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## PASSIVE SAFETY SYSTEMS

# INTRODUCTION

PASSIVE SAFETY is a multifaceted concept that deals with the protection of the driver and passengers of the vehicle and minimizing the damage to the vehicle once it is involved in a collision.

The foundation for the passive safety of the vehicle is the passenger cell which retains a stable shape when the vehicle is involved in an accident. This, coupled with the door anchoring system and crumple zones, serves to provide the best protection possible for the vehicle's occupants.

The use of the passenger restraint (three point seat belts) systems and airbags further enhance this safety cage concept providing the driver and passengers with additional protection during impacts or collisions.

BMW introduced the driver's side air bag in 1985 on the E23 7-Series. The E24 received the driver's side airbag in 1986. The Driver's airbag continued with the introduction of the E32 - 7 series introduced in Model Year 1988.

The Driver's side airbag was made standard equipment on all models starting with the 1990 model year. The passenger's front airbag was added to the 7 and 8 Series vehicles beginning with model year 1993.

The Central "Airbag" system ZAE was introduced in model year 1994 on the 3, 5 and 8 Series vehicles. This system carried over to the E38 7 series with its introduction

The "Multiple Restraint System" MRS was introduced on the 1997 model year E39 and E38s as of 3/96 production. The MRS II followed beginning with 5/97 production E38s

## Safety precautions when working with airbag circuits

- Work on the components of the airbag system must always be carried out with the battery disconnected. Disconnect and cover the negative terminal of the battery. Before disconnecting any airbag it is essential to wait the recommended time:
    - 30 minutes for vehicles up to 9/93
    - 10 seconds for vehicles from 9/93
- Components of the airbag system should only be checked when properly mounted and only using the measurement system of the DIS/MoDiC or a high quality, low impedance multi-meter.
- Always disconnect the negative terminal of the battery when performing any welding or body work on the vehicle.
- When removing airbags temporarily they should be stored in the trunk, face-up, with the trunk lid closed.
- Components of the airbag system that have been dropped from more than 18 inches should not be installed in the vehicle.
- Never treat airbag components or connectors with cleaning agents or conductive grease.
- Airbags must not be thrown into the trash, but must be properly disposed of according to local regulations for hazardous materials. Airbags returned to BMW must be shipped back in the original packaging of the replacement part.
- Always dis-arm mechanical seat belt tensioners before working on a seat or removing/installing the tensioners. Do not forget to re-arm when finished.
- Always follow safety precautions in the TIS repair manual instructions.

## MULTIPLE RESTRAINT SYSTEM III (MRS III)

## Model: E36/7, E38, E39, E46, E52, E53

## Production Date: E36/7: from 4/99
E38/E39: from 3/99
E46 sedan: from 9/99
All others from start of production.

**Objectives:**

After completing this module you should be able to:

- Describe the components used in the MRS III system.
- Explain the method used by the MRS III to provide three deployment speeds for the front airbags.
- Describe how the Fuel pump shut-off request is delivered.
- Review the service procedures necessary when replacing the control module.

## Purpose of the System:

The MRS III is a passive safety system that is designed to provide the maximum amount of driver and occupant protection in the event that the vehicle is involved in a collision. The system is designed to activate only the necessary components for protection based on:

- The severity of the impact.
- The number and positioning of the passengers.
- The direction from which the impact occurs.

The protection is provided by inflated air bags and tubes as well as seat belt tensioning devices.

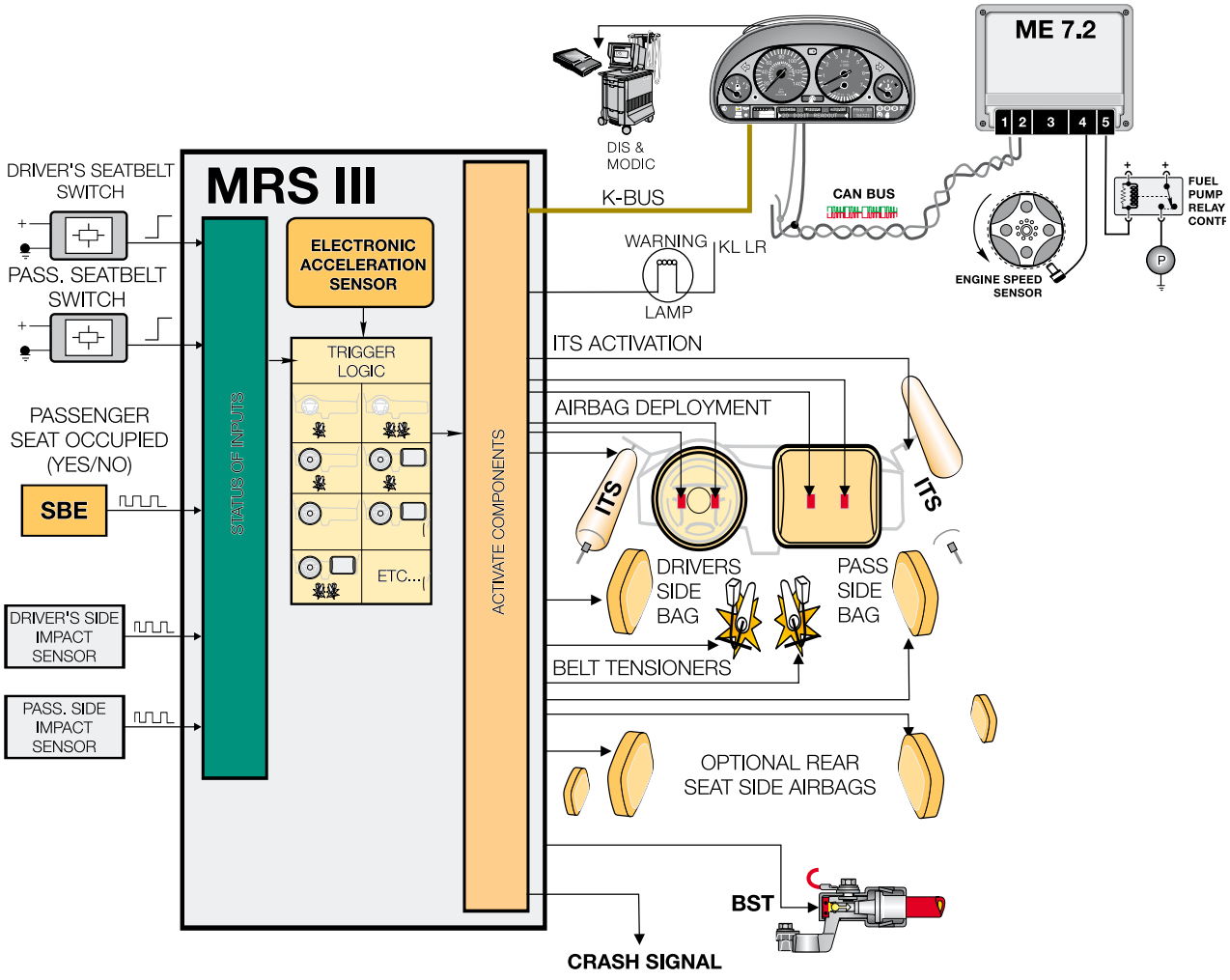
The Multiple Restraint System (MRS III) employs the use of “SMART” technology. Smart technology refers to the control module’s programming which allows for the deployment of the airbags, in stages depending on the severity of the impact. Two stage airbags are used for both the driver and front passenger which allows for a softer cushioning effect when the bags are triggered at lighter impacts.

In addition to the front air bags, the MRS III incorporates the following restraint/safety devices:

- Front door side impact (thorax) air bags.
- Head protection air bags (ITS).
- Rear door side impact (thorax) air bags - optional.
- Front pyrotechnic seat belt tensioners.
- Battery safety terminal (BST).
- Fuel pump cut off message.

MRS III control modules are manufactured by either Bosch or Temic. While the functional operation of both modules are the same. The control modules are not interchangeable from a replacement standpoint.

# MRS III I.P.O.


DIS & MODIC
ME 7.2
1 2 3 4 5
K-BUS
CAN BUS
WARNING LAMP
KL LR
ENGINE SPEED SENSOR
FUEL PUMP RELAY CONTR
DRIVER'S SEATBELT SWITCH
PASS. SEATBELT SWITCH
PASSENGER SEAT OCCUPIED (YES/NO)
SBE
DRIVER'S SIDE IMPACT SENSOR
PASS. SIDE IMPACT SENSOR
MRS III
STATUS OF INPUTS
ELECTRONIC ACCELERATION SENSOR
TRIGGER LOGIC
ETC...
ACTIVATE COMPONENTS
ITS ACTIVATION
AIRBAG DEPLOYMENT
ITS
ITS
DRIVERS SIDE BAG
PASS SIDE BAG
BELT TENSIONERS
OPTIONAL REAR SEAT SIDE AIRBAGS
BST
CRASH SIGNAL

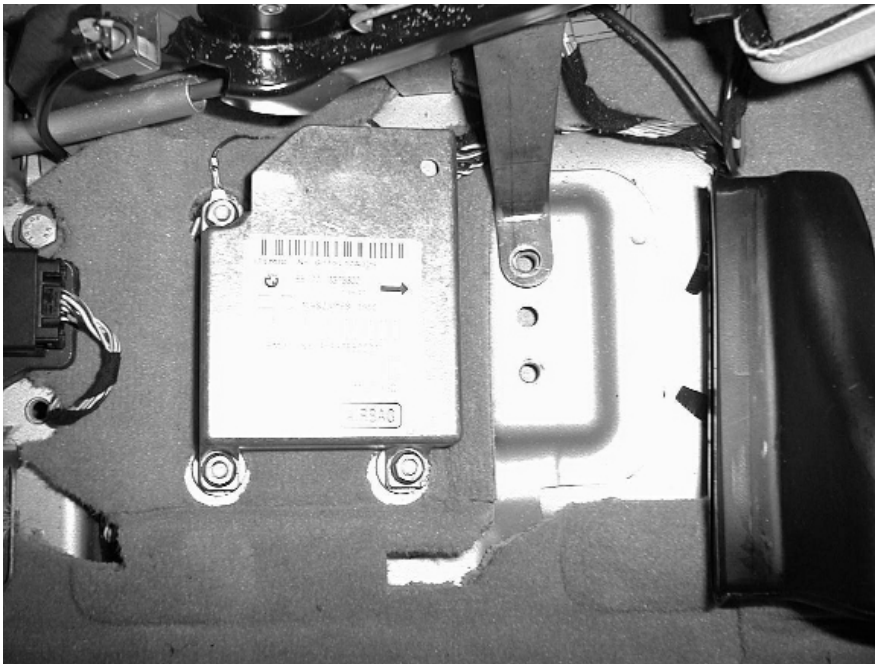
## COMPONENTS

### MRS III Control module

The control module is mounted in the center of the vehicle on the driveshaft tunnel below the center console. The control module contains the processing electronics (Smart Technology) for triggering of all air bags and pyrotechnic devices installed in the vehicle. Two electronic deceleration sensors are installed in the module for crash or impact detection.

The system is recognized by the 50 pin connector on the control module. There are two manufactures of MRS III systems: Bosch and Temic.  Definitive verification of the installed system is carried out through the identification pages of the diagnostic testers.

The MRS III is connected to the K-bus (except Z3).

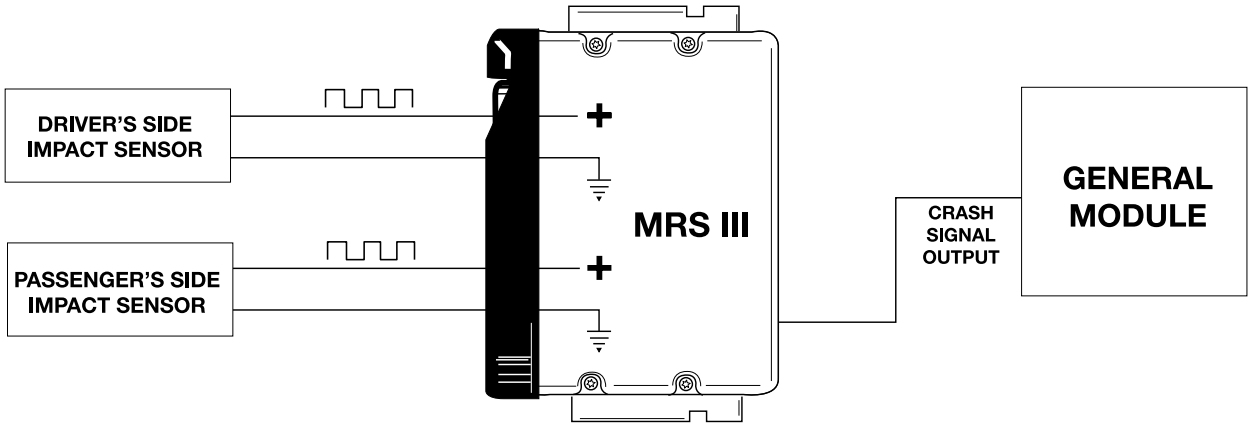


## Satellite Sensors

The satellite sensors are mounted below the driver's and passenger's front seats on the vehicle floor pan . The function of the sensors is to detect the severity of side impacts and signal the MRS III control module, through a pulse modulated signal, in the event of a crash. The control module uses this input signal along with its internal impact sensor signal to determine the deployment of the side/head airbags.


The satellite sensors of the MRS III use only two wires over the previous three wire sensors of the MRS II. The signal is received by the MRS III control unit over the reference voltage supply wire.

As with the control modules, the satellite sensors are manufacturer specific. The Temic sensors will not interchange with the Bosch sensors.

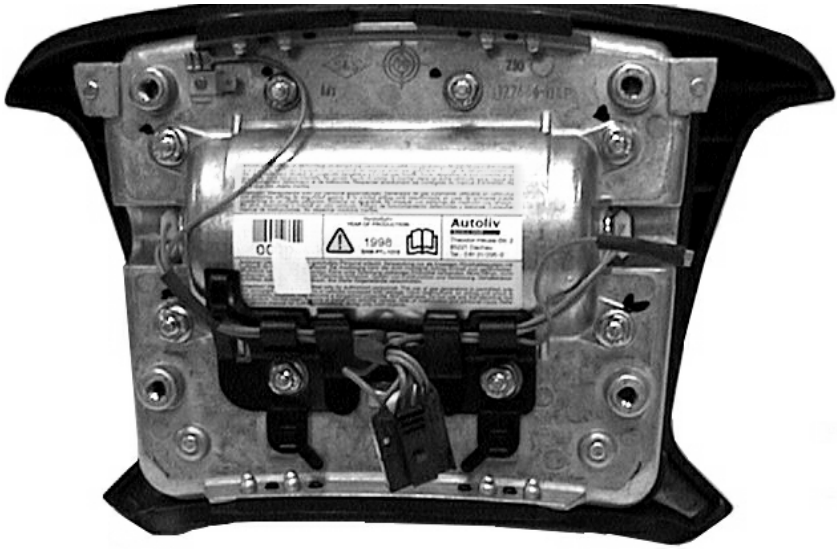


## Driver's front air bag

The driver's front airbag is a two stage bag similar to the passenger's front side bag, introduced on the 1999 model E38/E39s. The complete assembly is mounted beneath the cover in the center of the steering wheel as with previous airbags. The assembly contains the inert gas generator chamber and two ignition stages (ignitors).

**The airbag consists of:**

- Accumulator/gas generator
- Two ignition capsules
- Propellant gas - 13.5% Hydrogen/86.5% Oxygen

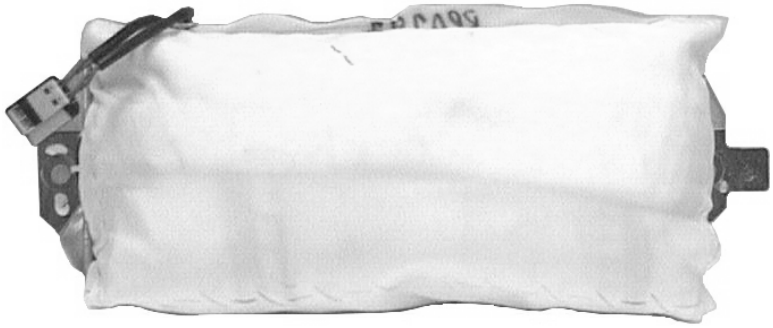


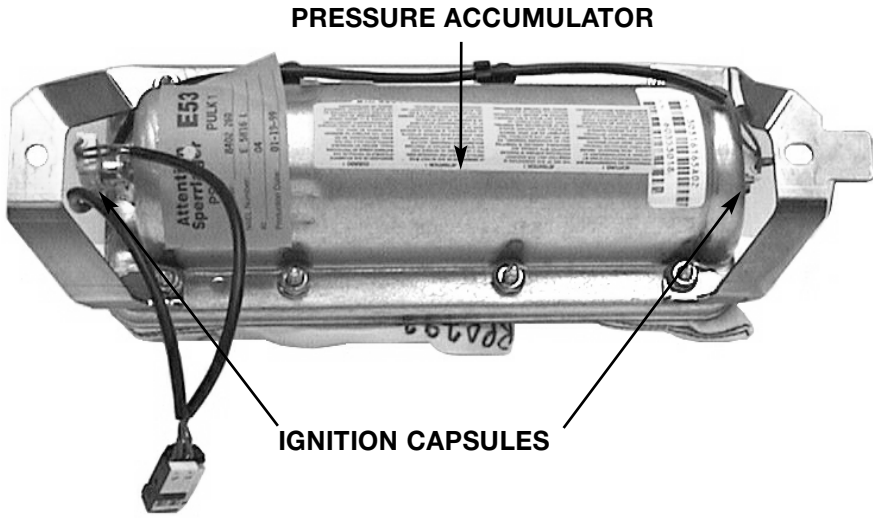
## Passenger's front air bag

The passenger's front airbag is mounted in the dashboard above the glove box.

