

Multiple restraint systems MRS3 and MRS4

The multiple restraint systems MRS 3 and MRS4 consist of a control unit, two sensors for detecting a side-on crash, a sensor for detecting seat occupancy of the passenger seat, and inflator assemblies for triggering the airbags.

The multiple restraint system MRS4 is a development of the MRS3 system.

Components

Control unit

All inflator assemblies and sensors are connected to the MRS control unit. The control unit registers and evaluates the sensor data. In the event of a frontal or side-on collision, the internal control-unit logic decides whether airbag triggering is required and which airbags have to be triggered.

To detect crashes, the MRS control unit contains acceleration sensors that assess the accident situation based on occurring deceleration values. In the event of a side-on crash, the external side sensors (satellites) are also evaluated.

In addition to all inputs and outputs, the MRS control unit also monitors internal components. Possible fault statuses are stored in non-volatile form in the MRS control unit and indicated to the driver by means of the failure warning lamp.

Triggering circuits

Based on the current maximum configuration, the MRS multiple restraint system consists of the following 15 triggering circuits:

- Driver airbag (stage 1)
- Front passenger airbag (stage 1)
- Driver airbag (stage 2)
- Front passenger airbag (stage 2)
- Side airbag, front left
- Side airbag, front right
- ITS left (ITS = Inflatable Tubular Structure)
- ITS, right
- Side airbag, rear left
- Side airbag, rear right
- Head airbag, rear left
- Head airbag, rear right
- Belt tensioner, driver's side
- Belt tensioner, passenger side
- Battery disconnection

Failure warning lamp

The failure warning lamp indicates to the driver the proper functioning of the overall MRS system.

The MRS control unit starts a self-test after the ignition has been switched on. The failure warning lamp is lit during this test period (approx. 3 - 5 s) and then goes out if no faults are found.

The failure warning lamp will light up permanently if the MRS control unit detects a current fault or a fault code that has already been stored during the test or during driving.

Seat belt buckle check (USA only)

A seat belt buckle check facility is fitted in USA version vehicles.

The MRS control unit receives information as to whether the seat belt is buckled from a switch in the belt buckle.

Based on this belt buckle monitoring function, the control unit decides whether the belt tensioners need to be triggered in the event of a crash and whether the airbag needs to be triggered at stage 1 (seat belt not

buckled) or stage 2 (seat belt buckled).

Satellites (sensors for side airbags)

The satellites are sensors mounted in the side area of the vehicle on the cross members beneath the driver's and passenger's seats. They are connected by a data line to the MRS control unit.

In this way, in the event of a side impact collision all airbags on the side of the vehicle facing the point of impact can be triggered.

The sidebags and head airbags are only triggered when both the sensor and the MRS control unit have detected acceleration.

Seat occupancy detection (SBE)

A seat mat that changes its resistance as weight load increases is located under the seat cushion of the passenger seat. This change in resistance is evaluated by the electronic seat occupancy control system and determines the status "seat occupied" or "seat not occupied". The result is then passed on to the MRS control unit.

Corresponding to this information, in the event of a head-on collision, the control unit can activate the triggering circuits for passenger airbag and passenger belt tensioner if the passenger seat is occupied.

Bus link

The MRS control unit is connected to the K-bus on all model series equipped with a K-bus. A version featuring a connection to the diagnosis bus (TxD link) is used for model series without a K-bus (Z3 and Z3 coupe).

Diagnosis and encoding are conducted via the bus.

Function

The task of the MRS is to define the type of collision with the aid of sensors. Within fractions of a second, the information is then evaluated, passed on to the corresponding inflator assemblies and the airbag triggered.

The intensity of an impact is determined based on the detected acceleration values and one or several ignition circuits are triggered depending on the determined value.

NOTE: Unintentional triggering of the airbag must not occur even in extreme driving situations.

Front airbags

The front airbags (driver and passenger airbag) support the function of the seat belts and prevent the head from making contact with the steering wheel or dashboard in the event of a head-on collision.

The passenger airbag and belt tensioner on the passenger side are not triggered if the control unit recognises that the passenger seat is not occupied.

2-stage airbags are used for the driver and passenger.

Only stage 1 of the front airbag or stage 1 and stage 2 are triggered depending on the detected intensity of the impact. A variable delay time that is also calculated on the basis of the acceleration values is set between ignition of both airbag stages.

On the country-specific version for the USA, an additional differentiation is made as to whether the occupants have their seat belts buckled. If the occupants do not have their seat belts buckled, the triggering thresholds are lowered so that the airbags are triggered earlier in stage 1 and stage 1/2.

Side airbags, ITS front, head airbags, rear

The side and head airbags protect the occupants in the event of a side impact collision. The main task of the side airbags is to support the body in the side chest area. Front ITS (ITS = Inflatable Tubular Structure) and rear head airbags prevent injuries in the head and neck area.

All side airbags, ITS and rear head airbags are controlled separately on the left-hand and right-hand sides of the vehicle.

In the event of a side impact collision, all side airbags, ITS and head airbag are triggered simultaneously on the side facing the source of impact.

For triggering the airbags on the passenger side in the event of a side impact, the following information applies:

- **System MRS3, supplier - Temic:** The airbags (side airbag, ITS, head airbag) are triggered regardless of whether the passenger seat is occupied.
- **System MRS3, supplied by Bosch and MRS4:** The side airbags are not triggered if the passenger seat is unoccupied.

Belt tensioner

The task of the belt tensioners is to take up slack in the seat belt and hold the body securely in the seat in the event of a collision. Within fractions of a second, the belt buckle is pulled back thereby simultaneously reducing any slack in both the lap and diagonal belts. and thus effectively preventing the body from slipping under the lap belt.

The belt tensioners are triggered both in the event of frontal impact as well as a rear-end collision if the triggering threshold for the belt tensioners is exceeded.

Safety battery terminal (battery isolation)

To reduce the risk of fire in the event of a frontal impact, the firing circuit for battery isolation is also activated when the airbag is triggered.

In this case, a gas generator (safety battery terminal) isolates the heavy-current lead (terminal 30) from the battery to the starter motor/alternator.

E46 4-cylinder model left-hand drive

Because no increased risk of fire can be ascertained when the battery is installed in the engine compartment, the safety battery terminal will be omitted as of March 2002 (03/2002) from all E46 LHD models with 4-cylinder engines.

The MRS in the workshop

CAUTION!

All work on the airbag must only be conducted with the battery disconnected!

Connect and disconnect control unit, sensors and inflator assemblies (gas generators) only with the battery disconnected!

The MRS control unit contains vehicle-specific data and must therefore be encoded before placing into operation!

Removal and installation in other vehicles is prohibited!