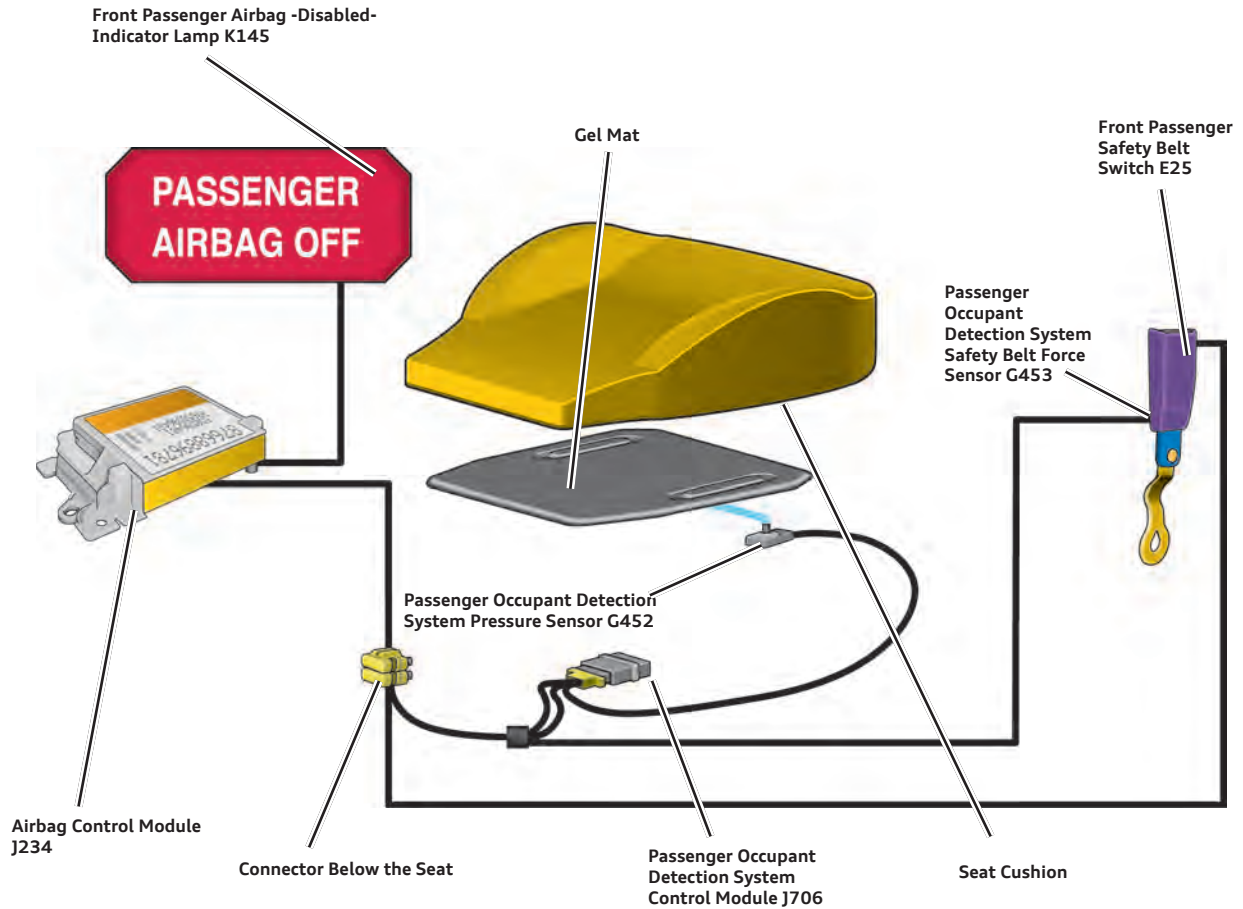
When repairing the seat occupant recognition system, always refer to ElsaWeb, Guided Fault Finding and the Electronic Parts Catalog (ETKA).

Passenger Occupant Detection System

Gel Mat System Overview

The gel mat design is specific for the US market. It is made up of a gel mat under the seat cushion. If weight is put on the seat, gel in the mat transfers pressure through a tube to the pressure sensor. This pressure sensor calculates how much weight is on the seat.

This information is combined with the safety belt tension to determine if a child seat is present. The Airbag Control Module uses this information to activate or deactivate the passenger airbag and the passenger knee airbags. It is also used to activate or deactivate the Front Passenger Airbag -Disabled- Indicator Lamp K145.