**The airbag consists of:**

- Pressure accumulator/gas generator
- Two ignition capsules - for two stage activation
- Propellant gas  of - 13.5% hydrogen/86.5% oxygen



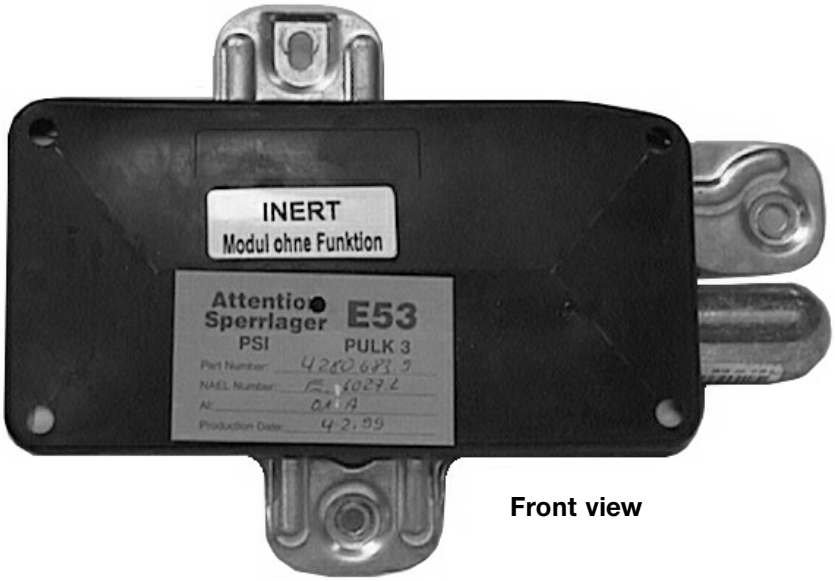


## Side air bags front and rear (thorax)

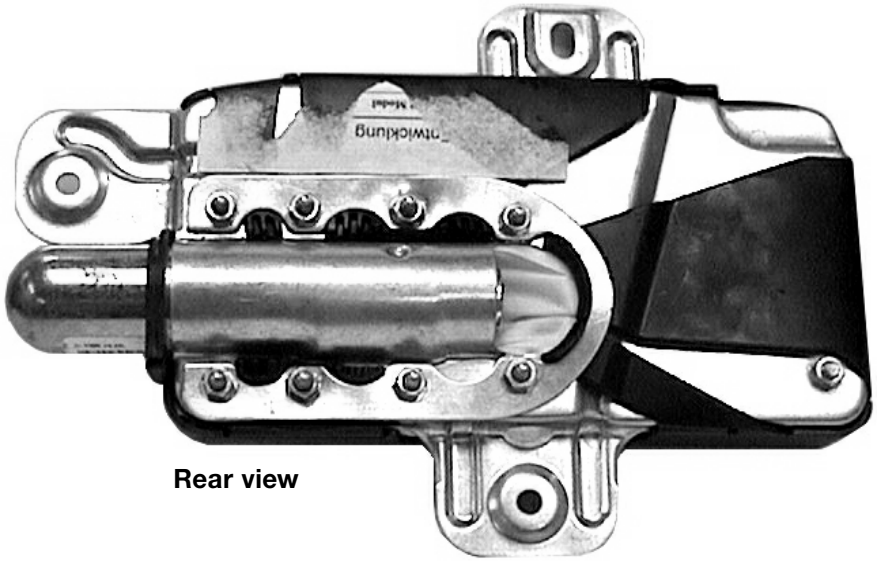
The side airbags are mounted on the inner door frame of the front and rear doors. Deployment of the side airbags is dependent on the triggering thresholds programmed in the MRS III control module and based on the inputs from the satellite sensors and internal crash sensors.

The side airbags use the same cold gas inflation method as the driver's and passenger's front bags.

Rear side airbags arrive de-activated from the factory and can only be enabled upon written customer request.  This is designed to prevent a risk of injury to small children who may be sitting out of position and too close to an airbag in the back seat.



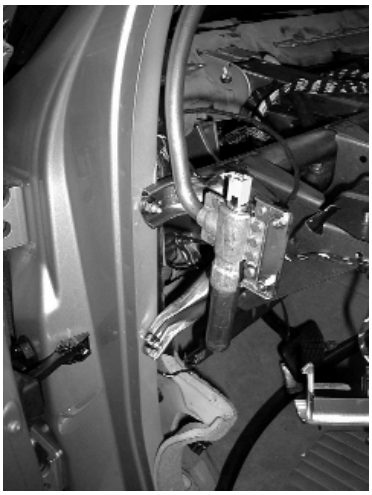

**Front view**



**Rear view**

## Front Head protection air bags (Inflatable Tubular Structure. ITS)

The head airbags are similar to the ITS bags used on the MRS II system. They are mounted from the “A” pillar up along the headliner and are anchored behind the “B” pillar. The ITS bags of the MRS III system are the cold gas inflation type. The head protection airbags are always triggered along with the front side (thorax) bags.

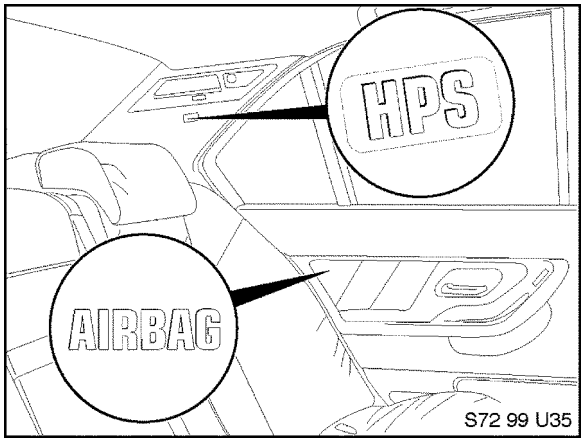


## E38 and E39 Rear Head Protection System

Rear Head protection is available on E38 and E39 sedans ordered with optional rear side airbags.

The airbags are a cushion (not an ITS) that is deployed from behind the C-pillar trim. The HPS will not be de-activated along with the side airbags from the factory since there is no danger to small children sitting out of position.

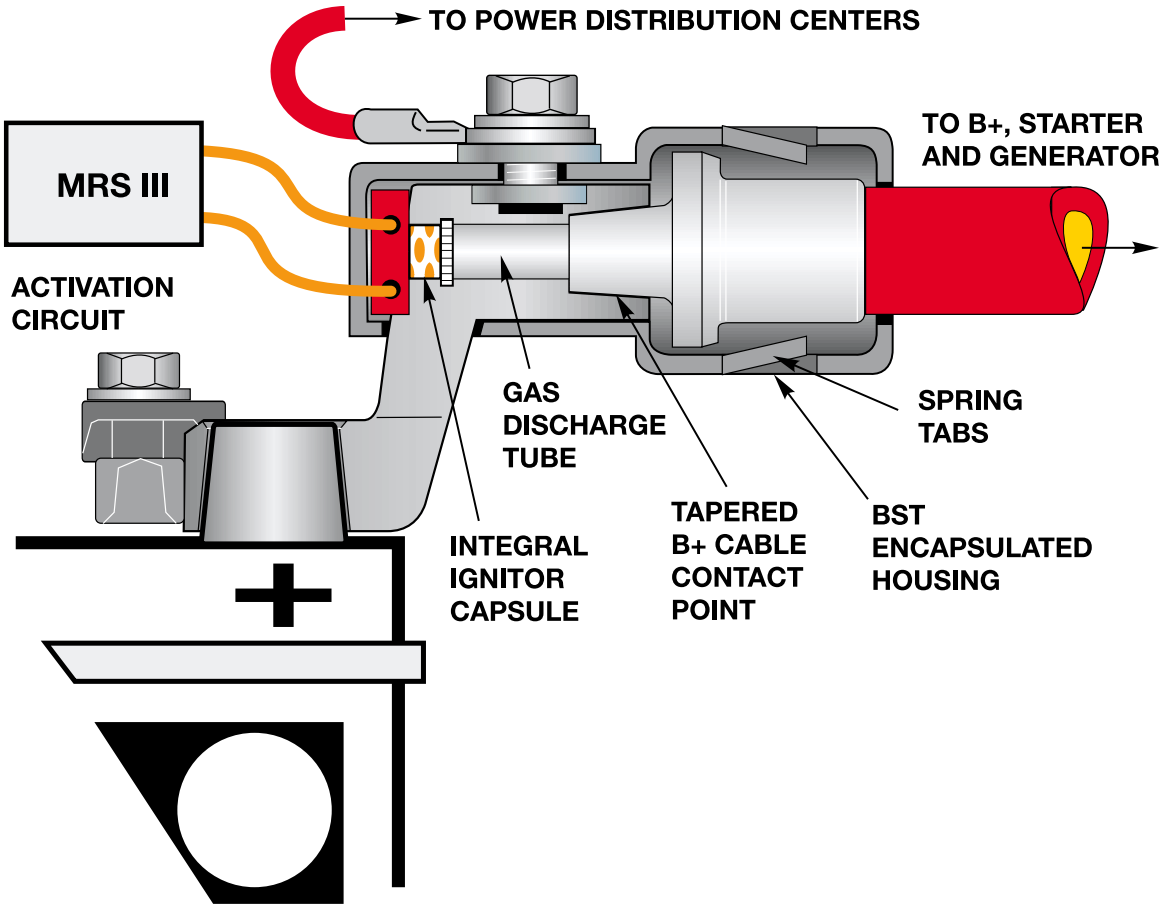
A vehicle with rear HPS can be identified by observing “HPS” embossed in the C-pillar cover.



## Battery Safety Terminal (BST)

The BST is used to disconnect the battery connection to the starter,  alternator and charging post in the event of a collision. This safety measure helps prevents the possibility of a short circuit in the engine compartment causing a fire.

The battery connection to the power distribution box and body electronics is un-affected.

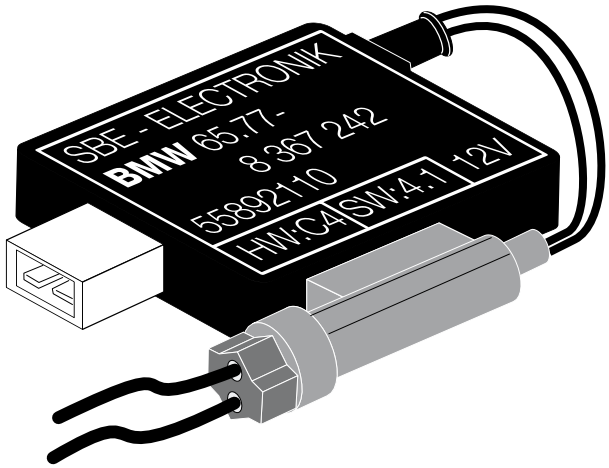


## Seat Belt Tensioners

The seat belt tensioners also make use of the inert gas for triggering. The MRS III control module will deploy the seat belt tensioners based on the programmed parameters during a collision.

## Seat Occupancy Sensor (SBE)

The SBE is used as an input to the MRS III control module for detection of a passenger in the right front seat. The MRS III uses the input to determine seat belt tensioner and/or front airbag deployment thresholds.



## MRS III Principle of Operation

As with previous MRS systems, the triggering thresholds are programmed in the MRS III control module. These thresholds are determined by BMW through crash and vehicle testing during the design and development of the vehicle. These thresholds will vary depending on the vehicle type.

There are several different thresholds for airbag and safety restraint deployment:

- Belt pre-tensioner threshold for activation of the seat belt tensioners.
- Airbag threshold #1 - the first level of activation for the two stage front airbags, always deployed first when the front triggering threshold is reached.
- Airbag threshold #2 - the second level of the two stage front airbags, can be deployed simultaneously or after a time delay, depending on the severity of the impact.
- Rear crash threshold - for activation of the seatbelt tensioners with a rear impact.
- Battery safety terminal threshold - for activation of the BST with airbag deployment.
- Side airbag/ITS threshold - for deployment of the side and thorax airbags.

## Triggering Thresholds For The Two-Stage Front Air Bags

The programming of the MRS III includes four triggering thresholds for the two-stage front airbags. The triggering of the front airbags is also dependent on whether the seat belts are used and if the front passenger seat is detected as occupied. The triggering thresholds for the two stage airbags are as follows:

| THRESHOLD | NO-SEATBELT | BELTED |
|---|---|---|
| 1 | Ignition Stage 1 | No Activation |
| 2 | Ignition Stage 1 & 2 with Time Delay | Ignition Stage 1 |
| 3 | Ignition Stage 1 & 2 with Time Delay | Ignition Stage 1 & 2 with Time Delay |
| 4 | Ignition Stage 1 & 2 Simultaneously | Ignition Stage 1 & 2 Simultaneously |

If the SBE is faulted when a triggering occurs, the MRS III will react as if the seat is occupied.

If the signal from the seat belt contacts are defective, the MRS III will deploy as if the belts were not buckled.

## Triggering Thresholds For The Remaining Safety Devices

### Side Airbags and Head Protection

The triggering thresholds for the side and head protection airbags is dependent on the signals from the satellite sensors and the crash sensors in the MRS III control module. The triggering thresholds are independent of the thresholds for the belt tensioners.

### Seat Belt Tensioners

The triggering of the seat belt tensioners is dependent on the signal from the seat belt contact and the severity of the impact as detected by the control module.

### Battery Safety Terminal

The BST will deploy in a frontal impact at threshold 2 or greater. The threshold for BST activation with a side impact is programmed separately in the side deployment criteria. The BST will also be deployed if a rear impact threshold is exceeded.

### Fuel Pump Shut-Off Request

The MRS III system is linked via the K-Bus/CAN Bus to the DME for deactivation of the fuel pump. The MRS III will signal the DME via the K-Bus through the instrument cluster and CAN Bus to shut off the fuel pump in the event that any crash threshold is exceeded.

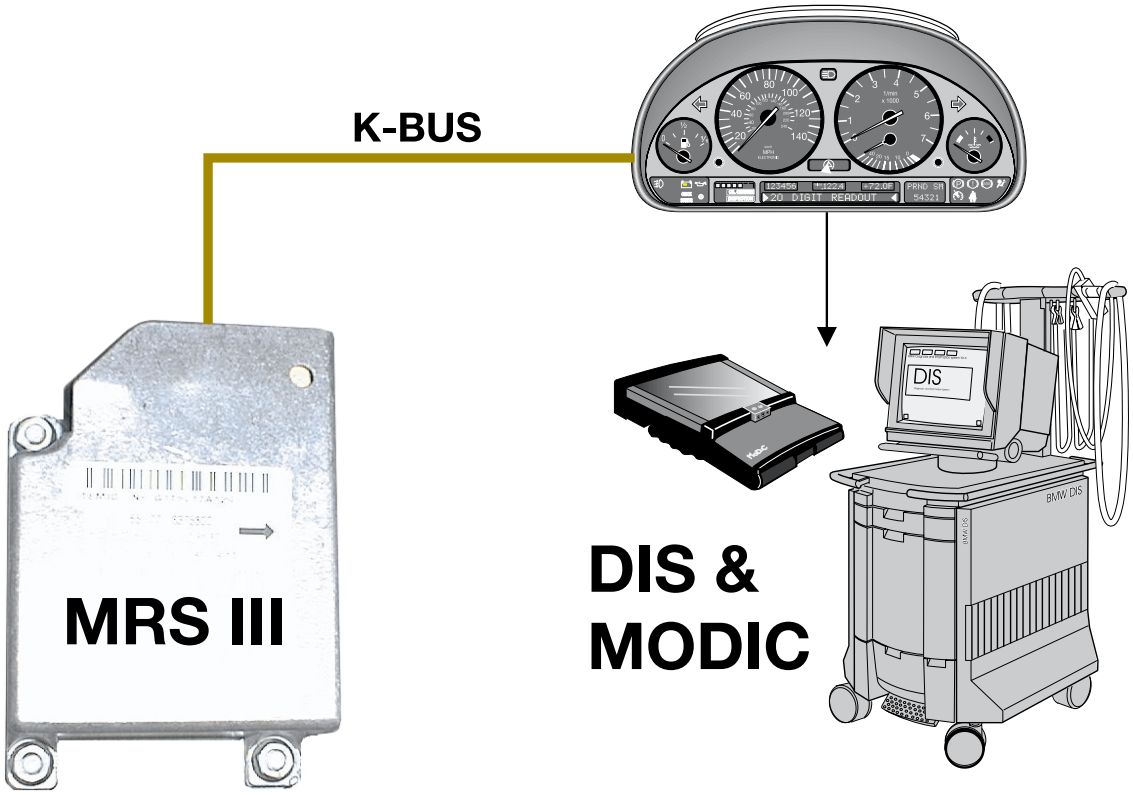
## Diagnosis

Diagnosis and troubleshooting of the MRS III system is fault driven and can be accessed using the DIS Tester or MoDiC. The control module performs a self test of the system every time the ignition is switched on ( this includes the satellite sensors and seat occupancy sensor). Any faults with the system will cause the warning lamp in the instrument cluster to remain illuminated after the engine is started.

Installation of a new or replacement  control module requires ZCS coding also using the DIS or MoDiC.

When servicing or replacing any MRS III components, always follow precautionary measures outlined in the repair manual of TIS. this includes disconnecting the battery prior to any repair or maintenance work being performed.

All airbag  components are part number specific by model and require verification in the EPC to ensure the correct component is being installed.



## MULTIPLE RESTRAINT SYSTEM (MRS & MRS II)

## Model: E36, E36/7, E38, E39, E46

## Production Date: MRS:

**E36: from 1/97 to production end**
**E36/7: from 9/97 to 8/98**
**E38: from 9/96 to 4/97**
**E39: from 9/96 to 8/97**

**MRS II:**
**E36/7: from 9/98 to 3/99,**
**E38: from 5/97 to 2/99,**
**E39: from 9/97 to 3/99,**
**E46 sedan: from start of production to 8/99.**

**Objectives**

After completing this module you should be able to:

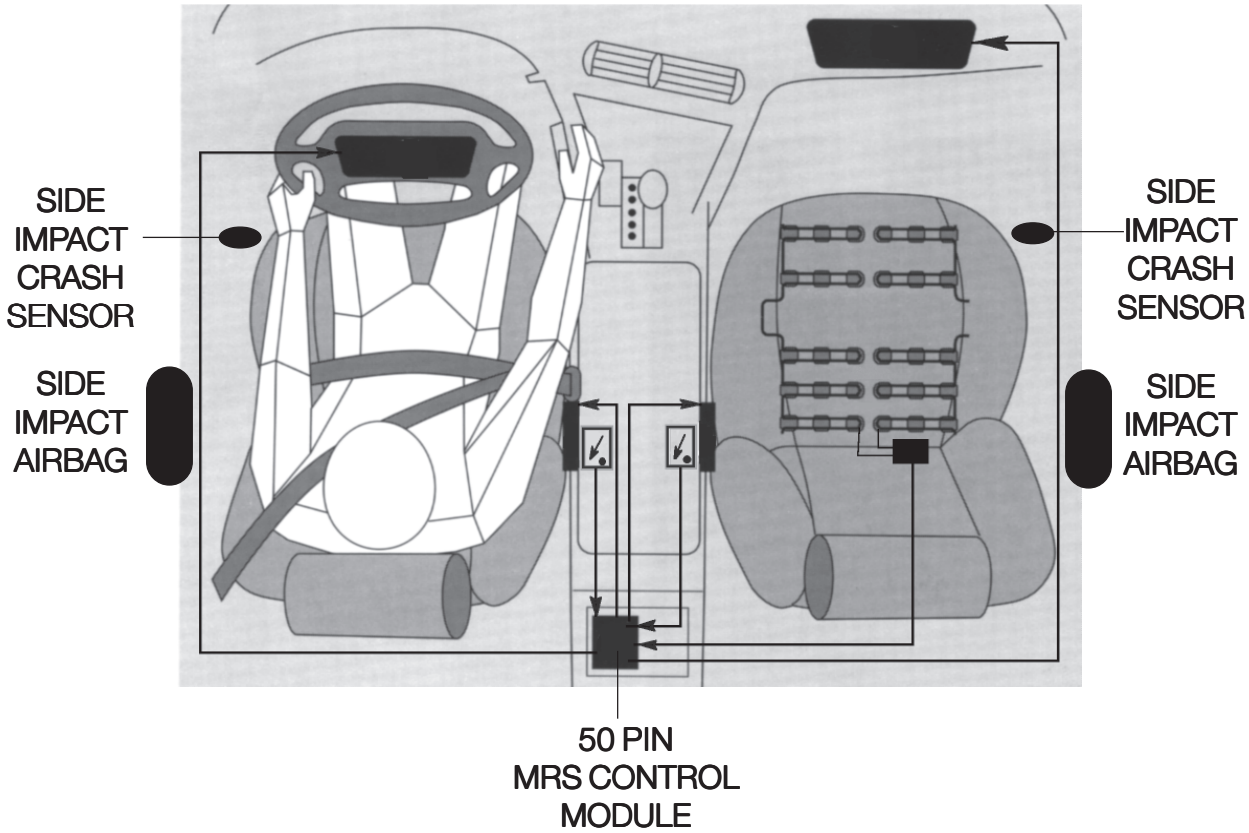
- Describe the components used in the MRS/MRS II system.
- Explain the operation of the ITS.
- Understand the function of the BST.
- Understand how to replace a deployed BST.

