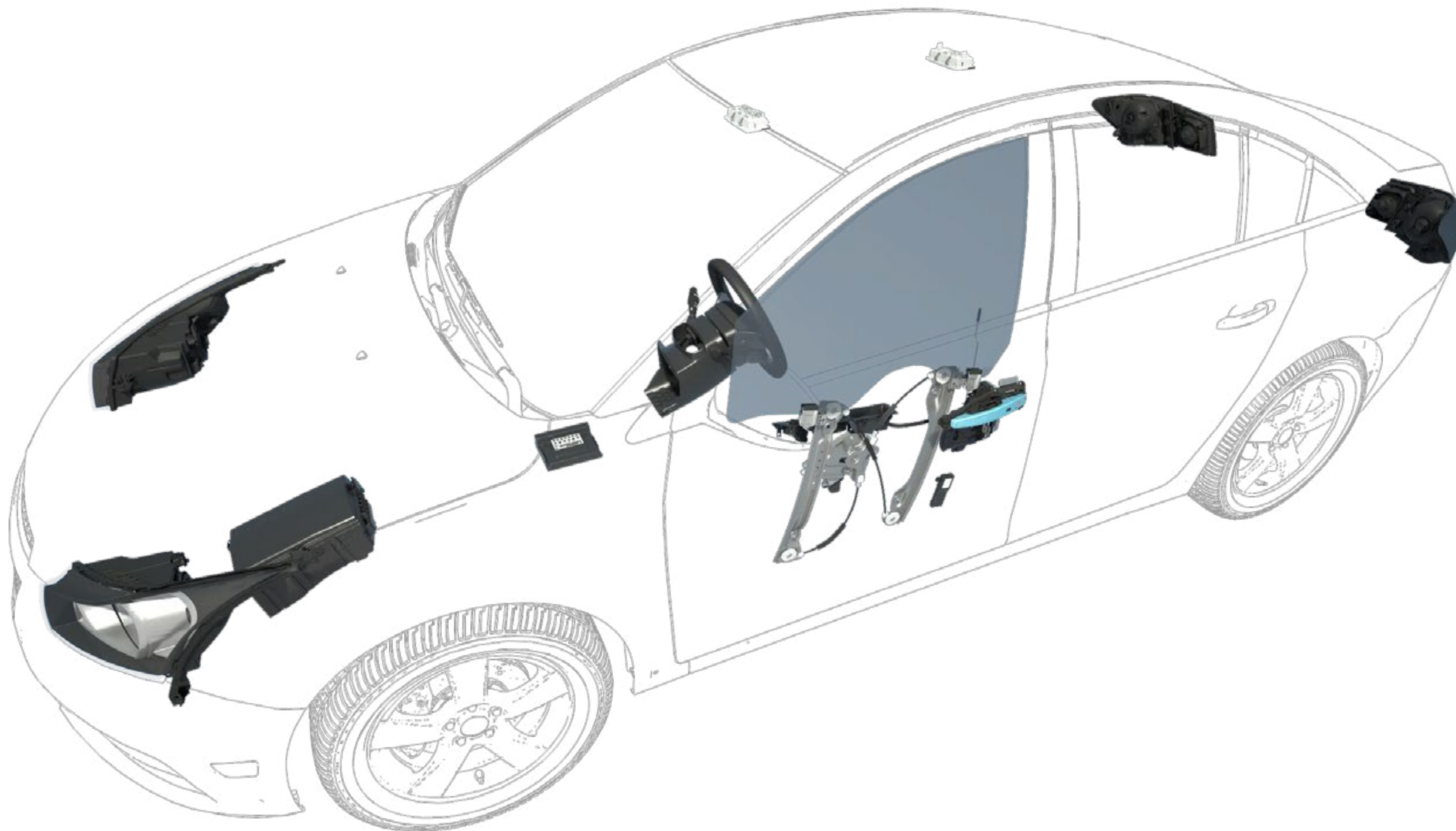


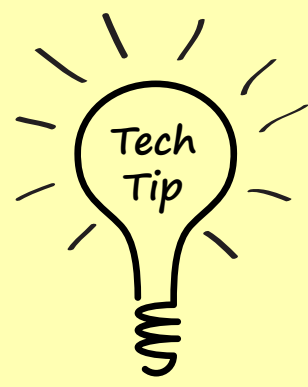
The Body Electrical and Lighting systems in the modern automobile are more complex than those in the past. The electronics, computer controls and networking have reduced the number of wires, while increasing the number of comfort, convenience and entertainment options. Interior and exterior lighting is now controlled by one or more Body Control Modules' or BCM. The BCM may also handle network messages for door locks and window operation; it may communicate with individual door modules, the instrument panel and other control modules. Networking allows data from switches and sensors to be shared with multiple control modules, reducing the number of individual circuits and sensors.



### Body Control Module

**Description/Function:** The Body Control Module or BCM is the computer that typically controls various functions relating to interior and exterior lighting, door locks, and power windows. Various switches within the vehicle provide inputs to the BCM. The BCM then determines the needed output based on the programming. The output may be a discreet output to a lamp, relay or actuator. The other form of output can be a network message broadcast over the vehicle network to other modules such as door modules. The receiving module then can operate the desired output. Many vehicles use one or more BCM, they may have different names, but the basic premise is the same.

**Faults/Symptoms:** Symptoms include: inoperative lighting, locks, windows, engine no crank or start. Faults include: software bug (calibration update), electrical malfunction, water damaged.



When installing a new BCM it typically requires programming or initialization, follow the manufacturer's service manual for instructions.