Note

Refer to SSP 991403 The 2005 Audi A6 Vehicle Introduction for more information on the gel mat PODS system.

Audi pre sense

Introduction

There are many terms for today's ever-evolving driver assistance systems:

- ▶ Active safety
- ▶ Passive safety
- ▶ Integral safety
- ▶ Driver assistance systems
- ▶ Preventive occupant protection

In order to provide the occupants with a good level of protection, the vehicle should be able to detect hazards early and use the latest technology to prepare the vehicle. This is the idea behind Audi pre sense.

Audi pre sense cannot prevent accidents from occurring. Its purpose is to alert the driver to hazardous situations and to assist the driver as much as possible.

The Audi pre sense system was made possible by networking many vehicle systems. The individual control modules transmit a continuous flow of information using the vehicle's data bus systems. As a result, the information is evaluated and the best possible course of action can be initiated.

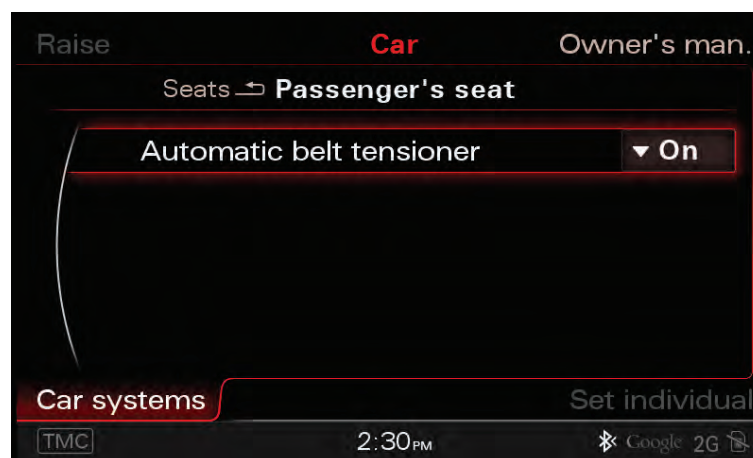
Audi pre sense Basic

Automatic belt tensioner function

If the front occupants have fastened safety belts and a speed signal of approximately 9 mph is detected (driving forwards), the Front Left and Right Safety Belt Tensioner Control Modules J854 and J855 reduce the belt slack. This is done by briefly activating the electric motors in the belt retractors.

After the gentle tensioning, the safety belt tension is released. If the front safety belts are fastened and the vehicle is driving forwards at a speed of < 9 mph, the belt slack is reduced after approximately 10 seconds. If the safety belts are not fastened, the electric motors in the belt retractors are not activated.

The occupants have the option of activating or deactivating the automatic safety belt tensioner function (belt slack reduction) using the MMI.



605_084

Longitudinal Dynamics Function

If the vehicle is moving forward and the driver brakes heavily, the Front Left and Right Safety Belt Tensioner Control Modules J854 and J855 initiate the partial tensioning of the safety belts when a certain brake pressure is reached.

This is detected when a driver applies sudden and hard brake pressure. The hydraulic pressure in the system raises quickly.

When this pressure raises quickly in a defined time, the safety belts are fully tensioned electrically by control modules J854 and J855.

The ABS Control Module J104 also activates the hazard warning flashers. Depending on the situation, the forward motion of the occupants can be reduced to approximately 4 in (100 mm) by tensioning of the safety belts.

Transverse Dynamics Function

If the vehicle oversteers or understeers, the Electronic Stability Program (ESP) is activated.

The safety belts are partially tensioned electrically. If the vehicle exceeds its physical limits and can no longer be stabilized, the safety belts are fully tensioned electrically.

In addition, the side windows and the tilt/slide sunroof¹⁾ are closed (if open).

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

Depending on the set-up in Audi drive select and if ESC is active or deactivated, the safety belts are tensioned electrically for the driving situation.



605_085

Audi Drive Select		Auto	Comfort	Dynamic
ESC	On	Partial and Full	Partial and Full	Full
	Off	Partial and Full Under Braking	Partial and Full Under Braking	Full Under Braking

Because of the speed at which events occur, the side windows and the tilt/slide sunroof¹⁾ cannot always be fully closed.