# MULTIPLE RESTRAINT SYSTEM (MRS & MRS II)

## OVERVIEW

The MRS was introduced for the 1996 - E38 and 1997 model year E39. The MRS II was introduced on E38s (5/97 production) and the E39 from start of production (9/97). The MRS and MRS II include the following restraint/safety components:

- Driver and passenger front airbags (MRS/MRS II)
- Side impact (Thorax) airbags for the driver and front passenger (MRS/MRS II)
- Side impact crash sensors left/right (MRS/MRS II)
- Side impact (Thorax) airbags for the rear passengers (MRS II)
- Head Protection System (HPS) for the driver and front passenger (MRS II)
- Battery Safety Terminal - BST (MRS II)
- Hall Sensor seat belt switches (MRS II)



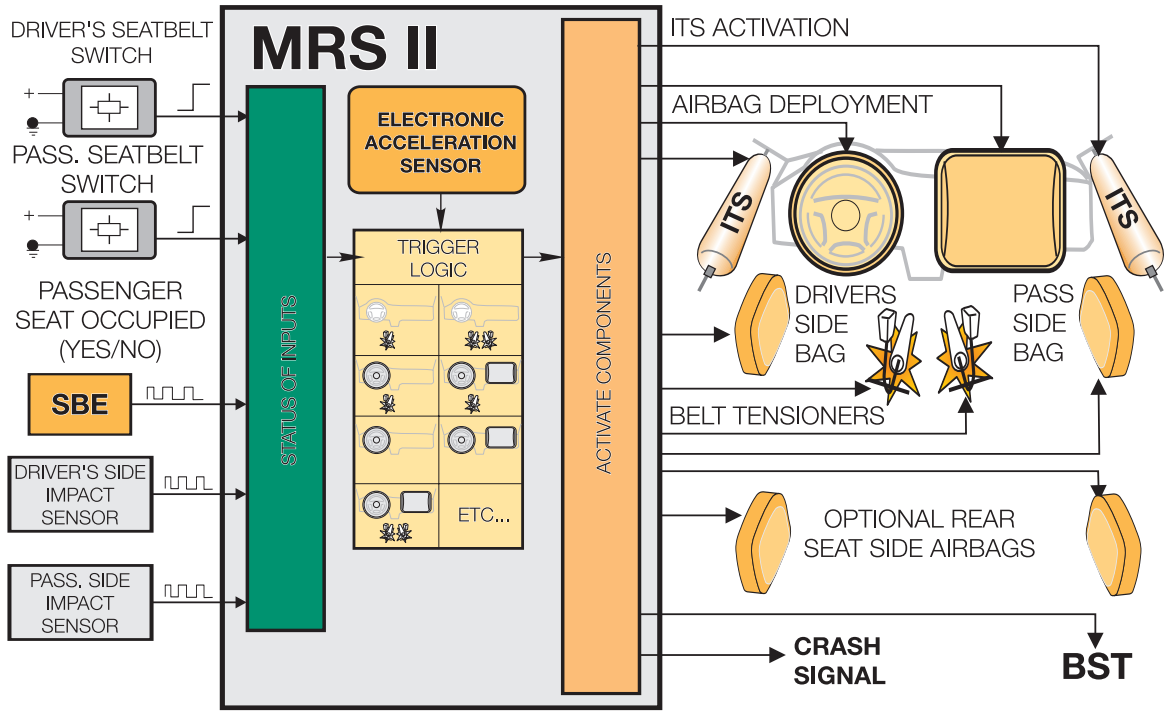
# MRS/MRS II COMPONENTS

## CONTROL MODULE

The control module is located along the center line of the vehicle, generally in the area of the center console depending on model and year. It contains the following circuitry:

- Electronic acceleration sensor for crash detection
- Processing electronics/final stages for airbag activation
- Self diagnostics for self test and system monitoring
- Internal mechanical safety switch - must close in conjunction with acceleration sensor before airbag activation

Replacement control modules must be coded when installed in the vehicle using the DIS tester or MoDiC.

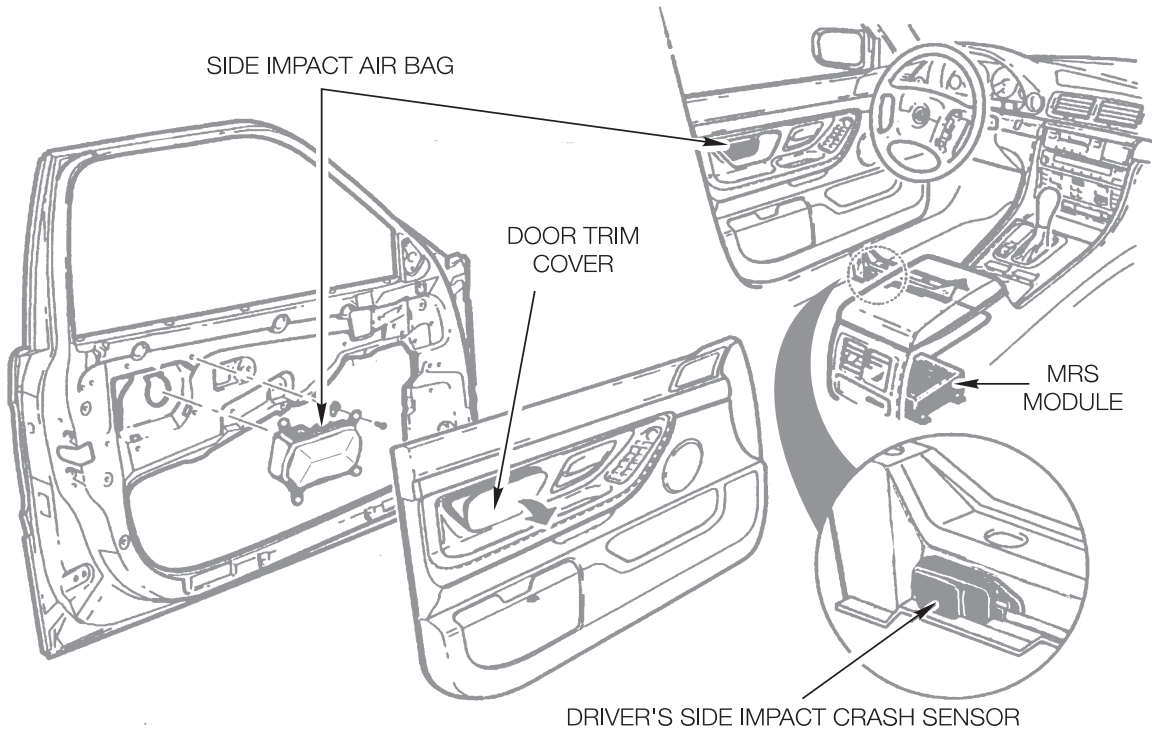


## FRONT PASSENGER AIR BAG ASSEMBLY

The front airbag is designed to protect the head and upper part of the body in the event of a frontal impact. The assemblies consist of a gas generator, ignition pill and the folded airbag.

## SIDE AIR BAG ASSEMBLY (FRONT/REAR)

The side airbag is designed to protect the upper part of the body (chest/thorax) in the event of a side impact. The assembly consists of a gas generator, ignition pill and folded airbag. The assembly is bolted to the inner door panel and the trim cover incorporates a break away airbag cover.



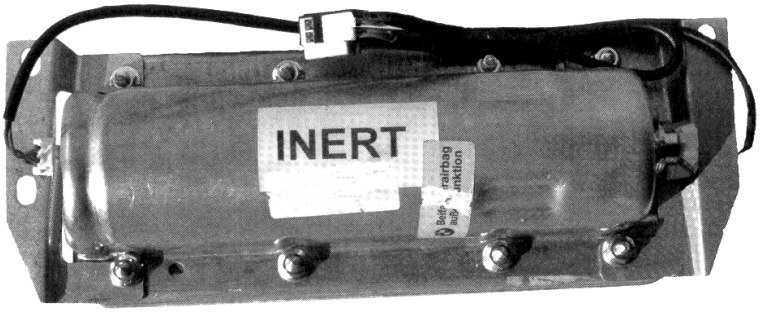
# 2-STAGE PASSENGER AIRBAG

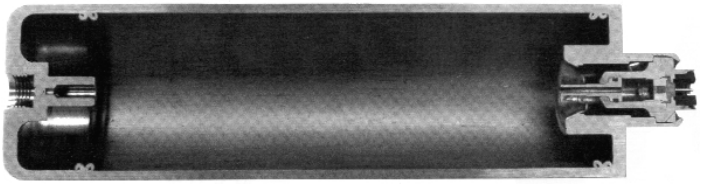
The E38 and E39 received the 2-stage airbag system as of 9/98 production..

The passenger's airbag is the only modification to the system. The remainder of the MRS II systems are carried over from the 1998 models. The system was modified as follows:

- New pressure accumulator generator
- New airbag - volume of 105 liters
- Two ignition capsules - for two stage activation
- Propellant gas made from 13.5% hydrogen and 86.5% oxygen
- Deployed units can be disposed of as scrap metal

The use of two ignition stages, coupled with the lower volume and new propellant, optimizes the deployment of the airbag and makes it less aggressive when the airbag inflates.



The main component is the gas generator which mounts below the airbag on the passenger's side of the dashboard. The gas generator consists of a pressure chamber with an ignition set at each end. A hose connects the airbag with the pressure chamber.

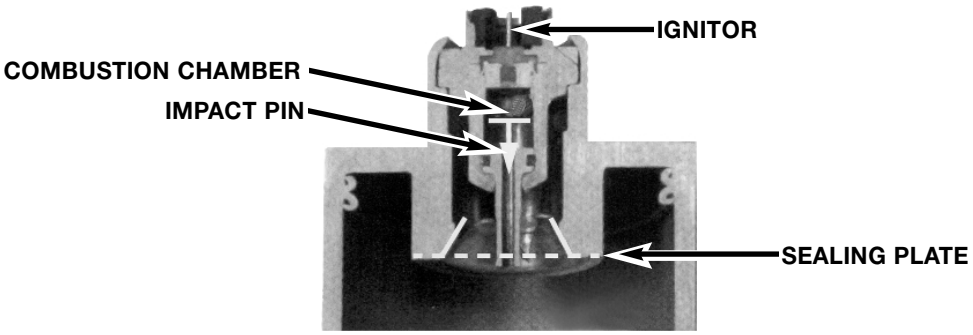
## PRESSURE CHAMBER

The propellant charge in the chamber is a mixture of approximately 13.5% Hydrogen and 86.5% Oxygen under pressure.

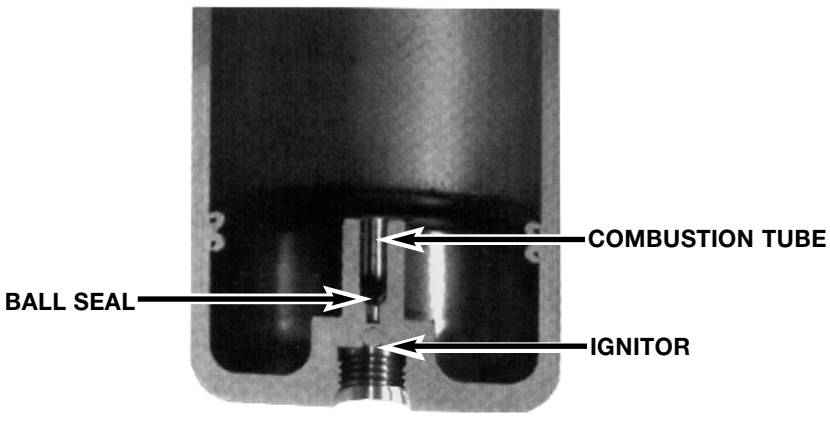
## IGNITION STAGE ONE

The main ignition capsule  consists of the ignitor, combustion chamber, the impact pin and the sealing plate.

## IGNITION STAGE TWO




The second ignition capsule consists of an ignitor, ball seal and combustion tube.



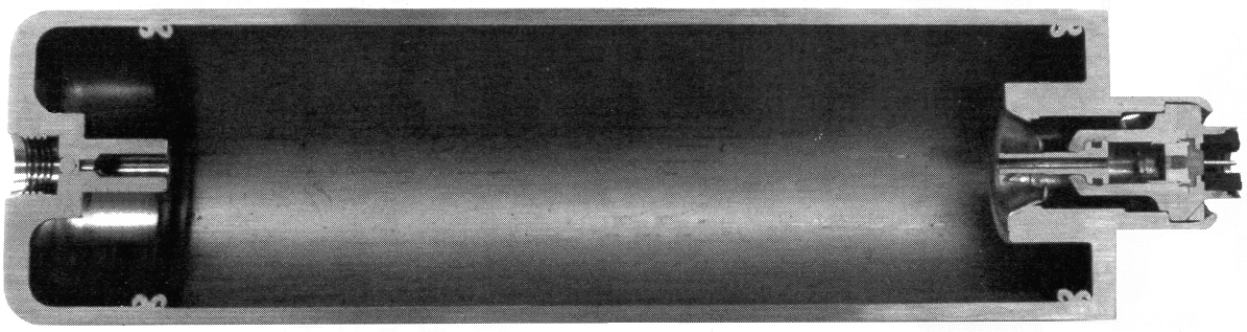
# AIRBAG ACTIVATION

Ignition stage one is always the first to be ignited during an impact. Ignition stage two is ignited after a time threshold that is programmed in the MRS II control module. The two stage activation is optimized by the airbag's inflation curve for each model.

When the ignition capsule is ignited, the impact pin is pushed against the sealing plate and the passageway for inflating the airbag is opened. The flame from the ignition capsule ignites the propellant gas and the expanding gas is forced through the tube into the airbag.

After the timed threshold, the second stage is ignited and the ball seal is forced off of its seat. The flame from the second stage ignites the propellant on the opposite side of the pressure chamber and causes further expansion of the gasses. This ensures that the required volume of gas is produced by the pressure chamber to fully inflate the airbag.

After inflation, the gasses (steam) are allowed to escape from the airbag as with previous generations.  The escaping gasses are not harmful to the passengers of the vehicle.

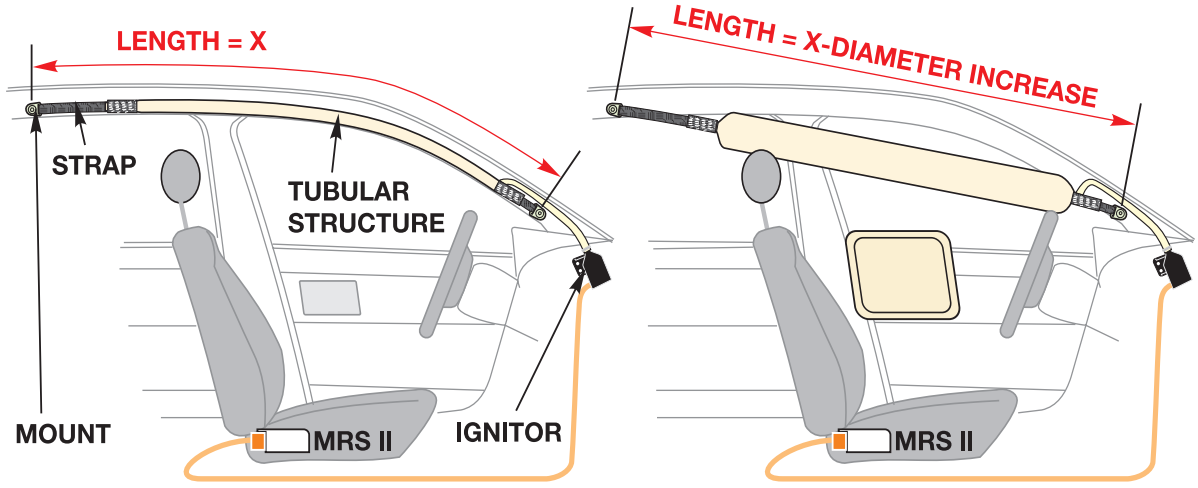


# HEAD AIRBAG ASSEMBLY (ITS)

The ITS is designed to protect the head in the event of a side impact. The assembly consists of a hermetically sealed rubber tube that is encased by a cross woven tubular nylon material, a gas generator and ignition pill.

The ITS is mounted from the “A” pillar , at the front, to the roof panel slightly behind the “B” pillar. The ignitor is mounted to the “A” pillar and is connected to the ITS through a reinforced sealed tube. The ITS is stored behind the roof panel trim over the front doors.

When triggered, the inflation charge causes the diameter of the tube to expand and its length to shorten. As the tube expands, it is forced out of the stored position and it drops over the side door glass to protect the occupants head against impact. The ITS remains fully inflated for several seconds after it is triggered due to the sealed expansion tube. This allows the ITS to continue to provide protection in the event of a secondary impact. The tube will deflate after the gas cools.



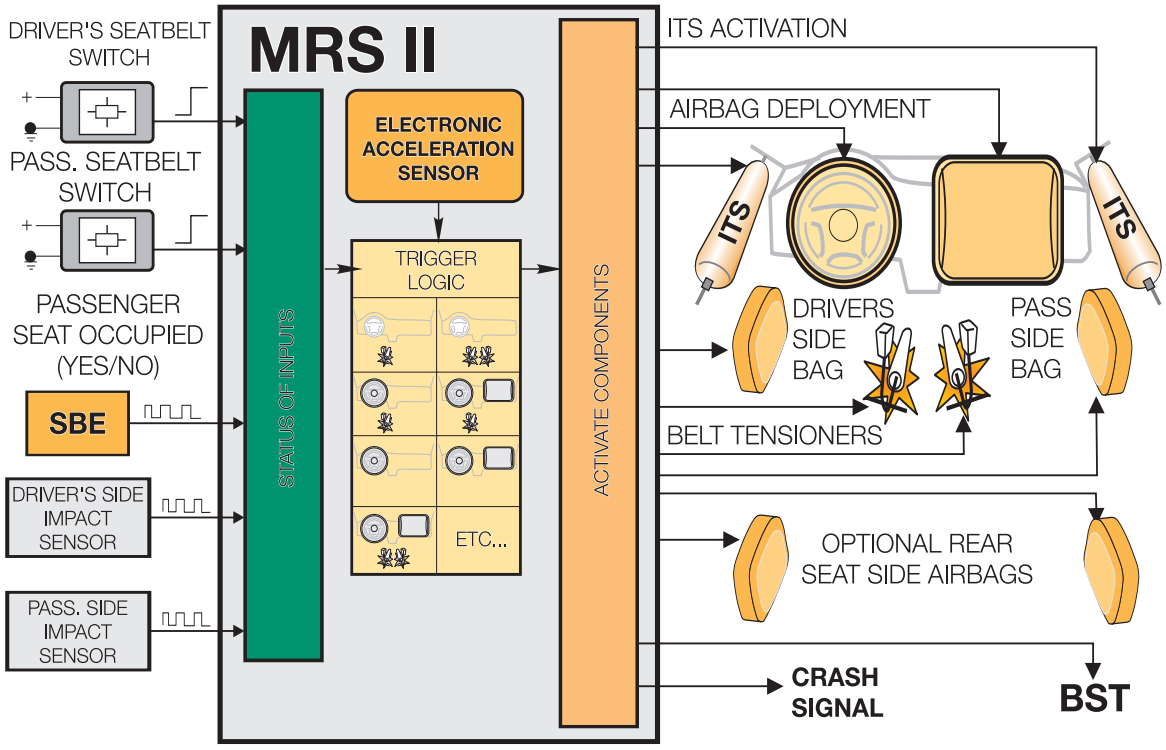

The expandable tube of the ITS is the same for all models. However the securing strap at the “B” pillar end is a different length for the different models. For this reason, the ITS is part number specific for each model and cannot be interchanged.