Before condemning a BCM check all the power and ground inputs, typically there are several power feeds into the module, a blown fuse can cause some functions to become inoperative.

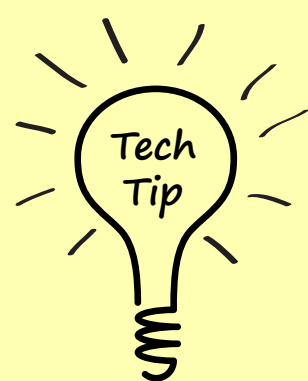
Some BCMs perform the anti-theft alarm functions, a capable scan tool is a necessity to diagnose anti-theft system concerns.



### Headlamp bulbs

**Description/Function:** Headlamps come in many designs, from the simple sealed beam to the modern High-Intensity-Discharge (HID) and LED's. The most common is the composite headlamp with replaceable bulb. This bulb comes in several sizes and terminal configurations. Some provide High and Low Beam, while others use separate bulbs for High and Low beam.

**Faults/Symptoms:** Symptoms include: inoperative headlight or bulb-out warning message. Faults include: broken filament, blown fuse or open circuit.



Never touch the bulb glass with your fingers, oil residue can cause the bulb to overheat and fail prematurely. Always hold it using the base.

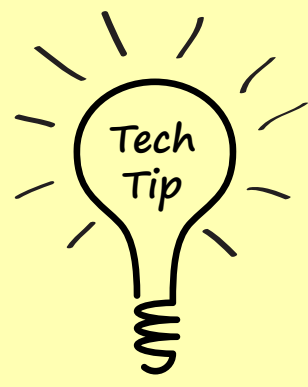
Replace bulbs in pairs, if one fails the other will likely fail soon.



### Light bulbs

**Description/Function:** Modern vehicles have many lamps inside and out. These can include brake lamps, dome light, and instrument lighting. The bulbs come in a variety of sizes and shapes. Most are incandescent, but many manufacturers are using LED lighting.

**Faults/Symptoms:** Symptoms include: inoperative lamp(s). Faults include: Open circuit or damaged filament.



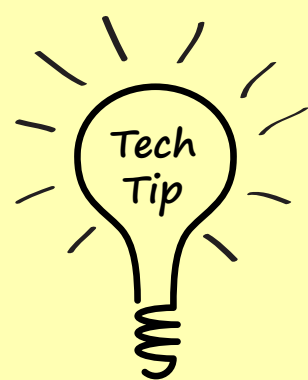
Dielectric grease can protect exterior bulb holders from corrosion.  
A single filament bulb in a dual-filament bulb holder can cause odd electrical concerns.