Closing the side windows and the tilt/slide sunroof reduces the possibility of miscellaneous objects entering the occupant cell.

¹⁾ Optional Equipment

²⁾ Reversible Safety Belt Tensioner

Audi pre sense

Audi pre sense Plus

Audi pre sense Plus requires the optional Adaptive Cruise Control (ACC) system. The ACC system also includes the Audi braking guard. The ACC radar sensors monitor the traffic ahead (within the scope of their technical capabilities) and send the information to the Distance Regulation Control Module J428. The data is evaluated and relevant information is sent out over the data bus. Other control modules are able to receive and evaluate

these messages and take appropriate action. Even when ACC is inactive for the driver, the radar sensors monitor the traffic ahead and send the data across the data bus.

Both the optional ACC and Audi side assist are required to implement the Audi pre sense plus system. Audi side assist monitors the traffic behind the vehicle.

Example of a Situation:

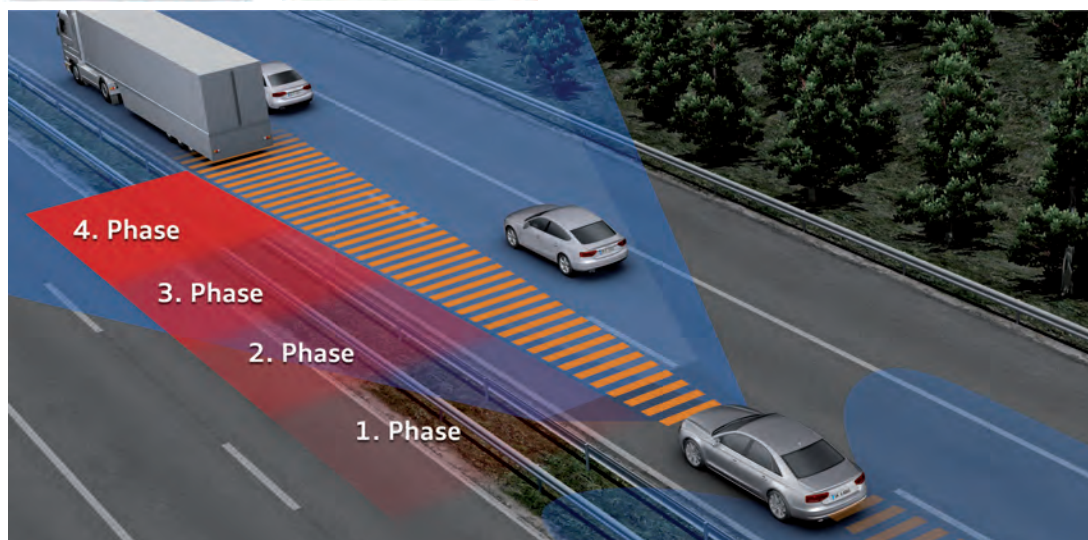
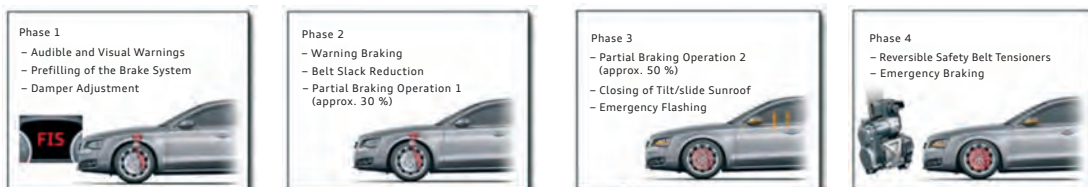
Phase 1: When the vehicle approaches a hazardous situation, the driver is alerted audibly and visually by the Instrument Cluster Control Module J285. At the same time, the ABS Control Module J104 prefills the brake system, and the Level Control System Control Module J197 sets the damping to "firm."

Phase 2: If the driver does not respond to the warnings indicated in the instrument cluster or only eases off the accelerator, the ESP control module performs a warning braking of about 30%. The belt slack in the safety belts is reduced during the warning braking phase by the Left and Right Safety Belt Tensioner Control Modules J854 and J855.