# BATTERY SAFETY TERMINAL (BST)

The BST is designed to disconnect the battery from the starter, generator and B+ terminal in the engine compartment during collisions. This passive safety component is designed to reduce the possibility of short circuits to ground occurring from these high amperage circuits.

However, other systems that require power to function during and after a crash continue to receive power from the positive battery post. These circuits include:

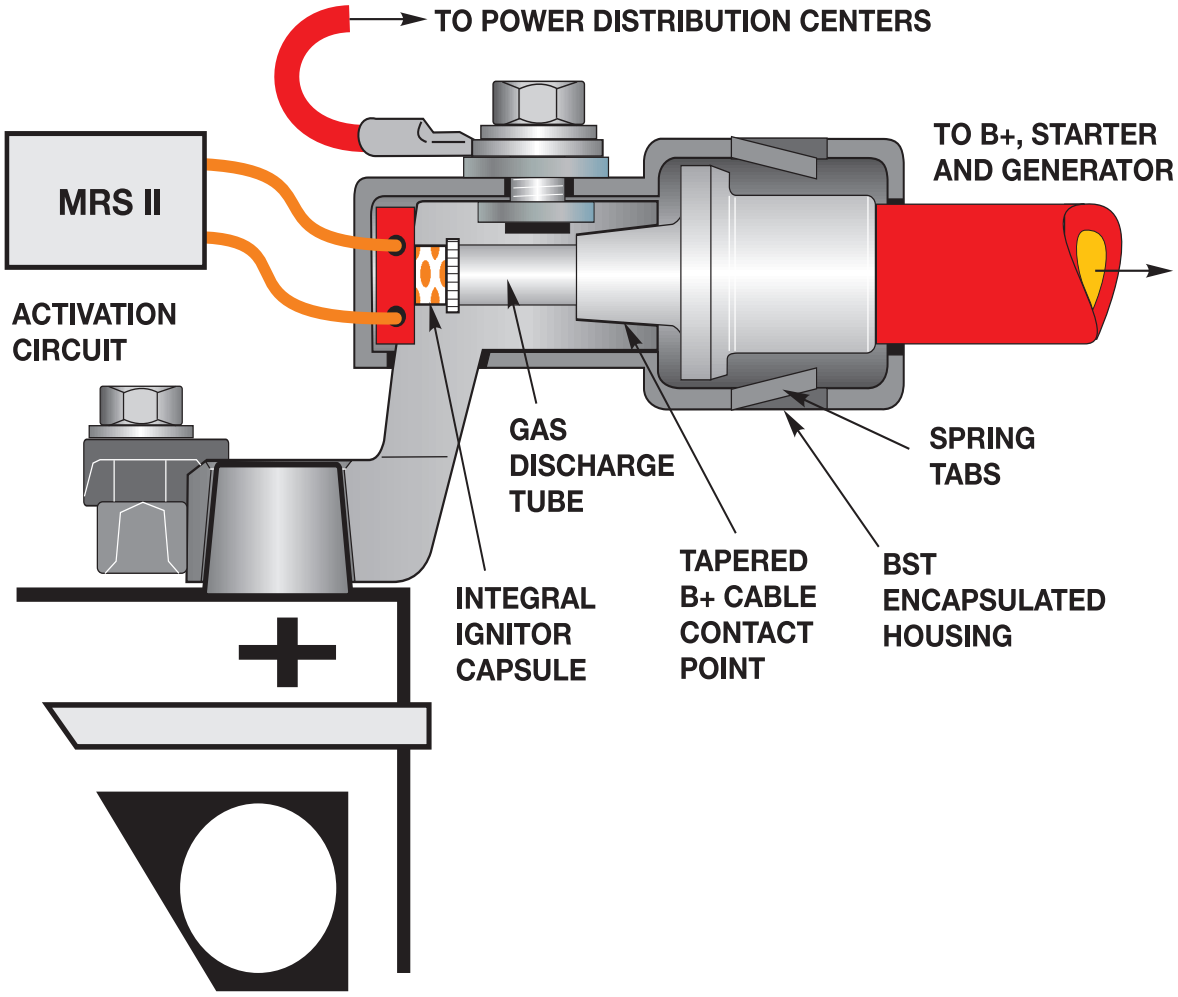
- ABS - provides continued operation if the vehicle is still in motion
- MRS II - remains operational for crash protection
- General Module - for unlocking the vehicle and interior light activation
- Lamp/Check module - for hazard warning light activation
- Telephone - provides communication after the crash
- Board Monitor - with navigation system for communication with Cross Country Group for assistance



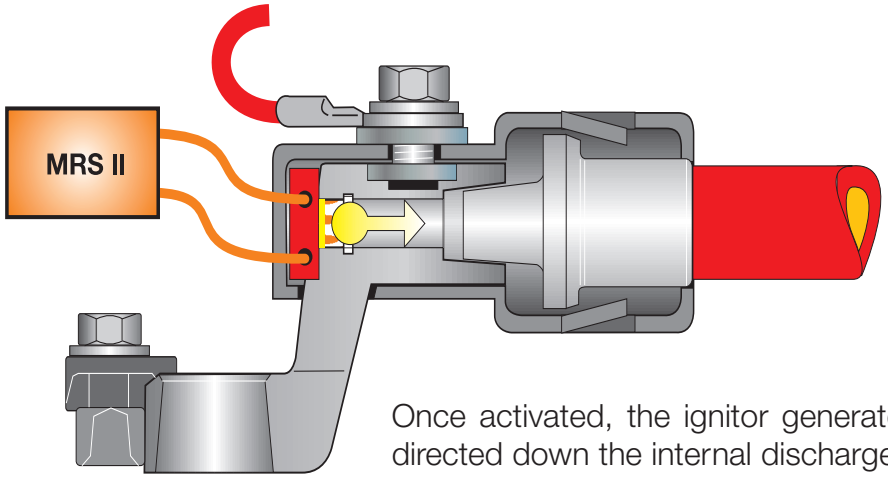
## BST CONSTRUCTION

The BST is an encapsulated pyrotechnic device that is similar to an airbag in operation. The BST contains an ignitor capsule and discharge tube that is mounted in front of the high amperage B+ cable. The B+ cable contains a tapered press fit contact that mounts behind the gas discharge tube.

During activation, the tapered B+ cable contact is forced away from the battery post and held away by spring tabs within the capsule.

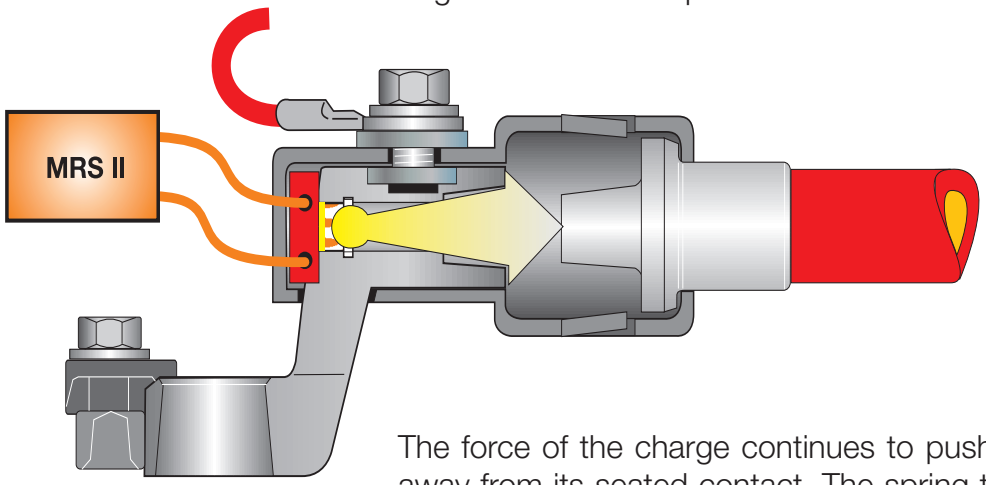


## BST ACTIVATION

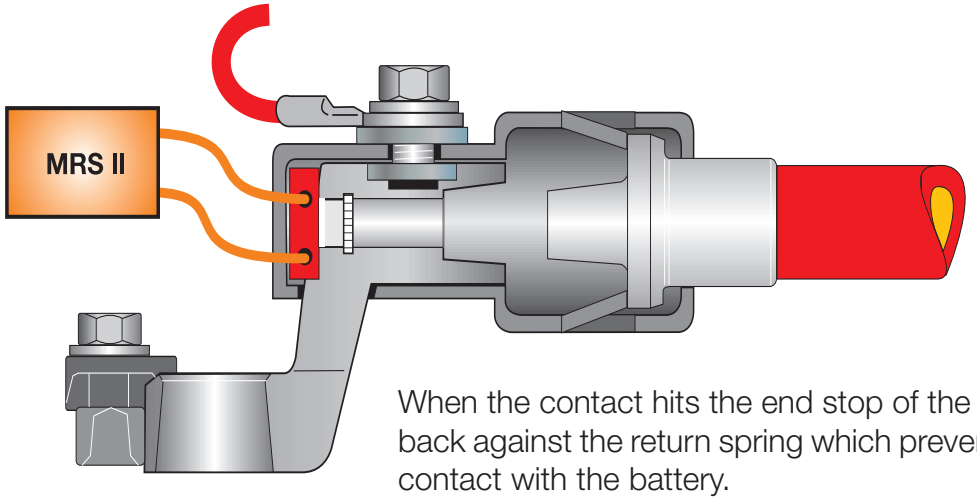



Once activated, the ignitor generates a gas charge which is directed down the internal discharge tube

This causes the tapered end of the B+ cable contact to dislodge from its seated position and immediately open the circuit.



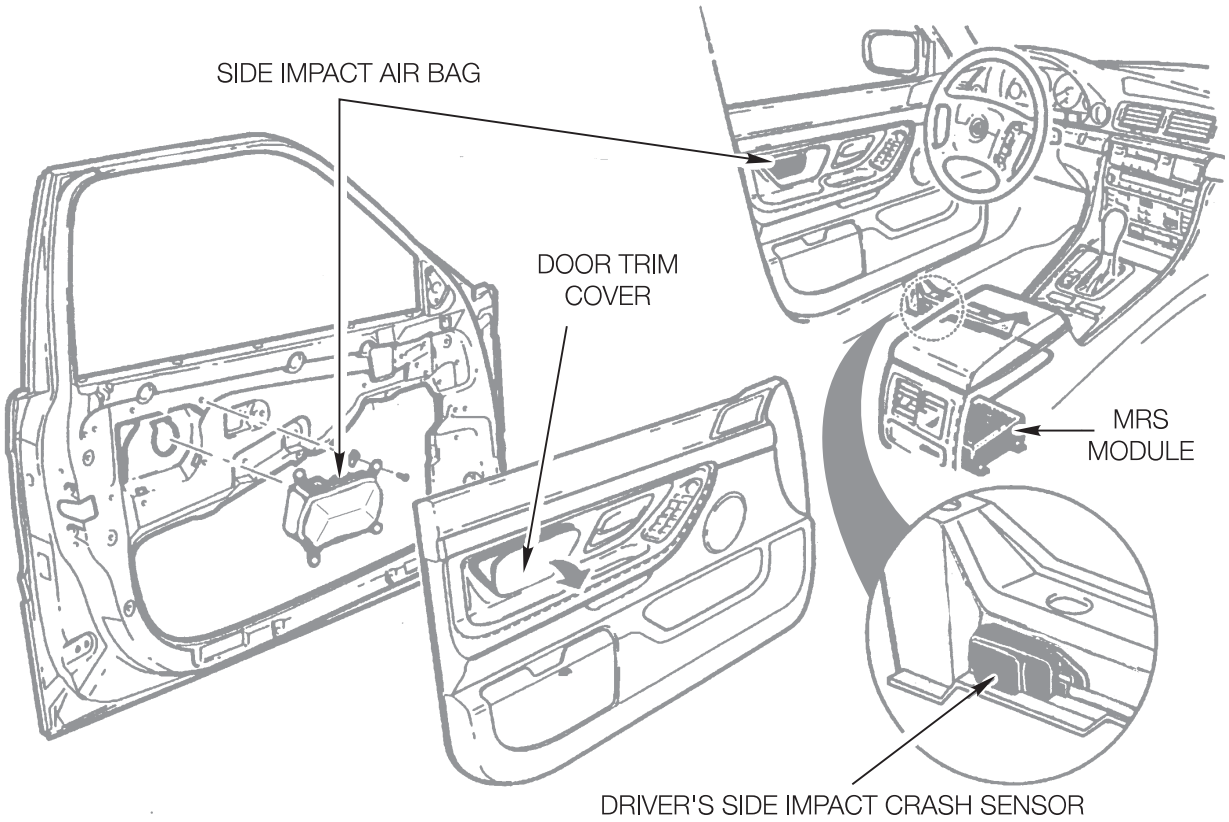

The force of the charge continues to push the cable contact away from its seated contact. The spring tabs of the housing are compresses as the contact pushes to the end of its travel.



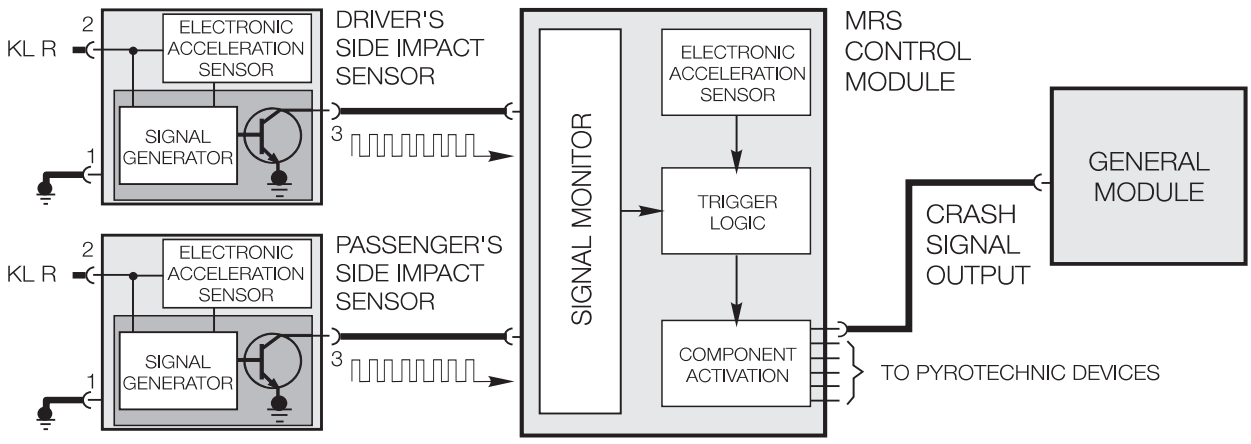

When the contact hits the end stop of the housing, it bounces back against the return spring which prevent it from closing the contact with the battery.

## SIDE IMPACT SENSORS

Electronic (piezoelectric) sensors are used for side impact detection. They are mounted at the left and right footwell cross members in front of the driver's and passenger's front seats. The sensors produce a pulse width modulated input signal to the MRS control module for side impact detection. The pulse width of the signal decreases in proportion to the severity of the impact.



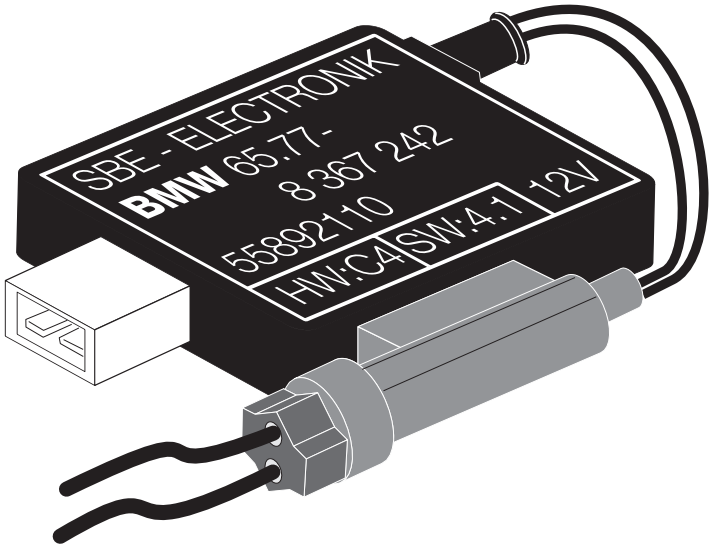

The control module uses the internal crash sensor as a plausibility check for deployment of the side impact and ITS airbags. Both sensors must detect that the trigger threshold has been exceeded before the bags will deploy.



## SEAT OCCUPANCY SENSOR (SBE)

An occupancy sensor pad is incorporated into the front passenger's seat cushion. The pad is a foil contact sensor that is open when the seat is not occupied. When the seat cushion is pressed by the weight of a passenger, the sensor circuit produces a resistance that varies with the weight and/or  movement.

This variable resistance signal is input to the Seat Occupancy Module (SBE). The SBE is a small signal converter module, mounted under the passenger's seat. It converts the analog signal, from the seat pad into a square wave modulated output signal that is sent to the MRS control module. The MRS control module uses this signal for air bag triggering in the event of a collision.