### Headlamp / Combination switch

**Description/Function:** The headlamp switch allows the driver to select the exterior lighting mode. Typical switches allow selection of OFF, Marker lights ON, Headlamps ON, and AUTO (if equipped) Some may have provision for switching on Fog Lamps and/or interior dome lamp. Depending on the vehicle electrical architecture the switch may directly switch the lamps, or serve as an input to the BCM.

**Faults/Symptoms:** Symptoms include: inoperative lamp(s), lamps remaining on. Faults include: malfunctioning switch or open circuit.



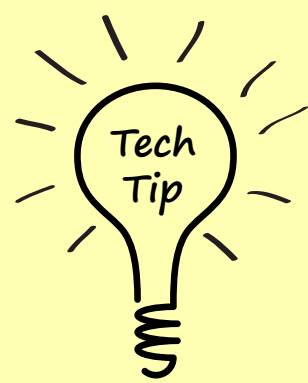
Before condemning a switch check all the inputs and outputs. Use scan tool to monitor switch function on BCM wired switches.  
Overheated switches are likely caused by using high wattage aftermarket headlamp bulbs, check for correct headlamp bulbs.



### Turn Signal Switch

**Description/Function:** The turn signal switch located on the left side of the steering column, allows the driver to indicate desired turns to motorists in front of and behind the vehicle. The switch is designed to turn off automatically after completing the turn. The switch stalk may include other switches and functions, such as switching between high and low beam headlamps and cruise control functions. The switch may switch the lighting circuits directly or be an input to the BCM.

**Faults/Symptoms:** Symptoms include: inoperative lamp(s), lamps remaining on. Faults include: malfunctioning switch or open circuit.



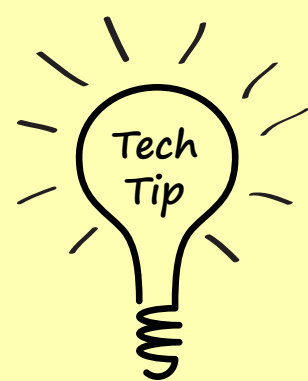
Before condemning a switch check all the inputs and outputs. Use scan tool to monitor switch function on BCM wired switches.

If turn signal switch does not cancel, suspect mechanical damage to switch.