Phase 3: This phase applies to Audi pre sense plus only. If the driver still does not apply the brake, approximately 50% braking force is applied by the ESP control module. In addition to this:

- ▶ The emergency braking function (hazard warning flashers) is activated by J428
- ▶ Side windows and the sunroof are commanded to close by the safety belt tensioner control module on the driver's side

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



¹⁾ Optional Equipment

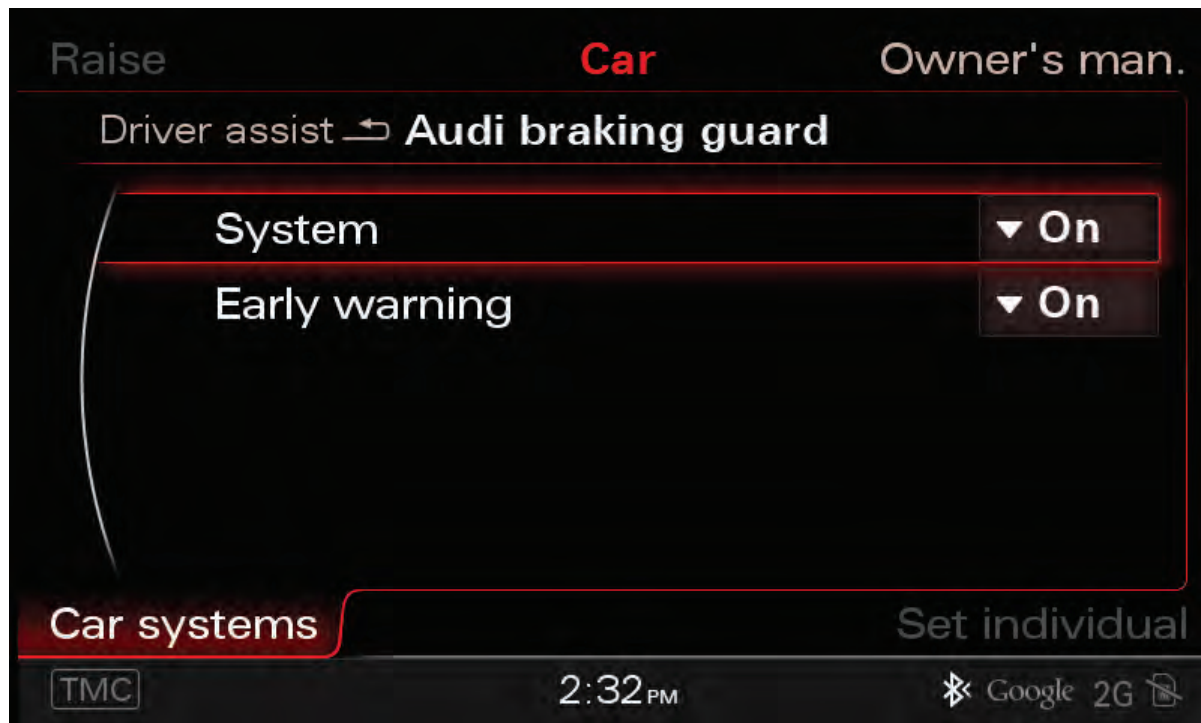
Additional Examples:

If the driver accelerates sharply in Phases 2 and 3 despite all of the warnings, the partial braking operation is cancelled after the warning braking. The ACC system determines that the driver knows of the dangers and is in control of the vehicle. No further braking operation is initiated by the ACC system.

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 Plus assists the driver. If the driver does not brake hard enough, the Audi braking guard may assist by increasing the brake pressure.

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



605_087

Audi pre sense Plus

The information which the Distance Regulation Control Module J428 sends through the data bus to all control modules. The Airbag Control Module collects key information such as "time to collision" and "speed relative to objects ahead." When a set value is exceeded,

Airbag Control Module is aware that a collision is imminent. The electronics in the Airbag Control Module are alerted and wait for information from the crash sensors.

Audi pre sense

Audi pre sense Plus

Audi pre sense Plus uses Audi side assist and supplies information on traffic behind the vehicle. The system uses radar sensors in the bumpers to continuously feed the Lane Change Assistance Control Module J769 with information.