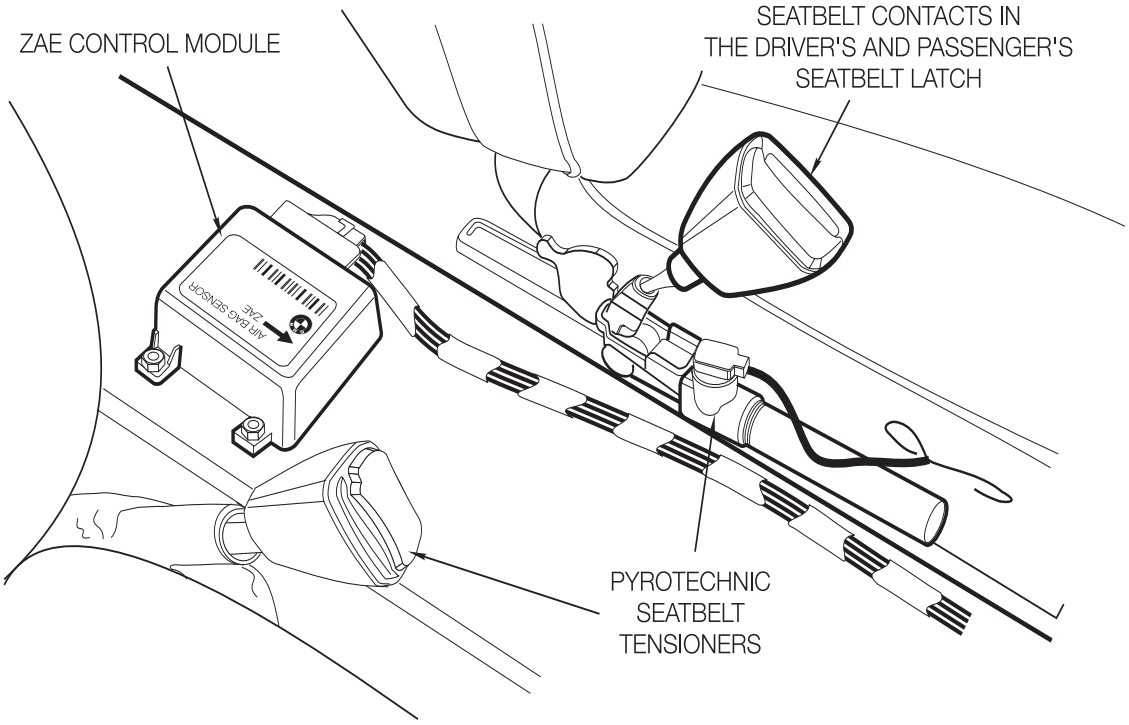


## SEAT BELT TENSIONERS

Pyrotechnic seat belt tensioners are used as a method of reducing the spooling effect of the seat belts during a collision.

The seat belt latch is connected to the pyrotechnic device through a cable. The control module is responsible for triggering the belt tensioner based on its programmed parameters.

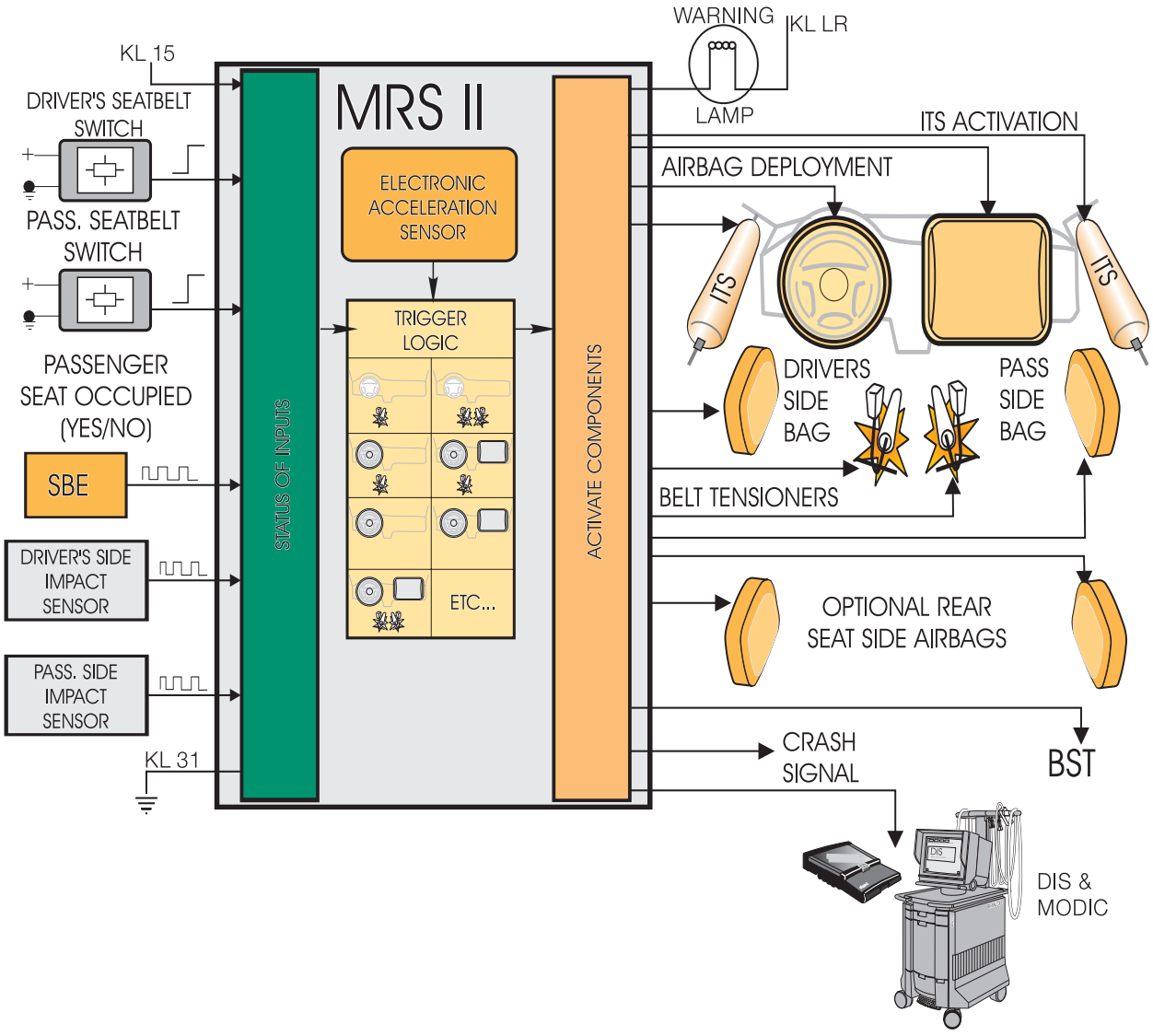
The pyrotechnic device is similar to an airbag assembly in that when the control module triggers the belt tensioner, a small gas charge is ignited in the tensioner assembly and the pressure forces the cable to pull the latch tight.




## SEAT BELT SWITCHES

The seat belt switch signals are input signals used by the control module for its deployment logic. Either switch contacts or hall sensors are used for this input, depending on the model year.

# MRS/MRS II I-P-O



# MRS/MRS II DEPLOYMENT LOGIC

The design of the MRS/MRS II allows the control module to trigger deployment of the airbags/ seat belt tensioners individually as needed. The logic is based on:

- The severity of the impact
- The direction of the impact (front/side/rear)
- The status of the front passenger's seat
- The status of the seatbelt contacts for the driver and passengers

## DRIVER'S FRONT AIRBAG

The deployment threshold for the driver's front airbag is designed so that minor impact forces, will not trigger the airbag, where the seat belt is sufficient to protect the driver. If the seat belt is not connected, the driver's front airbag will deploy to provide the driver with protection.

## PASSENGER'S FRONT AIRBAG

The passenger's front airbag is dependent on the seat belt contact and the signal from the SBE for its deployment. If the passenger's seat is unoccupied, the airbag will not deploy unless a severe collision occurs.

## SIDE AIRBAGS/ITS

The triggering of the side air bags/ITS depends on the degree of lateral acceleration as detected by the side impact sensors. An acceleration sensor in the control module acts as a plausibility check for side airbag/ITS deployment. Both sensors must detect that the trigger threshold has been exceeded before the airbags/ITS will deploy. The control module also looks at the signal from the SBE for deployment of the passenger's side airbag/ITS.

## PYROTECHNIC SEATBELT TENSIONERS

The triggering of the seatbelt tensioners is dependent on the seatbelt contacts. The tensioners will not deploy if the seatbelts are not connected.

The safety logic of the MRS/MRS II will deploy the airbags in an accident if faults are detected with the SBE or seatbelt contact inputs.

## BST TRIGGER LOGIC

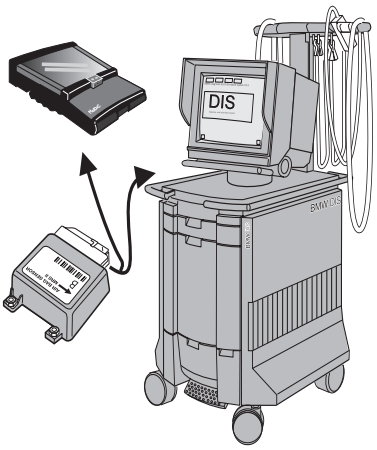
Triggering of the BST requires no additional sensors. The MRS II control module will trigger the BST as follows:

**FRONTAL COLLISION:** During a frontal collision that involves deployment of any front air bag, the BST will also be triggered

**SIDE IMPACT:** Depending on the severity of the side impact, the BST may also be activated.

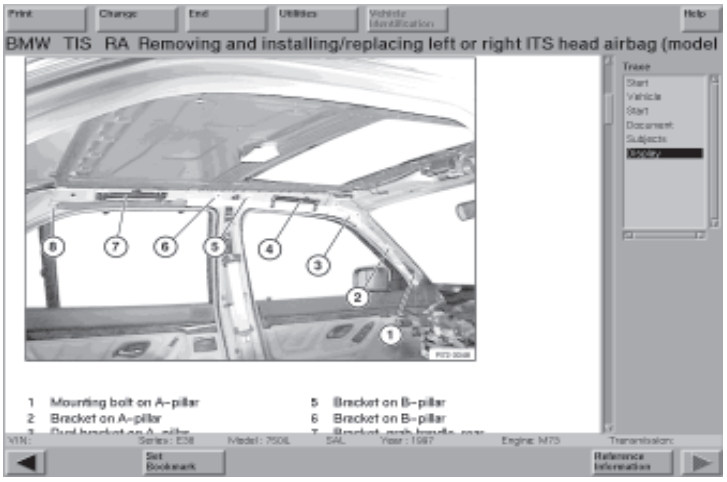
**REAR IMPACT:** Detection of server rear impact will cause the MRS II to activate the seat belt tensioners and simultaneously activate the BST.

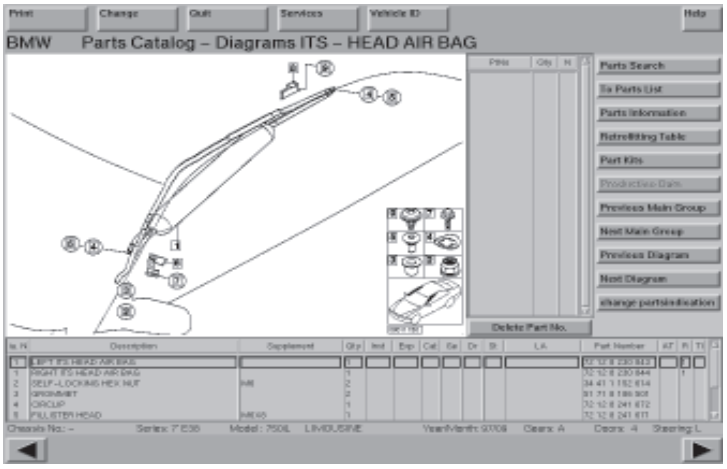
# DIAGNOSIS AND SERVICE PROCEDURES




The control module performs a self test of the restraint system every time the ignition is switched on. Any faults with the system's inputs/outputs or processing capabilities will cause the fault lamp in the cluster to illuminate. The troubleshooting of the MRS system is fault driven and can be accessed using the DIS tester or MoDiC.

Installation of a replacement control module requires ZCS coding also using the MoDiC or DIS.

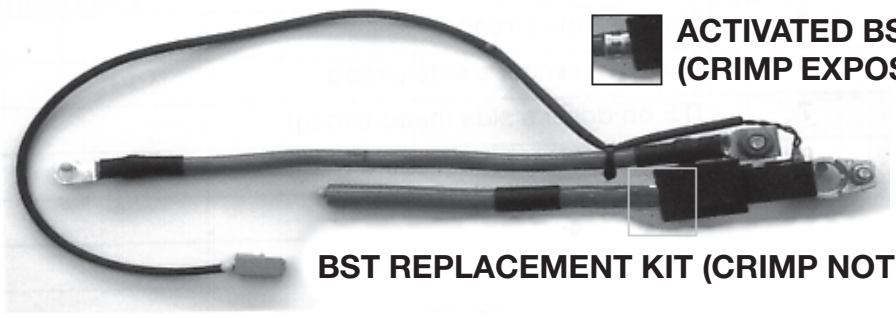



When servicing or replacing any MRS components, always follow the precautionary measures outlined in the repair manual of TIS. This includes disconnecting the battery prior to any repair of maintenance work being performed.

All airbag units , including the ITS assemblies are part number specific by model. Always use the EPC to verify the correct part number for any component being replaced.

A replacement splice kit is available for the BST following an impact that causes BST activation. The splice kit comes complete with instructions for cutting and stripping the B+ cable for replacement. Follow the instruction completely to prevent future voltage drop problems in the B+ cable circuit.



**ACTIVATED BST (CRIMP EXPOSED)**

**BST REPLACEMENT KIT (CRIMP NOT EXPOSED)**

## CENTRAL AIRBAG TRIGGER MODULE (ZAE & ZAE II)

## Model: E31, E34, E36, E36/7, E38

## Production Date: E31: from 9/93 to production end
E34: from 9/93 to production end
E36/7: from start of production to 8/97
E36: from 9/93 to 12/96
E38: from start of production to 8/96
E39: from start of production to 8/96

**Objectives**

After completing this module you should be able to:

- List the components used in the ZAE system.
- Understand the construction of mechanical seatbelt tensioners.

# CENTRAL “AIRBAG” TRIGGER MODULE (ZAE)

The ZAE passive safety system preceded the MRS systems. It was introduced for the 1994 Model Year vehicles including:

- E31 - all models
- E34 - all models
- E36 - all models

The ZAE was enhanced with added features for the E38 in model year 1995.

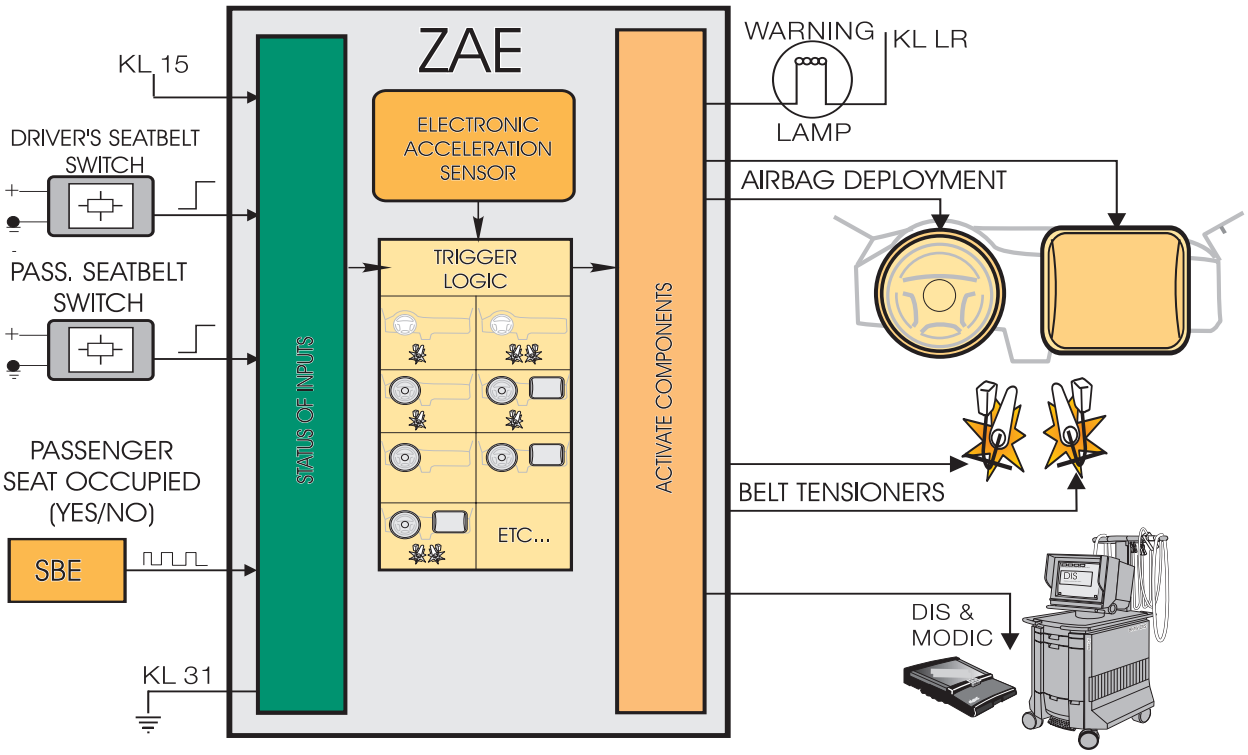
The ZAE system consists of the following components:

- ZAE control module
- Driver’s airbag
- Passenger’s front airbag
- SRS warning lamp
- Pyrotechnic seat belt tensioners (with E38)
- Seat belt switch contacts (with E38)
- Passenger’s seat occupancy sensor (with E38)

## SYSTEM OVERVIEW

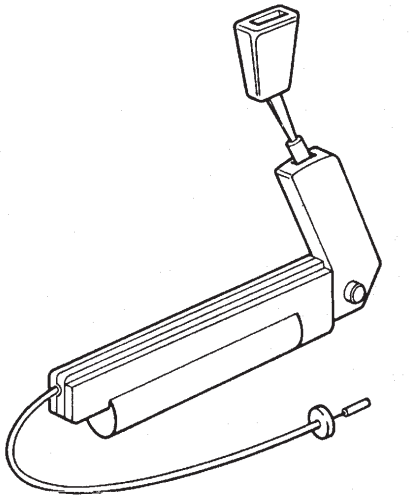
The ZAE control system is similar to the MRS system in that impact detection and airbag triggering are combined functions integrated into the ZAE control module.