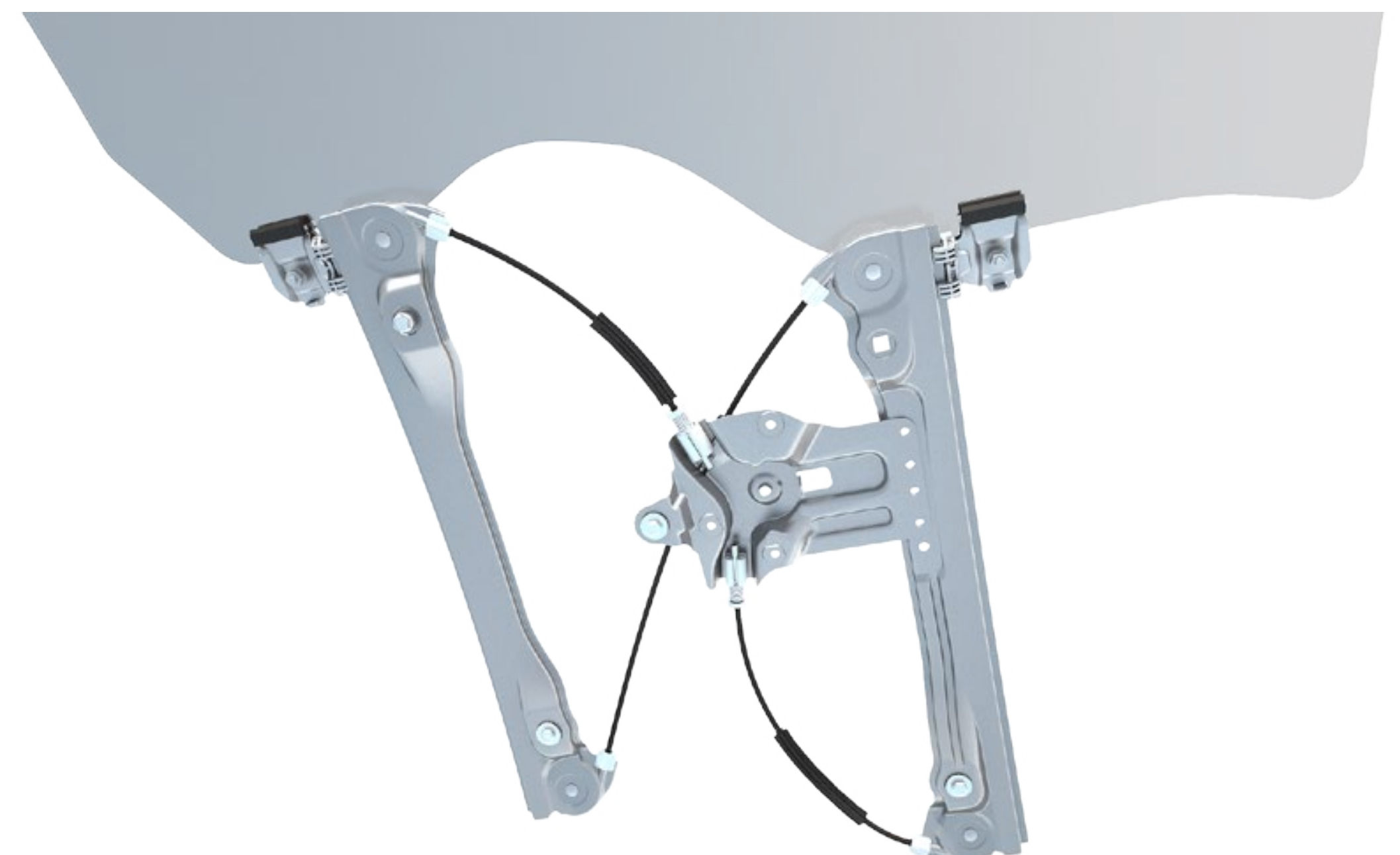
### Window Regulator

**Description/Function:** The window regulator is the mechanism that lifts and lowers the door window glass. It may be manually or electrically powered. Two common designs are the scissor and Bowden cable. Both designs lift the window so that it follows the curvature of the door glass channel and the glass remains parallel to the frame.

**Faults/Symptoms:** Symptoms include: binding window, abnormal noises, glass fallen into door. Faults include: broken glass clamps, broken cable, broken slides, stripped gear.



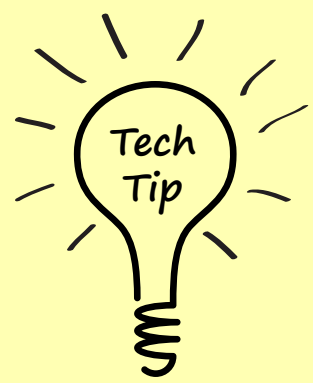
When replacing a broken regulator, ensure that any adjustments are performed to prevent binding or unnecessary stress on the regulator or glass.