Example of a Situation:

Phase 1:

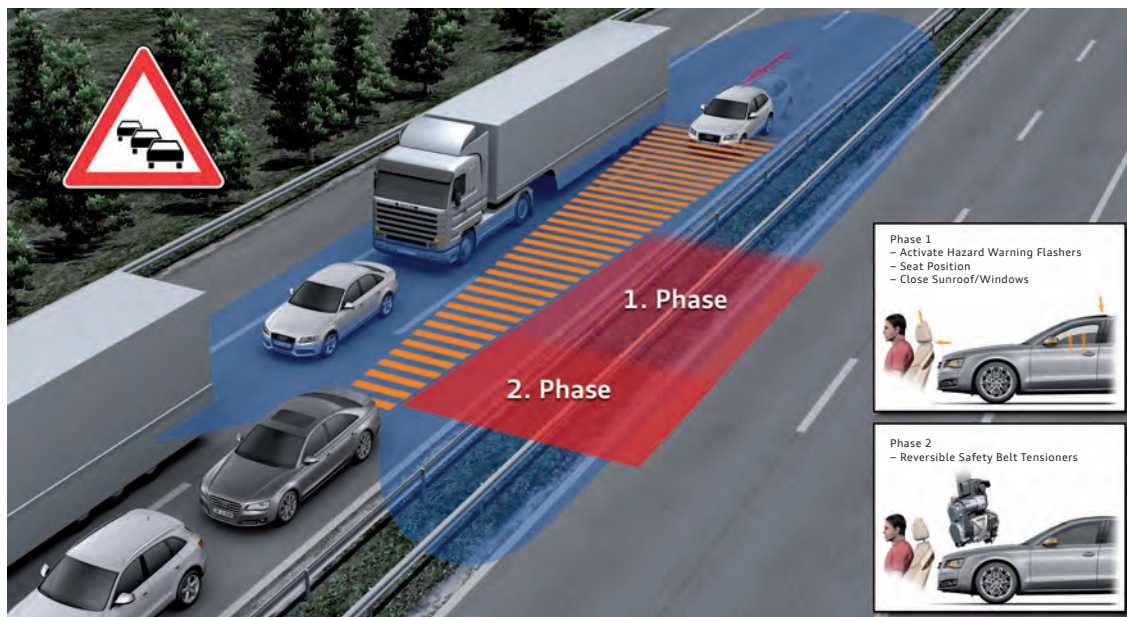
If a vehicle is approaching quickly from behind, the driver's front safety belt tensioner control module sends this information to the data bus. The side windows and the tilt/slide sunroof) begin closing and the hazard warning flashers are activated. If the vehicle has memory seats in the front, the 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.

The Audi lane assist control module evaluates this information and adds any relevant information to the data bus. Even if Audi side assist is deactivated by the driver, J769 still continues to send relevant data.

Phase 2:

If the vehicle continues to approach and a collision is determined to be unavoidable, the front safety belts are tensioned electrically.



605_088

On models with a trailer hitch, Audi pre sense rear is not active if a trailer is detected.