# ZAE - I P O


ZAE
KL 15
DRIVER'S SEATBELT SWITCH
PASS. SEATBELT SWITCH
PASSENGER SEAT OCCUPIED (YES/NO)
SBE
KL 31
STATUS OF INPUTS
ELECTRONIC ACCELERATION SENSOR
TRIGGER LOGIC
ETC...
ACTIVATE COMPONENTS
WARNING LAMP
KL LR
AIRBAG DEPLOYMENT
BELT TENSIONERS
DIS & MODIC

# SEAT BELT TENSIONERS

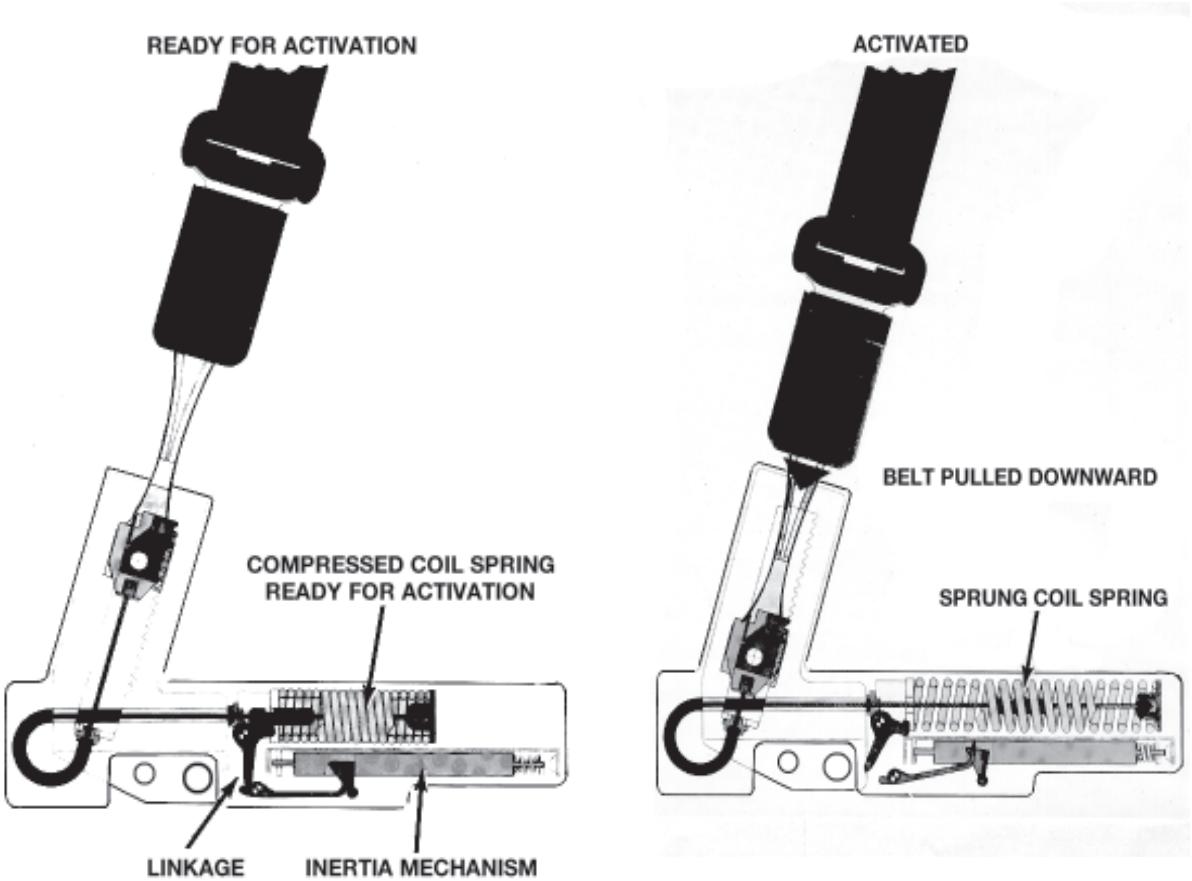
## MECHANICAL SEAT BELT TENSIONERS



The mechanical seat belt tensioner is a simple method of countering the effects of the occupant moving forward (seat belt stretch) during the sharp deceleration of a collision.

The seat belt tensioner consists of a cable operated seat belt latch, a tension spring and an inertia mechanism.

When the inertia mechanism is triggered during a collision, The linkage releases the tension spring and the seat belt latch is pulled downward to tighten the belt across the occupant's body. This action counters the effects of inertia and the "spooling" of the seat belt itself.



## CIPRO/SIEMENS AIRBAG SYSTEM

## Model: E23 (L7), E24, E30, E31, E32, E34, E36,

## Production Date: E23: 9/95 to production end
## E24: 9/96 to production end
## E30: 9/89 to production end
## E31: production start M.Y. 91 to 9/93
## E32: all models
## E34: from 9/88 to 8/93
## E36: from production start M.Y. 92 to 8/93

**Objectives**

After completing this module you should be able to:

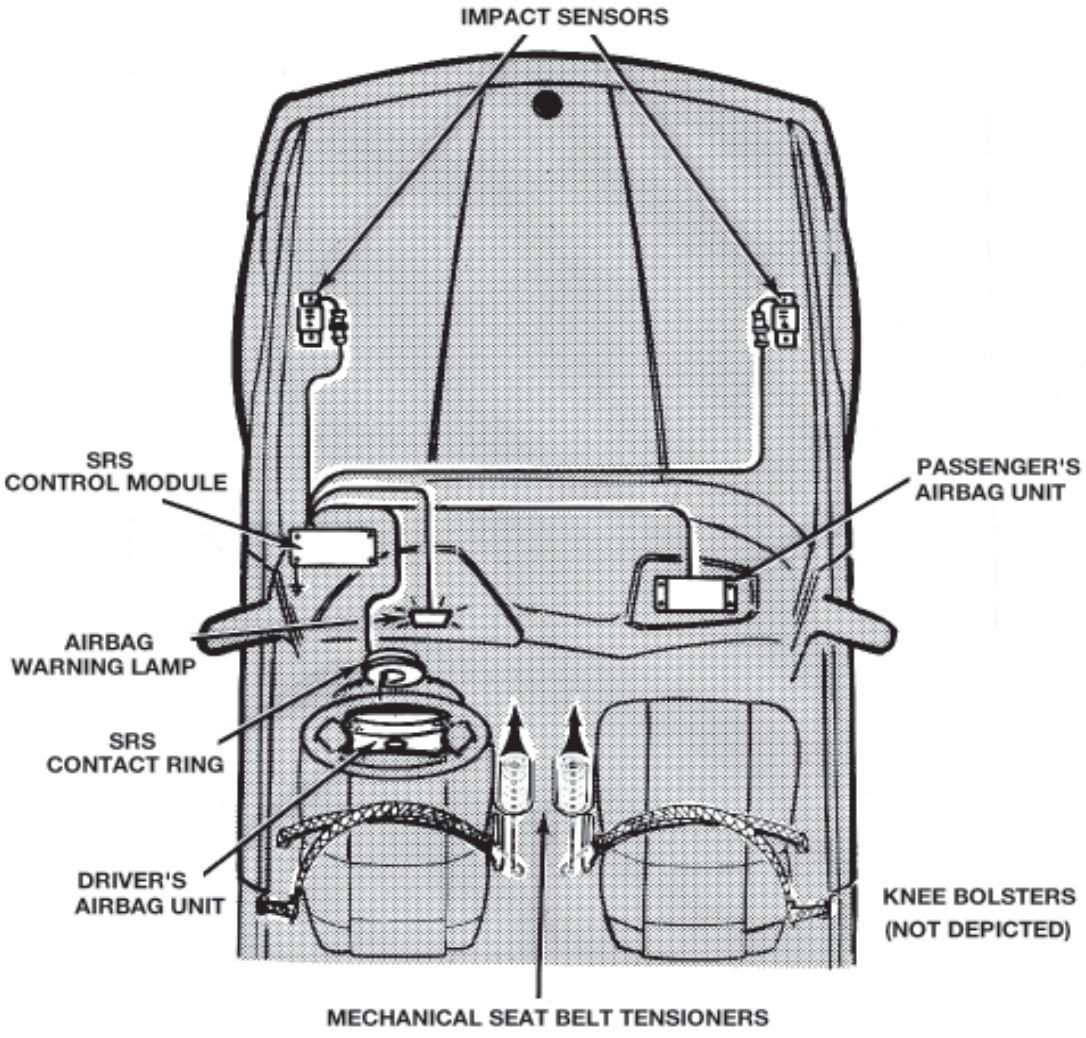
- List the components used in the Cipro/Siemens System.
- Describe how crash detection differs from newer ZAE and MRS systems.
- Explain how the control module ignites the airbags.

# CIPRO/SIEMENS 2B & 2C

## SYSTEM OVERVIEW

The early SRS consists of the following components:

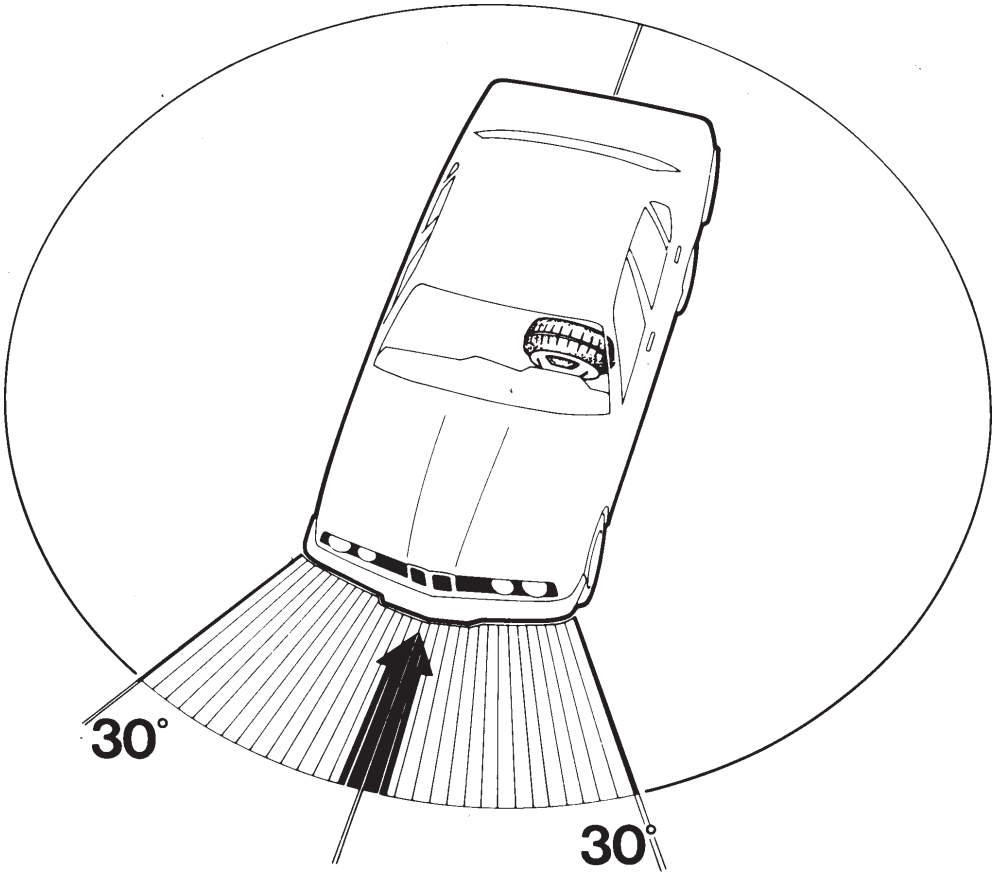
- Driver's air bag unit with gas generator - mounted in the center of the steering wheel
- Passenger's front air bag was added beginning with 1993 model year E32/E31
- Contact ring - under the steering wheel
- Front Impact Sensors - mounted on the left and right wheel housings
- Control module
- SRS warning lamp



## AREA OF IMPACT

The airbag(s) will only activate during a frontal impact and then only when the collision is within a 60° arc, equidistant to the vehicle center line.

The front airbag sensors are spring loaded inertia type switches. The weighted roller will move forward, in the event of a frontal impact, closing the contacts of the sensor.




## IMPACT SENSOR SIGNALS

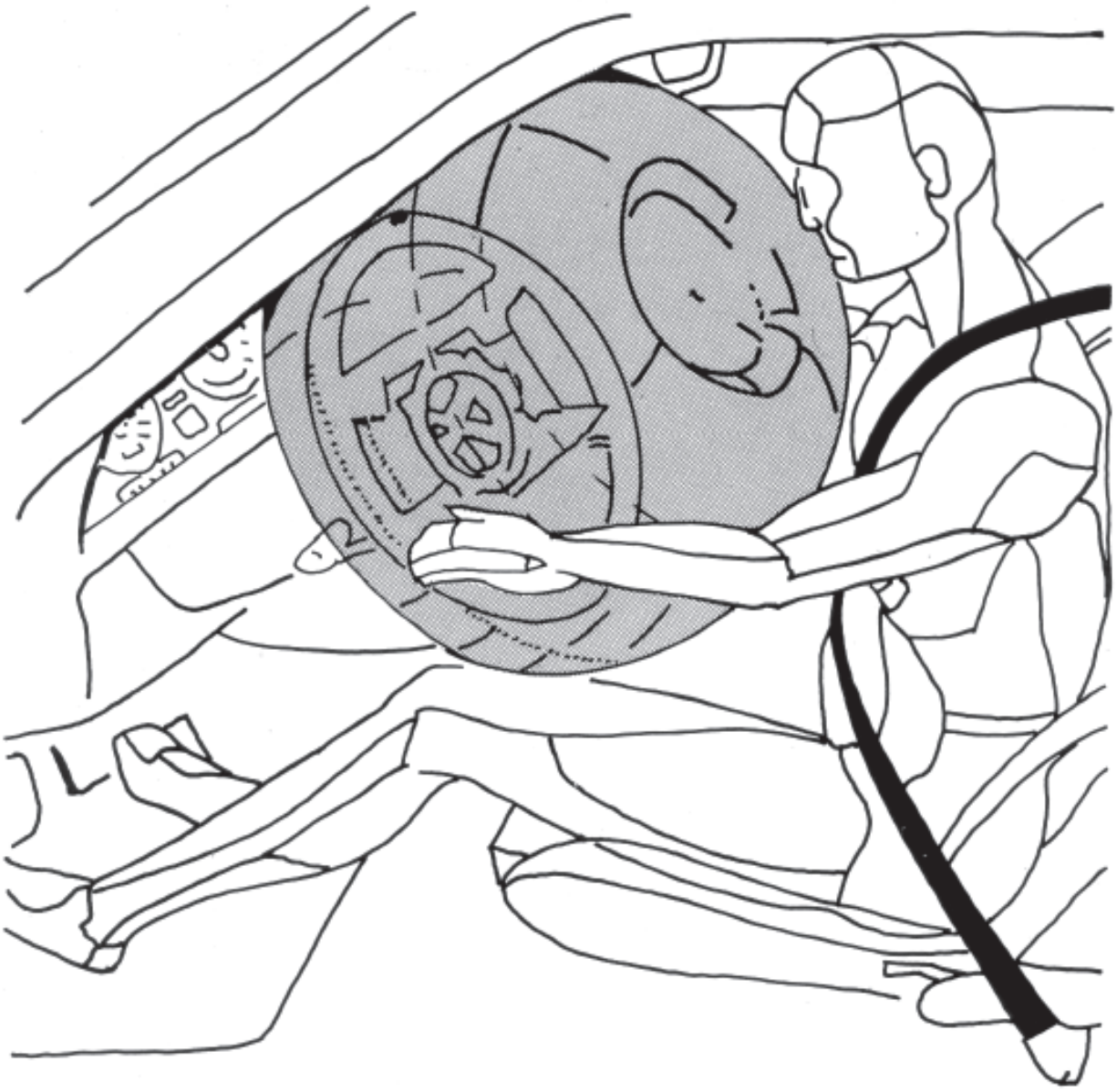
During a frontal collision of sufficient impact at least one impact sensor and the safety sensor in the SRS module will close signalling airbag activation.

Sufficient impact generally results from a collision with a solid, non-moving object at a speed greater than 12 MPH.

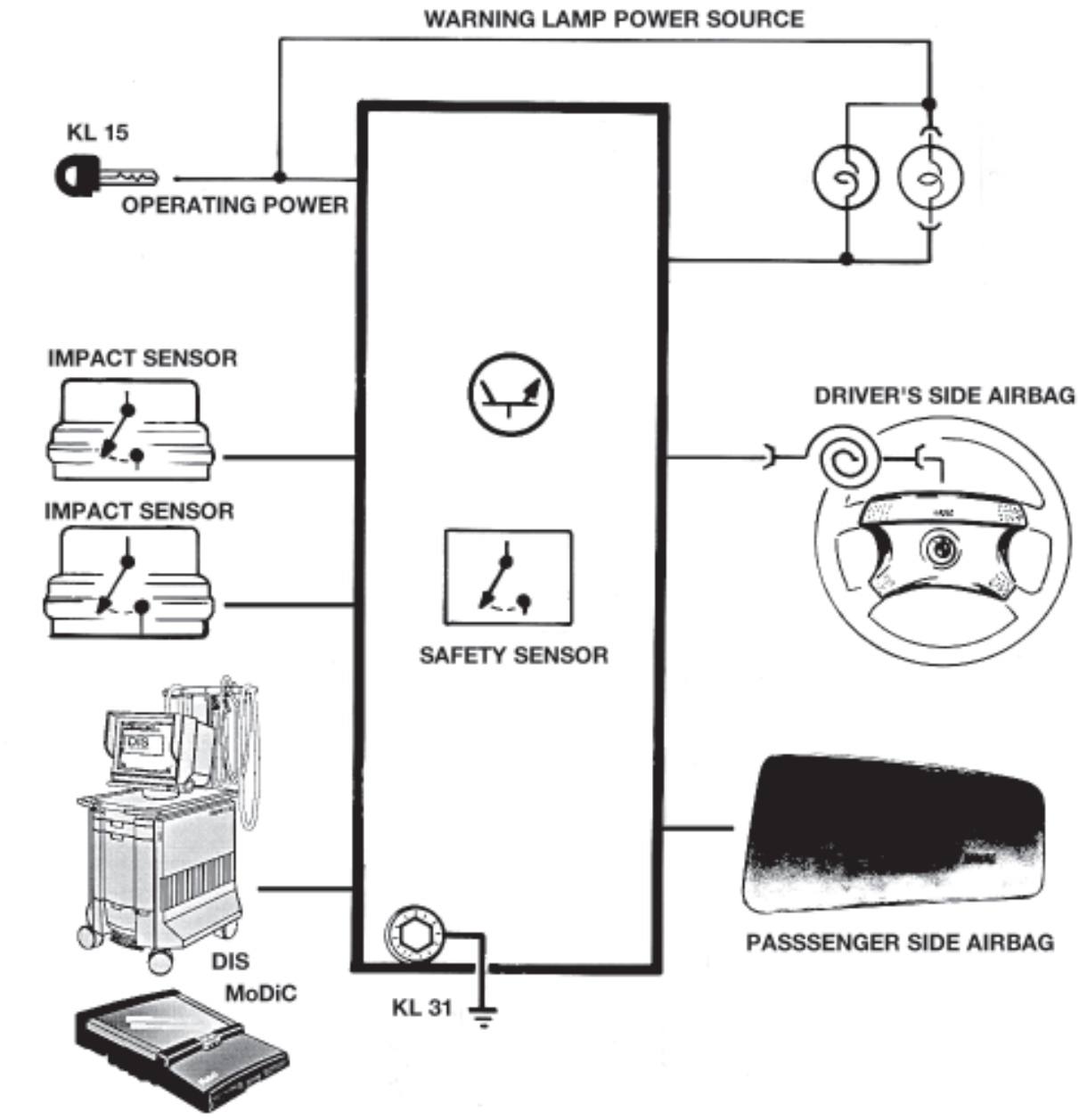
## SIEMENS OPERATION

The SRS control module and SRS warning lamp receive power when the ignition is switched on (KL R). The control module performs a self check and charges the internal capacitor to approximately 35 volts. The capacitor ensures that enough power will be available for airbag activation. If the self check is “OK”, the warning lamp goes out and the system is ready for activation should the need arise.

During the instant of activation the capacitor voltage is used to energize the ignition pill of each airbag gas generator. The airbag fills rapidly with a nitrogen gas (N2) supplying the needed margin of safety.



## CIPRO/SIEMENS 2B-2C  I P O



## ROLL-OVER PROTECTION SYSTEM (RPS)

## Model: E36

## Production Date: All E36 convertibles equipped with RPS.

**Objectives**

After completing this module you should be able to:

- List the components used in the RPS system.
- Describe how the roll-over sensor detects a deployment threshold.
- Explain how to retract a deployed roll-bar.