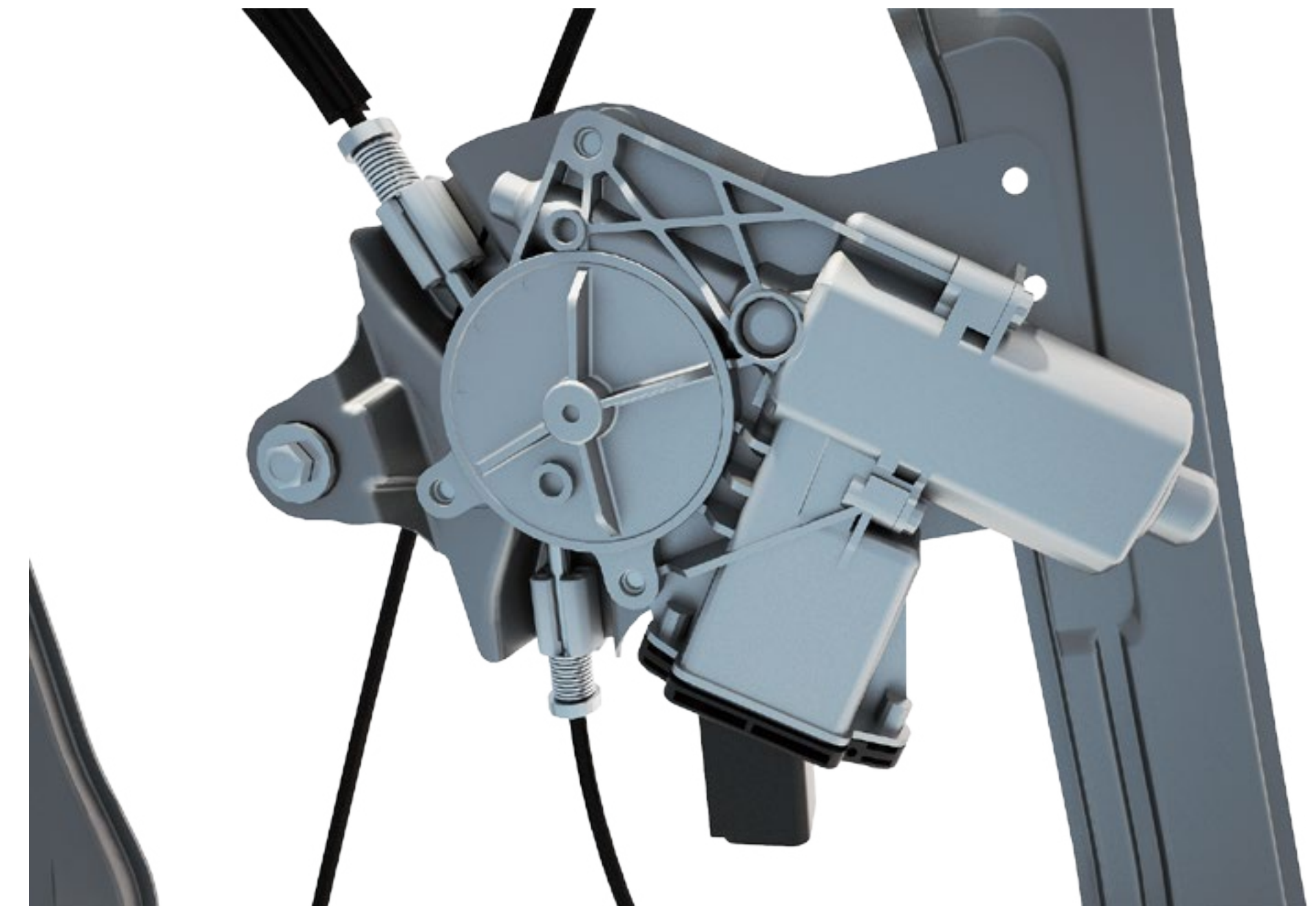
### Window Motor

**Description/Function:** Power windows have electric motors to drive the window regulators. The motors are reversible. The motor may be controlled directly by the power window switch or by a door control module. The electrical polarity is reversed to change direction.

**Faults/Symptoms:** Symptoms include: Inoperative window, slow or sluggish operation. Faults include: malfunctioning motor, open motor circuit, malfunctioning window switch or door control module.



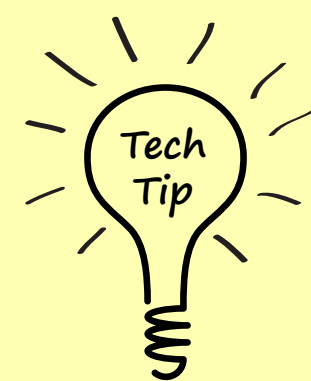
Check for excessive voltage drop on motor circuit, on some vehicles the door harness can become damaged at the A-pillar. (Broken wire strands from flexing when doors are opened and closed)



### Interior Switches

**Description/Function:** The modern vehicles interior is home to many switches, they control many comfort and convenience functions. Some of these are the rear defroster, hazard lamps, power door locks, power windows, heated seats, trunk release to name a few. Some of these control their function directly; others are inputs to the BCM.