¹⁾ Optional Equipment

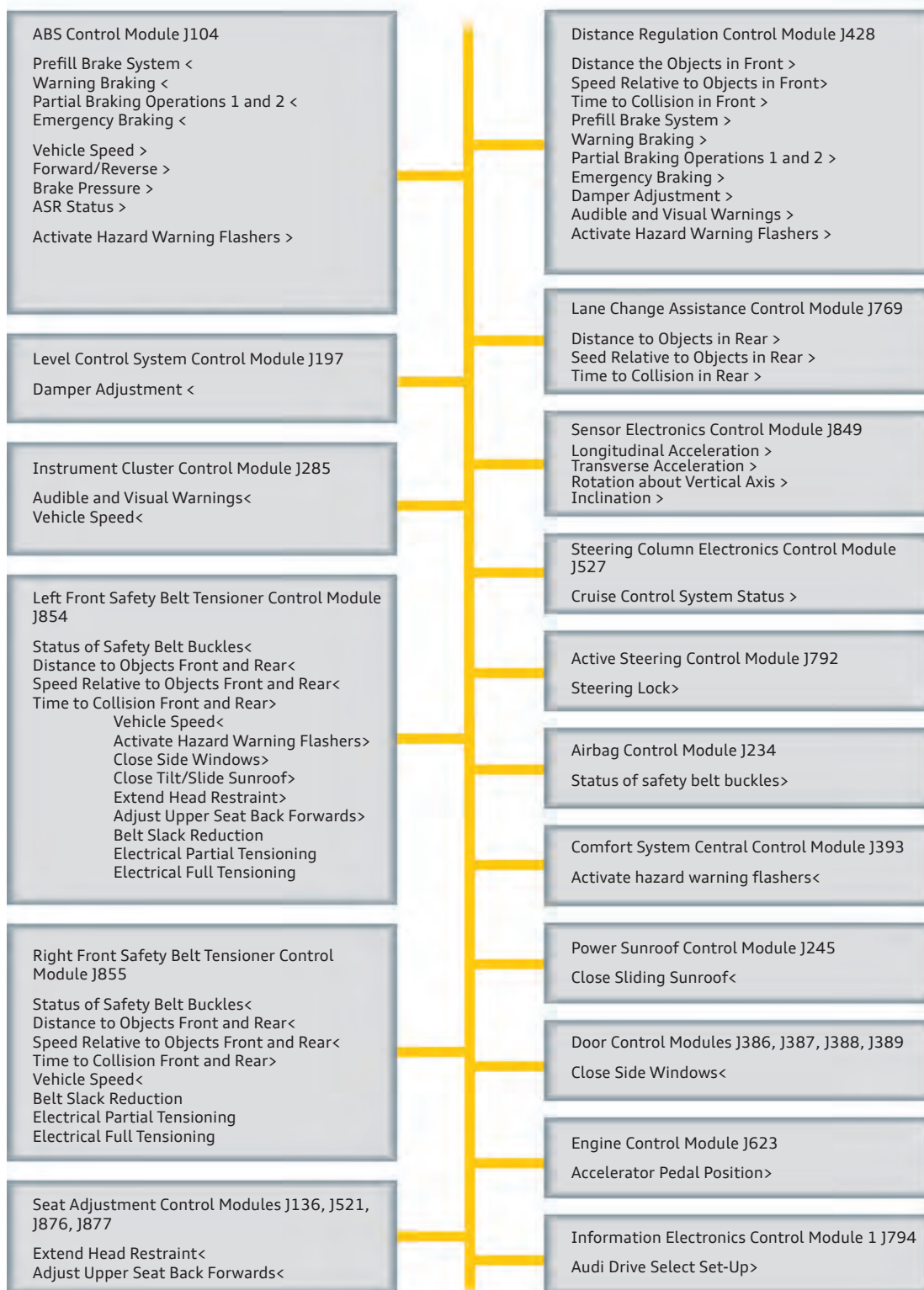
Data Bus Networking

The overview shows some of the information which is exchanged via data bus.

> = data is transmitted

< = data is received

without > / < = initiated actions



Airbag and Pyrotechnic System Precautions

Precautions

There are certain precautions that you should always take when working on an airbag system.

- ▶ Refer to the repair manual for the latest warnings and cautions as well as other important information on airbags and pyrotechnic devices.
- ▶ Empty pockets of pencils, pens, cigarettes, and other items that could fall out.
- ▶ Disconnect the battery ground (GND) strap before working on the airbag or pyrotechnic safety belts.
- ▶ Wear O.S.H.A approved safety goggles with a minimum ANSI rating of ANSI Z87_1_1968 and ANSI Z87_1_1989. Flying material released during an inadvertent deployment can damage eyesight or cause blindness.
- ▶ Electrostatically discharge yourself before handling an airbag or pyrotechnic safety belt. Do this by touching a suitable metal part, such as a door jam striker pin or ground point.

Airbag and Pyrotechnic Systems Precautions

When Working on Vehicles

There are quite a few things a Technician needs to know when working on vehicles with Airbags and pyrotechnic safety belts.

- ▶ NEVER erase Diagnostic Trouble Codes (DTCs) before discovering the root cause of an airbag fault.
- ▶ Never open or attempt to repair an airbag module or pyrotechnic safety belts.
- ▶ Do not install airbag components or pyrotechnic safety belts that have been dropped or show signs of damage.
- ▶ Never use a (nine volt) battery saver. Using a battery saver can cause an airbag or safety belt pretensioner to deploy.
- ▶ Never use a digital volt ohmeter or self powered test light when working on an airbag or pyrotechnic safety belt system. Using the wrong diagnostic tools can cause an airbag or safety belt pretensioner to deploy. Use only approved Audi diagnostic tools on airbag and pyrotechnic safety belt systems.
- ▶ Never use impact tools to remove or install pyrotechnic safety belts.
- ▶ Do not hammer in the area of pyrotechnic safety belts, the airbag control module or crash sensors. See ElsaWeb for the location of sensors that trigger safety belts and airbags.
- ▶ Do not use grease, cleaning solutions, solvents or similar substances on safety belts or airbag covers.
- ▶ Do not apply stickers or badges to airbag covers.
- ▶ Do not use salvage parts when repairing a safety belt or airbag system.
- ▶ Never turn the ignition to the ON position while reaching through the steering wheel spokes. The airbag could deploy and cause serious injury.
- ▶ Do not disable any safety systems on the vehicle
- ▶ Always wash your hands and face with mild soap and water after working on a vehicle in which the airbags and other pyrotechnic devices have been deployed, especially before eating. Also, do not let the particles and dust released from an airbag or pyrotechnic safety belt get into your eyes or into any cuts or scratches. If contact does occur, flush eyes with water and wash exposed skin with soap and water.

