

SIR System Description and Operation

SIR System Overview

The supplemental inflatable restraint (SIR) system supplements the protection offered by the occupant's seat belt system (2). The SIR system may contain several inflator modules located throughout the vehicle, i.e. steering wheel module (1) and instrument panel (I/P) module (1). Each inflator module has a deployment loop that is controlled by the sensing and diagnostic module (SDM) mounted inside the vehicle. The SDM determines the severity of a collision with the assistance of various sensor inputs. When the SDM detects a collision of sufficient force, it will process the information provided by the sensors to further support air bag deployment. The SDM performs continuous diagnostic monitoring of the SIR system electrical components. Upon detection of a circuit malfunction, the SDM will set a DTC and inform the driver by turning the AIR BAG indicator ON. The steering column (1) and knee bolsters (3) are designed to absorb energy and compress during frontal collisions in order to limit leg movement and decrease the chance of injury to the driver and passenger. After an air bag deployment, the SDM will send out a post-air message to the body control module (BCM). The BCM will unlock the doors and turn ON the interior lights 15 seconds after receipt of this message.

Frontal SIR System Description

The frontal SIR system consists of the following components:

- Inflatable restraint sensing and diagnostic module (SDM)
- Inflatable restraint passenger presence system (PPS)
- Inflatable restraint passenger AIR BAG ON/OFF indicator
- AIR BAG indicator located in the instrument panel cluster (IPC)
- Inflatable restraint steering wheel module
- Inflatable restraint instrument panel (I/P) module
- Inflatable restraint seat position switch (SPS) (left/right)
- Inflatable restraint seat belt pretensioners (left/right)
- Inflatable restraint front end sensor (left/right)
- Inflatable restraint steering wheel module coil
- Driver and passenger knee bolsters
- Inflatable restraint wiring harnesses
- Steering wheel and column

A frontal collision of sufficient force will deploy the frontal air bags. The SDM contains a sensing device that converts vehicle velocity changes to an electrical signal. In the event of a frontal collision, the SDM receives a signal from the front end sensors which assists the SDM in determining the severity of some frontal collisions. The SDM contains a microprocessor that performs calculations using the measured accelerations. The SDM compares these calculations to a value stored in memory. When the generated calculations exceed the stored value, the SDM will cause current to flow through the frontal deployment loops deploying the frontal air bags. Once the air bags are inflated, they quickly deflate through the air bag vent holes. After the air bags have deployed, the SDM sets a DTC and requests the IPC to turn the AIR BAG indicator ON. The SDM, I/P module, steering wheel module, steering wheel module coil, and the connecting wires make up the frontal deployment loops. The SDM continuously monitors the deployment loops for malfunctions and turns the AIR BAG indicator ON if a fault is detected.

Inflatable Restraint Sensing and Diagnostic Module (SDM)

The sensing and diagnostic module (SDM) is a microprocessor and the control center for the supplemental inflatable restraint (SIR) system. This SDM has 2 fused power inputs: one fuse is for the battery voltage and the other fuse is for the ignition voltage. The SDM uses vehicle battery voltage as its main power input. The SDM then uses the vehicles serial data communication line and the ignition voltage logic input for enabling or disabling the SIR deployment loops. The SDM contains internal sensors along with several external sensors, if equipped, mounted at strategic locations on the vehicle. In the event of a collision, the SDM compares the signals from the internal and external sensors to a value stored in memory. When the generated signals exceed the stored value, the SDM will cause current to flow through the appropriate deployment loops to deploy the air bags or seat belt pretensioners. If the force of the impact is not sufficient to warrant inflator module deployment, the SDM may still deploy the seat belt pretensioners. The SDM records the SIR system status when a deployment occurs and turns the AIR BAG indicator located in the instrument panel cluster (IPC) ON. As soon as 3 distinct deployment commands, representing different events, have been issued to any belt pretensioner, or the SDM commands any front and side air bag to deploy once, the SDM shall be considered to not be reusable. The SDM performs continuous diagnostic monitoring of the SIR system electrical components and circuitry when the ignition is turned ON. If the SDM detects a malfunction, a DTC will be stored and the SDM will command the AIR BAG indicator ON, notifying the driver that a malfunction exists. In the event that ignition positive voltage is lost during a collision, the SDM maintains a 23-volt loop reserve (23 VLR) for deployment of the air bags. It is important when disabling the SIR system for servicing or rescue operations to allow the 23 VLR to dissipate, which could take up to 1 minute.