# ROLLOVER PROTECTION SYSTEM (RPS)

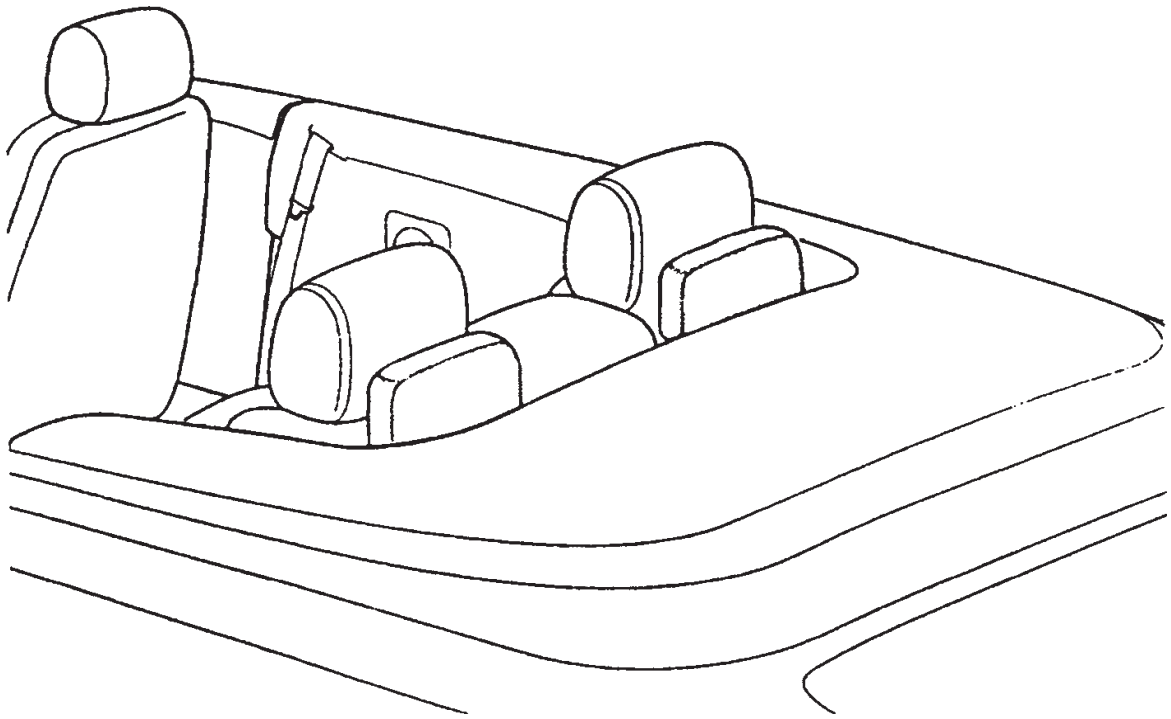
The RPS is a passive safety system which, like the SRS, will not deploy until needed. When the vehicle is in danger of rolling over, a rollover sensor mounted in the vehicle detects the amount of tilt and in a time span of approximately .3 seconds triggers the system to raise and lock the roll bars into position.

The U S market uses the acronym RPS for the roll over protection system while the German acronym is ÜRSS. This stands for the German words “Über Roll Shutz System”, which may appear in various publications or on the diagnostic teat equipment.

The RPS can be reset, in the service shop, in the event of an accident, or inadvertent triggering of the system.

The RPS supplements the integral reinforcement bar that is located in the front windshield frame/ “A” pillar area. It provides additional protection for passengers of the vehicle, especially those riding in the rear seats.

Deployment of the roll bars with the soft top raised, of the hard top installed will not cause any damage to the rear window. The plastic covers on the bars is designed to protect the window if inadvertent deployment occurs.



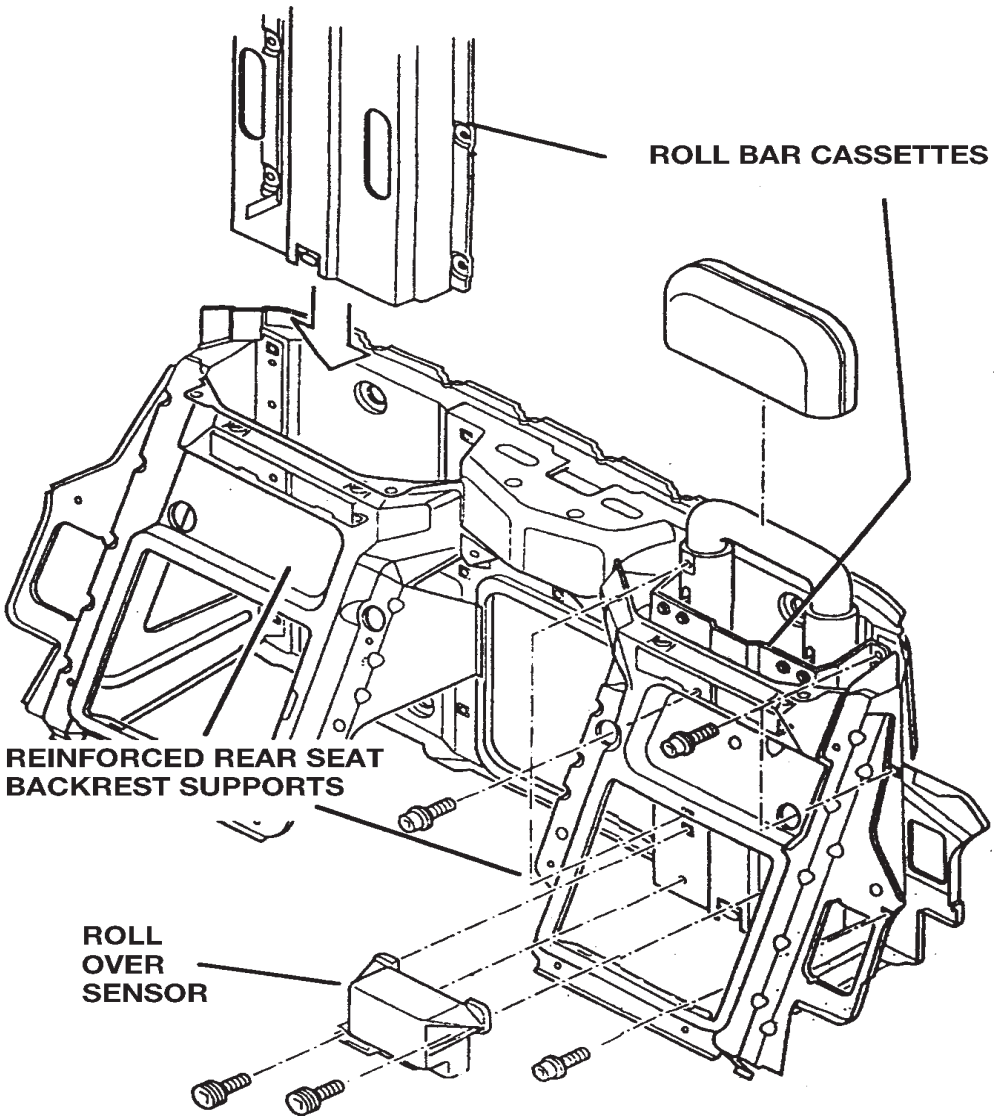
# RPS COMPONENTS - OPERATION

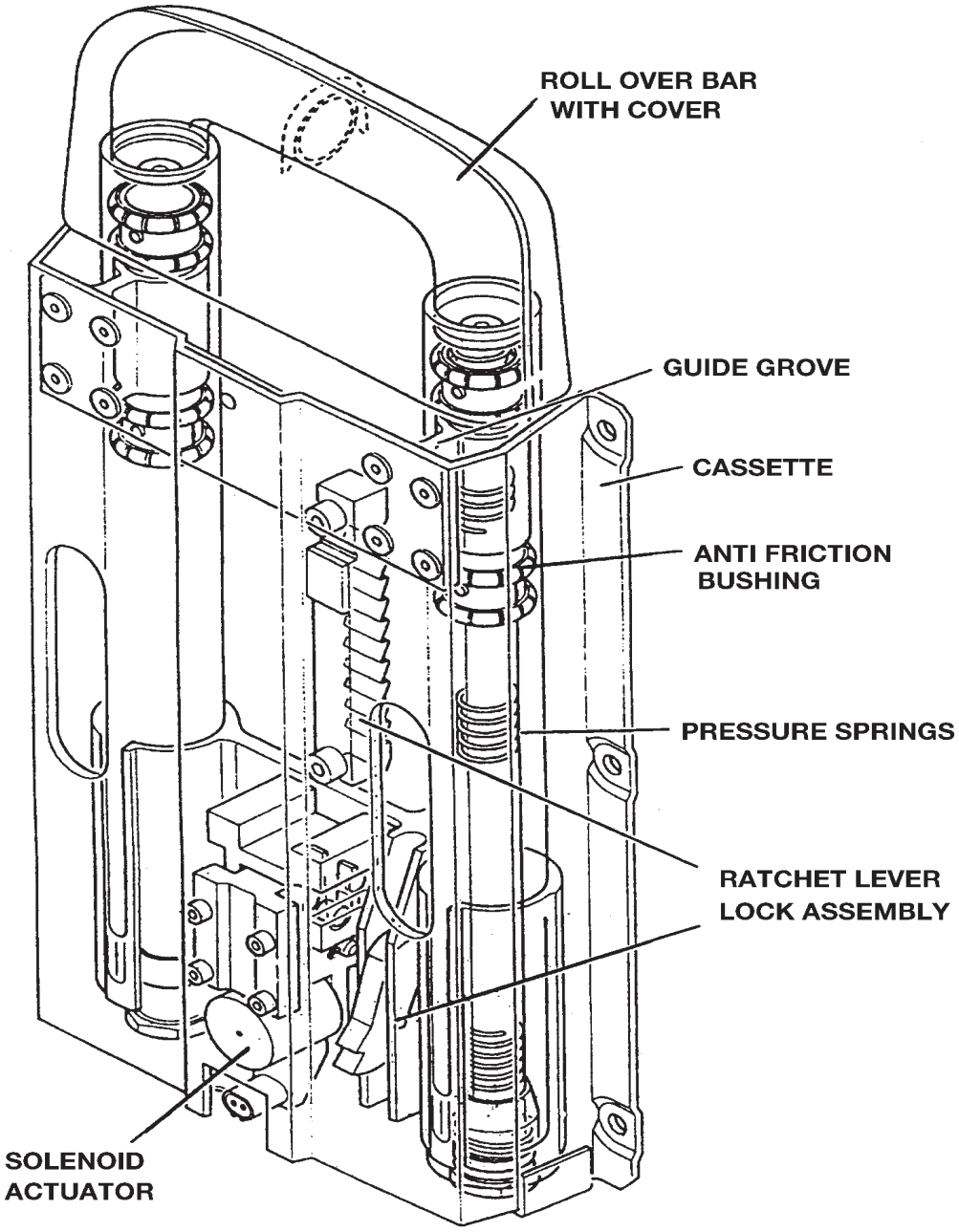
The main components of the RPS includes the following:

### TWO ROLL BAR CASSETTES

The cassettes are positioned in a reinforced body structure, behind the rear seat backrests. Each cassette assembly consists of a “U” shaped bar that is guided by low friction plastic bushings. The bar is held in the retracted positioned against spring pressure by a lever. The lever is solenoid controlled to unlock the bar for deployment. The two springs ensure that the bar will deploy quickly to provide adequate protection.

When deployed, the bar is held in place by a ratchet and lever assembly that locks the bar in the raised position.



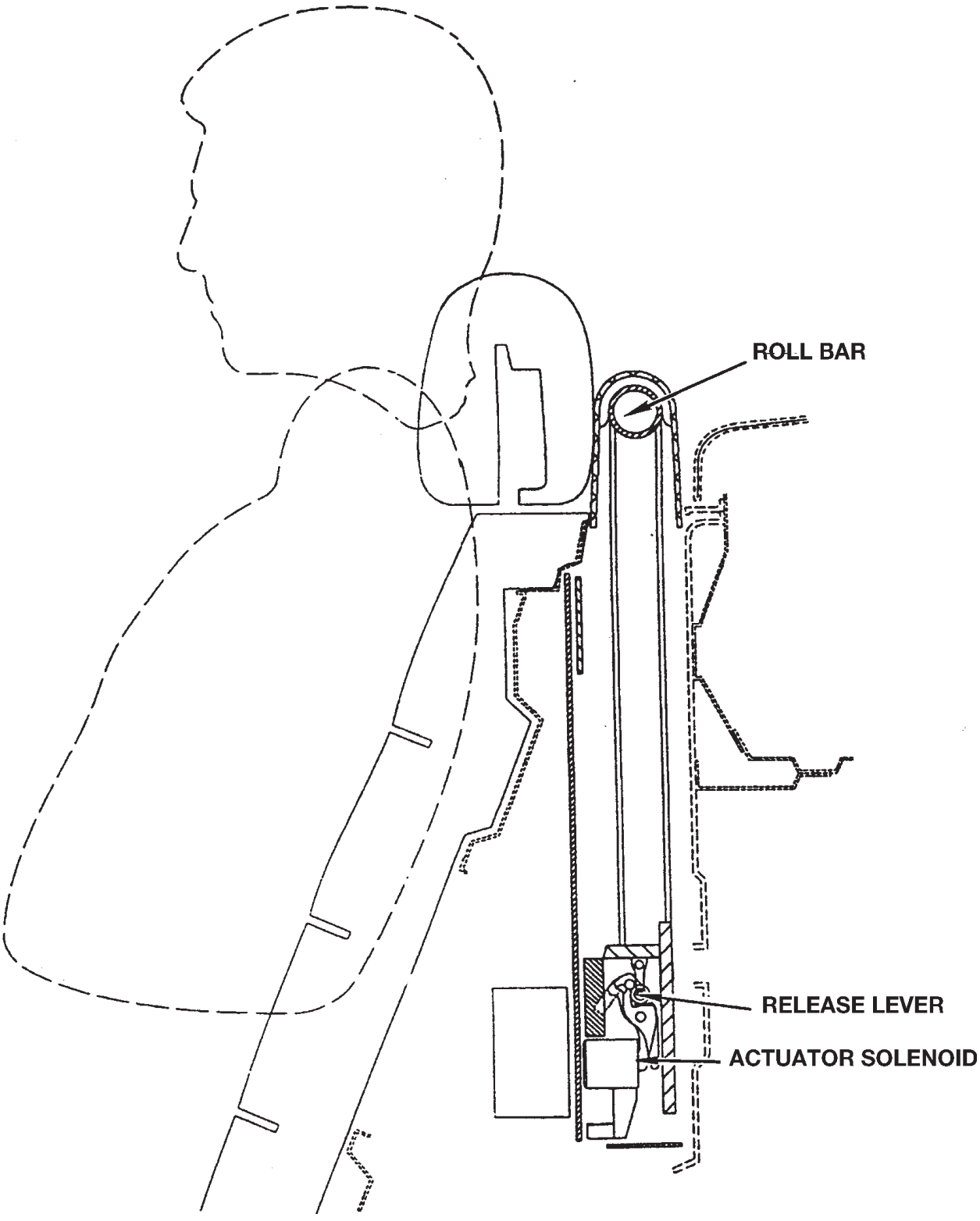



## Technical Data

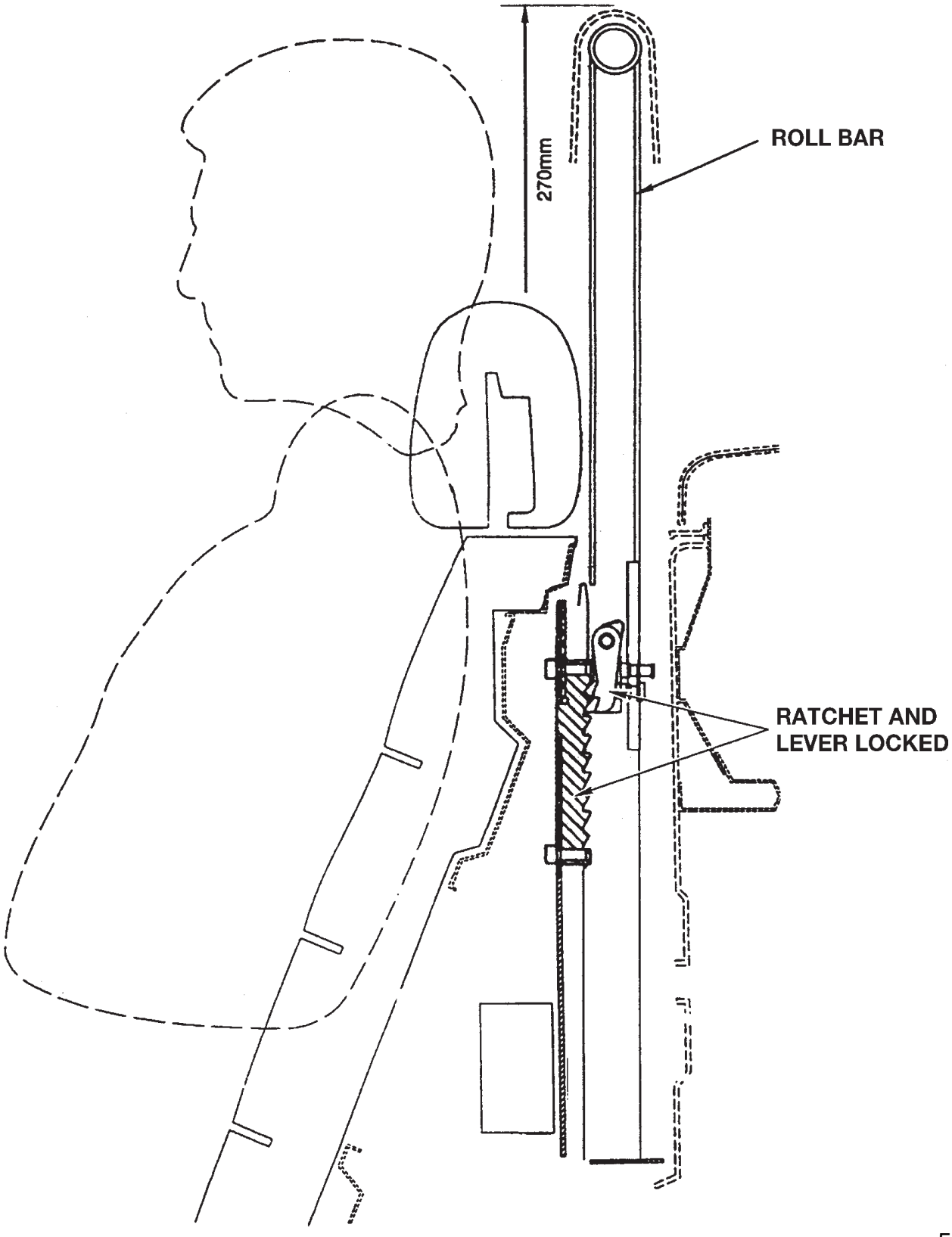
| | |
|---|---|
| Cassette dimensions | 249x507x75mm (retracted) |
| Maximum bar travel | 270 mm |
| Construction | Light alloy steel |
| Cassette weight | 5 kgs (11 lbs) |
| Absorption force | 35 KN |

# RPS COMPONENTS / OPERATION

## Roll Bar Retracted

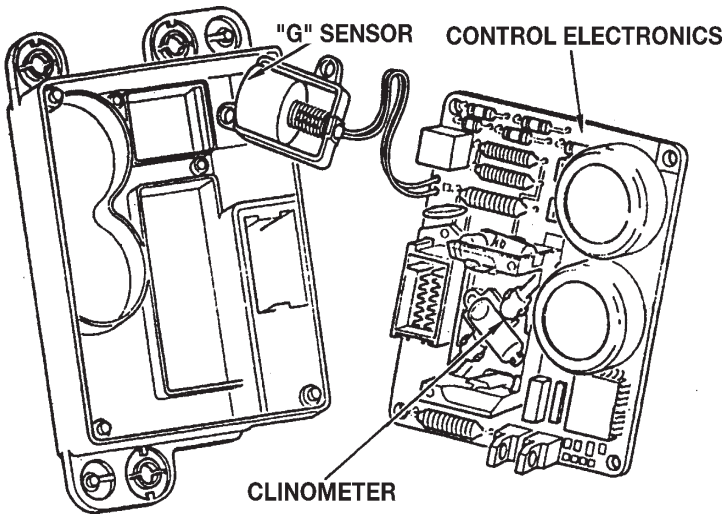


## Roll Bar Deployed



# ROLLOVER SENSOR

The rollover sensor in mounted on the longitudinal axis of the vehicle, behind the left backrest. It contains the sensors and control electronics for roll bar deployment.