Special Handling

On the following pages you will learn some of the special handling rules to follow for airbags and pyrotechnic safety belts.

- ▶ All airbags and pyrotechnic safety belts of a vehicle scheduled to be scrapped must be deployed using Airbag Deployment Device J-44210. Always read the instruction booklet and view the supplemental video for Airbag Deployment Device J-44210 and heed all warnings before using the device.
- ▶ Undeployed airbags and pyrotechnic safety belts are considered hazardous material. When disposing of an undeployed airbag or pyrotechnic safety belt that is either defective or expired, use the appropriate repair information and Airbag Deployment Device J-44210. Never deploy airbags or pyrotechnic safety belts in the vehicle.
- ▶ If airbag or pyrotechnic safety belt cannot be safely deployed or removed from the vehicle, contact the Audi Dealer Technician's Helpline.
- ▶ Make sure your dealer complies with federal, state and local regulations for explosive substances.
- ▶ Deployed airbags and pyrotechnic safety belts can be disposed of as normal scrap.
- ▶ Shipment of active, undeployed airbag gas generators and pyrotechnic safety belt retractors must be in accordance with the regulations published in the latest edition of the Code of Federal Regulations #49 (49 CFR). Shipment must be initiated and received by certified individuals. The penalties for noncompliance are severe. Civil penalties range from \$250 to \$27,500 per violation, per day. Criminal penalties, for willfully violating the regulations, range from \$250,000 for individuals and \$500,000 for corporations.

Special Procedures



NEVER erase Diagnostic Trouble Codes (DTCs) before discovering the root cause of an airbag fault.



Refer to the latest repair information in ElsaWeb to determine which components have to be replaced in the event of airbag and pyrotechnic safety belt deployment.



Inspect pyrotechnic safety belts even if the airbag(s) did not deploy.

Special Tools

Airbag Deployment Device J-44210

State and federal law requires airbags and safety belt tensioners to be deployed before being discarded.

The J-44210 Deployment Fixtures assists certified technicians on the deployment of Audi driver, passenger, side-impact airbags and safety belt tensioners for the purpose of disposal.

The fixture functions as a platform to which airbags and tensioners can be attached for deployment. It

incorporates a plastic tank that must be filled with water prior to use. It also includes the necessary bolts and brackets to properly attach the airbag/tensioners.

It is important that the technicians is familiar with all procedures to attach and deploy airbags using this device. Additional information regarding these procedures can be found on Servicenet in the J44210 Instruction Booklet.