Inflatable Restraint Passenger Presence System

Important: The passenger presence system (PPS), heated seat element, if equipped, and the seat bottom foam cushion is a calibrated unit and cannot be service separately. After repairing or replacing the PPS, the system must be rezeroed in order to function properly. The PPS is used to monitor the weight of an occupant on the front outboard passenger seat and communicate the status to the sensing and diagnostic module (SDM) whether to enable or suppress the deployment of the instrument panel (I/P) module and the right front side impact module. The PPS consist of an electronic control module, silicone filled sensor pad, pressure sensor, seat belt tension retractor sensor, wiring harness, and PASSENGER AIR BAG ON/OFF

indicators. The silicone filled sensor pad is located under the passenger seat foam cushion and is connected by a hose clamped to the pressure sensor. The weight of the occupant sitting in the front passenger seat is measured as a pressure change within the bladder by the pressure sensor. The pressure sensor sends a voltage signal to the PPS module. If the pressure from the occupants weight is less than a specified value, the PPS module will send a suppress signal to the SDM to disable the I/P and the right front side impact modules. If the pressure from the occupants weight is higher than a specified value, the PPS module will send an enable signal to the SDM to enable the I/P and the right front side impact modules. The PPS module will notify the customer of the enable/disable status by turning ON one of the PASSENGER AIR BAG ON/OFF indicators located on the rearview mirror. The PPS monitors itself for faults and will set DTCs if a fault is detected. The PPS will also notify the SDM of a fault. The SDM will respond by requesting the instrument panel cluster (IPC) to turn the AIR BAG indicator ON.

Inflatable Restraint PASSENGER AIR BAG ON/OFF indicator

The PASSENGER AIR BAG ON/OFF indicators located in the rearview mirror is used to notify the driver and passenger when the I/P air bag is enable or disable.

AIR BAG Indicator

The AIR BAG indicator, located on the instrument panel cluster (IPC) is used to notify the driver of supplemental inflatable restraint (SIR) system malfunctions and to verify that the sensing and diagnostic module (SDM) is communicating with the IPC. When the ignition is turned ON, the SDM is supplied with ignition 1 voltage and requests the IPC to flash the AIR BAG indicator 7 times. While flashing the indicator, the SDM conducts test on all SIR system components and circuits. If no malfunctions are detected, the SDM will communicate with the IPC through the serial data communication circuit and request the IPC to turn the AIR BAG indicator OFF. The SDM provides continuous monitoring of the air bag circuits by conducting a sequence of checks. If a malfunction is detected, the SDM will store a DTC and request the IPC to turn the AIR BAG indicator ON. The presence of a SIR system malfunction could result in non-deployment of the air bags. The AIR BAG indicator will remain ON until the malfunction has been repaired.

Dual Stage Inflator Modules

Dual stage inflator modules contain a housing, inflatable air bag, 2 initiating devices, canister of gas generating material and, in some cases, stored compressed gas. The 2 initiators are part of the inflator module deployment loop. The inflator modules have 2 stages of deployment, which varies the amount of restraint to the occupant according to the collision severity. For moderate frontal collisions, the inflator modules deploy at less than full deployment which consists of stage 1 of the inflator module. For more severe frontal collisions, a full deployment is initiated which consists of stage 1 and stage 2 of the inflator module. When the vehicle is involved in a collision of sufficient force, the sensing and diagnostic module (SDM) will cause current to flow through the deployment loops to the initiator. Current passing through the initiator ignites the material in the canister producing a rapid generation of gas and the release of compressed gas, if present. The gas produced from this reaction rapidly inflates the air bag. Once the air bag is inflated, it quickly deflates through the air bag vent holes.

Each dual stage inflator module is equipped with a shorting bar located on the connectors of the module. The shorting bar shorts the inflator module deployment loop circuitry to prevent unwanted deployment of the air bag when it is disconnected.

Inflatable Restraint Seat Position Switch (SPS)

The seat position switch (SPS) is used to determine the proximity of a front driver or passenger seat position with respect to the frontal air bag. The SPS interfaces with the sensing and diagnostic module (SDM). The state of the SPS allows the SDM to disable stage 2 of the frontal air bag for a front seat that is forward of a forward or rearward point in seat track travel. The SPS is a hall effect sensor that is mounted on the outboard seat track of both the driver and passenger seats. The seat track includes a metal bracket that shunts the SPS magnetic circuit creating 2 states of seat position. The shunted state represents a rearward seat position. The non-shunted state represents a forward position. The SPS provides 2 current ranges, one range for the shunted state and a second range for a non-shunted state. These 2 states are inputs to the SDM. State 1 (shunted) being the rearward threshold and state 2 (non-shunted) being the forward threshold. When the SDM receives input from a SPS that state 1 threshold is reached (seat is rearward), the SDM will not disable stage 2 deployment, if required by the deployment sensors. When state 2 threshold is reached (seat is forward), the SDM will disable stage 2 deployment on the side the seat is forward. The SDM monitors the SPS circuit and if a fault is detected the SDM will set codes B0083 or B0084 and defaults to disabling stage 2 frontal deployment. This will only default on the side of the vehicle the sensor has a fault.