**Faults/Symptoms:** Symptoms include: Inoperative function, illumination inoperative, aesthetic damage. Faults include: electrical malfunction, water damage, failed bulb or LED, cosmetic damage or wear.

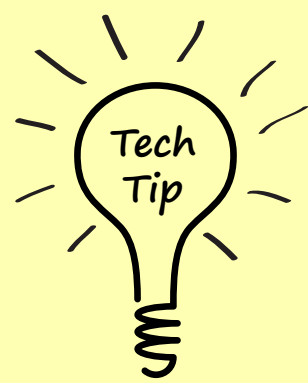


Refer to manufacturer wiring diagram to determine switch operation, test for proper function using DMM.

### Door Lock Actuator

**Description/Function:** Power door locks on many cars are operated by electric solenoid or motors known as a door lock actuator. The lock actuator may be part of the door latch assembly or a separate unit linked to the door latch by a lock rod. The actuator is electrically operated by either the door lock switches directly or via the BCM.

**Faults/Symptoms:** Symptoms include: inoperative door lock, unable to lock or unlock door. Abnormal noises. Faults include: electrical malfunction, water damage or mechanical malfunction.



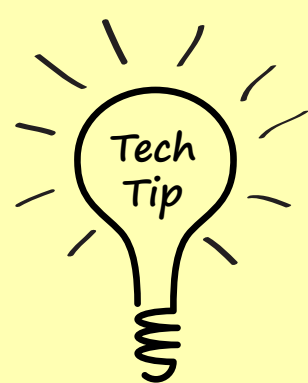
On some vehicles with BCM controlled actuators, a "Door Locked" feedback switch "ON" status may prevent the BCM from operating the actuator to lock the door, and vice versa. Check Lock and Latch feedback status using scan tool.



### Door Control Module

**Description/Function:** Many newer vehicles have door control modules. These computers receive network messages and inputs from switches on its door. The module controls the door lock actuator and the window motor as well as power mirror motors, mirror heating, and door mounted illumination.

**Faults/Symptoms:** Symptoms include: inoperative door lock, inoperative power window. Inoperative power mirror. Door illumination inoperative. Faults include: electrical malfunction, water damage, loss of communication with vehicle network.



Check power, grounds and network communication is present before condemning any door module. Some are accessible with the right scan tool, others may be slaves to the BCM and diagnosed through the BCM.

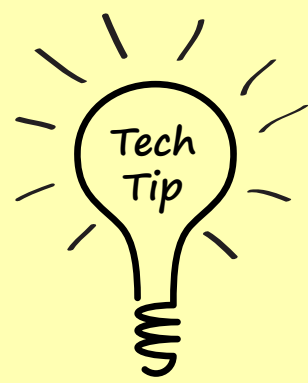
Check door harness at A-pillar for damaged wires.



### Fuses and Relays

**Description/Function:** The modern vehicle has numerous electrical circuits; these circuits may have overload protection in the form of a fuse or circuit breaker. These devices prevent the circuit from exceeding the rated current capacity for the wire. They are located in one or more fuse/relay panels. Circuits may also be controlled by relays, these are essentially electrical controlled switches, and they too may be located among the fuses in the fuse/relay panels.

**Faults/Symptoms:** Symptoms include: inoperative circuit function, illuminated warning indicators. Faults include: electrical malfunction, water damage, circuit shorted or overloaded (blown fuse or tripped circuit breaker)



For blown fuses and tripping circuit breakers, check for shorts to ground on the circuit, isolate components and test for internal shorts or excessive current draw.

Test relays according to wiring schematic, test control and load circuits.

Some relays have protection diodes or resistors, it is essential to use correct relay part number when replacing relays, even those that appear generic.