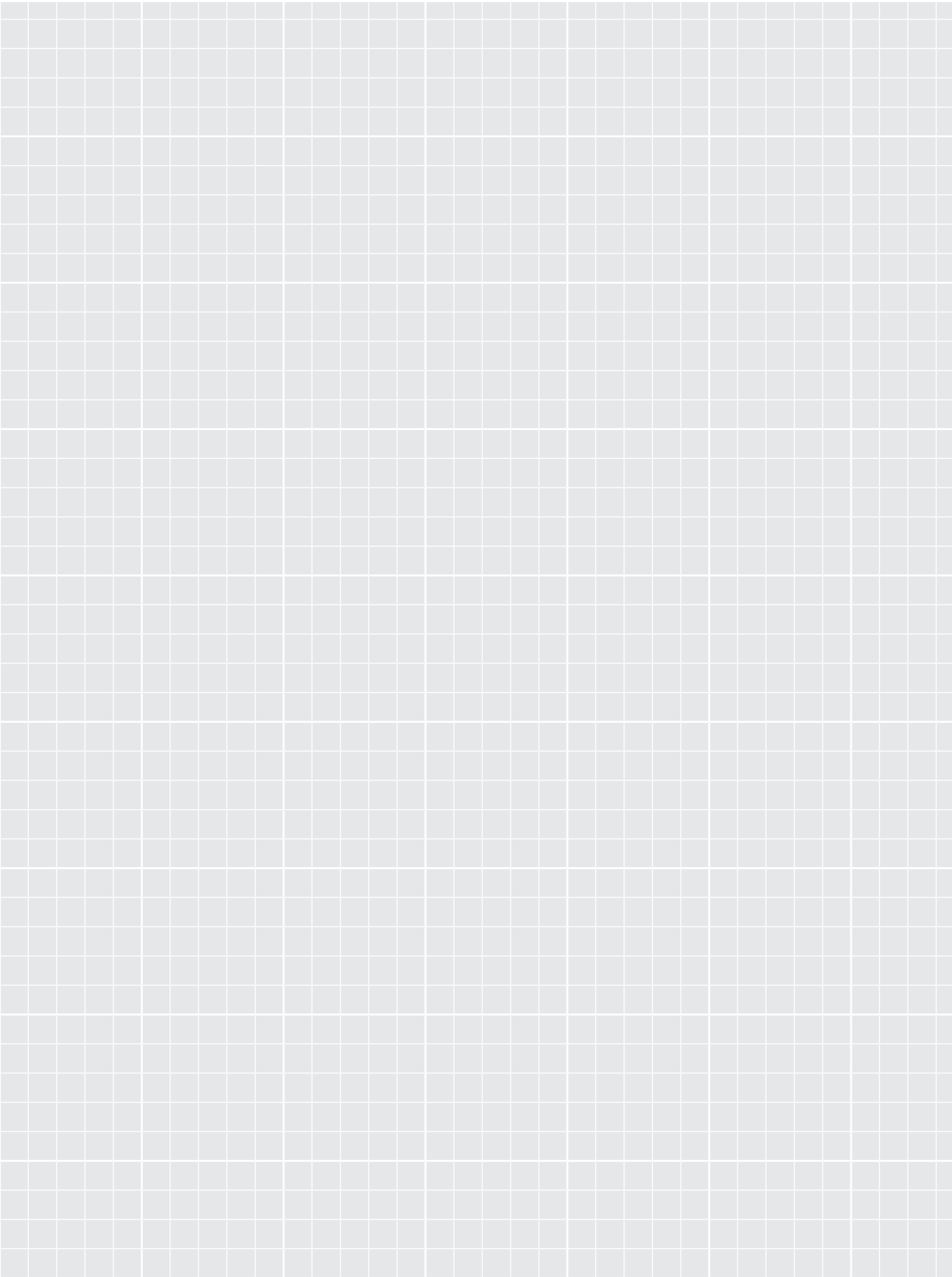
VAS 5056

The VAS 5056 simulates the resistance of the airbag. It can also simulate a short circuit when the button on the tester is pushed. The tester comes with adapter harnesses to fit all airbag and pyrotechnic safety belt igniter connectors.

For example, for the DTC Front Passenger Airbag Igniter 1-N131-Too High, a technician can connect the VAS 5056 and the proper adapter to the igniter wiring harness and monitor the Measuring Value Blocks on the Scan Tool. When the technician pushes the button on the tester, the value should change from Too High to Too Low. If this happens, the technician has verified that the wiring harness to the airbag is not the cause of the DTC. Always refer to the electronic service information systems and Guided Fault Finding for the latest diagnostic and repair information.



Notes



Knowledge Assessment

An online Knowledge Assessment (exam) is available for this Self-Study Workbook.

The Knowledge Assessment is required for Certification.

You can find this Knowledge Assessment at:

www.accessaudi.com

From the accessaudi.com Homepage:

- ▶ Click on the “ACADEMY” tab
- ▶ Click on the “Academy Site” link
- ▶ Click on Course Catalog Search and select “970133B – Audi Occupant Protection – Passive Systems II, Audi pre sense”

Please submit any questions or inquiries via the Academy CRC Online Support Form which is located under the “Support” tab or the “Contact Us” tab of the Academy CRC

Thank you for reading this Self-Study Workbook and taking the assessment.