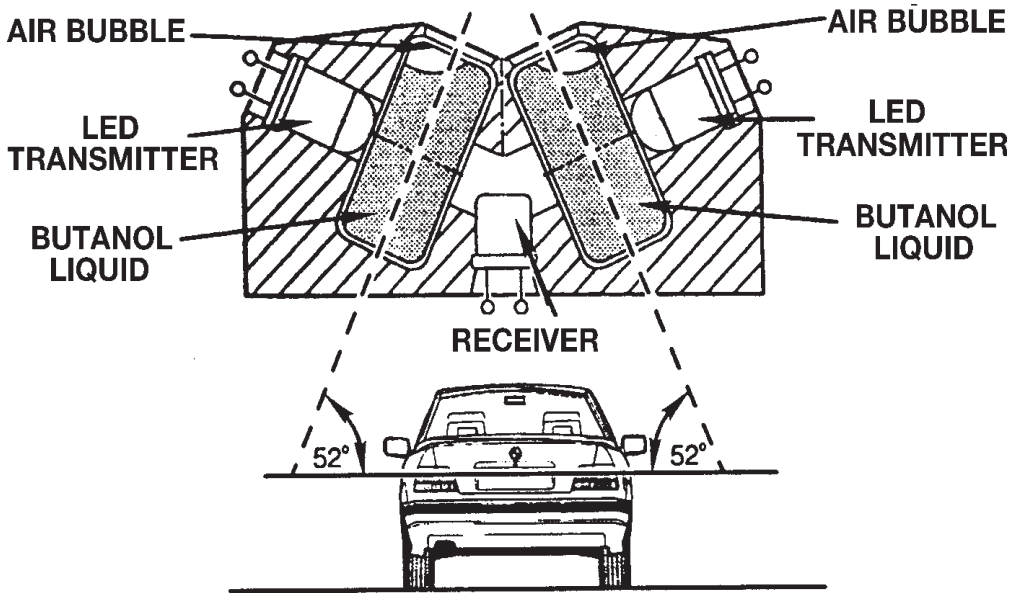



## CONTROL ELECTRONICS

The control electronics include the monitoring circuits for roll bar operation and two capacitors for triggering the roll bars in the event of an electrical failure.

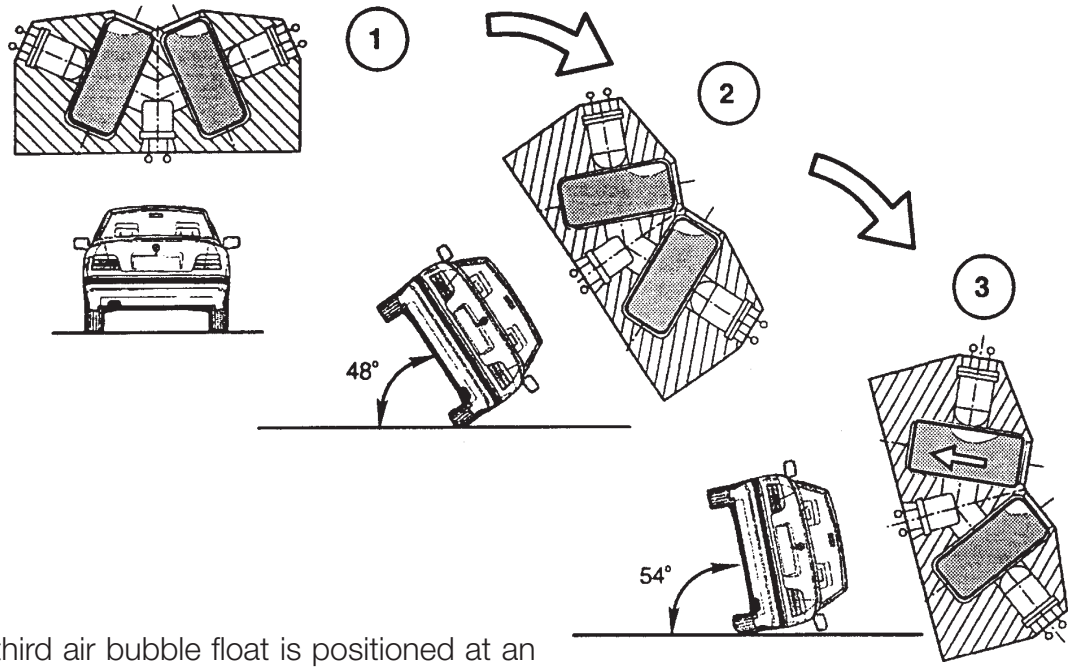
# CLINOMETER - (TILT DETECTION)

The clinometer identifies the vehicle's inclination and determines transverse and longitudinal acceleration.




The clinometer consists of three air bubble floats with LED transmitters and photo transistor/receivers. Two of the floats are positioned on opposing angles of 52° to the horizontal axis of the vehicle.

As the vehicle starts to rollover sideways the air bubble will move across the transmitter/ receiver circuit when the angel passes 52°. This will signal the electronics to deploy the roll bars. The critical angle for rollover on the E36 convertible is 62°.

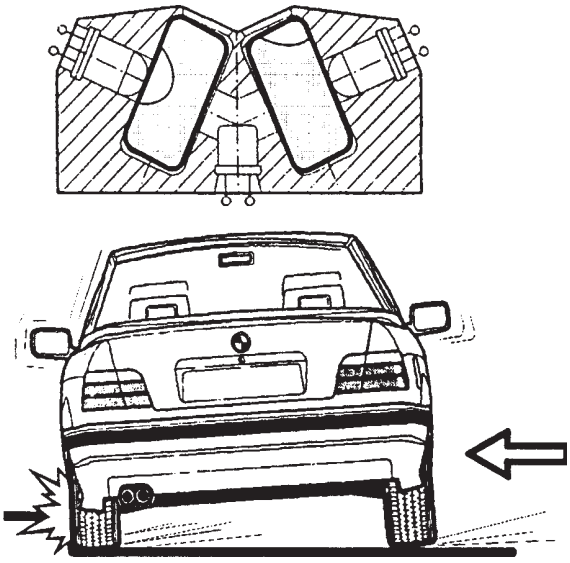



The third air bubble float is positioned at an angle of 72° to the longitudinal axis of the vehicle. If the vehicle starts to rollover end to end, the sensor will cause deployment of the rollover bars.

If the vehicle slips sideways into an obstacle (i.e.: the curb) the transverse acceleration is retarded rapidly.

The effect of the vehicle hitting the curb will force the air bubble in the float downwards, before the vehicle starts to rollover. In doing so the air bubble can pass the transmitter/ receiver circuit and trigger the deployment of the bars.

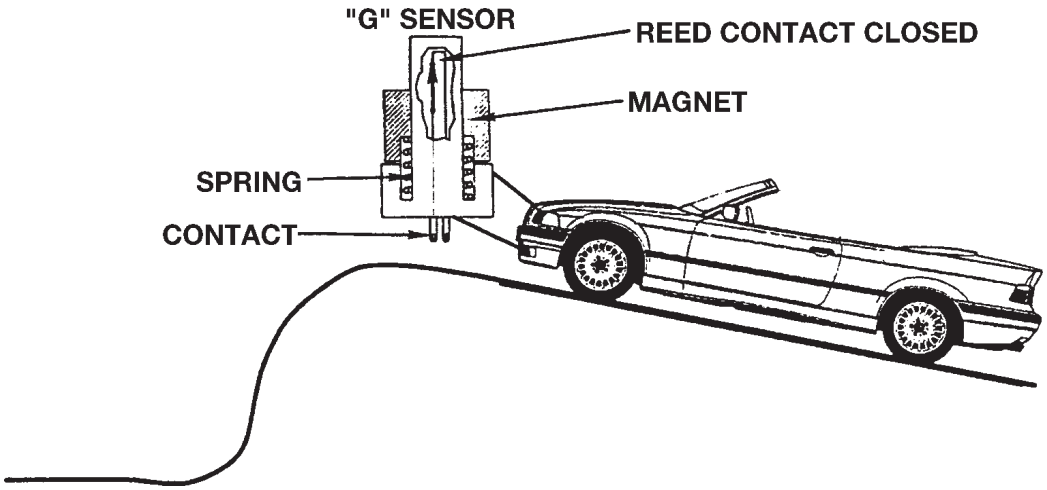
This requires an acceleration force of at least 1.28 “G” lasting for approximately 80ms.



## **“G” SENSOR** - detects vehicle’s loss of contact with the road surface

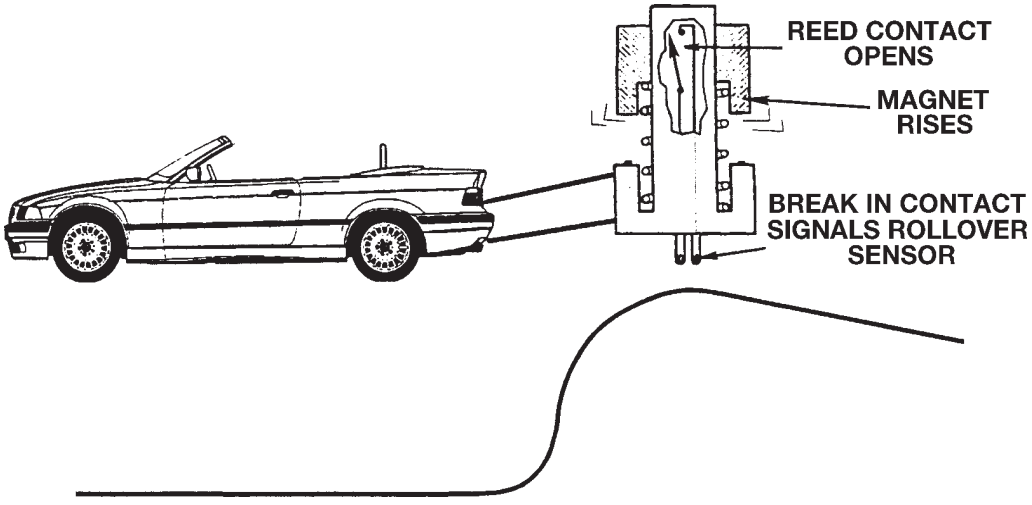
If the vehicle becomes airborne, and the rate of acceleration is 1 “G” or more, the effective weight of the vehicle is zero. At this point, the clinometers can no longer detect transverse acceleration with respect to the gravitational pull. In this situation, the “G” sensor will act as the triggering device for the roll bars.

The “G” sensor consists of a reed contact, magnet and spring assembly. As long as the vehicle is in contact with the road surface, the spring does not have enough tension to overcome the weight of the magnet and gravity.




However, if the vehicle becomes airborne, and weightlessness occurs, the spring will force the magnet up which opens the reed contact and triggers the deployment of the roll bars.

A time period of approximately .3 seconds with a “G” force of approximately 0.9 or less is required before the roll bars will deploy.



# RPS DIAGNOSIS AND TESTING

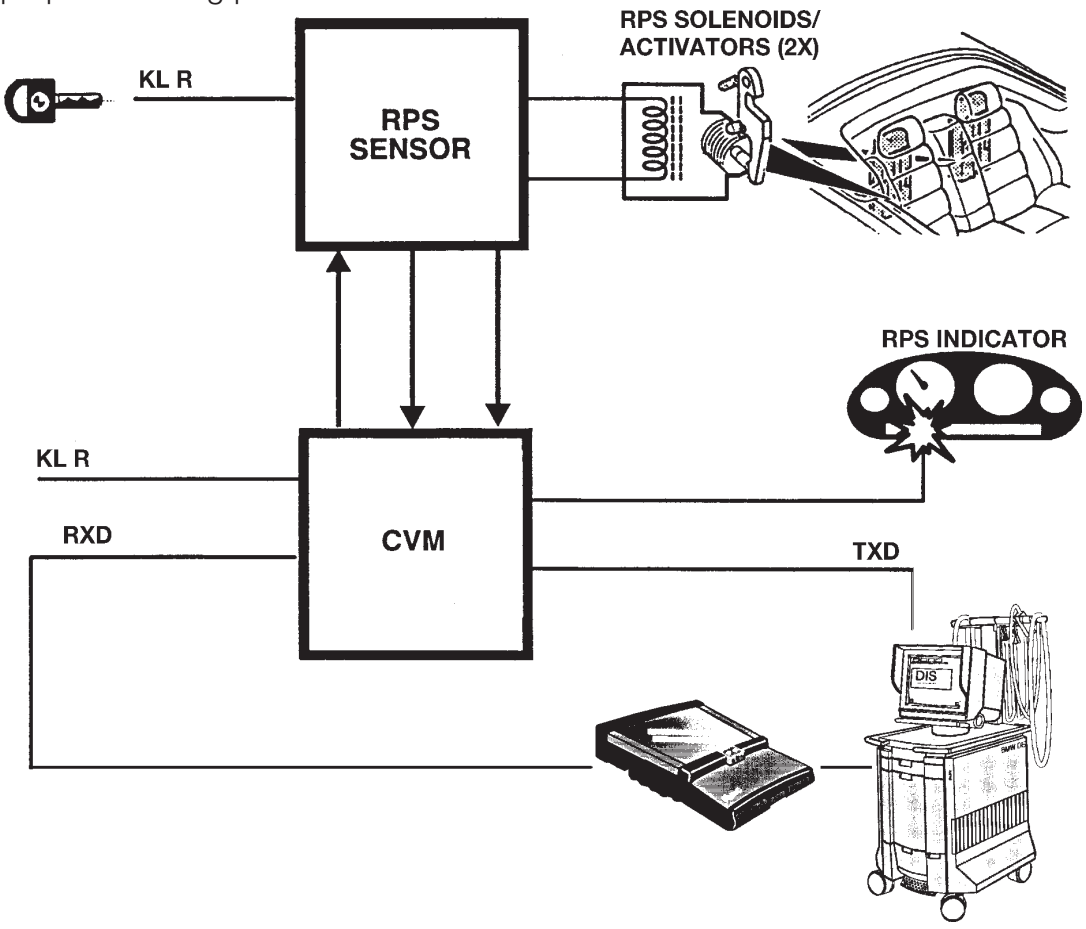
The roll over sensor performs a self check every time the ignition key is switched on. All components of the sensor are checked including the output stages for the roll over bar solenoids. If a fault is detected, the warning lamp in the cluster is illuminated and the fault is logged in the memory of the convertible top control module.

In the event of a power failure, the capacitors in the sensor can still trigger the solenoids for approximately 5 seconds.

The operation of the roll over protection system must be checked as every inspection I & II. The operation of the system is checked using the DIS tester or MoDiC to trigger the deployment of the roll bars. A signal is sent from the Convertible top module to the roll over sensor to activate the system.

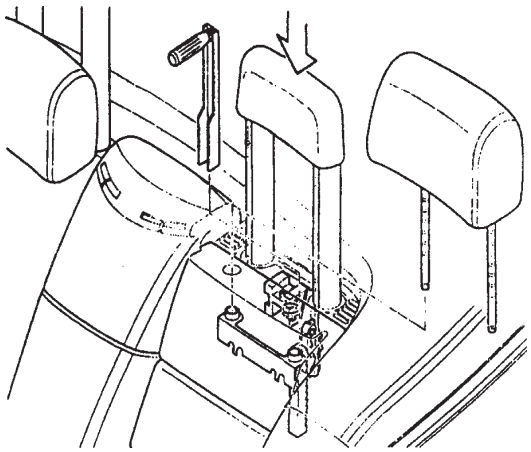
The total number of times the system is activated is stored in the memory of the top module.. It can be read out though the tester display.

After fifty activations of the system, it must be inspected for wear. Refer to the repair manual for the proper checking procedures.



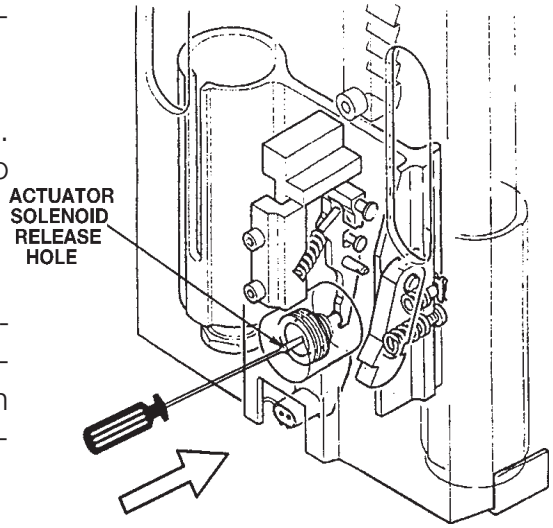
## RETRACTING OF THE ROLL BARS

The system can be reset (retracted) using the reset tool in the vehicle tool kit. The procedure is as follows:



- Remove the rear head rest
- Insert the tool in the slot in front of the roll bar
- Press the tool down to release the ratchet lock of the locking lever
- Push the roll bar down far enough to clear the ratchet.
- Remove the toll and press the roll bar down until it locks into the actuator.

**CAUTIONS:**




- Adjustments or repairs to the roll bar cassette and actuators are not permitted
- Each actuator lever has an overlap 1.2mm. This is a critical dimension: > 1.2mm = no release
  < 1.2mm = inadvertent release
- The cassette can only be removed in a released state. An emergency release is provided on the actuator. A screwdriver can be inserted into the small hole in the actuator to release the roll bar.
- Serious injuries could result from deployment of the roll bas while removing the cassette in an armed state.

## Review Questions

1. When should the battery negative terminal be disconnected when working with airbag systems?

2. What is meant by the term, “Smart technology”?

3. What components do the MRS systems use to detect side impacts? Where are these components located?

4. Define “cold gas inflation”. Which systems use this inflation method?

5. Which circuits are disconnected after the deployment of BST? Which circuits remain operational?

6. What is the purpose of the SBE module? What occurs to the triggering logic if this circuit is defective?

7. Where are the impact sensors located on a Cipro or Siemens SRS system?

8. When should the RPS system operation be checked?