Inflatable Restraint Seat Belt Pretensioner

The seat belt pretensioner modules contain a housing, an initiating device, canister of gas generating material. The initiator is part of the seat belt pretensioner deployment loop. When the vehicle is involved in a collision of sufficient force, the SDM will cause current to flow through the deployment loops to the initiator. Current passing through the initiator ignites the material in the canister producing a rapid generation of gas and the release of compressed gas, if present. The gas produced from this reaction rapidly shortens the seat belt buckle height. Each seat belt pretensioner is equipped with a shorting bar located on the connector of the pretensioner. The shorting bar shorts the seat belt pretensioner deployment loop circuitry to prevent unwanted deployment of the pretensioner when servicing the seat belt pretensioner.

Inflatable Restraint Steering Wheel Module Coil

The steering wheel module coil is attached to the steering column and is located under the steering wheel. The steering wheel module coil consists of 2 or more current-carrying coils. The coils allow the rotation of the steering wheel while maintaining continuous electrical contact between the driver deployment loop and the steering wheel module. Four coil wires are used for the steering wheel module deployment loop. Additional coil wires are used for accessories attached to the steering wheel depending on the vehicle model. The steering wheel module coil connector is located near the base of the steering column. The connector contains a shorting bar that shorts the steering wheel module coil deployment loop circuitry to prevent unwanted deployment of the air bag when it is disconnected.

Inflatable Restraint Front End Sensors

The inflatable restraint front end sensors, also known as electronic frontal sensors (EFS), are equipped on vehicles to supplement the supplement inflatable restraint (SIR) system performance. The front end sensors are electronic and are not part of the deployment loops, but instead provide inputs to the sensing and diagnostic module (SDM). The front end sensors can

assist in determining the severity of some frontal collisions. The SDM uses the input from the front end sensors to assist in determining the severity of a frontal collision further supporting air bag deployment. If the SDM determines a deployment is warranted, the SDM will cause current to flow through the deployment loops deploying the frontal air bags.

Driver and Passenger Knee Bolsters

The knee bolsters are designed to help restrain the lower torsos of front seat occupants by absorbing energy through the front seat occupants' upper legs. In a frontal collision, the front seat occupants legs may come in contact with the knee bolsters. The knee bolsters are designed to crush or deform absorbing some of the impact, which helps to reduce bodily injuries. The driver and passenger knee bolsters are located in the lower part of the instrument panel and must be inspected for damage after a collision.

Inflatable Restraint Wiring Harnesses

The inflatable restraint wiring harnesses connect the sensing and diagnostic module (SDM), inflator modules, front end sensors, side impact sensors, seat position switches (SPS), and the serial data communication circuit together using weather pack connectors. Only the supplemental inflatable restraint (SIR) deployment loop connectors are yellow in color for easy identification. When repairing SIR system wiring harnesses, follow the proper testing and wiring repair procedures outlined in this manual.

Steering Wheel and Column

The steering wheel and column are designed to absorb energy when driver contact is made with the steering wheel or inflated air bag. In a frontal collision, the driver may contact the steering wheel directly or load the steering wheel and column through the inflated air bag. When the driver applies load to the air bag or steering wheel, the column will compress downward absorbing some of the impact, helping to reduce bodily injuries to the driver. The steering wheel and column must be inspected for damage after a collision.

Side SIR System Description

The side supplemental inflatable restraint (SIR) system consists of the following components:

- AIR BAG indicator located in the instrument panel cluster (IPC)
- Inflatable restraint sensing and diagnostic module (SDM)
- Inflatable restraint side impact modules (LF/RF)
- Inflatable restraint side impact sensors (SIS) (left/right)
- Inflatable restraint wiring harnesses

The side impact modules are located in the outside portion of the front seat backs. The side impact modules contain a housing, inflatable air bag, initiating device, and a canister of gas generating material. The initiator is part of the side impact deployment loop. When a side impact of sufficient force occurs, the SIS detects the impact and sends a signal to the SDM. The SDM compares the signal received from the SIS to a value stored in memory. When the generated signal exceeds the stored value, the SDM will cause current to flow through the side deployment

loop deploying the side air bags. The SDM, side impact modules, and the connecting wires make up the side deployment loops. The SDM continuously monitors the deployment loops for malfunctions and turns the AIR BAG indicator ON if a fault is present.

Each side impact module is equipped with a shorting bar located on the connector of the module. The shorting bar shorts the side impact modules deployment loop circuitry to prevent unwanted deployment of the air bag when servicing the inflator module.

Inflatable Restraint Side Impact Sensor (SIS)

The side impact sensor (SIS) contains a sensing device which monitors vehicle acceleration and velocity changes to detect side collisions that are severe enough to warrant air bag deployment. The SIS is not part of the deployment loop, but instead provides an input to the sensing and diagnostic module (SDM). The SDM contains a microprocessor that performs calculations using the measured accelerations and compares these calculations to a value stored in memory. When the generated calculations exceed the stored value, the SDM will cause current to flow through the deployment loops deploying the side air bags.